3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the year

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Hydrological modeling with respect to impact of landuse and land-cover change on the runoff dynamics in Budhabalanga river basing using ArcGIS and SWAT model by Remote Sensing Applications	Manisha Bal , Asit Kumar Dandpat , Bandita Naik	CED	Society and Environment, Elsevier	2021	ISSN0346-251X.	https://doi.org/10.1016/j.rsase.2021.100527
Water surface profile in converging compound channel using gene expression programming	Bandita Naik, Vijay Kaushik, Munendra Kumar	CED	Water Supply IWA Publishing	2022	ISSN 1606-9749	doi: 10.2166/ws.2022.172
Groundwater Contaminant Transport Analysis and Numerical Solution of Diffusion in Saturated Aquifer	Shiphali Preeti Aind	CED	International Journal of Special Education	2022	ISSN: 0827-3383	https://www.researchgate.net/publication/361746892_Groundwater_Contaminant_Transport_Analysis_and_Numerical_Solution_of_Diffusion_in_Saturated_Aquifer
AUTOMATIC DETECTION OF EMOTIONS IN VEHICLE DRIVERS BASED ON ANALYSIS OF BIOMEDICAL DATA TO IMPROVE THE PERFORMANCE	Srikanth Renikunta	CED	Web of Science group - IJBPAS	2021	ISSN: 2277–4998	https://www.researchgate.net/publication/356776076_AUTOMATIC_DETECTION_OF_EMOTIONS_IN_VEHICLE_DRIVERS_BASED_ON_ANALYSIS_OF_BIOMEDICAL_DATA_TO_IMPROVE_THE_PERFORMAN
Access to carrier-based outreach service in the transportation system for latency tolerance in the environment	Srikanth Renikunta,	CED	Web of Science group - IJBPAS	2021	ISSN: 2277–4998	https://www.researchgate.net/publication/356776232_ACCESS_TO_CARRIER-BASED_OUTREACH_SERVICE_IN_THE_TRANSPORTATION_SYSTEM_FOR_LATENCY_TOLERANCE_IN_THE_ENVIRONMENT

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Study of security issues and solutions in Internet of Things (IoT)'	Srikanth Renikunta,	CED	Elsevier group – Materials Today: Proceedings, Publication	2021	2214-7853	sciencedirect.com/science/article/pii/S2214785321051543
Influence of Demographic variables on consumer buying behaviour of luxury cars in Hyderabad	K.V.PAVAN KUMAR	DBM	GIS Science journal	2021	1869-9391	https://drive.google.com/file/d/16BU5ydOaquSBgXrX4YeRA2Hb3vCgO810/view
An Exploratory study to analyse the gender perception in selection of Luxury cars- A Study with special reference to twin cities of Hyderabad & Secunderabad	K.V.PAVAN KUMAR	DBM	Journal of Interdisciplinary Cycle Research	2021	0022-1945	https://drive.google.com/file/d/14hxNeDlB_xw8CSaj6vuDfk2bczRPFCqx/view
Factors contributing cognitive dissonance behaviour among customers of luxury cars	K.V.PAVAN KUMAR	DBM	International Journal of creative research thoughts	2021	2320-2882	https://ijcrt.org/papers/IJCRT2110127.pdf
Studies on 4 - dimethylaminopyridinium salicylate monohydrate's optical, mechanical, and laser damage threshold	Dr.A. Arun kumar	Department of Humanities and Sciences	Solid State Communications	2021	0038-1098	https://doi.org/10.1016/j.ssc.2021.114347

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
"Insights into Weak and Covalent interactions, Reactivity sites and Pharmacokinetic Studies of 4-Dimethylaminopyridinium Salicylate Monohydrate using Quantum Chemical Computation Method	Dr.A. Arun kumar	Department of Humanities and Sciences	Computational and Theoretical Chemistry	2021	2210-271X.	https://doi.org/10.1016/j.comptc.2021.113483
Study of photo catalytical, antimicrobial activity, dielectric and ac impedance properties of Zn doped Mg nanoferrites synthesized from citrate gel auto combustion method	Dr. D. Ravi Kumar	Department of Humanities and Sciences	Materials Chemistry and Physics	2021	0254-0584	https://doi.org/10.1016/j.matchemphys.2021.125648
Structure, growth, characterization and anti-microbial activities of L-Isoleucinium-4-methylbenzenesulfonate monohydrate single crystals	Dr. A. Arunkumar	Department of Humanities and Sciences	Solid State Communications	2022	0038-1098	https://doi.org/10.1016/j.ssc.2021.114607
Radiation Shielding, EPR, and TL Mechanism in Cr3+: Ba(La)2SiO6 Glass Ceramics	Dr.Kodumuri Veerabhadra Rao	Department of Humanities and Sciences	Silicon	2022	1876-990X	https://link.springer.com/article/10.1007/s12633-022-01731-6
Synthesis, structural, photocatalytic and anti-cancer activity of Zn doped Ni nano chromites by citrate gel auto combustion method	Dr. D. Ravi Kumar	Department of Humanities and Sciences	Inorganic Chemistry Communications	2022	1387-7003	https://doi.org/10.1016/j.inoche.2022.109393

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Computational Insights On Charge Transfer and Non-covalent Interactions of Antibacterial Compound 4-dimethylaminopyridinium pyridine-2-carboxylate pentahydrate	Dr. A. Arunkumar	Department of Humanities and Sciences	Journal of Molecular Structure	2022	0022-2860	https://doi.org/10.1016/j.molstruc.2022.132525
Multifunctional CrxCa(10-x)Al30Si60 Glasses, Electrical Conductivity And Thermoluminescence	Dr.Kodumuri Veerabhadra Rao	Department of Humanities and Sciences	RASĀYAN Journal of Chemistry	2022	0974-1496	http://dx.doi.org/10.31788/RJC.2022.1516827
Mechanical and Spectroscopic Investigations of Cr2O3 doped Calcium Aluminium Silicate Glasses	Dr.Kodumuri Veerabhadra Rao	Department of Humanities and Sciences	Compliance Engineering Journal	2021	0898-3577	http://ijceng.com/gallery/cej%204053%20f.pdf
Preparation and Characterization of melt derived CaO-Sb2O3-Li2O containing borate glass for multiple application	Dr. D. Ravi Kumar	Department of Humanities and Sciences	Journal of non-Crystalline solids	2022	2049-3630	https://doi.org/10.1016/j.jnoncrysol.2022.121642
Impact of Protonation and Hydrogen Bonding Interactions on the Biological Properties of Antibacterial Compound4-Dimethylaminopyridinium Salicylate Monohydrate: Correlation with Its Precursor Molecules	Dr.A. Arun kumar	Department of Humanities and Sciences	Polycyclic Aromatic compounds	2022	1563-5333	https://doi.org/10.1080/10406638.2022.2110904

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
CREATING A SELF-ASSESSMENT TOOL FOR AN ENGLISH-LANGUAGE-TEACHER AND ITS IMPLEMENTATION	I.V.Sona Lakshmi, J.R.Hephzabah	Department of Humanities and Sciences	Indian Patent	2021	202141037269 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
SYNTHESIS, CRYSTAL STRUCTURE, SPECTRAL AND THERMAL PROPERTIES OF 4-DIMETHYLAMINOPYRIDINIUM SALICYLATE MONOHYDRATE	Dr.A.Arun kumar	Department of Humanities and Sciences	Indian Patent	2021	202141034416 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
GROWTH, STRUCTURAL, THERMAL, OPTICAL, AND ELECTRICAL PROPERTIES OF POTASSIUM SUCCINATESUCCINIC ACID CRYSTAL	Dr.A.Arun kumar	Department of Humanities and Sciences	Indian Patent	2021	202141033202 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Machine-Learning Based Size Suggestion Systems and Methodologies For Clothes E-Commerce	Dr.Kodumuri Veerabhadra Rao	Department of Humanities and Sciences	Indian Patent	2022	202241005316	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Designing an efficient forecasting routing protocol to secure the mobile ad hoc network communication	T.V. Suresh Kumar and Dr. Prabhu G Benakop	EEE	Bulletin Monumental	2021	e-ISSN 0007-473X	https://bulletinmonumental.com/gallery/20-jan2021.pdf
Low Power Ultra Wideband Low Noise Amplifier Employing Forward Body Bias and Current - Reuse for Wireless Sensor Networks Applications,	Dr.Prabhu G. Benakop Chandrasekhar Kandagatla	EEE	International Journal for Research Trends and Innovation	2021	ISSN 2456-3315	https://ijrti.org/papers/IJRTI2109021.pdf

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Usage of VCO's to Scale the Power of Wireless Receivers	Dr.Prabhu G. Benakop Chandrasekhar Kandagatla	EEE	Journal of Applied Science and Computations	2021	ISSN 1076-5131	https://drive.google.com/file/d/1cGbKheLYy5jakhkuIdlthzwIaIr2DHlE/view
Wireless Sensor Network Radio System Structure and RF Implementation of Transceiver Circuit	Dr.Prabhu G. Benakop Chandrasekhar Kandagatla	EEE	Turkish Online Journal of Qualitative Inquiry	2021	e-ISSN 1309-6591	https://www.tojqi.net/index.php/journal/article/view/8466
Progress in Biomedical Field with an Advancement of CMOS RF Transceiver Using Wireless Sensor Network	Dr.Prabhu G. Benakop Chandrasekhar Kandagatla	EEE	Design Engineering	2021	ISSN:119343	http://www.thedesignengineering.com/index.php/DE/article/view/2703
CMOS Applications and Implementation Procedure of Wireless Multimedia Sensor Network	Dr.Prabhu G. Benakop Chandrasekhar Kandagatla	EEE	Design Engineering	2021	ISSN:119342	http://www.thedesignengineering.com/index.php/DE/article/view/8033
A PROPOSED NEW TOPOLOGY FACTS CONTROLLER FOR REACTIVE POWER CONTROL IN NON LINEAR LOADS	Numburi Nireekshana	EEE	International Journal of Current Research	2021	0975-833X	https://mail.journalcra.com/article/proposed-new-topology-facts-controller-reactive-power-control-non-linear-loads
A NEW INNOVATED FACTS CONTROLLER (SVC) FOR REACTIVE POWER COMPENSATION	Numburi Nireekshana	EEE	International Journal of Current Research	2021	0975-833X	http://journalcra.com/article/new-innovated-facts-controller-svc-reactive-power-compensation
A CHARACTERIZED THYRISTOR CONTROLLED SERIES COMPENSATION FACTS DEVICE FOR PHANTOM POWER CONTROL	Numburi Nireekshana	EEE	International Journal of Current Research	2021	0975-833X	https://www.journalcra.com/article/characterized-thyristor-controlled-series-compensation-facts-device-phantom-power-control

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
A STATIC SYNCHRONOUS SERIES COMPENSATOR CONNECTED TO INFINITE BUS FOR POWER QUALITY IMPROVEMENT AND PHANTOM POWER CONTROL	Numburi Nireekshana	EEE	International Journal of Current Research	2021	0975-833X	http://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do?queryString=2021103489&resultsPerPage=
A Peer Survey on Load Frequency Contol in Isolated Power System with Novel Topologies	Numburi Nireekshana	EEE	International Journal of Engineering and Advanced Technology (IJEAT)	2021	2249-8958	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Frequency Regulation in Two Area System with PSO Driven PID Technique	Numburi Nireekshana	EEE	Journal of Power Electronics & Power Systems	2022	2321-4244	https://engineeringjournals.stmjournals.in/index.php/JoPEPS/article/view/6426
ENERGY EFFICIENT OTBFA PROTOCOL WITH WAKE UP RADIO FOR WIRELESS SENSOR NETWORKS	D.Sailaja & Dr. Prabhu. G. Benakop	EEE	Harbin Gongye Daxue Xuebao/Journal of Harbin Institute of Technology	2022	ISSN: 0367-6234	http://hebgydxxb.periodicales.com/index.php/JHIT/article/view/1134
Wireless Monotoring Of Pv Module Characteristics	Dr. Raghu Chandra Garimella P. Rajinikanth	EEE	Australian Patent	2021	2021103489	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Avidyutha Dvichakra Vahana-An Electric Bicycle	Dr. Raghu Chandra Garimella Mr. J. Ramesh Babu Mrs. Y mastanamma, Srikanth Renikunta	EEE	Indian Patent (filed)	2021	202141035210	Link: https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Vidyutha Traya Chakra Vahana-A Hybrid Electrical Cycle	Dr. Raghu Chandra Garimella Mr. J. Ramesh Babu Mrs. Y mastanamma, Srikanth Renikunta	EEE	Indian Patent (filed)	2021	NA	http://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do?queryString=2021106337&resultsPerPage
Abhigna Vidyut Samputah- A Smart Electric Extension Box	Dr. Raghu Chandra Garimella Mrs. Y mastanamma Mr. J. Ramesh Babu	EEE	Indian Patent (published) Australian (filed)	2021	202141034598	http://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do?queryString=2021104789&resultsPerPage
Bitti Astita Nagarata Nistantri Samvidha - A Wall Mounted Smart Wiring System	Dr. Raghu Chandra Garimella Nane Swarnadh Satapathi Mrs. Y mastanamma	EEE	Australian (Granted)	2021	2021106337	https://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do?queryString=2021106335&resultsPerPage=

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Parinata Vidyut Samyutanam- An Advanced Electric Extension Box	Dr. Raghu Chandra Garimella Nane Swarnadh Satapathi Mrs. Y mastanamma	EEE	Australian (Granted)	2021	2021104789	https://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do?queryString=2021106335&resultsPerPage=
Unnamed Aerial Vehicle (Uav) Based Sanitizing System	Dr. Raghu Chandra Garimella Namburi Nireekshan	EEE	Australian (Granted)	2021	2021106335	https://pericles.ipaustralia.gov.au/ols/auspat/quickSearch.do?queryString=2021106335&resultsPerPage=
A switch board unit to provide wireless switching operations for electrical appliances	Mrs. Y Mastanamma	EEE	Indian Patent (Granted)	2022	202141037910	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
MICROCONTROLLER BASED INFINITESIMAL NEUTRALIZED INFECTIOUS CIDE (M.I.N.I. CIDE)	Dr. Raghu Chandra Garimella, Dr. Prabhu G. Benakop, Neetoori Radhakrishna, Gandreti Pavani et al.	EEE	Indian Patent (Granted)	2021	202141017166	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Design Modelling And Analysis Of Knee Implant Using Different Biomaterials	Dr.M.Prasad, Dr.P.Ravi chander, Dr.M.Udaya kumar, Y.Madhu maheswara Reddy	Mechanical	The Journal Of Oriental Research Madras	2022	ISSN : 0022-3301	https://ijifactor.com/journals/1451/The-Journal-of-Oriental-Research,-Madras

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Design And Analysis Of Rotovator And Cultivator Blades By Various Materials Using FEA	Dr.P.Ravi chander, Dr.M.Prasad, Dr.M.Udaya kumar, Y.Madhu maheswara Reddy	Mechanical	The Journal Of Oriental Research Madras	2022	ISSN : 0022-3301	https://ijifactor.com/journals/1451/The-Journal-of-Oriental-Research,-Madras
Experimentation and study of abrasive water jet cuttingon AAA 6061	I.Sowjanya, Sai gayatrilahari.P, Dr.M.Udaya kumar	Mechanical	The Journal Of maharaja sayajirao university of baroda	2021	ISSN : 0025-0422	https://msubaroda.ac.in/Publication
Design and Analysis of Fan Blade with Dual Natural Fibers and Al 7075	Medichalam Srivinayak, Dr. Md. Fakhruddin H.N	Mechanical	International Journal of Engineering Research & Technology (IJERT)	2021	2278-0181	https://www.ijert.org/research/design-and-analysis-of-fan-blade-with-dual-natural-fibers-and-al-7075-IJERTV10IS100124.pdf
Computational Fluid Dynamics in Coronary and Intra-Cardiac Flow Simulation	Mohammed Abdul Mannan, Dr. Md Fakhruddin H.N.	Mechanical	International Journal for Research in Applied Science & Engineering Technology (IJRASET)	2022	2321-9653	https://www.ijraset.com/research-paper/computational-fluid-dynamics-in-coronary-and-intra-cardiac-flow-simulation

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
DESIGN AND FLOW ANALYSIS OF AIR-CONDITIONED SPACE	Dr. Md. Fakhruddin H.N., Mohammed Adeel Ahmed, Salman Khan	Mechanical	International Research Journal of Modernization in Engineering Technology and Science	2022	2582-5208	https://www.irjmets.com/uploadedfiles/paper//issue_7_july_2022/29010/final/fin_irjmets1659686843.pdf
A tool for friction stir welding and method there of	1)Dr.A.Raja sekhar 2)Dr.P.Prabhu raj	Mech	Patent	2022	202241036738	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Computer technology based automobile detection device and method there of	1)Dr.P.Ravi chander 2)Y.M.M.Reddy	Mech	Patent	2022	202241036113	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Apparatus for radiation assisted friction welding and methods there of	1)Dr.M.Prasad 2)Dr.A.Raja sekhar 3)Dr.P.Prabhu raj 4)R.Srikanth 5)Dr.Banditha Naik 6)Dr.M.Uday kumar 7)Y.Mastanamma	Mech	Patent	2022	202241036636	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Multipurpose expandable wheel chair	1)Dr.M.Prasad 2)J.Sudarshan 3)Methodist college of engineering and technology 4)Dr.P.Ravi chander 5)Dr.A.Raja sekhar 6)Y.M.M.Reddy 7)Dr.M.Uday kumar 8)Dr.Fakhruddin HN 9) Dr.P.Prabhu raj 10)I.Sowjanya	Mech	Patent	2022	202241050530	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Automatic multidie disposable plate manufacturing machine	1)Dr.M.Prasad 2)J.Sudarshan 3)Methodist college of engineering and technology 4)Dr.P.Ravi chander 5)Dr.A.Raja sekhar 6)Y.M.M.Reddy 7)Dr.M.Uday kumar 8)Dr.Fakhruddin HN 9) Dr.P.Prabhu raj 10)I.Sowjanya	Mech	Patent	2022	202241060180	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
An Efficient Approach for Bigdata Security based on Hadoop system using Cryptographic techniques	G.Saritha	CSE	International journal of computer science and Engineering(IJCSE)	2021	e-ISSN : 0976-5166	http://www.ijcse.com/abstract.html?file=21-12-04-132
An Adaptive Wolf Bsaed Dansing System for Securing HAdoop at the Data Cleaning Stage	G.Saritha	CSE	International journal of Engineering Trends and technology(IJETT)	2022	ISSN:2231-5381	https://ijettjournal.org/archive/ijett-v70i4p204

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Role of Machine Learning Algorithms for supply chain tracking the products to the university hostel with the utilization of IOT	Dr. Syed Azahad	CSE	Journal of Optoelectronics Laser	2022	ISSN:1005-0086	http://www.gdzjg.org/index.php/JOL/article/view/88
Development and Analysis of improvised AOMDV Routing Protocol based on Machine Learning Model for improvised Network Performance in MANETs	MVDS Krishnamurty	CSE	Journal of Interdisciplinary Cycle Research	2022	ISSN NO: 0022-1945	https://drive.google.com/file/d/1B00-nBxX5PCdgZcbJeb4kZn-sD9CwBME/view
CLASSIFICATION MODEL TO PREDICT DYNAMIC HEALTHCARE RESOURCE UTILIZATION AND ALLOTMENT METHOD BY USING CART ANALYSIS FOR SURGICAL PATIENTS LOS	Er Sandeep Ravikanti	CSE	JETIR	2021	ISSN : 2349-5162	https://www.jetir.org/papers/JETIR2105565.pdf
Secure Data Transmission and Deletion between Two Clouds without Overhead	Er Sandeep Ravikanti	CSE	JETIR	2021	ISSN : 2349-5162	https://www.jetir.org/papers/JETIR2105787.pdf
A Review on Multi-model Sentiment Analysis using Deep Learning for Text, Speech, & Emoji Reorganization	T Praveen Kumar	CSE	Journal of Harbin Institute of Technology (Scopus)	2022	ISSN No: 0367-6234 Vol-54 Issue:4 March-2022, p.56-66	http://hebgydxxb.periodicales.com/index.php/JHIT/article/view/934
Multimodal Sentiment Prediction based on the integration of Text and Emojis	T Praveen Kumar	CSE	Journal of Optoelectronics Laser (Scopus)	2022	ISSN No: 1005-0086 Vol:44 Issue:4 April:2022, p.489-499	http://www.gdzjg.org/index.php/JOL/article/view/243

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
A Pragmatic Approach to Emoji based Multimodal Sentiment Analysis using Deep Neural Networks	T Praveen Kumar	CSE	Journal of Algebraic Statistics (WoS)	2022	ISSN: 1309-3452 Volume 13, No. 1, May:2022, p.473-482	https://publishoa.com/index.php/journal/article/view/108
A Soft Hyper Tuned Voting Ensemble Classifier integrated with One Versus All Approach to Identify the Erythemato-Squamous Disease.	Deva Rajashekar	CSE	Journal of Optoelectronics Laser (Scopus)	2022	ISSN No: 1005-0086 Vol:41 Issue:5 April:2022, p.106-114	http://gdzjg.org/index.php/JOL/article/view/303
TRLU: A CUSTOMIZED ACTIVATION FUNCTION TO DETECT ERYTHEMATO-SQUAMOUS SKIN CANCER AT EARLY STAGE	Deva Rajashekar	CSE	Journal of Algebraic Statistics (WoS)	2022	ISSN: 1309-3452 Volume 13, No. 1, May:2022, p.511-516	https://www.publishoa.com/index.php/journal/article/view/113
AUTHENTICITY AND SECURITY FOR CRITICAL AND IMPORTANT DATA STORAGE USING BLOCKCHAIN	Dr Diana Moses	CSE	Patent	2022	202241020912	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Supply chain coordination in the internet of things for fresh agricultural products	Vasavi Sravanthi Balusa	CSE	Patent	2022	202241013174	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
An AI based framework for realizing ahuman emotion recognizing system	Dr. M. Sharada Varalakshmi	CSE	Patent	2021	202141025545	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
An IOT equipment based secured cloud network communication method"	Dr. Syed Azahad	CSE	Patent	2021	202141061935	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
Office titled "A SYSTEM FOR PRIVACY-PRESERVING MEDICAL RECORD SEARCHING ENGINE FOR AN ARTIFICIALLY INTELLIGENT BASED DIAGNOSIS IN IOT HEALTHCARE"	Dr. Syed Azahad	CSE	Patent	2022	202241020616	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
A Novel Method of Detecting IoT Malware using Deep Learning",	Dr. Syed Azahad	CSE	Patent	2022	202241013084	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
A server updation method and system using IoT environment"	Dr. Syed Azahad	CSE	Patent	2022	202241008725	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Real Time Agriculture Field Monitoring System Using IOT"	Dr. Syed Azahad	CSE	Patent	2022	202241017480	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
DETECT AND PREVENT THE DATA LEAKS USING SQL & AI SYSTEM FROM BIG DATA SOURCE"	Dr. Syed Azahad	CSE	Patent	2022	202211024152	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Improve Learning Possibilities Using Block chain & AI"	Dr. Syed Azahad	CSE	Patent	2022	202241025478	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Multi Speed Drone for Remote Field Monitoring System	Dr. Syed Azahad	CSE	Patent	2022	202241025480	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Smart Parking System Using AI of Things (AIOT)	Dr. Syed Azahad	CSE	Patent	2022	202241024357	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal
DIGITAL IMAGE PROCESSING TECHNIQUES USING MATLAB	Er Sandeep Ravikanti	CSE	Patent	2021	202141027199 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
AN INTELLIGENT WAY TO TRACK VALUABLES USING LOCATION TRACKING BUZZER BOX	Er Sandeep Ravikanti	CSE	Patent	2021	202141027310 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
A NOVEL APPROACH TO IDENTIFY THE FACIAL PARTS USING LOCAL BINARY PATTERN AND COMBINED LVQ CLASSIFIERS	Er Sandeep Ravikanti	CSE	Patent	2021	202141022167 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
Building Confidential and Efficient Query Services in the Cloud with RASP Data Perturbation	Er Sandeep Ravikanti	CSE	Patent	2021	202141025072 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
A Novel System for Digital Marketing using Artificial Intelligence and Blockchain	Er Sandeep Ravikanti	CSE	Patent	2022	2021103495	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus
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ARTIFICIAL INTELLIGENCE-BASED CANCER DIAGNOSIS AND TREATMENT BY USING NANO PARTICLES	DR. A. ARUN KUMAR	Department of Humanities and Sciences	Patent	2022	202241000502 A	https://ipindiaservices.gov.in/PatentSearch/PatentSearch/ViewApplicationStatus

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Hydrological modeling with respect to impact of land-use and land-cover change on the runoff dynamics in Budhabalanga river basing using ArcGIS and SWAT model

Manisha Bal [a], Asit Kumar Dandpat [b], Bandita Naik [c]

https://doi.org/10.1016/j.rsase.2021.100527

Abstract

Water Supply

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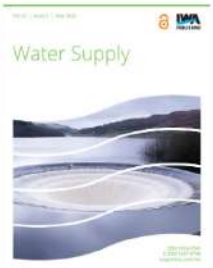

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RESEARCH ARTICLE | APRIL 18 2022

Water surface profile in converging compound channel using gene expression programming

Bandita Naik; Vijay Kaushik; Munendra Kumar

Water Supply (2022) 22 (5): 5221–5236.
https://doi.org/10.2166/ws.2022.172 **Article history**

Abstract

Assessment of water surface profile in compound channels is essential for flood defence systems. Agriculture and development activities in floodplains affect the floodplain shape over the length, leading in a converging compound channel. Few

Groundwater Contaminant Transport Analysis and Numerical Solution of Diffusion in Saturated Aquifer

Pappu Kumar[1], Sunny Agarwal[2], Mani Bhushan[3], Shiphali Preeti Aind[4] and Gara Megha Shyam[5]

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Abstract: At an Industrial site on a sand aquifer overlaying a clays silt aquitard contaminant transported due to diffusion. Groundwater diffusion plays a significant role in solute transport in saturated aquifer system predominantly in sand and silt. Diffusion is considered as analogous of permeability considering horizontal direction. But the analytical solutionisdifficult to apply either composite boundary condition or higher order solute transport problem.This study has used an analytical result of solute transport in an aquifer with a Dirichletand Neumann boundary condition. In the subsurface of groundwater movement Contaminant Concentration affected by sand silt and gravel. The diffusion analysis of Groundwater flow and contaminant transport using Numerical modeling and finite difference method is used for the case of the saturated aquifer. The graphical solution is obtained with the help of MATLAB software.

Keywords: Numerical Modeling, Groundwater Flow, Solute Transfer, FDM, MATLAB.

Article

AUTOMATIC DETECTION OF EMOTIONS IN VEHICLE DRIVERS BASED ON ANALYSIS OF BIOMEDICAL DATA TO IMPROVE THE PERFORMANCE

November 2021
DOI:10.31032/IJBPAS/2021/10.11.1060

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Abstract

Everybody on onboard your character vehicle will enjoy each feature. To achieve so, a machine should firstly assess that patient's psychological or stress state, something it should

Article

ACCESS TO CARRIER-BASED OUTREACH SERVICE IN THE TRANSPORTATION SYSTEM FOR LATENCY TOLERANCE IN THE ENVIRONMENT

November 2021
DOI:10.31032/IJBPAS/2021/10.11.1050

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Outline

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Study of security issues and solutions in Internet of Things (IoT)

Shashi Rekha [a], Lingala Thirupathi [b], Srikanth Renikunta [c], Rekha Gangula [d]

https://doi.org/10.1016/j.matpr.2021.07.295

Abstract

As smart devices are increasingly getting deployed in distinct scenarios it is important to examine how the various demands of these practical uses will affect

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Influence of Demographic Variables on Consumer Buying Behaviour of Luxury Cars in Hyderabad – A Study

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6.1 IMPACT FACTOR

Influence of Demographic Variables on Consumer Buying Behaviour of Luxury Cars in Hyderabad – A Study

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Abstract:
The Consumer behaviour doesn't keep identical or constant in every state of affairs it changes time to time. There are various factors that affects shopper behaviour. As a result of the modification comes in these factors, shopper behaviour to boot changes. The demographic factors that have a bearing on shopper behavior like cohort, gender, legal status, occupation, education, family background, family size etc. throughout this grim battle for snatching most share of market, only those producers' area unit destined to emerge victorious United Nations agency area unit able to scan the heartbeat of the shoppers, and this could be here, where customer behaviour contains a vital role to play. The area unit such an outsized quantity of demographic factors like age, sex, income, occupation, education, status and family background that affects the behaviour of shoppers of luxury cars. Here an effort has been created to know the influence of demographic variables under the study on these demographic variables on the purchase of luxury cars within the vicinity of Hyderabad. It's quite necessary for the manufacturers of those luxury cars to grasp the behaviour of customers, in order that they will, faucet on them to draw in towards the attracting the customers in their premium model of cars in this competitive market. A study in this regard was effectively conducted within the geographical limits of Hyderabad and Secunderabad and the conclusions were drawn in observing the influence of demographic variables on the purchasers of luxury cars in the geographic limits of Hyderabad and Secunderabad.

Key Words: Consumer Behaviour, Luxury Cars, Demographic variables, Premium Model of Cars, Elite group.

1) Introduction:

India domestic automobile (passenger vehicles + business vehicles) sales set a replacement record in financial year 2015-16 (April 2015-March 2016) with three.48 million units (8.1% year-over-year increase). This was a result of sturdy economic process, aggressive promoting of latest cars by every company, and falling fuel costs.

In 2020, India was the fifth-largest motorcar market, with ~3.49 million units combined sold within the traveller and business vehicles classes. It had been the seventh largest manufacturer of business vehicles in 2019. India is additionally an outstanding motorcar businessperson and has sturdy export growth expectations for the close to future.

The Indian luxury automotive market studied was valued at quite USD one billion in 2020, and it's expected to achieve a price of over USD a pair of billion by 2026, registering a CAGR of quite 6 June 1944 throughout the forecast amount.

The automobile trade these days is that the most remunerative trade, because of increase in income in each rural and concrete sector and accessibility of simple finance are the most drivers of high volume automotive segments. More competition is heating up with host of latest players coming back in and world brands like Porsche, Bentley, and Ferrari equipped to venture in Indian market. These analyses are useful for the prevailing and new entrant automotive producing firms in India to search out the client expectations and their market offerings.

Luxury Cars - terminology:

Luxury vehicle (cars) may be a promoting term for a vehicle that gives luxury — pleasant or fascinating options on the far side strict necessity — at increased expense. The term suggests a vehicle with higher quality instrumentation, higher performance, a lot of precise construction, comfort, higher style, technologically innovative fashionable, or options that convey a picture, brand, status, or status, or the other 'discretionary' feature or combination of them. The term is additionally broad, extremely variable and relative. It's a sensory activity, conditional and subjective attribute which will be appreciated otherwise by completely different people; "what is also luxury for one is also premium for one more."

In modern usage, the term is also applied to any vehicle type— together with sedan, coupe, hatchback, motorcar, and convertible body designs, yet on minivans, crossovers, or S.U.V. vehicles and to any size vehicle, from tiny to large—in any value vary. Moreover, there's a convergence within the markets and an ensuing confusion of luxury with high value: wherever there might are a transparent distinction in price between luxury et al., there's now not AN absolute separation between premium and luxury, with what is also premium brands currently costlier than the equivalent alleged luxury ones.

Automobile makers market specific makes and models that are targeted at explicit socio-economic categories, and therefore "social standing came to be associated a lot of with a selected vehicle than possession of an automotive in and of itself." so, automakers differentiate among their product lines in "collusion" with the car-buying public. Whereas a high value is that the most frequent issue, it's "styling, engineering, and even opinion that cars had the best and lowest standing related to them."

Every era in automobile history has had "a cluster of automotive Marques and models that are dear to get, because of their alleged superiority of their style and engineering". Aimed toward rich consumers, such cars can be generically termed luxury cars. This term is additionally used for distinctive vehicles created throughout "an era once luxury was individualistic thought, and coachwork may well be tailored to an owner sort of a bespoken suit." though there's hefty literature regarding specific Marques, there's an absence of systematic and erudite work that "analyzes the luxurious automotive development itself."

Luxury vehicle manufacturers might either be complete corporations in their claim, like BMW and Mercedes-Benz, or a division/subsidiary of a mass market car manufacturer (e.g., Lexus is a component of Toyota). Badge engineering is usually used for price savings, as an example, the Lincoln vehicles that area unit supported Ford platforms or Acura models derived from Honda. Though' wide used, the term luxury is broad and extremely variable. It's a sensory activity, conditional and subjective attribute and will be understood otherwise by completely different people: "What could be a luxury automobile to some... could also be 'ordinary' to others."

Luxury market segments:

- Premium compact segment: The premium compact category is comparatively new, having been initiated by many European brands within the mid-2000s, and have displaced their compact government cars to represent the smallest amount overpriced offerings in their line-ups. The classification varies, for example client Guide Automotive within the U.S. considers the Audi A3 and Mercedes-Benz CLA-Class as a part of the premium compact phase because of similar size and MSRP, though' these area unit familiar in Europe as a little family automobile and a compact government automobile, severally. Adding to some confusion, General Motors has positioned Buick as a "premium" plate to vie with Lincoln (whereas it erstwhile competed with Mercury) and front-wheel drive Acura and Lexus models, whereas Cadillac is geared toward the "luxury" phase that usually encompasses the performance-oriented BMW and Mercedes-Benz Marques.
- The Mercedes-Benz CLA-Class is associate degree example of a premium machine. The premium compact phase is targeted at a distinct segment market of shoppers UN agency found the prevailing entry-level luxury offerings (mostly consisting of compact government cars) to be too overpriced. By giving a smaller, lighter, a lot of fuel-efficient, and fewer overpriced vehicle, premium compacts introduces younger patrons to the luxurious name, in hopes of retentive the sought after client loyalty. This includes the Audi A3, Buick Verano, BMW a pair of Series, BMW i3, Cadillac ELR, Chrysler two hundred, Lexus CT, Mercedes-Benz CLA-Class, Mercedes-Benz B-Class, Saab 9-2X, and also the Volvo V40. Premium compacts vie with well-equipped midsize (non-luxury) cars, and with choices they overlap abundant with compact government cars (entry-level luxury cars).
- Premium compacts might share parts with mass market cars from the Marques's parent company (the Audi A3 as an example, shares abundant of its engineering with the cheaper Volkswagen Golf), and/or have less subtle platforms compared to upmarket vehicles within the line-up (such because the Mercedes-Benz B-Class that is front-wheel drive compared to the opposite Marques's dearer cars that area unit rear-wheel drive). However, the BMW one Series retains the front-engine longitudinal-engine rear-wheel drive configuration of dearer BMWs.

2) Review of Literature

In associate analysis of the impact of advertising on the patron durable goods market by Bhavaniprasad & Seethakumari (1987), it had been discovered that friends area unit the foremost authoritative part, followed by family. As a result, they must be higher attention whereas developing promotional plans. Advertising, additionally to friends, plays a major half in influencing client behaviour for consumer goods.

According to Sathyaraju (1992), the husband and mate along build quite four-hundredth of white goods shopping for selections. Whole choice was influenced by worth, durability, an honest mechanical device, word of mouth, and different factors.

Gupta & Verma, (2000) observed the influence of husband, significant other and children and additionally the interaction between them among the acquisition decision methodology. The study collectively think about the influence of socio-economic factors like education, income , age and employment among the decision methodology and situated that gain of the family and women employment is that the most issue influencing family higher knowledge. among the

acquisition choices, husbands tend to concern themselves with relatively necessary in purposeful product attributes like price whereas wives target relatively minor aesthetic product attributes like colour. He collectively recognized that financial resources that husband or significant other brings to the house collectively influence house choices.

Innocent Nkwocha, (2000) illustrious that prime involvement product unit of measurement expensive and infrequently purchased and additionally the shopper is not whole responsive to the merchandise. Therefore, activity match between parent whole and extension whole may become the dominant determinant issue at the time of next purchase. It's collectively found that importance of manufacturing or technical match between parent complete and extension complete is larger in high involvement product categories.

Jojo Paul, (2001), observed that advertising cannot exist whereas not ability. All awards, for best ads every national and international, unit of measurement being given supported ability alone. The investigator might observe the success stories of kind of Indian ads that have real gem of ability. It's collectively connected the influence of Advertising ability on shopper purchase behaviour. it's discovered that, for advertising, alone essential suggests that of fixing target market or market segmentation is by current behaviour and current communication effects and not by various variables like Media exposure, Demographics, Psychographics or temperament traits.

Szmigin & Carrigan, (2001) examined but and why promoting has principally neglected the older shopper and targeting younger targets. It explored variety of the myths of the older shopper and by examining latest analysis drained USA and up of nice GB and Northern Ireland makes a plea for acceptive the older shopper as still a good deal among the most stream of commercialism. It collectively explored but society considers age and also the approach older people ought to visualize themselves. Whereas age connected myopia is dissatisfactory for purchasers and merchant, older customers may show an oversized vary of identities, making them a probably advanced target for promoting.

Vijayakumar (2005) found that the cohort of people may be an important criterion to ascertain the consumption pattern of effervescent soft drinks. It's collectively noted that status, age, occupation and gain of the family were prominently related to the monthly payment on soft drinks.

James, (2003), examined Chinese children's shopper behaviour associated their influence on the client behaviour of their parents for a quantity of seven years. The foremost noticeable facts unit of measurement that the children's gain has doubled and their payment has nearly tripled throughout currently quantity. Moreover, the freelance store visits and vary of stores shopped severally has collectively increased. It had been collectively found that women have associate increasing amount of influence on family purchases and boys on fun and amusement things, though parents want the boys to review extra and play less.

Nabil Razzouk Victoria, (2007) compared the client decision-making behaviour between married and cohabiting couples. The results, compared to those of eighteen years past found that men and women of married couples build obtaining choices singly, whereas men and women of cohabiting couples created most of their choices on.

Saikat Banerjee, (2008) explained that the behaviour of a shopper principally depends on interaction between internal and external stimuli. Consumption decision created among the market cannot be treated as associate freelance incident. It's closely connected with values and social relationship and cultural factors.

Ushadevi, (2007) illustrious the dynamic shopper behaviour pattern of rural customers in Kerala. The study highlights shifting of customers from worth acutely aware to quality acutely aware , their preference towards low-unit packing, the interest for security aspects of durables goods consumer goods/shopper goods like once sale service and guarantee/warrantee offers and various factors influencing the acquisition alternative of durable goods/durables/durable goods/consumer goods and non durables.

Lilly, (2010) recognized that to alter the angle of the consumers from trial to preference, brands got to be compelled to deliver on their worth proposition, but as place another person from the customer's existing preference list. Philosopher professed, attaining and sustaining preference could also be a vital tread the road to grasp complete loyalty. This might facilitate to induce further revenue, gain larger market share and beat off the competition.

Sushanth, (2010) tried to explore the influence of media among the higher information or in influencing the shopper behaviour. Internet users have magnified and internet is popping into outstanding as a media that may facilitate a two-way interaction on the far side numerous media. The use and utilize of cultural values and beliefs in several permutations and combos do have an effect on the perception of the shopper. Media will influence the perception of the shopper and alter the worth system thanks to its continuous incidence over the shopper all the time.

Hindu deity & Rengaraja, (2011) found that girls play a major role in taking purchase would like merchandise. Associate understanding of purchase behaviour of girls towards merchandise could also be a necessary as results of it reflects the influence of brands, price, quality, quantity, mode of purchase, etc. The success of the market or the failure depends on the acquisition behaviour of customers. Thus, to grasp success among the market, it's become terribly inevitable to provide product in such a fashion as most well-liked by the consumer, as he's the king around whom the whole promoting activity revolves.

Senthil Kumar, (2012) analyzed the behaviour of customers associated with Maruti cars in Salem District, Tamilnadu. From the study, it's found that majority of the respondents in entire 9 taluks of Salem district value more highly to get consequent model of Maruti cars like Swift-VDI, Swift Dzire, SX4, Alto, Maruti-800, Omni, EECO, and Wagon R. So, Maruti maker got to be compelled to focus on the assembly of giant quite the on high of cars. And in addition it got to be compelled to introduce new technological enhancements among the manufacture of cars with the exception of the on high of models to draw in further customers. it's discovered from the analysis that the extent of satisfaction perceived by the Maruti automotive users is completely related to their age, academic qualification, occupation, monthly family gain, status, nature of family, wealth position, amount of observe the automotive, purpose of observe the automotive and model of automotive among the study space.

3) Research Objective:

The primary and main objective of this research is to study the effect of demographic variables and their relative influence on Consumer Buying Behaviour of Luxury Cars. This research was focused on understanding different demographic parameters that may be influencing the decision of Customer Buying Behaviour of Luxury Cars, in the geographical vicinity of Hyderabad.

Demographic Profile of the Respondents:

The demographic profile of the respondents for the research work describes the demographic grouping such as age group, income class, gender, occupation and marital status of the respondents.

4) Research Methodology

Sources of Data Collection:

Sources of data:

This research work is mainly based on the information collected through primary data which was gathered directly from the respondents by administering a structured questionnaire.

Secondary data in this research has been extracted by referring to various research reports, articles, Journals. The list of these have been given in the references.

Sample Size Calculations:

According to the RTA, Telangana, at the end of 2014, the private vehicle population of Hyderabad and Secundrabad was around 53 lakhs with approximately 10 lakhs being cars. However a clear figure for luxury cars was not available and hence the sample size was calculated taking ten lakhs as population. Sample size was determined using the following formula.

Sample Size:

$$Sample\ Size = \frac{z^2 X \frac{p(1-p)}{e^2}}{1 + (\frac{z^2 X p(1-p)}{e^2 N})}$$

Population Size = N | Margin of error = e | z-score = z

Using the formula given above, for a population of ten lakhs at 95% confidence level (z score 1.96) with a margin of error of 5%, the sample size is 385. It is suggested in the literature that in the development of a scale instrument, the size and composition of the sample should be considered with respect to the purpose of the study (Netemeyer et al. 2003). Clark and Watson (1995) suggest a sample size of 100-200 is adequate for this purpose. However, for better results, more number of customers were approached with the help of car showrooms. Questionnaires were administered when the respondents via personally to some customers who came to showroom for servicing of their cars and rest were administered via email. Finally, 629 responses were recorded and were used for analysis.

Sampling method:

Simple random sampling method was used, so that every customer from the database had equal chance of being a respondent. Customers randomly came to service centers and those who were approached via email were chosen randomly from the database.

Scope and Limitations of the Study:

The Scope of the research work was mainly focussed on studying **"**the Influence of Demographic Variables on Consumer Buying Behaviour of Luxury Cars in Hyderabad". The study was carried with a limited sample size of 629 respondents who are the owners of the luxury cars in the geographical vicinity of Hyderabad.

5) Data Analysis & Interpretations

Table 4.5 depicts the demographic characteristics of the respondents

Table 5.1 Demographic Characteristics – Age Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Age	Below 25 years	11	1.7	1.7	1.7
	26-40 years	57	9.1	9.1	10.8
	Above 40 years	561	89.2	89.2	100.0
	Total	629	100.0	100.0	

Interpretation:

It is evident from the above table 5.1 majority of the respondents who owned the luxury cars in Hyderabad are in the age group of above 40 years, followed by 9.1% of them in the age group of 26-40 years.

Table 5.2 Demographic Characteristics - Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Female	287	45.6	45.6	45.6
	Male	342	54.4	54.4	100.0
	Total	629	100.0	100.0	

Interpretation:

It is evident from the above table 5.2 that the majority of the respondents i.e. 54.4% are Male, followed by 45.6% are Females who owns the luxury cars in Hyderabad.

Table 5.3 Demographic Characteristics – Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Marital Status	Unmarried	61	9.7	9.7	9.7
	Married	568	90.3	90.3	100.0
	Total	629	100.0	100.0	

Interpretation:

From the above table 5.3 it can be observed that majority i.e. 90.3% of the respondents who owned luxury cars in Hyderabad are 'Married 'followed by only 9.7% of the respondents are unmarried class.

Table 5.4 Demographic Characteristics - Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Occupation	Business	346	55.0	55.0	55.0
	Politician	10	1.6	1.6	56.6
	Private Service	31	4.9	4.9	61.5
	Professional	59	9.4	9.4	70.9
	Self Employed	183	29.1	29.1	100.0
	Total	629	100.0	100.0	

Interpretation:

From the above table 5.4 with respect to the occupation of the respondents it can be observed that majority i.e. 55% of them are having 'Business' as their profession, followed by 29.1% are self-employed.

Table 5.5 Demographic Characteristics – Monthly Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Monthly Income	Below 10 lakhs	467	74.2	74.2	74.2
	10 - 50 lakhs	100	15.9	15.9	90.1
	50 lakhs - 1 crore	41	6.5	6.5	96.7
	Above 1 crore	21	3.3	3.3	100.0
	Total	629	100.0	100.0	

Interpretation:

The above table 5.5 reveals that majority i.e. 74.2% of the respondents have the monthly income of below 10 lakhs, followed by 15.9% of them have in the range of 10 to 50 lakhs.

Table 5.6: No of Cars owned by the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
No. of Cars	1	287	45.6	45.6	45.6
	2	172	27.3	27.3	73.0
	3	98	15.6	15.6	88.6
	Above 3	72	11.4	11.4	100.0
	Total	629	100.0	100.0	

Interpretation:

Table 5.6 gives us the picture that majority i.e. 45.6% of the respondents owned only one luxury car, followed by 27.3% owned two cars.

Table 5.7: The brand of luxury car presently owned by the Customer

		Frequency	Percent	Valid Percent	Cumulative Percent
Brand	Mercedes Benz	278	44.2	44.2	44.2
	Audi	111	17.6	17.6	61.8
	BMW	160	25.4	25.4	87.3
	Jaguar LandRover	80	12.7	12.7	100.0
	Total	629	100.0	100.0	

Interpretation:

Table 5.7 reveals that majority i.e. 44.2% of the respondents have presently owned Mercedes Benz car, followed by 25.4% of them pre owned BMW.

Table 5.8 Source of information for purchasing this brand of luxury car

	Frequency	Percent	Valid Percent	Cumulative Percent
Company Commercial Ads	159	25.3	25.3	25.3
Friends/Reference	324	51.5	51.5	76.8
Newspaper/Magazine Article	31	4.9	4.9	81.7
Others	104	16.5	16.5	98.3
Social Media	11	1.7	1.7	100.0
Total	629	100.0	100.0	

Interpretation:

Table 5.8 shows the sources of information for purchasing the vehicle brand. Majority i.e. 51.5% of the respondents have opined that they had relied on 'Friends and Reference groups for the purchase of their choice of vehicle, followed by 25.3% have opined it to be the company's commercial advertisements. Approximately 77% of the respondents have relied on these two sources for information in the purchase of their vehicle.

Table 5.9: Who has played a major role in influencing you in this Purchase Decision?

	Frequency	Percent	Valid Percent	Cumulative Percent
Advertisements	28	4.5	4.5	4.5
Family Members	274	43.6	43.6	48.0
Friends	41	6.5	6.5	54.5
Reference	28	4.5	4.5	59.0
Relatives	29	4.6	4.6	63.6
Self-decision	199	31.6	31.6	95.2
Spouse	30	4.8	4.8	100.0
Total	629	100.0	100.0	

Interpretation:

Table 5.9: Shows the influencers for purchasing the vehicle brand, significant no. of the respondents i.e. 43.6% have been influenced by family members for their purchase followed by 31.6% have opined that the purchase is not influenced by anybody and it is their 'self decision'.

Research Findings:

1. The research found that majority of the respondents who owned the luxury cars in Hyderabad are in the age group of above 40 years, followed by only 9.1% of respondents are in the range of 26-40 years.
2. It was found in the study that the luxury car owners in Hyderabad were dominated by Male class which is 54.4%, followed by 45.6% of them owned by Female customers.
3. It was found in the study that majority i.e. 90.3% of the respondents that owned luxury cars in Hyderabad are 'Married classes followed by very less percent i.e. 9.7% of them are unmarried.
4. It was found in the study that majority i.e. 55% of the respondents of the luxury cars in Hyderabad are 'Business Class' followed by 29.1% of them are self-employed. Hence it can be concluded that approximately 84% of the respondents of the luxury car owners are from 'Business Class & Self-employed'.
5. It was observed in the study that greater part of the respondents i.e. 74.2% have the monthly income of below 10 lakhs, followed by 15.9% of them have in the range of 10 to 50 lakhs. It can be concluded that majority of the respondents i.e. 80% have their monthly income in the range below 10 lakhs and 10 lakhs to 50 lakhs range.
6. It was found in the study that majority i.e. 45.6% of the respondents had presently owned only one luxury car, followed by 27.3% of the respondents owned two cars. It can be concluded that approximately 73% of the respondents in Hyderabad owned 1 – 2 luxury cars.
7. It was observed in the study that majority i.e. 44.2% of the respondents had presently owned Mercedes Benz car in Hyderabad, followed by 25.4% of the respondents owned BMW. It can be concluded that approximately 69.6% of the respondents have owned Mercedes Benz and BMW cars in vicinity of Hyderabad.
8. The study found that majority i.e. 51.5% of the respondents have opined that they had relied on 'Friends and Reference groups for the purchase of their choice of vehicle, followed by 25.3% have opined it to be the company's commercial advertisements. Approximately 77% of the respondents have relied on these two sources for information in the purchase of their vehicle.
9. The research found that majority of the respondents are of the opinion that they are influenced by 'family members in their purchase decision and 31.6% have opinioned that there is no influence of other but it's their 'self decision'.

Conclusion:

Demographic data is the key element for analyzing the demographic variables and their influence on buying behaviour of customers of luxury cars in geographical vicinity of Hyderabad. It was observed that the majority of the respondents who owned the luxury cars in Hyderabad are in the age group of above 40 years, is dominated by Male class segment and Married class. It was also observed that mostly businessmen prefer the luxury cars in Hyderabad are this class is having a monthly income of 10 to 50 lakhs. It can be concluded that majority of the respondents own 1 to 1 to 3 cars, most of them prefer Mercedes Benz as their first choice. For purchasing the luxury cars most of the respondents have relied on opinions of 'Friends and Reference groups and 'Company's Commercial Advertisements. Finally it can be concluded that the respondents are influenced by their family members in the purchase of premium/luxury cars.

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"An Exploratory study to analyze the gender perception in Selection of Luxury cars – A Study with special reference to twin cities of Hyderabad & Secunderabad"

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Title: An Exploratory study to analyze the gender perception in Selection of Luxury cars – A Study with special reference to twin cities of Hyderabad & Secunderabad.

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Abstract:
Luxury brands have a superior perceived value when compared to other companies. Customers are willing to shell down premium amount in the purchase of luxury class vehicle when they sense that the value reflects the worth that they're receiving in return. Few luxury cars are functionally indistinguishable to low-cost models, but the details and the way the vehicle is placed makes the difference.

Car possession would extremely facilitate ladies and men would be ready to go any journey direction they need. Automotive shopping for choices is very important for client to quicker their daily quality economically, quicker social access and cozy, still automotive shopping for choice is a lot of vital. Presumptively ladies and men behavioural factors influence automotive choice efforts before shopping for. Physically and psychologically ladies and men are having totally different desires, commonplace analysis, interest, and behavioural choice influencing their choice of shopping for automotive for daily activities match with their desires criteria considers to car's characteristics, style, and car's size. That automotive characteristics most outstanding have chosen by ladies and men, therefore it's foreseen that there's important totally different between ladies and men of choosing the automotive interims of automotive category, style, characteristics and automotive size.

Effective marketing can raise a vehicle brand's perceived value and make it more attractive for premium/luxury car buyers looking to maximize their investment in the luxury vehicle's purchase.

The main purpose of this study is to analyze the gender perception in Selection of Luxury Cars. The study was also focused on the factors that are associated with the selection of Luxury cars by considering the design criteria such as Safety, Comfort, Luxury interiors, exteriors and style. The study was focused on to access the impact of gender towards the selection of Luxury cars in the vicinity of Hyderabad and Secunderabad, by taking into consideration of design feature criterions. For this purpose a sample of 629 respondents were considered and their responses were analyzed.

Although there are many independent variables such as cost of luxury cars, brand preference, Comfort, Luxury interiors and exteriors and the relative motivation in buying them were compared to the dependent variable gender difference for 629 respondents in the geographical limits of Hyderabad and Secunderabad.

Key Words: Luxury Cars, Safety features, Comfort, Design, Brand Preference, Relative Motivation.

I) Introduction

A luxury automotive is one that's more leisurely, has additional safety options and prices quite a customary automobile. There's no set definition of a luxury automotive, though sometimes they're going to have animal skin seats, the most recent gadgets in terms of maps and cameras and a strong engine.

In order to be thought-about a luxury automotive, the vehicle should have high-end options that go higher than and on the far side the typical requirements. The term luxury is employed to categorize vehicles that square measure equipped with higher performance capabilities, lavish interiors and every one the most recent safety and technology options.

Even though the automotive trade has knowledgeable exceptional turbulence within the past few years, some things haven't modified all that abundant. One among these are that the propensity of males to buy bound styles of vehicles and females different sorts. Men, United Nations agency still comprise quite 0.5 the new vehicle shopping for population, remain the dominant purchasers of pickups (all sizes) and high-end vehicles within the luxury market. Four of the 5 segments with the very best proportion of male consumers 3 years alone also are among the highest 5 this year

Woman, on the opposite hand, square measure additional seemingly to shop for a tiny low automotive or sport utility vehicle than different styles of cars or lightweight trucks. Like the results for males, four of the 5 segments with the very best pace of feminine consumers back in 2007 re-emerge on the list this year. These embrace 3 tiny automotive classes and one tiny utility phase.

These trade trends square measure driven by the vehicles' practicality, basic social science and cultural norms. Relating to practicality, men square measure merely additional seemingly to want pickups for his or her jobs than ladies (though there square measure different reasons for men to like pickups as well). Economically, young single ladies haven't got unlimited monetary resources, so that they tend to gravitate to the additional economy-minded vehicles, that square measure smaller. Older ladies square measure additional seemingly to be married, during which case most of the time the particular legal buyer within the social unit is that the male. Similarly, households with exceptional amounts of income with that they'll purchase high-end sports cars tend to incorporate a handful wherever, again, the buyer are going to be the male.

II) Review of Literature

According to Naughton (2003), generally, it's not one's profession that establishes one's identity however rather the possession of bound varieties of cars, houses, or clothes, living in an exceedingly bound neighborhood or suburban area, looking in bound stores, about to bound theaters, decorating one's living accommodations in an exceedingly bound method, and taking bound vacations. Society attaches bound connotations of superior, totally different or traditional identity to those social symbols. The question one asks is: why do individuals have the tendency to spot powerfully with product or services they consume particularly those with industrial complete names and obvious status? Or higher still why square measure some merchandise and services bought and used not for survival however to demonstrate one's superior wealth and social position as compared to others? What square measure the implications of the extra-possession of products and services?

Hurst et al. (2007) shows that minorities within the USA pay additional on conspicuous things than whites, dominant for variations in financial gain. People use conspicuous payment as a proof of financial gain. Equally, considering the actual fact that the lads within the town of urban center square measure richer: they dominate girls in remunerative posts and sectors (Robert, 2014) will gender distinction in terms of financial gain have a sway on the consumption of luxury cars within the town of Douala?

The modern analysis into client behaviour of cars. It shows a structural relationship of 5 main constructs: (1) analysis of automotive models' attributes and decisions, (2) attitudes towards the automotive models, (3) activity intention, (4) complete image, and (5) cultural/social influences. The primary 3 area unit the foremost researched areas, while the fourth construct - the importance of brand name image on the client/the buyer/the patron, shopping for method - has solely recently come to attention particularly within the consumer behaviour of luxury cars (as drawn in Section three.3). In their study, Clarke and Mcdowell (1996) found that, for the factory-made Ford, a widespread dealer network, substantial and value effective conjugation facilities and support were notably vital to the name of Ford cars. In distinction, the niche BM W was characterized preponderantly by problems with congruence between complete image and self-image or presentation of the patron instead of product differentiation.

Brecht and Halleman (1997) show that German customers think about purposeful attributes of BM W and Mercedes to be equally smart. What differentiates them is that the 'dimension of dynamism', wherever BMW features a clear lead over Mercedes. This suggests that client decisions of luxury cars' area unit driven by not solely utilitarian however additionally hedonistic concerns.

These completely different concerns map onto freelance elements of product evaluations and attitudes and modify the patron to tell apart between product consistent with their relative hedonistic or utilitarian nature.

Nicholls and captain (1999) state that consumption was related to girls within the early twentieth century. Consumption wasn't simply with girls however with specific social teams, the 'suburban's composed in the main of the families of workplace staff, minor professionals and elementary academics. Consumption was essential to the present category, although scarcely reasonable since its aspiration, in veblesnesque vogue were to ape 'high society' and to differentiate itself from its frightening social other: the manual socio-economic class. Sculptor and Podoshen (2012) exploitation one, 180 Americans living in four North Jap all over those vital variations exist between the genders in terms of materialism, consumption and impulse shopping for. No vital distinction was found in terms of brand name loyalty.

Although worth connotes standing, worth itself doesn't confirm the desirability of a standing complete. Complete alternative will send significant social signals to different customers concerning the kind of person exploitation that complete (Wernerfelt, 1990). The symbolic that means customers derive from a specific complete is commonly supported associations between the complete and its users or the 'type' of shopper World Health Organization buys that complete.

An increase in visible expenditures of one's reference cluster leads to a rise (decrease) in an exceedingly household's expenditure shares on visible (non-visible) merchandise. This work conjointly explains the extent to that one's friend's possession of luxury cars conjointly influences one's consumption of luxury cars.

According to Neva et al. (2008) consumption doesn't give direct utility to the person or the girl behaving so, not like the consumption of food and shelter, necessary commodities that do give direct utility – physical and 242 N.B. parliamentarian psychological satisfaction – to the client. The question so is: why do customers wish what they want? Why do they purchase what they buy? What square measure the motives that push men and ladies to buy merchandise that don't give direct utility to the consumers?

Szmigin & Carrigan, (2001) examined however and why promoting has mostly neglected the older client and targeting younger targets. It explored a number of the myths of the older client and by examining latest analysis worn out USA and United Kingdom of Great Britain and Northern Ireland makes a plea for acceptive the older client as still a great deal within the main stream of selling. It conjointly explored however society considers age and the way older individuals might need to visualize themselves. Whereas age connected nearsightedness is disappointing for customers and vendor, older customers might show a large vary of identities, creating them a doubtless advanced target for promoting.

Belch &Willis, (2002), found that within the family {decision making / deciding / higher cognitive method} process there are important changes within the roles compete by relations, with the spouse gaining additional influence altogether call areas. The results indicated that marketers should re-examine their promoting ways for a few merchandise and/or services.

Nabil Razzouk Victoria, (2007) compared the buyer decision-making behavior between married and cohabiting couples. The results, compared to those of eighteen years past found that men and ladies of married couples build getting selections individually, whereas men and ladies of cohabiting couples created most of their selections along.

Maehle, Otnes & Supphellen, (2011) examined however customers type their perceptions of the various dimensions of name temperament known in Aaker's scale (sincerity, excitement, competence, sophistication and ruggedness), and what characteristics of product or complete influence these perceptions. it's known the styles of brands customers understand as typical for every temperament dimension, discovered their common characteristics and explained the explanations why some brands square measure powerfully related to a selected dimension and a few don't seem to be.

Prasanna, (2012) found from the analysis that there's an enormous distinction between the perspective of widowed and married girls towards the acquisition of the icebox, washer and microwave. compared to single, the married girls have additional satisfaction towards their purchase. The wants of the married girls take issue from that of one lady.

Thus their level of satisfaction additionally differs. It had been confirmed that among the ladies respondents, „working women" square measure additional happy with the merchandise when the acquisition instead of the „home makers". As a result of their job, family financial gain and education they may analyze the market and get the simplest product and thereby derive additional satisfaction when the acquisition of the merchandise.

Marichamy, (2013) analyzed the buyer behaviour in respect of their purchase of consumer durables in Madurai town. The buyer behavior to the buyer durable goods changes from time to time as a result of their preferences within the accessible product within the market. The ladies customers possess a decent degree of awareness of the modification going down in their atmosphere. Girls don't seem to be solely price aware however additionally a high quality aware purchaser. It's quite vital to boost core product with price addition to complement client satisfaction additional within the similar value vary. The producers and therefore the retailers should perceive the importance of the customers and their modification in perspective within the method of promoting. Solely then the businesses will face up to and survive within the sale of durables.

Marcia, (2014) explored however the interaction between gender and emotions affects consumers" searching behaviour outcomes. Results demonstrate that positive emotions increase searching behavior outcomes for men, to achieve an equivalent level as for ladies. The findings additionally indicated that retail atmosphere perception mediates the consequences. Moreover, the results showed that positive emotions increase levels of indulgent buying men which negative emotions scale back levels of indulgent buying girls.

Dianne, Boon & Don (1991) tried to "predict purchase behavior" with Juster scale. It is a verbal probability scale designed to estimate future behavior. This study was done in New Zealand involving Juster scale. Compared to other intentions scales, Juster scale has been found to be superior as it accurately forecasted the consumer car purchase behavior.

Philip Kotler, (1965) Philip Kotler and Harry Armstrong, (1995), opined that all the models developed so far by various scientists can be utilized in an integrated manner to understand the consumer in general. As per his view, buying patterns are being influenced by price, quality, availability, service, style, option and image. Depending on the product involved, different behavioral mechanisms and different variables have different degrees of significance in influencing the purchase decision process.

Marsha & Peter, (1991) examined changes in post-purchase satisfaction for the acquisition of consumer goods. Overall, customers with high product involvement showed slightly larger satisfaction with their cars than low product involvement customers over the amount of possession. But, during a amount of 2 months once purchase, customers with high product involvement showed a coffee level of satisfaction and consumes of low involvement showed a high satisfaction.

The major object this paper addresses is to seek out whether there's any gender difference within the choice of luxury cars within the urban area of Hyderabad and Secunderabad terms of their price, variety of them possessed, and brand.

III) Research Objective

1. To study the factors associated with the selection of Luxury cars considering the design criteria such as Safety, comfort, luxury interiors, exteriors and Style,
2. To study the impact of Gender towards the selection of Luxury cars by taking into consideration of design criteria.

Hypothesis:

H0: There is no significant difference between the perceptions of Male and Female towards Design Features Criteria
H1: There is a significant difference between the perceptions of Male and Female towards Design Features Criteria

IV) Research Methodology

4.1 Sources of Data Collection:

Sources of data:

This research work is mainly based on the information collected through primary data which was gathered directly from the respondents by administering a structured questionnaire.
Secondary data in this research has been extracted by referring to various research reports, articles, Journals.

4.2 Sample Size:

The population of luxury car owners in Hyderabad as per the data released by the Road Transport Authority is approximately ten lakhs. By using the formula for determining the sample size with a population size of 10 lakhs at 95% confidence level (z score 1.96) with a margin of error of 5%, the sample size is 385. However, for better

results, more number of customers were approached with the help of car showrooms. Questionnaires were administered when the respondents via personally to some customers who came to showroom for servicing of their cars and rest were administered via email. Finally, 629 responses were recorded and were used for analysis.

4.3 Sampling method:

The method of simple random sampling was adopted, so that every customer from the database had equal chance of being a respondent. The customers who have visited the service centers were randomly selected. Some of the respondents were contacted through email and their responses were also recorded.

4.4 Tools for Data Analysis:

In this research work appropriate statistical tools such as Mean, Standard Deviation, and Factor Analysis were used in the study.

4.5 Scope of the Study:

The Scope of the research work was mainly focussed on studying **"**the Influence of Demographic Variables on Consumer Buying Behaviour of Luxury Cars in Hyderabad".

The study was carried with a limited sample size of 629 respondents who are the owners of the luxury cars in the geographical vicinity of Hyderabad.

V) Data Analysis & Interpretations

Table 5.1 Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Safety Features	Female	287	3.94	1.223	.072
	Male	342	4.01	.964	.052
Comfort of the vehicle	Female	287	3.37	.764	.045
	Male	342	3.32	.580	.031
Luxury interiors & exteriors	Female	287	4.12	1.031	.061
	Male	342	4.18	.743	.040
Style and Design	Female	287	4.34	.962	.057
	Male	342	4.37	.593	.032

Interpretation:

From the above table 5.1 Group Statistics – For the first criteria i.e. 'Safety Features' on Gender, the mean values stood at 4.01 for Male respondents as against 3.94 for female respondents, the standard deviation was recorded as 1.223 for Male respondents as against 0.964 for female respondents.

For the Second criteria i.e. Comfort of the vehicle' the mean values are 3.37 for female respondents as against 3.32 for Male respondents, the standard deviation was recorded as .764 for Female respondents as against .580 for Male respondents.

For the Third criteria i.e. Luxury interiors & exteriors, the mean values recorded were 4.18 for male respondents as against 4.12 for female respondents, the standard deviation was recorded as 1.031 for Female respondents as against 0.743 for Male respondents.

Finally, for the fourth Criteria, the mean values of 4.37 were recorded for male respondents as against 4.34 for female respondents, and the standard deviation was recorded as 0.962 for Female respondents as against .593 for Male respondents.

It was observed that there is not much of difference between the mean scores of Male and Female respondents, it can be interpreted that both gender perceives the factors such as 'Safety features', 'Comfort of the vehicle', Luxury interiors & exteriors, 'Style and Design' in the similar manner. However, the standard deviation for female respondents have been found to be significantly high in respect of the four criteria studied.

From the analysis it is concluded that Alternative hypothesis is accepted since there was a significant difference were found among the male and female respondents in terms of perceptual levels.

Table 5.2: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Safety features	Equal variances assumed	4.178	.041	-.779	627	.436	-.068	.087	-.239	.103
	Equal variances not assumed			-.764	539.032	.445	-.068	.089	-.243	.107
Comfort of the vehicle	Equal variances assumed	36.506	.000	.954	627	.341	.051	.054	-.054	.157
	Equal variances not assumed			.932	525.981	.352	.051	.055	-.057	.159
Luxury interiors & exteriors	Equal variances assumed	18.369	.000	-.845	627	.399	-.060	.071	-.199	.079
	Equal variances not assumed			-.821	508.498	.412	-.060	.073	-.203	.083
Style and Design	Equal variances assumed	24.887	.000	-.467	627	.640	-.029	.063	-.152	.094
	Equal variances not assumed			-.449	458.512	.653	-.029	.065	-.158	.099

Interpretation:

From the above table it is evident that there is no significant difference between the perceptions of male participants when compared with female participants towards design criteria of the luxury cars as the significance values are more than 0.05.

Factor	***Variables***
Design Features criteria	Safety features Comfort of the vehicle The luxury interiors and exteriors Style and Design of the vehicle
Brand criteria	Brand comparison Brand image Reliability of the brand
Economic Criteria	Price Fuel economy
Post-Purchase Criteria	Maintenance cost After sales service

VI) Conclusion

Factor Analysis was applied to identify the under lying dimensions. The study conveyed that the pre purchase behaviour of luxury car customers is a multidimensional structure with many factors such as Design Features, Brand, Economic and Post-Purchase Criterion etc. However, the focus was limited to design Features Criteria.

VII) Scope for Further Research:

The present research reveals the facts with the special emphasis on exploring the gender perception in Selection of Luxury cars – A Study with special reference to twin cities of Hyderabad & Secunderabad was limited to design criteria as the research is multi-dimensional, the researcher may extend the study further by exploring on the criteria's such as Brand, Economic & Post-Purchase Criterion apart from Purchase criteria Dissonance, New Models Dissonance. Such healthy research on the future date will certainly help the companies and the policy makers to sensitize the reduction of 'Cognitive Dissonance of the customers and to enhance their satisfaction and value.

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Factors contributing 'Cognitive Dissonance Behaviour' among Customers of Luxury Cars

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Abstract:
The luxury automobile market accounts for 6 per cent of automobile sales among the USA, resulting in a little low however a significantly gratifying fragment. Companies desperate to extend their luxury vehicle sales at automobile show have to be compelled to understand the factors that drive luxury automobile shoppers throughout this sector. This information provides live marketers the insight they have to make personalised electronic communication competent of changing extravagance patrons.

Cognitive dissonance is one among the foremost deeply determined phenomena within the history of psychological science. The term psychological feature dissonance describes a condition during which an individual's cognition—beliefs, attitudes, and behaviors—are at odds (Festinger, 1957). Psychological feature dissonance is incredibly abundant connected with perspective modification. It's a condition during which two cognitions are conflicting with each other. The psychological feature dissonance theory dissension or need of harmony or contradiction happens once a private holds contradictory thoughts a few beliefs or a perspective object. Once psychological feature dissonance happens when a sale it's referred to as post-purchase dissonance. As a result of purchase call typically needs some quantity of compromise, post purchase dissonance is kind of traditional. Shoppers will rationalize the choice as being wise, hunt down advertisements to support their selection or look to glorious happy house owners for support (Schiffman & Kanuk, 2008).

The theory of "cognitive dissonance" is of nice importance in client behavior and marketers have various interests in analyzing the post purchase behavior of shoppers toughened by them. This paper has effectively broached the associated factors that contribute to understand the 'Cognitive Dissonance behaviour of shoppers of luxury cars.

Keywords: Cognitive Dissonance, Customer Beliefs, Attitude, Consumer Behaviour, Post Purchase Behaviour.

1. Introduction:

Cognitive dissonance happens once tension arises between a human attitudes or beliefs and a decision that contradicts those pre-existing modes of thinking. The psychological development jointly happens once a personal chooses between two equally engaging and equally unappealing decisions. In line with the Business Dictionary's website, the foremost common example of psychological feature dissonance at intervals the business world is that the incidence of "buyer's sadness." This happens once a consumer makes a decision to shop for academic degree item and, shortly once, experiences guilt over the choice, curious if the alternative equally appealing item may have brought larger satisfaction.

Marketing and Dissonance:

Cognitive dissonance can occur across multiple product lines additionally as a competitor's product. Marketers work to combat dissonance by providing customers with ways in which of narrowing down product choices and separating product from the competition. Advertising and promotional campaigns can facilitate raise consumer confidence regarding making product purchases and deflate the chances of buyer's rue which will cause customers to return product in favor of those offered by the competition.

Dissonance-Fighting Tools:

Marketing campaigns may search for to manage consumer doubts regarding making product purchases with the utilization informative advertising. This allows marketers to herald testimonials and freelance studies confirming the quality construction and choices of a company's product. Marketers may also use persuasive promoting, beside humour or celebrity appearances in commercials, as a way of encouraging customers to associate positive emotions with obtaining the company's product. Once customers feel sensible regarding obtaining a company's product, there's a lower chance that dissonance will occur.

Managing the buying methodology

Customer can experience rue over a product purchase at any purpose at intervals the sales experience, beside well once the patron makes the acquisition decision. Marketers search for to carry the buyer's emotional standing through comforting post-purchase services, beside a money-back guarantee or free product service for the period of the acquisition. As associate degree example, several vehicle dealerships across the country maintain service departments to form vehicle repairs and supply free safety inspections of vehicles purchased through the dealerships for as long as a result of the cars unit on the road. These incentives can set corporations except competitors and allow patrons to form less-stressful obtaining decisions.

2. Review of Literature:

Quite a heap of researches are meted out antecedently on “Cognitive Dissonance” and have established the ways that & means that of sinking this from purpose of read of the marketers. “Determinants of psychological feature Dissonance and its relative importance to shopper Product Purchase” that has been conducted by Hamza & Zakkariya within the year 2012. Within the study conducted by them, they need ascertained with relation to ‘Cognitive Dissonance and its relative behaviours among the varied students of the University, relating people of nineteen to twenty-five years, and people WHO recently concerned within the purchase of a ‘durable product’. It had been ascertained therein they possess varied determinants and conjointly totally different class of influences within the construction of ‘Cognitive Dissonance’ among the scholars contained within the on top of people.

Egan et al., (2007) have conducted a probe named “The Origins of psychological feature Dissonance: proof from youngsters and Monkeys. The study was expected subjects to alter their angle toward the unchosen different, deeming it less valuable. Then they conferred subjects with an alternative between the unchosen choice associate degree a choice that was originally as enticing as each choice within the initial alternative. Each teams most popular the novel over the un-chosen choice during this condition, however not during a standard during which they didn't participate within the initial call. These results offer the primary proof of call rationalization in youngsters and apelike primates.

Another study done by Lieberman et al., (2001) named “do amnesic exhibit psychological feature dissonance reductions? The role of express memory and a spotlight in angle change”. It has known the roles of express memory and basic cognitive {process} resources within the process of behavior-induced angle amendment.

Though most theories of angle amendment (cognitive dissonance and self-perception theories) assume a vital role for each mechanism, they planned that behavior-induced angle amendment will be a comparatively automatic method that doesn't need express memory for, or consciously controlled process of, the discrepancy between angle and behavior. Employing a free-choice paradigm, they found that each amnesic and traditional participants beneath psychological feature load showed the maximum amount angle amendment as did management participants.

Kaish (1967) conducted a probe on psychological feature dissonance titled "Cognitive Dissonance and therefore the Classification of shopper Goods" to seek out its impact on commodity things. Korgaonkar & Moschis (1982) conducted a study titled "An Experimental Study of psychological feature Dissonance, Product Involvement, Expectations, Performance and shopper Judgment of Product Performance" to seek out its significance on product & customers.

Cognitive Dissonance & Attitudes:

Cognitive dissonance is another very important factors poignant customer's angle. It's a state of affairs once to cognition (knowledge or thoughts) unit inconsistent with one another. By dynamic his angle he may bring psychological feature dissonance consistency. An individual may expertise, either internal dissonance or intra-attitude dissonance, if there is a conflict ensue between the emotional associate degree psychological feature parts of associate degree angle. Thus, marketers may bring modification to consumer's angle by influencing their psychological feature. It's done by dynamic the beliefs of some angle objects. As associate degree example: if a bunch of shoppers believes that a specific complete or product is not smart, the marketer of the aforesaid complete may develop academic degree informative and persuasive publicity to gift the whole to the consumers in a slender approach, therefore it'll bring changes to their attitudes (Festinger, 1957).

Cognitive Dissonance:

Cognitive dissonance can be a psychological development that refers to the discomfort felt at a discrepancy between what you already acknowledge or believe, and new information or interpretation. It so happens once there is a demand to accommodate new ideas, and it's planning to be necessary for it to develop therefore we tend to become "open" to them makes the generation of acceptable dissonance into a big feature of academic (and other) teaching: he shows the simplest way to drive this sort of intellectual wedge between learners' current beliefs and "reality". Psychological feature dissonance was initial investigated by Festinger (1957) and associates, arising out of a participant observation study of a cult that believed that the earth was near to be destroyed by a flood, and what happened to its members — considerably the terribly committed ones World Health Organization had given up their homes and jobs to work for the cult — once the flood did not happen. Whereas fringe members were further inclined to acknowledge that they'd created fools of themselves and to "put it right down to experience", committed members were further ostensibly to re-interpret the proof to point that they were all along (the earth wasn't destroyed as a result of the fidelity of the cult members).

A classical illustration of psychological feature dissonance is expressed at intervals the fable: The Fox and so the Grapes by storyteller. At intervals the story, a fox sees some high-hanging grapes and desires to eat them. Once the fox is unable to contemplate how to reach them, he decides that the grapes unit presumably not worth consumption, with the justification the grapes presumably are not ripe or that they are bitter (hence "sour grapes"). This instance follows a pattern: one wants one issue, finds it undoable, and reduces one's dissonance by criticizing it. Jon Elster calls this pattern "adaptive preference formation".

Smoking can be a typical example of psychological feature dissonance as a result of its wide accepted that cigarettes can cause malignant neoplastic disease, and smokers ought to reconcile their habit with the desire to live long and healthy lives. In terms of the speculation, the desire to live associate degree extended life is dissonant with the activity of doing one issue which is able to presumptively shorten one's life. The strain created by these contradictory ideas is reduced by any kind of changes in cognition and behaviors, beside quitting smoking, denying the proof linking smoking to malignant neoplastic disease, or justifying one's smoking. For instance, smokers may rationalize their behavior by terminal that alone several smokers become sick, that it alone happens to very important smokers, or that if smoking does not kill them, one issue else will (Wikipedia, psychological feature dissonance).

Factors creating psychological feature Dissonance:

People tend to hunt steadiness in their beliefs and perceptions. The term psychological feature Dissonance is utilized to clarify the feeling of discomfort that results from holding two conflicting beliefs. Once there is incongruity between beliefs and behaviors, one issue ought to modification therefore on eliminate or reduce the dissonance. Several factors unit in charge of creating psychological feature dissonance. Variety of those unit like values, belief, attitudes, customs, political philosophy, non-secular worth, emotional reaction, norms, culture, position, generation influence etc. people living in a {very} very express culture may hold a sturdy belief that he or she will be able to obtain that product that needs to be accepted by that specific culture. In obtaining product conflict may arise concerning whether or to not get or not. Will or not it's accepted by my society? This case creates psychological feature dissonance. Besides, people might need whole totally different values, belief, customs that may manufacture dissonance simply just in case of shopping for product. A religious worth is one of the foremost very important factors that unit in charge of generating psychological feature dissonance. People of varied religion purchase things supported their theological virtue. Some things unit powerfully prohibited by some religion and once people obtaining those, it creates dissonance. In addition to the present political worth, emotional reactions, position in addition have a bearing on purchase decision and so creating psychological feature dissonance (Bhasin, 2010).

Importance of measure psychological feature Dissonance in commission and products Industry:

In the area of service promoting customer's perspective plays a significant role for the marketers. It's one in every of the mandatory determinants in buying behavior. Marketers should worry relating to the service connected issues that directly affects the customer's perspective. Success within the business principally depends on delivering quality merchandise to the target markets. Psychological feature dissonance is associated degree of obstruction throughout this business. Marketers therefore got to be awfully careful in delivering merchandise to the target markets therefore on avoid generating psychological feature dissonance (Festinger, 1957). Psychological feature dissonance theory suggests that dissonance or inconsistency happens once a non-public holds conflicting thoughts a couple of belief or academic degree object. Once the dissonance happens the individual will try to produce a balance in his psychological feature, that's he will try to reduce dissonance. By dynamic his attitudes he may bring psychological feature consistency. A non-public may experience either the inside dissonance or the inter-attitude dissonance.

Marketers got to even watch out that the message that is ready to be delivered to the target customers ought to be free from any dissonance, that is it ought to be matched with the customer's culture, values, belief, non-secular worth, political philosophy, emotional reaction. Thus, a seller may bring change in consumer's attitudes by influencing their psychological feature Behaviour. This can be finished the help of promoting promotional tools. As an example if a gaggle of consumer believes that a specific complete of product is not sensible, the seller of that aforementioned complete may develop academic degree informative and persuasive advert to gift the whole to the purchasers in a {very} very means that which is able to bring change in their attitudes. As a result of the shoppers get new knowledge, that weren't known to them, they're going to change their attitudes towards their complete. This may happen as consumer's cognition change. Marketers could in addition try to change the emotions or the emotional a part of customer's attitudes. By presenting the whole in academic degree emotional context marketers could in addition bring changes in customers mind.

Marketers could in addition try to manufacture dissonance towards their competitive brands at intervals the mind of target customers. Thus, it's a necessity for the service marketers to chop back psychological feature dissonance from the customer's mind & therefore survive competition at intervals the business.

3. Research Objectives:

The objective of this study is to identify the factors contributing to Cognitive Dissonance Buying behaviour of customers of Luxury Cars.

4. Research Methodology:

Sources of data: This research was mainly done by considering the secondary data, which was extracted from previous studies.

5. Discussions:

Perceived value

Luxury brands have a better perceived value compared to utterly completely different firms. Customers' unit of measure willing to pay higher costs for a vehicle once they feel that the price reflects the value that they are getting into return. Some luxury vehicles unit of measure functionally clones of lower-priced models; however the tiny print and then the fashion the automotive square measure positioned makes the excellence.

Effective promoting will elevate a vehicle brand's perceived value associated build it a lot of fascinating for luxury patrons academic degree attempt / attempting to maximise their investment in an automobile purchase.

Status image

A luxury automotive will act as a standing image for the consumer. Firms that need to convey they're in might need employees drive around in luxury vehicles once they visit shopper sites. A typical story shut luxury vehicle getting is that the mid-life crisis. The patron wants a replacement, elegant automotive to represent academic degree modification of pace in their life or to purpose that they've reached a private milestone.

According to a study written within the Journal of mercantilism, there unit of measure 2 differing kinds of motivations that drive customers to buy for product, additionally as vehicles. These 2 motivations unit of measure indulgent and utilitarian. Whereas utilitarian motivations unit of measure a lot of targeted on positioning the patron nearly as good and accountable, indulgent motivations unit of measure a lot of targeted on self-promotion, and elevating them to a better category on the social scale.

Thus, people who purchase luxury cars a lot of potential crave rank and material wealth, as against utilitarian cars that customers purchase automatically.

The luxury company ought to maintain their word and quality to draw in these customers. They pay shut attention to, however folks react to the corporate and might keep one's hands off from vehicles that return from businesses that do not align with their personal or hot values.

Self-esteem

Some folks gravitate towards luxury brands because the thanks to boost their shallowness. This issue would possibly cross over with utterly completely different purchase influencers, like wanting a standing image to extend confidence. This development is termed antagonistic consumption. The action would possibly occur thanks to psychological threats or negative life events that impact the person's ego.

The promoting messages for approaching this market half ought to target the emotional impact of owning a luxury vehicle. Once marketers will turn out this association at academic degree wheeled vehicle show, they go to point out the consumer that they are capable of fulfilling the customer's shallowness goals.

Passion

Car enthusiasts love vehicles as a part of their hobby, thus as that they have a durable attachment to brands that supply distinctive experiences or ranking performance. They are doing not seem to be making an attempt to hunt out a vehicle to urge from purpose A to purpose B. each a part of the automotive contributions to the fashion they get pleasure from their free time, that means this sort of consumer pays shut attention to each aspect of a luxury automotive.

They are better-educated patrons, as they generally consume automobile content in publications and on-line. Selections that get unmarked by the standard shopper find yourself front and center for the enthusiast.

In academic degree analysis of luxury consumption, individual Humeira Aslum Bilge observes "In recent years, the conception of luxury has distended from materialism to time and fervour, and become eventually a lot of out there. As customers satisfy their feelings of enjoyment and gratification through the luxurious product, the out there luxury product jointly will still enhance its charm for purchasers."

Auto show marketers ought to even bear in mind that this shopper demographic would possibly share careful info about the complete purchase expertise with their social circles or on enthusiast forums.

Consumer expertise

"Luxury" covers quite the standard of the best product. It put together sets academic degree expectation that the patron expertise are becoming to be elevated compared to buying from another automobile company.

According to Autotrader, the bulk of shoppers (54%) same they'd purchase from a priority that options a superior expertise over one with rock bottom worth.

Marketers ought to regard each shopper bit purpose within the strategy and confirm it meets or exceeds the assumptions that the consumer brings to the table. Some that} inside which luxury automotive brands will convey this at academic degree wheeled vehicle show embody having enough workers to provide one-on-one attention, providing extra perks to the booth and delivering a bespoken expertise that they can not get anyplace else.

Build Quality

Some luxury automotive brands merely have academic degree improved build quality than their competitors. The premium costs for the vehicles turn out it doable for the corporate to use high-end finishes, higher quality materials and innovative selections.

When the consumer has to possess the best-in-class vehicle, they understand apparent for luxury brands that deliver all the bells and whistles.

Exclusivity

The luxury automotive market incorporates a high barrier to entry for the everyday shopper, that produces it academic degree exclusive club that no-one square measure a part of. Some automotive householders notice themselves being the sole real person with that specific model in their town or region, that might provide them grade of native fame that is in person fascinating.

One way to bolster this issue at academic degree wheeled vehicle show is to speak about the restricted vary of vehicles free by the complete terribly} terribly year. The little numbers would be a negative for a budget automotive whole, however it lands up adding to the value and desirability of the luxurious whole.

People want product they can not have, and this consumer enjoys evoking these feelings once they have a part of a restricted run. They might put together notice themselves maintaining the value of their investment if they understand that no utterly completely different cars get created once the initial producing amount.

Optimizing a promoting strategy for luxury cars at associate wheeled vehicle show wishes a deep understanding of the audience and what drives them to seem for these cars. Leverage these triggers to maneuver patrons on their journey and increase the chances of attracting qualified leads inquisitive about moving forward.

6. Conclusion:

The present study has tried to fill the analysis gaps relating dissonance and its implications in shopper behaviour. For many years, would possibly firms have tried to want in to the deep stock-still grasp that this psychological thought has over the minds of the purchasers guarding and clouting their shopping for behaviour. Dissonance has incessantly been a self-contradictory term for the marketers' world over. In state too, it's been Associate in nursing enigmatic thought for the promoting gurus and agencies World Health Organization are making an effort to relate it with the client behaviour as accurately as get table.

The analysis sprinkles light-weight on the interrelatedness between the involvement of the client within the acquisition call and then the number of dissonance hooked up with it. The analysis all over that if the client is additional in person concerned in creating a range – that's, he himself seeks information relating to the probable product to be purchased and then the makes the shopping for charm his own, then he's less potential to come back across the uncomfortable feeling of dissonance. Thus, it's safe to assume that the involvement level of {the shopper / the client / the patron} in his purchase call would have an important result on the dissonance he feels post purchase which would possibly guide his future shopper behaviour still.

An organization eager to regulate the unpleasant feeling of tension inside their customers post purchase ought to make certain that their customers unit of activity directly concerned inside the acquisition call and shouldn't take the acquisition call in consultation with others or at a lower place influence of others. Since dissonance might even be a psychological thought, it becomes somebody's tendency to doubt the validity of his call if it's been taken in compliance with others. Time as well plays a polar role in leverage with the sensation of dissonance. If the acquisition call is made within the haste and then the patron doesn't pay copious time in creating the acquisition call, then the client would get additional anxious over his call as compared to once he takes considerable time before creating a purchase call. Thus, this aspect of analysis might even be used whereas coaching the staff in any organization.

Often, salespeople unit of activity trained to be useful and extended, however this study shows that the longer the purchasers would wish to create the choice, the higher possibilities of them being happy, hence, salesmen ought to push the patrons to create {the call / the choice} within the match of fury lest they'll regret their decision presently. The longer the salesmen supply to the patrons to create the choice, the additional content they're going to be with their call and would possibly come to identical marketer once more. Dissonance is found to be prevailing additional within the customer's choices once they involve the acquisition of luxury merchandise. Since the value hooked up with a luxury product is additional, the extent of tension and dissonance is additional still.

Scope for any Research:

The study has unfastened many doors for the potential analysis which could effectively be performed to unearth the facts. The reasons that make the non-public involvement of a shopper inside the buying decision associate fascinating an area of examining the vital reasons for the dissonance in shopper behaviour which could tons of typically studied. Besides, the importance of it slow constraint having a bigger result on a shopper being dissonant can also be thought-about in profundity.

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Studies on 4 - dimethylaminopyridinium salicylate monohydrate's optical, mechanical, and laser damage threshold

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ABSTRACT

Slow evaporation solution growth was used to grow single crystals of 4-dimethylaminopyridinium salicylate monohydrate. Single crystals of good optical quality with dimensions up to 14 × 6 x5 mm^3 are obtained. Single crystal X-ray diffraction analysis verified the unit cell parameters of the grown crystals. In the wavelength range of 200–1100 nm, the UV–Vis–NIR Transmittance spectrum was observed. Vicker's microhardness test was used to examine the mechanical behaviour of the grown crystal. Using 5 ns laser pulses at a 10 Hz repetition rate from a Q-switched Nd: YAG laser with a wavelength of 1064 nm, the laser damage threshold value was calculated.

1. Introduction

For many applications in telecommunication, optical data storage, optical information processing, optical switching, frequency transfer, and electro-optical modulation, the science and technology of crystal growth has progressed rapidly [1,2]. The synthesis and growth of organic nonlinear optical crystals, as well as their structure-property relationship, have recently seen an exponential increase in research into new organic nonlinear optical materials for their possible use in a variety of devices. The first and most important benefit of using organic materials is that the molecular structure can be fine-tuned with desired nonlinear optical properties and a wide structural diversity using chemical synthesis [3,4]. Photonic applications, such as all-optical switching and data processing, necessitate molecules with significant optical nonlinearities. Nonlinear optical processes are dominated by material nonlinear susceptibilities. Non-linear susceptibilities are graded as second order, third order, and so on, depending on the number of applied electric fields. When using a traditional laser, the non-linear polarization and the size of the non-linear effect decreases as the order of susceptibility increases [5–7]. As a result, in practical applications, nonlinearity up to the third order is used. Optical, mechanical, and laser damage threshold studies on 4-dimethylaminopyridinium salicylate monohydrate were addressed in this study.

2. Material synthesis and crystal growth

In an equimolar ratio, analytical grade 4-dimethylaminopyridine and salicylic acid were used. The synthesis and reaction scheme have already been explored [8]. DMAPSA solubility was determined as a function of temperature in the range of 30–50° Celsius. DMAPSA solubility was determined using a gravimetric method in a methanol-water (1:1) solvent at temperatures ranging from 30 to 50 °C. Fig. 1 shows the DMAPSA solubility curve.

DMAPSA has a positive solubility gradient in the methanol-water (1:1) solvent, according to the solubility curve. The purity of the solute and solvent determines the consistency of single crystals. As a result, the synthesized material was recrystallized number of times to produce a highly purified product. According to the solubility results, the saturated solution was prepared by continuous stirring for 4 h at a temperature of 36 °C. The prepared solution was then filtered using Whattmann filter paper before being covered with a good quality perforated polythene cover to prevent the solvent from evaporating too quickly. Finally, to keep the temperature of the prepared solution stable, it was held for evaporation in a constant temperature bath with an accuracy of ±0.01 °C. DMAPSA crystals of large size (14 × 6 x 5mm^3) were obtained after 20-days. Fig. 2 shows a photograph of a DMAPSA single crystal.

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Insights into Weak and Covalent Interactions, Reactivity sites and Pharmacokinetic Studies of 4-Dimethylaminopyridinium Salicylate Monohydrate using Quantum Chemical Computation method

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ABSTRACT

The quantum chemical computation technique was utilised in this study to scrutinise the reactivity sites, weak interactions, and pharmacokinetic aspects of 4-Dimethylaminopyridinium Salicylate Monohydrate. Molecular Electrostatic Potential and Fukui function descriptors were used to examine the reactive sites and electron distribution. The chemical implication of the molecule was explained using Electron Localization function and localized orbital locator. Reduced Density gradient analysis and density Overlap Region Indicator analysis gives information about covalent and Non Covalent interactions. Electrostatic potential map and Fukui functions validate that electronegative oxygen and electropositive hydrogen atoms are sites for electrophilic and nucleophilic attack. The drug likeness criteria were computed in order to grasp the biological properties of the title molecule. Absorption, Distribution, Metabolism, Excretion and Toxicity properties analysis gives an idea about pharmacokinetic properties of titled molecule.

1. Introduction

Pyridine is a basic heterocyclic organic compound; it is a bioisosteres of benzene with one carbon displaced by a nitrogen atom [1]. Pyridine moieties play an imperative role in medicinal chemistry ascribed to their antimicrobial, antiviral, antidiabetic, anticancer, antioxidant, antimalaric, anti-inflammatory and antibacterial properties [2]. They are used as solvents and initiative materials for the synthesis of some important compounds, such as insecticides, herbicides, medicines, vitamins, food flavourings, food, rubber chemicals, explosives, disinfectants and adhesives [3]. The formation of a hydrogen bond between the target and the electron of the lone pair in the sp^2 hybrid orbitals of the nitrogen atom is primarily responsible for biological exploitation of these molecules [4]. Salicylic acid is extensively used as a preservative for food products, an antiseptic, antifungal agent and as a plant growth regulator [5,6].

Screening of literature reveals that the crystal structure of 4-dimethylaminopyridinium Salicylate Monohydrate (DPSM) was reported by Arun Kumar et al. [7] and, so far, there is no meticulous study on reactivity sites, wave functional studies and pharmacokinetic properties of DPSM. So, DFT (Density Functional Theory) method was used to explore the reactivity sites, weak, non-covalent and covalent interactions of molecule. The Computational drug discovery program has been gaining popularity because of its potential to discover robust molecules prior to their synthesis, whereas any traditional drug discovery approach is expensive and may take decades to accomplish [8]. In silico ADMET (Absorption, Distribution, Metabolism, Excretion and Toxicity) analysis and prediction of drug likeness, are also being implemented to scrutinize potential drugs from several databases. These computational based approaches reduce experimental costs and time in

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Study of photo catalytical, antimicrobial activity, dielectric and ac impedance properties of Zn doped Mg nanoferrites synthesized from citrate gel auto combustion method

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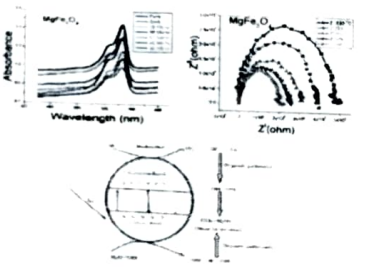
HIGHLIGHTS

- Zn substituted Mg nano ferrites synthesized through citrate gel auto composition method.
- Optical properties enhanced with dopant Zn content.
- Zn substituted Mg nano ferrites show superior UV-light photocatalytical activities for MB and AR dyes.
- Sigma AC enhanced with Zn content and applied frequency up to one ordered 10^{-5} to 10^{-4}.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Mg-Zn nano ferrites
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Antimicrobial activity
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ABSTRACT

Mg–Zn nano ferrites with composition $Mg_{(1-x)}Zn_xFe_2O_4$ where x = 0.0 to 1.0 with 0.2 variation, were fabricated through citrate gel auto combustion method with step wise variation 0.2 mol%. UV–Visible spectroscopy confirmed the direct allowed transitions and optical band gap increased from 2.61ev to 2.71 with the addition of dopant Zn. The PL spectroscopy revealed that the broad near band edge emission in visible range 350–450 nm wavelength region. Antibacterial efficiency of the nano ferrites enhanced with the antibacterial dopant element Zn against gram positive Bacillus subtilis (MTCC 121) and gram negative *Escherichia coli* (MTCC 1687) strains. Organic dyes such as methylene blue and acid red were used to do photocatalytical degradation process and significant rate of degradation was found. Frequency dependent AC conductivity (σ_{ac}) of the nano ferrites increased as a function of temperature and dopant Zn content. Dielectric parameters such as dielectric constant, dielectric loss (tan δ) were decreased with applied frequency. The results of dielectric studies reveals that the dielectric dispersion because of the hopping mechanism of electrons takes place in between Fe^{2+} and Fe^{3+} ions.

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Structure, growth, characterization and anti-microbial activities of L-Isoleucinium-4-methylbenzenesulfonate monohydrate single crystals

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ABSTRACT

The synthesis, growth, crystal structure, characterization, and antimicrobial activities of L-Isoleucinium-4-methylbenzenesulfonate monohydrate are all covered in this paper (LI4MBSA). Slow evaporation solution growth technique was used to grow single crystals of the title compound. At 293 K, single crystal X-ray diffraction analysis was used to establish the crystal structure, which showed that the compound crystallises in a monoclinic crystal system with a space group of $P2_1$ (Z = 2). The grown crystal was then subjected to FT-IR, FT Raman, and UV–Visible spectral analysis to validate the molecular structure. The material is thermally stable up to 120 °C, according to thermal analysis. The title compound's SHG density was compared to KDP using the Kurtz – Perry powder technique. The disc diffusion approach was used to test the title compound's antibacterial properties. As compared to Gram-positive bacteria, LI4MBSA reported a lot of activity against Gram-negative bacteria.

1. Introduction

Infectious diseases and bacterial infections are one of the leading causes of death in the world. Bacteria can spread it directly or indirectly from person to person or animal to human [1–4]. Furthermore, certain bacterial infections, such as salmonella, campylobacter, and E.coli, are transmitted by food and water. Many life-threatening diseases, such as pneumonia and plague, have been linked to these bacterial infections [5–8]. Infectious disease treatment, on the other hand, appears to be a problem. Newly emerging infections, as well as the treatment of these diseases with antibiotics with high bacterial resistance, pose a significant challenge to public health because they can result in a slew of serious side effects [9,10]. As a result, new medications with improved efficacy and less side effects are needed to treat these diseases. Amino acids and their derivatives have gotten a lot of attention in this area because they have been shown to have antibacterial activity, particularly against Gram-positive bacterial infections [11–13]. Beyond that, these amino acids and their complexes have the ability to have nonlinear optical action, making them interesting candidates for nonlinear optical applications. Since amino acids contain zwitterions, i.e. both a proton donor carboxyl acid (-COOH) group and a proton acceptor amino ($-NH_2$) group, they have exceptional physical and chemical properties [14–16]. In addition to the conventional linear optical effects, chiral centres of amino acids react differently to light and are responsible for circular dichroism, optical rotation, nonlinear optical effects, and optical rotatory dispersion [17–20]. In other words, the optical properties of chiral molecules are influenced by electric and magnetic dipole transitions between states. L-Isoleucine is a branched hydrocarbon chain amino acid with chiral aliphatic side chains and is one of the basic amino acids. These side chains are nonpolar, hydrophobic, and nonreactive in nature [21]. As a result, they play a smaller role in the creation of a new covalently bonded compound. They do, however, play an important role in ligand binding and stabilization. Furthermore, L-Isoleucine is one of the amino acids that contains both glucose and fatty acid precursors and is graded as both glucogenic and ketogenic [22,23]. With the support of additives, the morphology, physical, and chemical properties of L-isoleucine crystals can be easily tunable. In this case, the reaction of p-toluene sulfonic acid with isoleucine was chosen. p-Toluene sulfonic acid monohydrate is an organic acid made up of a pyramidal oxonium ion H3O + holding a protonated water molecule with three hydrogen atoms bonded to oxygen atoms of various sulfonate groups. L-Isoleucinium-4-methylbenzenesulfonate monohydrate (LI4MBSA) forms a complex with L-Isoleucine. The centrosymmetric structure of p-Toluene sulfonic acid monohydrate is found to be non-centrosymmetrically

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ORIGINAL PAPER

Radiation Shielding, EPR, and TL Mechanism in Cr^{3+}: $Ba(La)_2SiO_6$ Glass Ceramics

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Abstract
The current research aimed to prepare the Cr_2O_3 doped $Ba(La)_2SiO_6$ glasses and planned for elastic, radiation shielding, electron paramagnetic resonance, and thermoluminescence characterization. The X-Ray diffraction reports reveal the glassy behavior of the pure glass. At the same time, the other test samples show ceramic behavior. Mechanical properties of test samples reveal the range of the microhardness. DTA studies reveal the values of thermal studies of the test samples. After that, the glass-ceramics were tested for radiation shielding properties. The values of mass attenuation coefficient and radiation protection efficiency of the glasses are measured and compared with values obtained with the help of standard photon shielding and dosimetry software. The studies indicate that the glasses developed are capable of radiation shielding. The electron paramagnetic resonance reports suggest high dipole-dipole super-exchange interaction and rhombohedral distortion within the glasses.
Furthermore, we have tested the glasses for radiation shielding properties. Upon 50 kGy, γ - irradiation, the thermoluminescence properties of the glasses are reported. The results were exciting and revealed that the resource developed is thermoluminescent at low activation energies. Additionally, the electron paramagnetic resonance and thermoluminescence properties obtained for the glasses are highly interlinked. In this view, to initiate the comprehensive link between electron paramagnetic resonance and thermoluminescence phenomenon, we have annealed the glasses under 0 to 300 °C of temperature and upon the 0 to 50 kGy, γ - irradiation dose level.

Keywords Cr^{3+}: $Ba(La)_2SiO_6$ glass · Elastic studies · EPR studies · Radiation shielding · TL studies

1 Introduction

Usually, the SiO_2 glass substances are translucent, rigid, non-corrosive, and thermally stable. Their anticipated structural and dielectric characteristics, such as high dielectric constant, low A.E., and values of density of states, will be used for various dielectric applications. There has been significant investigation on silicate glass substances due to their abnormal dielectric determinations considering a few decades to recent years [1, 2]. The La_2O_3 is not a pure glass former, but the joining of La_2O_3 to the silicate glass substances promotes their elastic characteristics, thermal resistance, non-corrosion features. The joining of La_2O_3 to the SiO_2 glasses enhance sharp melting point and grainy hardness. Generally, La_2O_3 doped silicate glasses are employed as a dosimeter for radiation healing and protection due to their high radiation shielding ability [3, 4]. Incorporating the alkali oxides such as Li_2O, BaO, KF, and CaF_2 into the La_2SiO_5 glasses will advance the thermoelement characteristics. The involvement of BaO in the La_2SiO_5 will improve the polymerization phenomenon of glasses [5, 6]. Amongst the whole transition metal oxides, the nucleation agent Cr_2O_3 has been adopted to improve the features of $Ba(La)_2SiO_6$ glass substances considering the collaboration inside the glass interface and the Cr^{3+} ions provide fast

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Short communication

Synthesis, structural, photocatalytic and anti-cancer activity of Zn doped Ni nano chromites by citrate gel auto combustion method

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ABSTRACT

Nano structured zinc doped nickel chromites $Ni_{1-x}Zn_xCr_2O_4$ (where $0 \leq x \leq 1$ by step 0.2) were fabricated by the citrate gel auto combustion route and were characterized with several techniques like XRD, SEM, EDS, Transmission Electron Microscope (TEM), FT-IR, UV–Vis and Photoluminescence. A formation of single-phase cubic structure and the crystalline state of fabricated samples in size range of 9-to–20 nm were established by the X-ray diffraction studies. The SEM images have revealed the shape of Ni substituted Zn nano chromite. The existence of Ni, Zn, Cr and O in the series of samples were also confirmed by the elemental analysis (EDS) study. FTIR spectra revealed the formation of metal oxide bands and spinel chromite structures which have tetrahedral and octahedral stretching frequency bands. Using the UV–Vis spectrometer, the optical properties of Ni-Zn chromite has been studied and also have that the band gap energy of Ni chromite (3.54 eV) is smaller than that of Zn chromite (3.85 eV). The optical band gap energies were found to be 2.10–3.08 eV for the direct band gap calculated from Tauc plots. The present study mainly focused on the photo-degradation of methylene blue and acid red on the Ni-Zn chromite's under UV light. The chromites have shown good and clear degradation at certain time intervals with the reference. The biological activity of the synthesized Ni-Zn chromites were performed for their anticancer activity on Hela cell lines and all the molecules exhibited with different IC_{50} values ranging from 21.83 to 74.15.

1. Introduction

Chromite is mined as an ore ($FeO.Cr_2O_3$) mainly containing chromium as base metal along with other transition metals. It mainly occurs in stratified ultramafic invasive stones also in the metamorphic rocks such as serpentinites. Ore deposits of chromite also occur as early igneous differentiates [1–3]. One specific spinel chromite i.e. nickel chromite ($NiCr_2O_4$) is a good catalytical material for the industrial processes [4]. Spinel compounds of the type $A^{+2}B_2{}^{+3}O_4{}^{-2}$ are frequently and extensively used in various fields due to their tremendous applications and properties. The spinel type of metal oxides contains A^{2+} and B^{3+} cations, in this the tetrahedral (A) sites and octahedral (B) sites are occupied and they are further surrounded by oxygen atoms [5,6], which means that the spinel crystal structure includes magnetic or nonmagnetic nature of transition elements occupying all of the tetrahedral sites and magnetic nature of chromium ion occupying all of the octahedral sites [7]. Spinel type structures are more attractive currently due to their physico-chemical properties and its large variety of applications as sensors [8], as semiconducting materials [9], as magnetic behavior of substances [10], as catalyzing agent [11], as high temperature materials [12], as very good catalysts for industrial purpose for example Zn-chromite and Ni- chromite [13], refractories. Calcium chromite and Magnesium chromite [14–16], are used as pigments and glazes, ex: Cobalt chromite [17]. Among the $Ni_{1-x}Zn_xCr_2O_4$ spinel chromites are used as a photocatalyst in degradation of the organic dyes. A varied number of methods are available for the synthesis of chromite's, they are sol-gel method [18], hydrothermal method [19–21], chemical method [22], micro emulsion method [23], microwave method [24], ultrasonic pyrolysis method [25], solution method [26], ball milling method [27], mechanical activation process [28], and the auto combustion method [29]. Among all of these techniques most of them are very difficult to handle the reaction process due to various complications involved in the progress of reaction, time consuming processes, high reaction temperatures, formation of bi products and the hazardous chemicals involved in these preparation methods [30]. The Citrate gel method is one of the best and most simple method to synthesize the spinel nano chromites because of its cost effective, simple synthesis method, homogeneous mixer, resulting nano sized powder, non-toxicity, ecofriendly, high

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Computational Insights On Charge Transfer and Non-covalent Interactions of Antibacterial Compound 4-dimethylaminopyridinium pyridine-2-carboxylate pentahydrate

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ABSTRACT

The proton transfer compound 4-dimethylaminopyridinium pyridine-2-carboxylate pentahydrate was synthesized and evaluated using spectroscopic methods and quantum chemical computations in the proposed investigation. To validate the molecular structure, a single X-Ray Diffraction study was performed. With the use of Reduced Density Gradient Analysis, the molecule's weak interactions are identified based on electron density. The Fukui and Electrostatic potential plot analysis can provide information about the molecule's electrophilic and nucleophilic locations. The eventual charge transfer inside the molecule is supported by frontier molecular orbital analysis and natural bond orbital analysis. To investigate the ligand-protein interaction, a molecular docking simulation was used, whereas drug likeness and ADMET analysis were used to determine the biological characteristics of the title molecule. Antibacterial testing was performed to investigate the compound's efficacy against bacterial strains.

1. Introduction

Infectious diseases caused by bacteria resistant to diverse antimicrobial agents have risen sharply in recent years. Several causes have been linked to this increase, particularly the use and exploitation of antimicrobial drugs, which has resulted in increased morbidity and death as well as an overall increase in healthcare expenditures. Another significant issue is the sharp decline in the discovery of new medicines that are effective against these multidrug-resistant bacteria. As a result of these issues, we desperately require new antibacterial medicines. Pyridine-based compounds are a significant class of chemicals with a wide range of different activities including antibacterial activity [1]. The pyridine nucleus may be found in a wide range of products, including several medicines, vitamins, food flavourings, plants, colours, rubber products, adhesives, pesticides, and herbicides [2,3]. The biological effects of methyl-substituted pyridine derivatives have been found to have anxiolytic, antibacterial and antitubercular action [4]. The inclusion of a carbonyl group in a bio-active molecule would substantially impact the interaction between the ligand and the receptor protein molecule, therefore increasing bioactivity through hydrogen bond formation. Carbonyl complexes with pyridine have been studied for their reactivity to diverse electrophiles [5].

The aim of this analysis is to synthesize and evaluate the biological activity of pyridine derivatives with the aid of quantum chemical computations due to the relevance of this class of chemicals and the prevalence of multiple drug resistance (MDR) in the antibacterial sector. An overview of the literary works uncovers that there has been no meticulous experimental and theoretical exploration of 4-dimethylaminopyridinium pyridine-2-carboxylate pentahydrate to date (DAPC). In order to better understand the structure-activity relationship, DAPC has been explored using density functional theory, vibrational spectroscopic techniques and docking simulation. The complete spectroscopic vibrational investigation of the molecule is carried out in order to provide a detailed assignment of fundamental bands in the FT-IR, FT-Raman spectrum based on normal coordinate analysis (NCA). The study of fron-

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MULTIFUNCTIONAL $Cr_xCa_{(10-x)}Al_{30}Si_{60}$ GLASSES, ELECTRICAL CONDUCTIVITY AND THERMOLUMINESCENCE

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ABSTRACT

The SiO_2 glasses embedded with Cr^{3+} ions are notable for solid state optical resource, which are useful in various opto-electronic and semiconducting applications. However, the available thermoluminescent resource, which include different electronic and semiconducting materials, need some refinement in their structure, luminescence, and electronic properties towards development of advanced glass resource. In this vision, $Cr_xCa_{(10-x)}Al_{30}Si_{60}$ glassy materials have planned for synthesis and testing. The GT, and GC phase transition points, and thermal stability (~1.2639) of test samples are identified. Structural vibrations are identified with the help of FT-IR spectra. The order of electrical conductivity (~$1.657x10^{-4}$ ohm^{-1} cm^{-1}), and A.E. (~0.3669 eV) of test samples reveal their electrical strength. The symmetry (~ 0.576%) factor, frequency (1.1172×10^{20} S^{-1}) factor, and A.E. (0.682 eV) of the test samples are recorded under 30 kGy irradiation. Overall, the results, which include structure, electrical and luminescence of the test samples suggest the materials might be useful electrically conductive and thermal stimulated light resource.

Keywords: $CaO-Al_2O_3-SiO_2-Cr_2O_3$Glasses, X-Ray Diffraction, DTA, FT-IR, Electrical Conductivity, Thermoluminescence.

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INTRODUCTION

Inherently, the glass with silicon dioxide chemical constitutes is highly non-corrosive, transparent, and thermally stable. Their anticipated properties, such as high refractive index and luminescence, will make them needful optoelectronic industrial applications.[1] Since many years to present, there have been wide-ranging research on a glasses with SiO_2 chemical constitutes due to their abnormal structure, and spectroscopic results.[2] The aluminum oxide is not a conventional glass former, but add-on Al_2O_3 to the glasses with SiO_2 improves their elastic nature, thermal stability, non-corrosion properties.[3-4] And also increase of Al_2O_3 in the SiO_2 glass host lead to more microhardness and thermal stability. SiO_2 embedded with Al_2O_3 glasses have a high order of thermally stimulated luminescence, which will highly useful for radiation dosimetry process.[5] The addition of CaO to the silicate glass substances enhance the refractive index, and optical inertness. Calcium silicate glasses embedded with different transition metal oxides are the most favorable candidates in the current semiconducting sectors and finds plentiful usage in the area of thermoluminescent and D.C. Conductivity applications.[6-7] The addition of Al_2O_3 also influence SiO_2 ions, which furtherimproves the strength, chemical endurance, mechanical and spectroscopic properties to a considerable extent of the overall glass network.[8] The CaO, and Al_2O_3 in the silicate glass host stimulates Cr^{3+} ions for better optical output. The metal oxide like Cr_2O_3 is a well-known nucleation agent, which involves tri-valent oxidation states in silica glass matrix to enhance thermoluminescence and D.C. conductivity properties.[9] Usually, Cr^{3+} ions have a substantial effect on the glass lattice, further which lead to advance in thermoluminescence and D.C. conductivity properties.[10] The glass with silicon dioxide chemical constitutes enclosing mixed valence states of Cr^{3+} ions are of recent interest as a thermoluminescence and cathode resource in rechargeable batteries as of their abnormal energy density,and capacitance.[11]

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Mechanical and Spectroscopic Investigations of Cr_2O_3 doped Calcium Aluminium SilicateGlasses

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Abstract

The Cr^{3+} ions of silicate host glass is noteworthy for optical use, and which are useful as spectroscopic diode lasers in various electronic industrial applications. However, the available optical resource, which include different elastic and solid state electronic materials, need some refinement in their elastic structure, and spectroscopic properties towards development of advanced solid state LED's. In this view, the elastically flexible and optically efficient resource of chemical composition $60SiO_2+30Al_2O_3+(10-x)CaO:xCr_2O_3$ has planned for synthesis followed by elastic, optical absorption and photoluminescence characterization. The materials developed are showing glassy behavior, and which was confirmed by the X-Ray diffraction. Physical properties of glasses are studied. Mechanical properties of glasses studied by means of measuring ultrasonic velocities. Which suggest materials of present kind are mechanically flexible. Optical absorption spectra of glasses is recorded, and which helps to calculate the Racah parameters of glasses. Refractive index, optical band edge, identified, and band gap also calculated. The Peak half width maximum, emissive cross-section, and transition probability of glasses evaluated with the help of photoluminescence characterization. This suggests glasses embedded with Cr^{3+} ions are photonic and with suitable excitation.All the results from the various characterization of glasses which include physical, mechanical, optical absorption, and photoluminescence results suggest a glass with 0.8 mol% Cr_2O_3 concentration is a helpful in mechanical, optical absorption, and photoluminescence results resource.

Keywords

SiO_2-Al_2O_3-CaOglasses;Physical Properties;Mechanical Properties;Optical absorption;Photoluminescence;

1. Introduction

Naturally, SiO_2glasses are highly translucent, mechanically hard, and thermally stable. Their richproperties, such as density, refractive index, micro hardness, and optical transmittance will make them needfulspectroscopicand W-LED host applications [1]. Since many years to present,

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Preparation and Characterization of melt derived CaO-Sb_2O_3-Li_2O containing borate glass for multiple application

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Highlights

- CaO doped antimony lithium borate glasses were synthesized by melt-

POLYCYCLIC AROMATIC COMPOUNDS
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Impact of Protonation and Hydrogen Bonding Interactions on the Biological Properties of Antibacterial Compound 4-Dimethylaminopyridinium Salicylate Monohydrate: Correlation with Its Precursor Molecules

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ABSTRACT

The hypothetical molecule 4-dimethylaminopyridinium salicylate monohydrate was synthesized and investigated leveraging FT-IR spectra, UV visible, NMR and quantum chemical calculations and also compared with its precursor molecules 4-dimethylamino pyridine and salicylic acid in the present work. To explore the impingement of hydrogen bonding on molecule the geometrical parameters, interaction energies, and vibrational spectra are employed. Natural Bond Orbital analysis indicated the existence of intermolecular hydrogen bonding N–H … O contact, which is mediated by a hyperconjugative interaction between the carbonyl oxygen atom donor and the pyridine ring N–H acceptor. The stretching wavenumber of hydrogen bond donor O–H and hydrogen bond acceptor C–O is red shifted due to elongation in respective bond lengths, according to vibrational analysis. The presence of intermolecular charge transfer from electron-rich pyridine to electron-deficient salicylate is revealed by FMO analysis, and this is corroborated by charge transfer due to excitation. A molecular docking simulation was also executed to better understand the structure-activity relation and further antibacterial tests confirmed that the compound inhibits the bacterial pathogens.

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KEYWORDS
Charge transfer; interaction region; protonation; pneumococcal infections

1. Introduction

Antibacterial resistance is regarded as one of the most serious public health issues since it has a large economic impact over the world. Antibacterial resistance is limiting treatment choices for treating infections, which is increasing the morbidity and mortality associated with infectious illnesses caused by bacteria. Medicinal chemistry is concerned with the discovery, development, interpretation, and identification of the molecular mechanism of action of physiologically active molecules. Several physiologically active synthetic compounds incorporate a six-membered nitrogen containing heterocyclic ring in their structure. Structural frameworks have been defined as favored structures, and N-containing polycyclic structures, in particular, have been linked to a

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(54) Title of the invention : CREATING A SELF-ASSESSMENT TOOL FOR AN ENGLISH-LANGUAGE-TEACHER AND ITS IMPLEMENTATION

(51) International classification	:G09B0011906(0000), G06Q0010060000, G06Q0050200000, G09B0007020000, G06N0005040000	(71)Name of Applicant : **1)Md. Thofeeq, Assistant Professor/ Department of H&S, Sri Indu College of Engineering & Technology (Autonomous).** Address of Applicant :Sri Indu College of Engineering & Technology (Autonomous), Ibrahimpatnam, R.R. District, Telangana-501510. Telangana India **2)Dr. S. Rangaraju, Associate professor /Department of H&S, CMR Engineering College.** **3)Dr.B.Deepa, Assistant Professor/Department of H&S, CMR Institute of Technology.** **4)A.Divya, Assistant Professor /Department of H&S, CMR Engineering College.** **5)S.Nagapadma, Associate professor /Department of H&S, CMR Engineering College.** **6)Priyanka Vennam, Assistant professor/ Department of H&S, AVNIET.** **7)I.V.Sona Lakshmi, Assistant Professor / Department of H&S, Methodist College of Engineering & Technology.** **8)J.R.Hepzabah, Assistant Professor / Department of H&S, Methodist College of Engineering & Technology.**
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(57) Abstract :
Abstract Many information sources are cited in this literature as best practices for teacher assessment. One head examined in-depth in this article is teacher self-assessment. Using the specific self-assessment tool, we develop and results from its use with around 1700 teachers of English. We characterize how that tool was developed, analyze the data of its usage, and critically evaluate what these data mean for this precise tool and the need for self-assessment in Language learning and training, wherever teacher evaluation research is limited. About 93% of test-takers approved or strongly approved that the SAT covers most of the abilities, knowledge, and behaviors that instructors require. Another question was posed, Have you finished the SAT within the allotted time of 30 minutes More than 91% of respondents claimed to have.

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(51) International classification	:G01N0021640000, C30B0029220000, G01N0005040000, C30B0015000000, C30B0019120000
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(57) Abstract :

Abstract 4-dimethylaminopyridinium salicylate monohydrate (DMAPSA) was synthesized and its crystal structure was determined using single crystal X-ray diffraction analysis. From the crystal structure analysis it can be inferred that the crystal belongs to monoclinic system with space group of P21/n. Investigation has been carried out to assign the vibrational frequencies of the grown crystals by FTIR spectral studies. 1H and 13C FT-NMR has been recorded to elucidate the molecular structure. Molecular mass of DMAPSA has been measured using mass spectroscopic analysis. The thermal stability and thermal decomposition of DMAPSA have been investigated by means of thermo gravimetric analysis and differential thermal analysis. The melting point of crystal was observed as 172° C by melting point apparatus. Fluorescence spectra were taken for the excitation wavelength of 240 nm.

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(51) International classification :C30B0007000000, C30B0029020000, C30B0029040000, C30B0029160000, C30B0029600000

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(57) Abstract :

Abstract Potassium succinatesuccinic acid (KSSA), semi-organic single crystals were grown by slow evaporation growth technique using water solvent. Single crystal X-ray diffraction study revealed that the KSSA crystal belongs to monoclinic system. FT-IR and FT-Raman spectral studies were performed to identify the vibrations of functional groups. TGA/DTA analyses were carried out to characterize the melting behavior and stability of the title compound. The UVVisNIR spectrum showed that the grown crystal is transparent in the entire visible region. Fluorescence studies were carried out in the range of 200700 nm. The optical nonlinearity of KSSA was investigated at 532 nm using 7 ns laser pulses, employing the open aperture Z-scan technique. The photoconductivity study was carried out to know the conducting nature of the crystal. The laser damage threshold was measured using Q-switched Nd: YAG laser (1064 nm). Electrical properties of the crystal are studied using Hall Effect measurement.

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(57) Abstract :
MACHINE-LEARNING BASED SIZE SUGGESTION SYSTEMS AND METHODOLOGIES FOR CLOTHES E-COMMERCE
Deliberated how to provide size information using methods, systems, and storage medium. A computer device may collect purchasing information connected with particular users in certain examples. Each individual user may be associated with at least one of a number of different user devices. Individual users may have purchased an item based on the purchase information. A subset of individual users may submit feedback information to the computing device in connection with the item. Based on the purchase information and the feedback information, the computer device may create size information for the item. A suggestion for the item might be generated by the computing equipment.

No. of Pages : 16 No. of Claims : 6

Designing an Efficient Forecasting Routing Protocol to Secure the Mobile Ad Hoc Network Communication

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Abstract- *The mobile ad hoc network (MANET) is organized with the group of mobile nodes that are communicated in a wireless medium. However, several malicious activities are present in the MANET that can interrupt the data transmission. In MANET, Black-hole (BH) attacks are the crucial malicious activity that can able to drop the packets while transmitting the messages. To prevent the BH attacks in MANET, the current research develops the Optimized Fisheye Swarm Routing Protocol (OFSRP) model. Here, the developed OFSRP approach detects the BH attacks in the network and transmits the message in a secure path. Moreover, the developed model creates a network based on the structure of 'Fisheye' that is utilized for securing the communication. The implementation of this developed protocol is done with the use of Network Simulator 2 (NS-2) tool. Moreover, the performance metrics are evaluated with existing methods in terms of Packet Delivery Ratio (PDR), prevention accuracy, throughput, and end-to-end delay.*

Keywords – ***mobile ad hoc network, malicious activities, Black hole attack, routing protocol,***

I. INTRODUCTION

In recent years, MANET is an efficient and exciting technology due to the rapid proliferation of communication devices in the wireless medium [1]. Ad hoc networks are utilized for many applications because it is more reliable for preserving the capability of the traffic load, robustness, and flexibility [2]. In general, MANET is a collection of devices that are employed to transfer the message in a wireless network [3]. Also, these MANET is not having a particular infrastructure like mobile switching centers and base stations [4]. So, nodes in the network are freely moved anywhere in the channel while communicating between the nodes [5]. In MANET, the mobile nodes are employed for sending the message from the initial hub to the target and the in-between nodes are doing the function of router [6]. MANET nodes are utilized the dynamic

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Authors Name:	Chandrasekhar Kandagatla , Dr. Prabhu G. Benakop
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Abstract: Wireless communication is a critical necessity for biomedical applications, and it has recently sparked a lot of research attention. Low-power receivers are required for such applications, while nevertheless allowing for acceptable communication range and coexistence with other receivers operating in the same frequency band. In wireless sensor network nodes, RF modules account for the majority of power usage. The basis of an RF module is a transceiver. Several methods for lowering the receiver's power consumption have lately been published. The RF local oscillator and RF low noise amplifiers, for example, are the most power-hungry blocks in the whole circuit. The RX power can be greatly decreased to the nanowatt level by using an all-passive RF front-end. We propose to use two stage CS amplifier with a Forward Body

USAGE OF VCO's TO SCALE THE POWER OF WIRELESS RECEIVERS

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ABSTRACT

Low-power radio receivers are becoming more important in the present paradigm of constant connectivity. The modules' battery life will need to be increased as the number of WSN applications increases. Power scalable WSN receivers may lower their power consumption if the input circumstances are favourable. For power scalable receivers, circuit topologies and system-level designs haven't been widely studied in literature. In their article, we discussed how VCOs may be used to scale the power of wireless receivers. In order to achieve a power-noise balance, an LNA with power scaling for varying input strength was used. For both noise and linearity, we developed a front-end power scalable for LNAs. Each block in the receiver chain has its power scaled depending on its performance requirements, which we discuss in detail in this article.

Index Terms: VCO, wireless recievers, power scaling

I. POWER SCALING MOTIVATION

It is possible to get 2.4 percent and 1.3 degrees of gain and phase error in the worst-case scenarios by adding the largest variances into the preceding two equations. The actual matching performance should be higher than this estimate if the architecture is properly constructed in such a way that the matching is good.

Absolute levels of resistance and capacitance must also be taken into account. IC implementations are prone to deviations from the nominal design values of R and C's absolute values. According to the process literature, the RC-CR filter's absolute R and C values have three tolerances of around 10% each[1]. Depending on the filter's transfer functions, the R and C values' changes in absolute value only cause gain error. Maintaining the 90-degree phase shift The gain error may be expressed mathematically as follows:

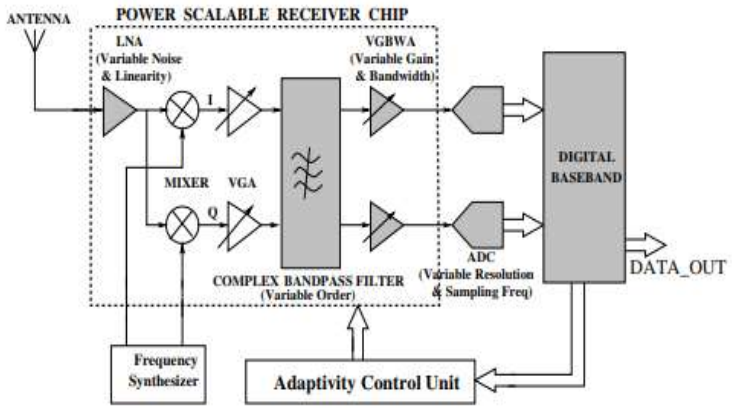


Figure 1: "Power Scalable Receiver System"

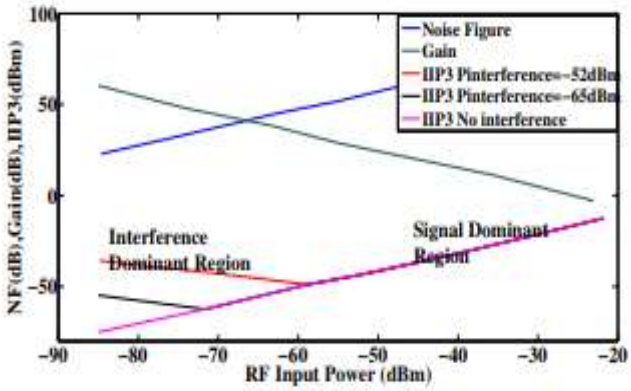
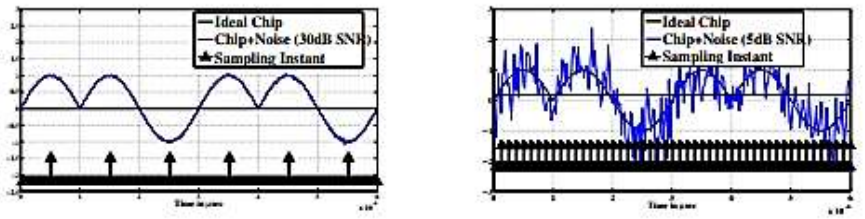


Figure 2: "Performance Requirement of Zigbee Receiver with Varying Input"

As you can see, there are several chips in the Zigbee baseband signal. The ideal/high SNR signal must be sampled just once per chip since the only possible values of a chip are 1 as a positive/negative half sine pulse. To obtain a satisfactory correlation between demodulation and sampling, even in the absence of noise, additional samples are required (Fig. 3). Noisy ADC inputs need more bits (i.e., higher resolution). In order to avoid aliasing, a higher sample rate is required in the ADC. The amount of power that can be scaled down from a clean signal may be limited by using a lower sample rate and resolution in the ADC. Lower sampling rates need less bandwidth (settlement time) for the VGA driving the ADC. This variation informs the VGBWA's power scaling.



(a) Chip with 30dB SNR AWGN (b) Chip with 5dB SNR AWGN

Figure 3: "Effect of Noise on Sampling Requirement for Demodulation in Zigbee"

Table 1: "Performance Budgeting of WSN Receiver"

Parameters	LNA	Mixer	VGA	Filter	VGBWA	Total
Gain (dB)	4-15	1	0-38	2-6	8-20	15-80
NF (dB)	2-10	15	20	25-35	35-40	15-40
IIP3 (dBm)	0 to -10	5	5	10	10	-5 to -35

II. POWER SCALABLE RECEIVER SPECIFICATIONS

Reduced power consumption may be achieved by adjusting the performance of a receiver based on signal and interference levels. Depending on the incoming signal circumstance, the needs for a front-end function have been stated. The receiver's NF, IIP3, and IR requirements change based on the input situation. According to published Zigbee receiver findings and empirical formulas, such as Sensitivity, Friis, and Cascode IIP3, the receiver's performance budget (Table 1) is calculated. QPSK modulation requires a 7dB SNR at the demodulator

input to achieve 103 BER. An 800mVpkpk differential ADC input is used for gain calculation. Between 20 and 85 dBm, the strength of the input signal may be adjusted.

III. RECEIVER ARCHITECTURE

A. Low Noise Amplifier-Mixer (LNAM)

Due of in-band blockers at the LNA input, good gain with low noise and linearity are necessary for LNA. A receiver's capacity to filter out background noise is critical to its performance. When the LNA gain is high, a decent mixer isn't as important. Since the LNA power accounts for a considerable fraction of the receiver's power, this might result in significant energy savings[2]. Use higher voltages for LNA and input transistor gms to lower noise levels. The input transistor's width (W) and bias current (I) may be individually adjusted.. A transistor's drain current noise voltage (Vni) and 3rd order intercept point voltage (VIP3) may be computed using the equations if k=Boltzmann constant, T=temperature, =noise coefficient, and =fitting parameter(107/tox)V1 are supplied. As a result of separate width and current control, it is feasible to achieve optimal noise and linearity while using as little power as possible.

$$V^2_{\text{ni}} = \frac{4kT\gamma}{gm} \propto \frac{1}{\sqrt{IW}} \qquad (1)$$

$$V^2_{\text{IP3}} = \frac{16}{3}\frac{I}{gm\theta} \propto \frac{\sqrt{I}}{\sqrt{W}} \qquad (2)$$

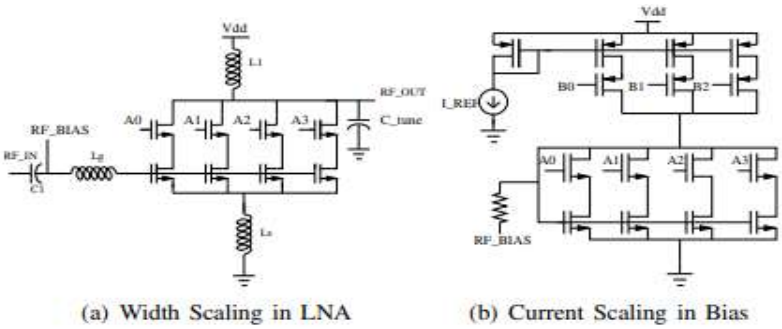


Figure 4: 'Power Scaling LNA Schematic with Replica Biasing'

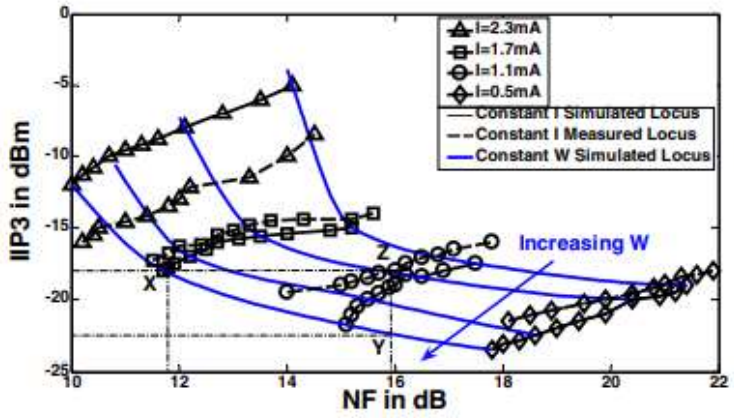


Figure 5: 'Power Scaling Results (Measured & Simulated) for LNA-Mixer showing NF and IIP3 Variations with Locus of Constant I and W'

A cascode transistor with variable width and current capability is used in the LNA design, which is an inductively degraded CS stage. The LNA scheme is seen in Figure 4. Wopt is the maximum input transistor width for NFmin. A 4-bit (A3-A0) control and the cascode transistor as a switch are utilised to produce width scaling through parallel transistors with binary weighted widths for the input transistor. An LNA copy is used to apply the bias, which keeps I constant even when W changes. This allows RF BIAS to track width variations. Transistors with binary weighted widths and 3-bit (B2-B0) control are used in tandem to scale the current in a PMOS current mirror transistor. There are three different ranges for NF: 2.1-6.5 dB, -2 to 14 dB, and -0 to -5 dBm for IIP3. Scaling of the LNA's current output at 1V ranges from 0.3 to 2.11 milliamperes (mA), NF from 2.1-2.65 decibels (dB), Gain from -2 to 14.3 decibels (dB), and IIP3 from 20 to 5 decibels (dBm).

Figure 5 illustrates the LNA power scaling approach by graphing NF vs. IIP3 for the LNAM with different W and I. Because of the nature of these places, both (1) and (2) are supported (2). Start at pt.X (12dB N/F, 18dBm I/P3) and adjust the input conditions to accommodate more N/F. With the existing control and a set width, we may reach pt. Y (16dB NF and -23dBm IIP3), which has a higher NF but a lower IIP3[3]. A 35 percent reduction in current expenses is possible because to the addition of width control, which enables us to operate at point Z (which has a bigger NF but the same IIP3 as X) with 16dB NF and -18dBm IIP3. The trade-off between noise and linearity is made possible by using independent W and I controls.

B. Complex Bandpass Filter

Filtering is essential to remove in band blockers from the IF path of a receiver. Greater-order active filters emit more IR, but at a higher power. When using variable order filters, the amount of IR needed and the amount of electricity used are directly related. BPFs are used in low-IF receivers to reduce DC offset and flicker noise by filtering out near-dc blocks. Complex filters are more effective at reducing the image frequency than simple band pass filters. For a complicated filter implementation, it is possible to use I and Q signals together with two cross-coupled resistive feedback low-pass filters (LPFs) to convert the LPF into a resultant bandpass filter (BPF). There are a lot of benefits to the current trend of using sophisticated filters in low-IF receivers, including:

- Image rejection without the need for extra power.
- Reduced footprint due to lack of input capacitance on BPF side. It has a 3MHz centre frequency and may be used as a 1st/2nd/3rd order filter with several modes of shutdown when using MUX. Higher-order filters might be added if more IR is required.

C. Amplifier with Variable Gain and Bandwidth (VGBWA)

After the filter, a VGA is needed to ensure full-scale input to the ADC. A variable sample rate ADC may be included in a power scalable receiver, as shown in Section II. The sampling capacitors may settle more slowly when the ADC is running at a lower sampling rate. In addition to being able to adjust gain, the amplifier driving this ADC can also adjust output resistance (bandwidth). A study at how the input trans conductance (gm), which is a function of current, affects G and BW of a VGBWA closed loop will follow. Two miller-adjusted amplifiers with scalable current in both stages and a variable compensation capacitor (Cc) in feedback with adjustable resistors are used in the VGBWA's two-stage miller amplifier. When multiple transistors are switched on in parallel with the same gate bias using digital bits, the current is scaled linearly. BW may be maintained at different G values by altering gm1 and Cc. If the first stage has no parasitic loading, then the closed loop BW, non-dominant pole (P2), and Phase Margin (PM) may be approximated:

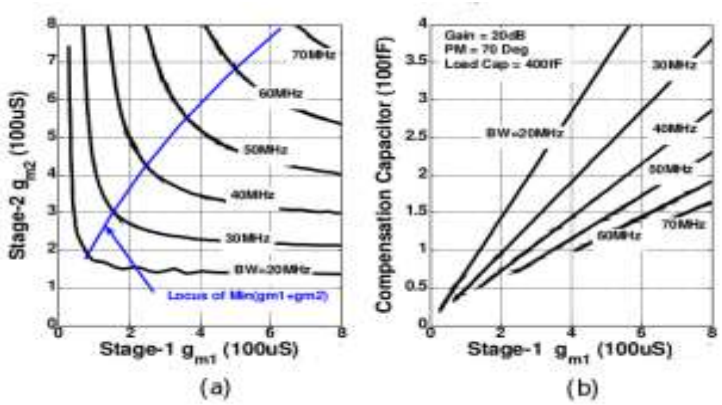


Figure 6: Simulation Contours of (a) gm_2 and (b) C_c with gm_1

$$BW = \frac{\text{gm1}}{2\pi C_c\,(1+\text{G})} \qquad (3)$$

$$P_2 = \frac{gm2}{2\pi C_l}\left(\frac{C_c}{C_{c+C_p}}\right) \qquad (4)$$

$$\text{PM} \simeq 90 - tan\text{-}^1\left(\frac{BW}{P_2}\right) \qquad (5)$$

Other numbers for gm1, gm2, and Cc may satisfy these equations, but only one set will result in the lowest power consumption. In order to find this, one may apply a constraint to minimise (gm1+gm2) It's demonstrated in the figure in which MATLAB models are used to indicate where Min(gm1+gm2) is located in relation to Cc, as well as the contours of gm2 and Cc. Feedback resistors are used to change the value of G, which is determined by the desired receiver gain[5]. The settling time of the ADC input capacitors is used to calculate the BW and PM. Figure 6 depicts the present setup for a specified BW value (a). To maintain the PM, the gm1 from Min(gm1+gm2) is used to determine Cc in Fig. 6(b). The VGBWA has a gain range of 8 to 20 dB (3 bits), a bandwidth range of 15 to 45 MHz, and a current scaling range of 0.1 to 0.17 mA at 1 V.

IV. THE DESIGN FLOW

Some of the processes in Cadence's integrated circuit design environment are shown in the picture.

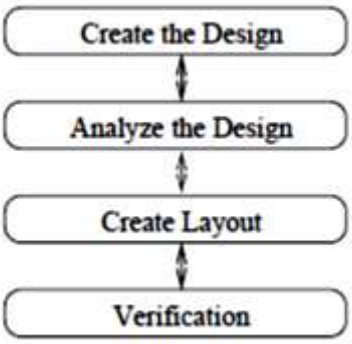


Figure 7: The Design Flow

Schematic views of all cells and blocks are drawn in the stage "Create the Design." Wiring and other components are shown in a schematic representation of transistor symbols, along with the connections between them. Since the cell may be utilised at a higher level of hierarchy thanks to the symbol view being constructed (almost) automatically from the schematic view,

This is the procedure to follow: Functional verification (simulation) of the design at the schematic level is a part of analysing the design. Using a Layout Editor, you may finish the last step of the design process: creating a layout. The final semiconductor layers are shown using a variety of colours. The final chip's size is determined by the sum of all the cells and blocks used. The last step in the process is testing the design. Checks are performed on the layout and physical execution to ensure that there are no deviations from the established geometrical or electrical requirements.

Cadence Tool for Circuit Designing

For a range of activities, Cadence provides a number of applications, including schematic drawing and layout. These applications are compatible with a wide range of operating systems. As a result, third-party or bespoke solutions may be integrated into the system because of the open design.

The Design Framework programme is the pillar of the Cadence environment. There is now a single UI for all tools and a shared database. Users don't have to worry about changing their databases while switching between applications.

Cadence User Interface

In Cadence the user interface is graphic and based on windows, forms, and menus. The main windows of DFW are:

- The environment is controlled by the Command Interpreter Window (CIW). Other tools can be launched from here, and it also acts as a log window for a variety of programs.
- The Library Manager provides a perspective of the design libraries and the many constructs found inside them.
- The current design is displayed in the Design Window (DW). It is possible to open multiple DWs with various, or the same, tools at the same time.
- The Text Window (TW) displays text. It could be a requested log or report, or an editor.

There are usually pull-down menus in Cadence, which means they display when you click the title with your left mouse button. Pop-up options appear in the design window's foreground when the centre button is pressed. Information like the transistor size, for example, must be entered into the forms in order to fulfil the function's requirements.

Schematic and Symbol Tools

To create the schematic, we utilised Virtuoso Schematic Composer. Using this editor, you may create schematics by linking and instantiating basic components (transistors, capacitances, etc.). Standards-compliant values (properties) for each component may be altered. Text and comments may also be added. The editor will also generate cell symbols that may be utilised in other parts of the construction.

V. POWER AMPLIFIER

This last 30 year has seen a dramatic increase in the development of CMOS RF circuits. Trade-offs between high performance and cheap cost and high power consumption design are always being sought for. A negative capacitance cascade circuit is shown in the illustration. The parasitic capacitance may be changed at the driver stage, resulting in reduced parasitic capacitance. It is possible to filter out unwanted parasitic capacitance by using a shunt inductor at the driver stage rather than a capacitor. As indicated in the figure, negative capacitance may be implemented using a capacitor with a common gate amplifier. Class E power amplifiers use transistor M1 as a switch. The transistor M2 has a lot of gain when biassed at saturation.

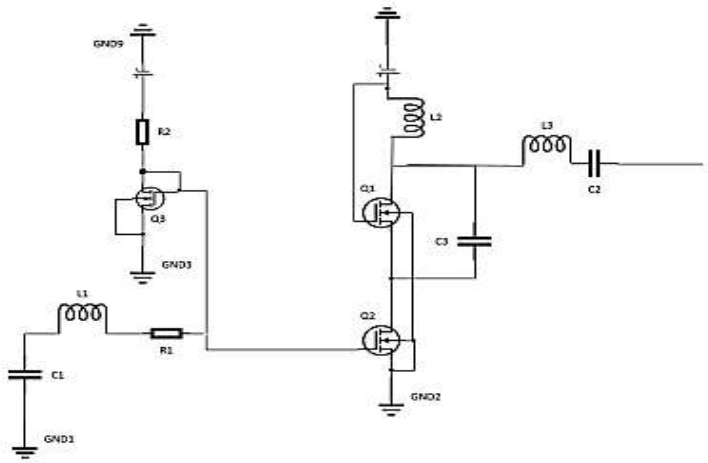


Figure 8: Block diagram of a class E power amplifier

Cadence simulations, such as PSS, are used to determine the best bias. Table shows the design values in detail.

Table 2: 2.4GHz PA driver stage component

Parameter	Size (Unit)
Q1	W/L=0.3um/0.6um (f=66,m=24)
Q2	W/L=0.3um/0.6um (f=66,m=24)
Q3	W/L=0.8um/0.6um (f=4,m=2)
L1	36nH (Q=20)
L2	20nH (Q=20)
L3	20nH (Q=20)
C1	240fH
C2	600fH
C3	11pF
R1	10.5ohm
R2	3.8Kohm

FET Switch designs such as shunt and combinatorial are among the most often used. Combinatorial topology is often requested by medical practitioners, as seen in Figure. It is possible to send a signal to the next transistor, which in turn may be used by the series FET, which is switched on by the high control voltage. As long as the control is set to low, the series FET is turned off, but the shunt FET will still allow the signal to flow through it. S11,

S21, and S31 are all critical to the switch's overall functioning. Reflected wave to original wave ratio, or S11, is used to describe this.

The voltage standing wave ratio, another name for impedance mismatch, is a measure of this (VSWR). It is the voltage gain in the forward direction that is represented by S21. To maximise efficiency, the distance between the source and the active switch must be minimised. Also, S31 is one of the most important switch parameters. Three ports must be open in order to determine the transmission coefficient from source to arm when two ports are open and one is closed. That's how much power you're losing when you're not using your arms. It is important to examine the value of a switch design in addition to the S11, S21, and S31 (IP3). Use this measure to evaluate a device's linearity; it is also called intermediation distortion.

The fundamental frequency meets the fundamental frequency's third order at the third order intercept point. Among other things, look at the S-parameters and IP3 as well as a variety of other variables. An RF switch that can handle a lot of power, has minimal insertion loss, and provides excellent isolation is a good one. Using a shunt FET, you may connect the ground. As long as the control is set to low, the series FET is turned off, but the shunt FET will still allow the signal to flow through it.

SoI or GaAs-based FETs have three terminals. In the diagram, you can see the fundamental procedure. When the source bias is greater than the gate bias, a channel is formed between the source and drain sides, enabling source-to-drain current flow. If the gate voltage is lower than the source voltage, a channel cannot form, resulting in a higher channel resistance and no current flow.

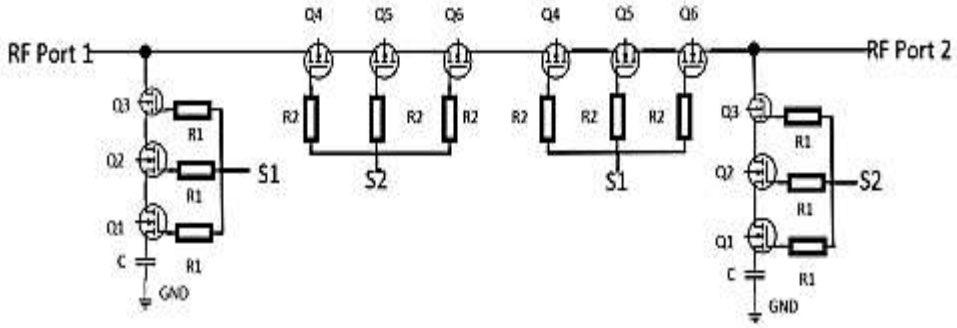


Figure 9: Modified series-shunt FET switch

VI. TRANSMISSIONS-LINE TRANSFORMERS

Constructions

There are windings on both conductors of a transmission-line transformer, which is formed of a coaxial cable. Step-up transformers use a coaxial cable, with the secondary winding as the inner conductor and the main winding as the screen. Fig. 10 shows the Tuned receiver circuit step-up design and its circuit schematic with an equivalent winding ratio of 4. Secondary winding inductance may be determined using the Wheeler formulas [9] for single layer coils with inductance, resistor.

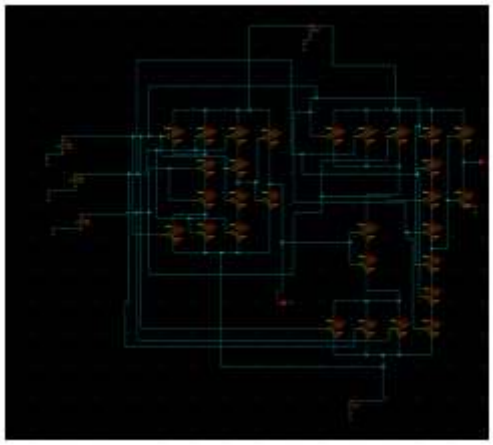


Figure 10: Tuned receiver circuit with functional block of the transmission line

With Z = kL + Mn', the capacitance per unit length, and Z = sL', the inductance per unit length, the tapered transmission lines are assumed to be lossless. Suppose the transmission line has a decreasing wave velocity and is composed of nearly perfect conductors hanging in an insulating medium with a permittivity of E. A transmission-line transformer may be recreated extremely accurately with distributed inductance, capacitance, and resistance in an analogous electric circuit network. As a result, the main and secondary capacitances are composed of four inductors each coupled in series and parallel to each other. Circuit model input parameters are same because the magnetic flux density of K'1 and L'1 is identical.

$$K'1 = L'1$$

The two-dimensional magnetic field solver Ace was used to compute the transformer's main, secondary, and mutual inductances. Static magnetic analysis and a constant permeability are used to determine the total magnetic field energy. For each frequency step, a solution is found and used in the simulation. The computations at each frequency step take a lengthy time because of the large structure and mesh. The total energy of a magnetic field in a given volume; Coaxial transmission lines, as well as the number of stages in a TLT, must be capable of turning a high-voltage pulse into hundreds of kilovolts. Due to parasitic secondary transmission lines, such as the short circuit paths seen in Figure, pulse droop may have a negative influence.

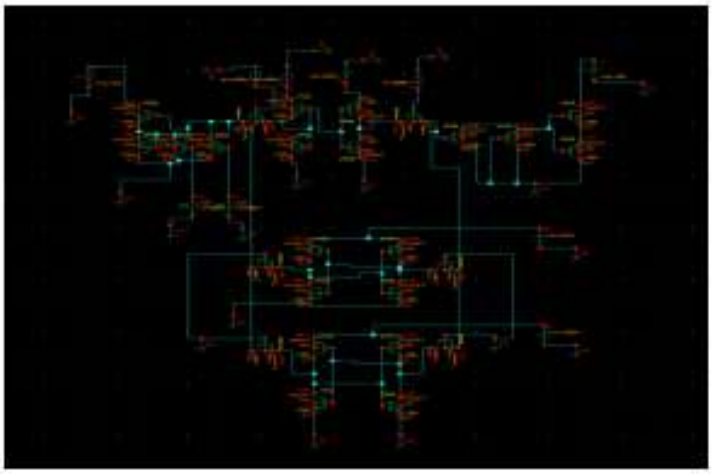


Figure 11: Narrow band circuit model

Increase the impedance of secondary lines to reduce the effect, and lengthen main lines to reduce it. The secondary line impedance may be effectively raised by using magnetic rings with a high permeability to reduce output pulse droop. However, if the pulse width is less than twice the propagation time over the secondary lines, then extending the main lines is favourable. For longer pulses, it is not necessary to use excessive transmission line lengths because of the technique of adding magnetic rings to the transformer. These two well-known techniques of adding magnetic rings are the rings wrapped around transmission lines and winding wires onto them. Pulse propagation may be successfully reduced by raising the practical impedances of the parasitic secondary lines. This kind of transformer was evaluated using a referral method by Graneau et al, as seen in Figure. To calculate the output pulse voltage of this particular n-stage transformer, the standard equation is used.

$$\mathrm{Vt}^{n} = nV - \sum_{k=0}^{n-1} \left(\mathrm{K}_{k}^{n}\right) Nf^{1/}\mathrm{nL}^{n-0}$$

For each secondary line, there is an inductance formed by wrapping it onto magnetic rings, and the characteristic impedance (Zo) of the transmission line is a function of the amplitude (V) and duration (t) of each pulse from the input voltage source. All secondary lines with inductances L that are the same may be predicted using the original equation. However, this is not the greatest method to use the magnetic rings. It is necessary to first change the equation from to by replacing L with Lk to arrive at the optimal arrangement.

$$\mathrm{Vt}^{n} = nV - \sum_{k=0}^{n-1} \left(\mathrm{K}_{k}^{n}\right) Mf^{1/}\mathrm{K}^{n-0}$$

Where k is the ordinal stage number of the main line. L2 + L3 + + Ln is maintained constant, and the goal of optimization is to minimise this equation as much as possible:

$$\left(1 + \sum k\,x\right)^{\mathrm{k}} = 1 + \frac{nMf}{L!} + \frac{M(m-1)x^{2}}{2L!} + \cdots$$

EMF produced on a dc line by a nearby parallel ac line is calculated using electromagnetic transient software (EMTP). The parallel ac/dc transmission lines system pictured was simulated using a multi-conductor overhead voltage.

VII. OSCILLATOR FREE ARCHITECTURE

Because the only purpose of the Wake-Up radio is to detect a specified bit pattern of the ID-code in the air, its architecture has been simplified to the utmost. Oscillators, control loops, or calibration loops are not required for phased-locked loops or super regenerative systems. Faster boot-up times and less lock-in processes result, which reduces power usage overall. The reader or interrogator should be able to handle as many radio functions as possible. (the name "reader" comes from the RFID community and is a bit misleading here because we only utilise downlink communication).

During each wake-up session, just a few hundred bits of ID code will be sent. As a result of the short broadcast bursts and the simplicity of the receiver design, on–off keying is used to modulate the carrier, which is spectrally inefficient. To see past obstacles, the envelope detector's baseband output voltage is proportional to the square of RF carrier input amplitude, and the carrier frequency of 2450 MHz (ISM) is a fair compromise between size and range.

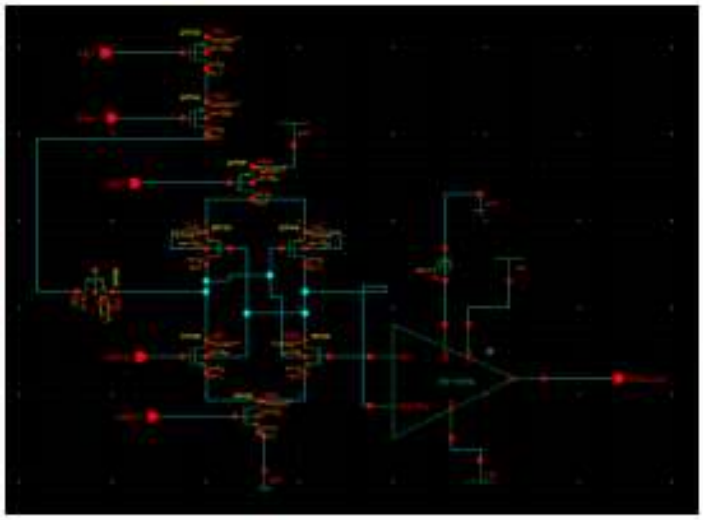


Figure 12: Magnetically coupled transformer circuit with distributed inductance

Envelope Detection

Components like as diodes and various rectifiers are used to convert the radio frequency carrier current. The envelope detector's self-mixing efficiency decreases as the carrier power decreases. A tuned RF receiver is less sensitive than one with a super heterodyne mixer that is constantly driven by a powerful LO signal, as a result. Wake-Up receivers, on the other hand, typically only need a broadcast range of around 10 metres. The drop in active power that occurs when the local oscillator is eliminated is pretty realistic. The envelope detector reduces the modulated spectrum to baseband frequency by folding it around the carrier. There is an impedance at the other end of the cable. While the whole transformer's windings are represented by equivalent impedance, only a fraction of these windings may be studied. Each frequency's equivalent impedance must be correctly calculated. It is possible to precisely compute this impedance by following a given method. Layer-type windings may be approximated using hybrid modelling. The transformer is shown using layers rather than turns in this manner.

It is necessary to accurately predict transformer parameters while calculating voltage transients in transformer windings. Inductances, capacitances, and frequency-dependent losses are among the variables of interest to researchers. Construction and kind of windings have a considerable impact on the modelling technique. The oil transformer under test here is a single-phase layer type. Note that the secondary winding varies from the primary winding in that it employs foil-type layers rather than layered construction.. High-voltage transformers have accurate measurement points in the centre, at both ends of each layer, and in between layers. From the exterior of the transformers, measurements may be taken directly at the layers of the transformers.

The Transformer Parameters are determined in Capacitance

A magnetically connected transformer circuit with distributed inductance is required to calculate quick transients inside the windings, as shown in Figure. The fundamental formulae for plate and cylindrical capacitors were used to determine these values. Because the twists and turns are so close together, the edges don't have much of an effect. Between-turn capacitances have a significant impact on the calculation of transients. Although it is feasible to use a matrix reduction to alter the sequence of the matrices, this will only affect a single turn at a time. Stable voltages are achieved by using this technique. It is possible to utilise

these voltages in order to find the voltage transients in a series of turns. By considering each layer as a cylindrical capacitor, we were able to determine the capacitance between them and between the primary and secondary windings.

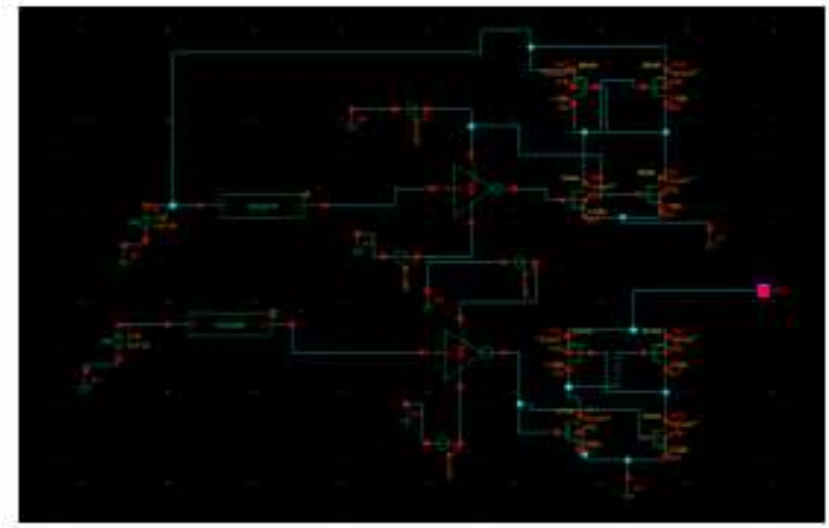


Figure 13: Baseband circuit for the converter operation

In this example, the ground capacitance is expected to be less than 1 pF. In the following table, we summarise the capacitances of the different layers and the core of the circuit. Because just a small portion of the layers' surfaces are located close to the layers' centres, their values are most heavily dependent on their surface geometry. An alternative option is to extend the layer's breadth halfway through the barrier on either side of the layer. Capacitances to the ground influence the distribution of static voltage. The static voltage distributions for each layer are shown in the figure. In a linear power spectrum, a ground capacitance of 1 to 100 pF is required. The converter's terminal phase-to-ground capacitance is almost identical to the input capacitance shown in Figure. Interlayer capacitances may be estimated with modest ground capacitances using a high voltage series connection of the interlayer capacitances.

The interlayer capacitances are shown in the table below. Using these capacitances, you get the corresponding value of 1.21 nF. Phase-to-ground capacitance may be measured in two methods at high voltages. Analyzers can typically measure 1.25 nF on average. Alternately, you might utilise the voltage divider approach. Connecting the transformer's high-voltage windings to a specific capacitance capacitor in series is a common practise. Input voltages on both sides of a square impulse are monitored. The phase-to-ground capacitance of a transformer is determined by dividing the voltage across the transformer. An average of 1.14nF was found after utilising this method.

Direct Current Component

In order to determine how much direct current is flowing into a transformer induced from an ac line, it is necessary to first compute the total impedance of the dc line circuit, which includes both the pole conductor self-impedance and the impedances of smoothing reactors at both ends of the dc line. The internal impedance of conversion equipment is insignificant in comparison to the pole conductor self-impedance and smoothing reactor impedances of a dc line. The smoothing reactor's self-impedance and the DC line's pole conductor self-impedance may be used to determine the DC line's overall impedance. For DC lines, the overhead pole conductor self-impedance may be estimated with precision by using the Carson's model;

however, this model requires extensive evaluation time due to the inclusion of several complex infinite integrals.

System with a High Voltage

The smoothing reactor's self-impedance and the DC line's pole conductor self-impedance may be used to determine the DC line's overall impedance. For DC lines, the overhead pole conductor self-impedance may be estimated with precision by using the Carson's model; however, this model requires extensive evaluation time due to the inclusion of several complex infinite integrals.

The capacitor bank connection was relocated to another base band portion.

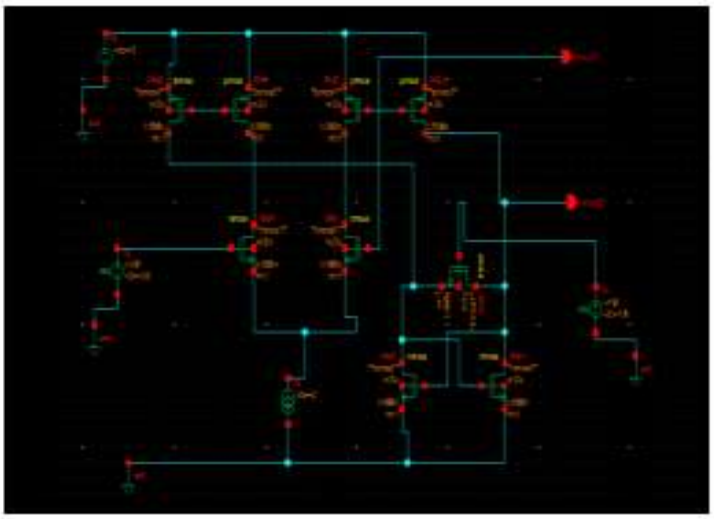


Figure 14: Narrow band circuit

VIII. CONCLUSION

In order to determine how much direct current is flowing into a transformer induced from an ac line, it is necessary to first compute the total impedance of the dc line circuit, which includes both the pole conductor self-impedance and the impedances of smoothing reactors at both ends of the dc line. The internal impedance of conversion equipment is insignificant in comparison to the pole conductor self-impedance and smoothing reactor impedances of a dc line. Level switching at the digitizer requires an amplified and filtered baseband signal voltage across the output capacitance. To do this, two amplifier stages are connected in series. Cascade stages with differential feedback form the basis of the phases. Each stage has an amplification gain of around 30 dB and is not linearity-tuned to any one frequency. An adjustment to the dc-level output voltage of the last stage might affect the bias point of a following digitizer.

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Wireless Sensor Network Radio System Structure and RF Implementation of Transceiver Circuit

Chandrasekhar Kandagatla, Dr. Prabhu G. Benakop

PDF

Abstract

In terms of overall system design, CMOS radio frequency (RF) transceiver architecture has a considerable influence. Performance, power consumption, die size and cost are the most important factors to consider while making a selection. The IEEE802.15.4 standard has a minimum performance requirement. According to the application in issue, all other considerations are of secondary importance. The RF transceiver must be able to interface with small devices, such as sensor nodes, in order to be portable and low-power. As a result of the battery's dimensions and kind, the system's size, weight, and cost are all determined by its power consumption. In wireless sensor networks operating in the sub-GHz ISM band, the design and testing of CMOS integrated RF transceivers is the emphasis of this chapter. Here, you'll learn about radio system design, RF transceiver circuits, and data collection. As a concluding illustration of the size and floor design of a high-integration transceiver device, we demonstrate a completely CMOS transceiver chip. This paper illustrates the wireless sensor network radio system structure and RF implementation of transceiver circuit.

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Progress in Biomedical Field with an Advancement of CMOS RF Transceiver Using Wireless Sensor Network

Chandrasekhar Kandagatla, Dr. Prabhu G. Benakop

Keywords: CMOS, Transceiver, WBAN, wireless sensor network

ABSTRACT

There is a strong demand to govern the communication of portable and implantable personal health care devices in a single wireless network as the number of these devices grows. Wireless communication technology advancements have made these gadgets more user-friendly. The power consumption of these gadgets is one of the hurdles in their implementation. WBAN (wireless body area network) has recently gained a lot of attention. WBAN is made up of a variety of healthcare equipment or physiological sensors that communicate wirelessly to provide continuous and ambulatory health care. WBAN technologies have been a

CMOS Applications and Implementation Procedure of Wireless Multimedia Sensor Network

Chandrasekhar Kandagatla, Dr. Prabhu G. Benakop

PDF

ABSTRACT

CMOS technology has a major advantage over NMOS and BIPOLAR in this regard. Unlike NMOS and BIPOLAR circuits, complementary MOS circuits dissipate almost little static power." If a circuit does in fact switch, power is simply dissipated. Greater utilisation of CMOS technology leads in better performance as compared to that of NMOS or bipolar technology. To construct CMOS transistors, the P- and N-channel MOS diodes are used (NMOS). CMOS transistor manufacture is explained in detail here. This paper privdes the information about the applications of CMOS and also the implementation procedure of wireless multimedia sensor network.

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RESEARCH ARTICLE

A PROPOSED NEW TOPOLOGY FACTS CONTROLLER FOR REACTIVE POWER CONTROL IN NON LINEAR LOADS

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ABSTRACT

Reactive power problems usually occur at the interconnection points of different systems or now in the deregulated market between different owners of transmission or distribution networks, reactive power generators and consumers. As reactive power is a local product its value to system security and voltage control very much depends on the location in the system. STATCOM is a device that regulates the voltage level or the reactive power in the system. It is used to maintain voltage stability, enlargement of critical clearing time. In this paper Simulation has been done with one example

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INTRODUCTION

Reactive power gives the important function of regulating voltage. If voltage on the system is not high enough, active power cannot be supplied. Reactive power is used to provide the voltage levels necessary for active power to do work which is useful. Reactive power is required to move active power through the transmission and distribution system to the customer .Reactive power is needed to maintain the voltage to deliver active power (watts) through transmission lines. If some active power is transferred to the load, there must be the presence of the reactive power in a transmission line assuming there's no power factor correction instrument connected to it. Reactive power is the component of power which is settled by the inductor in the form of magnetic field in the transmission line. It is unwanted, as it reduces effective power transfer capability of the transmission system, but is present due to the inductive elements present in the power system. If you apply power factor corrections at the load end, suppose before an induction motor, there will not be any reactive power consumptions by the total load. (Although, motor draws the reactive power which is compensated by Capacitor bank, resultant effect on the generator is zero). Real power achieves useful work while reactive power holds up the voltage that must be controlled for system reliability. Reactive power has an intense effect on the security of power systems because it affects voltages throughout the system Reactive power is important because of

Voltage control: Power system equipment is designed in a way to operate within ±5% of the nominal voltages. Fluctuations in voltage levels lead to break down of the various appliances. High voltage damages the insulation of windings whereas low voltage causes poor performance of the various equipment like low illumination of blubs, overheating of induction motors, etc. If the power demand is higher than that supplied by transmitting lines, current drawn from supply lines goes to a higher level, which causes the voltage to fall extremely at the receiving end side. If this low voltage is decreased further, it leads to the tripping of generator units, overheating of motors and other equipment failures.To overcome this, reactive power should be supplied to the load by putting reactive inductors or reactors in transmission lines.

The capacity of these reactors depends on the amount of apparent power to be supplied.If the power demand is less than reactive power supplied, the load voltage rises to a higher level which leads to automatic tripping of transmission equipment, low power factor, insulation failures of the cables and windings of various mechanical devices. To overcome this, additional reactive power available on the system must be compensated. Various compensation equipment is synchronous condensers, shunt capacitors, series capacitors, and other PV systems. These devices inject the capacitive reactive power to compensate inductive reactive power in the system.

Proper working of various devices/machines: Transformers, motors, generators and other electrical devices require reactive power to produce magnetic flux. This is because the generation of magnetic flux is necessary for these devices to do useful work. In the above figure reactive power, indicated by red color, helps to create a magnetic field in the motor but it leads to a decrease in the power factor. This is why a capacitor is placed to compensate for the inductive reactive power by supplying capacitive reactive power.

Sources and Sinks of Reactive Power: There are two types of reactive power sources namely dynamic and static reactive power sources.

Dynamic Reactive Power Sources: These include transmission equipment and devices, which are capable to respond to the reactive power changes quickly by injecting or providing a sufficient amount of reactive power into the electrical system. These are of more cost and some of these devices are

- Synchronous generators:
- Synchronous condensers:
- Solid state devices: power electronic converters and FACTS by SVC devices.

Static Reactive Power Sources: These are low-cost devices and response to reactive power variation is somewhat less than the dynamic power devices. Some of the static resources are given below.

- Capacitive and inductive compensators:
- Underground cables and overhead lines:.
- PV systems: These are used for active power injection as well as harmonic and reactive power compensation in the grid systems by photovoltaic power.

Proposed Topology

STATCOM

- STATCOM is a static synchronous compensator which is also known as STATCON a static synchronous condenser.
- STATCOM is used for alternating current electricity transmission networks as it is a regulating device
- It is one of the important device for FACTS that is Flexible AC Transmission System. It provide active AC power
- The STATCOM is a voltage converter mostly a DC capacitor with an energy storage unit. It is a DC-AC converter
- As STATCOM is a voltage sourced converter, it mostly uses three phase converter as its core. The voltage output of the system is connected through transformer or reactor. absorb or produce reactive power by regulating AC voltage amplitude.STATCOM compensate current for impact load. It also compensate harmonic current

Working: It is a voltage source converter-based device. The STATCOM has very little active power capability because of the voltage created from DC capacitors. But the active power capability can increase by connecting a suitable energy source with the DC capacitor. The amplitude of the voltage source will decide the reactive power at the terminals of the STATCOM. If the terminal voltage of VSC is higher than the AC voltage at the point of connection, the STATCOM generates a reactive current. And if the terminal voltage of VSC is lower than the AC voltage at the point of connection, the STATCOM absorbs the reactive power. The response time of the STATCOM is shorter than the Static VAR Compensation (SVC). Due to fast switching using IGBTs of voltage source converter. The STATCOM provides better reactive power support at low AC voltage than an SVC. Since the reactive power from a STATCOM decreases linearly with the AC voltage.

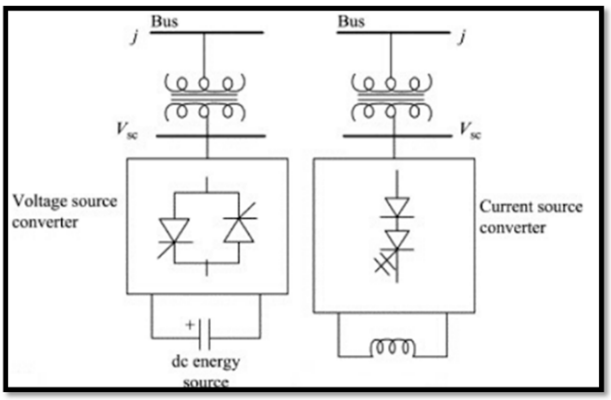

Figure 1. Diagram Of Statcom

Principle of Operation: A STATCOM is a controlled reactive-power source. It provides the desired reactive-power generation and absorption entirely by means of electronic processing of the voltage and current waveforms in a voltage-source converter (VSC)

- STATCOM is seen as an adjustable voltage source behind a reactance i.e capacitor banks and shunt reactors are not needed for reactive-power generation and absorption, thereby giving a STATCOM a compact design, or small footprint, as well as low noise and low magnetic impact.
- If the output voltage equals the ac system voltage, the reactive-power exchange becomes zero, in which case the STATCOM is said to be in a floating state.
- Adjusting the phase shift between the converter-output voltage and the ac system voltage can similarly control real-power exchange between the converter and the ac system. In other words, the converter can supply real power to the ac system from its dc energy storage if the converter-output voltage is made to lead the ac-system voltage.

- On the other hand, it can absorb real power from the ac system for the dc system if its voltage lags behind the ac-system voltage.

Advantages of STATCOM

- It occupies a small footprint, for it replaces passive banks of circuit elements by compact electronic converters.
- It offers modular, factory-built equipment, thereby reducing site work and commissioning time; and
- It uses encapsulated electronic converters, thereby minimizing its environmental impact.
- Fast time response.
- Active power control is possible.
- Components that are used in the STATCOM are smaller than SVC.
- Characteristics are superior.
- The output voltage is nearly equal to the input DC voltage.
- Better transient response.
- It reduces harmonic to minimum level.
- It reduces equipment volume and foot-print.

Applications of STATCOM

- This device used in long-distance transmission lines and power substations. For voltage stability, it used in industries where a large amount of reactive load connected.
- Reactive power compensation
- Better voltage control
- Maintain balance in each phase of the transmission line
- Reduce harmonics
- Power factor correction
- Increase the power transfer capacity of the transmission line
- Reduce temporary over-voltage condition in the transmission line
- Improve transient stability

RESULTS AND SIMULATION

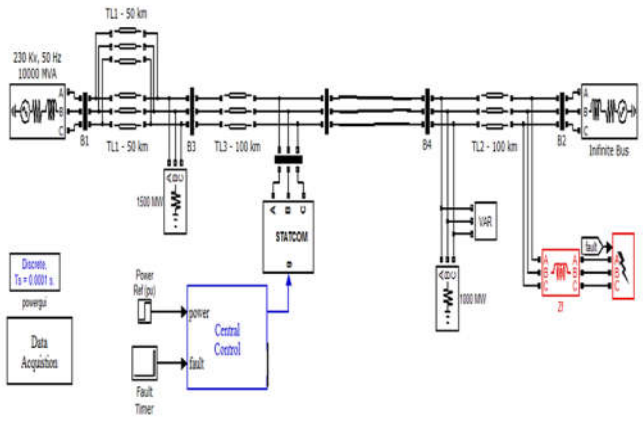

Figure 2. Simulation diagram of STATCOM

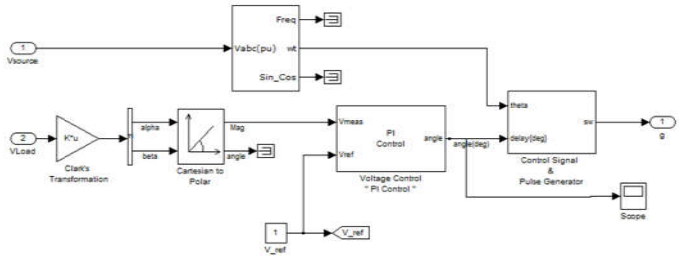

Figure 3.2. Representation of control circuit

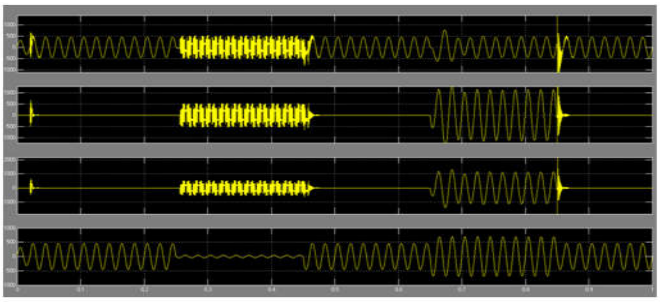

Figure 3. Simulation results

CONCLUSION

To improve power quality in the power transmission system, there are some effective methods. In this project, the voltage sag and swell mitigation, using a new FACTS device called STATCOM is presented.

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RESEARCH ARTICLE

A NEW INNOVATED FACTS CONTROLLER (SVC) FOR REACTIVE POWER COMPENSATION

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ABSTRACT

Power system has made a stunning entrance to the market.. The structured power systems has effected by different kinds of problems. Whether system stability problems or Power Quality issues, these issues need solving. Classically passive filters were used but nowadays active filters such as Static Var Compensator (SVC) has been chosen for the task. SVC is a device that regulates the voltage level or the reactive power in the system. It is used to maintain voltage stability, enlargement of critical clearing time. In this paper Simulation has been done with one example.

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INTRODUCTION

Role of Reactive Power Control In Power System: Reactive power importance is increasing with the growing demand for electrical power , in a power system network. The stability and reliability of the electrical power system depend on reactive power management. It is required to generate energy in a more efficient, reliable and cost-effective way. An effective way of delivering electrical energy includes technologies like FACTS (Flexible AC transmission system), SVC (Static voltage compensation), etc to maintain voltage stability, high power factor, and fewer transmission losses. Reactive power plays a very important role in the power system network.

Importance of Reactive Power: AC power supply system produce and consume two types of powers; they are active and reactive power. Real power or active power is the true power given to any load. It accomplishes useful work like rotating motors, lighting lamps, etc.

Also, reactive power is the imaginary power or apparent power, which does not do any useful work. It is a by-product of AC systems and produced due to inductive and capacitive loads. It exists when there is a phase displacement between voltage and current. It is measured in units of volt-ampere reactive (VAR).

Reasons Why Reactive Power Is Important: There are mainly 3 reasons why reactive power is important.

Voltage control: Fluctuations in voltage levels lead to poor functioning of the various appliances. High voltage damages the insulation of windings whereas low voltage causes poor performance of the various equipment like low illumination of blubs, overheating of induction motors, etc. If the power demand is more than that supplied by transmitting lines, current drawn from supply lines increases to a higher level, which causes the voltage to fall drastically at the receiving end side. If this low voltage is decreased further, it leads to the tripping of generator units, overheating of motors and other equipment failures.

To overcome this, reactive power should be supplied to the load by putting reactive inductors or reactors in transmission lines. The capacity of these reactors depends on the amount of apparent power to be supplied. If the power demand is less than reactive power supplied, the load voltage rises to a higher level which leads to automatic tripping of transmission equipment, low power factor, insulation failures of the cables and windings of various mechanical devices. To overcome this, additional reactive power available on the system must be compensated. Various compensation equipment is synchronous condensers, shunt capacitors, series capacitors, and other PV systems. These devices inject the capacitive reactive power to compensate inductive reactive power in the system. Therefore we can say that apparent power is required to maintain voltage levels within limits for the stability of the transmission systems.

Electrical Blackouts: Electrical blackouts, like that in France during 1978, many parts of India during 2012, have noticed insufficient reactive power on the electrical power system is the main reason for blackout situations. This is raised because the demand for apparent power is unusually high due to long-distance transmission. This ultimately leads to the shutting down of various equipment and generation units due to low voltages. To ensure proper working of the electrical system, a sufficient amount of reactive power must be present in it.

Proper working of various devices: Transformers, motors, generators and other electrical devices require reactive power to produce magnetic flux. This is because the generation of magnetic flux is necessary for these devices to do useful work. Reactive powerhelps to create a magnetic field in the motor but it leads to a decrease in the power factor. This is why a capacitor is placed to compensate for the inductive reactive power by supplying capacitive reactive power.

Problems/Losses in Power Systems

4.1 Figure

Harmonics: Distortion occurs when harmonic frequencies are added to the 60 Hertz voltage or current waveform, making the usually smooth wave appear distorted. Distortion can be caused by solid state devices such as rectifiers, adjustable speed controls, fluorescent lights, and even computers. At high levels, distortion can cause computers to malfunctions and cause motors, transformers and wires to heat up excessively. Distortion is probably the most complicated and least understood of all power disturbances.

Frequency deviations: Normal utility power in the United States is supplied at a frequency of 60 cycles per second, or 60 Hertz. On large interconnected utility systems such as SRP's, frequency is very stable and deviations are rarely a problem.

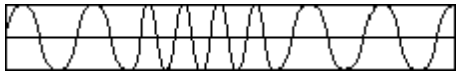

Figure.4.2 deviations

However, on smaller power systems, especially those supplied by on-site generators, frequency deviations can cause electronic equipment to malfunction and affect the speed of motor driven clocks.

Transients: Transients are sudden deviations from normal voltage or current levels. Transients typically last from 200 millionths of a second to half a second. Transients are typically caused by lightning, electrostatic discharges, load switching or faulty wiring. Transients can erase or alter computer data, resulting in difficult-to-detect computational errors. In extreme cases, transients can destroy electronic circuitry and damage electrical equipment.

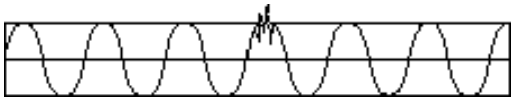

Figure.4.2. Transients

Noise: Electrical noise, is a rapid succession of transients tracking up and down along the voltage waveform. The magnitude of these rapid transients is usually much less than that of an isolated transient. Noise often originates in electrical motors and motor control devices, electric arc furnaces, electric welders, relays, and remote atmospheric discharges such as lightning. Although less destructive than a large rapid transient, electrical noise can cause computers to malfunction and can interfere with the operation of communications equipment.

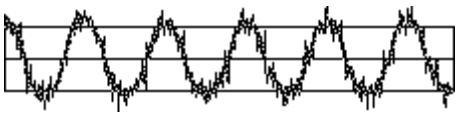

Figure.4.2 noises

Voltage sags: A voltage sag is a short duration decrease in voltage values. Voltage sags longer than two minutes are classified as undervoltages. Common causes of voltage sags and undervoltages are short circuitson the electric power system, motor starting, customer load additions, and large load additions in the utility service area. Sags can cause computers and other sensitive equipment to malfunction. Undervoltage conditions can damage certain types of electrical equipment.

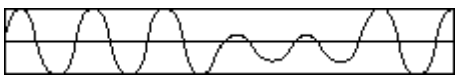

Figure.4.2 sags

Interruptions: Interruptions occur when voltage levels drop to zero. Interruptions are classified as momentary, temporary, or long-term interruptions. Momentary interruptions occur when service is interrupted, but then is automatically restored in less than 2 seconds. Temporary interruptions occur when service is interrupted for more than 2 seconds, but is automatically restored in less than 2 minutes.

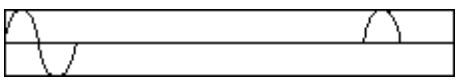

Figure.4.2 interruptions

Long-term interruptions last longer than 2 minutes and may require field work to restore service. In some cases, momentary outages may go unnoticed or cause no apparent problems.

However, even momentary outages can last long enough to shut down computers and disrupt the operation of sensitive electrical equipment.

Voltage swells: A voltage swell is a short duration increase in voltage values. Voltage swells lasting longer than 2 minutes are classified as overvoltages. Voltage swells and overvoltages are commonly caused by large load changes and power line switching. If swells reach too high a peak, they can damage electrical equipment. The utility's voltage regulating equipment may not react quickly enough to prevent all swells or sags.

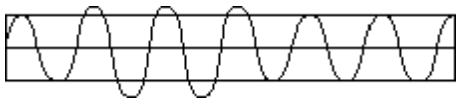

Figure.4.2 swells

Flicker: Flicker can be defined as small amplitude changes in voltage levels occurring at frequencies less than 25 Hertz. Flicker is caused by various fluctuating loads such as arc furnaces and electric welders. Flicker is rarely harmful to electronic equipment, but is more of a nuisance because it causes annoying, noticeable changes in lighting levels.

Objectives of SVC: A static VAR compensator is a set of electrical devices for providing fast-actingreactive poweron high voltage electricity transmission networks. SVCs are part of theflexible AC transmissionsystem device family. They regulate voltage, power factor, harmonics and stabilize the system. A static VAR compensator has no significant moving parts (other than internal switchgear). Prior to the invention of the SVC, power factor compensation was the preserve of large rotating machines such as switched capacitor banks. The SVC is an automated impedance matching device, designed to bring the system closer to unity power factor. SVCs are used in two main situations:

- Connected to the power system, to regulate the transmission voltage.
- Connected near large industrial loads, to improve power quality.
-

Working Principle of SVC: In transmission applications, the SVC is used to regulate the grid voltage. If the power system's reactive load is capacitive or leading, the SVC will use thyristor-controlled reactors to consume VARs from the system, lowering the system voltage. Under inductive or laggingconditions, the capacitor banks are automatically switched in, thus providing a higher system voltage.

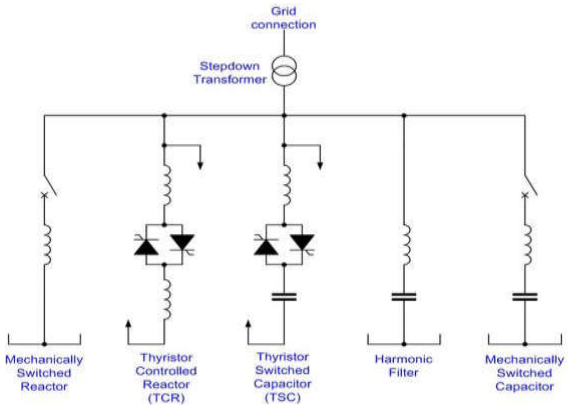

Figure 6.1 Static Var compensator configurations

By connecting the thyristor-controlled reactor, along with a capacitor bank step, the net result is continuously variable leading or lagging power. In industrial applications, SVCs are typically placed near high and rapidly varying loads, for example arc furnaces, where they can smooth flicker voltage.

Advantages of Static Var Compensator

- It increases the power transmission capability of the transmission lines.
- It improves the transient stability of the system.
- It controls the steady state and temporary overvoltages.
- It improves the load power factorand therefore, it reduces the line losses and improves system capability.
- It gives fast response to change in power system.
- Less costly, high capacity, faster and more reliable.
- It reduces harmonics and voltage fluctuations.
- It provides load balancing function.

Applications of SVC

- SVC provides fast acting reactive power.
- To fast theresponse time.
- To enhance the transient stability margin.
- To enhance voltage.
- To reduce the voltage variation.
- To controlvoltage and stabilize the frequency.
- SVC is used to regulate the grid voltage.
- If the power system's reactive load is capacitive or leading, SVC will be used to the thyristor-controlled reactors to consume VARs from the system and lowers the system voltage and if the reactive load is inductive or lagging, SVC will be used to the thyristor controlled reactors to generate VARs to the system and increase the system voltage.

RESULTS AND SIMULATION

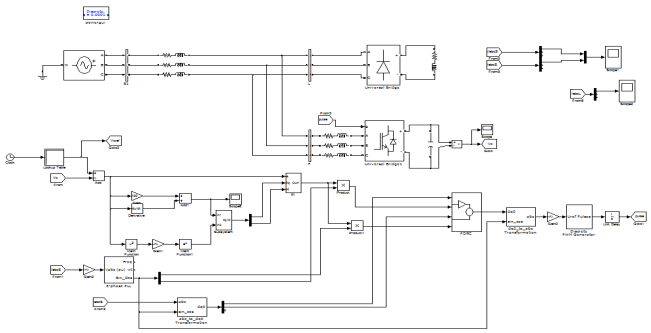

Figure 9.1. Simulation design of the proposed system

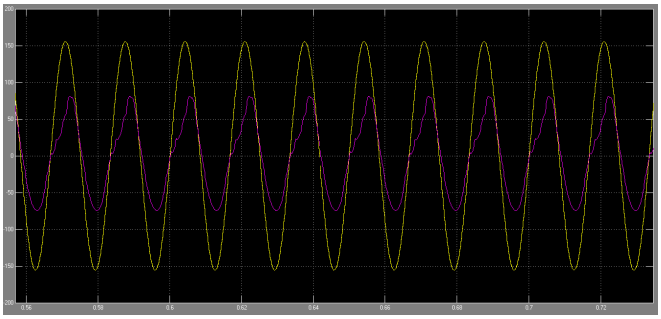

Figure 9.2 Voltage and current waveforms of grid side

CONCLUSION

By the proposed paper, it is possible to totally cancel the oscillation in both the active and the reactive power, or reduced the oscillation amplitude in the reactive power. Meanwhile, the current amplitude of the faulty phase is significantly relieved without further increasing the current amplitude in the normal phases. The advantage and features of the proposed controls can be still maintained under various conditions when delivering the reactive power.

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RESEARCH ARTICLE

A CHARACTERIZED THYRISTOR CONTROLLED SERIES COMPENSATION FACTS DEVICE FOR PHANTOM POWER CONTROL

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ABSTRACT

Nonlinear loads connected to electric energy distributionnetworks generate harmonic pollution. Such nonlinearloads drain currents with varying degree of harmoniccontents. The harmonic current components do not representuseful active power due to the frequency mismatch with the gridvoltage. A remedy to the harmonic current injection problem is to connect series controllers in transmission lines.

Citation: Namburi Nireekshana, Shivani, V., Rohini, A., Prathyusha, B. *"*A Characterized Thyristor Controlled Series Compensation FACTS Device for Phantom Power Control*", 2021. International Journal of Current Research, 13, (11), 19720-19723.*

INTRODUCTION

The quality of power supply is very important in any power network particularly to electricity consumers.

Power quality is poor when at least one of these occurs

- The supply is not constant (outage or interruption),
- When the supplied voltage is lower to or above acceptable range of magnitude,
- When the power system frequency is fluctuating
- And when the current and voltage sinusoidalwaveform of the supply.

Power Quality Issues in Power System:

Voltage Sag: Voltage sag or dip represent a voltage fall to 0.1 to 0.9 p.u. and existing for less than one minute. This is shown in fig2 Voltage sag can cause loss of production in automated process since a voltage sag trip a motor or cause its controller to malfunction namely microprocessor based control system, programmable logic controller, adjustable speed drives, that may lead to a process stoppage, tripping of contractors and loss of efficiency of electric machine. Impact of long duration variation is greater than those of short duration variation.

Figure 2.1.Voltage Sag

Voltage Swell: Voltage swell is the rise in voltage of greater than 1.1 p.u. and exists for less than one minute shown in fig. Swells are usually associated with system fault conditions, but they are much less common than voltage sags. A swell can occur due to a single line-to-ground fault on the system which can result temporary voltage rise on the other unwanted phases. Swells can also be caused by switching off a large load or switching on a large capacitor bank.

Voltage swells can put stress on computer and many home appliances. It also causes tripping of protective circuit of an adjustable speed drive.

Figure 2.2.Voltage Swell

Voltage flicker: Voltage flicker is one of the power quality problem.Due to sudden switching on and off of loads on a weak distribution system voltage flicker occurs. Voltage variations occur due to the small short circuit capacity in the distribution system. It results in rapid variation in voltage due to fast changes in load as shown in fig The voltage flicker magnitude depends upon type of the electrical load that is producing the disturbance. Voltage flicker can also occur due to the sag in the power system. This voltage sag can generate inrush current and this current passes into the sensitive loads in the distribution system.

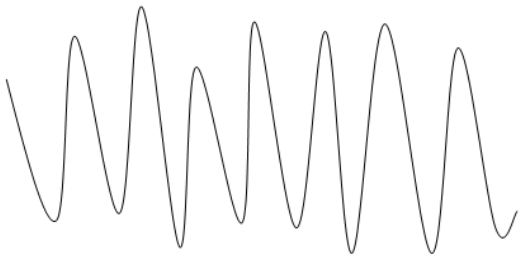

Figure 2.3 Voltage Flicker

High harmonic in distribution system: It is a sinusoidal component of a periodic wave having a frequency that is an integral multiple of the fundamental frequency as shown in fig,Harmonics can be considered as voltages or current present on an electrical system at some multiple of the fundamental frequency. Non-linear elements in power system such as power electronic devices, static power converters, arc discharge devices, and lesser degree rotating machines create current distortion. Harmonics cause wave from distortion power system problems such as communication interference, heating and solidstate device malfunction can be direct result of harmonics.

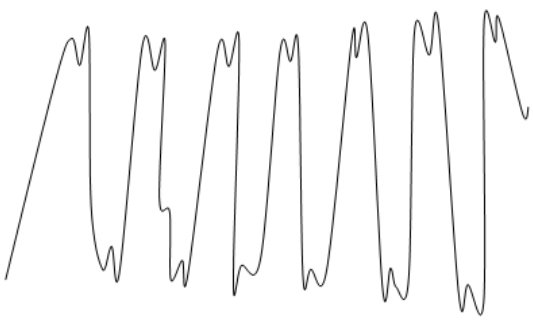

Figure 2.4. Voltage Harmonics

Mitigation of Power Quality Issues: There are two approaches to the mitigation of power quality problems. The solution to the power quality can be done from customer side or from utility side. Solutions for power quality problems:

Lightening and Surge Arresters: Lightening protection of transformers is done by arrestors but can't protect from voltage surges because there is no voltage limit.

Thyristor Based Static Switches: The static switch is a unique device for switching a new element into the circuit when the voltage support is needed. It has a dynamic response time of about one cycle. To correct quickly for voltage sags or interruptions, the static switch can used to switch one or more of devices such as capacitor, filter, alternate power line, energy storage systems etc.

Isolation Transformers: Isolation transformers consist of two coils:

- Primary and
- secondary.

These are intentionally coupled together, on a magnetic core.Isolation transformers should be designed to minimize the coupling capacitance between primary and secondary sides, while increasing the coupling to ground. Unshielded isolation transformers can only attenuate low frequency common mode noise.High frequency normal mode noise can be attenuated by specially designed and shielded isolation transformers.

Energy Storage Systems: Storage systems can be used to protect sensitive production equipments from shutdowns caused by voltage sags or momentary interruptions. These are usually DC storage systems such as UPS, batteries, superconducting magnet energy storage (SMES), storage capacitors or even fly wheels driving DC generators. The output of these devices can be supplied to the system through an inverter on a momentary basis by a fast acting electronic switch. Enough energy is fed to the system to compensate for the energy that would be lost by the voltage sag or interruption.

Electronic tap changing transformer: A voltage-regulating transformer with an electronic load tap changer can be used With a single line from the utility. It can regulate the voltage drops up to 50% .It can have the provision of coarse or smooth steps.

Working Principle of TCSC: It can be defined as a capacitive reactance compensator. It consists of a series capacitor bank shunted by a thyristor-controlled reactor in order to provide a smoothly variable series capacitivereactance. In a practical TCSC implementation, several such basic compensators may be connected in series to obtain the desired voltage rating and operating characteristics. The idea TCSC scheme is to provide continuously variable capacitor bycancelling the effective compensating capacitance by the TCR. The basicTCSC comprises a series capacitor, C, in parallel with a thyristor controlled reactor. A TCSC can provide continuous control of power on the ac line over a wide range. The principle of variable-series compensation is simply to increase the fundamental-frequency voltage across a fixed capacitor (FC) in a series compensated line by varying the firing angle(α). This voltage changes the effective value of the series capactive reactance.

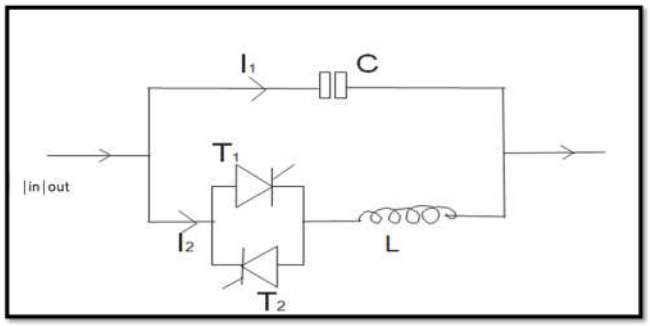

Figure 4.1. Structure of TCSC

Modes of Operation: There are three modes of operation of TCSC depending upon the firing angle of the pulses fed to the thyristor.

- Thyristor blocked mode
- Thyristor bypassed mode
- Vernier operating mode

Thyristor Blocked Operating Mode: When the thyristor valve is not triggered and the TCSC is operating in blocking mode. In this mode, the TCSC performs like a fixed series capacitor.

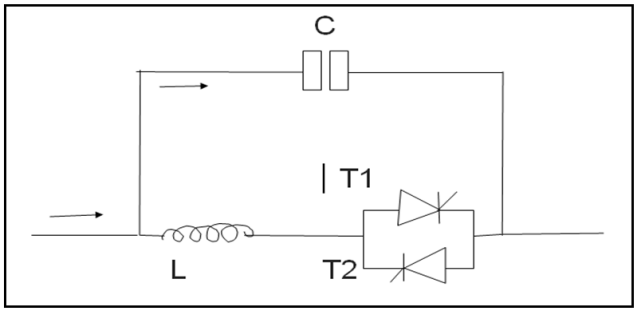

Figure 4.2. TCSC Operation

Thyristor Bypass Operating Mode: In bypass mode the thyristor valve is triggered continuously and the valve stays conducting all the time; so the TCSC behaves like a parallel connection of the series capacitor with the inductor, Ls in the thyristor valve branch. In this mode, the resulting voltage in the steady state across the TCSC is inductive and the valve current is somewhat bigger than the line current due to the current generation in the capacitor bank. For practical TCSC's with ratio (XL/XC) between 0.1 to 0.3 ranges, the capacitor voltage at a given linecurrent is much lower in bypass than in blocking mode. Therefore, the bypass modeis utilized as a means to reduce the capacitor stress during faults.

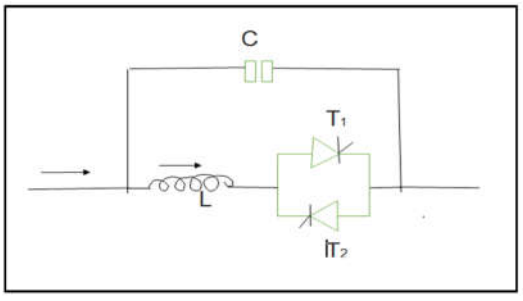

Figure 4.2 TCSC Operation

Vernier Operating Mode:In Vernier control the TCSC dynamics are varied continuously by controlling the firing angle. The firing angle is possible from 0o to 90o for each half cycle when it is generated from the zero crossing of the line current hence divided into two parts:

- Capacitive Boost mode
- Inductive Boost Mode

Capacitive Boost Mode: In capacitive boost mode a trigger pulse is supplied to the thyristor having forward voltage just before the capacitor voltage crosses the zero line, so a capacitor discharge current pulse will circulate through the parallel inductive branch. The discharge current pulse adds to the line current through the capacitor and causes a capacitor voltage that adds to the voltage caused by the line current. The capacitor peak voltage thus will be increased in proportion to the charge that passes through the thyristor branch. The fundamental voltage also increases almostproportionally to the charge.

From the system point of view, this mode inserts capacitors to the line up to nearlythree times the fixed capacitor. This is the normal operating mode of TCSC.

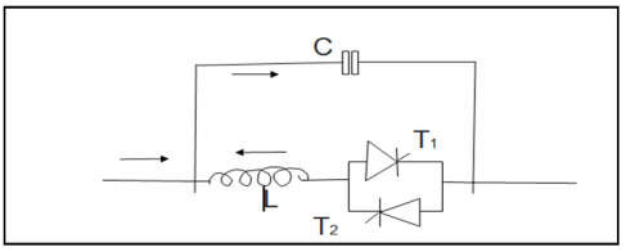

Figure 4.3. TCSC Operation

Inductive Boost Mode: In inductive boost mode the circulating current in the TCSC thyristor branch is bigger than the line current. In this mode, large thyristor currents result and further the capacitor voltage waveform is very much distorted from its sinusoidal shape. The peak voltage appears close to the turn on. The poor waveform and the high valve stress make the inductive boost mode less attractive for steady state operation.There are three modes of operation of TCSC depending upon the firing angle of the pulses fed to the thyristor.

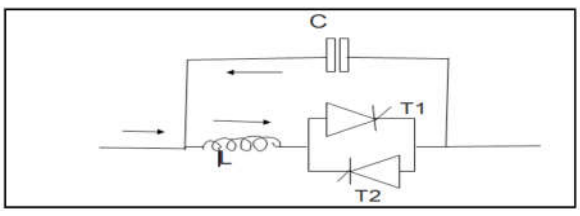

Figure 4.4. TCSC Operation

Advantages

- Rapid, continuous control of the transmission-line series-compensation level.
- Dynamic control of power flow in selected transmission lines within the network to enable optimal power-flow conditions and prevent the loop flow of power.
- Damping of the power swings from local and inter-area oscillations.

- Suppression of subsynchronous oscillations.
- Decreasing dc-offset voltages. The dc-offset voltages, invariably resulting from the insertion of series capacitors, can be made to decay very quickly (within a few cycles) from the firing control of the TCSC thyristors.
- Enhanced level of protection for series capacitors. A fast bypass of the series capacitors can be achieved through thyristor control when large over voltages develop across capacitors following faults. Likewise, the capacitors can be quickly reinserted by thyristor action after fault clearing to aid in system stabilization.
- Voltage support. The TCSC, in conjunction with series capacitors, can generate reactive power that increases with line loading, thereby aiding the regulation of local network voltages and, in addition, the alleviation of any voltage instability.
- Reduction of the short-circuit current. During events of high short-circuit current, the TCSC can switch from the controllable-capacitance to the controllable-inductance mode, thereby restricting the short-circuit currents

Applications

- TCSC device has high potential in applications because it improve power system performance including power flow control, transfer capability enhancement of the transmission system, transient stability enhancement and sub-synchronous resonance (SSR) mitigation etc.
- Accurately regulating the power flow on a transmission line
- Improves transient stability
- Damping inter area power oscillations
- Mitigates subsynchronous resonance
- Post-contigency stability improvement
- Dynamic power flow control

RESULTS AND SIMULATION

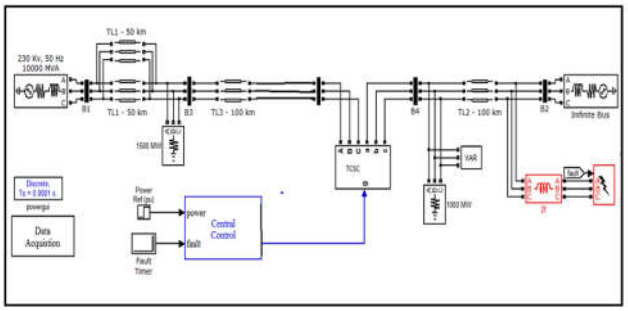

Fig. Representation of simulation circuit

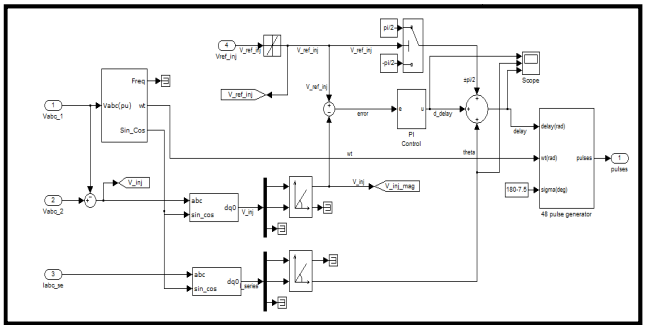

Fig. Representation of control circuit

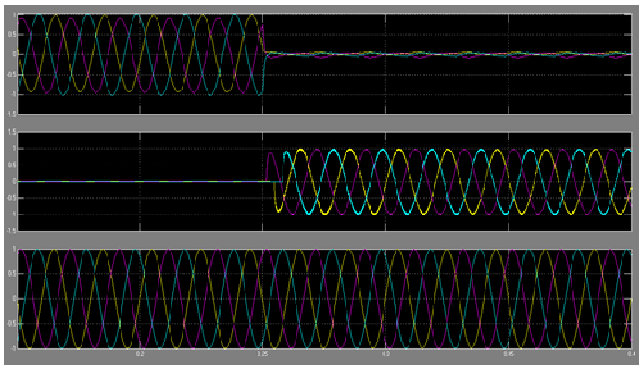

Figure. Output waveforms

CONCLUSION

The proposed configuration could be very useful for modern load centres where strict voltageregulation are required.The proposed configuration can operate in different modes based on the grid condition.The comprehensive simulation study and experimental validation demonstrate the effectiveness of the proposed configuration and its practical feasibility to perform under different operating conditions.

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RESEARCH ARTICLE

A STATIC SYNCHRONOUS SERIES COMPENSATOR CONNECTED TO INFINITE BUS FOR POWER QUALITY IMPROVEMENT AND PHANTOM POWER CONTROL

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ABSTRACT

The new inventions in technology lead to more power consumption by more number of nonlinear loads, which in turn effecting the quality of power transmitted. The power transmitted in a line is needed to be of high quality. The flow of power basically depends on the line impedance, sending end and receiving end voltage magnitudes. Nonlinear loads create harmonic currents which in turn creates system resonance, capacitor overloading, decrease in efficiency, voltage magnitude changes. The simulation results show that FACTS devices improve the system stability; furthermore, the SSSC-based stabilizer provides a better effectiveness on damping power system oscillation.

Citation: Namburi Nireekshana, Sravan Kumar, K., Vijayakar, N. and Teja, K. *"*A Static Synchronous Series Compensator Connected to Infinite Bus for Power Quality Improvement and Phantom Power Control*", 2021. International Journal of Current Research, 13, (11), 19724-19727.*

INTRODUCTION

What is Reactive Power?

It is the quantity that has become a fundamental concept to the analysis and understanding of AC electric power systems. In general, this quantity is only defined for Alternating Current (AC) electric systems. Reactive power control has been the subject of a systematic study as it plays an important role in maintaining a secure voltage profile in a large-scale transmission system. Though it is a byproduct of alternating current systems, it is needed for the acceptable functioning of various electrical systems such as transmission lines, motors, transformers, etc. It is essential for the operation of all most all of the electromagnetic energy devices for producing the magnetic field. In some cases it is forcefully injected into the power system network to maintain higher node voltage.

Reactive power is both the problem and solution to the power system network for several reasons. It plays an important role in the electrical power system for various functions such as satisfying the reactive power requirement, improving the voltage profiles, decreasing the network loss, providing sufficient reserve to ensure system security in emergencies, and other several functions.

Proposed technology: An SSSC is used to investigate the effect of this device in controlling active and reactive powers as well as damping power system oscillations in transient mode. The SSSC equipped with a source of energy in the DC link can supply or absorb the reactive and active power to or from the line. The SSSC offers an alternative to conventional series capacitive line compensation. It is a solid-state voltage source that internally generates the desired compensating voltage independent of the line current. The voltage source nature of the SSSC provides the basis for its superior operating and performance characteristics not achievable by series

capacitor type compensator: Internal reactive power generation and absorption without ac capacitors or reactors: control of reactive compensating voltage independent of the magnitude of the line current. An SSSC is a member of FACTS family, which is connected in series with a power system, consisting of a solid state voltage source converter that generates a controllable alternating current voltage at fundamental frequency. When the injected voltage is kept in quadrature with the line current, it can be emulated as inductive or capacitive reactance – so as to influence the power flow through the transmission line. Primary purpose of an SSSC is to control power flow in steady state; it can also improve transient stability of a power system. SSSC controller provides efficient damping to power system oscillations and greatly improves the system voltage profile. The inter-area and local modes of power system oscillations are effectively damped by using this proposed SSSC controller. The proposed stabilizers have been applied and tested on power systems under severe disturbance and different loading conditions. It is also FACTS-based stabilizer provides great damping characteristics and enhances significantly the system stability compared to individual designs.

Working: SSSC is a modern power quality FACTS device that employs a voltage source converter connected in series to a transmission line through a transformer. The SSSC operates like a controllable series capacitor and series inductor. The primary difference is that its injected voltage is not related to the line intensity and can be managed independently. This feature allows the SSSC to work satisfactorily with high loads as well as with lower loads.

The Static Synchronous Series Compensator has three basic components:

- Voltage Source Converter (VSC) – the main component
- Transformer – couples the SSSC to the transmission line
- Energy Source – provides voltage across the DC capacitor and compensate for device losses

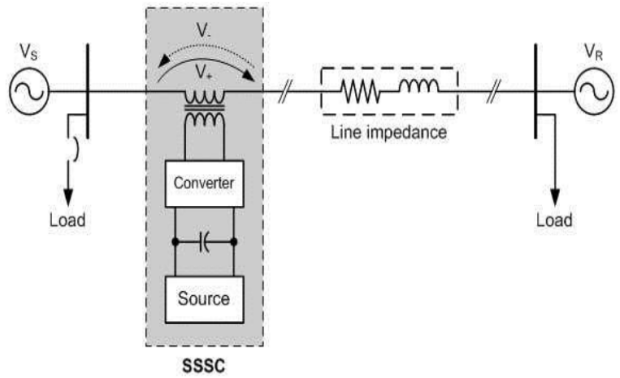

Figure 3.1. Structure of SSSC

Operation and Capabilities: Static synchronous series compensator works like the STATCOM, except that it is serially connected instead of a shunt. It can transfer both active and reactive power to the system, permitting it to compensate for the resistive voltage drops – maintaining high effective X/R that is independent of the degree of series compensation. However, this is costly as a relatively large energy source is required. On the other hand, if control is limited to reactive compensation then a smaller supply should be enough.

In this case, only the voltage is controllable because the voltage vector forms 90º with the line intensity. Subsequently, the serial injected voltage can advance or delay the line current, meaning, the SSSC can be uniformly controlled in any value. The SSSC when operated with the proper energy supply can inject a voltage component, which is of the same magnitude but opposite in phase angle with the voltage developed across the line. As a result, the effect of the voltage drop on power transmission is offset. In addition, the static synchronous series compensator provides fast control and is inherently neutral to sub-synchronous resonance.

Modes of Operation: Generally, the line reactance is constant but its net effect can be controlled through voltage injection. For instance, the line current decreases as the inductive reactance compensation level increases from 0% to 100%. Meanwhile, the line current increases with the capacitive reactance compensation level from 0% to 33%.

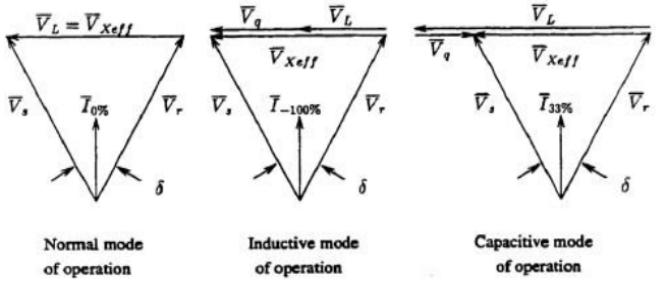

Figure 4.1. SSSC Modes of Operation

It can be noted that the static synchronous series compensator does not only increase the transferable power but it can also decrease it, by simply reversing the polarity of the injected voltage. This reversed polarity voltage is fed directly to the line voltage drop as if the line impedance was increased. In short, the effects of reactance compensation on normalized power flow in the transmission line are as follows:

- When the emulated reactance is capacitive, the active and reactive power flow increases, and the effective reactance decreases as the reactance compensation increases in the positive direction.
- , When the emulated reactance is inductive, the active and reactive power flow decrease, and the effective reactance increases as the reactance compensation increases in the negative direction.

Advantages: Compared to other FACTS controllers, SSSCs are superior due to the following advantages

- They eliminate bulky passive components such as capacitors and inductors.
- They can supply or absorb reactive power. The ability to offer inductive and capacitive operating modes symmetrically is also a benefit.
- When connected with a DC power source on the DC side of an SSSC, they can exchange real power to the power system.
- SSSCs can also connect to other renewable sources such as wind or any AC source. In such cases, an extra converter is included to convert AC to DC, which precedes the DC-link capacitor in an SSSC's structure.

- The power electronic converter (which, in most cases, is a DC-AC converter or inverter) is the heart of an SSSC. Cadence's software is a popular tool for simulating different topologies of power electronic inverters, and is not limited to circuits ranging from rectifiers, choppers, and cyclo converters.

Applications

The main role of SSSC is controlling the active and reactive powers; besides these – it could fairly improve the transient oscillations of the system.

- SSSC is capable of controlling the flow of power at a desired point on the transmission line. It injects a fast changing voltage in series with the line irrespective of the magnitude and phase of the current.
- The capability of SSSC to exchange both reactive and active power makes it possible to compensate both the reactive and resistive line voltage drops and there by maintain a high effective X/R ratio for the line independently of the degree of series compensation. Thus, optimal power transmission (high active to reactive power ratio) can be attained even at a high degree of series compensation.
- The reactive shunt compensation is highly effective in maintaining the desired voltage profile along the transmission line interconnecting two busses of the AC system and providing support to the end voltage of radial lines in the face of increasing power demand.
- The Total Harmonic Distortion studies – performed under both the conditions keeping SSSC on and off – shows that the harmonic content introduced to the line current is very low, due to the utilization of a multi-pulse inverter in the construction of the device, which inherently filters harmonics up to certain levels and thus enhances the output waveform quality.
- Controllable series line compensation is applied to achieve full utilization of transmission assets by controlling the power flow in the lines, preventing loop.
- With the use of fast controls, minimizing the effect of system disturbances, thereby reducing traditional stability margin requirements.
- The non-capacitor like nature, the superior operating characteristics and application flexibility that SSSC offers effectively is a compensation for power flow control and system stability improvement

RESULTS

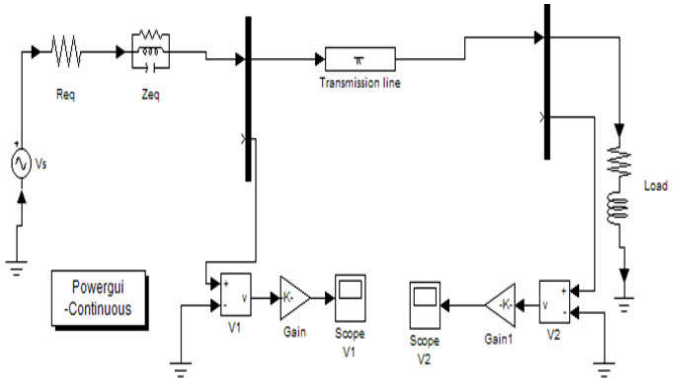

Fig.7.1. Circuit of a transmission line

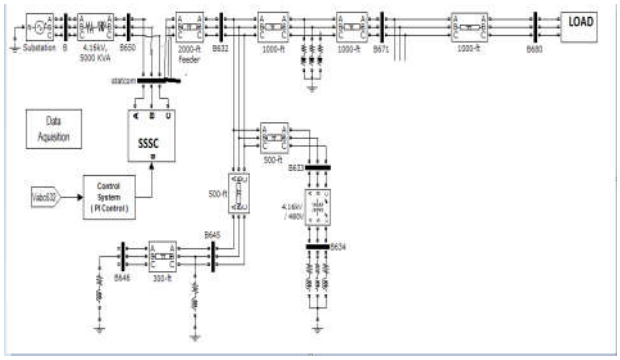

Figure.7.2. Simulation diagram

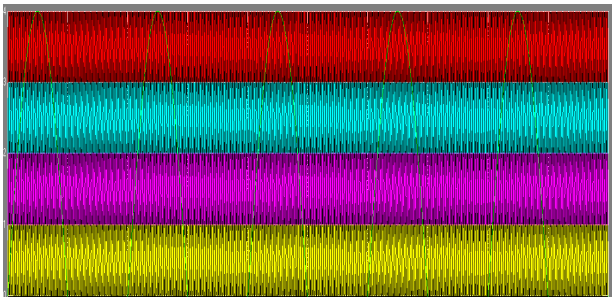

Figure.7.3. Voltage wave form

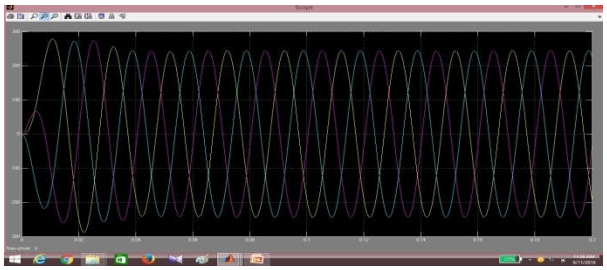

Figure.7.4. Source voltage wave form

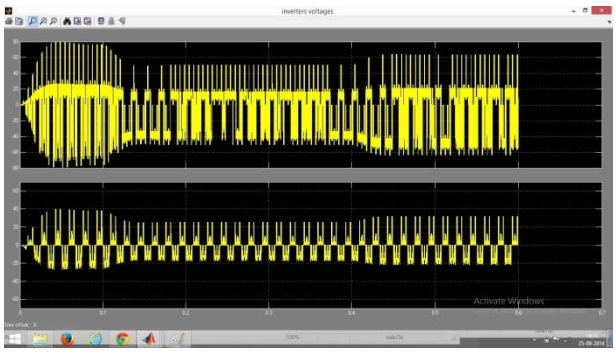

Figure 7.5. Inverter voltages

CONCLUSION

The proposed method introduces low cost low power rating SSSC in Single Machine Connected to infinite Bus system which improves the power quality.

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A Peer Survey on Load Frequency Contol in Isolated Power System with Novel Topologies

Namburi Nireekshana, R. Ramachandran, G. V. Narayana

Abstract: ***Electrical Power systems are paramount intricate system which built by human beings, therefore this type of systems should maintain stable and to get upgrading for upcoming days need multiple control techniques. In these convoluted power systems voltage frequency plays a major role .Hence frequency has to control proper. To control frequency of voltage has three control techniques are primary, secondary and also tertiary frequency control techniques .Thereby second technique also known as Load Frequency Control[1], It is to maintain the desirable frequency even after occurrence of disturbance. Several techniques have been used (like classical, adaptive) to mitigate the power flow disturbances, but drawbacks (parameters tuning, cyber-attacks) are having in these methods. This paper proposes soft computing techniques to build up the operation, control and then stability of the electrical power system.***

Keywords: ***load frequency controlling, power system structure, control methods***

I. INTRODUCTION

The novel power systems status is growing inch by inch because of emergence of low cost, profuse wind, solar and fossil cell energy sources in distributed energy systems[2] as renewable energy sources are giving boosting and digitalization grow thing. These factors may lead to growing of structural power systems[3].

Primary frequency helps out in sustaining the frequency stability of frequency, balancing of the power generation and load consumption pertaining to the grid[3] [4]. When the lack of balance occurs in between load and generation, the frequency of power systems will get change, at that time primary frequency control responds in fastest way. It is automatic control and the purpose is to clear unbalance conditions between source and load, in order to take the system in stable mode[1]. This control is compulsory for all generators in power systems areas . Once primary frequency control finished its work, if the frequency value different from nominal value and power exchange between interconnected systems different from predefined value, therefore it is necessary to restore the nominal frequency[5]. In this situation secondary control comes into picture.

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The secondary frequency control is plays lead role in controlling the frequency in power systems structures like 1,2 , 3 4 and multi area electrical power systems[6]. Every single area will be allotted with set of generators coupled with each other, which helps in forming an organised group[7]. So that all machines will react simultaneously to changes in load. Firstly, any changes in load are governed by speed governing system[3].

Tertiary frequency control is supreme to restore the session in transmission system operator (TSO).The tertiary control is not automatic but it needs when grid operator's request, its importance follows the same rules of rest of the frequency control techniques [1] [8] In power systems Automatic generated control is a system for adjusting the power flow deviations and frequency of different generators at multiple power plants. Load Frequency Control helps to maintain stable frequency[9] [8]. Therefore Automatic Generated Control is called as Load Frequency Control[10].

A. Objective of Load Frequency Control

Govern the nominal frequency variations and power flow deviations then outcomes give improvement of the power system stability, operation and control.

II. REVIEW METHODOLOGY

Multiple papers reviewed to learn about the importance of load frequency control and knowledge has gained. As a part of extensive review, a reputable and honoured database such as IEEE, Scopus, SCI, Energies, Elsevier. This database has been very helpful to write the article on load frequency control strategies. These are tabulated in table 1.

Table.1 illustration of review methodology adopted

ID	Number	Usage
IEEE	12	60%
Elsevier	8	60%
Energies	8	50%
Books	5	50%
Articles	7	70%

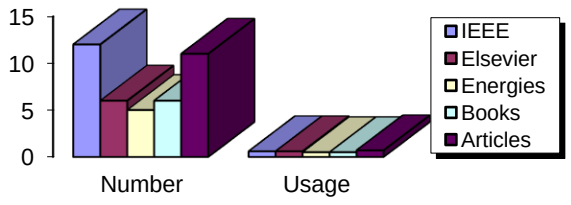

Figure 1 .Chart for review methodology adopted

1. Necessity of frequency as constant value

Few reasons are examined for control the frequency variations.

- The speed of synchronous and asynchronous motors depends on the frequency of supply. Here speed should maintain consistency with follows constant frequency [10].
- If the turbine blades are damaged the generator will stop because of nominal frequency 50 Hz falls down to 47 Hz or goes up to 52hz.Therefore should maintain frequency in stable mode.
- In case of power transformer frequency operation conditions, if frequency gets below nominal value, the power transformer winding is over heated and will give low efficiency. Hence frequency values should maintain desired level to get the constant flux for constant voltage [11] [12]
- Most of the AC machines runs by particular speeds which are straight correlated to frequency. Their speed and developed EMF may vary with respect to change in the nominal frequency [13] [14].
- Many devices connected to the grid will only work properly when the input frequency is within certain range[15].
- For parallel power stations running , it is mandatory that frequency of the generators must remain constant for synchronization [16].
- Frequency effects the transmission of interconnected lines[17] [18].
- Household appliances are most sensitive to frequency variations and also gets damaged with changes in frequency.

III. LITERATURE REVIEW

3.1 Control Area Concept Isolated Power System

Most of the machinery (Generators) in any area incorporate a well-organized family so, that their speed can be controlled with respect to power angle [19] in the sense all the generators are unison with their speed changer setting, load variations, maintaining constant frequency under steady state and dynamic responses .Control area has speed governing , turbine and load models. As shown figure 3.1

Consider

K_p = gain of the system
Tp = Power system time constant
Kg = Generator gain
Kt = Turbine gain
Tg = Generator time constant
Tt = Turbine time constant
ΔPd = Power change in load
ΔPg = Power change in generation
$\Delta F(s)$ = Change in frequency
$\Delta Xt(s)$ =Change in steam valve opening
R= speed regulation of the governor

3.1.1 Steady state analysis [20]

Three possible steps are there to get steady state response

1. Constant speed changer setting & variable load (uncontrollable) [20]

2. Constant load (controllable) & variable speed changer setting [20]

3. Constant speed changer setting & constant load[20]

3.1.2 Dynamic state analysis

Dynamic response gives the relation between variations in frequency with respect to time for a small change in load for a particular load frequency system[20].

3.2 Speed governing system[21] mainly controls real power flow, which consists of (shown in figure 3.2)

- First stage of Speed governing system
- Second stage of Linkage tool system
- Third stage of Hydraulic elaboration system
- Final stage of acceleration of speed system

3.2.1 First stage of Speed governing system

The heart of this system is a fly ball type governing system, which senses the speed or else frequency [20] [21].

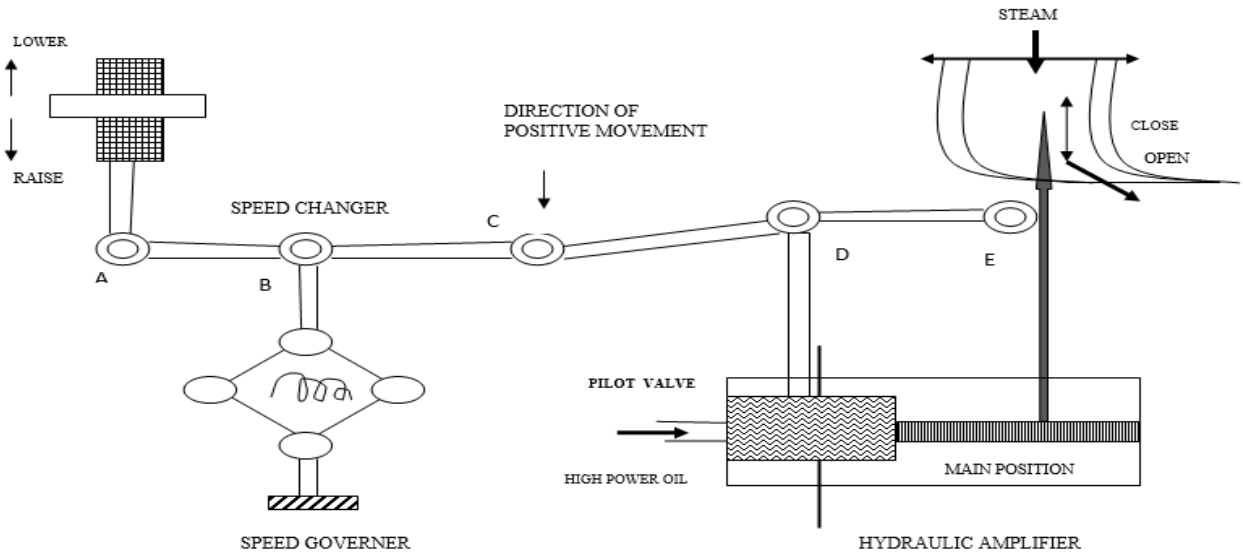

Figure 3.2 Speed governing system

3.2.2 Second stage of Linkage tool system

This system yields a moment to control valve position in corresponding to changes in the speed [20] [21].

3.2.3 Third stage of Hydraulic elaboration system

Which consists of main piston and pilot valve[20] [21].

3.2.4. Final stage of acceleration of speed system

An acceleration of speed system produces the steady state power output[20] [21].

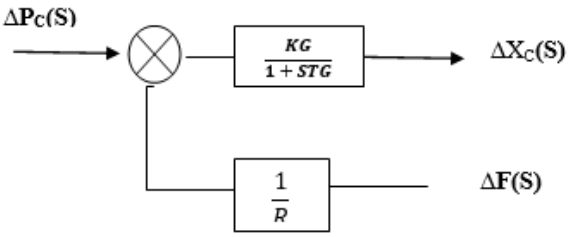

Figure3.2.1. Block diagram of speed governing system

3.3 Turbine Model

This model gives the relation between varieties in steam turbine power output and change in steam valve position ΔXt [20].

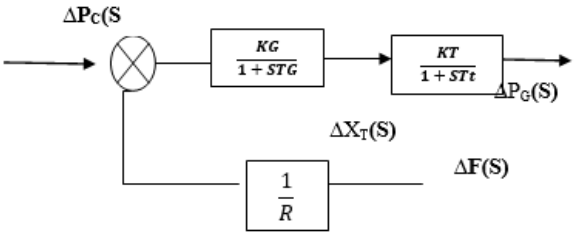

Figure. 3.3. block diagram of turbine model

3.4 Load Model

This model offers the relation between time and change in the nominal frequency results in change in generation[21] [20].

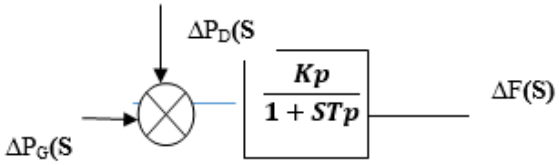

Figure .3.4.Block diagram of load model

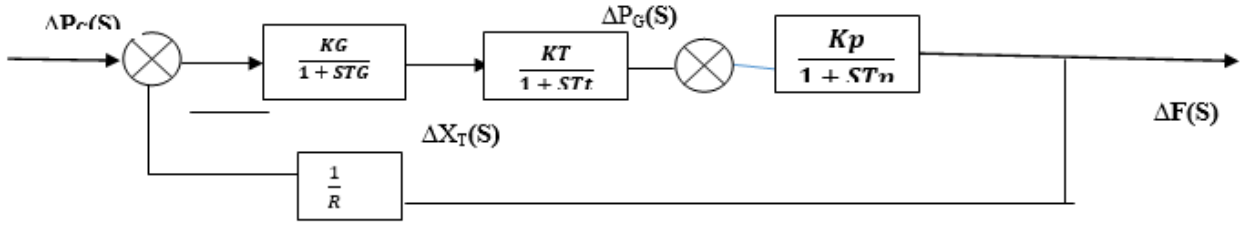

Figure 3.1.Complete diagram of isolated power system

IV. ADOPTED PROPOSAL

4.1 Mathematical model of LFC

Basically, an optimization problem, which of these can be written like F1(t),F2(t)...,Fm(t)[22]

t= (t1, t2…tm)

Generally

Hn(t) equal to 0, (n=1, 2...)

Kn(t) less than or equal to 0, (n=1, 2...)

And, where F1, F2…Fm are the objectives, and Hn, Kn are the equality and inequality constraints, respectively [22].

If m=1 … single-objective

m = 2, it becomes a multi objective problem and solution scheme is different from single objective [22].

Load frequency control mechanism is basic and simple used in power system operation and control when load varies where an unbalance between active and reactive powers occur. Which control the active power through interconnecting line by sensing the changing power flow[23] [24]. In Interconnected power systems, all areas are interconnected through tie line systems, here any area controlled by control area and tie lines allows power flow among the interconnected systems [25]. If get any small variations in load in any interconnected areas so that the tie line power flow will be disturbed, thereby all areas of output frequencies will be affected. In such type situations must gathered all information about all areas transient state to restore the nominal tie line powers and area frequency in interconnected systems [26]. In interconnected power systems are tied with all other neighbouring systems shown in figure 4.1.

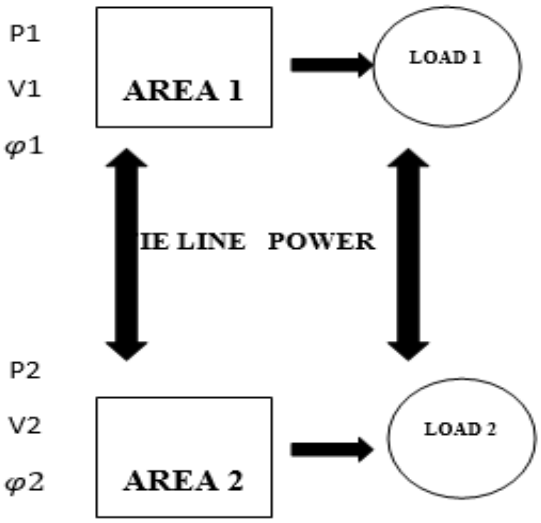

Figure4.1. Two area structured power system

Consider two generators are running parallel, in which load changes occures.to get balancing of generators production have various frequency control methods as follows

1. If the P1 generator alone is regulated to have constant frequency, this type of regulation is called flat frequency regulation [21] [27].
2. If both generators P1, P2 are regulate to maintain constant frequency, it is called parallel frequency regulation [21] [27].
3. the generator takes care of the variations in a particular area, there by maintaining the tie line load constant, here to maintain constant frequency is known as flat tie line loading control[21] [27].

Consider

$\varphi 1 \& \varphi 2$

= power angles of equavalent machines of two areas

Pr1= rated capacity of area1

Pr2= rated capacity of area 2

Ptie1=power transmitted from area 1

Ptie2= power transmitted from area 2

T12 & T21 are the synchronous co efficient

Power transmitted from the area1 is given as

$P_{tie1=} \frac{V1V2}{X12} \mathrm{Sin}(\varphi 1 - \varphi 2)$

Power transmitted from the area2 is given as

$P_{tie2=} \frac{V2V1}{X21} \mathrm{Sin}(\varphi 2 - \varphi 1)$

For the incremental changes in power angles the incremental line power can be represented as [27]

$\Delta P_{tie1}=T_{12}(\Delta\varphi_1 - \Delta\varphi 2)$

Where $T_{12}=\frac{V1V2}{Pr1X12} \mathrm{COS}(\varphi 1 - \varphi 2)$

For the incremental changes in power angles the incremental line power of area2 can be represented as

$\Delta P_{tie2}=T_{21}(\Delta\varphi 2 - \Delta\varphi 1)$

Where $T_{21}=\frac{V2V1}{Pr2X21} \mathrm{COS}(\varphi 2 - \varphi 1)$

4.2 Classification of LFC adoptive techniques

To bring the frequency under one palm in all areas of this interconnected system, LFC will be adopted few control strategies[10] [28]. These techniques will be helpful in maintaining constant tie line frequency and control the power flow disturbances. These control techniques are beneficial for the normal and abnormal conditions of loads to get the real frequency and power of pre specified value[29] [30]. Control techniques are classical, adaptive, intelligent and soft computing types[31]. Based on application of control will be picked from them. The total classifications shown in figure.4.2

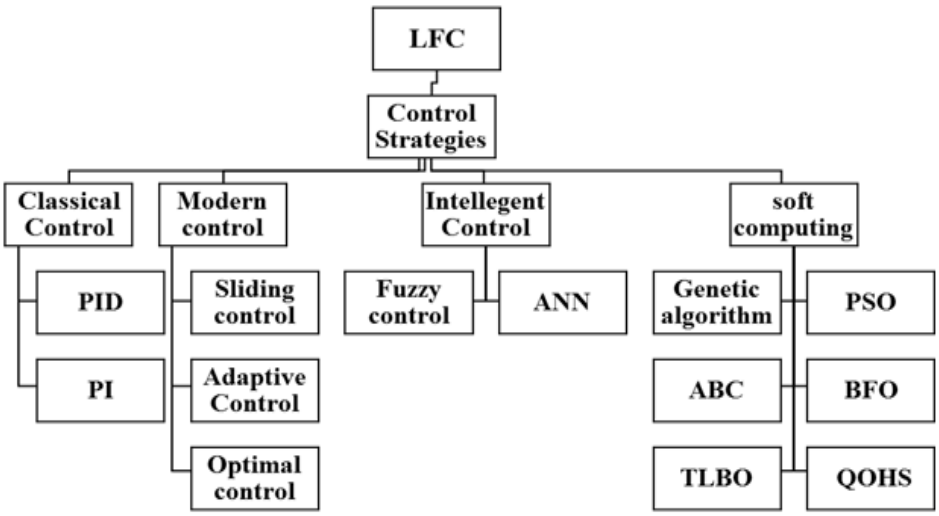

Figure 4.2. Classifications of LFC control techniques

In classical control strategies mostly used techniques are PID and PI .These techniques help to set the actual frequency and power from a process predefined value or set point as possible. And also help to analyze the phase margin and gain margin using nyquist and bode pot methods. But these classical techniques are poor in optimally tuning the parameters of load frequency, robustness and cyber-attack issues[32].

In modern control or optimal control strategies commonly involved methods are sliding control, adaptive control and optimal control[33]. These methods are developed to provide the solution, system has state variable models such as system state vector, therefore this type of control techniques are given accurate solutions, if all the state variable are consider to design closed loop control systems. But these strategies are lag performance in large scale power system applications[9].

In intelligent control strategies fuzzy and ANN are strongly involed. This type of techniques help to govern the frequency and power issues[9]. In order to mitigate the load frequency and power of tie line of interconnected systems in power system structure, have to be analysed the peak over shoot, peak undershoot and setting time [34].

Therefore intelligent control strategies can easily analyse the above responses and establish the solution. But these techniques are lag in explicit parameters identification. Sometimes controller is complicated and unrealistic[35].

Finally **soft computing methods** are frequently used and get benefited in inter connected systems for load frequency control[31]. In which mostly used control schemes are G.A, PSO.ABC, BFO, TLBO and QOHS.These techniques are made to solve nonlinear problems and introduced the human intelligence such as cognition, recognition, understanding, and learning by means of these control schemes involve to reach tractability and robustness on simulating the human decision-making behavior with desirable cost[36].

Genetic algorithm provides consistency of tuning of parameters, the load parameters changes accordingly load. Conventional control schemes cannot maintain consistency of tuning of parameters[37], but GA can do.GA provides desirable dynamic response for the control system.

PSO stands particle Swarm Optimization is one of the finest method in soft computing control scheme family to supervise the frequency and power. It is helps to find approximate solution to difficult maximization or minimization problems. It is easy and simple algorithm to implement. Which scheme is used to solve the frequency regulation problems in inter connected systems[38].

ABC stands Artificial Bee Colony have investigated from the intelligent scavenge honey bees behaviour. This ABC algorithm is specifically based on model of scavenge behaviour of honey bee colonies [39]. The model contains three parts such as employee and unemployed foraging bees, and food sources. The first two components, employed, unemployed foraging bees search for third component i.e. rich food sources. Therefore in this method, a colony of artificial forager bees like agents search for wealthy artificial food sources. In order to analyze the system nominal frequency and tie-line power flow with respect load changes, ABC scheme have been used[40].

BFO stands Bacterial Foraging Optimization was developed based on nature-inspired optimization method, this one is taken based on the bacteria's foraging behavior. In LFC this scheme provides clampdown of oscillations in power system. And also helps to analyze for optimal controller parameters by keep down the time domain analysis.

TLBO stands Teaching Learning Based Optimization is a teaching-learning process developed algorithm and it is made on the impact of a teacher on the outcomes of students in a the lecture hall. TLBO involve to solve continuous as well as disjoined optimization problems in single or multiple objectives. This scheme consists of two modes of operations such as teacher and learner point of views. This mechanism is used to brush up the transient response of the structure of the power systems [41].

Generally Fertilizers are used to kill insects on the cotton field and many methods have been adopted to market the cotton for good profit using natural fertilizers and farming methods as well as There are several methods used to obtain quality power by controlling the frequency based on various load applications in the power system areas[42]. Some of them are listed in the table2

Table 2 Load Frequency Analysis

Structural Power Systems	Control techniques	Novel Applications
multi area power systems • Single • Two • Three	• PID • Centralized & decentralized • GA • PSO • FUZZY • ANN • Variable structure control	• HVDC • Deregulation • Distributed energy generation • Smart grid • Micro grid

V. CONCLUSION

Soft computing methods are increasingly playing a major role in controlling the frequency of the load in the electrical structured power system area to suit the present days conditions. Therefore better results can be obtained by using soft computing techniques for govern the nominal frequency and power flow disparities and also mitigate these problems.

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Frequency Regulation in Two Area System with PSO Driven PID Technique

Namburi Nireekshana[1,*], R. Rama Chandran[2], G.V. Narayana[3]

Abstract

Now a modern days power system structures gives a major advantages in applications at the time, losses are also produced. To get the stable operation of this structured power system need balancing between total generation with total load demand and system losses. Rising and falling load demand throws off the real and reactive power balances. As a result, the system frequency and tie line interchange power deviate from their pre-programmed values. A significant change in system frequency can result in system failure.. In that scenario load frequency control optimization techniques is used Multiple Connect Area System to provide reliable and quality operation on frequency, tie line power flow.The Load Frequency Control (LFC) problem of an interconnected power system is solved using a recently proposed optimization method known as particle swarm optimization (PSO). In each section of the system, a standard Proportional Integral Derivative (PID) controller is employed for control. The PSO method of optimization is used to calculate the controllers' optimum gain values KP, KI, and KD.

Keywords: LFC, ACE, Two area power system, PSO

INTRODUCTION

Based on the literature survey most of the authors are focused on the power system operating state and generation's problems, and they are tends to overcome the problems on it.to overcome the issues on state of operation and to maintain normal state operation, have to control the real and imaginary powers. The control system's model parameters are very useful for doing this [1].

Variations of true power leads to frequency down falls or gets changes, however the reactive power is less sensitive to changes in frequency, And mainly depends on changes in voltage magnitude. Therefore, the actual and reactive forces have to be controlled separately [2].

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Under steady-state conditions, the aggregate power generated by power stations balances the load and losses experienced by the system. Off-nominal frequency occurs once the frequency deviates from its nominal value due to the sudden development of generation-load mismatches. Off-nominal frequency has a substantial impact on the operation and reliability of power systems. A high frequency deviation can destroy equipment, reduce load performance, overload transmission lines, and interact with protection mechanisms, all of which can lead to an unstable power system

The real power and frequency are controlled by the load frequency control systems. The reactive power and voltage magnitude are controlled by an

automatic voltage regulator. Load frequency control has become important day by day with the growing of interconnected system and has done the operation of interconnected system possible. Now days it is mostly used the basis of many advanced concepts for the control of large systems [2].

Regulation of Frequency in Two Area System

In the case of a single area, the frequency variations are represented by the single variable F. Assume that each area is strong on its own, and then connect them with weak tie-line power. This leads to the idea that the frequency changes in the two areas can be shown by two variables, F1 and F2 [3].

An extended power system can be divided into several load frequency control areas that are linked together by tie lines. [4]. Consider the two-area case shown in the Figure 1, which is connected by a single tie line.

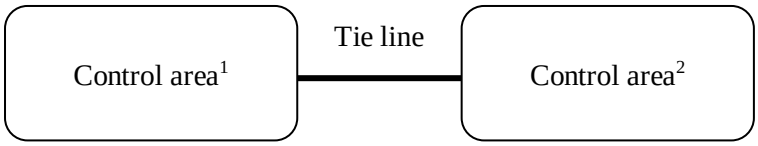


Figure 1. Interconnected control areas (two).

The load frequency mechanism has

1. To keep the frequency at the scheduled value and to ensure that there is no steady-state frequency error. [5]
2. To regulate the tie line frequency power as per inter area arrangement [5].

In a separate control zone, the difference between $(\Delta Pg - \Delta Pd)$ is accounted as change in stored energy in real power demand of the loads.

Because a tie line moves power into or out of an area, it must be included in the incremental power balance equation for each area.

Mathematical Modeling [5]

Power transmitted from area 1 is provided by in Figure 2

$$\text{Ptie1} = \frac{|V1||V2|}{X12}\sin(\delta 1 - \delta 2) \quad (1)$$

Where,

$\delta 1, \delta 2$ Are power angles of comparable machines in the two areas

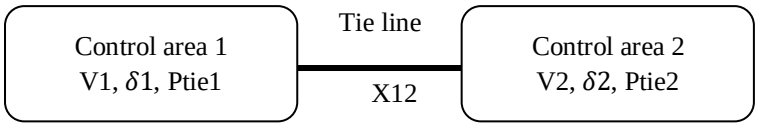


Figure 2. Two interconnected control areas.

The incremental tie line power can be expressed for the incremental changes in $\delta 1$ & $\delta 2$ as

$$\Delta Ptie1(pu) = T12\ (\Delta\delta 1 - \Delta\delta 2) \quad (2)$$

Where

$\text{T12} = \frac{|V1||V2|}{X12|Pr1|}\cos(\delta 1 - \delta 2)$ called as synchronizing coefficient

Pr1 is rated capacity of area1

The incremental change in angle can be expressed as $\frac{d\delta}{dt} = \omega = 2\pi f = speed$

$$\delta = \int 2\pi f$$

$$\Delta\delta = 2\pi \int \Delta f$$

Change in angle can be expressed as the integral of change in frequency

$$\Delta Ptie1 = T12(\int 2\pi f1 - \int 2\pi f2)dt \quad (3)$$

$$= 2\pi \left(\int \Delta f1dt - \int \Delta f2dt\right)T12 \quad (4)$$

Here f1, f2 are incremental frequency changes of area 1 & 2

Similarly power transmitted from the area2 is given by

$$\text{Ptie2} = \frac{|V2||V1|}{X21}\sin(\delta 2 - \delta 1) \quad (5)$$

The incremental tie line power can be expressed for the incremental changes in $\delta 2$ & $\delta 1$ as

$$\Delta Ptie2(pu) = T21\ (\Delta\delta 2 - \Delta\delta 1)$$

Change in angle can be expressed as the integral of change in frequency of area 2 is given by

$$= 2\pi \left(\int \Delta f2dt - \int \Delta f1dt\right)T21 \quad (6)$$

Where $\text{T21} = \frac{|V2||V1|}{X21|Pr2|}\cos(\delta 2 - \delta 1)$

$$= \frac{Pr1}{Pr2}\ T12$$

$$= a12\ T12$$

In general load model, the equation for incremental power balance of area 1can be written as

$$\Delta Pg1 - \Delta Pd1 = \frac{2H1}{fo}\frac{d(\Delta f1)}{dt} + B1\Delta f1 + \Delta Ptie1 \quad (7)$$

Taking the Laplace transform for this equation

$$\Delta Pg1(s) - \Delta Pd1(s) = \frac{2H1}{fo}s\Delta f1(s) + B1\Delta f1(s) + \Delta Ptie1(s)$$

$$\Delta Pg1(s) - \Delta Pd1(s) - \Delta Ptie1(s) = \frac{2H1}{fo}s\Delta f1(s) + B1\Delta f1(s)$$

$$\Delta Pg1(s) - \Delta Pd1(s) - \Delta Ptie1(s) = \Delta f1(s)\left(\frac{2H1}{fo}s + B1\right)$$

$$\Delta Pg1(s) - \Delta Pd1(s) - \Delta Ptie1(s) = \Delta f1(s)B1\left(\frac{2H1}{foB1}s + 1\right)$$

$$(\Delta Pg1(s) - \Delta Pd1(s) - \Delta Ptie1(s)) * \frac{Kp1}{1+sTp1} = \Delta f1(s) \quad (8)$$

Where

$$\text{Kp1} = \frac{1}{B1},\ \text{Tp1} = \frac{2H1}{foB1}$$

The only difference in the isolated inter-integrated case is the occurrence of the signal $\Delta Ptie1(s)$ as shown in Figure 3

Where

$$\Delta Ptie1 = T12(\int 2\pi f1 - \int 2\pi f2)dt$$

Apply Laplace transform on both sides as depicted in Figure 4

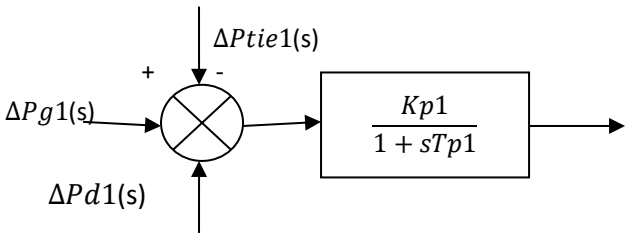


Figure 3. $\Delta Ptie1$(s) signals.

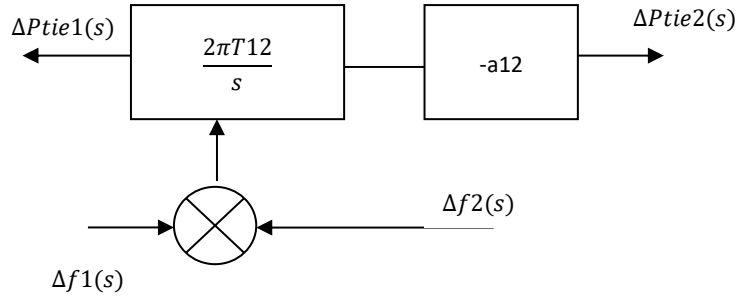


Figure 4. $\Delta Ptie2$(s) signals.

$$\Delta Ptie1(s) = \frac{2\pi T12}{s}(\Delta f1(s) - \Delta f2(s)) \quad (9)$$

For control area 2

$$\Delta Ptie2 = T21(\int 2\pi f2 - \int 2\pi f1)dt \quad (10)$$

Apply Laplace transform on both sides

$$\Delta Ptie2(s) = \frac{2\pi T21}{s}(\Delta f2(s) - \Delta f1(s))$$

$$\Delta Ptie2(s) = \frac{2\pi T12a12}{s}(\Delta f2(s) - \Delta f1(s))$$

$$\Delta Ptie2(s) = \frac{-2\pi T12a12}{s}(\Delta f2(s) - \Delta f1(s)) \quad (11)$$

Where T21 = a12*T12

A single integrated block by redefining the area control area as the linear combination of incremental frequency and tie line power.

For control area 1

$$\text{ACE1} = \Delta Ptie1 + b1\Delta f1 \quad (12)$$

Where b1 is area frequency bias

Apply Laplace transforms ACE1(s) = $\Delta Ptie1(s) + b1\Delta f1(s)$

For control area 2

$$\text{ACE2} = \Delta Ptie2 + b2\Delta f2 \tag{13}$$

Apply Laplace transforms ACE2(s) = $\Delta Ptie2(s) + b2\Delta f2(s)$

Placing together the basic block diagrams of the two control areas corresponding to Figure 5.

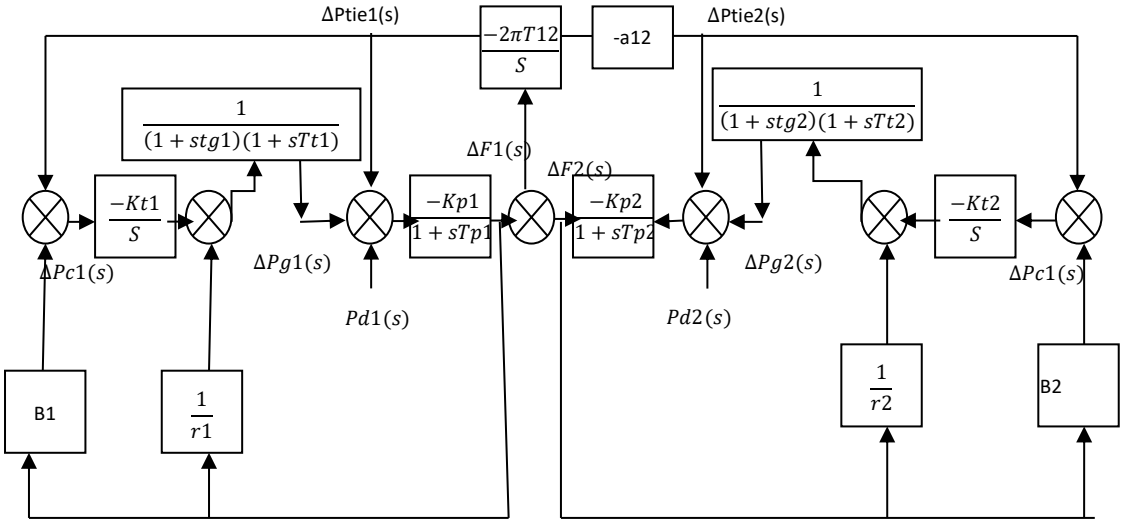


Figure 5. Block diagram of two area frequency control.

PARTICLE SWARM OPTIMIZATIONS TOPOLOGY

This particle swarm optimization is developed by using different features of natural evaluation. So, it has different components velocity, position of the particle as well as it includes local best of the each particle of the swarm [6].

Introduction

PSO principle and working can understand through Rosen brock function. It can be motivated from the foraging and social behaviour of swarm which sense these are motivated from natural phenomenon or natural process that process called flocking of birds or else school of fishing [6, 7].

PSO is proposed by Eberhart and Kennedy (1995).” Anew optimizing using particle swarm theory” in the proceeding of the 6th international symposium on micro machines and human science, PP 3943Nagoya, japan mar 1316 1995.In this particular paper proposes optimization for continuous nonlinear functions. These methods are direct search methods and does not need any gradient information, so even if function is discontinuous, PSO can use [6, 7].

PSO is developed using two methodologies

1. Artificial life(mimicking bird flocking, fish schooling, swarming theory)
2. Evolutionary computation.

In artificial life, swarm searches for food in cooperative way.in the sense in swarm has lot of birds and fishes are there, so they work in cooperative manner. In general observations lot of birds are flying in the sky and they are move in one direction, in this scenario any bird see the food ,then rest of the birds also follow the particular bird or searching food .hence the same concept is follow is borrowed and PSO have been developed [7, 8].

While doing this process, each member in the swarm learns from its experience and also from other members for changing the search pattern to locate the food. Based on this process in swarm theory, if

any particle moving from one position to another, means the particle started from one position after that generation or iteration and it reaches to another position [8, 9].

In swarm theory each particle will know what was its best position, hence they keep a track of the position as well as their task is search for food or in end optimization of solution. Therfore, in swarm theory particle knows their best position, work individually as well as they see the pattern of other members, so that we can find optimal solution for given problem[7].

PSO is developed using the simple concepts and primitive operators. This is computationally inexpensive both in memory and speed and also can be easily implemented using computer programming. And one more PSO does not involve probability calculations [8].

Working

PSO starts with initializing population randomly similar to genetic algorithm. Unlike genetic algorithm operators, solutions are assigned with randomized velocity to explore the search space. Each solution in PSO referred as particle [10, 11].

Three distinct features of PSO

- Best fitness of each particle.
- Best fitness of swarm.
- Velocity and position update of each particle.

Best Fitness of Each Particle

Example: consider

P is swarm and i is particle

$Pbest_i$ ---------- The best solution or fitness ever achieved by cell'i'

Verification

When the fitness value of the particle with its previous position, so we keep the column vector of variable corresponding to position which will gives the best [7].

Best Fitness of Swarm

Example: consider

- g is swarm
- gbest----- The best solution or fitness ever achieved by any particle in the swarm[7].

Velocity and Position update of Each Particle [7, 11].

For survey and make the use of the search space to help locate the optimal solution.

Example:consider

- I = particle
- xi(t) = current position
- xi(t+1) = new position
- vi(t+1) = velocity

The particle position 'i' is presented as

$$X_i\,(t+1) = X_i\,(t) + V_i\,(t+1) \tag{14}$$

Velocity of particle 'i' is represented as

$$V_i(t+1) = AV_i(t) + B_1R_1(P_{(I,lb)}(t) - X_i(t)) + B_2R_2(P_{gb}(t) - X_i(t)) \tag{15}$$

Where i = i^{th} particle

- t = the generation counter
- Vi (0) = initial velocity
- A = the inertia of the particle
- R1, R2 = Random numbers ∈ [0 1]
- B1, B2 = acceleration coefficients
- P(I lb)(t) = the best of the ithparticle
- $P_{gb}(t)$ = the global best

Velocity particle from equation (2) includes three components, which means addition of three vectors as shown in Figure 6.

- *First component AVi(t)*–is called as momentum part.in which inertia components involves to take weight of velocity of previous iteration i.e. 't'. Inertia components including says that memory of previous flight direction. Purpose of first component is to prevent particle from drastically changing direction [12].
- *Second component* $B_1R_1(P_{(I,lb)}(t)–X_i(t))$–is called as cognitive part. This part quantifies performance relative to past performances. This component says memory of previous best position [12].
- *Third component* $B_2R_2(P_{gb}(t)–X_i(t))$**–**is called as social part. This component quantifies performance relative to neighbors. This part called as envy [12]

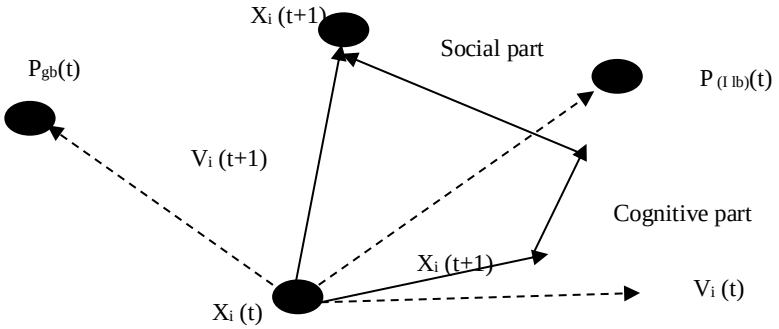


Figure 6. Geometrical illustration of velocity components.

Basic Algorithm for PSO[7]

The flow chart depicted as in Figure 7 for PSO while the steps are mentioned below.

Step 1: solution representation *% genetics*
Step 2: Input t:=1 (generation counter), maximum allowed generation = N
Step 3: initialize random swarm (P(t)); *%swarm*
Step 4: Evaluate (p(t)); *evaluate objective, constraints and assign fitness*
Step 5: While t ≤ N do
Step 6: update $P_{(I\,lb)}(t)$ of each particle 'i' and find $P_{gb}(t)$; *%new step*
Step 7: for (i = 1; i ≤ N, i++) do *%for eachone 'i'*
Step 8: update velocity $V_i(t+1)$;
Step 9: Update position $X_i(t+1)$;**%** *variation*
Step 10: Evaluate $X_i(t+1)$ and include it in P(t+1);
Step 11: End for
Step 12: =t+1;
Step 13: End while

LOAD FREQUENCY WITH PSO

Abnormal frequency deviations can lead to system failure. It requires a precise and fast operating controller to keep a constant frequency. Hence, in this scenario, the conventional controller (PID) provides good results in maintaining system nonlinearities [13, 14].

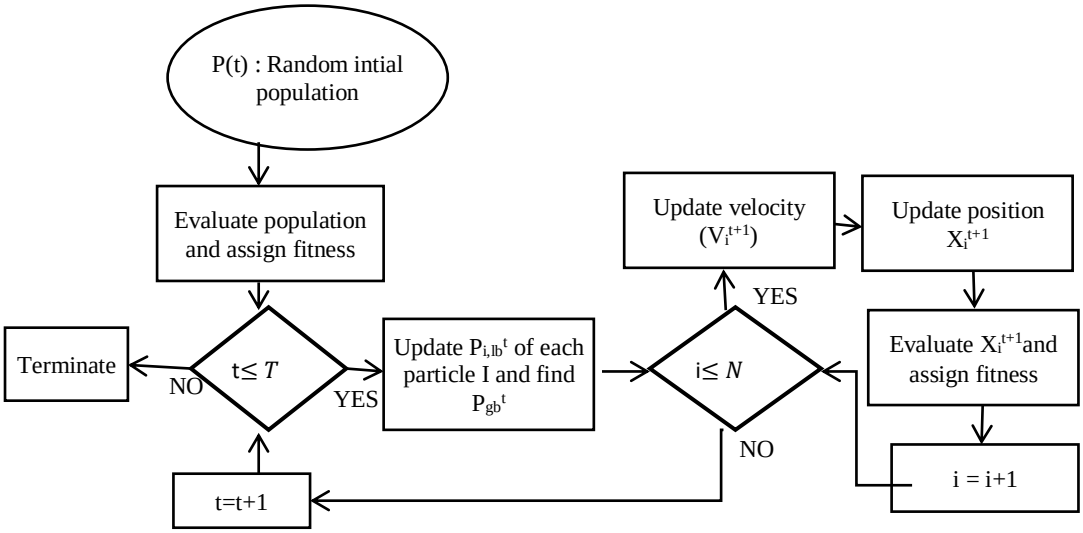


Figure 7. Flow chart for PSO.

For optimum response of LFC control scheme must be applied at both generation side and load side using modern algorithm and techniques [15].

Problems with the generator if any changes occur in the load, means shaft speed falls down from the pre-set value and the system frequency falls from the nominal value results in fall over of frequency [15].

The administration of an electric power system is based on objective less magnitudes and durations; this produces in oscillations in the tie line power and frequency, which can be regarded as a load frequency problem and is one of the problems associated with automatic generation control. To maintain the power system's efficiency and stability, frequency and tie line power variations should be kept to a minimum. To accomplish this, a control signal is constructed from tie line flow variations and the same signal is applied to frequency deviations, resulting in the desired target. This control signal is equivalent to an area control error [16, 17].

There are numerous control areas present. In a networked system, each can keep its load frequency under control and keep the size of the ACE close to "0" by using different schemes. [18].

Because the power system is non-linear, the system parameters are simplified around the operating point. The unit's response time is determined by turbine dynamics, including constants and non-linearities [18, 4].

ACE (Area Control Error)

A significant deviation in the system's frequency can result in the system collapsing. By tying together power flows and calculating net changes, load frequency control optimization techniques are used to ensure reliable and high-quality operation in a multi-connected area system means Area Control Error [15, 19].

Finally

- Control the generators' value settings to keep the ACE to a minimum.
- Drives ACE to zero, which means that frequency and power flow through the tie lines will also zero out as soon as AGC is turned on.

Objective Function Formulation [4, 15]

The mostly used objective functions as follows

- Integral of absolute error
- Integral Square Error
- Integral of time multiplied square error
- Integral of Time multiplied absolute error

Consider

- F1 and F2 are frequency variations in area1 and area2
- J is objective function

Integral Square Error

$$J=\oint_0^t(\Delta square\ of\ F1+\Delta square\ of\ F2+\Delta square\ of\ tie\ line\ power)d \quad (16)$$

This objective is the function to minimize "J" during load disturbance.

Integral of Time multiplied absolute error

$$J=\oint_0^\infty t(|\Delta F1|+|\Delta F2|+|\Delta\ tie\ line\ power|)dt \quad (17)$$

This objective is composed of tie line power and frequency fluctuations of given areas.

Integral of time multiplied square error

$$J=\oint_0^t(\Delta square\ of\ F1+\Delta square\ of\ F2+\Delta square\ of\ tie\ line\ power)dt\ . \quad (18)$$

Integral of absolute error

$$J=\oint_0^\infty(|\Delta F1|+|\Delta F2|+|\Delta\ tie\ line\ power|)dt \quad (19)$$

In which objective functions most and widely used function is Integral Square Error.

RESULTS

Requirement of design model parameters are mentioned in Table 1.

Table 1. Requirement of design model parameters

S.N.	Quantity	Area 1	Area 2
1	Kp = 0.54, ki = 0.71, kd = 0.8		
2	Frequency Load Coefficient	0.6	0.9
3	Turbine Time Constant	0.5 sec	0.6 sec
4	Governor Time Constant	0.2 sec	0.3 sec
5	Speed Regulation	0.05	0.06
6	Inertia Constant	5	4
7	Base Power	1000MVA	1000MVA

Consider that the two interconnected sections operate in parallel on a common frequency. The synchronising the power coefficient is calculated from the initial operating condition i.e. 2.0 percentage. If the load change occurs in area 1 due to frequency drop, to get nominal operation in this article used PSO with PID controller based optimization technique. Simulink model and algorithm have done and produced results in Table 2 [20, 21]. Two area power systems are presented in Figure 8. Plots of Frequency and power variations without PID are illustrated in Figure 9 while with PSO driven PID the variation is presented in Figure 10.

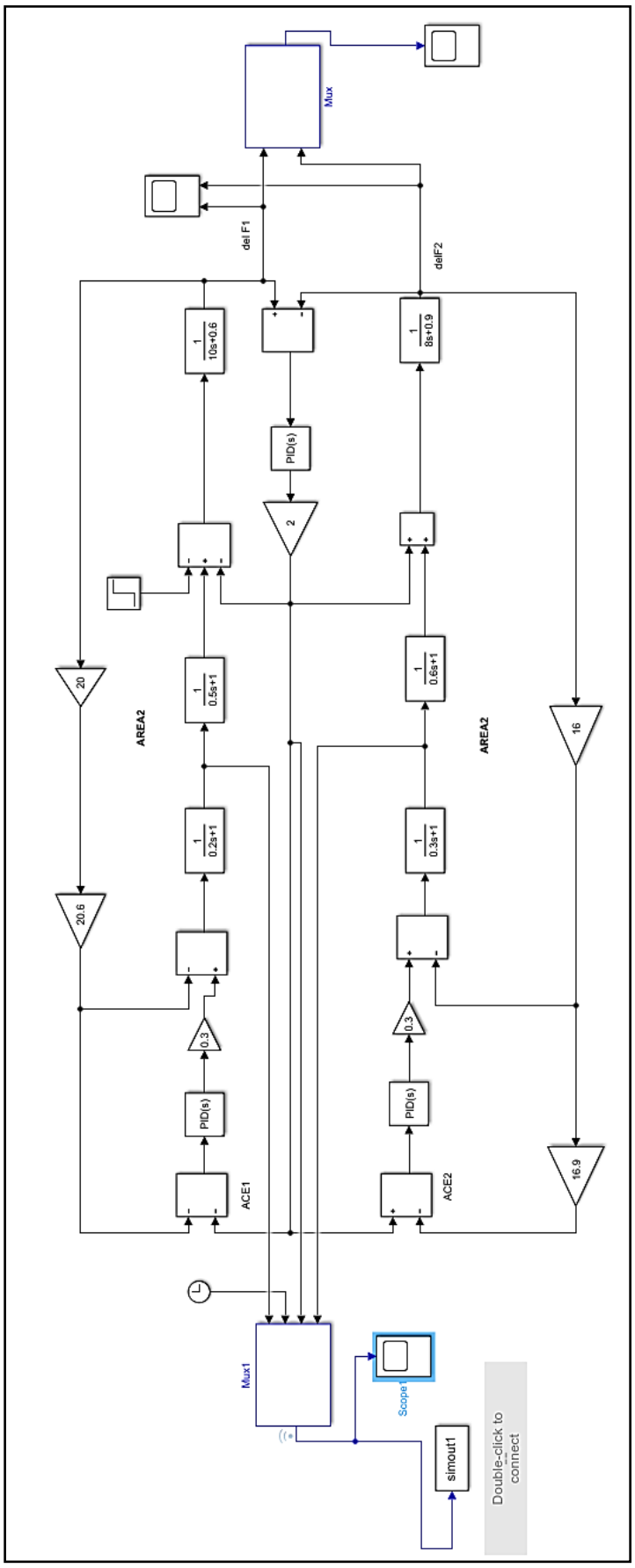
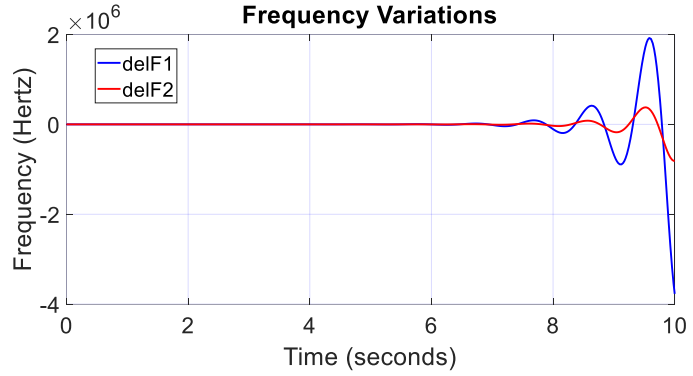
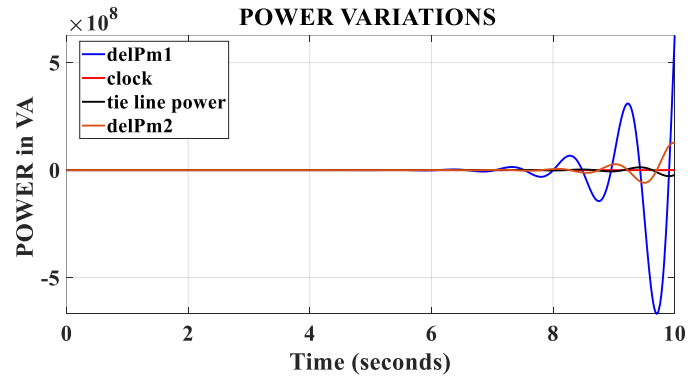


Figure 8. Simulink diagram for two area power systems.

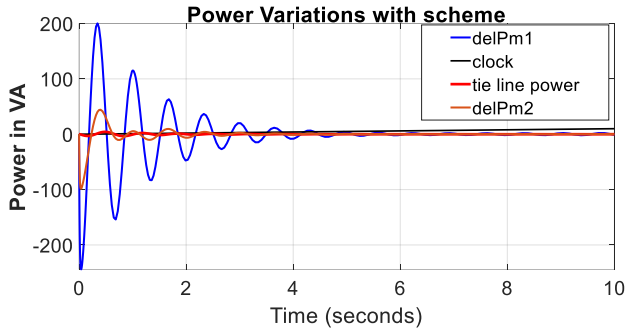


(a)



(b)

Figure 9. Frequency and power variations without PID scheme in two area system.



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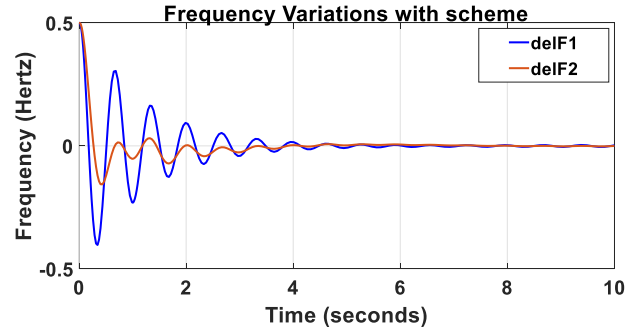

(b)

Figure 10. Frequency and power variations with PSO driven PID scheme in two area system

Table 2. Simulink parameters

No of iterations	75
Population size	10
Step time	0.0001
PID Controller parameters	
$K_p$mn	0
K_p mx	100
K_i mn	0
K_i mx	40
$K_d$mn	0
K_d mx	40

PSO driven PID resulted observations are provided in tabular manner in Table 3.

Table 3. PSO driven PID

Variables	**Shoot(pu)**	**Settle time**
Load change in area 1	0.1875	..
Load change in area 2	0.1875	..
Steady state frequency deviations area 1	-0.0025	5.1
Steady state frequency deviations area 2	-0.0025	5.1
Change in mech power 1	0.10	10
Change in mech power 2	0.080	5.3
Tie line power	-0.0845	4

CONCLUSION

The linearization mistakes are treated as parametric uncertainties and unmodeled dynamics in this research, which investigates a two-area power system. In multi area interconnected power systems load frequency control is major issue and which can be workout from particle swarm optimization technique with PID controllers and which can be optimize the tie line power values. From these techniques get optimize response of load frequency control scheme must be applied to generation side and destination side. According to the simulation results, the proposed controller has a faster response time and fewer undershoots than other controllers.

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ENERGY EFFICIENT OTBFA PROTOCOL WITH WAKE UP RADIO FOR WIRELESS SENSOR NETWORKS

D.Sailaja* & Dr. Prabhu. G. Benakop

Keywords: Wireless Sensor Networks, Wake up Radio system, False Wake up Interference, Frequency Allocation.

ABSTRACT

Nowadays , Wireless Sensor Network(WSN)s have revolutionary development in the field of communication networks. WSNs interconnected with the sensor nodes and communicate with each other to collect information from surrounding areas. WSNs gain a lot of popularity due to their nature but they create many open problems. The sensor nodes of traditional WSNs have faced different network problems such as transmission problems, receiving problems, idle listening, and overhearing problems. Many researchers are introduced different frameworks to overcome the limitations of WSNs. In the previous

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Application Details	
APPLICATION NUMBER	202121034017
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	28/07/2021
APPLICANT NAME	1 . Dr. Raghu Chandra Garimella 2 . Ramesh Babu Jarapala 3 . Srikanth Renikunta 4 . Pavani Gandreti 5 . Radhakrishna Neetoori 6 . Tarun Gandreti 7 . Anitha Kumari Azmeera 8 . Mastanamma Yarram
TITLE OF INVENTION	VIDYUTHA TRAYA CHAKRA VAHANA – A HYBRID ELECTRICAL TRICYCLE
FIELD OF INVENTION	ELECTRICAL
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E-MAIL (UPDATED Online)	
PRIORITY DATE	

Office of the Controller General of Patents, Designs & Trade Marks
Department of Industrial Policy & Promotion,
Ministry of Commerce & Industry,
Government of India

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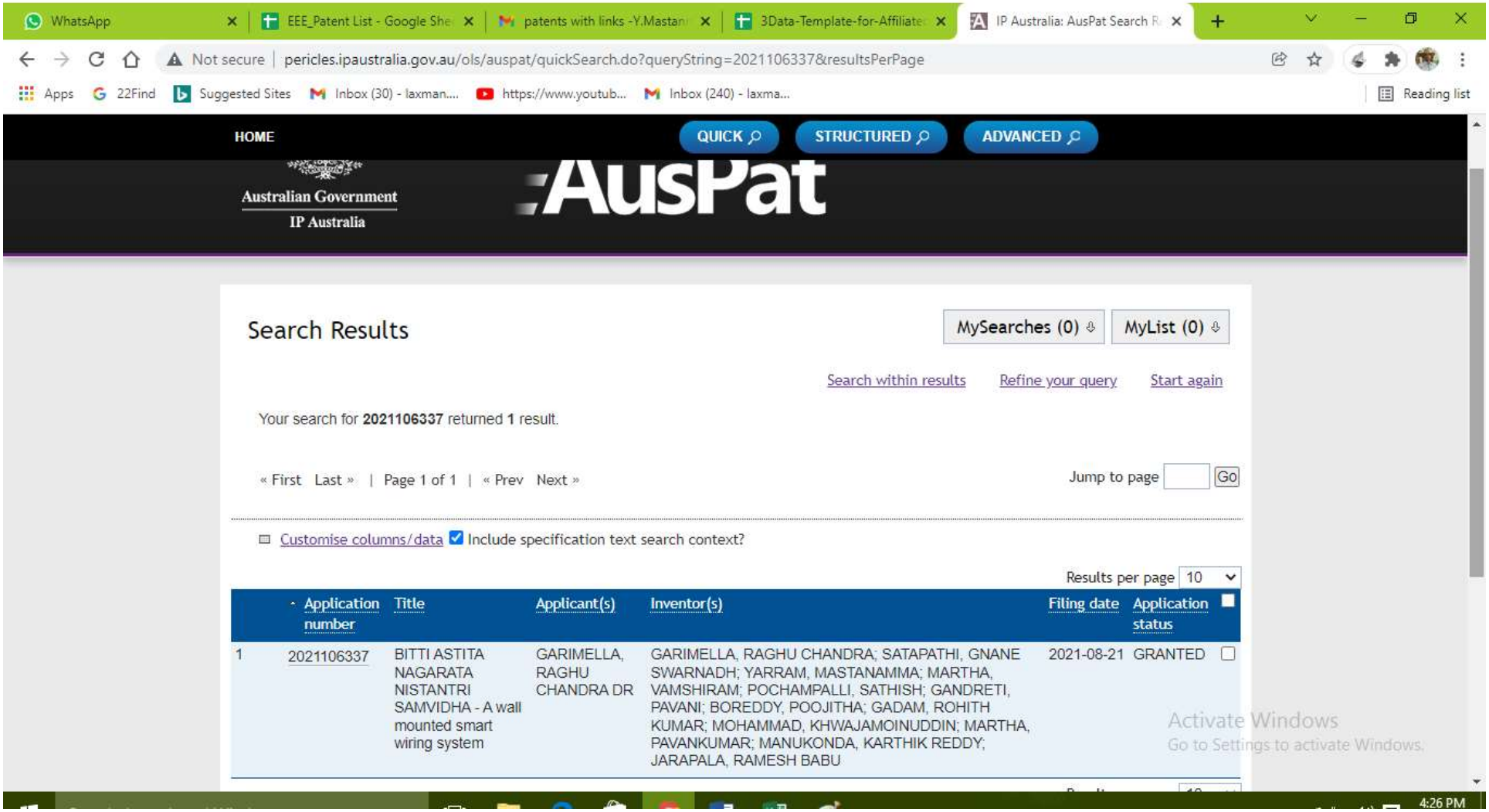
Application Details	
APPLICATION NUMBER	202141034598
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	01/08/2021
APPLICANT NAME	1 . RAGHU CHANDRA GARIMELLA 2 . GNANE SWARNADH SATAPATHI 3 . MASTANAMMA YARRAM 4 . RAMESH BABU JARAPALA 5 . VAMSHIRAM MARTHA 6 . SATHISH POCHAMPALLI 7 . PAVANI GANDRETI 8 . POOJITHA BOREDDY 9 . ROHITH KUMAR GADAM 10 . KHWAJAMOINUDDIN MOHAMMAD 11 . PAVANKUMAR MARTHA
TITLE OF INVENTION	ABHIGNA VIDYUT SAMPUTAH – A SMART ELECTRIC EXTENSION BOX
FIELD OF INVENTION	COMMUNICATION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Application number
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GARIMELLA, RAGHU CHANDRA DR
GARIMELLA, RAGHU CHANDRA; SATAPATHI, GNANE SWARNADH; YARRAM, MASTANAMMA; MARTHA, VAMSHIRAM; POCHAMPALLI, SATHISH; GANDRETI, PAVANI; BOREDDY, POOJITHA; GADAM, ROHITH KUMAR; MOHAMMAD, KHWAJAMOINUDDIN; MARTHA, PAVANKUMAR; MANUKONDA, KARTHIK REDDY; JARAPALA, RAMESH BABU
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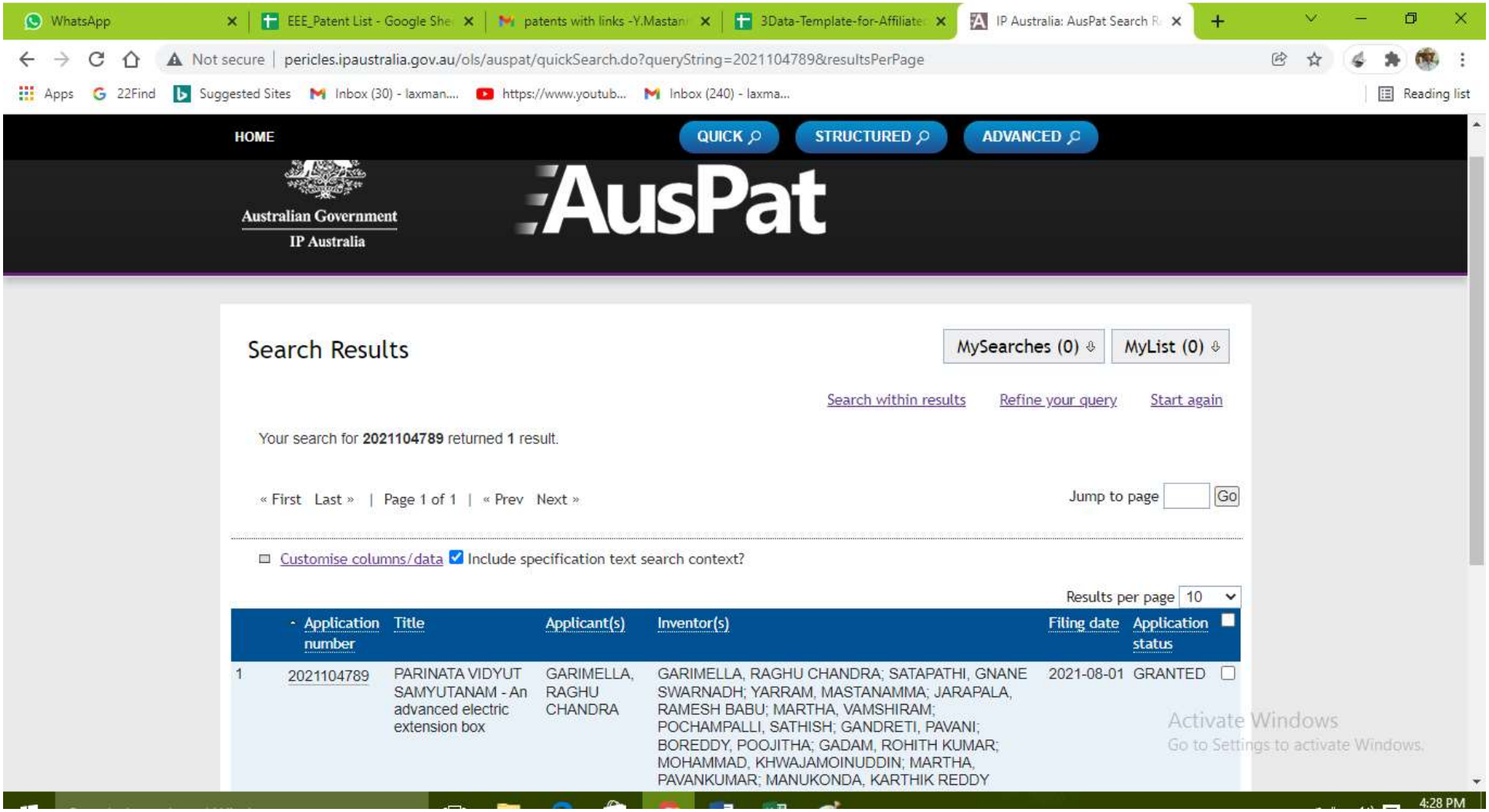
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Inventor(s)
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PARINATA VIDYUT SAMYUTANAM - An advanced electric extension box
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GARIMELLA, RAGHU CHANDRA; SATAPATHI, GNANE SWARNADH; YARRAM, MASTANAMMA; JARAPALA, RAMESH BABU; MARTHA, VAMSHIRAM; POCHAMPALLI, SATHISH; GANDRETI, PAVANI; BOREDDY, POOJITHA; GADAM, ROHITH KUMAR; MOHAMMAD, KHWAJAMOINUDDIN; MARTHA, PAVANKUMAR; MANUKONDA, KARTHIK REDDY
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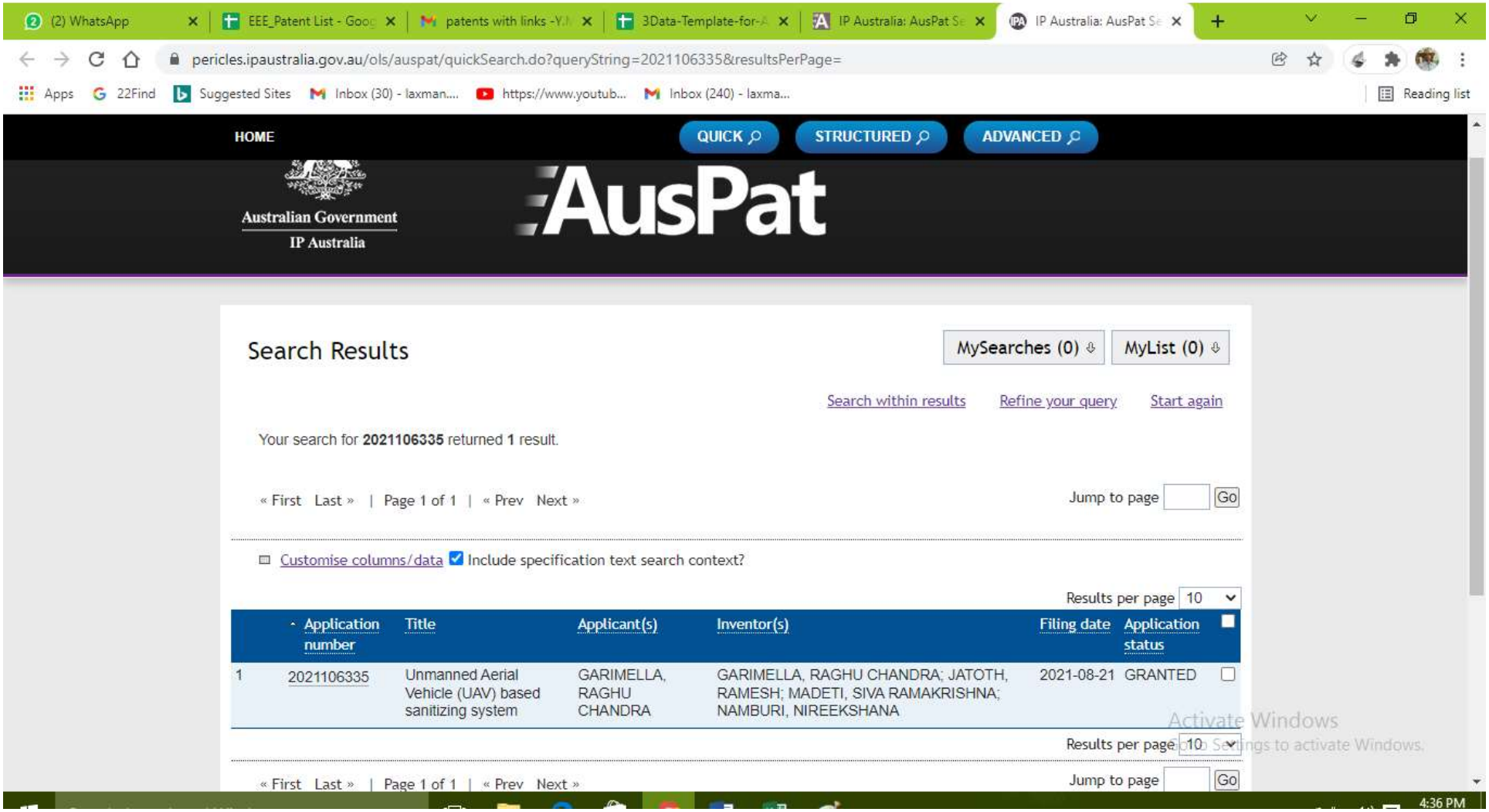
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Application number
Title
Applicant(s)
Inventor(s)
Filing date
Application status
1
2021106335
Unmanned Aerial Vehicle (UAV) based sanitizing system
GARIMELLA, RAGHU CHANDRA
GARIMELLA, RAGHU CHANDRA; JATOTH, RAMESH; MADETI, SIVA RAMAKRISHNA; NAMBURI, NIREEKSHANA
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क्रमांक : 044142731
SL No :

भारत सरकार
GOVERNMENT OF INDIA
पेटेंट कार्यालय
THE PATENT OFFICE

पेटेंट प्रमाणपत्र
PATENT CERTIFICATE

(Rule 74 of The Patents Rules)

पेटेंट सं. / Patent No.	:	400975
आवेदन सं. / Application No.	:	202141037910
फाइल करने की तारीख / Date of Filing	:	20/08/2021
पेटेंटी / Patentee	:	1.RAGHU CHANDRA GARIMELLA 2.GNANE SWARNADH SATAPATH 3.MASTANAMMA YARRAM 4.VAMSHIRAM MARTHA et al. et al. et al. et al. et al. et al. et al. et al.

प्रमाणित किया जाता है कि पेटेंटी को, उपरोक्त आवेदन में यथाप्रकटित A SWITCH BOARD UNIT TO PROVIDE WIRELESS SWITCHING OPERATIONS FOR ELECTRICAL APPLIANCES नामक आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख अगस्त 2021 के बीसवें दिन से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled A SWITCH BOARD UNIT TO PROVIDE WIRELESS SWITCHING OPERATIONS FOR ELECTRICAL APPLIANCES as disclosed in the above mentioned application for the term of 20 years from the 20th day of August 2021 in accordance with the provisions of the Patents Act,1970.

एकस्य कार्यालय THE PATENT OFFICE GOVT.OF INDIA भारत सरकार

अनुदान की तारीख : 07/07/2022
Date of Grant :

पेटेंट नियंत्रक
Controller of Patent

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, अगस्त 2023 के बीसवें दिन को और उसके पश्चात प्रत्येक वर्ष मे उसी दिन देय होगी।

Note. - The fees for renewal of this patent, if it is to be maintained will fall / has fallen due on 20th day of August 2023 and on the same day in every year thereafter.

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क्रमांक : 044136045
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पेटेंट प्रमाणपत्र
PATENT CERTIFICATE

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पेटेंट सं. / Patent No.	:	382696
आवेदन सं. / Application No.	:	202141017166
फाइल करने की तारीख / Date of Filing	:	13/04/2021
पेटेंटी / Patentee	:	1.Dr. Raghu Chandra Garimella 2.Dr. Prabhu G. Benakop 3.Neetoori Radhakrishna 4.Gandreti Pavani et al. et al. et al.

प्रमाणित किया जाता है कि पेटेंटी को उपरोक्त आवेदन में यथाप्रकटित MICROCONTROLLER BASED INFINITESIMAL NEUTRALIZED INFECTIOUS CIDE (M.I.N.I. CIDE) नामक आविष्कार के लिए, पेटेंट अधिनियम, १९७० के उपबंधों के अनुसार आज तारीख 13th day of April 2021 से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled MICROCONTROLLER BASED INFINITESIMAL NEUTRALIZED INFECTIOUS CIDE (M.I.N.I. CIDE) as disclosed in the above mentioned application for the term of 20 years from the 13th day of April 2021 in accordance with the provisions of the Patents Act,1970.

एकस्य कार्यालय THE PATENT OFFICE GOVT.OF INDIA भारत सरकार

अनुदान की तारीख :
Date of Grant : 25/11/2021

पेटेंट नियंत्रक
Controller of Patent

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, **13th day of April 2023** को और उसके पश्चात प्रत्येक वर्ष मे उसी दिन देय होगी।

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DESIGN MODELLING AND ANALYSIS OF KNEE IMPLANT USING DIFFERENT BIOMATERIALS

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Abstract

Knee prosthesis has done a lot of advancement in the recent decade as this facilitates people to do various activities even after their old age or some injury. Knee-joint is a complex structure of the human body having a complex shape, femoral condoyle which moves over the complex shaped meniscus of the tibia bone and acquires various critical loads at various walking, moving and sitting activities. Metal alloys have been the materials of choice since the start of orthopedic surgery. components support individuals with above-knee amputations. The primary requirement for this is a light-weight structure that can withstand high loads. The knee dimensions are taken Prosthetic knee joint from human body dimensions and analyzed with the help of Ansys software. This work investigates the compatibility of materials in prosthetic knee with material properties which has high longevity, low cost and maintenance free. The materials that are utilized as biomaterials are TI-6AL-4V,TI-6AL-7NB, stainless steel, for knee implants. The objective of this Project is to prepare 3D CAD model of prosthetic knee joint implants, study the distribution of von-misses stresses, total deformation, shear stress, Strain by assigning it the different loads on different combination of biomaterial components. 3D modeling software Catia is used for 3D modeling of knee implant and finite element analysis software ANSYS and finally concluding by suggesting suitable material for knee prosthesis.

Keywords*:* Prosthetic knee joint,knee replacement biomaterials,Von-Misses Stresses, Total Deformation, Shear Stress

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1. Introduction

In orthopedic medicine, prosthesis, prosthetic, or prosthetic limb is an artificial device or an extension that replaces a missing body part. It is part of the field of bio mechatronics, the science of using mechanical devices with human muscle, skeleton, and nervous systems to assist or enhance motor control lost by trauma, disease, or defect. Prostheses are typically used to replace parts lost by injury (traumatic) or missing from birth (congenital) or to supplement defective body parts. Inside the body, artificial heart valves are in common use with artificial hearts and lungs being in less common use but under active technology development. Other medical devices and aids that can be considered prosthetics include artificial eyes

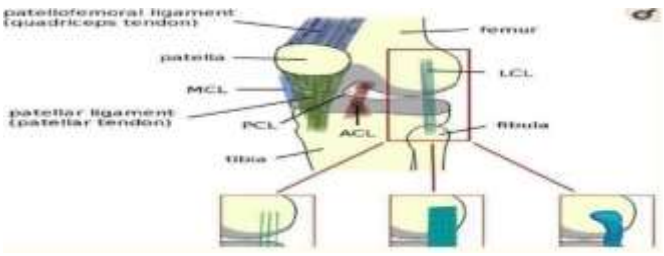

Figure 1.1 Parts of knee joint

In the field of medicine prosthesis is defined as an artificial device which is replaced in the position of any defective body part or when any body part goes missing because of trauma, disease or any congenital condition. Mainly two types of prosthesis are being used i.e. craniofacial and somato (body). Craniofacial prosthesis is of two types i.e. extra oral prosthesis and intra prosthesis whereas somato prosthesis are of many types like limb prosthesis, ear prosthesis any defective body parts when being replaced by an artificial organ. At the end of World War II, the NAS (National Academy of Sciences) began to advocate better research and development of prosthetics. Through government funding, a research and development program was developed within the Army, Navy, Air Force, and the Veterans Administration. The development of prosthetic knee since ancient pyramids to world war-I.

Figure 1.2 Prosthetic Knee from the Ancient Pyramids to World War I

The Egyptians were the early pioneers of prosthetic technology. Their rudimentary, prosthetic limbs were made of fiber and it is believed that they were worn more for a sense of "wholeness" than function. However, scientists recently discovered what is said to be the world's first prosthetic toe from an Egyptian mummy and it functioned well. Prosthetic toe which was used by Egyptians

2. Literature review

Milner [1] showed that some patients remain walking abnormally following TKR. The altered gait patterns do not necessarily mean that the TKR has failed, but it may have an impact on the patient's functional capacity in everyday life.

Bonnefoy-Mazure et al. [2] presented their research on the evolution of the knee gait kinematic in patients with knee osteoarthritis before and three months after TKR; they pointed out that the disability is still significant for most patients three months after TKR. They suggested that a better understanding of the impairments and functional limitations following surgery would help clinicians design rehabilitation programs.

Rahman et al. [3] showed that even 12 months after surgery, many TKR patients have not improved their gait relative to preoperative states. With the abnormal kinematics, the TKR can reduce efficiency of the quadriceps and change patella mechanics, and patients would not have the feeling of a normal knee. The demands in a higher range of motion such as squatting and kneeling require the total knee replacement to provide better function.

Lavernia et al. [4] also pointed out that the mean bone mineral density (BMD) in the anterior femoral condylar zone in TKR specimens was significantly lower than that in normal specimens without arthroplasty, most likely due to stress shielding.

To achieve close to normal kinematics in TKR, Walker [5] showed that a knee implant which has medial stability and lateral mobility characteristics should be designed. For example, the SAIPH™ knee (MatOrtho, UK) has been designed to have a medial pivot knee kinematic pattern and an asymmetric posterior translation of the lateral femoral condyle to mimic the natural knee motion.

Shimmin et al. [6] studied the stability of the SAIPH knee by video fluoroscopy during four different weight-bearing activities. They concluded that the medially conforming total knee shows a medial pivot motion with tibial internal rotation.

HoweveWarth et al. [7] showed that a medial pivot pattern may not significantly govern clinical success after TKR based on intraoperative kinematics and modern outcome measures. They pointed

out that further research is warranted to determine if a particular kinematic pattern promotes optimal clinical outcomes.

Li et al. [8] studied the kinematics of knee joint with TKR and concluded that the clinical outcome after TKR may be affected by factors such as preoperative range of motion, flexion space balancing, posterior tibiofemoral articular contact stability, and quadriceps contraction.

3. Objective of the present work

Minimization of stress concentration developed on contact surfaces between the femur and tibia there by reducing the wear of the implant after knee prosthesis. Design and analysis for selecting the proper prosthetic material

4. Methodology

- Collecting information and data related to knee Prosthesis.
- A fully parametric model of the artificial knee created in Catia software.
- Model obtained in IGS.is Analyzed using ANSYS (workbench), to obtain stresses, deformation, Shear stress, Strain etc.
- Taking boundary conditions.
- Finally, we compare the results obtained from ANSYS and compared geometry with different materials

5.Modelling and finite element analysis of Knee implant

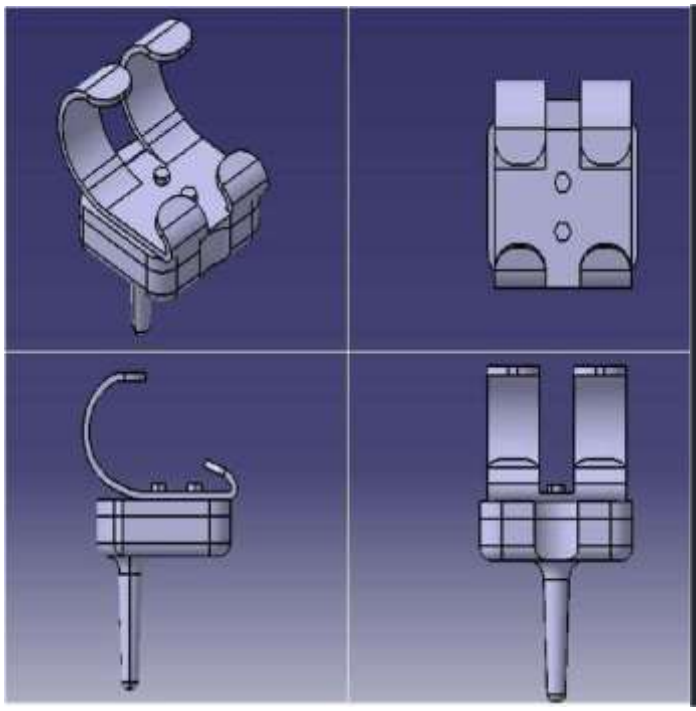

Fig5.1 Knee Implant prosthesis

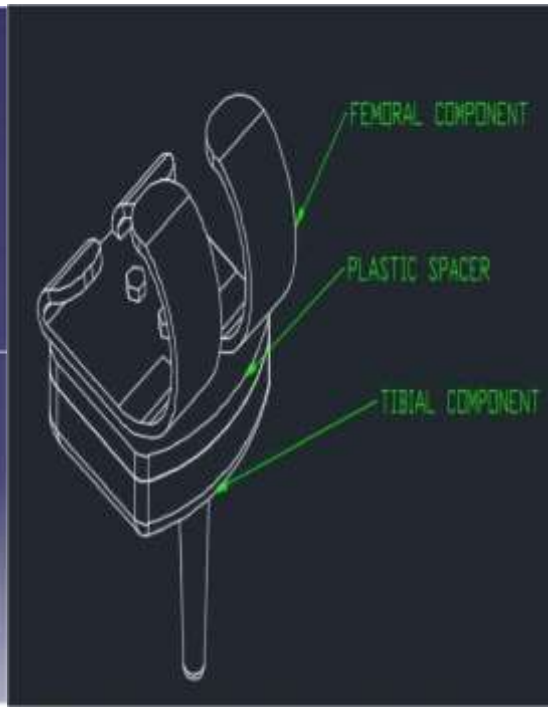

Fig5.2 Femoral, Plastic and Tibia components of knee implants

5.1 Material Properties

Material Properties	Stainless steel 316l	Ti-6al-4v	Ti-6al-7nb
Density(g/cm^3)	8.0	4.420	4.52
Poisson's ratio	0.3	0.35	0.35
Young's modulus(Gpa)	165	114	117

Ultimate tensile Strength (Mpa)	515	930	980

5.2:Load acting on Knee joint

Walking condition

Gravity =9.81m\s^2

Mass = weight of the body = 70kg

Force acting on the knee joint in walking condition is 3 to 4 times the body weight.

Force acting on the knee joint = 255 X 9.81 = 2500N

Running condition

Gravity =9.81m\s^2

Mass = weight of the body = 70kg

Force acting on the knee joint in running condition is 5 to 7 times the body weight.

Force acting on the knee joint = 460X9.81 = 4500N

5.3 ANALYSIS PROCEDURE IN ANSYS:

Designed component in CATIA V5 workbench after imported into ANSYS workbench now select the steady state thermal ANALYSIS.

- Engineering materials (material properties).
- Create or import geometry.
- Model (apply meshing).
- Set up (boundary conditions).
- Solution.
- Result

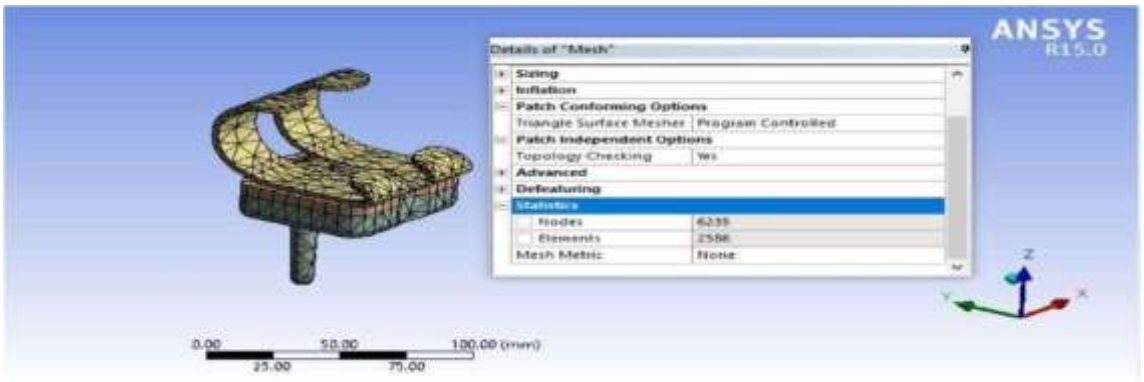

Fig 5.3 Mesh of knee implant

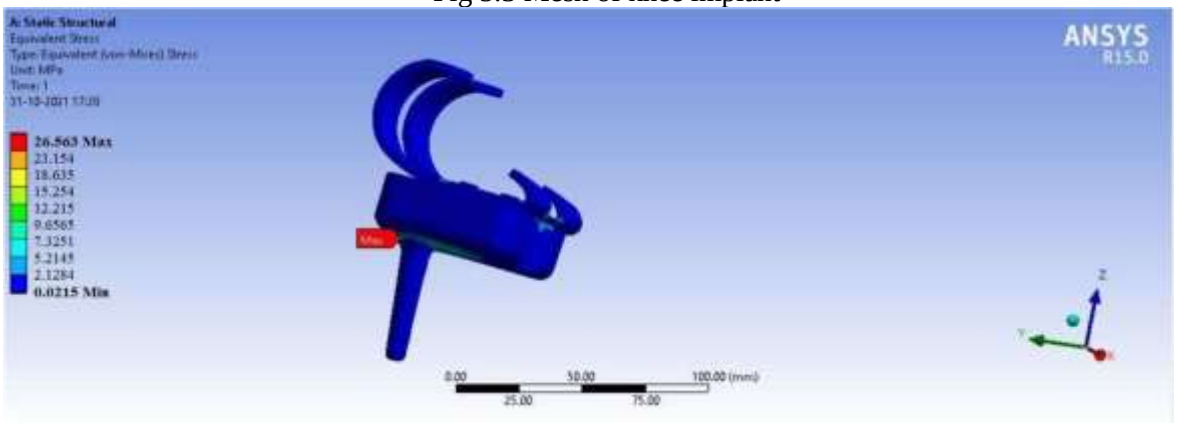

Figure5.4. Von-misses stress of Stainless steel 316 Material

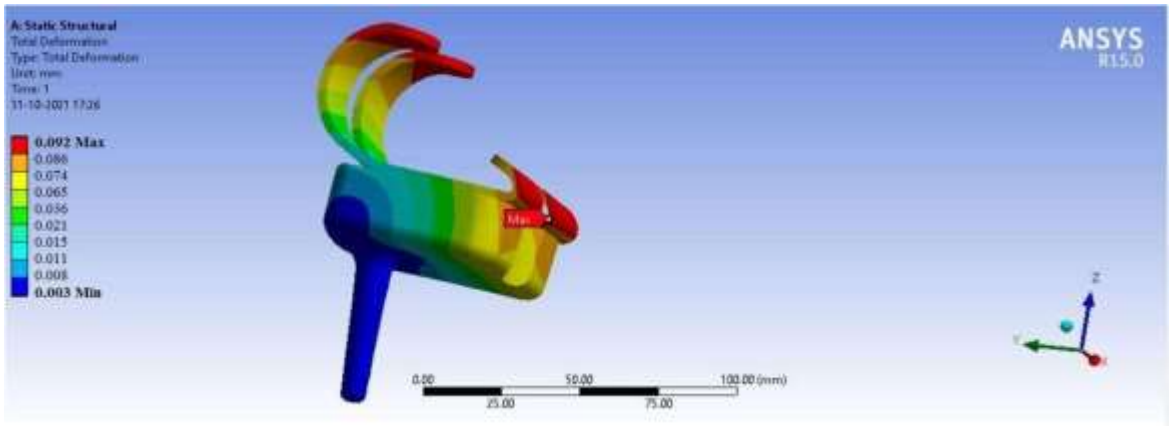

Figure5.5. Total deformation of Stainless steel 316 Material

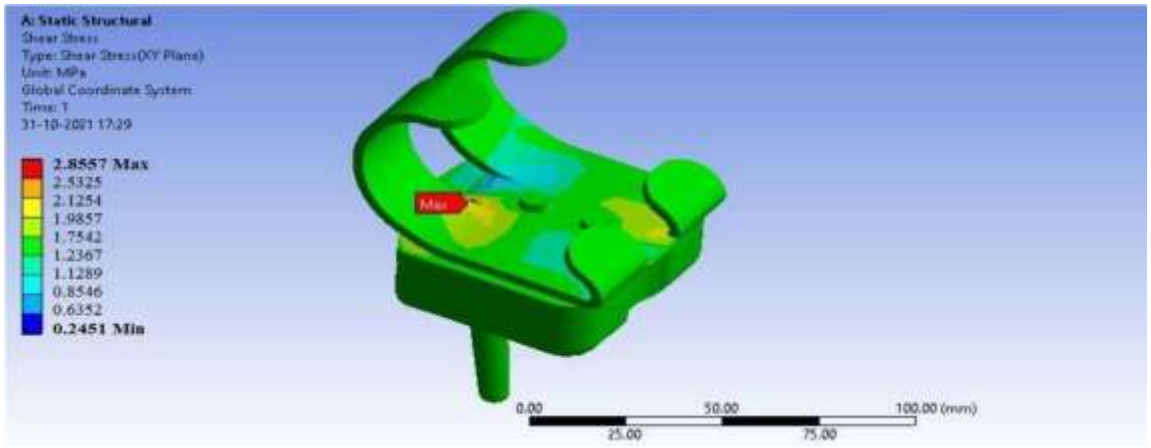

Figure5.6. Shear tress of Stainless steel 316 Material

6.Results and Conclusions

1)At 2500N Walking conditions

Material Properties	Stainless steel 316L	Ti-6al-4v	Ti-6al-7nb
Vonmisses stresses(Mpa)	26.56	25.60	25.35
Total deformation(mm)	0.92	0.087	0.084
Shear stress(Mpa)	2.85	2.84	2.72
Strain	0.096	0.094	0.088

1)At 4500N Running conditions

Material Properties	Stainless steel 316L	Ti-6al-4v	Ti-6al-7nb
Vonmisses stresses(Mpa)	33.12	32.11	31.68
Total deformation(mm)	0.0191	0.0164	0.147
Shear stress(Mpa)	3.21	3.16	3.14
Strain	0.965	0.864	0.0845

Conclusions

In this project static and modal analysis have been performed on knee implants of four different materials these are ABS-M30i, Stainless steel, TI-6AL-4V, TI-6AL-7NB, in order to find out better

material with minimum stress concentration and increased life span.

In this study, the design approach for a tibia and femur component implants using CATIA software has been developed and analysis is carried out using Ansys.

- The analysis is carried out under walking and running conditions, varying the load on the knee implant from 2500, 4500 Newton's.
- From the results of Static analysis of knee implant, we can conclude that Titanium alloys have developed minimum stresses and have low deformation when compared to other materials used.
- From the results of the Modal analysis, we can observe that the natural frequencies at different modes is higher and deformation at corresponding frequencies is less for Titanium alloys when compared to other materials under consideration.

Finally we concluded that TITANIUM ALLOY material is suitable for Knee joint replacement and titanium alloy implants have increased the life span.

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[2]A. Bonnefoy-Mazure, S. Armand, J. Y. Sagawa et al., "Evolution of knee kinematics three months after total knee replacement," Gait & Posture, vol. 41, pp. 624–629, 2015.

[3]J. Rahman, Q. Tang, M. Monda, J. Miles, and I. McCarthy, "Gait assessment as a functional outcome measure in total knee arthroplasty: a cross-sectional study," BMC Musculoskeletal Disorders, vol. 16, no. 1, p. 66, 2015.

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DESIGN AND ANALYSIS OF ROTOVATOR AND CULTIVATOR BLADES BY VARIOUS MATERIALS USING FEA

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Abstract

Rotavators are widely used in tillage operations in allotments and fields, to break up,churnandaeratethesoilbeforeplantingseeds,Rotavatorsusesasetofbladesorrotors which twist and break through thesoil.A cultivator is a type of farm implement used for secondary tillage. In other sense the name refers to frames with teeth (also called shanks) that pierce the soil as they are dragged through it linearly, mainly used for depth weed removal in fields.The energy constrained for the tillage tool applications is 35Hp power tractor for estimated forces acting at soil-tool interface. The resultant effects on tillage blades of rotavator and cultivator blades are going to be obtain from stress distribution and deformations Graphs and natural frequencies. The present working model with tillage blades of Rotovator (C type, L type, J type) and cultivator Blades (Chisel, Chamfer edge, Curved shape) are going to be analyzed with its constrained geometric and boundary conditionsforthemaximumweedremovalbypresentingitspracticalresultsfromthefield performances are Considered. In this project analysis of only Rotovator and cultivator blades with different materials like En24 mild steel**,** grey cast iron**,** carbon steel, Nimonic80A**.**The Aim of the paper is Design Optimization of Rotavator and cultivator blades, toenhancebladesmaterialpropertiesinagriculturalapplicationoftillagetoolonthebasis offiniteelementanalysisandsimulationmethodbyusingCAE-softwareforthestructural analysis. The different tillage tool parts of rotary tools are geometrically constrained with actual field performance rating parameters along with boundary conditions to identify the better performing material for loadingconditions

Keywords*:* Rotovator (C type, L type, J type), Cultivator Blades,(Chisel ,Chamfer edge, Curved shape),En24 mild steel**,** grey cast iron**,** carbon steel, Nimonic80A**.**

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1. Introduction

The rotavator will create an ideal seedbed in less passes. It is the best carry out for cash crop ranchers who need to cover and fuse crop deposits immediately, between crops. Culturing devices direct energy into the dirt to cause some ideal impact like cutting, breaking, reversal, or development of soil. Soil is moved from an underlying condition to an alternate condition by this interaction. A rotavator is a mechanical cultivating device with power sharp edges appended to a turning surface to furrow soil and give ideal culturing. Diverse rotavator are intended to suit distinctive planting needs. India positions second worldwide in agrarian homestead yield. India has shown a consistent normal cross country yearly expansion in the kilograms created per hectare for different yields, in the course of the most recent 60 years. One of the primary contributing element for the consistent development is the beginning of motorization of the ranch types of gear prompting a consistent expansion

in the yield of the ranchers Tillage is the main activity in agribusiness. It is done fundamentally to extricate the upper layer of soil to blend the dirt in with manure and to eliminate weeds. Revolving turner or ROTAVATOR (got from rotational cultivator) is a culturing machine intended for planning land by breaking the dirt with the assistance of pivoting edges reasonable for planting seeds (without toppling of the dirt). It likewise assumes an essential part in killing weeds, blending compost or manure into soil, to separate and remodel pastures for pounding hunks and so on It offers a benefit of quick seedbed planning and decreased draft contrasted with customary culturing. The first rotavator was presented in US by a Swiss producer in 1930s. Rotavator activity includes the immediate utilization of farm vehicle motor force through a rotor and edges of an extraordinary plan to soil arrangement in setting up the best development conditions for seedlings and seeds. In this undertaking, the work is done towards exploring soil dynamic conduct coming about because of the effect of a rotating edge against a dirt surface. It is hard to communicate the genuine state of the sharp edge numerically on the grounds that it comprises of three-dimensional bended lines. This should be drawn closer by the assistance of FEA apparatuses to anticipate the ongoing situation.Turning culturing machine which is utilized in soil-bed arrangement and weed control in arable field and organic product planting farming. It has a colossal limit with regards to cutting, blending to dirt setting up the seedbed straightforwardly. And furthermore It has more blending limit multiple times than a furrow. It's segments works under incidental powers in light of force, vibration, inconsequential, sway impact of soil parts as in the wake of coming to higher side. The plan improvement and assembling blunders can be limited by its segments plan examination and streamlining. Particularly cutting edges and transmission components must be dependable in field the exhibition against to working powers. Foreseeing to pressure disseminations is so significant for the fashioners, makers and end client. The plan enhancement of culturing device is acquired by diminishing its weight, cost and by further developing a field execution to high weed expulsion effectiveness .The PC helped plan examination by setting up a three dimensional strong displaying and limited components strategy applications are getting so far reaching in the business. Subsequently because of undesired pressure appropriations on its parts, it can't remunerate to the working powers i.e., field climate and results in breakdown and disappointment because of higher anxieties and distortion. The proposed work fosters a PC supported trial framework for configuration testing and valuation of rural instruments and supplies. The chose actual model of rotavator is estimated with exact measurements and a strong (3-D) model is ready in CAD-programming like Ansys, Catia, and so on by amassing an individual parts with detaildeterminations.

Fig. 1 Rotavator Assembly

Fig. 2.Cultivator Assembly

2. Literature review

H.Imprint Hanna et al in this paper few contrasts were noted taking cultivator styles in account on corn field and gave information regarding solitary development procedure with transmission system and checked functional speed increments and crude control treatments To maintain corn yield with a single cultivation strategy as compared to a broadcast only strategy, it is recommended to use a 38-cm (15-in.)-wide herbicide band.

Cultivator style is less significant[1].

N.M.Zarrogue et al. In his experimental approach he gave information of different loading conditions on mild steel EN8 rod test under combined loading to improve the torque and also loading conditions by this, this approach concludes that the working hours of blade has been improved and also states that the wear resistance conditions of the blades can be improved by using different materials and concluded that stress values on blades reduces on bladedesign[2].

Godwin R.J et al in his analytical approach gave the information regarding structural analysis of different blades by different material under similar dimensions of blades by analyzing the stresses and deformation induced in it Since blade life is a crucial part of rotavator and depends on forces acting on it and also geometry in this approach he stated how loading conditions vary the deformation of blade in vertical as well as horizontal directions and reduced the deformation of material in his approach[3] .

SirisakChertkiattipol et all in his research approach gives details about Variations of torque and specific tilling energy for different rotary blades at various speeds and gives information regarding blades impact on mass of soil in different countries like he compared rotary blades of Thailand and Japanese blades at different speeds to give suitable blade for loamy sand and clay conditions and concludes c shape Japanese blade gives better result comparatively European L shaped blades and states Japanese c shaped blades were suitable for seedbed operations in Thailand [4].

Mehmet Topakci et al in this case study they conducted experiments on deep tillage tool optimization by means of FEM, Performance of blades also depends on weight of the material also in this optimize study was undertaken to obtain optimum geometry to reduce its weight, and in results it was observed that the deflection of tyne blade has been reduced and mass of the component also has been reduced [5].

U. R. Badegaonkar et al in their experimental approach they found that an increase in horizontal and vertical forces was observed with increasing depth for all experimental shanks having different bend length, bend angle and width. The analysis of variance showed that the effect of design parameters of shank and operational variables and their interactive effect on draft and vertical force was significant. On the basis of minimum draft requirement, the optimum values of bend length and bend angle for cultivator shank were found to be 200 and 300 mm respectively. The shank width dimensions have been optimized to avoid bending [6].

Md.Abdul Rahman et al in their approachperformed static structural and thermal analysis with various crown geometries and found out that the total deformation, equivalent (von-misses) stress and maximum shear stress is less in the case of piston withcrown-b geometry when compared to other geometries,Whereas the temperature and total heat flux is less in the caseof piston with crown-c geometry. [7]

3. Problem Defnition

From literature review it is identified that the blades bend and breaks while cultivation this is because the existing material grey cast iron cannot with stand the given load conditions of red soil with clay and also it is observed that working hours for a blade is 20-200 hours but the cultivation time is more so it is not that good for farmers to use, because chances of tool failure may occur due to deformation in tool, to avoid this we are finding which set of rotovator and cultivator blades goes as a single unit so that field performance will improve and analysis will be carried on rotovator and cultivator blades with various material to avoid bending or breaking of the existing material, various materials with better mechanical properties will be tested to withstand loading conditions of soil on tool to optimize and enhance the tool life with suitable material.

4. Objective of the work

- To perform static analysis on rotovator and cultivator blades.
- To perform dynamic analysis on rotovator and cultivator blades

- To find better material by Comparing the results
- To find suitable combination of rotovator and cultivator blades as single unit

5. Methodology

- Design and analysis of rotvator and cultivatorblades
- literature review
- problem defnition
- Designing of blades using CATIA and analysis by Ansys
- static and modal analysis
- Finding out stress strain and deformation, modes of frequencies
- Comparing results and Conclusions

5.Modelling and finite element analysis

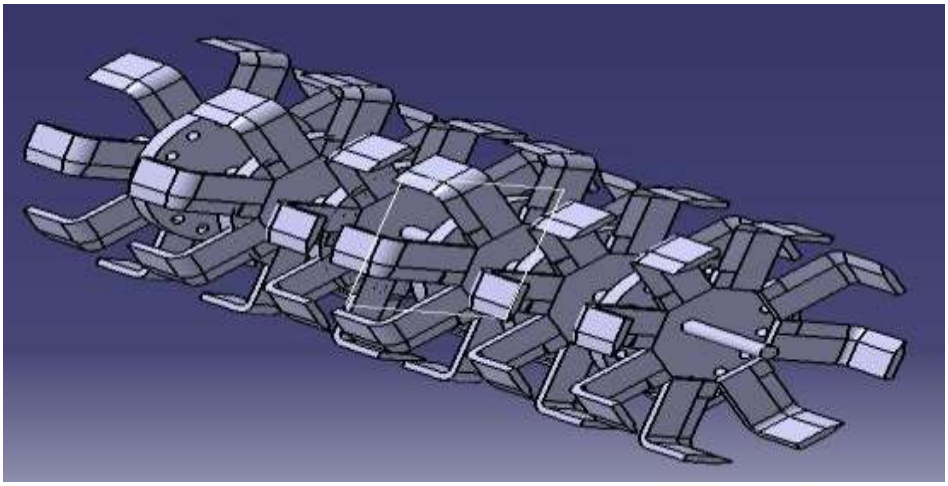


Fig5.1 Rotovator Assembly Unit InCatia

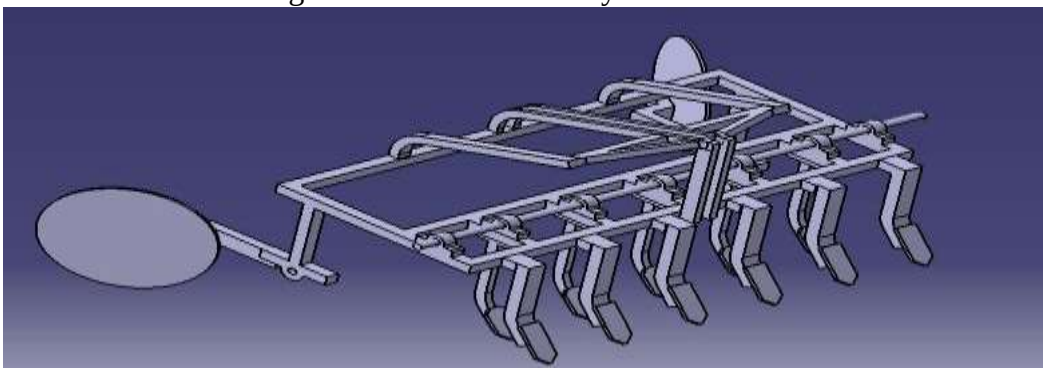


Fig5.2Cultivator Assembly Unit In Catia

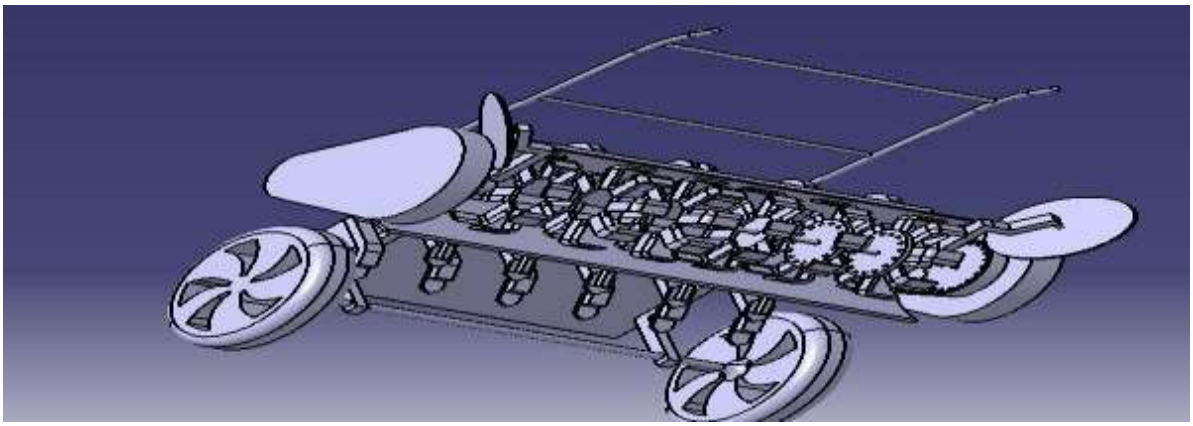


Fig5.2Rotor And cultivator Assembly Unit In Catia

5.1 Material Properties

Material Properties	CarbonSteel	Grey cast Iron	EN24 mild Steel	Nimonic 80a
Density (gm/cc)	7800	7200	7800	7900
Young's modulus(Gpa)	200	110	205	200
Poisson's ratio	0.29	0.30	0.30	0.30
Ultimate tensile strength(Mpa)	550	550	850	890
Yield strength(Mpa)	650	190	680	720

5.2ANALYSIS PROCEDURE IN ANSYS:

Designed component in CATIA V5 workbench after imported into ANSYS workbench now select the steady state thermal ANALYSIS.

- Engineering materials (material properties).
- Create or import geometry.
- Model (apply meshing).
- Set up (boundary conditions).
- Solution.
- Result

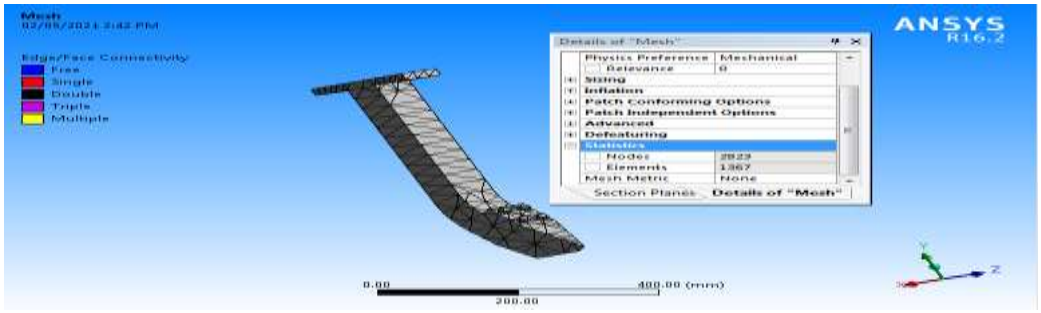


Fig5.3Meshing of cultivator blade for carbon steel

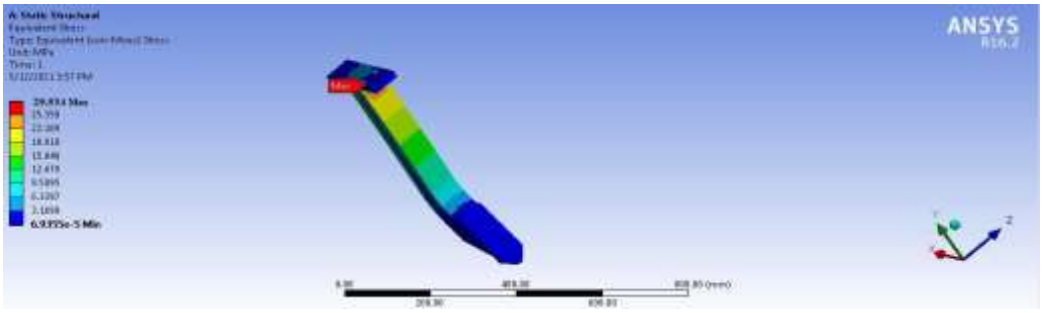
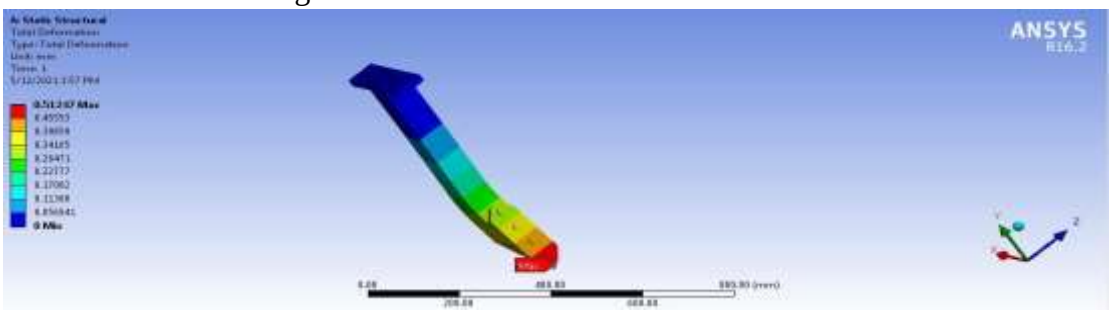


Fig 5.4 Vonmises stresses of cultivator blade for carbon steel

Fig 5.5 Strain in cultivator blade for Carbon steel



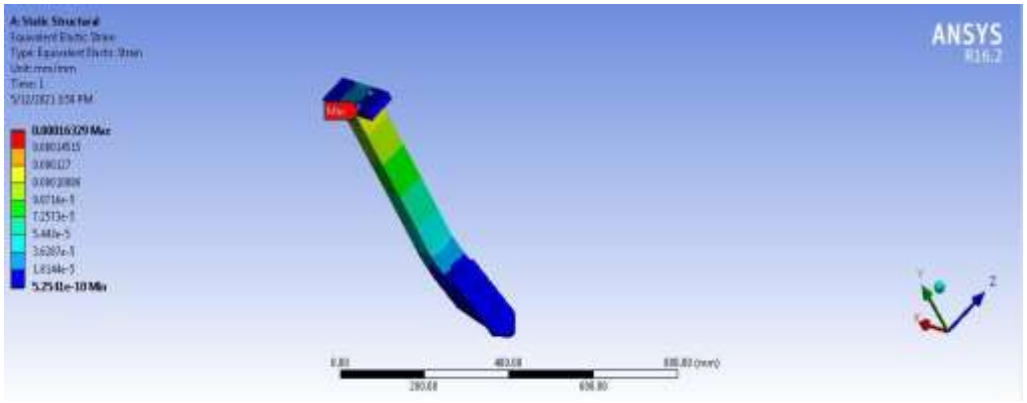


Fig 5.6 Deformation in cultivator blade for Carbon steel

6.Results and Conclusions

Cultivator blade	Material Properties	Carbon steel	Grade cast iron	Mild steel	Nimonic80A
Chamfer Edge Cultivator Blade	Vonmisses stresses(Mpa)	12.76	14.35	11.16	8.13
Chisel Edge Cultivator Blade		18.70	21.27	16.02	13.62
Curve Shape Cultivator Blade		31.83	33.67	30.61	27.55
Chamfer Edge Cultivator Blade	Totaldeformation(mm)	0512	055	0.48	0.46
Chisel Edge Cultivator Blade		0.491	0.53	0.46	0.44
Curve Shape Cultivator Blade		0.543	0.59	0.61	0.53
Chamfer Edge Cultivator Blade	Shear stress(Mpa)	4.11	5.21	4.71	2.99
Chisel Edge Cultivator Blade		8.46	9.62	7.22	6.17
Curve Shape Cultivator Blade		14.47	15.32	13.94	12.53

Chamfer Edge Cultivator Blade	Strain	0.00015	0.0001	0.0001	0.0001
Chisel Edge Cultivator Blade		0.00083	0.0009	0.0007	0.0006
Curve Shape Cultivator Blade		0.00065	0.0007	0.0005	0.0004

Rotavator Blade type	**Material Properties**	**Carbon steel**	**Grade cast iron**	**Mild steel**	**Nimonic80A**
C-Shape Rotavator blade	Vonmisses stresses(Mpa)	12.76	14.35	11.16	8.13
L-Shape Rotavator blade		18.70	21.27	16.02	13.62
J-Shape Rotavator blade		31.53	33.67	0.61	27.55
C-Shape Rotavator blade	Totaldeformation(mm)	0.24	0.31	0.18	0.12
L-Shape Rotavator blade		0.18	0.21	0.15	0.13
J-Shape Rotavator blade		0.17	0.18	0.17	0.15
C-Shape Rotavator blade	Shear stress(Mpa)	4.11	5.28	4.70	2.99
L-Shape Rotavator blade		8.46	9.67	7.25	6.17
J-Shape Rotavator blade		14.47	15.31	13.92	12.53
C-Shape Rotavator blade	Strain	0.00015	0.0001	0.0001	0.0001
L-Shape Rotavator blade		0.00083	0.0009	0.0007	0.0006
J-Shape Rotavator blade		0.00065	0.0007	0.0005	0.0004

Conclusion:

In this paper static and dynamic analysis have been performed on three rotavator blades(L,C,J) and three cultivator blades(chisel, chamfer, curved) by using different types of materials like Carbon steel, EN24mild steel, Nimonic80A along with existing material grey cast iron, to find a better material in order to optimize and enhance the properties of tool and improve its life and following conclusions are derived.

- The results obtained from this research work helps us to reach a conclusion that changing the design parameters like material properties also can reduce the deformation which a blade

undergoes during loading and enhances the life of ablade.

- In our case blades with Nimonic80A as base material shows least deformation for mechanical loading conditions in static and dynamic analysis followed by EN24 mild steel and carbon steel as second and third positions when compared to grey castiron.
- In Cultivator blades Chisel type blade shows low deformation when compared with other geometric shapes of cultivator blades followed by chamfer and curvedblades.
- From Rotavator blades analysis C type blade shows low deformation when compared with other geometric shapes like J andL.
- The mechanical loads are the major cause of deformation, wear and tear in the tool material. From the static and dynamic analysis of rotovator and cultivator blades it is seen that existing material grey cast iron shows more deformation, which results in decrease in tool life, to enhance the properties we have analyzed different materials with existing material.
- Finally, we can conclude that Nimonic80A as base material for C type rotovator blade and Chisel type cultivator blades as an assembly result in low deformation and enhancement in tool properties can beseen.

Future scope:

- The density of the all materials are more or less same so weight reduction can be done to improve the performances of the blade.
- The analysis is carried only for blades so analysis can be performed for entire unit and efficiency of the machine can be improved by reducing the defects.
-

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EXPERIMENTATION AND STUDY OF ABRASIVE WATER JET CUTTING ON AA 6061

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Abstract

In advanced areas of space, missile and nuclear technologies, there arises a need for machining components to maintain exact sharp edges, high accuracy. In the present era of modern machining, these requirements can be achieved with the help of advanced machining processes like Abrasive Water Jet Machining. In the present work the Design of Experiments which are calculated by Taguchi techniques and experiments are conducted in varying process parameters such as Carrier fluid pressure, Abrasive flow rate, Speed/Feed rate, Thickness of workpiece on Material Removal Rate (MRR) and Surface Roughness (SR).The generated regression equation is used to predict the values MRR and SR for various settings and is compared with the experimental results. Better surface finish is achieved through this experimentation at the optimum cost of MRR.

Keywords*:* Abrasive water jet machining, Material Removal Rate(MRR),Surface Roughness (SR),Regression analysis, Taguchi method

1. Introduction

The mechanism of any machining process evolves to acquire dimensional accuracy, better surface finish with optimum cost .The term abrasives are used in machining processes such as abrasive jet machining, abrasive flow machining and ultrasonic machining, but usage of abrasives differs based on area of work. In AJM air is driven with abrasive to strike the work piece while in USM abrasive grains in liquid slurry strikes the work piece at ultrasonic frequency. Recently developments were processed in jet cutting technology by using abrasive water jets with water as a carrier fluid. In abrasive water jet (AWJ) cutting technique , a thin, high velocity water jet accelerates abrasive particles that are directed through an abrasive water jet nozzle at the material to be cut.[10]

The main aim of this work is to reduce the defects in AWJM such as taper in kerfs, surface finish etc., The mechanism and rate of material removal during AWJ cutting depends both on the type of abrasive and on a range of process parameters.

2. Literature review

A lot of experimental and theoretical research was carried out on single objective functions. Usharta aich has published a paper on “Abrasive water jet cutting of Borosilicate Glass” [1] in which they have used particle swarm optimization technique to optimize the process parameters. They considered Water pressure, Abrasive flow rate, Traverse speed, Standoff distance as process parameters and depth of cut as performance measure. M.chitirai pon selvan worked on “Assessment of process parameters in AWJC in stainless steel”[2]. They used regression analysis to assess the process parameters i.e. Traverse speed, abrasive flow rate, standoff distance, water pressure and considered depth of cut as a performance measure in cutting stainless steel. Aleberdi and four others did an experimental study on abrasive water jet cutting of CFRP stacks for drilling operation[3]. They used ANOVA technique to study the process parameters i.e. Traverse speed rate, orifice, focusing tube diameter, abrasive flow rate, water pressure and the performance measures as kerf profile, taper angle, surface roughness K.S.Jai Aultrin and two other has did modelling the cutting process and cutting performance[4] in AWJM using fuzzy logic genetic algorithm in which water pressure and nozzle exit

diameter are the process parameters and material removal rate and surface finish are the performance measures while cutting aluminium silicon carbide .chitirai pon selvan and two other published a paper on the effect of process parameters on surface roughness in AWJC of aluminium. In this design of experiments using Taguchi philosophy is done. Water pressure, traverse speed, abrasive mass flow rate, standoff distance are the process parameters and surface roughness is the performance measure[5].Zhongbo yue and two other has done optimization of machining parameters in AWJ turning of Alumina. Water pressure, jet feed speed, abrasive mass flow rate, surface speed, nozzle tilt angle are the process parameters and MRR, surface roughness are the performance measures. The method used is RSM model sequential approach[6]. Among the various advanced machining technologies, AWJM has exhibited significant emergence in manufacturing industries due to its extensive operations and exceptional quality of cut of intricate profiles with a minimum cutting force on the workpiece and yield of better dimensional accuracy due to insignificant distortion [7]. The underlying operating structure of AWJM includes a high-pressure pump system, a cutting head, a table and a computer-based controller [8].The AWJM process of removing material from a target workpiece emerges through an erosive venture of abrasive particles travelling with high velocity [9].The computer-based controller is incorporated into the AWJM system, functioning independently, which enables to download varied types of diagram programs. This comprises tools that are distinct to AWJM, such as manual or automatic cut in/out tools, tools for the generation of cutting paths, collision prediction and resolution, tool assignment for surface quality, etc. [11].The water travels with a high level of velocity and is forced out of the orifice in a very thin stream structure [12].The high-speed waterjet, set alongside abrasive particles, is compounded and accelerated to create an abrasive waterjet. The focusing tube directs the abrasive waterjet to its focal point when cutting a working piece [13]

3. Methodology

A Flow chart is drawn in Figure 1 which explains about the layout of the present work. The main aim of this study is to reduce the defects in AWJM such as taper in kerfs, decrease in surface roughness In order to find the conditions favoring the improvement in the product quality and to decrease the cutting time, experiments are conducted by varying process parameters such as thickness ,abrasive flow rate, water pressure, standoff distance and considering abrasive size and nozzle diameter as constant.

Later an empirical model is developed for the prediction of material removal rate and surface roughness for Aluminium AA 6061 by using regression analysis. The model is verified with experimental results that reveals high applicability of the model within the experimental range. Finally the process parameters are optimized to achieve the targets such as Maximization of MRR and minimization of Surface.

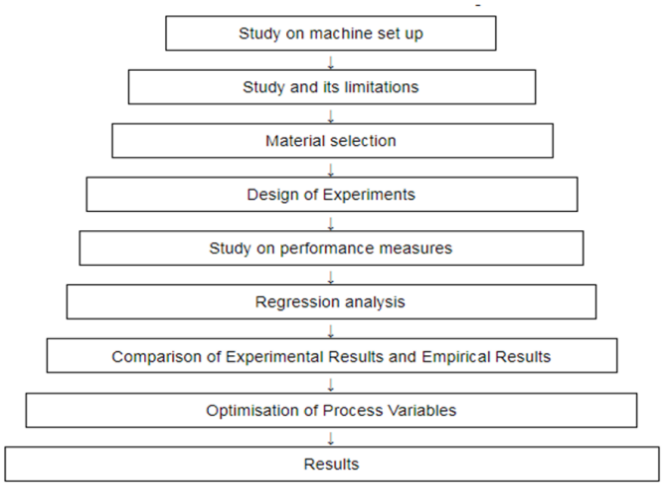


Fig. 1. Methodology

4. Experimental Procedure

The experiments were conducted on a AQUAJET MACHINE TOOL G3020 shown in figure 2. Abrasive water jet cutting machine equipped with an ultrahigh pressure pump of 4100 bar/60000 PSI.as shown in the figure. a pneumatically controlled valve and a workpiece table with dimensions of 3000 mm x2000 mm. A 0.35 mm diameter sapphire orifice was used to transform high pressure water into a collimated jet with a carbide nozzle of 0.76 mm diameter to form an abrasive water jet. Throughout the experiments, the nozzle is frequently checked and is replaced with a new one whenever the nozzle was worn out significantly. The abrasives used were 80 mesh garnet particles with the average diameter of 0.18 mm and density of 4100 kg/m^3 .The abrasives were delivered using compressed air from a hopper to the mixing chamber and were regulated using a metering disc. The standoff distance within the range of 2-3 mm is controlled through the controller in the operator control stand. Abrasive flow rate is controlled in system settings. The debris of material and the slurry were collected into a catcher tank. Cutting is performed on aluminum slabs of different thicknesses 20 mm ,40 mm and 60 mm. The constant process parameters are shown in table 1.

Fig. 2. AQUAJET MACHINE TOOL G3020

Constant parameters	Nozzle diameter	tandoff distance	Abrasive type	brasive size (grit no)
Value	0.20 mm	3 mm	GMT garnet	80 mesh

Table 1. Constant parameters and their values.

Four variable process parameters have been selected for the present study shown in table 2. Selection of a particular orthogonal array from all the standard OA depends on the number of factors, levels of each factor and orthogonal array was selected using Taguchi technique. L9 OA is selected and Experimentation is done, the samples are shown in Fig.3 a

level	Variable parameters(factors)			
	Traverse speed (mm/rev)	Abrasive mass flow rate(kg/min)	Pressure (bar)	hickness nm))
L1	30	0.3	2500	20
L2	40	0.4	3000	40
L3	50	0.5	3500	60

Table 2. Variable parameters and their values

Performance measure has been the surface roughness. Surface roughness on the cut surface was measured in terms of the average roughness *Ra*, using the TIME3220 instrument; see Fig.3 b.

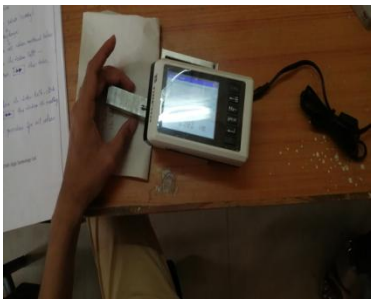
a)  b) 

Fig. 3. (a) AA 6061 samples cut in AQUAJET AWJM b) The measurement of surface roughness.

5. Results and discussions

In this section, the effect of the process parameters such as: traverse speed, abrasive mass flow rate and material thickness and pressure on the surface roughness and MRR during AWJ cutting of aluminum plate is analyzed by using Minitab 19 Software. Experimental results of AA 6061 are shown in Table 3.

Experiment No.	MRR (g/sec)	Surface Finish (micrometers)
1	0.009699	6.393
2	0.004878	6.886
3	0.006469	7.128
4	0.015550	4.979
5	0.012709	5.368
6	0.007755	6.490
7	0.024796	5.364
8	0.021149	7.658
9	0.013383	10.080

Table 3. Experimental results (MRR & SR) on Aluminum 6061

5.1 The effect of the variable parameters on the MRR

The following observations were shown in the figure 4 Variation of MRR with process parameters. As thickness increases, time taken to cut the samples increases therefore the material removal rate has been increased. As the jet pressure increases, material removal rate are also increasing because cutting time is decreasing at each interval. With increase in jet pressure, brittle abrasives break down into smaller ones and remove the material faster. Initial run of 0.3 kg/min is found to be optimum from the observations and as the Abrasive flow rate increases, MRR reaches its peak for AA 6061 samples. Feed rate increases from 30 mm/rev to 40 mm/rev which leads to increasing the material removal rate due to the enough gap between the tool and work piece. After that feed rate was further increased to 50 mm/rev, MRR decreased due to the increase in thickness and decrease in water jet pressure.

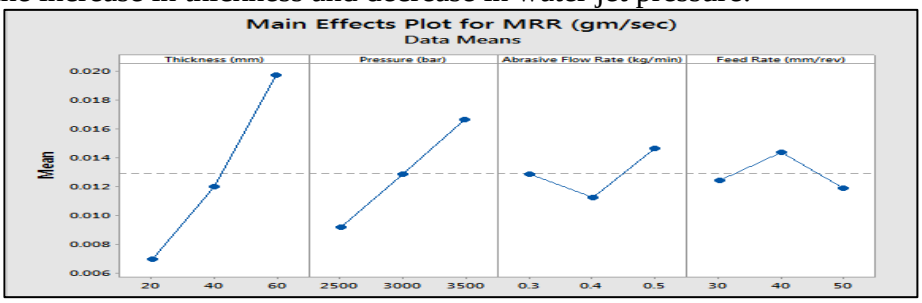


Figure 4 Variation of MRR with process parameters

5.2 The effect of the variable parameters on the surface roughness

The following observations were made shown in the figure 5 Variation of SR with process parameters Initially surface roughness is observed very minimum, when thickness is increased from 20mm to 40mm,which increases surface roughness then after, when it reaches to 60mm the maximum surface roughness is observed of AA 6061 samples. As the jet pressure increases, the surface becomes smoother due to an increase in jet pressure, the kinetic energy of the particles increases which results in a smoother machined surface. The surface roughness increases from optimum to maximum at the

increase of abrasive flow rate from 0.3 Kg/min to 0.4 Kg/min. surface roughness increases with increased feed rate because of the rapid movement of tools.

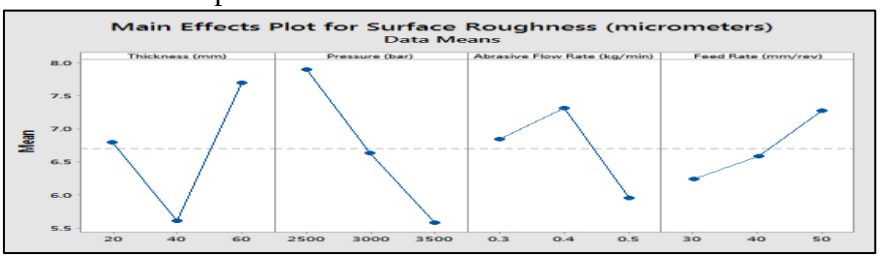
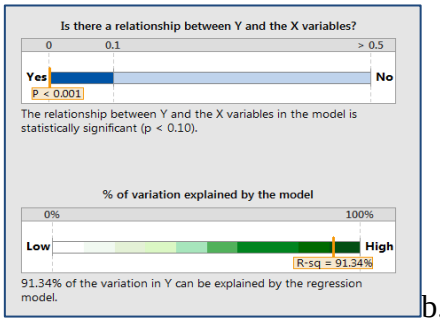


Figure 5. Variation of SR with process parameters

In the next stage multiple regression analysis is done and Fitness variations for responses are generated. Fitness variation for Material removal rate of AA 6061 is shown in Figure 6,a and 6b it shows that fitness measures for MRR and SR are good with a value of 0.9134 and SR is with a value of 0.42. This shows that the models can explain the variation in MRR up to the extent of 91.34%. and S.R 42.03%. On the basis of the high values of R-squared, it can be said that the models are adequate in representing the process.

a.) 

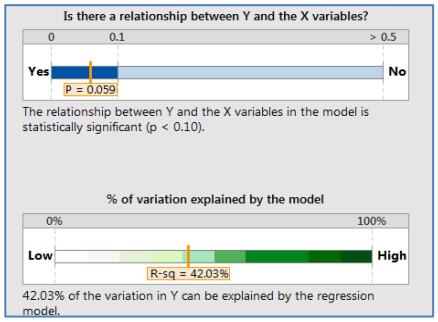
b.) 

Fig. 6. (a) Fitness variation for MRR b) Fitness variation forSR

The regression model generated for MRR and SR are given below

MRR (gm/sec) = -0.02476 + 0.000319 Thickness (mm) + 0.000007 Pressure (bar) + 0.0090 Abrasive Flow Rate (kg/min) - 0.000027 Feed Rate (mm/rev) — (1)

SR(micrometers) = 12.49 + 0.0225 Thickness (mm) - 0.00232 Pressure (bar) - 4.47 Abrasive Flow Rate (kg/min) + 0.0517 Feed Rate (mm/rev) — (2)

The above model is valid for the operating parameters in the following range for practical purposes and machine limitations.

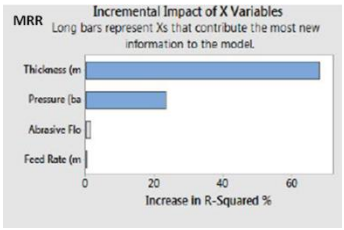
Water pressure: $2500 \leq P \leq 3500$ bar

Abrasive mass flow rate: $0.3 \leq ma \leq 0.5$ Kg/min

Feed rate: $30 \leq Vc \leq 50$ mm/rev

Thickness: $20 \leq t \leq 60$ mm

Incremental impact of variables on MRR and SR are also studied to know about which variable plays most significant role. Figure 7a shows that feed rate and abrasive rate are insignificant, pressure and thickness plays prominent role to enhance MRR. Figure 7b shows while increasing jet pressure which influences better surface finish is obtained by considering sufficient feed rate is maintained

a) 

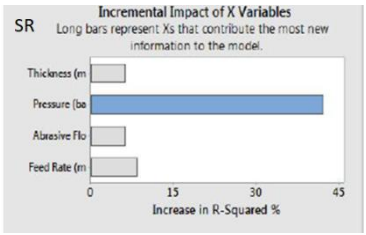
b) 

Fig. 7. (a) Incremental impact of variables on MRR b) Incremental impact of variables on SR

5.3 Maximization of MRR and Minimization of SR

Single objective optimization is done in MINITAB 19 based on the regression equation (1). MRR is maximized at 95% confidence level, the predicted value is 0.023052 gm/sec a t pressure 3500 bar, and thickness 60 mm shown in figure 8 a

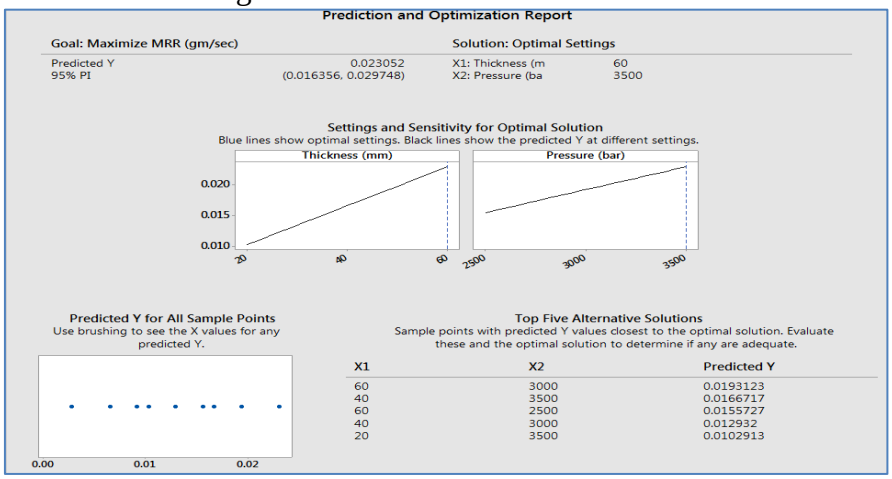


Fig.8. (a) Prediction and optimization report on MRR

Based on regression model (2) SR is minimized at 95% confidence level, the predicted value is 5.54478 µm at Pressure 3500 bar shown in figure 8 b.

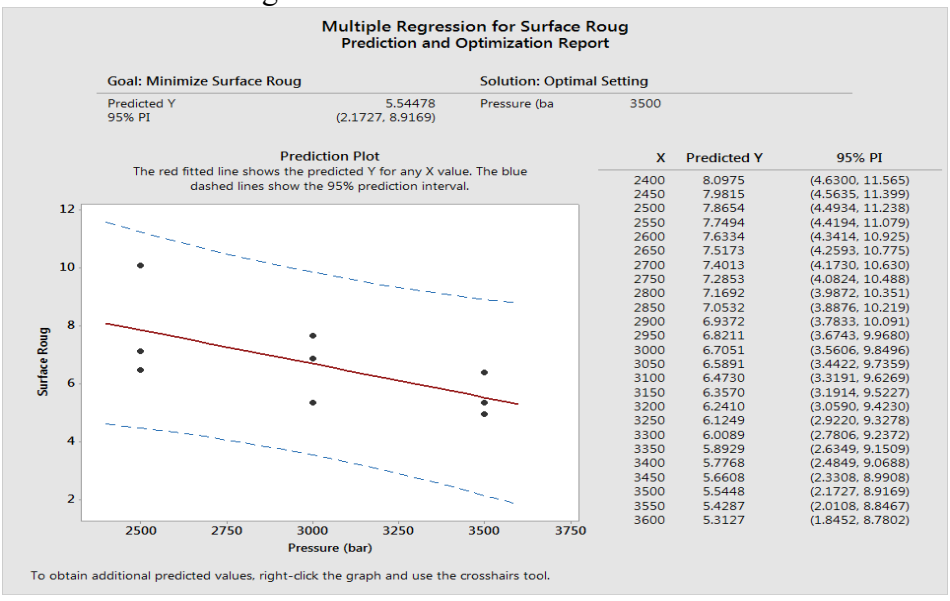
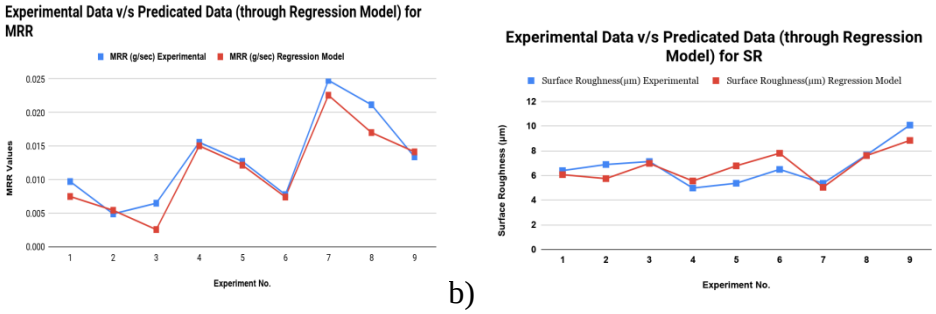


Fig. 8. (b) Prediction and optimization report on SR

Validation of Experimental values versus predicted values is plotted in a graph and figure 9 a and 9 b no high differences or errors are seen .These indicate that the developed models satisfactorily represent the outputs.



a) b)

Fig. 9. (a) Validation chart on MRR b) Validation chart on SR

Conclusions

1. The Maximum value of MRR is 0.023052 gm/sec at pressure 3500 bar, and thickness 60 mm. Abrasive flow rate and Feed rate are the least influential parameters as they have insignificant impact on MRR.
2. The Minimum value of SR is 5.54478 µm at Pressure 3500 bar .Thickness, Abrasive flow rate and Feed rate are the least influential parameters as they have insignificant impact on SR .
3. The optimal values obtained by the proposed methodology could serve as a ready-reckoner to operate the specific machine with great ease to achieve the quality and the production rate as demanded by the consumers

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Design and Analysis of Fan Blade with Dual Natural Fibers and Al 7075

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***Abstract*— Fan blades are one among the foremost common engineering parts which are employed by everyone in day to day life. The increasing energy and decreasing efficiency in the present and future generations of Industries have become the major issues. This can be achieved by minimizing the weight and increasing the efficiency of the fan blades. In this work, the design and analysis of fan blade which is made up of natural fibers (hemp fiber and basalt rock fiber) is carried out, and also a complete comparison of aluminium alloy 7075 and the blades made of natural fibers is achieved. The design of the fan blade is modeled in Solidworks 2016 and converted it into IGS format. The analysis of different materials is carried out using Ansys 2021 in which static analysis, fatigue analysis and model analysis were done. Through Static, Fatigue and Modal analysis of the materials, The Basalt rock fiber has shown better results than Aluminium alloy 7075 and Hemp fiber.**

***Keywords*— *Efficiency, Fan blade, Fiber, Material* .**

I. INTRODUCTION

The ceiling fan has become a crucial appliance for domestic also as industrial purposes. As we knew that power consumed by the fans is less but as fans run continuously with minor breaks they consume a lot of power which leads to a high power consumption. Having low consumption of power with low weight and effective utilization of natural recourses is the main target of the electrical appliances companies these days. The mentioned goal can be achieved by implementing a better design, material, and manufacturing process. In spite of many benefits of Aluminium Alloy 7075, there are some limits mainly good strength to weight ratio, lower resistance to corrosion, higher cost etc. To replace Aluminium alloy 7075 we can use composite materials which can also contain natural fibers, where the directions of fibers affect the properties of the composite material. Natural Fibers have similar properties as Aluminium alloy 7075 and is also good in strength to weight ratio. The work on this project is to focuses on dual natural fibers that are hemp fiber and basalt rock fiber.

II. LITERATURE SURVEY

Sanjay M R et.al. [1]. This study proposes a definite review of the various sorts of retting measures, chemical and surface treatments and portrayal strategies for regular fibers. The following review talks about the reason for natural fiber and its potential, Advantages and burdens of utilizing a natural fiber, Extraction techniques: dew retting and water retting process, chemical treatment: by utilizing a synthetic treatment on the natural fibers permits lessening its strands hydrophilic components, Surface treatment:The natural fibers require some surface chemicals to work on its surface performance. Characterisation method:This area is devoted to presents the most valuable portrayal techniques for the natural fibers. The characterisation strategies are exceptionally fundamental to choose the natural fibers appropriate as support for polymer composites.

Priyanka Dhurvey et.al. [2]. Complete examination of ceiling fan is accomplished for four distinct cutting edge materials. Underlying examination and optimal design investigation is finished utilizing ANSYS programming. COP examination is finished utilizing MATLAB Program and weight and power utilization examination is additionally presented.From the outcomes gotten from the current work, it can reason that the ceiling fan having sharp edges of PVC material outcomes in higher COP than the cutting edge of other material inside the scope of speed. Fan having sharp edges of PVC material is able to do reduce the force utilization than different sharp edges prompting higher effectiveness of fan and is energy saving.

Swaroop M P et.al. [3]. From the investigation that they have led, it very well may be seen that there is absolutely an impact on wind stream as the sharp edge point changes. What struck them the most is that the speed of air which gets through the power source continues to increment up to a specific sharp edge point and afterward the speed diminishes after the ideal cutting edge point is reached. From 4 unique examinations that they have directed, they have discovered the best cutting edge point to be at 8 degrees.

S Prabhakaran et.al. [4]. In this task the composite cutting edge has been planned and manufactured. This composite cutting edge has more strength over existing fan edge. The current fan cutting edge weighs about 295grams while the heaviness of composite fan edge is 215grams, which is 28% lesser than existing edge. It is tried that the force devoured by the current sharp edge (0.052units) is more when contrasted with composite blade(0.037units). So when we utilize composite fan implies we can decrease 30% of force devoured by the current roof fan. Cost of composite roof fan cutting edge is Rs. 279/ - which is 44% not exactly existing aluminum cutting edge. The strength of the composite cutting edge additionally high when we contrasted and aluminum sharp edge. From the review, it is presumed that fiber built up plastic material is an appropriate material for assembling the composite roof fan cutting edge.

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Junjie Zhou et.al. [5]. The outcomes show that R40 pivotal stream fan runs stable under resounding working conditions, reverberation doesn't happen; the bigger turn speed can expand the regular frequencies of cutting edge; the edge has the greatest reaction of the thrilling power at 120Hz.

A. Shaniavski [6]. Air consumption has harms just from bombed fan cutting edges parts. There were no hints of any unfamiliar articles which might enter the air admission in flight and cause its failing and upset a motor activity. A deficiency of air admission in flight was brought about by disappointment of the multitude of screws which attach air admission to motor due to extremely high energy of flying pieces of broken fan edges.

Ebrahim Mustafa et.al. [7]. Four distinctive harmony length and five curving point of their sharp edges were examined. The fan was planned by utilizing NACA 5505 series. The primary examination is directed to the sharp edge plan in the variety of harmony length

Santosh Kumar Dahare1 et.al. [8]. In this plan of fan edge, material changed over from existing aluminum into Nylon66. Fan sharp edge plan strategy for an ideal outcome as indicated by FEM hypothesis is performed.

A. Summary

From the above literature review we can say that:

- Less measure of work is accomplished For Vibration Analysis of fan edge.
- Less consideration is given to the Resonance and normal Frequencies of Fan Blade
- Most of the review in the field of fan edge is led for primary disappointment of the fan edge configuration utilizing FEA.

III. PROBLEM DEFINITION AND OBJECTIVES

A. Problem Definition

The Fan blade have been the most common engineering part which are used by everyone in everyday life. The increasing population and technology have made the use of fan blade a priority and the fan blades used today. The high energy consumption and decreasing efficiency in the present and future generations of Industries have become the major issues. This can be addressed by minimizing the weight and increasing the efficiency of the fan blades. So, The main aim of this project would be get a best material which will save energy and have higher efficiency.

B. Objective of the Work

- Replacement of Aluminium Alloy 7075 with Natural fibers
- Calculating the properties of Aluminium Alloy 7075 and Natural fibers
- Testing whether Natural Fibers are better Aluminium Alloy 7075.

IV. METHODOLOGY

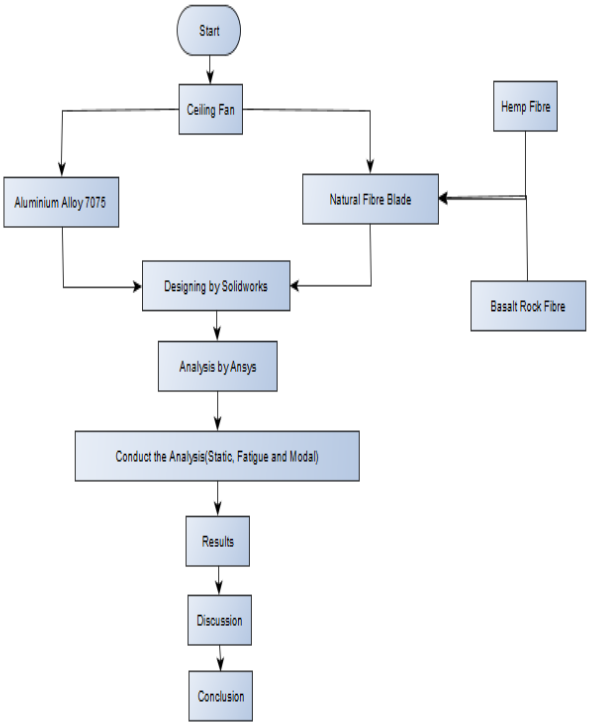

Fig. 1 Methodology

A. Materials

1) Aluminium Alloy 7075: The 7000 sequence aluminium alloys are functional in a many applications. The low weight and robustness character of grade 7075 are cherished very much by manufacturers and end users. As a physically powerful machinable aluminium alloy, it is highly used in the aerospace industries, aircraft and automotive.

2) Hemp Fiber: Benefits of hemp is that, it can be full-grown without chemicals, it gives extensive fibers and it is fastest growing plant on the earth. The scientific name of the hemp is cannabis sativa.

3) Uses of hemp: The 7000 sequence aluminium alloys are functional in a many applications. The low weight and robustness character of grade 7075 are cherished very much by manufacturers and end users. As a physically powerful machinable aluminium alloy, it is highly used in the aerospace industries, aircraft and automotive.

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Fig. 2 Hemp Fiber

4) Basalt Fiber: Basalt is an igneous rock formed by rapid cooling of lava from volcano. Crushed basalt rocks is used a raw material for manufacturing basalt fibers. Basalt fiber has a wider temperature range from -4520F to 12000F. when compared to carbon and armored fiber it has a higher oxidation resistance, higher compression strength, higher shear strength and higher radiation resistance. It has excellent shock resistance and can be used for ballistic purposes. Good fatigue and corrosion resistance. Easy to handle, environmentally friendly and can be recyclable. The chemical components include SiO2, Al2O3, CaO, MgO, Na2O + K2O, TiO2, Fe2O3 + FeO etc. The products on basalt fiber include basalt cloth, roving and yarn, chopped strands, needled felts and georgics.

The sequence of operations of basalt fiber includes:

- Melting of basalt breads into basalt melt
- Homogenization of basalt melt and its preparation for production
- Forming of basalt melt through a platinum alloy bushing assembly
- Extraction of initial fiber, lubrication and winding on bobbins.

B. *Properties of Materials*

TABLE I. PROPERTIES OF DIFFERENT NATURAL FIBERS

Properties	***Hemp fiber***	***Basalt rock fiber***	***Aluminium alloy 7075***
Tensile Strength (Mpa)	250	300	450
Young's Modulus (Gpa)	70	110	71.7
Density (g/cc)	1.447	2.7	2.8

a. *Modeled Using Solid Works*

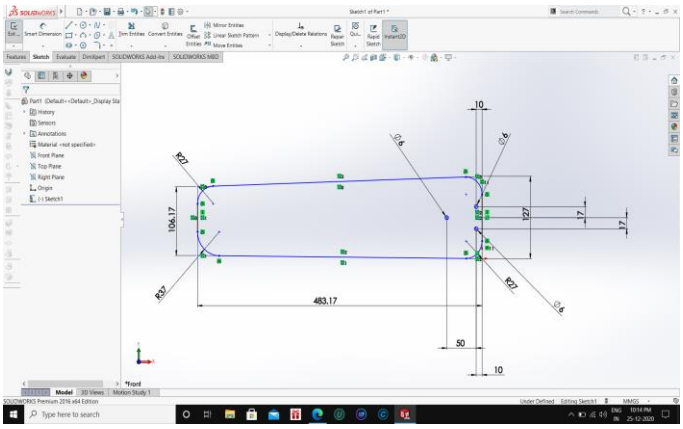

Fig. 3 2D Diagram of Fan Parts – Ceiling Fan Blade

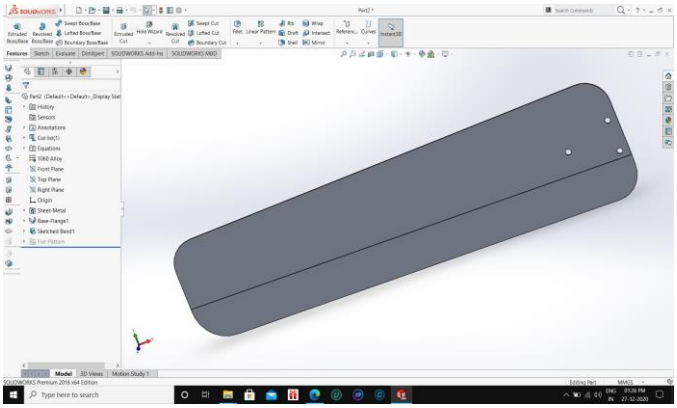

Fig. 4 3D Diagram of Fan Parts – Ceiling Fan Blade

TABLE II. DIMENSIONS – CEILING FAN BLADE

Geometric Attribute	***Dimension***
Fan Blade Length	483.17 mm
Fan Blade Thickness	0.8 mm
Fan Blade Bend Angle	10^{0}
Fan Blade Punch Hole Radius	6 mm
Fan Blade Tip Width	106.17 mm
Fan Blade Root Width	127 mm

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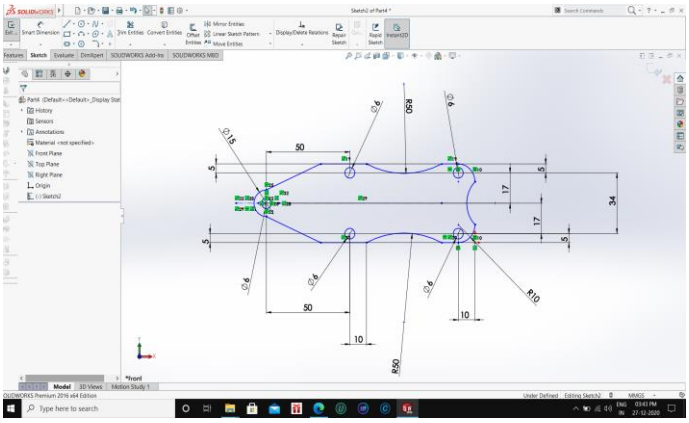

Fig. 5 2D Diagram of Fan Parts - Ceiling Fan Blade Shank

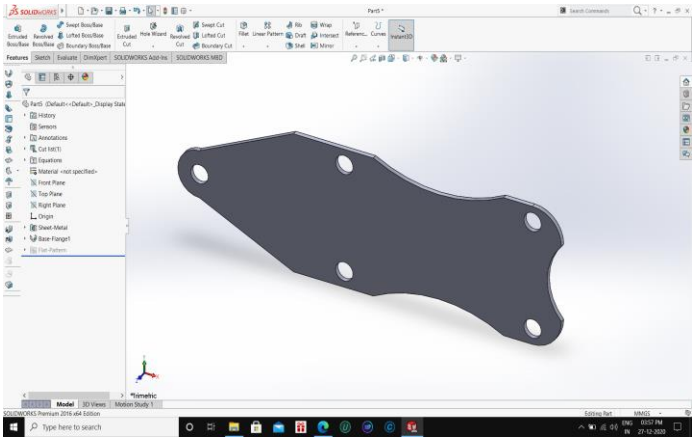

Fig. 6 3D Diagram of Fan Parts – Shank

TABLE III. DIMENSIONS – CEILING FAN BLADE SHANK

Geometric Attribute	*Dimension*
Shank Length	132.50 mm
Shank Width	44 mm
Punch Hole Radius	6 mm
Shank Thickness	1.5 mm

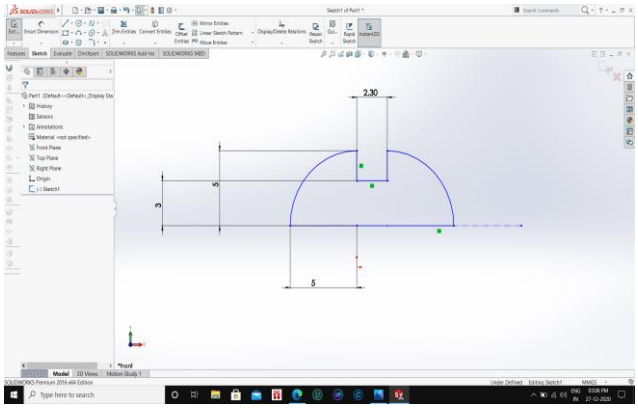

Fig. 7 2D Diagram of Fan Parts – Rivet

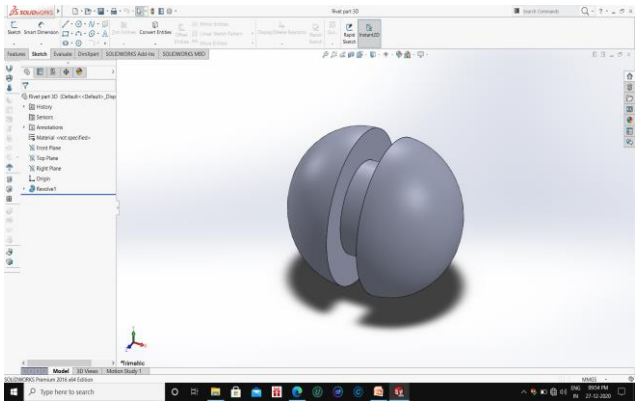

Fig. 8 3D Diagram of Fan Parts – Rivet

TABLE IV. DIMENSIONS – RIVET

Geometric Attribute	*Dimension*
Rivet Diameter	6 mm
Rivet Grip Range	2.30 mm

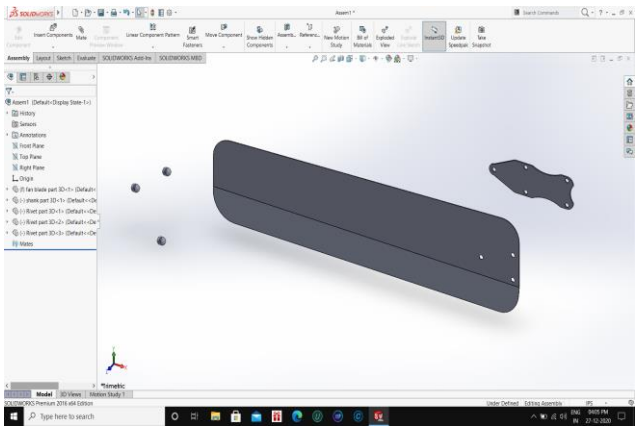

Fig. 9 Assembly of all parts

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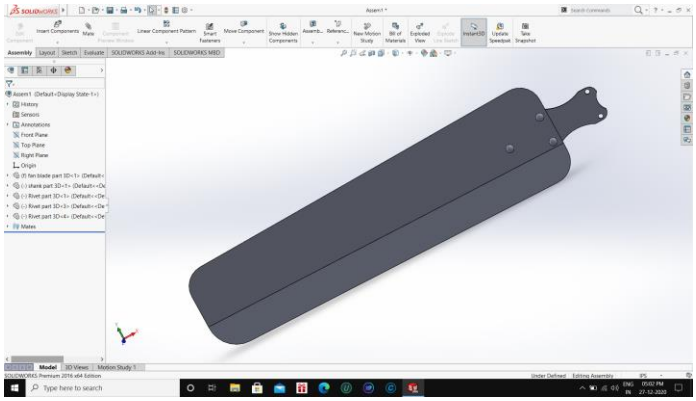

Fig. 10 Assembly of all parts

C. Static Analysis Of Fan Blade

1) Material: Aluminium Alloy

a. Total deformation

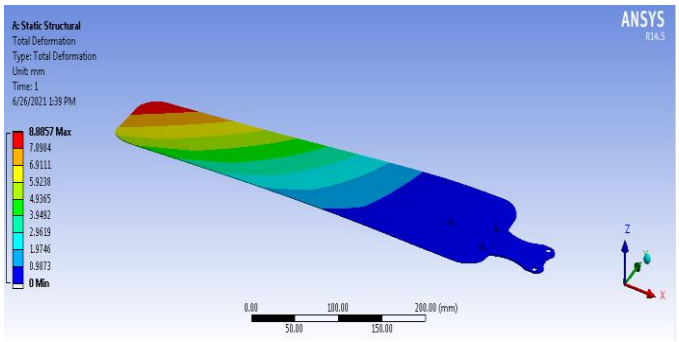

Fig. 11 Total deformation of Aluminium Alloy

b. Stress

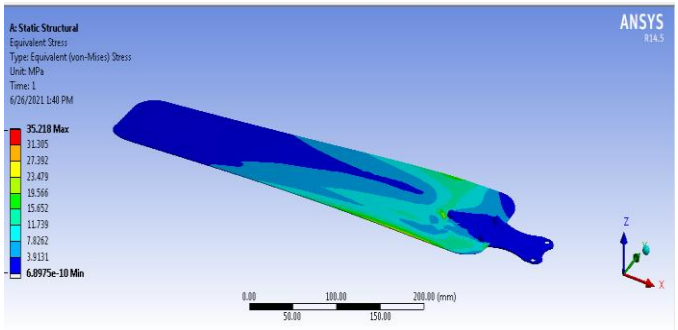

Fig. 12 Stress of Aluminium Alloy

c. Strain

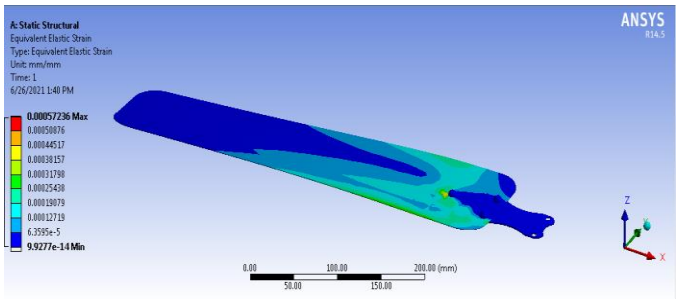

Fig. 13 Strain of Aluminium Alloy

2) Material: Hemp Fiber

a. Total deformation

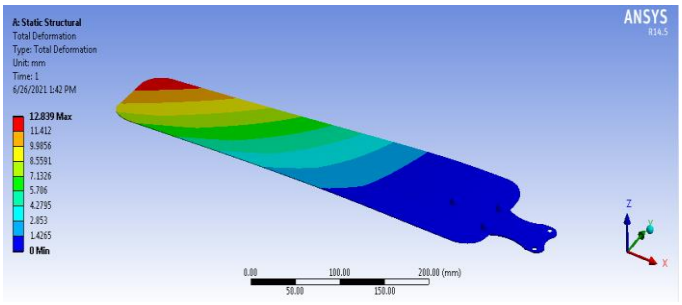

Fig. 14 Total deformation of Hemp Fiber

b. Stress

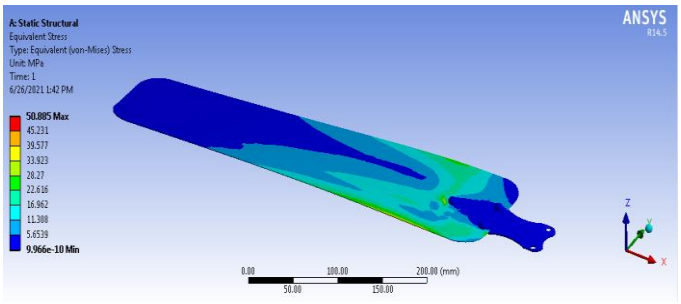

Fig. 15 Stress of Hemp Fiber

c. Strain

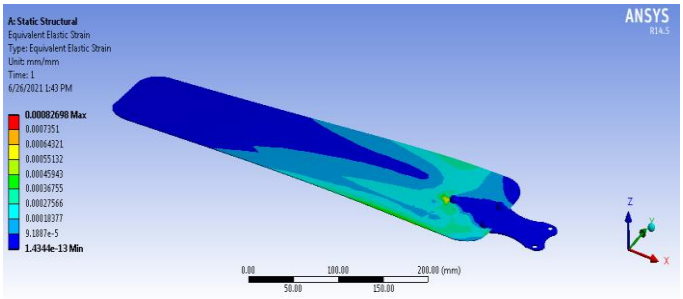

Fig. 16 Strain of Hemp Fiber

3) Material: Basalt Rock Fiber

a. Total deformation

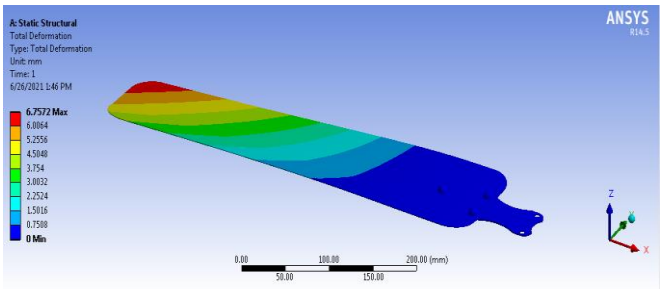

Fig. 17 Total deformation of Basalt Rock Fiber

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b. Stress

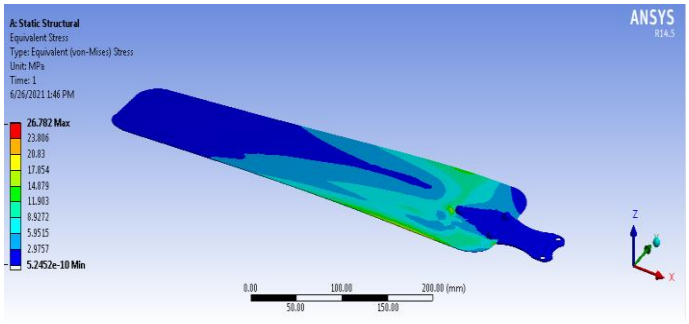

Fig. 18 Stress of Basalt Rock Fiber

c. Strain

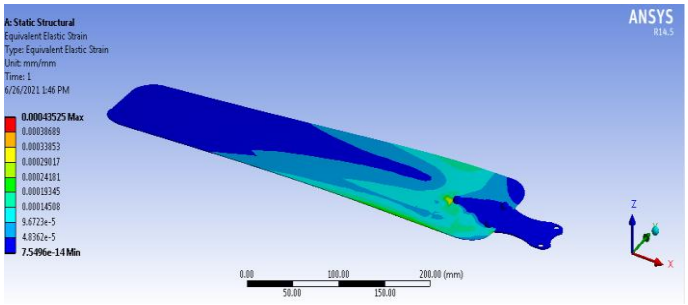

Fig. 19 Strain of Basalt Rock Fiber

D. Fatigue Analysis Of Fan Blade

1) Material: Aluminium Alloy

a. Life

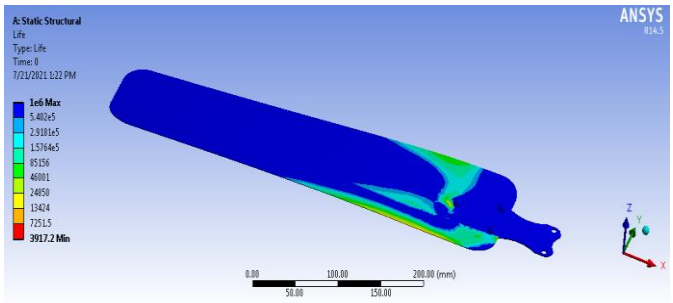

Fig. 20 Life of Aluminium Alloy

b. Damage

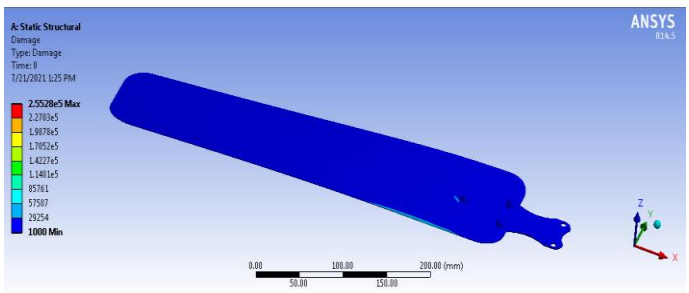

Fig. 21 Damage of Aluminium Alloy

c. Safety Factor

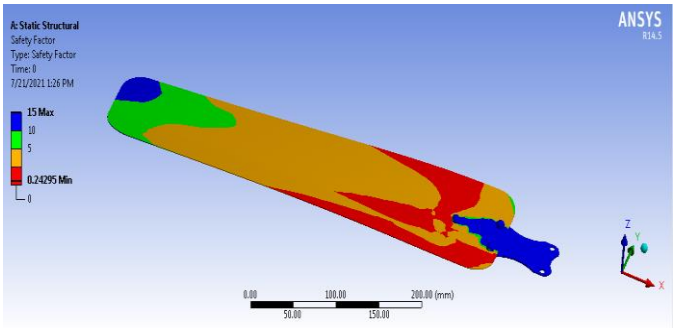

Fig. 22 Safety Factor of Aluminium Alloy

2) Material –Hemp Fiber

a. Life

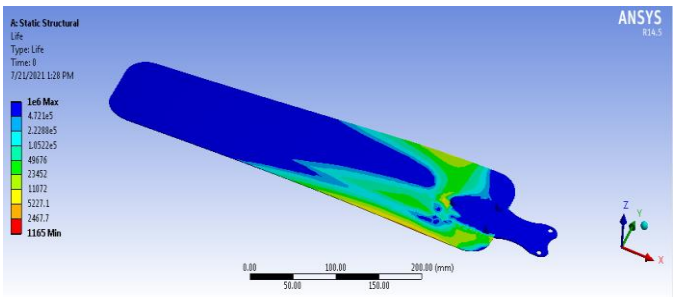

Fig. 23 Life of Hemp Fiber

b. Damage

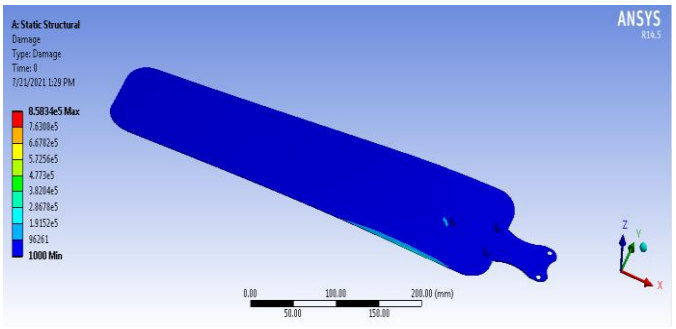

Fig. 24 Damage of Hemp Fiber

c. Safety Factor

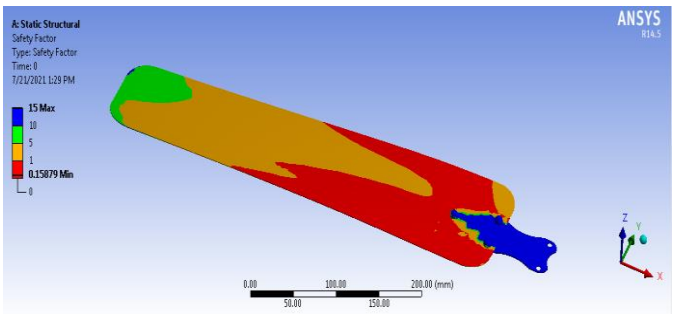

Fig. 25 Safety Factor of Hemp Fiber

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3) Material: Aluminium Alloy

a. Life

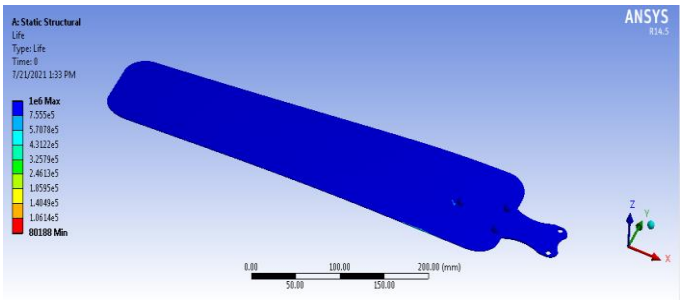

Fig. 26 Life of Basalt Rock Fiber

b. Damage

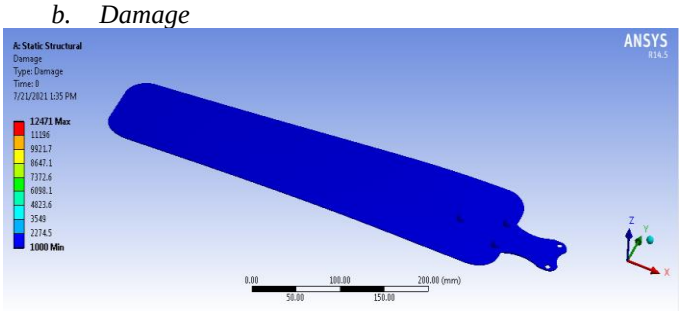

Fig. 27 Damage of Basalt Rock Fiber

c. Safety Factor

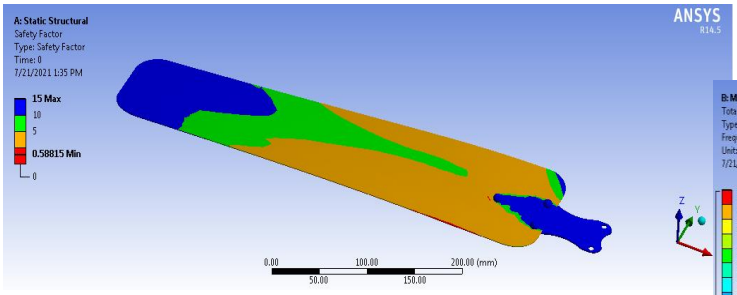

Fig. 28 Safety Factor of Basalt Rock Fiber

E. Modal Analysis of Fan Blade:

1) Material: Aluminium Alloy

a. Total deformation 1

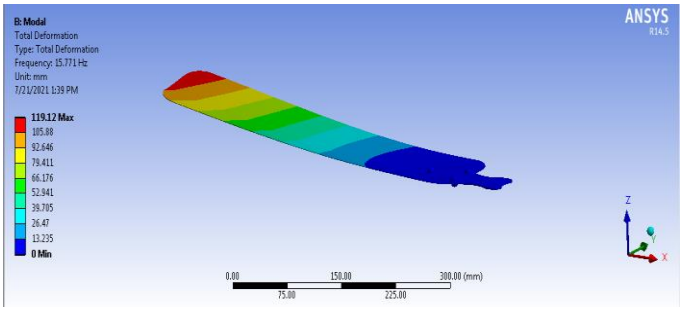

Fig. 29 Total deformation 1 of Aluminium Alloy

b. Total deformation 2

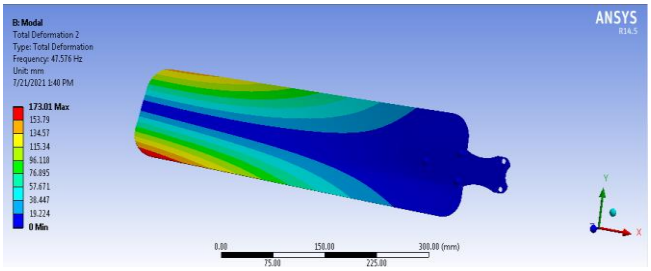

Fig. 30 Total deformation 2 of Aluminium Alloy

c. Total deformation 3

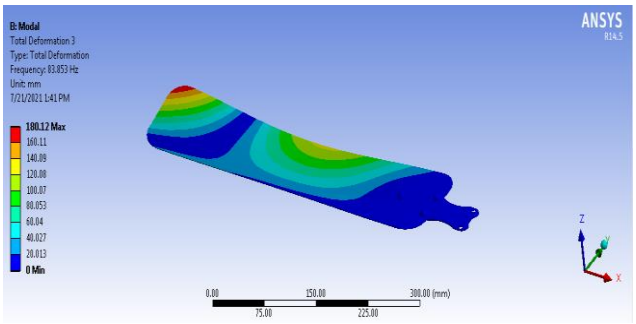

Fig. 31 Total deformation 3 of Aluminium Alloy

2) Material –Hemp Fiber

a. Total deformation 1

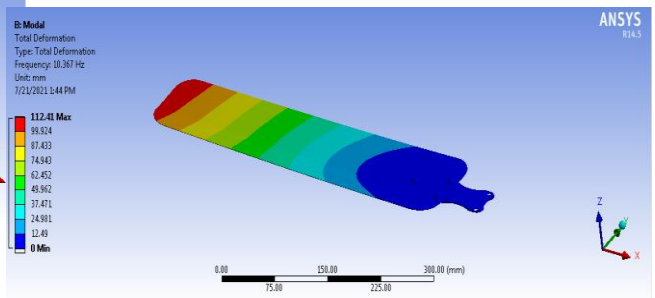

Fig. 32 Total deformation 1 of Hemp Fiber

b. Total deformation 2

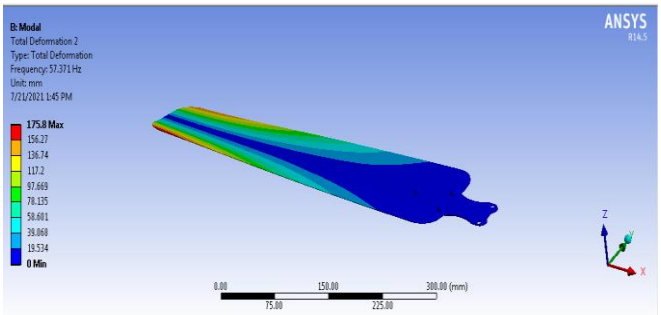

Fig. 33 Total deformation 2 of Hemp Fiber

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c. Total deformation 3

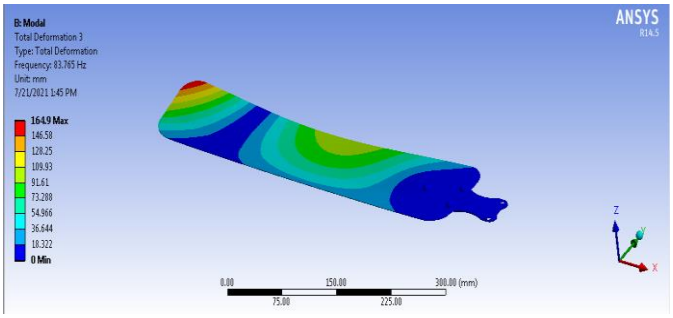

Fig. 34 Total deformation 3 of Hemp Fiber

3) Material –Basalt Rock Fiber

a. Total deformation 1

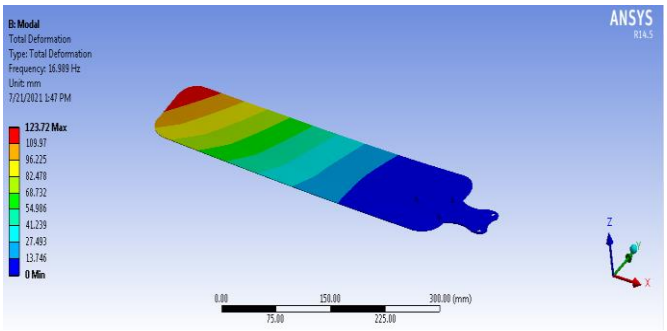

Fig. 35 Total deformation 1 of Basalt Rock Fiber

b. Total deformation 2

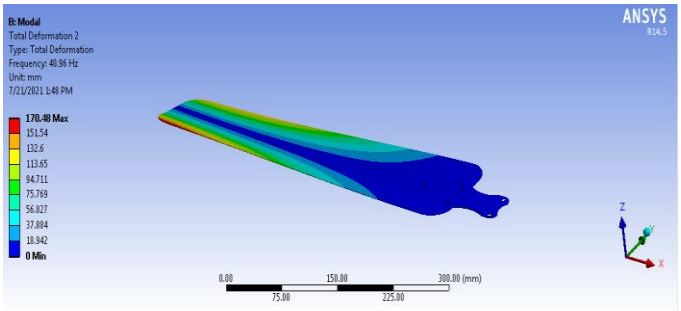

Fig. 36 Total deformation 2 of Basalt Rock Fiber

c. Total deformation 3

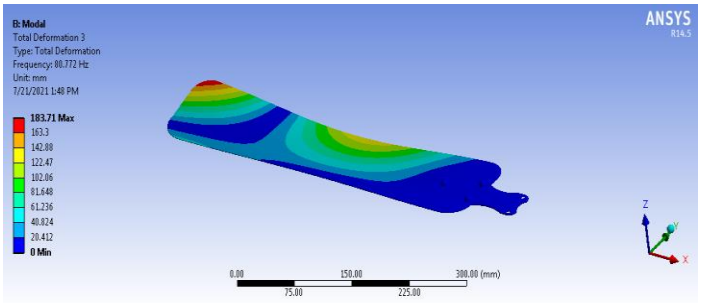

Fig. 37 Total deformation 3 of Basalt Rock Fiber

V. RESULTS

Static, Fatigue and Modal analysis were performed and the results are given in Table 5, Table 6 and Table 7.

TABLE V. STATIC ANALYSIS RESULTS

Materials	*Total Deformation (mm)*	*Stress (N/mm^2)*	*Strain*
Aluminium alloy 7075	8.8857	35.218	0.00057236
Hemp fiber	12.839	50.885	0.00082698
Basalt rock fiber	6.7572	26.782	0.00043525

TABLE VI. FATIGUE ANALYSIS RESULTS

Materials	*Damage*	*Safety factor*
Aluminium alloy 7075	2.5585e+05	0.24295
Hemp fiber	8.5834e+05	0.15879
Basalt rock fiber	1.2472e+04	0.58814

TABLE VII. MODAL ANALYSIS RESULTS

Materials	*Mode1*	*Frequency*	*Mode2*	*Frequency*	*Mode3*	*Frequency*
Aluminium alloy 7075	119.12	15.771	173.01	47.576	180.12	83.853
Hemp fiber	112.41	10.367	175.8	57.371	164.9	83.765
Basalt rock fiber	123.72	16.989	170.48	40.96	183.71	80.772

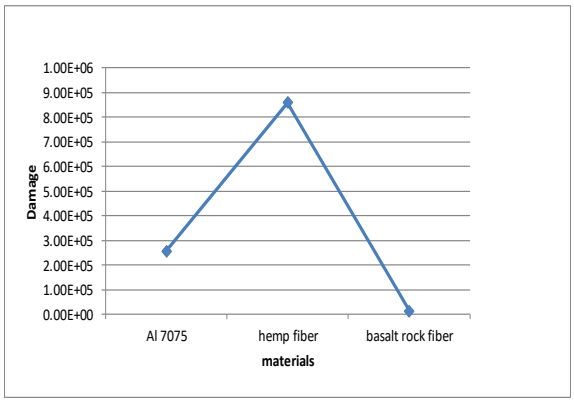

Fig. 38 Materials Vs Damage

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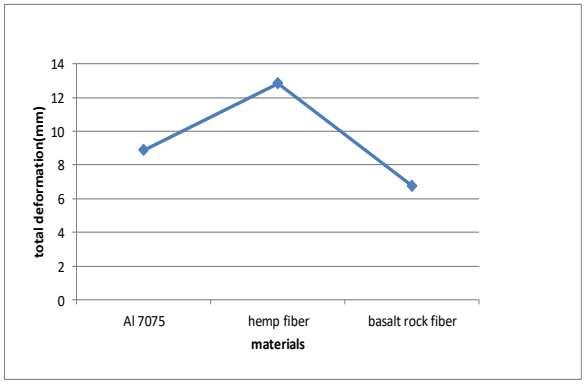

Fig. 39 Materials Vs Deformation

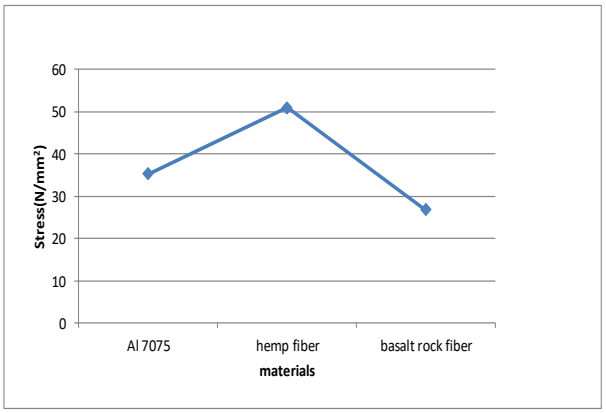

Fig. 40 Materials Vs Stress

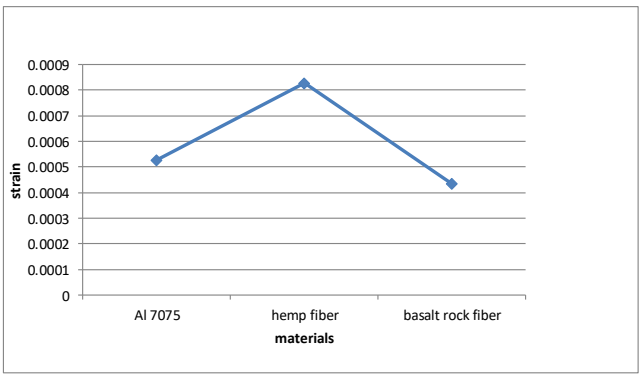

Fig. 41 Materials Vs Strain

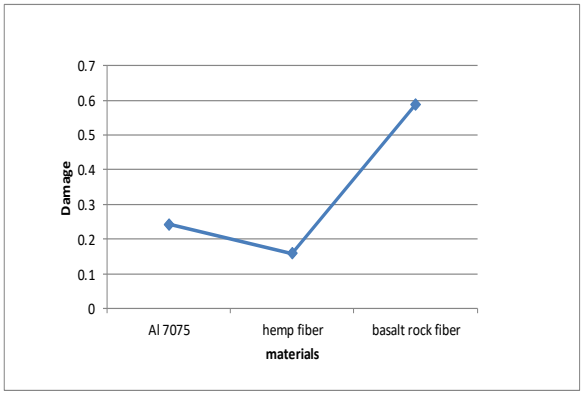

Fig. 42 Materials Vs Safety factor

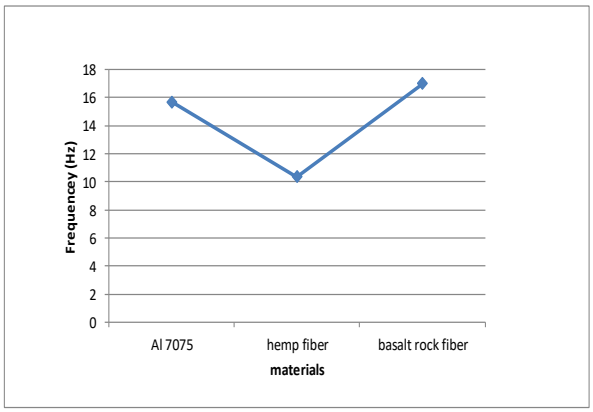

Fig. 43 Materials Vs Frequency

VI. CONCLUSION

Through Static, Fatigue and Modal analysis of the materials, when comparing the stresses at Basalt fiber to aluminum alloy and hemp, the static analysis findings show that the stresses at Basalt fiber are lower. When comparing aluminum alloy and hemp fiber to the findings of the Fatigue analysis, the safety factor for Basalt fiber is the highest.

From the above experiment we have obtained the following results:

Total Deformation (mm):

Basalt fiber(6.7572 mm) > Aluminium Alloy 7075(8.8857 mm) > Hemp Fiber(12.839 mm)

Stress (N/mm2):

Basalt fiber(26.782 N/mm2) > Aluminium Alloy 7075(35.218 N/mm2) > Hemp Fiber(50.885 N/mm2)

Strain:

Basalt fiber(0.00043525) > Aluminium Alloy 7075(0.00057236) > Hemp Fiber(0.00082698)

Damage:

Basalt fiber(1.2472e+04) > Aluminium Alloy 7075(2.5585e+05) > Hemp Fiber(8.5834e+05)

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Safety Factor:

Basalt fiber(0.58814) > Aluminium Alloy 7075(0.24295) > Hemp Fiber(0.15879)

In modal analysis by comparison of Model-1, Model-2 and Model-3:

Basalt fiber> Aluminium Alloy 7075> Hemp Fiber

From the results we can conclude that the Basalt rock fiber has shown better results than Aluminium alloy 7075 and Hemp fiber. Basalt rock fiber gives better efficiency and can be obtained at low cost. Due to its light weight property the consumption of energy will also be decrease.

VII. FUTURE SCOPE

The further extension of this project would be to make a composition of the natural fibers by using the data of this project, which can suit our environment and replace the materials used now.

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Computational Fluid Dynamics in Coronary and Intra-Cardiac Flow Simulation

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***Abstract*: Computational fluid dynamics (CFD) is a field of mechanical engineering for the analysis of fluid flows, heat transfer, and related phenomena, using computer simulations. CFD is a widely adopted methodology for solving complex problems in many areas of modern engineering. The merits of CFD are the development of new and improved equipment and system designs, and optimizations are performed on existing equipment through simulation, leading to increased efficiency and reduced costs.**
However, in the biomedical sector, CFD are still emerging. The main reason why CFD in the biomedical field lags behind is the enormous complexity in the workings of human body fluids. Recently, biomedical CFD research has become more accessible as high-performance hardware and software are readily available because of advances in computing. Every CFD process contains three main components that provide useful information, Pre-processing, formula resolution, and post-processing. Precise initial boundary conditions and geometric models are essential to obtain appropriate results. Medical imaging, like ultrasound imaging, computerized tomography, and resonance imaging can be used for modeling, and Doppler ultrasound, manometers, and non-invasive manometers are used for flow velocity and pressure as boundary conditions.
Many simulations and clinical outcomes are used to study congenital heart disease, coronary failure, ventricular function, aortic disease, arterial carotid, and intracranial cerebrovascular disease. With reduced hardware costs and faster computation times, researchers and healthcare professionals can use this reliable CFD tool to urge accurate results. A sensible and interdisciplinary approach is essential to performing these tasks. Open-ended collaboration between mechanical engineers and clinical and medical scientists is important. CFD is often an essential tool for understanding the pathophysiology of disease onset and progression, and for establishing and developing treatments within the cardiovascular field.
Keywords: Hydrodynamics; Viscosity; Cardiovascular diseases.

I. INTRODUCTION

The heart is fist-sized organ that pumps blood throughout the body. It's the first organ of the vascular system. The heart contains four main sections (chambers) fabricated from the muscle and powered by electrical impulses. The brain and nervous system direct the heart's function. The aorta is the main vessel through which oxygen-rich blood travels from the heart to the remainder of the body. It also delivers nutrients and hormones. These branches ensure that the nutrients reach the internal organs and the tissues.
The aorta is the primary source of oxygen and essential nutrients for several organs. An injury or disease can affect the blood flow and can increase many life-threatening diseases. These include aneurysm, internal bleeding, aortic dissection, renal disorder, stroke, attack, heart failure. Some conditions like congenital defects, genetic diseases and trauma, are difficult to forestall. But there are steps which can be taken to avoid other kinds of aortic diseases.

A. Coranary Artery Disease (CAD)

Coronary Artery Disease (CAD) is a heart disease, which is the major reason behind the death of round the world. This is often caused thanks to the narrowing of the aortic valve due to the build-up of plaque. This is often called atherosclerosis. CAD tends to develop when cholesterol builds up on the artery wall. If a chunk of plaque breaks off or rupture, platelets will cluster within the area in an attempt to repair in the blood vessel. This cluster can block the arteries and reduce or block blood flow, which might result in a coronary failure. An attack occurs when the heart muscle doesn't have enough blood or oxygen, when a clot develops from the plaque in one coronary arteries. This clot, if it's sufficiently large, can completely stop the availability of blood to the heart blood vessel. The explanation of coronary plaque relies not only on the formation and progression of atherosclerosis, but also on the vascular remodelling response. The local inflammatory response will simulate the formation of so-called vulnerable plaque, which is at risk of rupture with superimposed thrombus formation. Since the progression and development of vulnerable plaque is related to low wall shear stress and therefore the presence of expansive modeling, the measurement of those characteristics in vivo will enable risk stratification for the entire coronary circulation.

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II. METHODOLOGY

The project started by compiling preliminary research data on the topic from journals and research papers. In the literature review, the author focused studies on patient-specific computational fluid dynamics flow simulation. Once an adequate understanding of the steps and software required to perform the project is acquired, a preliminary model is made using the Sim Vascular software. The model is generated from a CT scan image, a patient-specific model. The required parameters are specified here. Once this step is completed, the model is generated. Then, simulation is performed on the model.

After the simulation is performed, the results are analysed. The flow simulation results were studied and verified with the available data. Here, the results are discussed afterward.

III.DATA ACQUISITION

A. Importing Data

- The coronary artery can be imaged using intravascular ultrasound, MRI, CTCA, CT scan.
- The image is used to construct a 2-D and 3-D model of the organ.
- The image acquired is in VTI format.
- The image is opened using “SimVascular” software.
- SimVascular is open source software that gives a medical image data segmentation for patient-specific blood flow simulation and analysis.

B. Path Planning

- Creating an anatomic model supported medical image data requires construction geometry of the region using image segmentation.
- SimVascular uses approximate vessel centrelines called Paths to spot anatomical regions of interest within the image volume.
- These paths are later employed by the segmentation tools to construct a model of vascular anatomy.

C. Segmentation

- This is an operation used to identify objects or structures within an image in an automated way.
- 2D segmentation method has been incorporated in SimVascular.
- To create a 3D model from 3D imaging data, we generate a group of 2D segmentation along a given path.
- These 2D segmentations are often stitched together to create a 3D model.

D. Model Generation

- The solid model is employed as geometric representation of the volume of vascular anatomy.
- It’s created by joining together vessel surfaces fitted to a group of 2D segmentations.
- A solid model provides the data needed to generate a finite element volumetric mesh.
- The lofted surface created from groups of 2D segmentations is converted to a solid model.

E. Meshing

- The continuous volume enclosed by a solid model is divided into discrete tetrahedral elements using mesh generation software.
- A good mesh is integral to finite element simulation techniques.
- It enables a computer to numerically solve the governing equation and simulate the results.
- The mesh quality determines the accuracy, convergence and speed of the simulation process.
- Meshes are mainly of two types, they are

1) Surface Mesh

- A surface mesh uses 2D elements, which are typically triangles or quads to approximate the outer surface of a 3D body.
- Surface meshes are employed in manufacturing and rendering applications.

2) Volume Mesh.

- A volume mesh is also known as solid mesh, it uses 3D elements, typically tetrahedrons or hexahedrons, to define both the surface and interior surface.

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F. Applying Boundary Conditions

- In this step, we will define the inlet and outlet parameters.
- The inlet condition is a steady velocity profile.
- We select the prescribed velocities and define the flow velocity.
- Based on the location of the geometry, different types of flow shapes are available in SimVascular.

G. Results

- After the simulation is performed, to view the results we need software named "Para View."
- Para View is an open source, multi-platform and visualization application.
- This helps users to quickly build visualizations to investigate their data using qualitative and qualitative techniques.

IV. SIMULATION

After the model is generated we must assign the inlet and outlet conditions to the model. We specify the flow velocity, flow over a period time i.e., one cycle. We prescribe the flow as BC type with prescribed velocities where we prescribe the flow velocity and constant steady state at inlet.

For the outlet we select the BC type as "Resistance." This represents that the impedance is caused by the down flow. The value can be determined clinically, can be based on the flow distribution, or can be studied from literature review. The wall properties are considered as rigid i.e., they do not deform.

We use Navier-Strokes equation to unravel the linear equations, the time-steps are determined accordingly and therefore simulation files are generated.

These files are created and viewed using Para View. It's open source software, multiplatform and visualization application. This helps us to quickly visualize and analyse data using qualitative techniques.

V. RESULT AND DISCUSSION

We have performed a simulation and obtained results for pressure, direction of flow, velocity and pressure fields value at any particular location, surface displaced by the velocity vector, visualization of velocity globally, and also the visualization of fluid motion in the geometry. The results are shown below.

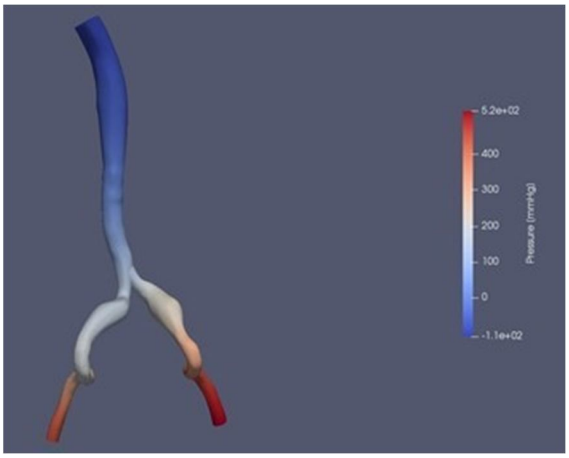

Figure 1 Pressure in mmHg

Figure 1 shows the values of pressure exerted by the fluid when it is flowing through the artery.

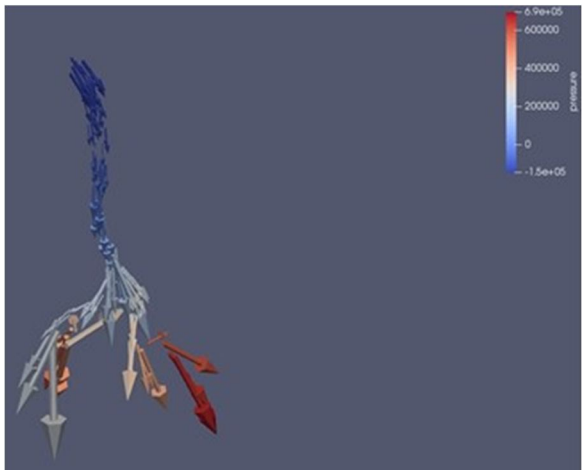

Figure 2 Glyph

Figure 2 shows glyph i.e., it represents the direction of flow of the fluid and also shows the values of the pressure exerted.

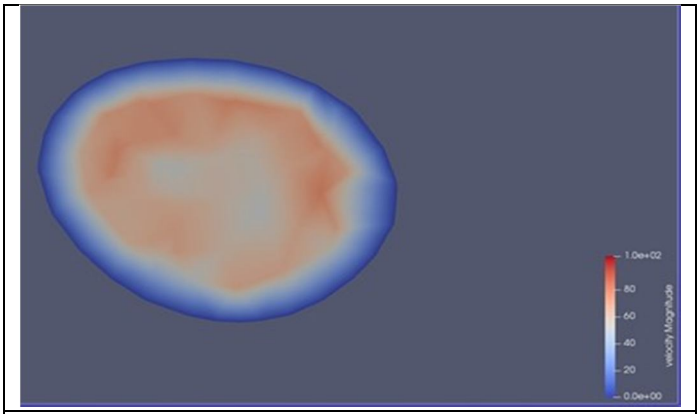

Figure 3 Slice

Figure 3 shows slice, i.e., it can slice the geometry at a particular location and study the velocity or pressure fields.

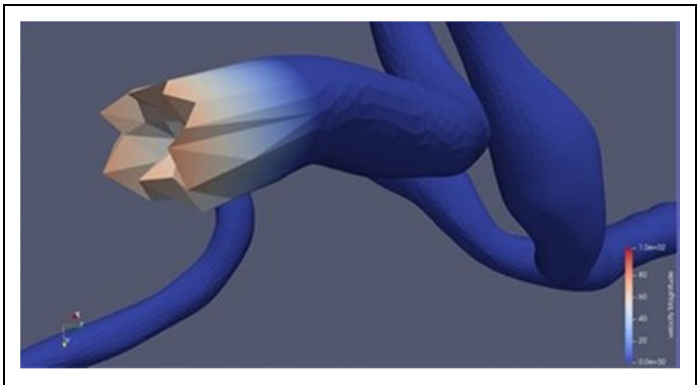

Figure 4 Wrap by vector

Figure 4 shows wrap by the vector i.e., how the surface displaced by the velocity vector when the fluid is flowing through the artery.

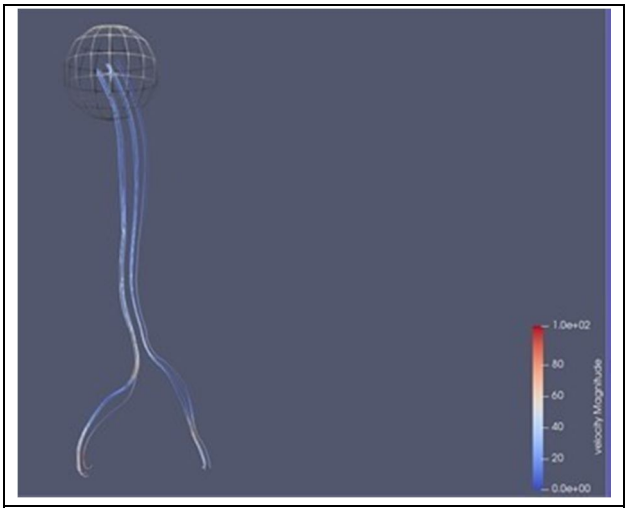

Figure 5 Streamline

Figure 5 shows the visualization of the fluid motion in the geometry.

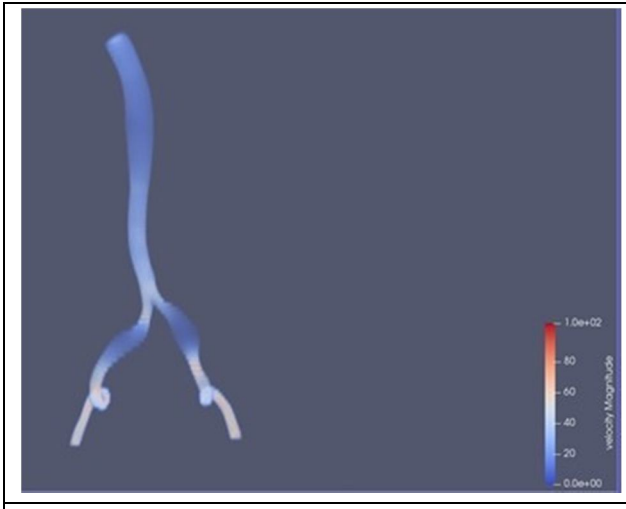

Figure 6 Resample to image

Figure 6 shows the visualization of flow globally.

VI. CONCLUSIONS

From the above simulation, we will see that we have created a patient-specific model of the aorta and have performed a flow simulation and gathered the values of pressure, velocity, flow direction, velocity or pressure fields at a specific location, the surface displaced by the velocity vector, velocity visualization globally, visualization of fluid motion within the geometry.

With the development in technology, we could model and develop a patient-specific model, with which we will be able to save many lives. This also helps reduce the cost of the surgery and improve the approaches used in the procedure.

The future scope of this work is to perform a simulation with plaques present in the arteries and help to remove the plaques using efficient methods.

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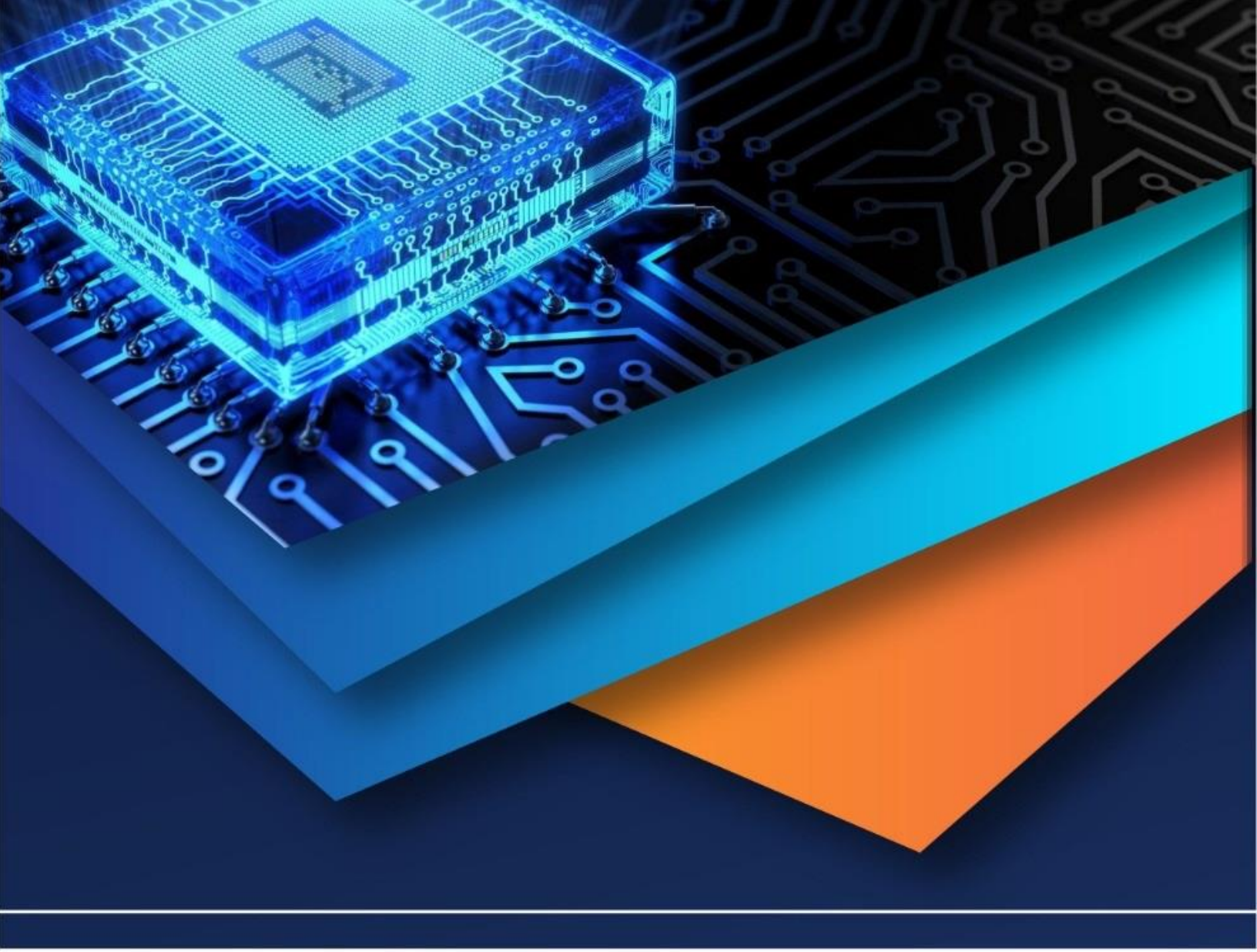

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DESIGN AND FLOW ANALYSIS OF AIR-CONDITIONED SPACE

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ABSTRACT

Today, the field of air conditioning design is more technologically challenging than ever before. While design innovations and product improvement promise sleeker, more versatile, more powerful and more energy-efficient air conditioners, the challenge today lies in identifying the most appropriate products, for their application at hand. Indeed, today the emphasis is no more on understanding air conditioning "products" but on crating "solutions" and not just solutions, but "customized solutions" that suit specific needs i.e., heating/cooling or ventilation. To quantify the air distribution required plays a vital role in HVAC. Quantity of air, which is evaluated from the heat gains/loss into the space need to be properly evaluated considering the orientation if the building, type of glass/structure, occupancy and nature of work in the conditioned area, so is the quantity of air need to be exhausted for the design of duct and to execute the flow analysis for the same.

Keywords: HVAC, Air Distribution, Duct Design, Analysis.

I. INTRODUCTION

Chilled water central air conditioning plant is more useful for large buildings comprising of a number of floors. It has the plant room where all the important units like the compressor, condenser, throttling valve and the evaporator are housed. The evaporator is a shell and tube. On the tube side the Freon fluid passes at extremely low temperature, while on the shell side the brine solution is passed. After passing through the evaporator, the brine solution gets chilled and is pumped to the various air handling units installed at different floors of the building. The air handling units comprise the cooling coil through which the chilled brine flows, and the blower. The blower sucks hot return air from the room via ducts and blows it over the cooling coil. The cool air is then supplied to the space to be cooled through the ducts. The brine solution which has absorbed the room heat comes back to the evaporator, gets chilled and is again pumped back to the air handling unit.

II. LITERATURE REVIEW

While moving heat via machinery to provide air conditioning is a relatively modern invention, the cooling of buildings is not. Wealthy ancient Romans circulated aqueduct water through walls to cool their luxurious houses.

The 2nd century Chinese inventor Ding Huan of the Han Dynasty invented a rotary fan for air conditioning, with seven wheels 3 m (10 ft) in diameter and manually powered. In 747, Emperor Xuanzong of the Tang Dynasty had the Cool Hall built in the imperial palace, which the Tang Yulin describes as having water-powered fan wheels for air conditioning as well as rising jet streams of water from fountains. During the subsequent Song Dynasty (960–1279), written sources mentioned the air conditioning rotary fan as even more widely used.

III. METHODOLOGY

Estimation of heating/cooling load may be done both E-20 method and using Carrier made hourly analysis program (HAP)- software. Hourly Analysis Program (HAP) is a computer tool which assists engineers in designing HVAC systems for providing estimation for AC load for a given building or occupancy. HAP is two tools in one. First it is a tool for estimating loads and designing systems. Second, it is a tool for simulating building energy use and calculating energy costs. In this capacity it is useful for LEED®, schematic design and detailed design energy cost evaluations. HAP uses the ASHRAE transfer function method for load calculations and detailed 8,760 hour-by-hour simulation techniques for the energy analysis.

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IV. MODELING AND ANALYSIS

HAP estimates design cooling and heating loads for commercial buildings in order to determine required sizes for HVAC system components. Ultimately, the program provides information needed for selecting and specifying equipment. Specifically, the program performs the following tasks:

1-Calculates design cooling and heating loads for spaces, zones, and coils in the HVAC system.

2-Determines required airflow rates for spaces, zones and the system.

3-Sizes cooling and heating coils.

4-Sizes air circulation fans.

5- Sizes chillers and boilers.

V. RESULTS AND DISCUSSION

Air System Sizing Summary for COO System

Project Name: DESIGN OF HVAC SYSTEM FOR OFFICE SPACE 01/23/2020
Prepared by: ADEEL, SALMAN, RAHEEL, IZHAAN 04:25PM

Air System Information

Air System Name	COO System		Number of zones	1	
Equipment Class	CW AHU		Floor Area	203.0	ft²
Air System Type	VAV		Location	Mumbai, India	

Sizing Calculation Information

Calculation Months	Jan to Dec		Zone CFM Sizing	Peak zone sensible load	
Sizing Data	Calculated		Space CFM Sizing	Individual peak space loads	

Central Cooling Coil Sizing Data

Total coil load	1.8	Tons	Load occurs at	Nov 1500	
Total coil load	21.9	MBH	OA DB / WB	88.0 / 70.0	°F
Sensible coil load	20.3	MBH	Entering DB / WB	76.7 / 62.6	°F
Coil CFM at Nov 1500	865	CFM	Leaving DB / WB	55.0 / 53.7	°F
Max block CFM at Dec 1600	954	CFM	Coil ADP	52.6	°F
Sum of peak zone CFM	954	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.924		Resulting RH	45	%
ft²/Ton	111.0		Design supply temp.	55.0	°F
BTU/(hr-ft²)	108.1		Zone T-stat Check	1 of 1	OK
Water flow @ 10.0 °F rise	4.39	gpm	Max zone temperature deviation	0.0	°F

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Dec 1600	954	CFM	Fan motor BHP	0.00	BHP
Standard CFM	952	CFM	Fan motor kW	0.00	kW
Actual max CFM/ft²	4.70	CFM/ft²	Fan static	0.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	32	CFM	CFM/person	8.05	CFM/person
CFM/ft²	0.16	CFM/ft²			

Results of the energy analysis are used to compare the energy use and energy costs of alternate HVAC system designs so the best design can be chosen. Specifically, HAP performs the following tasks during an energy analysis:

1- Simulates hour-by-hour operation of all heating and air conditioning systems in the building.

2- Simulates hour-by-hour operation of all plant equipment in the building.

3- Simulates hour-by-hour operation of non-HVAC systems including lighting and appliances.

4- Uses results of the hour-by-hour simulations to calculate total annual energy use and energy costs.

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Costs are calculated using actual utility rate features such as stepped, time-of-day and demand charges, if specified. Generates tabular and graphical reports of hourly, daily, monthly and annual data.

Table 1. Duct Design by Equal Friction Method, AHU-1

S.NO	Section	Total CFM	Place CFM	Place	DUCT H X W (inch)	Room Dimensions L X B(Feet)
1.	0 - 1	4300	247	UPS ROOM	20 X 27	7'2"x9'0"
2.	1 - 2	4053	355	GM Room-5	20 X 25	9'10"x9'0"
3.	2 - 3	3698	274	GM Room -4	20 X 24	9'10"x9'0
4.	3 - 4	3424	360	GM Room -3	20 X 22	9'10"x9'0"
5.	4 - 5	3064	324	GM Room -2	20 X 20	9'10"x9'0"
6.	5 - 6	2740	317	GM Room -1	20 X 19	9'10"x9'0"
7.	6 - 7	2423	197	Repro Room	20 X 17	6'0"x5'6"
8.	7 - 8	2226	486	Meeting Room-1	20 X 16	10'x10'6
9.	8 - 9	1740	380	President Room-1	15 X 18	10'x9'
10.	9 - 10	1360	406	President Room-2	15 X 15	10'x9'
11.	10 - 11	954	954	COO Room	15 X 11	14'0"x14'6"

Similar calculation for is done other zones comprising three AHU which are tabulated below.

Table 2. Ton and CFM for all conditioned space

S.No	Condition Space From AHU	Tons (TR)	CFM
1.	AHU-1	14 tr	6728
2.	AHU-2	8.5 tr	3197
3.	AHU-3	19.1tr	8072
	TOTAL	**41.5 tr**	**17,996**

Model developing using solid works for Analysis

Rectangular Duct Part Sketch

A front-oriented sketch named Duct Sketch.

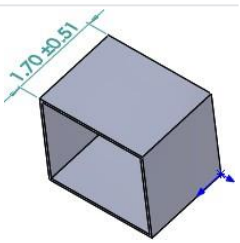
A square or rectangle, created from the origin of the sketch, with dimensions named:

- Height@ Duct Sketch
- Width@ Duct Sketch
- Thickness @ Duct Sketch

Extrusion

- An extruded base feature named Extrusion, extruded in the direction of the positive Z- axis
- A depth dimension named Length @Extrusion

Length @ Extrusion = 1.70



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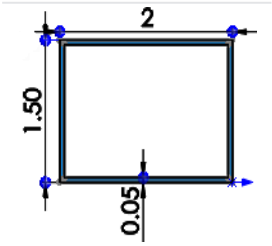


Height @Duct Sketch = 1.50

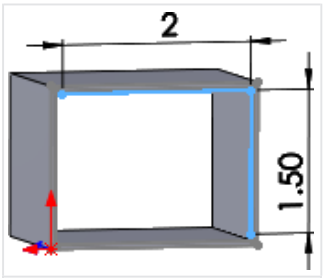
Width @Duct Sketch = 2

Thickness @Duct Sketch = 0.05

Filter Sketch

- A sketch named Filter Sketch
- A line with a dimension named Nominal Height
- A line with a dimension named Nominal Width

Nominal Height = 1.50



Nominal Width = 2

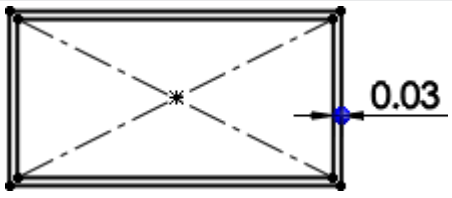
filter sketch

Height@Sketch1 = 0.50

Width@Sketch1 = 1

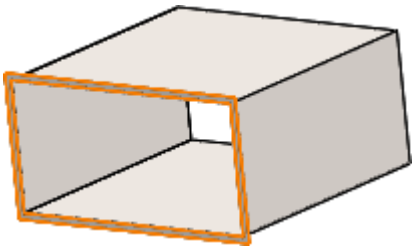
A sketch on the Front plane named Sketch2 with a defined offset on the end face of Extrude.

Thickness @Extrude = 0.03



Boss-Extrude1: An extruded boss feature named Flange_thickness@Boss-Extrude1.

Boss-Extrude1

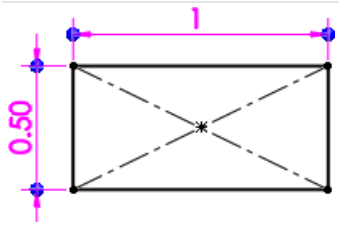


Width@Sketch1 = 1

Rectangular Duct End Sketch

A sketch on the Front plane named Sketch1.

A square or rectangle, created from the origin of the sketch, with dimensions named:



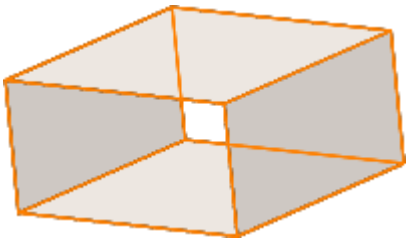
Height@Sketch1

Height@Sketch1 = 0.50

Width@Sketch1 = 1

Extrusion

Extrude: An extruded base feature named Extrude, extruded in the direction of the positive Z-axis.



Rectangular Duct Elbow Sketch

A sketch on the Right plane named Sketch1.

A square or rectangle, created from the origin of the sketch with dimensions named:

Height@Sketch1

Width@Sketch1

AlignmentAngle@Sketch1

(mandatory dimension)

Height@Sketch1 = 0.50

Bend Radius @ Elbow Arc = 1.5

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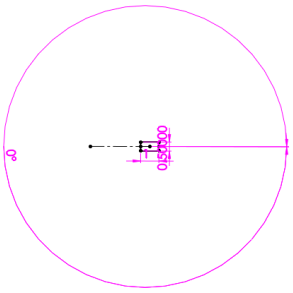
A sketch on the Top plane named Elbow Arc with dimensions named:



Bend Radius and Bend Angle

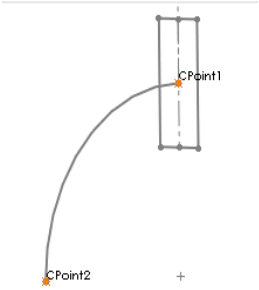
- A sketch for connection points called Sketch2:

A connection point property on the Right plane called CPoint1 with dimensions named:

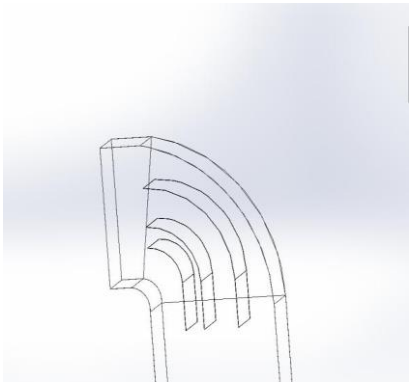
- Depth@CPoint1
- Width@CPoint1.

A connection point property on the Front plane called CPoint2 with dimensions named:

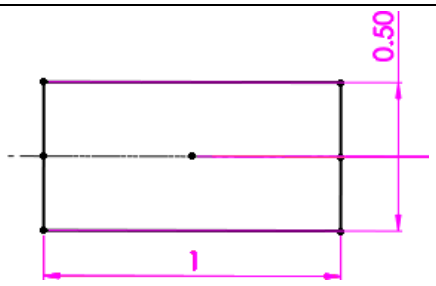
- Depth@CPoint2
- Width@CPoint2.



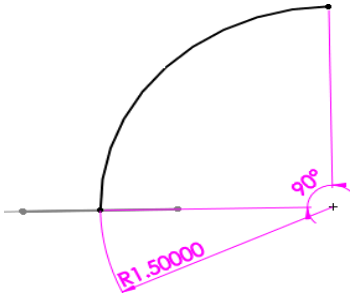
Sketch2: C Point 1 and C Point 2



vanes line diagram

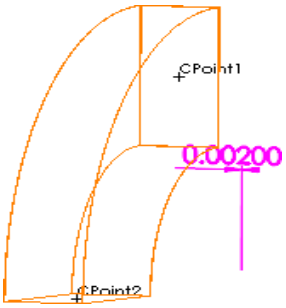


Bend Angle@ Elbow Arc= 90°

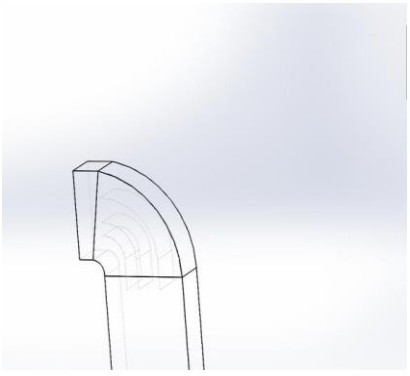


Sweep

A sweep feature on the Top plane named Sweep-Thin1 with dimension named Thickness@Sweep-Thin1.



Thickness@Sweep-Thin1= 0.002



vanes in duct

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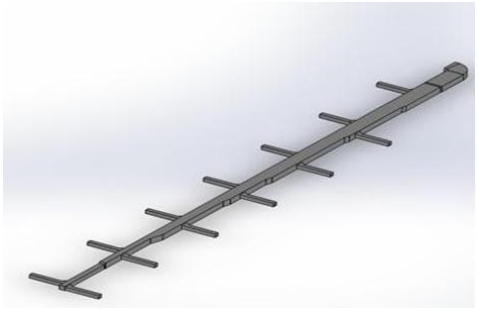
3d models of vanes in duct

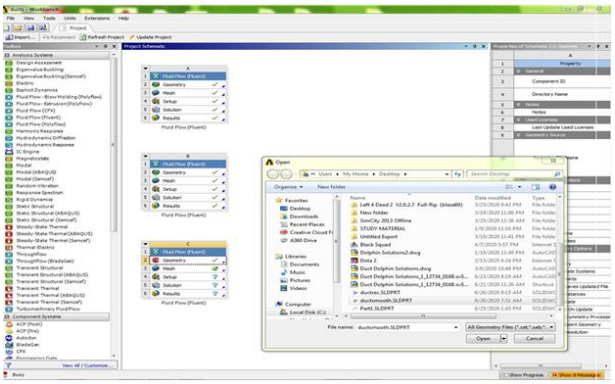


3d model of the duct

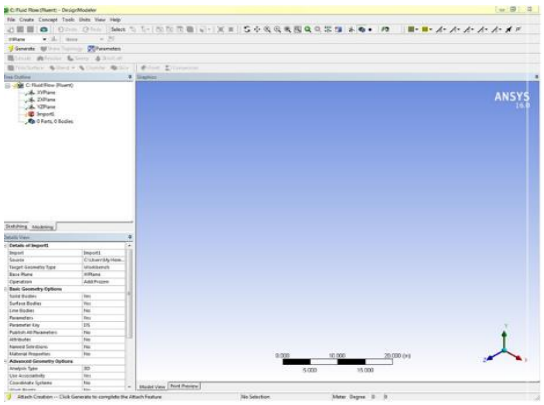
Figure 1: Modelling in Solid Works

Import a Geometry

All engineering simulations start with geometry to symbolize the layout, be it a strong aspect of a structural evaluation or the air quantity of a fluid or electromagnetic area. The engineer either has geometry that has been created in a CAD (Computer-Aided Design) system or builds the geometry from scratch. The ANSYS Design Modeler is a gateway to geometry coping with for an ANSYS analysis. Geometry created the usage of ANSYS Design Modeler software that is particularly designed for the creation and education of geometry for simulation. In engineering simulations, the geometry consists of info now not wished for simulation. Only the physics involved is to be included, simulating such a fully designated version will boom solver run times. It can be more efficient to spend a short time doing away with this information to decrease the full run time through hours or days. Fig suggests the selection of the geometry.



Selection of the Project Geometry



Fluid Flow(fluent) –Design Modeler

After selecting the project geometry, Ansys provided the ability to open and edit the project. Right click the Geometry tab and select the edit feature, it opens the Fluid Flow(fluent) – Design Modeler. This is shown in Fig . After this select the import feature and click on the generate geometry feature. Doing so would generate the Project Geometry in Design Modeler, the generated body can now be edited. By using the fill command in TOOL drop down bar we create a new body shown in Fig . Right click the main body and suppress it. The new body generated name Solid is the project Flow Domain show in fig .

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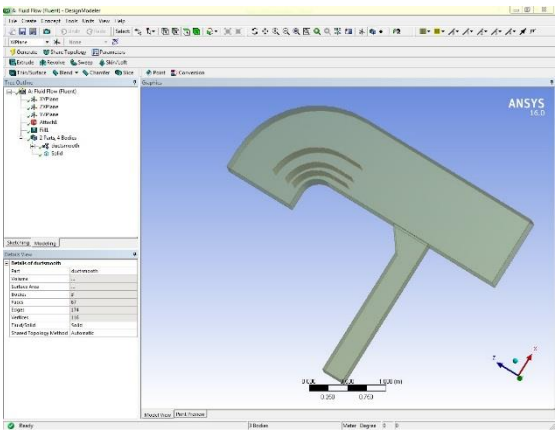
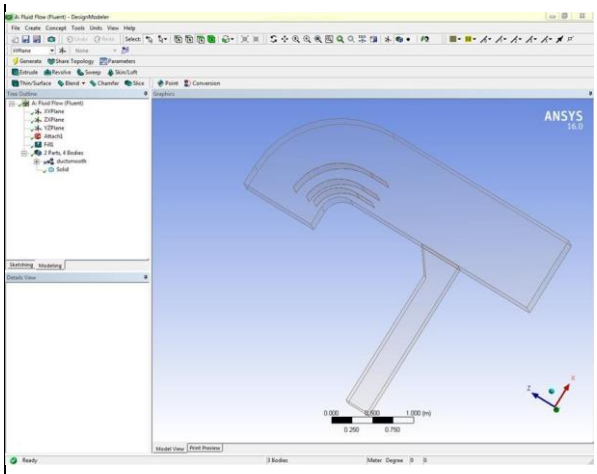


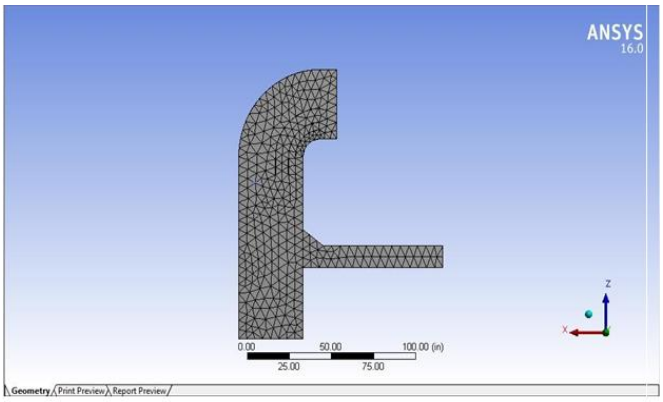
Creating a Second Geometry using Fill command



Suppress the main geometry

Figure 2: Editing the Project Geometry

One of the tedious and time taking event of the CFD simulation is the discretization of the computational domain. It is also famous as Mesh generation. Analytical solutions to the Navier-Stokes equations exist for only the simplest of flows under ideal conditions. To obtain solutions for real flows, a numerical approach must be adopted whereby the equations are replaced by algebraic approximations which may be solved using a numerical method, by using the approach of 'Discretization of the Governing Equations' involves fragmenting the spatial domain into small finite control volumes using a mesh. The governing equations are integrated over each control volume, such that the relevant quantity (mass, momentum, energy, etc.) is conserved in a discrete sense for each control volume. Fig and Fig show the meshing of the duct section with guide vanes and the meshing details respectively.



Shows the separate view of the meshed duct section

Details of "Mesh"

Display	
Display Style	Body Color
Defaults	
Physics Preference	CFD
Solver Preference	Fluent
Relevance	0
Sizing	
Use Advanced Size Function	On: Curvature
Relevance Center	Fine
Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Fine
Curvature Normal Angle	Default (18.0 °)
Min Size	1.0 in
Max Face Size	5.0 in
Max Size	6.0 in
Growth Rate	Default (1.20)
Minimum Edge Length	2.5e-002 in
Inflation	
Assembly Meshing	
Patch Conforming Options	
Patch Independent Options	
Advanced	
Defeaturing	
Statistics	

Details of the "Mesh" for the duct section

Figure 3: Meshing of Geometry (discretization of the computational domain)

The mesh in finite volume method considers points that form a set of volumes which are called cells. The finite element methods use sub-volumes called elements which have nodes where the variables are defined. The values of the dependent variables, such as temperature, pressure, velocity etc. will be described for each element. The quality of the CFD result is strongly dependent on the mesh quality.

Parameters Taken for Result

- Temperature: temperature distribution in 3D plane.
- Velocity: The velocity of an object is the rate of change of its position with respect to a frame of reference,

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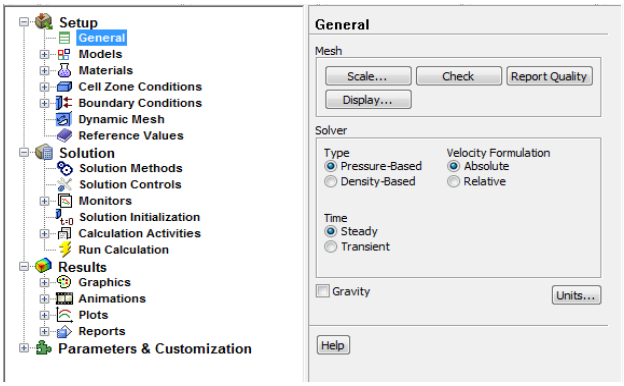
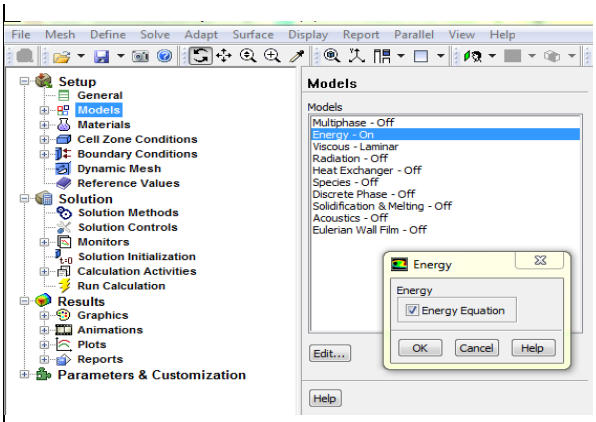
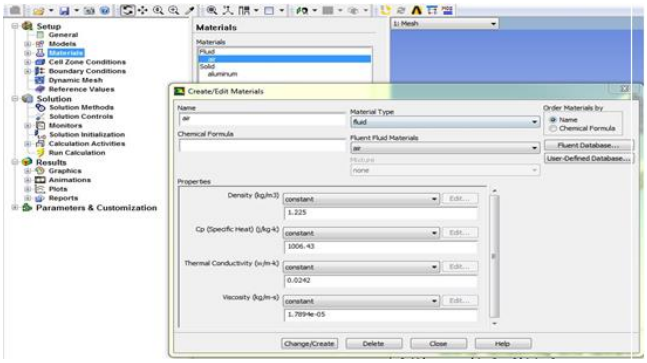
and is a function of time.



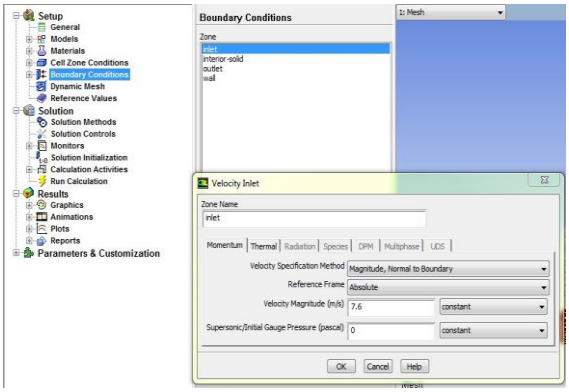
Initial step in CFD Fluent



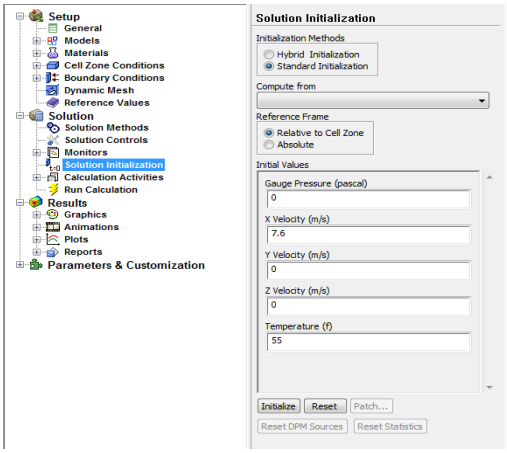
Second step after general is model specification



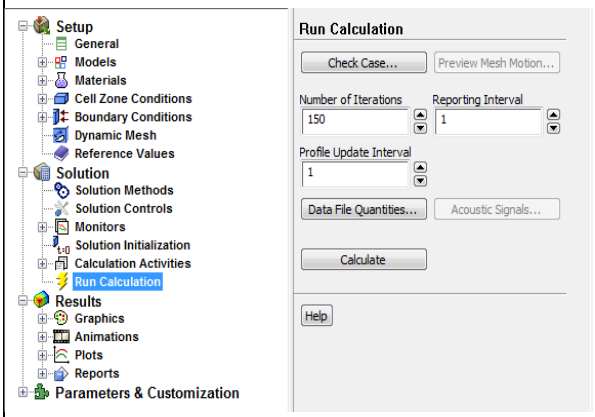
Then go for material selection: Inserting material taken into consideration



Editing boundary condition



Initializing solution setup



Running calculation set up

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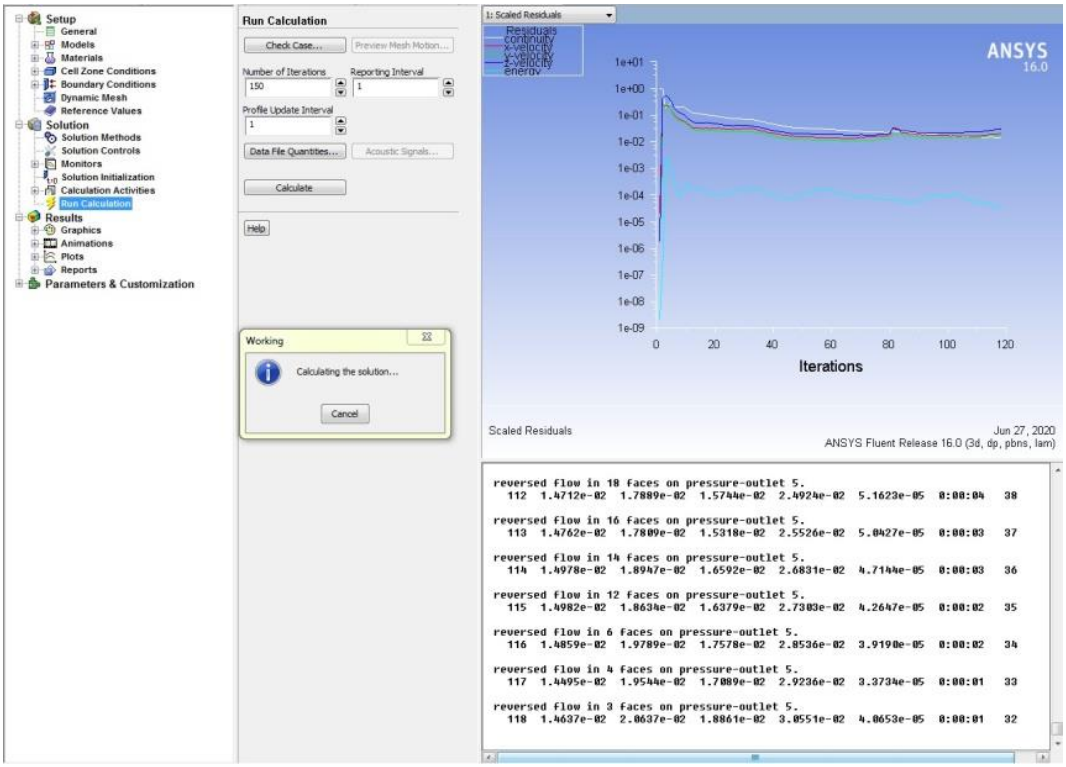

Figure 4: Flow analysis

VI. CONCLUSION

- The HVAC System has been designed for the project site.
- The site is divided into three zones with each zone having its own AHU.
- Ducts were designed for each AHU delivering the calculated CFM to the conditioned area.
- The duct design is optimized by the use of guide vanes and 45deg connecting branch.
- CFD analysis has been done for air flow in duct.

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Application Details	
APPLICATION NUMBER	202241036738
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APPLICANT NAME	Methodist College of engineering & Technology
TITLE OF INVENTION	A TOOL FOR FRICTION STIR WELDING AND METHOD THEREOF
FIELD OF INVENTION	MECHANICAL ENGINEERING
E-MAIL (As Per Record)	patentagent@prometheusip.com
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(57) Abstract :
Exemplary embodiments of the present disclosure are directed towards a friction stir welding tool that can friction-stir-weld a metal or alloy having a high melting point of 1350° C. or more as an object to be worked. At least a portion brought into contact with the object to be worked has a composition containing iridium, containing rhenium, ruthenium, molybdenum, tungsten, niobium, tantalum, rhodium, or two or more of them, and containing zirconium, hafnium, lanthanum, cerium, samarium, gadolinium, scandium, yttrium, or two or more of them, and has a Micro Vickers Hardness of 300 Hv or more. FIG.1

No. of Pages : 32 No. of Claims : 10

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APPLICANT NAME	Methodist College of Engineering and Techonology
TITLE OF INVENTION	COMPUTER TECHNOLOGY BASED AUTOMOBILE DETECTION DEVICE AND METHOD THEREOF
FIELD OF INVENTION	COMPUTER SCIENCE
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(54) Title of the invention : COMPUTER TECHNOLOGY BASED AUTOMOBILE DETECTION DEVICE AND METHOD THEREOF

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(57) Abstract :
Exemplary embodiments of the present disclosure are directed towards a computer technology based vehicle inspection and test device. The said device comprises a chassis and a host machine. The host machine comprises a rectangular top cover provided with an opening, a lower cover provided with a battery case, a touch screen whose shape is fitted to the opening, an electronic circuit unit comprising a central processing unit, a program storage which can be reprogrammed and a plurality of interfaces, and, a fixing rack on which the touch screen and the electronic circuit unit are fixed. Thus, the chronic status of manual work, examination and repair in the industry of automobile maintenance gradually progresses to the stage of computerization and automation. FIG.1

No. of Pages : 14 No. of Claims : 8

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TITLE OF INVENTION	APPARATUS FOR RADIATION ASSISTED FRICTION WELDING AND METHODS THEREOF
FIELD OF INVENTION	MECHANICAL ENGINEERING
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(51) International classification :B23K0020120000, A61N0005060000, G01B0011160000, A61B0008000000, F01D0021000000
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(57) Abstract :
Exemplary embodiments of the present disclosure are directed towards an apparatus and method for friction welding structural members. The apparatus includes a connected shank and probe. The probe defines an absorption surface and a cavity extending thereto. The absorption surface is configured to receive electromagnetic radiation from an electromagnetic radiation source such as a light source or RF generator. The radiation heats the probe, supplementing the heat generated by friction between the probe and the structural members, and thereby increasing the speed at which the probe can be used to frictionally weld the structural materials.
FIG.1

No. of Pages : 20 No. of Claims : 10

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TITLE OF INVENTION	Multifunctional expandable wheel chair
FIELD OF INVENTION	BIO-CHEMISTRY
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(61) Patent of Addition to Application Number :NA
Filing Date :NA
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(57) Abstract :
Multipurpose wheel chair are useful for patients for transportation and a replacement for walking especially in indoor and outdoor environment. Transferring the patients from wheelchair to stretcher or to the medical bed is always an issue for the attendant or helper. Understanding the various issues regarding the mobility equipment and introducing a better design will be an asset for the medical field and helping hand for disabled individuals. There is a need for a wheelchair cum stretcher to facilitate the disabled patient's mobility and to provide a novel medical equipment for use in the Indian hospitals. The proposed stretcher cum wheelchair model has clearly shown that the mechanism used to perform reclining and lifting backrest is more efficient, economical and effective. The stretcher cum wheelchair eliminates the steps of transferring of patients from wheelchair to stretcher or vice versa. In this model cross brace-x mechanism is used for lifting and reclining of backrest.. This model consumes less space as well as less maintenance which provides human comfort. Here we are developing(fabricating) a system which is capable of shifting various positions (Chair, Semi-Chair and Stretcher) manually

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(57) Abstract :
Automatic multi die leaf plate making machine is designed to make more than two plates at its single punch in order to increase the rate of production at the most feasible price that a common man can afford. In this machine cutting and punching operations and raw material insertion also done automatically with its self- loader capacity and timer control arrangements. Automatic multi die plate making machine combines both the punching and the raw material inserting operations, which leads to reduces the time of production and it helps increases the production rate

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AN EFFICIENT APPROACH FOR BIGDATA SECURITY BASED ON HADOOP SYSTEM USING CRYPTOGRAPHIC TECHNIQUES

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Abstract:

When relational database systems could no longer keep up with the huge amounts of unstructured data created by organizations, social media, and all other data-generating sources, big data came into being. The amount of data being added every day, together with Hadoop, makes for an urgent and growing need for more data processing solutions. The MapReduce programming model is one common approach for processing and handling huge amounts of data, especially when used to big data research. As HDFS, a distributed, scalable, and portable file system constructed in Java for the Hadoop architecture, is already useful, it is noteworthy that it is built using Java technology. This computing environment suffers from two issues. First, when intruders access the system, they can steal or corrupt the data stored in the system. The AES encryption mechanism has been implemented in HDFS to safeguard the security of data stored in HDFS. Some data saved in HDFS can be secured with the application of AES encryption technique. I conducted an extensive research on security challenges around large data in the context of Hadoop, along with numerous solutions and technologies utilized to secure it.
Keywords: HDFS, MapReduce, AES encryption method, Hadoop

I Introduction

There are currently a growing number of interested communities in cloud computing, which has led to the creation of substantial software resources, storage, and high-performance computing resources [1] available to users. A tremendous amount of data is created every day in the digital world, which demands a considerable quantity of storage space, processing power, and system performance. Another well-known cloud computing platform is GFS and MapReduce, which are both used by Google. Analysis of the hazards helped increase the odds of a predictive capability's analysis and Big Data features by way of data analytics. A second issue associated with cloud is its inherent variability; it can be tailored, but it may be unsecure, more expensive, slower, incompatible, less reliable, or difficult to manage. Over the past few years, data sizes have increased from tens of terabytes to multiple zettabytes (that's 100,000,000,000,000,000,000 bytes), and they're only getting bigger. To fully glean insights from different and complicated data sets, you need a collection of methodologies [2]. Concerns related to Big Data are categorized under four headings: volume, velocity, variety, and validity. When it comes to data, every problem has its own mission, which is to get it through to the end.

- Volume: The term "large" by itself defines the size of the data in Big Data. Big data is connected with the amount of data produced. In the near future, it is predicted that the data will reach petabytes in size, and this could eventually expand to zettabytes.
- Velocity: Velocity in Big data involves measuring the pace of multiple data streams. The speed at which data flows is part of the velocity characteristic.
- Variety: The diversity of data is represented by the amount of variability in the data. You can include any type of media as long as it's formatted properly.
- Value: The value of data is measured in terms of its utility in making decisions. In terms of analyzing the data, "data science" deals with data, but "analytic science" concerns predictive data analysis. Varying users can execute various querying the data and so has the ability to pull out valuable results from the

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Original Article

An Adaptive Wolf Based Dansing System for Securing Hadoop at the Data Cleaning Stage

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Abstract *- Nowadays a large amount of data is available for the association of authority using business decisions. Moreover, the collected data from various resources are too noisy, which affects the prediction results and accuracy. Hence, Data cleaning has been introduced to provide better data quality, but the main issues of data cleaning are time consumption and malicious attacks. In this paper, a novel Wolf based Wide Dansing System (WbWDS) is developed to provide security for data during the cleaning stage. Hence, the novel WbWDS is designed with four layers: logical, physical, execution, and data cleaning. Furthermore, wolf fitness is updated to the developed framework for enhancing the security function. In addition, the involvement of wolf fitness has afforded the finest continuous monitoring results of malicious events. Additionally, the proposed WbWDS technique is implemented in Python, and an attack is launched in the cleaning layer to check the developed method's reliability. Finally, achieved performance metrics of developed WbWDS are compared with existing methods and gained the finest results with outstanding confidential rate and low execution time.*

Keywords *- Attacks detection, Confidentiality measure, Data cleaning, Secure Hadoop application.*

1. Introduction

Data cleaning identifies and removes corrupted records from the datasets, tables, and recordsets, which includes the detection of incorrect, incomplete, irrelevant parts of data and modifying, replacing [1, 2]. Moreover, data cleaning is important as it enhances data quality and increases whole productivity [3]. All incorrect or outdated information should be removed in the data cleaning process, and the finest high-quality information must be attained [4]. Additionally, the main purpose of data cleaning is to ensure consistent, correct and usable data and clean the data by detecting errors and correcting them or preventing the error when it occurs [5, 6]. Data clearing also contains more actions such as standardising data sets, fixing spellings, correcting mistakes and syntax errors [7]. In addition, some examples of malicious data are insuring data, incomplete data, duplicate data, incorrect data, and outdated data [8]. The process of data cleaning is illustrated in fig. 1.

Combining multiple data renders many opportunities for mislabelled or duplicate data [9]. While the data is incorrect, the algorithm results are unreliable [10]. The data cleaning process contains no absolute way of predicting data because the process varies from dataset to dataset [11]. The benefit of data cleaning is that it ultimately increases all productivity and permits the highest quality information [12]. Furthermore, data cleaning is not about erasing information. It will identify how to maximise dataset accuracy without deleting information [13, 14]. It is also considered a foundational element of basic data science and plays a significant role in uncovering reliable answers and analytical processes [15]. Frequently, data cleaning helps make certain matched information easier and interact with the dataset to identify information efficiently [16]. The most common application in data cleaning is data warehouse [17]. The warehouse store contains various data from disparate sources optimised by analysing and modelling [18]. The main problem of data cleaning is high bandwidth, energy consumption, time consumption and data noise [19].

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Role of Machine Learning Algorithms for Supply chain tracking the products to the University Hostel with the utilization of IoT

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ABSTRACT With the form of complex networks, large supply chains have evolved globally, and due to variant issues, the chain management systems are facing enough difficulties to manage their capacity. Here, the issues would affect the party members like upstream, downstream, and finally, the production cost. Blockchain is one of the parts of managing Supply Chains. In that case, with the help of machine learning algorithms, the experts are connecting the supply chain with various technologies. Through this paper, it is concluded that the solutions for the cause of blockchain-based Internet of Things devices according to the recent technologies.

Keywords: Internet of Things, Machine Learning, Blockchain, Supply chain tracking.

I. INTRODUCTION

Machine learning is becoming one of the popular applications in supply chain management because creating a separate model for a machine learning algorithm requires heavy data with its accuracy. Through this paper, the author has discussed a few points that help in understanding machine learning and other driving parties to understand the efficiency and optimization of supply chain management. We usually know the concept of machine learning which acts as a subset of Artificial Intelligence and works with the ordinary system. This method follows the techniques of converting the ordinary system to an intelligent system. The system does not require any programming knowledge with the data fed to the system here. The data collection and statistics replaces the use of programming tool. With the help of necessary data and observation, it is being used to train a model using different patterns once the data is combined. In the case of analyzing and sporting trends, machine learning with its algorithm is one of the massive options to enhance and make a few advancements in it. One of the most employing technologies in supply chain management is enhanced by automatic inspection. Apart from pre-accessing data, machine learning algorithms automate the analysis of industrial equipment effects and identify the damage in particular objects or matters. Artificial Intelligence data is considered one of the best coping technologies that adapt easier with the Big Data modules. With the help of a Machine learning algorithm, we could detect the missing patterns listed from the variable section with an insight tool.

Behind the Machine learning modules, there is a strong enough basis that helps in various applications that can be implemented in ML techniques by separating the techniques with different parts. This would require a supply chain area with more than two areas. Through this paper, the author has managed a few contributions compared with the efficiency and traditional AI methods when it faces the Big Data models. The second thing is to review and summarize the technique classified with AI-based Supply Chain Management. Apart from the concept of intelligence, the module is based on supply chain management to optimize the routing sectors. As we know that ML algorithms could be able to analyze and understand historical delivery records.

II. LITERATURE REVIEW

Companies that co-operate with the supply chain influence might get enough data transfer options compared to the other companies. With this paper, the author combines the Machine Learning Models with data referring, which is raised from the news sources [1]. While analyzing the supply chain management report ensures the demand in forecasting the knowledge of Machine Learning Algorithms. With the help of practical resourcing tools, the author has explained the reports taken from 2007 [2]. The study of supply chain management would deal with the enormous field, so after

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Development and Analysis of improvised AOMDV Routing Protocol based on Machine Learning Model for improvised Network Performance in MANETs

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Abstract – *A MANET is a self configurable wireless ad-hoc network in whichnode mobility exists. Due to this flexibility many security threats can occur in the routing. So, in order to address this issue,the performance of IDS should be improvised. In this paper, a methodology is proposed based on Machine Learning(ML) algorithm in terms of accuracy and detection rate for IDS improvisation for AOMDV routing protocol.*

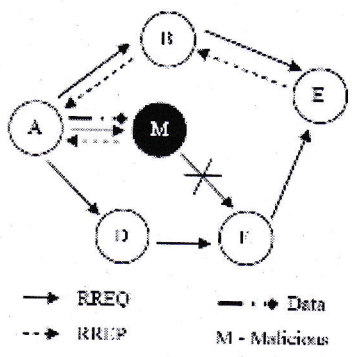
Key Words: MANET, Support Vector Machine, Intrusion Detection System,AOMDV(Ad-hoc On-demand Multi-path Distance Vector) routing protocol.

1. INTRODUCTION

IDS is to detect the attack before the malicious node(s) causes security threat to the network. It looks into monitoring, detecting and notifying aspects. The Blackhole attack is the most affected type on MANETs. Usage of an anomaly IDS protects the network from Black hole attack with the help of Machine Learning algorithm ,SVM

1.1 Malicious Node(s) causing Black hole attack in AOMDV Routing Protocol.

Black hole attack is one of the major attacks in MANETs. Malicious Node(s) causing this attack on MANET security has the data viz. Source node, Destination node and Neighbouring node. The source node sends a RREQ (Route Request Packet) to its neighbouring nodes to search for the route destination. However, black hole node sends a fake route reply to the source node resulting packet loss which will degrade the performance of the network. In order to prevent this, the performance of the IDS should be improvised with machine learning algorithm by detecting the malicious node(s) .



Fig(1) : Malicious Node Causing Black hole Attack

2. RELATED WORK

Maralkodi et.al Evaluated the performance of adhoc on demand multipath distance vector (AOMDV) routing protocol in the presence of Poisson and bursty self similar traffic and compares them with that of CBR traffic and observed that the end to end delay in the presence of self similar traffic is lesser than that of CBR and higher than that of Poisson traffic

Pooja Rani et.al In this paper, the protection against dual attacks has been presented for BHA and GHA by using the concept of Artificial Neural Network (ANN) as a deep learning algorithm along with the swarm-based Artificial Bee Colony (ABC) optimization technique. The performance of the system has been increased by the selection of appropriate and best nodes for data packets transmission

Shweta Pandey et.al The proposed approach uses the Artificial neural network (ANN) and the Support Vector Machine (SVM) for the discovery of the black hole attacks in the network. The results are carried out between the black hole AODV and the security mechanism that was provided as the Secure AODV (SAODV) ,shows an improvement viz. energy consumption of 54.72%, throughput of 88.68kbps, packet delivery ratio of 92.91% , E to E delay of about 37.27ms

Salwa Othmen et.al Propose a new power and delay aware routing protocol for wireless Ad Hoc networks. The goal of proposed routing protocol is not only to find more stable paths from a source to a destination node in terms of remaining life time of battery, but also to find multi-paths that satisfy Quality of Service (QoS) requirements, given in terms of delay and bandwidth

Indira N et.al Proposed Anomaly based intrusion detection technique using the SOM classification method provides higher detection rate than other anomaly detection method. As anomaly-based intrusion detection techniques are based on statistical data they can result in false positive identification of normal pattern as an attack. This false identification of benign behavior as abnormal can result in isolation of non-malicious node as malicious, thus may result in partitioning of the network

Sujithra L et. al In this paper ,the approach improves the conservation of energy in heterogenous network and also reduces the active time of IDS running in the nodes. In order to achieve this, proabilistic approach is implemented, here optimal proabilistic of node is to be set, thus decreases active time of IDS in each node and conserves the energy of the node , hence increases the network lifetime significantly.

CLASSIFICATION MODEL TO PREDICT DYNAMIC HEALTHCARE RESOURCE UTILIZATION AND ALLOTMENT METHOD BY USING CART ANALYSIS FOR SURGICAL PATIENTS LOS

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Abstract: Healthcare costs and the increased demand for services especially during corona pandemic time we are facing lot of havoc which requires us to use healthcare resources and hospitalization of patients more efficiently. Static resource requirements and stay duration makes the care delivery process less efficient. We can create dynamic system by classifying patients into similar clusters by predicting stay. Developed a classification model to classify patients into various clusters of stay by using e-patients' record. There are various statistical tools for classification and prediction. However, classification and regression tree (CART) analysis is a more suitable method for analyzing healthcare data. We found that the CART analysis is also useful for determining the patient attributes that can explain the variability in resource requirements. Furthermore, we can predict the stay duration of patients based on certain factors, such as the age, the admission point, severity, emergency type and the disease type.

Keywords —ICU, LoS, Machine Learning, Data mining, CART, Bernoulli

I. INTRODUCTION

Healthcare demand is growing in several countries across the world. In General, the healthcare system comprises a mix of private and public organizations, such as hospitals, clinics, and aged care facilities. These healthcare systemsare quite affordable and accessible[1]. However, soaring healthcare costs and growing demand for services are increasing the pressure on the sustainability of the government-funded healthcare system. To be sustainable, we need to be more efficient in delivering healthcare services[2].

We can schedule the care delivery process optimally and subsequently improve the efficiency of the system if demand for services is well known. However, there is a randomness in demand for services, and it is a cause of inefficiency in the healthcare delivery process. It is possible to design a deterministic system optimally to achieve a very high, ≥ 90%, utilization of the available resources. However, in a system with intrinsic randomness[3], improving the resource utilization diminishes the quality of services. For example, if we operate an intensive care unit (ICU) at a very high, ≥ 85%, occupancy level, we may need to refuse admissions frequently because of a capacity shortage. To manage healthcare facilities efficiently, we need to minimize the effect of the randomness in demand for services on the efficiency of the system.

The random arrival time and the uncertainty in resource requirements of each individual are the sources of variability in demand for services. In hospitals, resources are bundled together, and medical professionals work in teams. A patient's resource consumption is measured by one's length of stay (LoS) at various care steps, such as the LoS in the General ward, the LoS in a surgical ward, and one's surgery duration. Therefore, the variability in resource requirements can be approximated by the variability in LoS. Moreover, in the case of elective operations, patients' arrival times are scheduled by the hospital administration. The remaining source of variability in the elective patient flow process is the randomness in LoS. We can manage a surgical suite more efficiently if we can predict patients' LoS accurately[3].

The prediction of stay duration for the distinct wards allows for effective management of the patients, the categorization[4] of patients into three types on the basis of ward type indirectly reduces the overload from the occupancy in the ward. Maintaining

Secure Data Transmission and Deletion between Two Clouds without Overhead

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Abstract: *With the rapid development of cloud storage, an increasing number of data owners prefer to outsource their data to the cloud server, which can greatly reduce the local storage overhead. Because different cloud service providers offer distinct quality of data storage service, e.g., security, reliability, access speed and prices, cloud data transfer has become a fundamental requirement of the data owner to change the cloud service providers. Hence, how to securely migrate the data from one cloud to another and permanently delete the transferred data from the original cloud becomes a primary concern of data owners.*

Keywords: Cloud storage, Data transfer, Data deletion, Counting bloom filter, Public verifiability.

I.INTRODUCTION

Cloud computing, an emerging and very promising computing paradigm[1], connects large-scale distributed storage resources, computing resources and network bandwidths together. By using these resources, it can provide tenants with plenty of high-quality cloud services. Due to the attractive advantages, the services (especially cloud storage service) have been widely applied, by which the resource-constraint data owners can outsource their data to the cloud server, which can greatly reduce the data owner's local storage overhead. According to the report of Cisco, the number of Internet consumers will reach about 3.6 billion[6] in 2019, and about 55 percent of them will employ cloud storage service. Because of the promising market prospect, an increasing number of companies (*e.g.*, Microsoft, Amazon, Alibaba) offer data owners cloud storage service with different prices, security, access speed, *etc*. To enjoy more suitable cloud storage service, the data owners might change the cloud storage service providers. Hence, they might migrate their outsourced data from one cloud to another, and then delete the transferred data from the original cloud. According to Cisco, the cloud traffic is expected to be 95% of the total traffic by the end of 2021, and almost 14% of the total cloud traffic will be the traffic between different cloud data centers. Foreseeably, the outsourced data transfer will become a fundamental requirement from the data owner's point of view.

To realize secure data migration, an outsourced data transfer app, Cloudsfer, has been designed utilizing cryptographic algorithm to prevent the data from privacy disclosure in the transfer phase. But there are still some security problems in processing the cloud data migration and deletion. Firstly, for saving network bandwidth, the cloud server might merely migrate part of the data, or even deliver some unrelated data to cheat the data owner. Secondly, because of the network instability, some data blocks may lose during the transfer process. Meanwhile, the adversary may destroy the transferred data blocks. Hence, the transferred data may be polluted during the migration process. Last but not least, the original cloud server might maliciously reserve the transferred data for digging the implicit benefits. The data reservation is unexpected from the data owners point of view. In short, the cloud storage service is economically attractive, but it inevitably suffers from some serious security challenges, specifically for the secure data transfer, integrity verification, verifiable deletion[2]. These challenges, if not solved suitably, might prevent the public from accepting and employing cloud storage service.

II. LITERATURE SURVEY

A verifiable data deletion has been well studied for a long time, resulting in many solutions. Xue et al. studied the goal of secure data deletion and put forward a key-policy attribute-based encryption scheme, which can achieve data finegrained access control and assured deletion. They reach data deletion by removing the attribute and use Merkle hash tree (MHT) to achieve verifiability, but their scheme requires a trusted authority. Du et al. designed a scheme called Associated deletion scheme for multi-copy (ADM)[3], which uses pre-deleting sequence and MHT to achieve data integrity verification and provable deletion. However, their scheme also requires a TTP to manage the data keys. In 2018, Yang et al. presented a Block chain-based cloud data deletion scheme, in which the cloud executes deletion operation and publishes the corresponding deletion evidence on Blockchain. Then any verifier can check the deletion result by verifying the deletion proof. Besides, they solve the bottleneck of requiring a TTP.

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A REVIEW ON MULTI-MODEL SENTIMENT ANALYSIS USING DEEP LEARNING FOR TEXT, SPEECH, & EMOJI REORGANIZATION

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ABSTRACT

The sentimental analysis (SA) is a rapidly developing domain that aims at computational classifying people's opinions corresponding to a specific brand, movie, product, or anything which will be an opinion. Currently, the SA from text is broadly utilized for brand analysis and customer satisfaction assessment among others. With the social media proliferation, the Multimodal Sentimental Analysis (MSA) is set for bringing new opportunities with the advent of complementary data streams to improve, going beyond SA based on text. Because sentiment is detected via affective traces and it leaves vocal and facial displays, MSA allows promising ways to analyze vocal and facial expressions in addition to the contents of textual or transcript. Recently multimodal sentiments have become a challenge to the researchers and equally sophisticated to an appliance for understanding and applying deep learning in SA has become most popular. A review is presented over MSA using deep learning for text, speech, and emoji reorganization. In this survey, many algorithms are introduced and different applications of MSA are presented. A 10% performance improvement can be obtained on the state of the art through the text, audio, and visual features combination using deep learning techniques in MSA.

KEYWORDS: Sentiment Analysis, MSA, deep learning, text, speech, and emoji reorganization.

1. INTRODUCTION

The analysis of sentiment is very tightly integrated with the statistics field where statisticians few times referred to it as "applied statistics". Statistical techniques are needed for analyzing exploratory data and for deriving meaningful correlations among data items and turning raw observations into information. Often information comes in many modalities and humans have the ability for combining them seamlessly. As an example, in recognition of speech, humans are integrating visual and audio information for understanding speech. The SA and recognition of emotion bring several opportunities related to social media for understanding the habits, contents, and preferences of the users. Nowadays huge amount of data is being uploaded like video instead of text due to the abundance of mobile devices, advanced communication technologies, and the increase of social media. The key advantage of video analysis over mere text analysis, to detect sentiment and emotions, is behavioral cues surplus. Multimodal data is provided by videos in terms of visual and vocal modalities. In visual data, the facial expressions and vocal modulations along with text data provide significant clues for better identifying opinion holders' true effective states. So that combining video and text data helps to create a better emotion and SA model. In recent times, several schemes have been presented for MSA that provide interesting results.

With the rapid advancements in Artificial Intelligence domains, an ui system that can take data from different sources and discern attitudes in them is required. With the enormous increase of usage of social media, they contain a huge amount of multimodal information (images/videos, text, and audios) that will be utilized for determining sentiment. Most of the research works over SA concentrated only on a single aspect utilizing that it is hard for determining the correct people sentiments. In addition, these unimodal systems have some drawbacks related to their reliability, robustness, and accuracy. Therefore, it is needed for exploring the usage of multiple modalities for improving the SA performance. The major motivation is to build an MSA that takes many inputs to improve the performance levels in sentiment analysis. Few techniques have been reviewed that address these issues and a baseline is a setup based on cutting-edge techniques based on a deep learning system for features extraction from different data modalities. This work concentrates on producing a detailed description that corresponds to feature extraction techniques, classification schemes, datasets, challenges, and fusion schemes integrated into MSA.

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Multimodal Sentiment Prediction Based on the Integration of Text and Emojis

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ABSTRACT Multimodal Sentiment analysis has captured much attention in recent years. Multimodal reviews are often used to share opinions and sentiments about the products they purchased. People these days use emojis in their text more and more to express their feelings in the form of reviews. Earlier the sentiment analysis of the text or emojis or images alone were considered whereas emojis with text has always been ignored, thus many gut reactions were overlooked. This research proposed an algorithm and approach for multimodal sentiment analysis using both text and emojis. Data used in this study are online product reviews collected from Flipkart.com. In this work, both modes of data were analysed with machine learning algorithms to find sentiments using various word embeddings including TF–IDF, Count Vectorizer, and emoji's lexicons. This experiment shows that whenever emojis are used, the emotions attached with them effects the sentiment communicated by textual data analysis. The research has also outperformed by increasing the accuracy of SA for customers product reviews.

Keywords: Multimodal Sentiment Analysis, Word Embeddings, Feature Extraction, Opinion Mining, Machine Learning.

I. INTRODUCTION

The worldwide web from the past 30 years has generated huge amounts of data. This data is available to users in the form of text, sound and pictures. Natural language processing (NLP) is the computational approach applied for processing this free text or speech to do useful things [13]. So, in NLP, especially the fourth phase also known as the Lexical and Corpus phase is increasing its influence in this decade with the help of sentimental analysis and machine learning algorithms [14]. The origin of sentimental analysis can be traced back to early 20th century studies on public opinion analysis and computational text subjectivity analysis. The Sentiment Analysis is generally defined as the computational process of determining writings, facial expressions and voice to capture an individual's opinion, sentiments and emotions [15].

The technologies like string matching, keyword searching, glossary lookup are the past and new technologies like grammar checks, conceptual search, event extraction, interlingual ongoing and straightforward. The technologies are developed for recognizing, detecting and determining all opinions. However, these methodologies and tools on the other hand were mostly for Slavic languages like English, Spanish and French focused on the text modality. Even though these resources were well-validated and produced reasonable empirical results. They are nevertheless difficult to use and are likely to produce skewed results when applied to semantically and syntactically rich languages.

Another way of identifying people's perceptions is through emoji and emoticons. The emoticons assist the user in articulating sentiments, moods and emotions, as well as blending nonverbal compounds into a written message like :-) represents a face emotions[13]. Emojis are a very popular way of communicating in social media and are regularly used by 92% of internet users. These emojis are graphic symbols that portray a wide range of topics and ideas spanning events, weather, automobile and structures, refreshments, animals and plants etc and emotions, feelings and activities [14]. The fig-1 below represents a miniature of emojis.

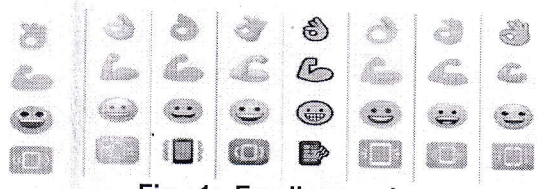

Fig - 1: Emojis sample

The comprehensive and significant analysis of this online media also aids in the development of a brand, service, advertising campaigns, and commercial or personal decisions. Many machine language researchers have been drawn to the use of emoticons for sentiment multi-label classification problems in the context of social language processing.

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A Pragmatic Approach to Emoji based Multimodal Sentiment Analysis using Deep Neural Networks

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ABSTRACT
The Opinions of the customers regarding products have also become an important parameter for sales. The manufacturing companies are also continuously monitoring the feedback given on social media sites about their products, especially mobile reviews. The Sentiment Analysis (SA) is playing a vital role. The analysis cannot be limited to only text categorization as positive, negative, or neutral. The Emojis are also capturing emotions. So, in our proposed work the multi-modal sentiment analysis is done using text and Emojis. And the malleability of Deep learning models on the text has also increased. The combination of Word embedding models CBOW and SG are combined with the deep learning classifiers like LSTM, CNN, Bi-LSTM, and CNN-LSTM. The novelty of this work is to develop an Emoji-Based sentiment lexicon and cosine similarity usage for finding similarity. These were all modeled to predict the emotions in new mobile product reviews collected from various social media sites. The evaluation parameters proved that our proposed work had better results. The CNN-LSTM model topped in the accuracy of 94.94%.
KEYWORDS: Word2Vec-CBOW, Word2Vec-SkipGram, LSTM, CNN, Bi-LSTM

1. INTRODUCTION
The success of the company and product depends on the customers. The customers' review of a particular product helps in increasing or decreasing the sales. Sentiments are one of the best features for analyzing customers' responses [13]. SA can be defined as a process of computationally identifying and categorizing opinions from a piece of review or voice message and determining whether the writer's attitude towards a particular product is favorable or adversarial or nonpartisan. The input for SA is either collected as text or emojis together from comments on Mobile apps, LinkedIn posts, social media posts, or Facebook shares. These millions of reviews/posts are mostly in the form of texts and emojis or only emojis to express emotion. These things on a single product will help the companies identify its pros and cons in a simpler manner using SA.

The SA combines the two languages namely Natural Language Processing (NLP) and Deep Learning. The NLP is a language that transforms human language into something which machines can understand. The syntactic techniques and semantic techniques are used for processing the text. Now the processed text is ready for classification by deep learning algorithms. These algorithms help in making predictions based on the patterns. These algorithms are not dependent on the explicit instructions but the sample data i.e., trained data. A model is built that will analyze sentiments based on emotions. These emotions are either only text, text, and Emojis or only Emojis. This will reduce the manual overhead and error on the bias [14]. Conventional sentiment analysis involves using reference dictionaries to determine how positive specific keywords are, then combining these scores to get the text's emotion.

Recent studies suggest that the SA is also done using Deep Learning algorithms that achieve remarkable results. In this work, we propose a SA technique which is analyzing emotions based on Text and Emojis. The Emojis were 76 in the year 1995 and have increased to 3663 by 2022. The 😭 (loud crying face) is considered to highest used in the year 2021[1]. The accuracy of SA increases by including Emojis. They represent unique sentiments and emotions embedded in them. So, our proposed work includes SA with both text and Emojis using Deep learning algorithms. We also propose to generate embedding for Emojis with similar words around them. The DL algorithms accept the numeric data. So, in this paper, we used word embeddings like Word2Vec to convert product reviews into a vector form and four Deep Learning classifiers are used [16] [20].

The proposed research work is organized in the following manner. Related Literature Survey is in section-2, the Solution for the proposed problem in Section 3 and in Section 4 the Sentiment Analysis of Product Reviews.

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A Soft Hyper Tuned Voting Ensemble Classifier integrated with One Versus All Approach to Identify the Erythemato-Squamous Disease.

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ABSTRACT One of the dangerous diseases that are ruining the life of many people in different countries irrespective of age and gender is "Skin Cancer," and generally, people neglect skin-related issues with a view that it is not dangerous. Patients need a system to did developed so that it should be able to predict the type of cancer at an early stage so that it helps them take precautions and get rid of adverse effects on their lives. In the existing systems, either the traditional algorithm that supports multi-classification is applied, or native ensemble approaches are implemented, because of which overfit problem is raised among the recall and precision metrics. So, the proposed system first identified the best features among the existing 34 features and selected three multi-classification algorithms, which are given reasonable accuracy rates when executed standalone. Now, the system hyper tuned all these algorithms to generate the best estimators for each algorithm so that these modules generate optimal values based on the weights and overcome the problems associated with recall and precision by defining soft voting ensemble classification and also improve the accuracy of the model using one versus all mechanisms.

Keywords: One versus All, Estimators Hyper Tuning, Soft Voting, Ensemble, Pipeline, Multi Classification.

I. INTRODUCTION

In the current scenario, the "Optimal Weights" is the most popular word continuously repeating in the world of machine and deep learning to yield better results by the different models with less time complexity. The process of selecting ideal values for each algorithm is known as "Hyper Parameters," and presenting the best model with an optimal solution is known as "Hyper Tuning." The primary concept of the tuning process is dividing the entire data into three parts instead of two parts, unlike the naive approaches. The validation part is the crucial element in the tuning phase, which optimizes the entire architecture. There are two types of Hyper Tuning mechanisms, as illustrated below.

Grid Search

A dictionary is created with all possible values of various parameters. It is the best example for exhaustive search, for every iteration. Suppose the system wants to check possible parameter combinations for C-value and gamma in SVM, then it is represented in table 1.

Table 1: Grid Structure for C-value and Gamma

C-Value/Gamma	1	0.1	0.001
1	(1,1)	(1,0.1)	(1,0.001)
10	(10,1)	(10,0.1)	(10,0.001)
100	(100,1)	(100,0.1)	(100,0.001)

Bayesian Optimization

The major focus of this approach is to reduce the loss function along with the steps to find the minimum weights. It always finds the best current node with less weight by constructing a tree at every step and designing an activation function. The activation function always considers the population while training the data. Various frameworks like OPTUNA, Hyper Band, and Ray Tune use this approach, but all these are good at training the smaller datasets with more effort invested on it.

II. LITERATURE SURVEY

In [1], Sivasankari Sivasubramanian et al. exhibited a case study using the ontology for marking the benchmarks to the classifiers. The author has chosen ontology to clearly represent the relationship between the disease and treatment based on the patients' symptoms in the current instance. The primary focus of this work deals with the attribute selection by computing the gain values for all the non-redundant features. In this approach, the model represented 19 features as important; to achieve this, it has constructed an automated rules generator component

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Trlu: A Customized Activation Function to Detect Erythemato-Squamous Skin Cancer at Early Stage

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ABSTRACT: The life risk factor for the cancer disease is becoming more and more in the present living life style. Many researchers focused on skin cancer using machine learning approaches, but when working with multi classification data, it is observed that ANN gives better results, if the input data is keeps on adding in the real time scenario. This proposed system focuses on the classification of the skin cancer types by designing the neural network based on the customized activation function. Many parameters are involved in designing a suitable classifier using NN like learning rate, optimizer, activator, and other normalization layers. This paper majorly focuses on the activation function and number of neurons associated with the layer because these two parameters play a vital role in the entire accuracy of the model. Among the existing activators, the combination of tanh and relu has given high value base on them; a new activation function is designed.

Keywords: Multi Classification, tanh, relu, estimators, optimizer, sparse categorical loss, cross entropy

INTRODUCTION:

The existing skin cancer detection system using neural network has used either same activation function for all the layers or different activation functions for different layers but the proposed system identifies the deviation of the input values at different points and designed a mathematical function that normalizes the inputs units[6]. The process of converting the dot product sum obtained from input into desired output form is known as "activation or transfer function". The derivation computation of the activation function from the input values helps the back propagator to adjust the weights to minimize the error.

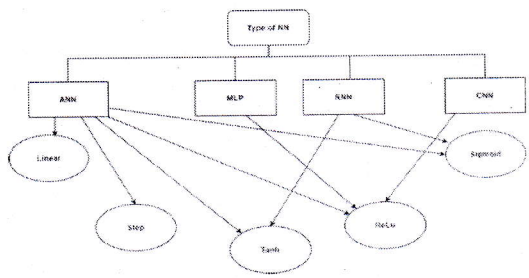

Figure 1: Common Activation Functions Implemented in Hidden Layers

In general, any neural network contains input layer, hidden layer, and output layer. Regarding output layer based on problem statement only 3 activation functions are available but when it comes to hidden layer, figure 1, represent the common activation functions utilized by different networks. The major goal of the tanh function is to adjust the values in between -1 to 1. Generally plotting these values on input scale of -10 to 10, the function produces an s-shaped graph[7]. The mathematical representation of this function is presented in equation (1)

$$\tanh(input) = \frac{(e^{input} - e^{-(input)})}{(e^{input} + e^{-(input)})} \text{ - (1)}$$

Tanh is famous for uniform weight initialization process but it suffers from "vanishing gradient problem", where the activation function tries to converge the large input vector space into small range of values by using derivates, during this process, at some point saturation occurs and the value becomes zero. ReLu normalizes the values either to 0, if it is positive else gives the value as 1[8]. The function appears to be linear but it learns the complex function rapidly because of its linear units associated with the previous layers. The model suffers from "Dying ReLu problem" when most of the input values are normalized

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(57) Abstract :

Abstract of the Invention: It is very important and crucial to see that the files/documents which are of at most important to the organization and the government departments including the Research departments are to be maintained with complete security, privacy, and with authenticity. So in this process in order to ensure that the documents are protected and maintained we have made use of the Blockchain for the same. Blockchain technology will provide magical solutions for all the problems associated with the centralized storage. This technology will help the organizations to safeguard their documents with complete integrity and transparency. The use of Blockchain technology will help in providing security in distributed environment, eliminating the need for centralized authority. This will also help in maintaining complete transparency where in no user can make any kind of modifications to the data stored in Blockchain database. The data is stored in a encrypted form which enhances the security layer for the data stored. As the data is stored in a distributed manner where in all the nodes store the data it becomes easier to have an access to the required data. As it is performed in distributed ledger System. The technology also ensure corruption free data, which is because the data is stored on multiple nodes and the access is providing or the request for storage is given only when majority of the nodes validates the request. The consensus algorithm used will help the network to make faster decisions where in all the nodes has the say for the request made. The technology is completely organized and is not dependent on the calculations made by the human beings, which makes it highly fault tolerant. The technology makes use of the concept of decentralization to store the data which makes it to survive from any kind of malicious attacks. So we can say the system will not have any kind of breakdowns. This will also ensure that the high cost will be involved to break or to temper the system by the hackers. The dependency on the third party is completely eliminated as the data is stored in decentralized manner and not in a centralized form. This will make the user to have control over the data and dependency on third party is almost negligible. The other advantage of this technology is it programmable where in smart contracts can be created to decide on the policy of providing access to the system. The records/data stored are immutable which is to say cannot be altered at any point of time, because of the use of timestamp associated with each block. All the nodes will unanimously will help to make the decision in order to validate the record for access or to store.

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(57) Abstract :
Abstract IoT is employed in the supply chain for garden-fresh agrarian products (FAPs), which can be synchronized via an income-sharing partnership. This research aims to make the different stages of the source system chain in the IoT coordination by enchanting into the stimulus of FAP on marketplace needs and the expenses of freshness control. One of this study's primary aims is better to understand the 3 tiered FAP supply system chain in IoT. As a result of this research, an enhanced revenue-sharing contract is developed, along with a profit-related model based on the practical solution whenever the supply chain accomplishes extreme profitability in three different decision-making scenarios. Using the improved revenue-sharing contract, manufacturers, distributors, and retailers in the IoT supply chain can all benefit from better supply chain coordination. After coordinating the supply chain, it is possible to increase the utilization rate of resources. Aside from reducing waste, IoT also improves FAPs' circulation efficiency, which reduces costs. A case study is recycled to test the model's validity.

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(57) Abstract :
The current invention is meant for recognizing human emotions and classifying them into different categories such as anger, happy, sad, surprise etc. It is an Artificial Intelligence (AI) enabled framework that leverages detection performance. It follows a supervised learning based phenomenon to detect human emotions and classify the same. It has different components involved to realize the system. They include pre-processing, ROI detection, feature extraction, training and testing. Pre-processing takes care of enhancing given image for better quality. ROI detection is meant for detecting face region from where expressions can be recognized. Feature extraction is made up of a hybrid approach that has fusion of different approaches such as colour features, SIFT features, DWT features and daisy wheel features. It has provision to exploit training database continuously. At the same time, it improves labelling from time to time and updates training database so as to improve quality of training on regular basis. CNN based classifier is used for training the model. An emotion recognition system is realized with the underlying components that work together. The current invention has benefits to many stakeholders. The stakeholders include businesses using computer vision applications, organizations, governments, researchers and academia.

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(57) Abstract :
The present invention discloses an Internet of Things (IOT) equipment based secured cloud network communication system and method thereof. The method and system include, but not limited to, an IoT communication interface configured to receive IoT data signals from and transmit signals to a IoT access point and a user terminal via an IoT cloud network; and a processing unit configured to receive, via the IoT communication interface, an access request sent by the IoT access point, the access request carrying user / node information of the IoT user terminal attempting to access the IoT access point; determine whether the IoT access point is a trusted IoT access point after the access request is received. Accompanied Drawing [FIG. 1]

No. of Pages : 22 No. of Claims : 9

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :05/04/2022

(21) Application No.202241020616 A
(43) Publication Date : 15/04/2022

(54) Title of the invention : A SYSTEM FOR PRIVACY-PRESERVING MEDICAL RECORD SEARCHING ENGINE FOR AN ARTIFICIALLY INTELLIGENT BASED DIAGNOSIS IN IOT HEALTHCARE

(51) International classification :G16H0010600000, A61B0005000000, G16H0050200000, G06N0020000000, G06N0005020000
(86) International Application No :PCT//
Filing Date :01/01/1900
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA
Filing Date :NA
(62) Divisional to Application Number :NA
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(57) Abstract :
The present invention discloses a system for privacy-preserving medical record searching engine for an artificially intelligent based diagnosis in IoT healthcare and method thereof. The system includes, but not limited to, at least one processor; at least one non-transitory computer readable storage medium storing instructions thereon, that, when executed by the at least one processor, cause the system to: a local host having an artificial intelligence security interface who owns a disease case-database, in which medical record searching engine is a data provider who possesses disease case-database containing a set of confirmed cases solutions and corresponding body parameters, and the patient is a client who needs to invoke useful confirmed case solutions associated with the body parameters from the artificial intelligence security interface for protecting the security of the patient and the artificial intelligence security interface, the proposed system needs to achieve bilateral security. Accompanied Drawing [FIG. 1]

No. of Pages : 24 No. of Claims : 9

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :10/03/2022

(21) Application No.202241013084 A
(43) Publication Date : 25/03/2022

(54) Title of the invention : A Novel Method of Detecting IoT Malware using Deep Learning

(51) International classification :G06F0021560000, H04L0029080000, G06K0009620000, H04L0029060000, G06N0003040000
(86) International Application No :PCT// /
Filing Date :01/01/1900
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA
Filing Date :NA
(62) Divisional to Application Number :NA
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(57) Abstract :
In response to the growing availability of the Internet, the Internet of Things (IoT) is a network of devices that gather and transmit data across wireless networks without the need for human interaction. The IoT Malware is capable of scanning open ports for IoT services and launching a brute-force attack in order to get access to IoT. The analysis of malware in an IoT network of this nature is difficult. The IoT Malware Analysis System with Deep Learning Approach that has been disclosed here makes IoT Malware Analysis a simple task to perform. The present invention discloses a system for detecting threats in IoT networks and method thereof. The method and system include, but not limited to, a method of deep learning to detect the IoT Malware. The present invention disclosed herein is a Novel Method of detecting IoT Malware using Deep Learning comprising of: IoT Malware Dataset (201); Clean Dataset (202); Converter (203); Descriptor (204); Detection (205); Classification (206); used to detect and classify the various IoT Malwares present in the IoT Network. The present invention disclosed herein uses a deep learning approach to detect and classify the malwares. The Deep Convolutional Neural Network Classifier provides the Malware Classification Accuracy of 98.6%.

No. of Pages : 14 No. of Claims : 9

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :18/02/2022

(21) Application No.202241008725 A
(43) Publication Date : 04/03/2022

(54) Title of the invention : A server updation method and system using IoT environment

(51) International classification	:H04L0029080000, H04L0029060000, G06F0008654000, H04W0012060000, G06F0008658000
(86) International Application No Filing Date	:PCT// :01/01/1900
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

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(57) Abstract :
The present invention discloses a server updation method and system using IoT environment. The system includes, but not limited to, a terminal device provided in the Internet of Thing (IoT) based system, having a data updating server, the data updating server is in communication connection with the terminal device; the terminal device includes a receiving module configured to receive the encrypted public key sent by the data updating server in the IoT environment; the receiving module is configured to receive an update secret key sent by the data updating server, which is encrypted by the update service area using an encryption private key that matches the encryption public key in the IoT environment. Accompanied Drawing [FIG. 1]

No. of Pages : 23 No. of Claims : 9

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :26/03/2022

(21) Application No.202241017480 A
(43) Publication Date : 15/04/2022

(54) Title of the invention : Real Time Agriculture Field Monitoring System Using IOT

(51) International classification	:A01G0025160000, H04L0029080000, A01C0023040000, H04L0029060000, A01G0025020000
(86) International Application No Filing Date	:PCT// :01/01/1900
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

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(57) Abstract :
A cloud-based intelligent irrigation system is the subject of the invention. Irrigation devices, sensors, and an Internet of Things terminal management controller are connected to the Internet of Things terminal management master controller with enabled Artificial Intelligence (AI). The Internet of Things terminal management controller is connected to the intelligent irrigation cloud data center via a wireless network. A user logs in to the intelligent irrigation cloud data center. Cloud computing, the Internet of Things (IoT), big data, mobile application, and artificial intelligence technology are all employed in the system, which is simple, easy, and convenient; the timeliness is good, and network convenience is easy; the reliability is high; the transmission rate is fast, and an advanced Internet of Things intelligent irrigation system based on cloud computing is provided for the application and promotion.

No. of Pages : 24 No. of Claims : 5

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :25/04/2022

(21) Application No.202211024152 A
(43) Publication Date : 29/04/2022

(54) Title of the invention : DETECT AND PREVENT THE DATA LEAKS USING SQL & AI SYSTEM FROM BIG DATA SOURCE

(51) International classification :H04L0029060000, G06N0020000000, G06K0009200000, G06F0016280000, G06N0007000000
(86) International Application No :NA
Filing Date :NA
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA
Filing Date :NA
(62) Divisional to Application Number :NA
Filing Date :NA

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(57) Abstract :
When utilized in a computer network context, a security platform is a collection of techniques and processes used to detect and react to security-related irregularities and threats. Big data is used to power the security platform, which conducts security analysis using machine learning methods. The security platform leverages user/entity behavioural analytics to discover security-related anomalies and threats. This is true regardless of whether the security platform was previously aware of the anomalies or threats. When it comes to spotting irregularities and threats, the security platform may include real-time and batch techniques and modes and different detection methods. Through the provision of graphically represented analytical data graded with risk ratings and supporting evidence, the security platform enables network security administrators to respond to an anomaly or threat that has been identified and take the necessary action as quickly as feasible.

No. of Pages : 20 No. of Claims : 4

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :01/05/2022

(21) Application No.202241025478 A
(43) Publication Date : 13/05/2022

(54) Title of the invention : Improve Learning Possibilities Using Block chain & AI

(51) International classification :G06Q0050200000, G06N0020000000, G09B0005080000, G06Q0090000000, A45C0015060000
(86) International Application No :PCT// Filing Date :01/01/1900
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA Filing Date :NA
(62) Divisional to Application Number :NA Filing Date :NA

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(57) Abstract :
Though advances in technology have enabled the education sector to improve faster than ever before, there are still many areas that have yet to be found, and there is always the potential for future advancements in the field of education. Machine learning (ML) and blockchain, two of the most disruptive technologies, have assisted in replacing traditional methodologies employed in the education industry with more technological and effective solutions. In this research, a system is developed that integrates these two radiant technologies and aids in the resolution of issues such as forgeries of educational records and the issuance of bogus degrees. When these technologies are combined and a system is developed that uses blockchain to store student data and machine learning to accurately predict students' future job roles after graduation, it is hoped that the problems of further counterfeiting and insecurity surrounding student achievements will be avoided. Additionally, machine learning models will train and forecast legitimate data. This system will offer the institution an official decentralized database of student records about those who have graduated from the university due to their participation. Also included is a platform for businesses to verify the educational records of their workers, which is accessible via this system. Online sites such as LinkedIn, which is used for maintaining professional accounts, allow students to share the educational information included in their e-portfolios with their peers. Students, businesses, and other sectors will have an easier time obtaining clearance for student data due to this.

No. of Pages : 19 No. of Claims : 3

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :01/05/2022

(21) Application No.202241025480 A
(43) Publication Date : 13/05/2022

(54) Title of the invention : Multi Speed Drone for Remote Field Monitoring System

(51) International classification :G08B0013196000, H04N0007180000, G08B0013140000, H04W0088020000, H04W0080000000
(86) International Application No :PCT//
Filing Date :01/01/1900
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA
Filing Date :NA
(62) Divisional to Application Number :NA
Filing Date :NA

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(57) Abstract :
Proposed Invention related to a remote control video surveillance device that incorporates the video camera and various kinds of sensors that transmit sensed data to other computers through wireless Internet capabilities. The remote unit is equipped with a cellular telephone transceiver, allowing it to be utilized in distant places or on mobile platforms without any hard-wired cable connections. In this case, the remote unit serves as a video surveillance platform, communicating with the base station computer through the cellular network and then the Internet. The IP address of the remote device is dynamic, but the IP address of the base station computer is static. Using the Internet, user PCs may also log in to the remote unit and receive data. This is accomplished by connecting the base station to the remote unit.

No. of Pages : 19 No. of Claims : 6

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :25/04/2022

(21) Application No.202241024357 A
(43) Publication Date : 27/05/2022

(54) Title of the invention : Smart Parking System Using AI of Things (AIOT)

(51) International classification :G08G0001140000, E04H0006340000, B60W0030060000, E04H0006300000, G06Q0020320000
(86) International Application No :PCT// Filing Date :01/01/1900
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA Filing Date :NA
(62) Divisional to Application Number :NA Filing Date :NA

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(57) Abstract :
An automated parking system is a system that is capable of parking, transferring, storing, and retrieving a large number of cars. At least one communication system includes a tracking system and a transport system that includes at least one vehicle-transporting movable transporter and at least one vertical transportation facility for transporting the vehicle-transporting movable transporter. The automated parking system creates a parking scheme that includes at least one vacant parking space in a parking area. The unoccupied parking space is determined by determining the number of vehicles in the parking area.

No. of Pages : 20 No. of Claims : 4

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :18/06/2021

(21) Application No.202141027199 A
(43) Publication Date : 02/07/2021

(54) Title of the invention : DIGITAL IMAGE PROCESSING TECHNIQUES USING MATLAB

(51) International classification	:G06T0005000000, G06K0009400000, G10L0021023200, H04L0027000000, G01N0029460000
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No Filing Date	:NA :NA
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

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(57) Abstract :
Abstract: High-frequency edges are among the most critical elements of a digital image. Reducing the noise using the conventional filter removes it efficiently. But the picture would be distorted. In other words, to keep the quality of the edge, we should avoid reducing the noise of the image. A wavelet analysis approach, also known as time-frequency analysis, utilizes an adjustable frequency band depending on the properties of the signal. To increase the time-frequency resolution, the frequency band must resemble the spectrum. The signal reduction process is much improved using the wavelet analysis approach. It covers the fundamentals of wavelet analysis. Our findings reveal that the de-noising approach is present in the orthogonal wavelet transform, which utilizes a soft and hard threshold. A de-noising approach has been proposed that utilizes the wavelet transform to resolve picture noise and edge protection based on MATLAB.

No. of Pages : 14 No. of Claims : 5

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :18/06/2021

(21) Application No.202141027310 A
(43) Publication Date : 02/07/2021

(54) Title of the invention : AN INTELLIGENT WAY TO TRACK VALUABLES USING LOCATION TRACKING BUZZER BOX

(51) International classification	:E05G0001000000, E05G0001140000, A45C0011160000, G08B0021180000, G06Q0010060000
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No Filing Date	:NA :NA
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

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(57) Abstract :
Abstract Security is one of the pivotal factors for people in contemporary world. From riches to lower middle class everyone has valuable items which are supposed to be guarded. The new age technology paved a way to create a product which serves a compact security • in terms of size and price. It is named as LTBB (Location tracking buzzer box) At a glance it can be described as moving security box with various user-friendly features available at shoe string budget.

No. of Pages : 15 No. of Claims : 6

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :18/05/2021

(21) Application No.202141022167 A
(43) Publication Date : 11/06/2021

(54) Title of the invention : A NOVEL APPROACH TO IDENTIFY THE FACIAL PARTS USING LOCAL BINARY PATTERN AND COMBINED LVQ CLASSIFIERS

(51) International classification	:G06K0009000000, G06K0009620000, G06K0009460000, G06K0009660000, G06N0020100000
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No Filing Date	:NA :NA
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

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(57) Abstract :
Abstract Security is place a major role in current industry. Authentication of the person is very important in the real world to access the information. One of the best methods is Face recognition which is used for human identification and verification. This biometric method has a unique feature from recognizing one person to another in security field. We propose an algorithm for Face recognition and classification called on Local Binary Pattern (LBP). In static approach, LBP consists of histogram properties for feature extraction. Combined Learning Vector Quantization (LVQ) Classifier is used as Neural Network approach in order to recognize the image form database. The input image is first divided into small regions like eyes, nose, and mouth from which Local Binary Patterns (LBP) histograms are extracted and concatenated into a single feature vector. This input vector is calculated using Euclidian distance to generate the output.

No. of Pages : 14 No. of Claims : 3

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :05/06/2021

(21) Application No.202141025072 A
(43) Publication Date : 11/06/2021

(54) Title of the invention : Building Confidential and Efficient Query Services in the Cloud with RASP Data Perturbation

(51) International classification	:G06F0016270000, H04L0029080000, A61B0017160000, G06F0016330000, G06F0016242000
(31) Priority Document No	:NA
(32) Priority Date	:NA
(33) Name of priority country	:NA
(86) International Application No Filing Date	:PCT// :01/01/1900
(87) International Publication No	: NA
(61) Patent of Addition to Application Number Filing Date	:NA :NA
(62) Divisional to Application Number Filing Date	:NA :NA

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(57) Abstract :
Abstract With the improvement of administrations figuring and distributed computing, it has turned out to be conceivable to outsource extensive databases to database specialist co-ops and let the suppliers keep up the range-inquiry benefit. Nonetheless, a few information may be touchy that the information proprietor does not have any desire to move to the cloud unless the information classification and inquiry security are ensured. We propose the Random Space Encryption (RASP) approach that permits productive range look with more grounded assault versatility than existing proficiency centered methodologies. The arbitrary space irritation (RASP) information annoyance technique to give secure and proficient range question and kNN inquiry administrations for ensured information in the cloud. The RASP information annoyance strategy consolidates arranges protecting encryption, dimensionality development, arbitrary com motion infusion, and irregular projection, to give solid flexibility to assaults on the irritated information and questions. It likewise saves multidimensional reaches, which enables existing ordering systems to be connected to speedup extend question handling. The kNN-R calculation is intended to work with the RASP go inquiry calculation to process the kNN inquiries.

No. of Pages : 15 No. of Claims : 5

Australian Government

IP Australia

CERTIFICATE OF GRANT

INNOVATION PATENT

Patent number: 2021103495

The Commissioner of Patents has granted the above patent on 16 March 2022, and certifies that the below particulars have been registered in the Register of Patents.

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Title of invention:

A Novel System for Digital Marketing using Artificial Intelligence and Blockchain

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Term of Patent:

Eight years from 21 June 2021

NOTE: This Innovation Patent cannot be enforced unless and until it has been examined by the Commissioner of Patents and a Certificate of Examination has been issued. See sections 120(1A) and 129A of the Patents Act 1990, set out on the reverse of this document.

COMMONWEALTH OF AUSTRALIA AUSTRALIA PATENT OFFICE

Dated this 16th day of March 2022

Commissioner of Patents

PATENTS ACT 1990

The Australian Patents Register is the official record and should be referred to for the full details pertaining to this IP Right.

This data, for application number 2021103495, is current as of 2022-08-09 21:00 AEST

Australian Government

IP Australia

CERTIFICATE OF GRANT

INNOVATION PATENT

Patent number: 2021103495

Dated this 16th day of March 2022

Commissioner of Patents

COMMONWEALTH OF AUSTRALIA AUSTRALIA PATENT OFFICE

PATENTS ACT 1990

The Australian Patents Register is the official record and should be referred to for the full details pertaining to this IP Right.

Extracts from the Patents Act, 1990

Sect 120(1A) Infringement proceedings in respect of an innovation patent cannot be started unless the patent has been certified.

Sec 128 **Application for relief from unjustified threats**

(1) Where a person, by means of circulars, advertisements or otherwise, threatens a person with infringement proceedings or other similar proceedings a person aggrieved may apply to a prescribed court, or to another court having jurisdiction to hear and determine the application, for:

(a) a declaration that the threats are unjustifiable; and

(b) an injunction against the continuance of the threats; and

(c) the recovery of any damages sustained by the applicant as a result of the threats.

(2) Subsection (1) applies whether or not the person who made the threats is entitled to, or interested in, the patent or a patent application.

Sec 129A **Threats related to an innovation patent application or innovation patent and courts power to grant relief.**

Certain threats of infringement proceedings are always unjustifiable.

(1) If:

(a) a person:

(i) has applied for an innovation patent, but the application has not been determined; or

(ii) has an innovation patent that has not been certified; and

(b) the person, by means of circulars, advertisements or otherwise, threatens a person with infringement proceedings or other similar proceedings in respect of the patent applied for, or the patent, as the case may be;

then, for the purposes of an application for relief under section 128 by the person threatened, the threats are unjustifiable.

Courts power to grant relief in respect of threats made by the applicant for an innovation patent or the patentee of an uncertified innovation patent

(2) If an application under section 128 for relief relates to threats made in respect of an innovation patent that has not been certified or an application for an innovation patent, the court may grant the application the relief applied for.

Courts power to grant relief in respect of threats made by the patentee of certified innovation patent

(3) If an application under section 128 for relief relates to threats made in respect of a certified innovation patent, the court may grant the applicant the relief applied for unless the respondent satisfies the court that the acts about which the threats were made infringed, or would infringe, a claim that is not shown by the applicant to be invalid.

Schedule 1 **Dictionary**

certified, in respect of an innovation patent other than in section 19, means a certificate of examination issued by the Commissioner under paragraph 101E(e) in respect of the patent

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A survey paper on design and implementation of multipliers for digital system applications

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Abstract
Multiplication is one of the essential functions in all digital systems. The evaluation of digital system, have brought out new challenges in VLSI (Very Large Scale Integration) designing. Multipliers are generally utilized in digital signal processing. Increasing technology has maximized the demand for rapid and efficient real-time digital signal processing applications. A huge number of multiplier designs have been developed for improving its speed. This manuscript provides an exploration of the different studies that have been conducted since 2015. This manuscript reviews investigation depends on various types of multipliers. A thorough statistical analysis is provided in this review which was conducted by extracting information from 100 papers published between the years 2015–2020. When comparing the adders, obtain the Ripple Carry Adder had lesser area while it had lower speed, in contrast to Carry Select Adders they are great speed but greater area. A Carry Look Ahead Adder sits among spectrum has a suitable balance among complexities of time and area. After designing and comparing the adders, turned to multipliers. At first opted for Parallel Multiplier and then Wallace Tree Multiplier. Meanwhile, learned the amount of delay was greatly decreased while Carry Save Adders were utilized on Wallace Tree applications. In this review, present the comparison and analysis of investigation manuscript depends on several criteria. In general, this manuscript summarizes the current state of knowledge of these multipliers. In this, the comparative analysis depends on timeline, reputation of simulation tools and types of device components are analyzed.

Keywords Very large scale integration · Multipliers · Digital signal processing (DSP) · Parallel multiplier · Carry save adders · Carry look ahead adder

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1 Introduction

In digital signal processing, Microprocessors and machine learning applications greatly dominated using multiplication. Multiplier is a significant component on several hardware platforms. There are four arithmetic operations, like addition, multiplication, subtraction, and division. Out of these multiplication is frequently used operation (Chang et al. 2020). The world today is moving towards digitalization i.e. existing analogue systems in all fields are being upgraded to digital systems with the aim of reducing size, power reduction and increasing speed levels through digital systems with IC. Multiplication often occurs at FIR filters, fast Fourier transformations, convolution and other significant DSP and multimedia kernels. But multipliers affect DSP speed and complexity systems, so high-speed with less complexity and low delay multipliers are required for maximizing system performance. Therefore, numerous studies have introduced low-power methods. By multiple low-power methods need a great design and area (Kavitha and Rangarajan 2020; Mythili et al. 2020).

In digital design, Approximate Computing (CA) is raising trend that relaxes the requirement of correct computing to obtain a substantial performance development based on power, speed and area. The focus is increasingly important for mobile and embedded systems, characterized using speed and energy constraints (Babu et al. 2018; and Rajesh 2020). Assume the huge number of application domains display an intrinsic fault tolerance. Some examples are DSP, data analysis, image processing, machine learning, and data mining. Fuzzy computing emerges as an effectual solution for reducing its power dissipation (Ernest Ravindran et al. 2019). At rough computing, error has shown to be commodity, which may be traded for major gains on power, energy, and performance, and outcome, it creates a hopeful design model that targets an energy-efficient system by greatly reducing the inherent error power consumption respective applications (Leon et al. 2018; Rajesh and Shajin 2020).

Therefore, digital multipliers are extensively used. Approximate computing decreases energy consumption and maximizes speed, more particularly, at numerous signal processing is a great part of energy consumption due to arithmetic operations, nearly 75% of total energy consumption (Shajin and Rajesh 2020). It creates good candidate approximate multipliers for use in error-tolerant signal processing units. Thus, it is important to work on the multiplier unit which provides high speed, low power consumption and low area (Alouani et al. 2018; Thota et al. 2020; Ansari et al. 2018; Behl et al. 2020).

Multipliers consist of three phases: (i) Generation of partial products (ii) Reduction of partial products (iii) Addition. Several methods have been proposed for decreasing partial products at multiplier. Out of them, compressor use at partial product reduction phase is most admired. Compressors are an essential circuit that creates up of full adders or half adders for counting a number of ones at input. At partial product reduction phase some compressors are required. Various compressors like 3–2, 4–2, 5–2 and 5–3 were proposed. Such compressors are helpful only the multiplier size is less. Large compressors are required in 16X16 and 32X32 bit multipliers. Higher-level compressors give good outcomes at power and speed. It takes up more area to low-level compressor. In this approximate 15–4 compressor is intended using approximately 5–3 compressor (Marimuthu et al. 2017; Afzali-Kusha et al. 2020; Ahmed et al. 2019; Bhattacharjee et al. 2017; Xue et al. 2018; Yan et al. 2020).

Multipliers occupy a significant role on today's digital systems. High performance systems like microprocessor, digital signal processing, and multiplication of two binary numbers are essential and frequently utilized arithmetic functions. But low speed, power and

delay affect the fast multiplication process. Review has been conducted from 2015 to 2020. We have collected the information from 100 research papers published between the years 2015–2020. Various multipliers based on speed, area, power and delay. This manuscript provides a survey on different type of multipliers in VLSI (Karunakaran and Gattim 2019; Soumya et al. 2019; Priyadarshini et al. 2019; Esposito et al. 2018). This review article summarizes the current state of understanding the multipliers. This paper surveys and summarizes previously published research papers.

This paper summarizes the literature survey in Sect. 2, whereas information regarding the background in Sect. 3, in Sect. 4 presents that taxonomy of multipliers (Mariya Priyadarshini et al. 2019; Ha and Lee 2018; Jiang et al. 2019a, b; Strollo et al. 2020). Comparison and analysis of the work related to multipliers are discussed at Sect. 5. Section 6 concludes the manuscript.

2 Literature review

Among various research works on multiplier designs, some of the most recent works were reviewed in this section.

Ullah et al. (2021) approximate multipliers for FPGA-based hardware accelerators. Soft multiplier IP cores FPGAs require enhanced designs to give great performance. This minimum latency, exact and approximate soft core multiplier optimized for generic areas, exploiting the architectural characteristics of FPGAs, i.e., lookup table structures (LUT) and fast carry chains to diminish resource and general delay of the critical path use of multipliers. Likened to Xilinx's Logi CORE IP multiplier, the precise unsigned and signed architecture gives up to 25% and 53% diminution on LUT utilization, correspondingly, for dissimilar multiplier sizes. Additionally, the unsigned approximate multiplier architectures up to 51% reduction under critical path delay may be accomplished through negligible loss at output accuracy likened to Logi CORE IP.

Mittal (2020) presented FPGA-based accelerators for convolutional neural networks to optimize integer and binary operations in FP operations and increase system efficiency. In this, the multiplier was used to reduce the number of multiplications on convolution operation. This algorithm maximizes that number of additions, the total cost was diminished based on greater relative overhead of multiplier likened to adder. They realize that 1D CONV engine under the form of a four-stage pipeline.

Mrazek et al. (2020) have presented the use of approximate circuit libraries under the design of deep neural network hardware accelerators. QoS under fault-resistant applications like deep neural network (DNN) hardware accelerators. For instance, EvoApprox8b has hundreds of approximate 8-bit adders and multipliers. Such circuits create Pareto fronts regarding with various error metrics, power consumption, along with other circuit parameters. The huge set of estimated multipliers may be utilized to execute resilience analysis of ResNet DNN hardware accelerator and choose most appropriate approximate multiplier.

Faraone et al. (2019) has presented Addnet: Deep neural networks with multipliers optimized for FPGAs. In this method, the proven reconfigurable constant coefficient multipliers (RCCM) suggest best option to save silicon area using low precision arithmetic. RCCMs multiply input values through constraint selection of coefficients with only adders, subtractors, bit shifts, and multiplexers (MUX). To lessen the loss of quantification information, developed novel training processes map the probable coefficient representations of RCCMs. To reveal that advantages of techniques with AlexNet, ResNet-18, and ResNet-50

networks. This RCCM of minimum resource requirements outperforms 6-bit fixed point precision, as the entire executions using RCCM accomplish accuracy at least equal to 8-bit uniformly quantized design.

Pilipović et al. (2020) have presented the logarithmic multiplier design with radix-4 booth encoding. Though, these advantages come at cost of decreased accuracy. RCCMs multiply input values through constrained selection of coefficients with adders, subtractors, bit shifts, and multiplexers (MUX). These RCCMs adapted to FPGA logic elements to guarantee its efficient use. To diminish the loss of quantification information, training techniques were developed. This allows the use of RCCMs on hardware, maintaining high precision. The advantages of processes with AlexNet, ResNet-18, and ResNet-50 networks. The outcoming performance accomplish up to 50% resource savings compared to traditional 8-bit quantized networks, resulting in major accelerations and power savings. The minimum resource requirement outperforms 6-bit fixed point precision, as the entire performances through RCCM realize precision at least equal with 8-bit uniformly quantized design.

Liang and Yin (2018) presented a binarized neural network (BNN) for FPGAs, radically reduces hardware consumption as maintaining acceptable precision. One method of resource-aware model analysis (RAMA) is to eliminate restricted access to bit-level XNOR multipliers and variable operations, and bottleneck of parameter access through data quantization and optimized storage on chip. The FP-BNN accelerator designs of MNIST's Multilayer Perception (MLP), Cifar-10 ConvNet, and AlexNet on Stratix-V FPGA system.

Shanmuganathan and Brindhadevi (2019) presented an overview analysis of several types of low effective power multipliers. The author discusses different kinds of multipliers, like Wallace's tree multiplier, Array multiplier, and Baugh's wooley multipliers. Physical verification of entire its surrogate blocks were done to test its capacity as well as appropriateness and for improving the low power through the transistor size. In this Wallace tree, the multiplier is utilized for high speed operations. Array multiplier displays significant part of delay and least important part of area. Therefore, it has been analyzed that entire multipliers has its own unique merits and demerits of several performance actions as well as application nature and restriction in area, the power and delay when utilizing Xilinx. Among three multipliers, speed and power consumption of Baugh wooley multiplier was least, though array multiplier might be best for small area functions.

Stoeva and Balazs (2020) presented survey on multipliers of frames and associated concepts. In particular, this survey contains a brief motivation for why it is interesting for assuming multipliers, a review and an extension of current outcomes, dedicated to unconditional convergence of multipliers, a adequate and essential condition for multiplier invertibility. A multiplier is a filtering variable in time. Multipliers are app-motivated and may be easily understood. In DSP, multipliers are specific way for implementing time-varying filters. Some of representations of inverse multipliers are performed at Matlab codes and algorithms are explained.

3 Background

3.1 Multipliers

Multipliers carry out a vital role on today's DSP and several other uses. Multiplication is one of the most important functions at numerous computer systems. The fundamental design goals

of multiplier contain high speed, low power consumption, design regularity together with less area. Addition and multiplication of two binary numbers is used in high performance system and it is the basic and most widely utilized arithmetic functions. We utilize a multiplier at various DSP applications. We utilize it for design calculators, mobiles, processors as well as digital image processors. Multiplier architecture consists of three parts.

Figure 1 shows the Block diagram of Multiplier Architecture.

Leon et al. (2019) suggest a novel and efficient algorithm for multiplying Double Least significant Bits (DLSB) number in 2's complement. DLSB arithmetic offers some advantages, like range of symmetric representation, numerical negation execute only using bitwise inversion, and facilitation of process at outcomes of floating point architecture. DLSB arithmetic depend on including additional least significant bit (LSB), which consist of similar weight as original LSB. (Praveen Kumar et al. 2020) Hardware overhead of proposed circuit, while executed in 45 nm, is insignificant compared to conventional modified Booth multiplier of ordinary 2's complement numbers. At last, they show the proposed multiplier may be used to execution of large multiplications based on conventional one, decreasing total complexity of circuit and gives better levels of energy consumption. (Singh et al. 2016).

A novel sequential multiplier design was proposed, which creates the radix-16 partial products from two components high (H) and low (L) (Hosseinzadeh Namin et al. 2018). 3X multiple are realized from rigid multiple and therefore unpleasant at multiplier design practice, as it takes a full cycle toward create. Modified cabin multipliers eliminate said multiples of radix-4 multipliers. At same time, for decreasing total number of cycles, larger radix multiplication methods are general in which highest radix Booth encoding cannot prevent multiples of 3X. Two radix-16 carry and save adders were utilized for creating cumulative partial product of radix16. Generated partial products were added to radix-16 carry storage adder. (Amanollahi and Jaberipur 2017) Result shows advantages in latency, power dissipation, as well as energy consumption more than earlier relevant designs in cost of extra silicon area, when energy area product too reduced.

An energy efficiency multiplier was designed with reduction and final addition of totally overlapping partial products (Yan et al. 2016). The multiplier works from left to right, allowing for total overlap among reduction of partial products at storage form as well as final addition that produces the product. This means that LRCF multiplier varies around very small O (n) size on-fly conversion circuit and in radix-4 full adder's use at conversion. A novel converter creates the most important half of product through the process of reduction. Eliminate the most important part of final adder. (Periyasamy et al. 2020) Least significant half of product was obtain by carryover adder through reduction. Therefore, converting carry-save format of accumulated partial products toward conventional product does not include with total multiplier time. Various multipliers from right to left, left to right and tree multipliers are calculated 16, 24, 32 and 56 bits, and roots 2 and 4, synthesized at 90 nm technologies, determine the merits and demerits of proposal design regarding area, delay, power as well as energy. They assumed disconnected multipliers and full precision (Fritz and Fam 2016).

Interlaced partition multiplier was proposed (Javadi et al. 2020). In this novel area is introduced for rapid multiplication of two numbers. Products are calculated without carries among partitions, at time necessary for multiplying the short partitions and include partial

Fig. 1 Block diagram of multiplier architecture

sums. Mohamed Asan Basiri proposed (Basiri and Shukla 2017) a flexible VLSI architecture for Galois Multipliers. These multipliers carry out an important role at engineering applications. Author proposes vector GF (2^m) and m-bit GF (p) multipliers execute lower multiplications at parallel. The proposed systolic vector parallel multiplier reaches 82% development in performance over reconfigurable bit series design.

A low energy dual base multiplier (DBM) was designed (Mahmoud et al., 2017). The proposed dual-base multiplier design modifies the existing architecture in partial product accumulation phase. The partial product accumulation phase is most important stage of multiplier. DBM splits accumulation phase in two parts. This proposed design provides reduction on area, power together with delay (Ye and Shieh 2018).

Systolic architecture gives higher (Pillutla and Boppana 2020a, b) throughput, it usually requires area overhead and high latency. Systolic architecture for high polynomial basis finite field GF(2^m) multiplier depending trinomial class was proposed. A proposed multiplier reaches less area and latency compared to similar multiplier. A proposed area-efficient multiplier is appropriate for Internet of Things edge-devices. Many different types of multipliers are used for digital systems. But most of the multipliers have low speed and high power.

To diminish the power consumption of the multiplier design, it is better direction to lessen the number of operations, thus diminishing the dynamic energy. Then it decreases the operations, thus diminishing a dynamic power that is an important part of total power dissipation. In the past, considerable effort was made to design a multiplier under VLSI. To lessen the number of operations, thus diminishing the dynamic power, this is vital part of the total power dissipation. At past, considerable effort was made to design a multiplier on VLSI under this direction.

To lessen power, it is better direction to diminish that number of operations, thus diminishing a dynamic power that is vital part of the total power dissipation. The past, considerable effort was made to design a multiplier in VLSI under this direction.

4 Taxonomy of multipliers

Figure 2 shows the Taxonomy of Multipliers.

4.1 Serial multipliers

The efficient design (Lee et al. 2019) of serial multipliers is necessary in many application areas as diverse as digital communication and the implementation of artificial neural networks. Because of these applications, serial architectures are a part of VLSI architectures and DSP. A novel architecture of bit-serial polynomial base (PB) multipliers on binary extension field GF (2^m) created using irreducible trinomials. Serial bit GF (2^m) Polynomial base multiplication presents throughput/area compensation. This architecture was proposed depend on LFSR (Linear-Feedback Shift Register) may execute multiplication on m clock cycles by stable propagation delay TA + TX. Such values coincide with best time outcomes found at bibliography for serial bit multipliers PB by slight reduction in space complexity. That may execute the two operand multiplication for t diverse finite fields GF (2^m) created using t irreducible trinomials at sane time on m clock cycles by enclosure of $t(m-1)$ flip-flops as well as tm XOR gates (Imana 2020; Hashemi Namin et al. 2017).

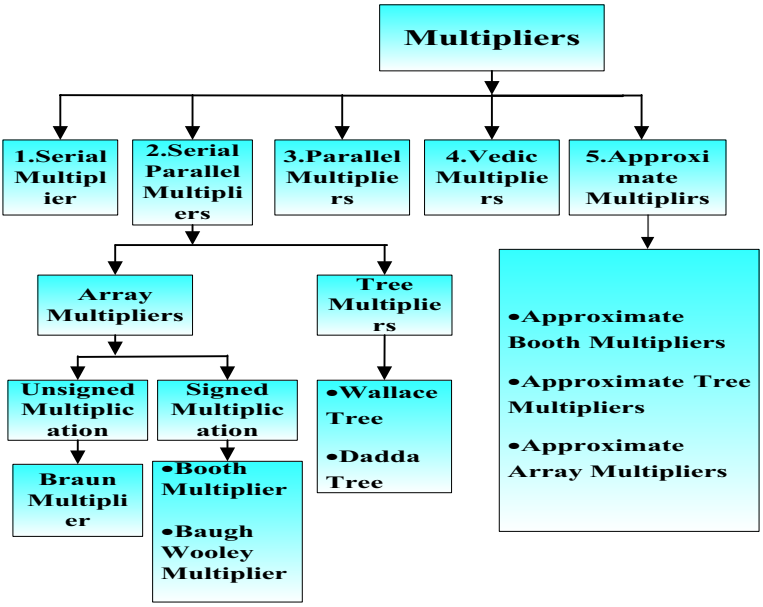

Fig. 2 Taxonomy of multipliers

Figure 3 shows the several algorithms (Pillutla and Boppana 2020a, b; Reddy et al. 2019) and architectures are proposed to implement finite field multiplication hardware to reduce area and delay. Modified interleaved modulus multiplication algorithm as well as their serial bit sequential architecture was proposed. It achieves reduction in partial delay product. (Chiou et al. 2017; Sundhari 2019) Verifies the application-specific integrated circuit (ASIC) execution of proposed multiplier and two comparable multipliers, which proposed multiplier exceeds based on area as well as area delay product. This proposed multiplier was appropriate to implement security on Internet of Things (IoT) gateways and peripherals (Lee et al. 2016; Radakovits et al. 2020; Reddy et al. 2018).

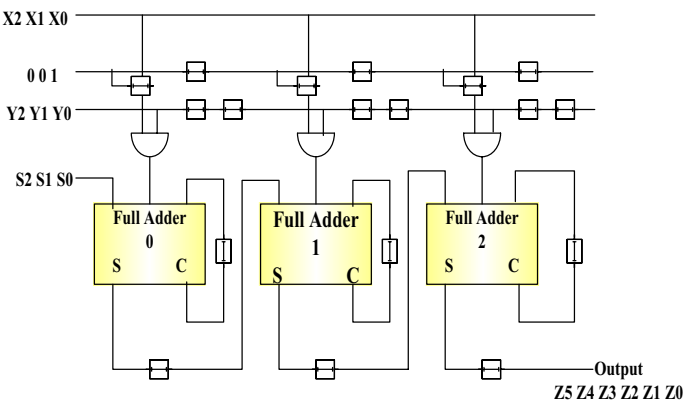

Fig. 3 Serial multiplier design

Sequential circuits with feedback are utilized in series multiplication. Series multipliers are utilized in which area and power is the utmost significance and delays may be tolerated. In this, multiplier and multiplier inputs must be arranged at special way synchronized by the behavior of circuit. Input should be presented in different speeds based on multiplicand and multiplier length. Series multiplier speed is lower compared to the Parallel multiplier.

4.2 Serial-parallel multipliers

Serial-Parallel multiplier operates on every bit in Serial multiplier but utilizes a parallel adder for partial accumulation of product. It provides an intermediate trade-off among a device that consumes a Parallel multiplier area and time-consuming Serial multiplier.

A new circuit design (Edrisi Arani and Rezai 2018; Bahar and Wahid 2019) of Series–Parallel multiplier was designed at quantum dot cellular automata technology. Quantum Dot Cellular Automaton (QCA) is new technology by superior potential for providing less size and great speed circuits. But multipliers are key components of digital circuits. The author estimates that the design of a new series–parallel QCA multiplier circuit depends on well-organized full adder circuit. By intended QCA full adder circuits as major building block, a new 4X4 QCA Series–Parallel multiplier circuit was intended. Figure 4 shows the Parallel Multiplier Design.

The efficient execution of finite field multipliers depend on rearranged usual base (RNB) is greatly enviable at current/emerging cryptosystems, as present's free performance of the quadrature operation. (Xie et al. 2019) propose a new bit-parallel and bit-serial finite field multiplier in G F (2 m) based on RNB. They have resultant a well-organized algorithm for less complex systolic mapping. The parallel bit and serial digit structures of multipliers are acquired and optimized for improving area-time efficiency. They used unique characteristic of proposed multiplication algorithm for obtaining systolic multipliers using Karatsuba like decomposition. To transform the original multiplication in extended form, they have derived parallel bit and Serial Digit multipliers, particularly systolic bit-parallel based on KA and Serial Digit multipliers.

A radix-4 two-speed Series–Parallel multiplier was presented (Moss et al. 2019). This multiplier was introduced to accelerate applications like digital filters, artificial neural networks, in addition to machine learning algorithms. The Serial-Parallel modified radix-4 car

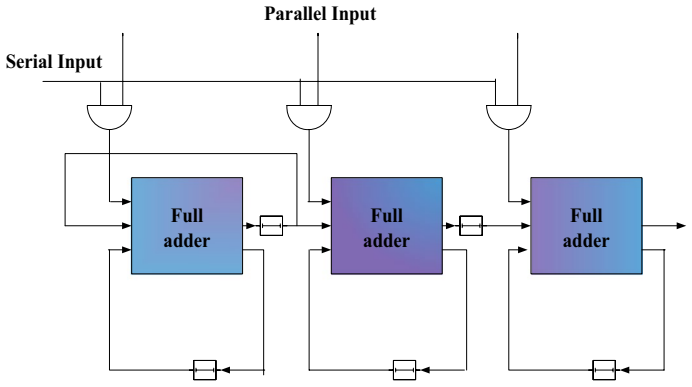

Fig. 4 Parallel multiplier design

multipliers, which include only non-zero booth encodings and omit zero operation, creating latency depend on multiplier value. At real time, performance of this multiplier may be enhanced only in bit representation distribution.

There are two types of Serial-Parallel multipliers.

- Array Multipliers
- Tree Multipliers

4.2.1 Array multipliers

Figure 5 shows the Array multiplier is combinational circuit utilized for multiplying two binary numbers using a full adders and half adders array. Array multiplier is utilized to perform arithmetic operation like filter, Fourier transform and image code. In Array multiplier the addition is performed serially as well as parallel. Array multiplier requires large number of gates.

Subathradevi and Vennila (2018) have presented a heuristic architecture, which utilized for Systolic multiplier for delay and power, as well as for minimization of delay product by several input bit sizes. Systolic systems are simple to perform. This architecture outcome in better performance, cost-effectual, special-purpose systems, which may clear up the broad variety of issues. Multiplication is the most common operation in both DSP and math applications. Systolic architecture will give good performance on design such as Matrix multiplication; filter depending finite impulse response, and distributed Matrix arithmetic.

For multiplication of two 4-bit binary numbers, (Shukla et al. 2020) designed an Array multiplier circuit. Initially, AOI logic (AND, OR, Inverter gates) was mostly utilized for designing any digital circuit. Binary multiplication utilize Array multiplier requires combinational digital components. 4-bit Matrix multiplier circuit design is proposed. At Matrix multiplier circuit, entire bits of multiplier needed to multiply by four bits of multiplier for creating partial product bits.

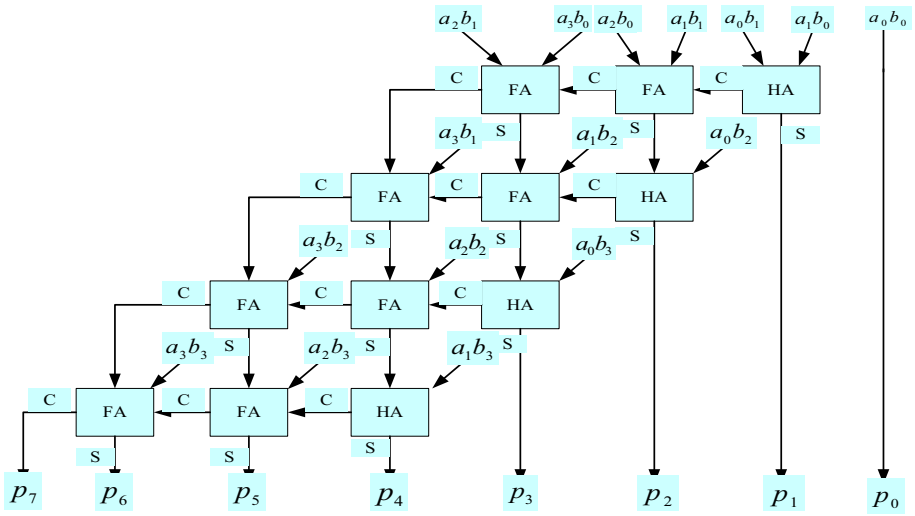

Fig. 5 Array multiplier

New reversible logic Array multipliers (Valinataj 2017) were proposed by ability to detect errors during the use of gates that preserve parity. By using novel arrangements of existing reversible gates, few novel circuits introduced for partial generation of products and addition of multiple operands needed at Array multiplier, resulting in two unsigned parity preservation Matrix multipliers and three signed. Between different kinds of multipliers, Array multipliers have arrived more attention from Rapid multipliers.

The main gain of Array multiplier is simple in design and regular in shape. It is easily scalable. Power consumption of Array multiplier is more. Disadvantage of an Array multiplier delay is high and hardware complexity is more. The Array multiplier occupies large area. It is classified into two types.

A) Unsigned Multiplication
B) Signed Multiplication

A) ***Unsigned Multiplication***

Unsigned can hold a larger positive value, and no negative value. Braun multiplier is an Unsigned multiplier.

i) *Braun Multipliers*

Braun multiplier is a basic Parallel multiplier. This multiplier avoids multiplying two signed numbers. It has been restricted to perform two unsigned numbers. It is simple to design and there is no requiring of logical registers. (Rajput and Swamy 2016) Braun multiplier architecture has few adders and a series of AND gates. At internal structure, every product may be created at parallel by AND gates and every partial product may be included by sum of partial product. The carryout will shift one bit to left or right and add to the sum that generates initial adder and currently created partial product. This is also called Non-Additive multiplier, as it does not include extra operand multiplication outcome. Braun multipliers are usual at structure, simple to design and design is channeled at nature. Braun multipliers size is small. The main drawbacks of Braun multiplier are number of components needed at construction blocks of Braun multiplier maximizes by number of bits and hardware is underutilized.

B) ***Signed Multiplication***

Signed multiplication is classified into two types.

i) Booth multipliers
ii) Baugh wooley multipliers

i) *Booth Multipliers*

Figure 6 shows that architecture of booth multiplier. The booth multiplier has three components. They are booth encoder, booth selector and adder tree. The booth coding scheme is fewer additions are required compared with conventional multiplication rule. Booth encoding is used to speed up multiplication process. The input of the multiplier denotes multiplicand X and multiplier Y. The Wallace tree calculates the last two rows by including the created partial products. The last two rows are included for creating final outcomes of the multiplication with carry-look-ahead adder (CLA). The major purpose design of the booth multiplier is realize that partial products to diminish delay and

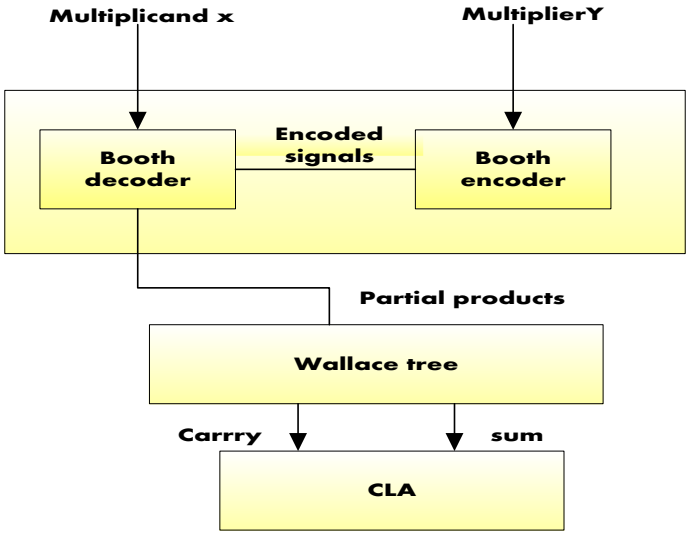

Fig. 6 Architecture of booth multiplier

maximize that speed of circuit. Thus it contains more number of zeros. The maximal delay time on tree-type binary multiplier circuit may be resolute via sum of time in which partial products created as outputs of booth decoder contain given multiplier and multiplier. The bit partial products $(m+1)$ must be created as m by multiplying.

Booth multiplication (Farrukh et al. 2020; He et al. 2017) is method permits smaller and rapid multiplication circuits, through recoding the numbers being multiplied. Booth multiplication algorithm may execute the multiplication operation of two signed binary numbers on its 2's complement form. Booth multiplier delay is less. Finite Impulse Response (FIR) filters (Haridas and George 2016; Bhattacharjee et al. 2017) are widely utilized at several DSP applications. The execution of the design of the FIR filters has huge number of multiplications that guides to unnecessary area as well as power consumption. An efficient low power FIR filter design was proposed by modified spanning tree based Booth multiplier. To obtain (He et al. 2020) a substantial development in circuit performance based on power, speed, and area cost, rough computing is preferably used at numerous error-resistant multimedia and DSP applications. (Behl et al. 2020) Fixed-width Booth multipliers are utilized extensively in applications, making them better determination for approximation by reducing the dynamic range.

The radix-4 Booth multiplier (Chang et al. 2020) is commonly used as it may decrease the number of part-products in half. Low-power radix-4 Booth pre-encoded mechanism was proposed for decreasing unwanted encoder and decoder switching activities. An outcomes display that proposed design may give a major reduction at power consumption as well as delay (Xue et al. 2018). Fuzzy computing (Liu et al. 2017) is a design methodology for reaching low power, low delay, and decreased circuit complexity through relaxing a precision requirement (Siva Kumar et al. 2017). Approximate Booth multipliers were intended in terms of approximate radix-4 Modified Booth encoding algorithms (MBE). Two approximate Booth encoders were proposed and evaluated for error tolerant calculation. Design has also been used for image processing, outcomes at very little loss of accuracy.

A traditional 8X8 multiplier needs 8 partial product numbers. Radix-4 Booth multiplier decreases number of partial products in half, which means 8–4. To multiply, all architecture is split into 4 almost equal stages. Every phase has encoder, 15-bit adder/subtractor, and 3: 1 multiplexers. Radix-4 Booth multiplier has decreased hardware complexity by eliminating redundant operations (Patali and Thottathikkulam Kassim 2020; Pilipovic and Bulic 2020).

Radix-4 Booth multiplier performance is high. At radix-2 Booth multipliers had some time delay and the processing speed also slow. To overcome these drawbacks radix-4 Booth multipliers were designed. Radix-2 Booth multiplier had two disadvantages:

- The number of operations of addition and subtraction and number of shift operations turn into variable and it turn into inconvenient at Parallel multiplier design.
- This algorithm turn into ineffective while it isolated 1's

Such issues may be overwhelming using radix-4 Booth multiplier.

Radix-8 approximate Booth multipliers (Mohanty and Choubey 2016; Boro et al. 2020) were designed for exploring approximate computing advantage. Approximate partial products are entered in little less important numbers of columns of matrix of partial products. (Jiang et al. 2016) Approximate radix-8 Booth multiplier reached good performance optimized for hardware and error metrics. At last, proposed multipliers effectiveness was evaluated by image compression together with handwritten digit recognition applications. These proposed multipliers created outcomes by greatest values for accuracy metrics (Del Barrio et al. 2019).

A novel sequential multiplier design was designed which creates radix-16 partial products from two high and low components. Two Radix-16 Carry Save Adders utilized for creating cumulative partial product of radix-16. An outcomes display better latency, power dissipation, as well as energy consumption. Radix-16 Booth multipliers (Antelo et al. 2017) were proposed for decreasing maximal height of partial product columns n/4 for n = 64-bit. One unit reduction at maximal height is reached. This decrease can allow for greater flexibility in design of ducted multiplier reduction. Radix-8 and Radix-16 Booth Re-encoded multipliers involve attractive for minimum power designs, primarily for less reduction shaft depth and complexity.

Two techniques were proposed to adjust the accuracy (Chen et al. 2017) of bottom signed bit (BSB) conditional probability bias estimate of fixed width two's complement Modified Booth multiplier. Compute the conditional probability among BSB as well as elements of partial product; involve other signed bits, for estimating predictable truncation part. This creates fine tuning of accuracy possible based on coarse tuning at columns on Fixed Width multipliers. Two BSB-based methods for estimating as well as compensate for Fixed Width multiplier of reducing truncation error. Two proposed techniques may perform signal-to-noise ratio (SNR) by little area penalty at Fixed-Width multiplier.

ii) *Baugh Wooley Multipliers*

Baugh Wooley multiplier is high speed multiplier. At signed multiplication, length of partial products as well as number of partial products would be high. As a result, algorithm for multiplication of signs known as Baugh Wooley algorithm was introduced. Baugh Wooley multiplication (Gudivada and Sudha 2020) is a cost-effective way of handling sign bits. For effective implementation of digital circuits, CMOS is often

used. CMOS has a problem based on short channel effects as well as below threshold leakage currents. This disadvantage may be overwhelming for Quantum dot cellular automata (QCA). An energy efficient 1-bit full adder design optimized for QCA area that gives well-organized timing, decreased cell count, and decreased energy dissipation. Full adder design is utilized for implementing a Wooley 4X4 Baugh multiplier. This is another vital element at DSP applications. In this multiplier, the delay is less. The power dissipation of Baugh wooley multiplier is low. Baugh Wooley multiplier occupies smaller area compared to other multipliers.

4.2.2 Tree multipliers

There are two types of tree multipliers.

A) Wallace tree multipliers
B) Dadda tree multipliers
A) ***Wallace Tree Multipliers***

Wallace tree method is utilized to execute high speed designs. Wallace tree multiplier is well-organized parallel multiplier that implements array multiplication. Array multiplier has more gates for performing the multiplication. So it occupies a large calculation area. To conquer this issue, Wallace tree multipliers are designed. First, partial products are created by AND array and, second stage, Wallace tree multipliers reduce the products by support of full adder and half adder. Wallace tree multiplier consists of number of full adders in their computational stages. In Fig. 5 represents the Array multiplier and 7 represents Wallace multiplier, from Fig. 5 has full adder by three input lines and two output lines. The array multipliers are the layout of combinational multipliers. Although it utilizes more gates the performance is simply increased with pipeline system. The add and shift algorithm is followed in array multipliers. The partial products generated and shifted according to bit orders and addition operation take place. The result for multiplying two numbers is obtained by using AND logic. So Array multiplier consists of following disadvantages such as 1. high power consumption, more digital gates out coming at great areas. while it has efficient execution of digital circuit. It multiplies two integers and given numbers are multiplied in structural format. Wallace tree multipliers are considered to perform efficiently but they are hard to implement. Although they are considered to be the faster multiplier than simple array multiplier. They include: 1. Partial Product Generation 2. Partial Product Reduction 3. Partial Product Addition. These will decreases delay and the speed of the operation is increased. Table 1 shows the Difference between array multiplier and Wallace multiplier.

Figure 7 shows the Design of Booth Multiplier. The complexity of Wallace tree multiplier is decreased. Wallace's tree multiplier is good in speed and complexity. Power consumption of Wallace tree multiplier is low. It also reduces the delay. Hence low power requirement and low delay requirement of Wallace tree multiplier are introduced.

B) ***Dadda Multiplier***

In Fig. 7 represents the Wallace tree and 8 represents Dadda tree, from Fig. 7 Wallace tree multiplier is well-organized realization of digital circuit. It multiplies two integers and given numbers are multiplied in structural format. Wallace tree multipliers are considered

Table 1 Difference between array multiplier and wallace multiplier

Array multiplier	Wallace tree multiplier
In this array multiplier uses only one CSA is active at time	More than one CSA is active at time
Column addition is lower	Column addition is quicker
Sum of partial products is sequential	Sum of partial products is parallel
High power consumption	Low power consumption

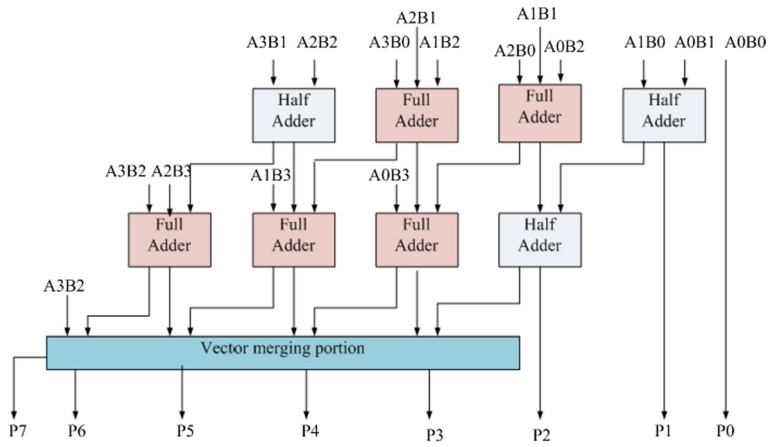

Fig. 7 Design of wallace tree multiplier

to perform efficiently but they are hard to implement. Although they are considered to be the faster multiplier than simple array multiplier. It has the following disadvantages such as They have more delay. The system consumes a lot of energy. To add more number of additions with carry ins and carry outs in parallel after generating partial products, group three rows as stage 1. The Dadda multiplier step is 1. Take 3 wires through the similar weights and feed them into a full adder. The consequence will be an output cable of similar weight and output cable using greater weight for every 3 input cables.

Data is taken with 3 wires and included with full adders and the carry from every stage is saved and sent to the subsequent stage. At second step, the partial products are included through the outputs of the earlier stage. In the final phase, the rapid addition process, namely CSA, is utilized to diminish the number of stages, whereby the product terms p1–p8 are realized. This will reduces delay. Table 2 shows the Difference between Dadda multiplier and Wallace multiplier.

Figure 8 shows the Architecture diagram of Dadda tree. In Dadda tree, this accomplishes decreased two-rowed Partial products on minimal number of diminution phases. For N-bit multiplier and multiplicand, such outcomes N by N partial products. Such partial products are prearranged under Matrix. Dadda decreased Matrix heights to two-rowed matrix, during a sequence of diminution stage.

Consider the last two-rowed matrix height $d1 = 2$, depending d1 the consecutive matrix heights arrived $dj + 1 = 1.5 * dj$, here $j = 1, 2, 3, 4, \ldots\ldots$, the matrix height must be performed down to minimum. i.e., $13.5 = 13$ (rounded). The matrix heights will be on fashion

Table 2 Difference between dadda multiplier and wallace multiplier

Dadda tree	Wallace tree
Lower area (3258 m^2)	Higher area (4574 m^2)
Less number of cells (112)	Large number of cells (123)
Lower leakage power (218.20 nW)	Higher leakage power (237.17 nW)
Lower delay (18.15 ns)	High delay (24.56 ns)

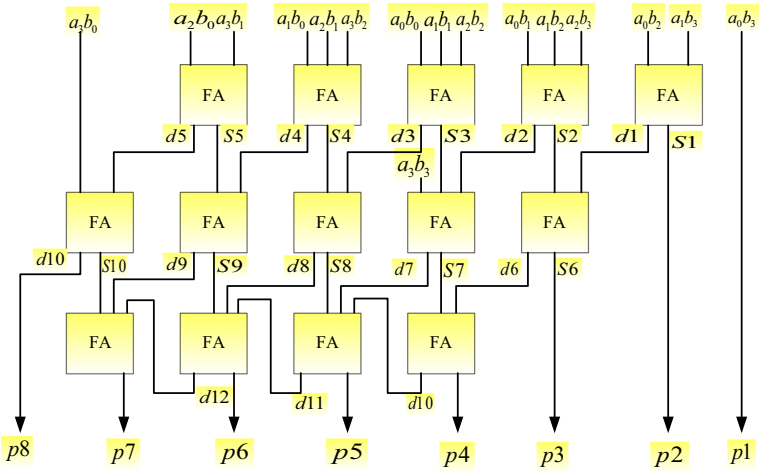

Fig. 8 Architecture 4 × 4 of dadda tree

2, 3, 4, 6, 9, 13, 19, 28. At last, greatest dj must be arrived matrix height couldn't go beyond Matrix overall height.

1. At initial stage of reduction, the compression of column must be performed through counters [3, 2] and [2, 2] so that the height of the reduced matrix must not go beyond *dj*.
2. During the compression, the sum will be transmitted with similar column under subsequent reduction phase and carry will be passed with subsequent column.
3. The previous two steps must be repeated until a last two-row condensed matrix is arrived.

Based on this, Dadda multipliers consist of least price reduction stage, other than numbers are bit longer. In this, some columns are compressed at early stages of column compression tree and more columns at later stages of multiplier. Summation proceeds at regular way but slower manner on Array multiplication scheme. Partial products are produced by an AND gates array in Parallel multiplier. A major concern is sum of partial products, and time required for performing sum decides that maximal speed that multiplier can work.

For a given configurable energy efficiency Accuracy multiplier (Afzali-Kusha et al. 2020), frame uses the over scaled voltage and coarse width adjustment as coarse buttons to improve energy consumption and multiplier reliability and life. The given accuracy

level, partial product columns, and over scaled voltage were decided to optimize energy. To improve the multiplier efficiency, a four-bit truncation of multiplier output was introduced. Data scheme reduces the number of summing stages necessary for implementing the sum of partial products. This is accomplished through the use of half and full adders. This reduces number of rows on bit matrix in every addition stage.

4.3 Parallel multipliers

Rapid processing of parallel bits Polynomial Base (PB) multipliers (Yan et al. 2020) was designed on binary extension field GF (2 m) via type I irreducible pentanomials. Complex analysis displays that multipliers provided a much shorter delay compared with equal bit parallel bit PB multipliers. To test the theoretical complexities, hardware executions have also been made on Xilinx FPGAs. The experimental outcomes display that the method presented the lowest delay while compared to equal multipliers (Imana 2018).

Parallel multiplier with enhanced performance is proposed taking advantage of properties of three diverse binary-coded decimal codes (BCD) (Diaz et al. 2017). This method employs the divide and conquers strategy for optimizing the processing time for arithmetic operations. In Parallel multiplier, the multiplicand is first multiplied via every bit of multiplier. Parallel multiplication process may be considered as two parts, called partial product accumulation and partial product generation. Parallel multiplier speed is high compared to Serial multiplier (Cui et al. 2017).

AN architecture for Parallel Decimal multiplication (Véstias and Neto 2018) was proposed, which enhances the earlier Decimal multipliers area. Decimal multiplication is often utilized operation at some applications. A novel area product unit is proposed in terms of 5221 multiplier digits redesign. By proposed multiplier, we can enhance the latest generation parallel decimal multipliers aimed at LUT-6 FPGAs (Perri et al. 2020).

4.4 Vedic multipliers

Vedic mathematics (Prabhu et al. 2018) is antique Indian technique of mathematics depend on 16 formulas relevant to several branches of mathematics such as calculus, trigonometry, conics, geometry, and so on. Multiplication is utilized efficiently at contemporary communication as well as DSP applications. It is necessary to carry from LSB to MSB when adding binary area products that restricts the overall multiplication speed. Vedic mathematics supports at sum generation and partial products at one step, and guarantee in general propagation delay reduction (Kumar et al. 2018). UrdhvaTiryakbhyam Sutra and Nikhilam Sutra are two multiplication methods utilized at Vedic mathematics. The word Urdhva-Tiryakbhyam means vertical and transverse multiplication. This algorithm meets the requirement for rapid multiplication operation due to the concept of vertical and transverse multiplication.

A fast and highly efficient multiplier (Chudasama et al. 2018) is huge significance for designing arithmetic circuits. Efficient structure of 8X8 Vedic multiplier was suggested that was performed by efficient structure of 4X4 Vedic multiplier as well as ripple transport adder at QCA. QCA is one of a rising nanotechnology, offering attractive aspects such as large speed, less power consumption and less size to implement computer architecture at opposed to CMOS technology. The 8×8 Vedic multiplier was designed at QCA by UrdhvaTiryakbhyam formula. Efficient 4-bit Vedic multiplier structure is utilized for constructing 8-bit multiplier. This design utilizes only 8-bit ripple carry adder, an 8-bit full adder,

and 4X4 3-bit four multipliers. The generated partial product additions are performed by ripple carry adders together with full adders. The simulation outcomes display that proposed design cell number of 8×8 Vedic multiplier is decreased by 60%, the area by 78% and delay by 75% compared to 8×8 Wallace multiplier.

In Fig. 5 represents the Array multiplier and 7 represents Wallace multiplier, from Fig. 5 that is full adder has three input lines and two output lines. The array multipliers are layout of combinational multipliers. The add and shift algorithm is followed in array multipliers. The partial products generated and shifted based on bit orders and addition operation take place. The result for multiplying two numbers is obtained by using AND logic. So Array multiplier consists of following disadvantages such as 1. High power consumption, more digital gates resulting at large areas. In Fig. 9 shows the 4 × 4 Vedic multiplier. Vedic Multipliers based on Vedic Mathematics. Advantage of the Vedic multiplier is 1. It increases the speed of the system, 2. It provides better efficiency, 3. They reduce time delay as well as path delay on multiplier, 4. It requires smaller area when compared to other multiplier. Thus time, space and area efficient in Fig. 8. The greater number N bit is broken down into lesser numbers $\left({}^{N}/_{2} * {}^{N}/_{2}\right)$ and lesser numbers are once more broken into still smaller numbers $\left({}^{N}/_{4} * {}^{N}/_{4}\right)$ till arrive multiplicand of size $2 * 2$. Table 3 shows the Difference between Array and Vedic Multiplier.

4.4.1 Highlight of vedic multiplier

- Vedic multipliers are establishing to have faster speed than other multipliers. This is because partial products created and added under parallel.

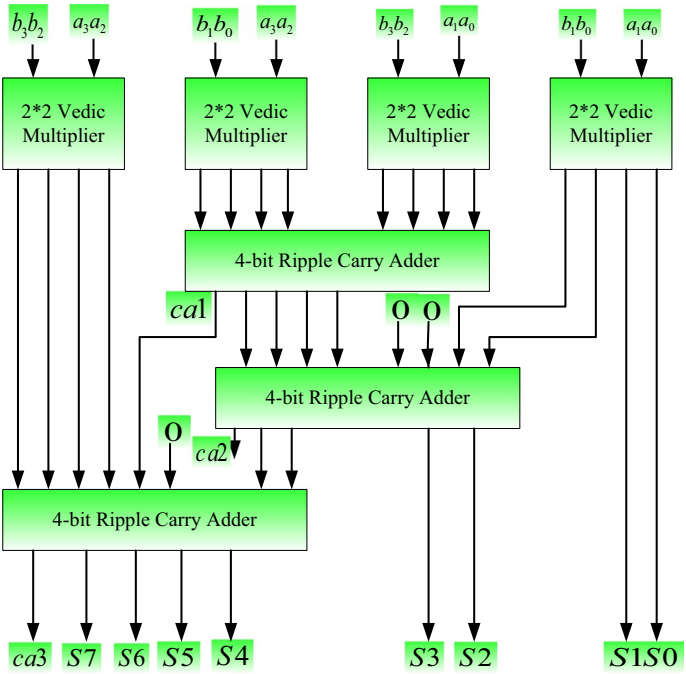

Fig. 9 Designing 4 × 4 vedic multiplier

Table 3 Difference between array and vedic multiplier

Array multiplier	Vedic multiplier
It consumes high power (29.34 mw)	It consumes low power (0.169 mw)
Higher delay (37.668 ns)	Lower delay (27.148 ns)
Low speed	High speed
Requires high area (32.001 ns)	Requires low area (13.102 ns)

- The delay linked through Vedic multipliers is mostly based on propagation of carry bits through adders.
- The high-speed adders similar to CLA, the efficiency of Vedic Multipliers may be enhanced again.
- The efficiency of Vedic multipliers is enhanced when they are high-speed adder.
- The Vedic multiplier is the rapid multiplier by minimum delay on the route.

At present, reversible logic (Ariafar and Mosleh 2019) is assumed a novel field of study, which consists of several applications like less-power CMOS circuit design, quantum computing, DNA calculations, and optical information processing. Parity preservation method is called as one of the well-known techniques to provide error detection capabilities. The Vedic method can maximize the multiplication operation speed via creating partial products as well as its sums at the same time in parallel. Vedic 4X4 multiplier module is implemented with four Vedic 2X2 bit multipliers together with three 4-bit Ripple-Carry adders. Delay of Vedic 4X4 multiplier may be reduced (Kivi Sona and Somasundaram 2020).

In digital signal processing (DSP) using (Savadi et al. 2016) Vedic mathematics that implements signal handling operation such as convolution, circular convolution, cross correlation, autocorrelation as well as filter design. DSP operations are the most important part in field of engineering and medicine. The proposed structure of Infinite Impulse Response (IIR) filters used Vedic mathematics Urdhava Tiryakbhyam formula. IIR filter is also convolution filter. A proposed design is done at XILINX 13.4 ISE version and performed in vertex-5 FPGA.

Global system is exaggerated by multipliers based on speed, delay, area, and computational complexity (Gupta and Sharma 2018). High speed 64X64 Vedic multiplier based on Han-Carlson Adder (HCA) was proposed. This proposed design of 64X64-bit Vedic multiplier performed by Xilinx ISE 14.2 browser at VHDL. Outcomes in this proposed design give enhanced delay, low hardware, and low complexity. (Barik et al. 2017).

Vedic multiplier is one such high speed multiplier architecture. It is mainly used for fast multiplication operations. Vedic multiplier technique usually reduces the delay of the processor. Power consumption of this multiplier is low. It occupies large area compared to Booth and Array multipliers. The complexity of Vedic multipliers is less.

4.4.2 Example

An 8×8 bit multiplier using Vedic Mathematics. In this, the digits of line are multiplied and included through carry from earlier step. This carry is involved under subsequent step and therefore the process continues. If there is more than one line, the entire outcomes are included with earlier carry. At every step, the least significant bit acts as consequence bit and the entire bits act as the carry for subsequent step. At first, carry is considered zero.

4.5 Approximate multipliers

Approximate computing is raising trend at digital design, which offsets the requirement for exact computing to improve speed and power efficiency. An energy-efficient approximate multiplier design by significance-driven logic compression (SDLC) method was designed (Qiqieh et al. 2018). Various multipliers by dissimilar bit widths (4-bit–128-bit) are intended at System Verilog. Post synthesis tests can save up to certain amount of energy savings and a 65% reduction nearly 45% at silicon area may be reached as 128-bit multiplier, compared to exact equivalent. (Van Toan and Lee 2020) Such gains obtained by less accuracy loss estimated at less to 0.0028 mean errors. Also, they determine the tradeoffs between performance, energy, and quality of various levels of compression, reached during configurable logic grouping. Assessing the efficacy of proposed method, three case studies were established. Initially, Gaussian blur filter was intended, showing the performance of SDLC multiplier energy quality trade-offs used at image processing application. (Jiang et al. 2019a, b; Priyanka et al. 2019) The second case study evaluates their method to apply machine learning by perception classifier. Third, proposed multiplier designs utilized at power-limited image processing application. SDLC may reach $ 60\times $ development at computing power, with the potential to be used at ubiquitous systems (Sabetzadeh et al. 2019).

High performance and energy efficient FIR adaptive filter was designed by approximate distributed arithmetic circuits (Jiang et al. 2019a, b; Yin et al. 2020). It uses an approximate Distributed Arithmetic (DA) integrated circuit, thus it reaches further improvements at delay, power dissipation and area. This design, Radix-8 Booth algorithm was utilized for decreasing count of partial products at DA design, though no explicit multiplication implemented. Approximate generations as well as partial accumulation methods were proposed for error calculation and weight upgrade modules. Additionally, partial products are created via roughly truncating input data by error compensation. Approximate Wallace tree is assumed for partial products accumulation, to reduce hardware cost. Finally, delay, area as well as proposed design power consumption radically decreased. Synthesis outcomes display that proposed design reaches on average 55% diminution on energy per operation (EPO) and efficiency of 3.2 times per area compared to correct design (Liu et al. 2019).

Approximate multipliers are significant (Mazahir et al. 2017) at energy efficient estimation and need vigilant error analysis. Author presents an error probability analysis of recursive approximate multipliers by approximate partial products. This analysis is depends on general characteristics of recursive multipliers recognized through careful study of behavior model of next-generation designs. Based on the analysis, the error probability mass function (PMF) is calculated via considering individually entire possible error cases and its interdependencies. This proposed analysis is authenticated by applying it to numerous last generation approximate multipliers and comparing to equivalent simulation outcomes. This outcome displays that most Recursive multipliers and obtain an exact evaluation of error performance. Additionally, it predicts the performance of multipliers at image processing application to determine their practical importance. (Mrazek et al. 2018).

Approximate computing (Venkatachalam and Ko 2017) may increase a design performance by decrease the design complexity and power efficiency for error resilient applications. Synthesis outcomes release that the two proposed multipliers reach power savings 72% as well as 38%, correspondingly, compared with correct multiplier. When

compared to the existing multipliers, they have better precision. (Sakellariou and Paliouras 2016) Mean relative error figures are less 7.6% and 0.02% of approximate multipliers. The efficiency of proposed multipliers is assessed by image processing request.

i) Approximate Booth Multipliers
ii) Approximate Wallace tree Multipliers
iii) Approximate Array Multipliers

i) ***Approximate Booth Multipliers***

Approximate computing (Venkatachalam et al. 2019) is a growing method that power efficient circuits are intended by condensed complexity at swap for loss of accuracy. Three approximate Booth multiplier models proposed where approximate computation is used to modified Radix-4 Booth algorithm. (Frustaci et al. 2020; He et al. 2020) Approximation method involves decrease the logical complexity of booth partial product generator and adjusts that partial product accumulation technique. Compared with exact Booth multiplier, approximate CABM is compressor-based approximate Booth multiplier achieves at area reduction and power reduction.

Design and analysis of approximate Booth multipliers power efficiency and area was designed (Waris et al. 2020). Approximate computing is growing method where power efficient circuits are intended by decreased complexity at swap of accuracy loss. Radix-4 modified Booth coding decrease the partial product array size in half. Here, three approximate Booth multiplier models are proposed (ABM-M1, ABM-M2 and ABM-M3) where approximation focuses on partial product generation. Approximate calculation is used to radix-4 modified Booth algorithm. Three well-liked applications linked toward signal processing are selected: image transformation, matrix multiplication, as well as FIR filtering have better performance to previous works.

ii) Approximate Tree Multipliers

Approximate Wallace tree multiplier (Esmali Nojehdeh and Altun 2020) was implemented by 1-bit full adders, 1-bit half-adders, as well as three-stage AND gates. At first stage, the multiplier inputs are AND first. After that AND gates output are sent to 1-bit adders. Assume that inputs of multiplier obtain logical values 1 and 0 by equivalent probability of 1/2, inputs of adder get the logical value 1 and 0 by probabilities 1/4 and 3/4, correspondingly. Because of, they choose wrong outputs equivalent to input assignments by 1/4 probabilities. While designing 1-bit adders, other motivation reach Cout = 0 which change the current full adder to a half adder or discards current half adder, with no loss of accuracy. Approximate full adders are not needed at second as well as third phases; approximate half adders are utilized at such phases. Multipliers forever have the lowest area and least delay.

iii) Approximate Array Multipliers

Approximate computing is emerging energy-efficient computing paradigm (Roy and Dhar 2020) appropriate for error-tolerant applications. An approximate broken Array multiplier design known as Sign Inclusive Broken Array Multiplier Design for Error Tolerant Applications (SIBAM) by partial error correction by adding discard sign bit. This method shows that 63% energy savings may be reached compared with correct multipliers. This method was applicable for image sharpening as well as handwritten digit recognition.

Array based approximate arithmetic computation (Shao and Li 2015) (AAAC) was proposed to guide processing error minimization. In this, error compensation unit (ECU) was recognized from main building block of AAAC circuits. This typical AAAC model reveals what practical design insights might look like accuracy as well as area over head. To further lessen the area of energy consumption, delay, together with AAAC circuits, they make ECU design simplifications through initiate don't-matter logic. To utilize this model, an estimated 16×16 fixed width Booth multiplier, which absorbs 44.85% and 28.33% less energy likened to theoretically more precise fixed width Booth multiplier. It decreases the maximum error, average error as well as mean square error.

4.6 Role of multiplier in digital systems and DSPs and the artificial intelligence are related with multipliers

Multiplier design is related to artificial intelligence. in this machine learning are discussed, at few imprecision on every computation leads with elegant degradation. Second, the key calculations of ML algorithms have multiplications of provided input vector and fixed, pretrained weight matrix. For instance, artificial neural network (ANN) has K inputs and L outputs. Assume $u = u(t)$ implies K dimensional exterior input, $y = y(t)$ the L-dimensional output, and W connection weight matrix of size $L \times K$ here wI, j refers weight among yj and xi. After that, y is provided $y = f(Wx + b)$ here f implies nonlinear function and b implies stable bias. Finally, note that every ML algorithm needs different degree of computational precision3 for acceptable inference precision, although, in general, few imprecision at every computation is tolerable. To assess the impact of the imprecision of multiplication on last precision of the inference, initially take three applications of ML: spoken isolated handwritten digit and ANN-based facial recognition, liquid state machine (LSM), 6 and support vector machine (SVM), correspondingly. This ANN depending on modern multilayer perceptron7 trained using modified NIST data set (MNIST). The LSM and SVMs qualified through Texas Instruments (TI) 9 voice database of 46 words and a data set.10. The resulting value is up to 5, 10, 15, 20, and 25 percent greater or less than exact value. For example, to accomplish 90 percent inference precision, LSM and SVM may only permit a maximum of 15 and 5 percent errors, correspondingly. This gives strong motivation multiplier through adjustable calculation precision that permits to lessen power consumption as accomplishing satisfactory inference precision.

5 Comparison and analysis

This section suggests the analysis of investigation papers depend on several criteria such as timeline, device type components and simulation tools are analyzed. Finally, we compare the various multipliers and their performance.

5.1 Timeline analysis

Here, the Fig. 10 shows the timeline analysis of the investigation papers taken for survey is discussed. This figure indicates the graph of timeline analysis of investigation works. From the timeline analysis graph, investigation papers in the field of multipliers considered for the review are published from 2015 to 2020. We reviewed three research papers in the year 2015. And, the remaining 97 research papers we have taken from 2016 to 2020.

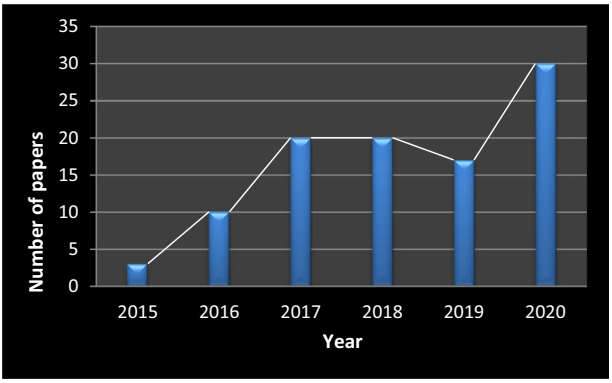

Fig. 10 Timeline analysis

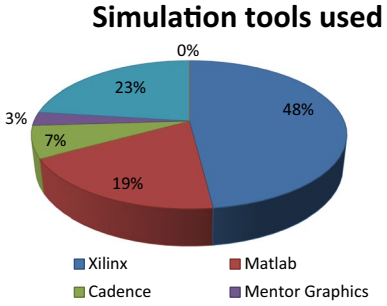

Fig. 11 Analysis based on simulation tools used

5.2 Reputation of simulation tools

Reputation-based analysis of the simulation tool is conversed in this section. This investigation works focused on this survey paper have been simulated by tools like Xilinx, Matlab, Mentor graphics and Cadence and others. This figure represents the simulation tools used for various multipliers at 100 investigation works assumed in this survey. Figure shows the simulation percentage by Xilinx tool is greater than other simulation tools. 48% of investigation works exploited Xilinx for implementation. Matlab tool was used by 19% of the research works. And also Cadence and Mentor Graphics tools were utilized by 7% and 3% of investigation works correspondingly. Figure 11 shows the Analysis based on simulation tools used.

5.3 Comparison of multipliers

Here we are comparing the various types of multiplier of the investigation manuscript is assumed for the survey is explained. We have compared the multipliers based on power consumption, delay, speed and area. Digital system requires less delay, high speed, low complexity and low area occupation. The delay of Array multiplier is more and it required maximal area since it utilizes great number of components. The main advantage of Array multiplier is, it has less complexity. Braun multiplier is constrained to perform multiplication of two unsigned numbers. Size of Braun multiplier is small and it is easy to design. Booth multiplier is commonly used multiplier. Speed of Booth multiplier is high and delay

is less. It occupies minimum area. Power consumption of Booth multiplier is low and complexity is high. In this Radix-4 Booth multiplier is frequently employed. The speed of Baugh Wooley multiplier is high and it occupies medium area. Delay and power consumption is less. Hardware complexity is more in Baugh Wooley multipliers. Wallace tree multiplier is good at speed and delay. Vedic multiplier implies High Speed multiplier, and delay of this is low. Power consumption of Vedic multiplier is less. But complexity of Vedic multiplier is high. Table 4 shows the Comparison of multipliers.

Digital system is affected by speed and complexity of the multipliers. So, in digital system requires high speed with low complexity and reduced Delay multipliers, for increasing the performance of system. At digital system, Approximate Computing is a developing trend, for gaining significant performance development based on power, speed and area. Approximate computing implements an effectual solution for decreasing its power dissipation. Therefore hybrid approximate multipliers were intended for increasing speed and performance of digital system. Approximate multiplier gives better result in speed and power. Partial product reduction stage takes more time and power. Compressors are needed at partial product reduction stage. Several types of compressor were proposed, but low order compressors are helpful only while the multiplier size is less. So, 16X16 and 32X32 bit multipliers required high order compressor. Hence, 15–4 approximate compressor was designed. It gives better result in power as well as speed, except it occupies large area to low order compressor.

5.4 Device components considered

This analysis depends on components assumed at multipliers of investigation manuscripts considered for survey is explained. Multipliers are designed using adders and logic gates. Adders are normally utilized in entire arithmetic circuits. For, multiplier adders are utilized for partial addition of products. Various adders are used to design multipliers, such as carry adder, ripple carry adder, full adder, half adder, Kogge stone adder, and carry save adder. Among these adders, from the 100 research papers we have reviewed that half adders and full adders are mostly utilized for multipliers.

6 Conclusion

This manuscript gives the collective survey of different types of multipliers. Here, we have taken 100 investigation papers for IEEE, Springer Link, Elsevier, IET, and Google Scholar survey. A geometric analysis is provided in this review which was conducted by take out information from 100 papers published between the years 2015 and 2020. Also, we have presented the taxonomy for the different types of multipliers. In this paper we have provided detailed explanation for various types of multiplier. Multipliers are commonly used in today's digital systems. But, the digital system could be affected by low speed, high delay, large area and high power of multiplier. Hence, hybrid approximate multipliers are intended to decrease delay, area, power consumption and maximize multiplication speed at digital systems. Compressors are needed at partial product reduction stage. High order compressors give best outcomes at power and speed. Hence, 15–4 approximate compressors are designed. This 15–4 approximate compressor is tapped to create the most important bits of outcome. The main reason of this review manuscript is briefly assess the recent progress of multipliers. In general, this manuscript summarizes the current state

Table 4 Comparison of multipliers

Multipliers	Speed (sec)	Area (sq.m)	Power (W)	Delay (ns)	Complexity (sec)
Array multipliers	Less, it requires large number of gates	Maximum area because it uses large number of adders	High power (5.045)	High delay requires large number of half adder and full adder	Less complexity; array multipliers have arrived more attention from rapid multipliers
Braun multipliers	High speed, it avoids signed numbers	Maximum area because number of components needed at building blocks are high	Low power (1.042)	High delay because it does not include an additional operand to multiplication outcome	It is small and it is easy to design
Booth multipliers	Highest as the cycle length is less as probable	Minimal area as adder/subtractor is roughly small/rapid as adder	Low power (1.022)	Low delay, due to the reduction of gates	High complexity, it requires many operands
Baugh multipliers	It requires high speed and it occupies medium area	Medium area Baugh tree utilized to lessen operands	Low power (1.043)	Low delay does not include an additional operand to multiplication outcome	Less complexity; array multipliers have arrived more attention from rapid multipliers
Tree multipliers	It requires high speed	Minimum area is required due to the small amount of gates	High power (6.542)	High delay because it requires more gates	High complexity due to the increasing number of bits
Vedic multipliers	High speed because, it constitute high speed adder	Area also increases due to the increasing number of bits	Low power (1.043)	Less delay. does not include an additional operand to multiplication outcome	High complexity, due to the increasing number of gates
Approximate multipliers	High speed, partial product reduction stage takes more time	Minimum area required because multiplier size is small	Low power (1.044)	Less delay due to approximate computing implements an effectual solution	Low, small amount of operands are needed

of knowledge of these multipliers. In this, we have presented the comparative analysis depend on timeline, reputation of simulation tools and types of device components used are analyzed.

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Data availability Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Declarations

Conflict of interest Authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

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(54) Title of the invention : REMOTE CONTROLLED AIR VEHICLE BASED SANITIZING SYSTEM WITH PAYLOAD CARRIER

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(57) Abstract :
In an embodiment of the present disclosure, Remote controlled air vehicle based sanitizing system with payload carrier (2400) is disclosed. The major advantage of present disclosure is to disinfect the larger surfaces and places where minimal human interference is expected, like covid-19 infected areas, isolation wards, public places, offices, educational institutions, factories etc. In the present disclosure, two (02) vacuum filled sanitizer can (2000) are used to disinfect the areas and controlled wirelessly through the data-sender (2100) unit. Further, the proposed system is capable of carrying a payload of about 15kg (like medicines, sanitizers, mini oxygen cylinders, etc.).

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(54) Title of the invention : IOT based fully autonomous personal service robotics device

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(57) Abstract :
Personal service robot that can monitor its owner's health and offer help if necessary. Sensors such as smoke, heat, temperature, and carbon monoxide sensors in IOT may be included in the system to identify dangerous conditions before they impact humans. The device is capable of protecting the house from intruders. A medication dispenser and blood pressure cuff may be included in the PRA. Broadband internet, MP3 player, reading lamps, and eyeglass trackers are all butler-type features that make the system appealing to a wider range of customers than only the elderly and infirmed. An X10 transmitter/receiver may be included in the system to automate different home lighting and appliances. The robot can retrieve things with a robot arm, turn on and off switches on the wall, open the fridge, etc.

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(57) Abstract :
Artificial intelligence-based cancer diagnosis and treatment by sing nano particles is the proposed invention that selectively targets cancerous cells, which results in more accurate diagnosis and early detection. The invention enables the visualization of cancer biomarkers that helps to identify the specific stages of cancer cells and thereby deciding upon treatments which targets to the death of cancer cells. The implementation of nano particles will help detect and diagnose cancer at molecular level by developing biomarkers.

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