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SPECTRUM

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59	186	52	6
PAPERS	AUTHORS	INSTITUTIONS	COUNTRIES

INSIDE THIS ISSUE

Big Data Analytics for Real-Time Fraud Detection in Insurance Claims p. 1

Small Businesses as the Basis of the Indian Economy p. 6

Comparative Analysis of Machine Learning Models for Diabetes Prediction: A Performance... p. 21

IJARIIT SPECTRUM

Spectrum is an e-magazine with the comprehensive collection of all the papers that have been published in our journal over the last two months — Volume 11, Issue 2 (March-April, 2025). This edition brings together 59 papers by 186 authors from 52 institutions. Each entry links to the abstract and the full paper.

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THIS EDITION AT A GLANCE

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Research areas		Authors by country	
Civil Engineering	**5**	India	**50**
Machine Learning	**4**	United States	**2**
Marketing	**3**	Maharashtra,india	**1**
Computer Science	**3**	Madhya Pradesh - 466114	**1**
Electronics And CommunicationEngineering	**3**	Maharashtra	**1**
Mechanical Engineering	**2**	India.	**1**

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Indexing of Volume 11 – Issue 2

S. No	Title	Page Number	Links
1.	**Big Data Analytics for Real-Time Fraud Detection in Insurance Claims** *Shaba Khatoon, Ankita Srivastava, Dr. Shish Ahmad* **Integral University, Lucknow**	1-5	View Abstract Download PDF
2.	**Small Businesses as the Basis of the Indian Economy** *Aayaan Sardana* **Modern School Vasant Vihar, New Delhi**	6-20	View Abstract Download PDF
3.	**Comparative Analysis of Machine Learning Models for Diabetes Prediction: A Performance Evaluation Study** *Taaha Ansari, Vaishali M. Bagade* **Alamuri Ratnamala Institute of Engineering and Technology, Tute, Maharashtra**	21-26	View Abstract Download PDF
4.	**Design and Development of V-Twin Stirling Engine** *Viraj Tambe, Ravi Singh, Rahul Mayekar, Tanish Tilak, Prof. Nikhil V.S.* **Rajiv Gandhi Institute of Technology, Mumbai**	27-51	View Abstract Download PDF
5.	**Energy Harvesting Poles: Harnessing Piezoelectric Power for Sustainable Infrastructure** *Ansh Mahadik, Aditi Gavand, Vivek Magar, Harashad Dhandar, Chaitali Bagul* **Vivekanand Education Society's Polytechnic, Chembur 400071**	52-56	View Abstract Download PDF
6.	**Crumb Rubber used in Pavement Design** *Lavanya Santosh Rokade, Manasi Shubhas Fulare, Srushti Kishor Salve, Saburi Shashikant Shivan, Suraj Surve* **VES Polytechnic, Mumbai, Maharashtra**	57-60	View Abstract Download PDF
7.	**Ai-Driven Vibebox: Adaptive Music Streaming Personalized Based on Emotion** *Dr. M.K. Jayanthi Kannan, Anirudh Kanwar, Harsh Chaturvedi, Aditya R Patil, Abhimaan Yadav* **VIT Bhopal University, Bhopal-Indore Highway, Kothrikalan, Sehore, Madhya Pradesh - 466114**	61-72	View Abstract Download PDF
8.	**CropVion: A VGG16-based Convolutional Approach for Plant Disease Detection** *Rishika Gazula, Asiya Jamadar, Avinash Shinde, Gauri Bilaye* **Marathwada Mitra Mandal's College of Engineering, Pune, Maharashtra**	73-76	View Abstract Download PDF
9.	**Rehabilitation and Retrofitting of the Rajabai Clock Tower** *Muktesh Hemanta Patil, Aakash Kedar Chauhan, Sujal Arwel, Suraj Surve* **VES Polytechnic, Mumbai, Maharashtra**	77-79	View Abstract Download PDF

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S.No	Title	Page Number	Links
10.	**Marine Pollution & Implementation of Regulations** *Laranya Sharma, Prof. Arun D Raj* **VIT School of Law, Chennai, Tamil Nadu**	80-84	View Abstract Download PDF
11.	**The Impact of GST on Accounting Practices in Chartered Accountant Firms** *Akshaya M, Arun Kumar S K, K M Rakshith* **CMR University, Bengaluru, Karnataka**	91-93	View Abstract Download PDF
12.	**Evaluating the Role of Artificial Intelligence in Tax Administration in India** *Delip Kumar S S, Dhanush Kumar A, Anshu kumar C, K S Monikkanth* **CMR University, Bengaluru, Karnataka**	94-98	View Abstract Download PDF
13.	**The Influence of Social Media on Customer Preference** *Prathiksha.s, Sushmitha .M, Sushmitha .V* **CMR University, Bengaluru, Karnataka**	99-101	View Abstract Download PDF
14.	**The Role of Consultants in Empowering SMEs** *Blessing David, Ashish Pradhan, Jeffrey Augustine* **CMR University, Bengaluru, Karnataka**	102-105	View Abstract Download PDF
15.	**Regulations to be Followed by Banks** *Sohan Das, Prarthana Panicker, V Roopashree* **CMR University, Bengaluru, Karnataka, CMR university, Bengaluru, Karnataka**	106-107	View Abstract Download PDF
16.	**Research on the Role of Social Media in Marketing** *Yakshendra Praneeth, Aishwarya. P, Madhavan. T, Vishwamoorthi Hebbar* **CMR University, Bengaluru, Karnataka**	108-109	View Abstract Download PDF
17.	**SynapseEd-Systematic LLM Neural Application for Personalized Educational Development** *Vinmay Vidyadhar Tondle, Priyanka Dhulchand Kapade, Rushikesh Jitendra Bobale, Dr. Geetanjali Vivek Kale* **New Horizon Institute of Technology, Thane, Mumbai**	110-119	View Abstract Download PDF
18.	**A Review On Alzheimer's Disease** *Munshi Shaikh Rahat, Maniyar Hassan, Surwase Mohini, Bagwan Wasim, Kasture Pranav, Sustarphod Vijay, Budge Ganesh, Chandel Adityasingh* **Godavari Institute of Pharmacy, Kolpa, Maharashtra**	120-126	View Abstract Download PDF
19.	**The Israel-Palestine Conflict: A Legal and Geopolitical Overview** *Siddharth Dua* **Amity Law School, Noida, U.P**	127-131	View Abstract Download PDF

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S.No	Title	Page Number	Links
20.	**ARIA: An Intelligent Voice-Enabled Virtual Assistant for Desktop Automation and Conversation** *Aniket Supe, Amey Waikar, Aditya Tripathi, Dr. Shudhodhan Bokefode* **Terna Engineering College, Navi Mumbai, Maharashtra**	132-137	View Abstract Download PDF
21.	**Utilization of Sugercane Bagasse Ash in Concert (SBA)** *Druv Ratndeep Aru, Karan Raju Ingle, Ganesh Gautam Gaikwad, Sujal Sunil Kamble, Chaitali Bagul* **Vivekanand Education Society Polytechnic Chembur Mumbai, Maharashtra**	138-141	View Abstract Download PDF
22.	**Autonomous AI Agents for Real-Time Financial Transaction Monitoring and Anomaly Resolution Using Multi-Agent Reinforcement Learning and Explainable Causal Inference** *Akash Vijayrao Chaudhari, Pallavi Ashokrao Charate* **Santander Bank, Sayreville, NJ, USA, Worldpay, Cincinnati, OH, USA**	142-150	View Abstract Download PDF
23.	**Sign Language Translator** *Khan Nausheen* **SK Somaiya Vidyavihar, Mumbai, Maharashtra**	151-156	View Abstract Download PDF
24.	**The Development and Importance of Complex Numbers in Mathematics** *Aniruddha Kumar* **DAV Degree College, Lucknow**	157-159	View Abstract Download PDF
25.	**Personalized Medicine Using AI and Genomics** *Khan NavidShaba* **S. K. Somaiya College, Somaiya Vidyavihar University, Mumbai, Maharashtra**	160-164	View Abstract Download PDF
26.	**Cybersecurity and National Security: Constitutional Issues in Digital Governance** *Rituraj Malik* **Amity University Noida, Noida, Uttar Pradesh**	165-169	View Abstract Download PDF
27.	**To Predict Calories Burnt During Various Physical Activities Like Walking, Running, Cycling, & Swimming** *Abhishek Shivprakash Jaiswar, Dr. Swati Maurya* **Somaiya Vidyavihar University, Mumbai, Maharashtra**	170-173	View Abstract Download PDF
28.	**Narrative Intelligence @ Generative AI in Storytelling And Reshaping Creative Writing From Prompt Engineering to Co Creation** *Dr. M.K. Jayanthi Kannan, Boda Sai Srujan* **School of Computing Science, Engineering and Artificial Intelligence, VIT Bhopal University, Bhopal**	174-180	View Abstract Download PDF

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S.No	Title	Page Number	Links
29.	**Obstacle Avoiding Arduino Controlled Bipedal Robot** *Kalyani Anumalla, Bhoomi Gupta, Mohd. Ajmal Javed, Prof. Nikhil VS* **MCT's Rajiv Gandhi Institute of Technology, Mumbai, Maharashtra**	181-185	View Abstract Download PDF
30.	**Power in Every Step: A Piezoelectric Staircase Solution** *Lakshya S* **Kumaraguru College of Technology, Coimbatore, Tamil Nadu**	186-190	View Abstract Download PDF
31.	**The Transformative Role of Artificial Intelligence in Healthcare: Current Applications, Challenges, and Future Directions** *Ashish Nakhate, Gaurav Saini, Jaipal singh, Jayprakash Asati, Yaman Singh* **Lovely Professional University, Phagwara, Punjab**	191-194	View Abstract Download PDF
32.	**Design and Implementation of IoT-Based War Spying Robot with Wireless Night Vision Camera** *Yathish M, Kavana M S, Ananya V R, Dr. Prakash Kuravatti* **Rajeev Institute of Technology, Hassan**	195-199	View Abstract Download PDF
33.	**Heart Disease Prediction** *Aniruddha Ambre* **SK Somaiya University, Mumbai, Maharashtra**	200-202	View Abstract Download PDF
34.	**Synthesis, Structural and Optical Characterization of Pure And Cobalt Doped Zinc Oxide Nanoparticles By Sol-Gel Method** *Dhivya R, Poonguzhali V, Sahana Fathima A, Abinaya B* **Sri Ramakrishna College of Arts and Science, Coimbatore, Tamil Nadu**	203-212	View Abstract Download PDF
35.	**Plant Irrigation Water Sprinkler Robot for Agriculture** *Manjunath B H, Anika Advika Gowda, Anusha T S, Ambika K* **Rajeev Institute of Technology, Hassan**	213-218	View Abstract Download PDF
36.	**Health Monitoring and the Tracking Systems for Soldiers Using IoT** *Sinchana K, Lokeshwari H S, Anvitha David, Harshitha B J, Amulya D P* **Rajeev Institute of Technology, Hassan**	219-223	View Abstract Download PDF
37.	**Using New Age Technology for Customer Gratification: A Review of Contemporary AI Use** *Aashi Vishnoi* **Amity University, Noida, Uttar Pradesh**	224-229	View Abstract Download PDF

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S.No	Title	Page Number	Links
38.	**Ku-Band Microstrip Antenna Array: A Design Approach for Satellite Communication** *Lavanya Ravi, Dr. G . Srinivasa Rao, Bachina Sri Divya, Katuru Meghana, Meesala Ramana Jyothi* **Bapatla Women's Engineering College, Bapatla, Andhra Pradesh**	230-237	View Abstract Download PDF
39.	**Smart Blind Stick Using Arduino** *Preethu M R, Ruchitha H S, Lokesh Gowda M P, Dr. Prakash Kuravatti* **Rajeev Institute of Technology, Hassan**	238-242	View Abstract Download PDF
40.	**An Intelligent Banking Management System with Fraud Detection** *Atirek Mani Diggal, Vatsal Sharma, Anushka Sharma, Ansh Narayan, Sristhi Vashistha* **Meerut Institute of Engineering and Technology, Meerut**	243-249	View Abstract Download PDF
41.	**A Real Time Driver Safety for Preventing Drowsiness Using Ear Algorithm and Truck Load Monitoring Alcohol Detections & Alert System** *Boya Indu, Konduru Munisai, K. Praveen, T V Balarama Krishna* **JNTUA, Anantapur, Andhra Pradesh**	250-253	View Abstract Download PDF
42.	**Comparing AC vs DC Systems for Electrocoagulation of Microplastics in Waterbodies – An Innovative Solution** *Atishaya Gupta, Agastyaa Goradia* **Dhirubhai Ambani International School, Mumbai, Maharashtra**	254-263	View Abstract Download PDF
43.	**PowerLift: Generating Energy through Gym** *Rishika Pathak, Vasant Parab, Sneha Shinde, Shrikant Jagtap, Vishwadeep Sardar, Vinay Koshti, Nidhish Dangare, Vaibhavi Taras, Jitesh Gond, C. M. Chaudhari* **Smt. Indira Gandhi College of Engineering, Navi Mumbai, Maharashtra**	264-272	View Abstract Download PDF
44.	**The Balance of Powers in Modern Democracies** *Raghav Gautam* **Amity University Noida, Uttar Pradesh**	273-275	View Abstract Download PDF
45.	**Automated Home Security and Intruder Detection System using IoT** *Paraansh Nisar* **MIT World Peace University, Pune, Maharashtra**	276-281	View Abstract Download PDF
46.	**Experimental Study On Stabilization of Subgrade Soil And Pavement Design** *Dinesh Patil, Shubham Janwade, Aviraj Jadhav, Ashish Ghogare, Vrashabh Gurav, Sagar E. Bhoyar* **Sinhgad Institute of Technology and Science, Narhe, Pune, Maharashtra**	282-286	View Abstract Download PDF

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S.No	Title	Page Number	Links
47.	**Non-Invasive Glucometer Using IoT** *Sheethal M S, Chandana H S, Adarsh J R, Paramesha H R, Ambika K* **Rajeev Institute of Technology, Hassan, Karnataka**	287-291	View Abstract Download PDF
48.	**Case Study Diabetes Mellitus** *Dr. Abhay Singh Deora, Dr. Prakash Gupta, Dr. Pulkit Goyal* **Goyal Hospital and Research Centre Pvt Ltd., Jodhpur, Rajasthan**	292-294	View Abstract Download PDF
49.	**Multiverse Theories and Predictions** *Shreesh Ghosh* **The Shri Ram School, Moulsari, Gurgaon, Haryana**	295-301	View Abstract Download PDF
50.	**Springless Suspension Using Bevel Gears** *Aditya Pol, Prof. Nikhil VS, Yash T Raut, Ninad Shinde* **Rajiv Gandhi Institute of Technology, Andheri (west), Mumbai,**	302-306	View Abstract Download PDF
51.	**Design and Development of an Automated Hydroponics System Based on IoT with Data Logging** *Manisha S, Karisni K, Gokul Raj V, Josphin M Sajith, Haritha M* **Sri Shakthi Institute of Engineering and Technology, Tamil Nadu**	307-314	View Abstract Download PDF
52.	**Movies Recommendations System** *Kamakshi Bhardwaj* **RD Engineering College, Basantpur Saitli, Uttar Pradesh**	315-321	View Abstract Download PDF
53.	**High-Frequency Capacitive Wireless Charging Using a 4-Plate Structure** *Dr. Muthukannan S, Ananya H R, Deekshitha A V, Jeevitha N U, Ruchitha K C* **Rajeev Institute of Technology, Aduvalli, Karnataka**	322-329	View Abstract Download PDF
54.	**Machine learning assisted Optical-SAR Radar for Target Classification** *Priyanka Shukla, Priti Singh, Ashutosh Dubey, Kritika Upadhyay, Pranshu Upadhyay* **Rama University, Kanpur, Uttar Pradesh, BSA College of Engineering and Technology, NIT,Delhi**	330-337	View Abstract Download PDF
55.	**AI-Generated Art and Intellectual Property: Navigating the Landscape of Ownership, Authorship, and Copyright** *Daphne Ekpe* **Independent Researcher**	338-343	View Abstract Download PDF
56.	**Detection of Insurance Fraud Using Machine Learning: A Data-Driven Approach for Accurate Classification** *Shaba Khatoon, Dr. Ankita Srivastava, Dr. Shish Ahmad* **Integral University Lucknow, Dashauli, Uttar Pradesh**	344-349	View Abstract Download PDF

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S.No	Title	Page Number	Links
57.	**A Smart Medicine Reminder System Using React Native and Timezone-Aware Notifications for Personalized mHealth Assistance** *Nandigama Prashanth Kumar* **Gear Up Studio, Telangana**	350-354	View Abstract Download PDF
58.	**The Effect of Dollarization on the Argentine Economy- A Global Analysis** *Kevin Isaac* **O.P Jindal University, Sonipat, Haryana**	355-373	View Abstract Download PDF
59.	**Survey Paper on Advancements in Dysarthric Speech Recognition Systems** *Sushmita Chaudhari, Mansi Chopkar, Harshvardhan Gaikwad, Anuj Raj* **Pune Vidhyarthi Grihas College of Engineering and Technology, Pune, Maharashtra**	374-380	View Abstract Download PDF

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ABSTRACTS

1 Big Data Analytics for Real-Time Fraud Detection in Insurance Claims

Paper ID V11I2-1151 · Pages 1-5 · Big Data Analytics

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The integration of Artificial Intelligence (AI) and Big Data Analytics is revolutionizing industries by optimizing efficiency, accuracy, and security. In healthcare and insurance, AI-driven intelligent Document Processing (IDP) automates workflows such as claims automation, medical data extraction, and regulatory compliance management. By utilizing Machine Learning (ML), Natural Language Processing (NLP), and Optical Character Recognition (OCR), IDP accelerates document classification, data validation, and anomaly detection, reducing errors by 90% and cutting processing time by 80%. In the financial sector, AI enhances fraud analytics, risk modeling, and compliance monitoring. Advanced deep learning architectures, pattern recognition, and predictive analytics improve credit risk assessment and real-time fraud mitigation. AI-powered anomaly detection techniques identify suspicious transactions, reducing cybersecurity threats and financial fraud losses.

Keywords: Artificial Intelligence (AI), Intelligent Document Processing (IDP), Machine Learning (ML), Natural Language Processing (NLP), Fraud Detection, Risk Assessment, Financial Technology (FinTech), Regulatory Compliance, Cybersecurity, Automation in Healthcare, AI in Insurance.

Read Full Paper · Download PDF · Back to index

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2 Small Businesses as the Basis of the Indian Economy

Paper ID V11I2-1140 · Pages 6-20 · Economics And Business

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India's economic progress and GDP growth have been mostly driven by small and medium-sized businesses, or SMEs. As of March 27, 2022, there were over 7.9 million MSMEs in India, according to the Ministry of Micro, Small & Medium Enterprises. India's and the world's economies have grown because of small enterprises. In a nation with an economy the size of India, small businesses make up 95% of the industrial units, and they provide 40% of the nation's total industrial production. Once more, tiny companies account for around 45% of India's overall export earnings. This paper explores the importance of small businesses in India, their contributions, their challenges, and their evolving role in driving sustainable and inclusive economic development.

Keywords: MSME Act, Sole Proprietorship, General Partnership, Limited Liability Partnership (LLP), Corporation, Franchise, Home-Based Business, Social Enterprise, Non-profit Organization, Employment Generation, Rural Development, Economic Diversification, Innovation, Gross Domestic Product (GDP), Export Promotion, Social Impact, Government Revenue, Capital Management

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3 Comparative Analysis of Machine Learning Models for Diabetes Prediction: A Performance Evaluation Study

Paper ID V11I2-1170 · Pages 21-26 · Machine Learning

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Diabetes is a chronic disease affecting millions worldwide, necessitating early diagnosis and effective prediction models for improved healthcare outcomes. This study evaluates seven machine learning algorithms for diabetes prediction using healthcare data. We compared Logistic Regression, K-Nearest Neighbors (KNN), Random Forest, Decision Tree, AdaBoost, XGBoost, and Support Vector Machine (SVM) models. The analysis focused on key performance metrics: accuracy, precision, recall, F1-score, and Area Under the Curve (AUC). Results showed that logistic regression achieved the highest overall performance with 79% accuracy and 0.88 AUC, suggesting its potential utility in clinical diabetes prediction applications.

Keywords: Diabetes Prediction, Machine Learning, Logistic Regression, KNN, F1-Score, AUC.

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4 Design and Development of V-Twin Stirling Engine

Paper ID V11I2-1166 · Pages 27-51 · Mechanical Engineering

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Ravi Singh, Student, Rajiv Gandhi Institute of Technology, Mumbai
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This project aims to address environmental issues like air pollution and noise generated by internal combustion (IC) engines through the development of a V-Twin Stirling engine. Stirling engines, which operate through cyclic expansion and contraction of gas via external heat sources, offer a more efficient and cleaner alternative to traditional IC engines. The design leverages a unique mechanism where one piston drives the motion of both pistons using a gear system, reducing fuel consumption and emissions. The project involves comprehensive analysis and design, with the engine components, such as flywheels, gears, and pistons, being meticulously crafted for optimized performance. The development process includes part drawings, weight and volume calculations, and precision manufacturing using aluminum. The Stirling engine's potential to harness renewable energy, integrate into power generation systems, and recover waste heat positions it as a viable alternative for future sustainable automotive technologies. The total project budget is approximately INR 6000, covering materials, manufacturing, and necessary accessories.

Keywords: Environmental Issues, Air Pollution, Internal Combustion (IC) Engine, V-Twin Stirling Engine

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5 Energy Harvesting Poles: Harnessing Piezoelectric Power for Sustainable Infrastructure

Paper ID V11I2-1189 · Pages 52-56 · Civil Engineering

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The integration of piezoelectric poles in road infrastructure presents a promising avenue for sustainable energy generation and smart infrastructure development. Piezoelectric materials, which generate electrical energy when subjected to mechanical stress or pressure, can be embedded in road poles to harness the energy from vehicles passing by. These poles can convert the vibrations and pressure created by traffic into usable electrical energy, which can then be utilized to power streetlights, traffic signals or even be stored for future use. The potential for reducing dependency on traditional energy sources while improving the functionality and sustainability of roadways is substantial. Furthermore, piezoelectric poles can contribute to the development of smart roads, integrating sensors and communication systems that enhance traffic management and safety. This paper explores the feasibility, design, and applications of piezoelectric poles on roads, evaluating their potential environmental and economic benefits, as well as the challenges in scaling this technology for widespread use in modern transportation networks.

Keywords: Piezoelectricity, Energy Harvesting, Smart Roads, Sustainable Energy, Road Infrastructure, Traffic-Induced Vibrations, Renewable Energy, Energy Conversion, Mechanical Stress, Road Sensors

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6 Crumb Rubber used in Pavement Design

Paper ID V11I2-1188 · Pages 57-60 · Civil Engineering

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Pavement design is a critical process in the construction of road infrastructure, aimed at creating durable, cost-effective, and sustainable surfaces that can withstand traffic loads, environmental conditions, and wear over time. The design methodology involves several factors, including traffic load, climate, soil properties, material selection, and the type of pavement (flexible or rigid). Traditional pavement design methods such as empirical approaches (e.g., AASHTO) rely on established guidelines and field data, while more advanced techniques, such as mechanistic-empirical methods, integrate both mechanical analysis and field performance data for a more accurate prediction of pavement behavior.

Keywords: Industrial Waste, Agricultural Waste, Rubberized Concrete

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7 Ai-Driven Vibebox: Adaptive Music Streaming Personalized Based on Emotion

Paper ID V11I2-1171 · Pages 61-72 · Machine Learning And Deep Learning

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Music recommendation systems play a crucial role in addressing the challenges of information overload and personalization in the digital music landscape. This paper presents the implementation and contribution of a novel music recommendation system that aims to enhance the user experience and overcome the limitations of existing approaches. The AI-Driven VibeBox: Adaptive Music Streaming personalized based on Emotion provides an overview of the project's architecture, methodology, and key findings, highlighting its contributions to music recommendation systems. The exponential growth of digital music platforms has led to an overwhelming abundance of music content, making it increasingly difficult for users to discover and explore new music that aligns with their preferences. Music recommendation systems have emerged as a vital tool to address this challenge, leveraging various techniques to provide personalized suggestions and enhance the user experience. MoodSync Vibebox is a music recommendation system that seeks to advance the state-of-the-art in this domain. This review paper aims to critically analyze the project's methodology, findings, and contributions, while also situating it within the broader context of music recommendation system research.

Keywords: Artificial Intelligence, ML, Intelligent Automatic Playlist Generation, Text Analysis, Fine-tuned BERT model, Sentiments and Emotions Recognition, Facial Emotion Analysis, CNN, Playlist Generation Model, React.js, Firebase, Web Application Development.

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8 CropVion: A VGG16-based Convolutional Approach for Plant Disease Detection

Paper ID V11I2-1138 · Pages 73-76 · Machine Learning

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This project focuses on developing a machine learning-based system for detecting plant diseases, providing valuable support to farmers, botanists, and researchers. The aim is to improve agricultural productivity and research efforts through automated plant health monitoring. The solution includes a user-friendly and

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responsive interface built with Streamlit, a Python framework that facilitates the creation of web applications, enabling efficient interaction for users, whether they are in farming or research. The system leverages Convolutional Neural Networks (CNN) with a fine-tuned VGG16 pre-trained model, utilizing transfer learning to accurately classify plant diseases based on leaf imagery. A diverse dataset of plant diseases is used for training, with advanced image preprocessing techniques applied to improve classification accuracy. This solution ensures a scalable, precise, and user-friendly method for disease detection, facilitating seamless adoption into modern agricultural workflows.

Keywords: Streamlit, CNN, VGG16, Deep Learning

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9 Rehabilitation and Retrofitting of the Rajabai Clock Tower

Paper ID V11I2-1183 · Pages 77-79 · Civil Engineering

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The Rajabai Clock Tower, an iconic Gothic Revival structure in Mumbai, has stood as a cultural and architectural landmark since its completion in 1878. Over the years, factors such as weathering, pollution, material aging, and structural stress have led to deterioration, necessitating a comprehensive rehabilitation and retrofitting strategy to preserve its historical and structural integrity. This study focuses on assessing the structural condition of the tower using non-destructive testing (NDT) techniques, such as ultrasonic pulse velocity, rebound hammer tests, and thermal imaging. A detailed damage assessment was conducted to identify material degradation, cracks, moisture infiltration, and foundation settlement. Computational finite element analysis (FEA) was also used to evaluate load distribution and stress concentrations. The rehabilitation approach involves restoration of damaged stonework, stained glass panels, and intricate carvings using compatible materials. Retrofitting techniques include micro-jacketing, crack injection, fiber-reinforced polymer (FRP) reinforcement, and waterproofing to enhance the tower's structural resilience while maintaining its original aesthetics. Advanced conservation methodologies ensure that modifications blend seamlessly with the existing heritage fabric. By implementing a sustainable and minimally invasive retrofitting approach, this project ensures that the Rajabai Clock Tower remains a historically preserved and structurally sound landmark for future generations. This research serves as a case study for heritage conservation, demonstrating a balance between architectural restoration and modern engineering solutions.

Keywords: Rajabai Clock Tower, Gothic Revival Architecture, Non-Destructive Testing (NDT), Finite Element Analysis (FEA), Material Degradation, Conservation Methodologies, Sustainable Restoration, Architectural Preservation, Engineering Solutions, Historical Landmark, Structural Integrity

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10 Marine Pollution & Implementation of Regulations

Paper ID V11I2-1165 · Pages 80-84 · Environmental Law

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The Global Environment Report on the Rule of Law, published by UNEP, emphasizes that inadequate enforcement of existing environmental laws and regulations is a significant barrier to preventing environmental degradation. Despite the existence of international legal frameworks to address and manage marine plastic pollution, they are frequently weakened by inconsistent enforcement and a lack of accountability. Consequently, these laws are not applied uniformly across nations, undermining their effectiveness in mitigating marine pollution. The lack of specific regional guidelines leaves countries to establish their standards, creating a disjointed and varied response to the issue. Many neighboring nations focus on enhancing their solid waste collection and management systems to combat marine plastic pollution. However, improving waste management infrastructure requires substantial financial investment, a considerable challenge for many low and middle-income countries. In this context, regional collaboration provides more benefits than multilateral agreements or bilateral pacts. Although global initiatives engage a broader range of stakeholders, countries' varying levels of commitment and capacity frequently hinder prompt collective action. Conversely, while bilateral agreements are simpler to negotiate, they have a limited scope and are less effective in addressing the cross-border nature of marine plastic pollution. As a result, regional cooperation emerges as a more practical solution because it reflects shared interests, considers geographical and political contexts, and enables customized strategies that meet the unique needs and priorities of the region.

Keywords: Plastic, Prevention, Responsibility, Contamination, Effectiveness

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11 The Impact of GST on Accounting Practices in Chartered Accountant Firms

Paper ID V11I2-1219 · Pages 91-93 · Accounting

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This study seeks to examine the effects of the implementation of Goods and Services Tax (GST) on the accounting practices of Chartered Accountant (CA) firms in India. Since its introduction in 2017, the GST has significantly transformed the landscape of indirect taxation, influencing how businesses and professionals approach financial reporting and compliance. The study delves into changes in accounting methodologies, the advisory roles of clients, the workload associated with compliance, and the adoption of technology by CA firms. Utilizing both primary and secondary data, the research assesses how these firms have adjusted to the GST framework, the challenges encountered, and the opportunities that have arisen. The findings reveal that while GST has simplified tax reporting processes, it has simultaneously heightened the complexity and frequency of compliance requirements, leading CA firms to invest in automation and digital solutions.

Keywords: Goods and Services Tax (GST) Chartered Accountant (CA) Firms Tax Compliance Accounting Practices Indirect Tax Reform Technology Adoption GST Portal Input Tax Credit (ITC) Regulatory Framework Client Advisory Services Training

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and Development Digital Transformation Tax Filing and Returns Compliance Burden GST Challenges and Opportunities

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12 Evaluating the Role of Artificial Intelligence in Tax Administration in India

Paper ID V11I2-1225 · Pages 94-98 · Tax

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This study explores how Artificial Intelligence (AI) is transforming tax administration in India. AI is helping the government improve efficiency, reduce tax evasion, and make tax processes easier for both officials and taxpayers. With tools like data analytics and machine learning, AI can quickly detect fraud, analyze large sets of financial data, and ensure better compliance. It also supports faster processing of returns and smarter decision-making. As India moves toward a digital economy, AI plays a crucial role in modernizing tax systems, making them more transparent, accurate, and user-friendly for everyone involved. AI is reshaping the landscape of tax administration in India by automating routine tasks, minimizing human errors, and enhancing transparency. It enables tax departments to identify irregularities through predictive analysis and real-time monitoring of transactions. Chatbots and AI-driven platforms are improving taxpayer services by offering instant support and guidance. Additionally, AI helps in risk assessment, audit selection, and fraud detection, ensuring a fair and efficient tax system. As technology continues to evolve, AI has the potential to bridge gaps in tax compliance, reduce administrative costs, and build trust between taxpayers and authorities, paving the way for a more robust tax framework.

Keywords: Artificial Intelligence (AI), Tax Administration, Tax Compliance, Fraud Detection

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13 The Influence of Social Media on Customer Preference

Paper ID V11I2-1217 · Pages 99-101 · Marketing

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In the modern digital era, social media sites play a dominant role in shaping consumer behavior. This research examines the complex interplay between social media usage and customer preference and the role of online participation, influencer promotion, and user-generated content in shaping purchasing behavior. Employing the analysis of a varied dataset of consumer behavior and purchasing behavior, we seek to identify the particular mechanisms by which social media shapes brand perception and product choice. Our results emphasize the influence of authenticity and community involvement in shaping positive customer preference, providing insightful recommendations to firms looking to harness the power of social media for strategic leverage.

Keywords: Social Media, Customer Preference, Interior Design, Online Behavior, Brand Perception, Influencer Marketing, User-Generated Content, Engagement Metrics, Content Types, Demographics, Sustainability, Personalization, Technology,

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Consumer Behavior

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14 The Role of Consultants in Empowering SMEs

Paper ID V11I2-1236 · Pages 102-105 · Consulting And Professional Services

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This research paper explores the vital role that consultants play in empowering SMEs. By providing access to specialized knowledge, skills, and expertise, consultants can help SMEs develop effective strategies, improve their operations, drive innovation, and expand their market reach. The paper highlights the benefits of consultant-SME partnerships, including enhanced performance, improved competitiveness, and sustainable growth. Through a nuanced examination of the consultant-SME relationship, this research sheds light on the ways in which consultants can tailor their services to meet the unique needs of SMEs. By adopting a collaborative approach and prioritizing the needs of their SME clients, consultants can deliver impactful results that drive long-term success. Ultimately, this paper demonstrates the value of consultants in empowering SMEs to achieve their full potential. By leveraging the expertise and guidance of consultants, SMEs can overcome their challenges, capitalize on opportunities, and thrive in an increasingly complex business environment.

Keywords: Small and Medium Enterprises (SMEs), Consultancy Services, Business Growth, Operational Efficiency, Financial Management, Market Expansion, Digital Transformation, Regulatory Compliance, Strategic Planning, Business Sustainability

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15 Regulations to be Followed by Banks

Paper ID V11I2-1203 · Pages 106-107 · Banking

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With an emphasis on compliance, risk management, and internal control systems, this research examines the broad framework of banking rules that oversee banks' financial operations. The report highlights the significance of reconciliation methods, regulatory compliance, and operational control across several regions through an internship at ANZ. It offers information on statutory ratios, capital adequacy standards, the Reserve Bank of India's directives, and regulatory acts such as the Prevention of Money Laundering Act of 2002 and the Banking Regulation Act of 1949. ANZ data analysis is also included in the research, outlining patterns in the company's financial performance, difficulties with regulatory compliance, and tactical recommendations for long-term banking operations.

Keywords: Money Laundering, Regulations, Financial Operations

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16 Research on the Role of Social Media in Marketing

Paper ID V11I2-1221 · Pages 108-109 · Marketing

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This study examines the transformative effects social media has made on marketing strategies to many variables. With the emergence of sites like facebook.com, instagram.com, twitter.com, linkedIn.com, and tik-tok.com, companies and organizations have shifted from their historic forms of marketing to more engaging, dynamic, and consumer-centric forms of health promotion and marketing strategies. This paper evaluates the impact of social media on developing brand awareness, targeting and engaging customers, and assessing the purchasing behaviours of consumers of brands and services, but also outlines the methods and benefits of use in paid social media advertising (targeted advertising, influencer marketing). The study is based upon a response of using quantitative and qualitative research practices/ techniques (surveys, expose case studies and data analysis) to determine various key trends, benefits and pitfalls associated with leverage social media advertising as part of a health promotion or social marketing strategy. The combination of research findings indicated to the study that social media offers huge opportunities for immediate engagement and can provide a whole new level of engagement using data-driven points of view. However, it invites brands to constantly innovate and respond to consumers. The research also provides evidence that a good social media marketing strategy is now essential for businesses who want to remain competitive and secure long-term growth, profit, and competitive advantage moving into an increasingly digital era of using social media for promotion, marketing, and advertisement.

Keywords: Social Media, Marketing Strategies, Brand Awareness, Consumer Behavior

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17 SynapseEd-Systematic LLM Neural Application for Personalized Educational Development

Paper ID V11I2-1198 · Pages 110-119 · Artificial Intelligence And Computer Science

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Education is evolving, yet traditional learning models struggle to adapt to individual student needs. Synapseed is an AI-driven, innovative learning system that personalizes education through Large Language Models (LLMs), Retrieval-Augmented Generation (RAG), and multi-agent AI frameworks. It dynamically tailors learning paths, providing real-time AI-driven content, interactive explanations, and coding assistance across various programming languages. The system integrates vector databases, conversational memory models, and CrewAI-powered multi-agent systems to enhance knowledge retrieval from PDFs, YouTube transcripts, and structured academic resources. Additionally, Code Synapse offers multi-language coding support with syntax-aware

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responses. The platform is scalable and suitable for K-12, higher education, and professional training. A key innovation of SynapseEd is its efficient memory utilization and computational optimization. Unlike traditional LLM-based educational models that require high-end GPUs and large-scale infrastructure, SynapseEd achieves similar functionality on a non-GPU system with just 8GB of RAM. Leveraging quantization (4-bit QLoRA) and lightweight fine-tuning techniques demonstrates that LL.M-powered educational platforms can be built within limited hardware constraints, making AI-driven learning more accessible and deployable across diverse environments.

Keywords: Large Language Models (LLMs), Finetuned-LLM, Retrieval-Augmented Generation (RAG), Synapse Agents, CrewAI, LangChain, LLMChain, Conversation Buffer Memory, Vector Databases, PEFT, LORA-QLORA

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18 A Review On Alzheimer’s Disease

Paper ID V11I2-1200 · Pages 120-126 · Pharmaceutics

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Alzheimer's disease (AD) is a progressive neurodegenerative disorder marked by a gradual decline in cognitive function, which affects memory, thinking, and reasoning abilities. As the disease advances, individuals experience worsening impairments in daily activities and exhibit behavioral changes. This condition is the most common cause of dementia, with a significant impact on quality of life for both patients and caregivers. Alzheimer's disease (AD) is the most common form of both pre-senile and senile dementia, affecting about 5% of men and 6% of women over the age of 60 worldwide, according to the World Health Organization (WHO). The disease typically begins with subtle memory failure, which progressively worsens and can become debilitating. Current treatments offer minimal impact, including acetylcholinesterase inhibitors (rivastigmine, galantamine, donepezil) and the NMDA receptor antagonist memantine. While these drugs can slow disease progression and relieve symptoms, they do not cure or prevent the disease's onset. Although the neuropathological features of AD are known, the exact mechanisms behind the disease remain unclear, which contributes to the lack of effective treatments. However, recent advances in understanding AD's pathophysiology have led to new therapeutic targets that may directly address the underlying disease process. This article discusses these recent developments in AD research and how they could potentially improve disease management and reduce care costs. It highlights the importance of advancing knowledge in this area for better treatment outcomes..

Keywords: Alzheimer's, Management, Diagnosis, Treatment, Therapy, Types & Phases of Dementia.

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19 The Israel-Palestine Conflict: A Legal and Geopolitical Overview

Paper ID V11I2-1248 · Pages 127-131 · Law

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The Israel-Palestine conflict is one of the most intractable and controversial geopolitical disputes in modern history. Rooted in colonial legacies, competing nationalist movements, and overlapping religious claims, it continues to generate widespread humanitarian, legal, and political implications across the globe. This paper seeks to provide a brief but comprehensive overview of the conflict by addressing its historical evolution, major flashpoints, key legal controversies, and contemporary developments—including the 2023–24 Israel-Gaza war, the South Africa v. Israel genocide case before the ICJ, and the regional reverberations involving Iran, Hezbollah, and major global powers.

Keywords: Israel, Palestine, Conflict, War, Crises, Politics, Law

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20 ARIA: An Intelligent Voice-Enabled Virtual Assistant for Desktop Automation and Conversation

Paper ID V11I2-1227 · Pages 132-137 · Computer Engineering

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To increase desktop productivity through natural language interaction, this research paper, Aria, introduces a Virtual Virtual Personal Assistant (VPA), built in Python. Application controls (memo blocks, calculators, etc.), webbrows, language typing, email, weather invocations, and natural conversations with DialOgpt conversation models are just some of the many tasks that ARIA can do. To interpret, create, and automate tasks on the user's computer, the assistant uses a variety of Python libraries, such as Speech_Recognition, Pyttsx3, Pyautogui, and Trans. Easy-to adjust modular architecture allows users to improve their skills according to their special needs. Integration of language-based automation into smartphones and intelligent devices has been passed considerably thanks to the efforts of established virtual assistants, providing Google Assistant, Siri, Siri, Alexa, Alexa and Cortana. The system and its capabilities rely primarily on a cloud-based ecosystem. Similarly, several open source initiatives, such as desktop-based Jarvis Clones and Mycroft AI, aim to introduce AI assistants to HR computers, but often only limited offline capabilities, are born on a specific platform and require conversational skills. Aria overcomes these limitations by providing a fully adjustable and conscious desktop assistant through privacy. Data security and user control are guaranteed by offline and online operations, support for customer-specific commands, and independence from local task cloud storage. These are open-source libraries, allowing developers and researchers to change or extend functionality at will. Aria is a convenient and clever way to improve interactions between humans and computers in everyday arithmetic environments. Thanks to the integration of conversation AI, you can respond directly to commands and have contextual conversations.

Keywords: Virtual Personal Assistant (VPA), Speech Recognition, Natural Language Processing (NLP), Text-to-Speech (TTS),

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Python, Artificial Intelligence (AI), Voice Automation, Desktop Assistant, Offline Functionality, Conversational AI.

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21 Utilization of Sugercane Bagasse Ash in Concert (SBA)

Paper ID V11I2-1253 · Pages 138-141 · Civil Engineering

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Sugarcane bagasse ash (SCBA) is an agro-industrial byproduct generated from sugarcane bagasse combustion in sugar mills. Due to its pozzolanic properties, SCBA can partially replace cement in concrete, enhancing sustainability and reducing environmental impact. This study explores the potential benefits of incorporating SCBA in concrete mixtures, focusing on its effects on mechanical properties, durability, and workability. Experimental results indicate that SCBA improves compressive strength, reduces permeability, and enhances resistance to chemical attacks when used in optimal proportions. Utilizing SCBA in concrete production minimizes industrial waste and contributes to cost-effective and eco-friendly construction practices.

Keywords: Sugarcane Bagasse Ash, Pozzolanic Material, Sustainable Concrete, Cement Replacement, Mechanical Properties, Durability, Green Construction.

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22 Autonomous AI Agents for Real-Time Financial Transaction Monitoring and Anomaly Resolution Using Multi-Agent Reinforcement Learning and Explainable Causal Inference

Paper ID V11I2-1252 · Pages 142-150 · Information Technology

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Real-time financial fraud detection systems face significant challenges from adversaries' continually evolving attack strategies. Traditional static classifiers fail to adapt to these changes and often lack interpretability, leading to false positives and missed anomalies. This paper proposes a novel framework combining Multi-Agent Reinforcement Learning (MARL) with Explainable Causal Inference for transaction anomaly detection and resolution. A defender agent learns to identify and intercept fraud in an adversarial environment where an attacker agent simulates fraudulent behaviors. The agents interact within a stochastic game setting and are trained using a centralized critic and decentralized policies. A causal inference module constructs a directed acyclic graph over transaction features to enhance interpretability and applies do-calculus and counterfactual reasoning to explain flagged transactions. We implement a scalable, real-time deployment architecture and evaluate the system using simulated and real transaction data. Results demonstrate that our MARL-based agent outperforms static classifiers in adaptability and recall, while the causal module reduces false positives

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and provides transparent justifications for fraud decisions. This combination of adaptability and explainability makes the system highly suitable for practical deployment in financial institutions..

Keywords: Real-Time Fraud Detection, Multi-Agent Reinforcement Learning (MARL), Explainable Ai, Causal Inference, Financial Transactions, Anomaly Detection, Adversarial Learning

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23 Sign Language Translator

Paper ID V11I2-1246 · Pages 151-156 · Computer Science

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Sign language is a fundamental mode of communication for the deaf and hard-of-hearing yet there is often a gap in understanding between sign language Operators and the broader population. this search introduces amp real-time house speech Explainer mature exploitation tensorflow mediapipe and opencv specifically organized to Method arsenic associate in nursing informative drive that acquired immune deficiency syndrome non-signers inch acquisition house speech. The system translates sign language gestures into spoken language while providing interactive Characteristics that allow Operators to practise receive feedback and Improve their signing Precision. done Fancy motion credit and judgement Operators get increasingly arise their skills devising house speech acquisition available and visceral. This paper details the system's Structure Applyation and real-world Use emphasizing its potential to Improve communication and inclusivity across linguistic communities by fostering a broader understanding of sign language.

Keywords: Sign Language, Real-Time Translation, Gesture Recognition, Interactive Learning, Inclusivity

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24 The Development and Importance of Complex Numbers in Mathematics

Paper ID V11I2-1256 · Pages 157-159 · Mathematics

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The journey of complex numbers from mathematical heresy to fundamental scientific tool represents one of the most remarkable intellectual transformations in history. These numbers of the form a + bi (where $i^2 = -1$) have transcended their origins in algebra to become indispensable across physics, engineering, and technology. This comprehensive study examines their historical evolution, deep mathematical properties, and unparalleled applications that continue to shape modern science. Through detailed analysis of pivotal developments, we demonstrate how complex numbers provide the mathematical language for describing phenomena from quantum entanglement to wireless communication.

Keywords: Algebra Physics Engineering Technology Historical Evolution Mathematical Properties Applications Modern Science Quantum Entanglement Wireless Communication Mathematical Language Intellectual Transformation Pivotal Developments

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25 Personalized Medicine Using AI and Genomics

Paper ID V11I2-1257 · Pages 160-164 · Artificial Intelligence In Healthcare

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A conceptual change in healthcare, personalized medicine uses an individual's genetic profile to forecast disease risk, customize drug treatments, and increase patient outcomes. With its great genomic variety, the development of such systems is hampered in the Indian setting by the scarcity of region-specific, annotated clinical datasets. Using IndiGenome and PharmGKB as main references, this work presents a framework for combining genomic and pharmacogenomic data to enable personalized medicine. A manually built dataset with standardized notations was produced to replicate patient data due to integration difficulties between accessible datasets. This enabled the application of treatment logic and important gene mutations (BRCA1, BRCA2, TP53) based on working artificial intelligence. Future deployment with actual genomic data builds on this Streamlit-based application, which is able to predict treatments and provide health recommendations.

Keywords: Personalized Medicine, Artificial Intelligence, Genomics, Brca1, Brca2, Tp53, Random Forest, Machine Learning, Drug Prediction, Pharmacogenomics

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26 Cybersecurity and National Security: Constitutional Issues in Digital Governance

Paper ID V11I2-1265 · Pages 165-169 · Law And Cybersercurity

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The research examines security connections between AI advancements and national security and constitutional governance within the Indian framework. Digital development in India has created obstacles for its constitutional framework that must balance cybersecurity requirements with cyber liberties safeguards. The closed connection between cybersecurity systems and national defence created new regulatory gaps requiring fresh constitutional reform. This paper examines how fundamental rights in Articles 19 and 21 of the Indian Constitution protect against digital threats. The Proportionality standard created in the Puttaswamy judgment for examining security measures has not been correctly executed within Indian cybersecurity governance operations. The separation of cyber threat responsibilities between the state and national governments remains unclear because traditional federal administrative structures cause difficulties when facing cross-jurisdictional threats. The original Information Technology Act of 2000 in India exists as pre-modern legislation to defend citizens against executive surveillance, but remains inadequate in these matters. The adoption of artificial intelligence technologies by national security operations creates constitutional tensions through machine-learning techniques that lead to issues explaining algorithm operations and automated system procedures. Previous judicial decisions in their outcomes and international cybersecurity strategies serve as research material to identify effective constitutional oversight models. The paper presents three proposed reforms establishing dedicated oversight bodies to enforce surveillance oversight and judicial supervision of security operations and set controls for AI systems in security applications. Analyzing Indian cybersecurity policies against constitutional requirements for security and personal rights enhances digital constitutional evolution beneficial to nations working on developing digital regulatory frameworks for people safety and

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national security.

Keywords: Cybersecurity, National Security, Indian Constitution, Digital Governance, Artificial Intelligence, Privacy, Data Protection, Surveillance

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27 To Predict Calories Burnt During Various Physical Activities Like Walking, Running, Cycling, & Swimming

Paper ID V11I2-1281 · Pages 170-173 · Computer Science

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This study aimed to create a new model to compute the number of calories expended during activities like swimming, cycling, running, and walking. We used vast data based on various criteria, including Vigor, activity duration, body heat, and heart rate. Our model estimates calorie burns accurately by using machine learning. Our model can be used for tracking personal exercise, controlling obesity, and improving sports performance by estimating calorie burn across different physical activities using the Mifflin St. Jeor equation. I am building a Kaggle dataset with crucial variables like heart rate, body temperature, and activity duration.

Keywords: Calorie Burn Prediction Physical Activity Machine Learning Health & Fitness Personalized Recommendations Data Collection Energy Expenditure Fitness Tracking Wearable Devices Activity Monitoring Resting Metabolic Rate (RMR) Activity Intensity Calories Burned

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28 Narrative Intelligence @ Generative AI in Storytelling And Reshaping Creative Writing From Prompt Engineering to Co Creation

Paper ID V11I2-1273 · Pages 174-180 · Machine Learning And Deep Learning

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In this research, we introduce a Generative AI-driven storytelling system that uses user prompts to produce a story with logic and without any grammar mistakes. The system uses DistilGPT2 and GPT2 transformer-based models and selects the best output using the BERTScore and coherence score. The chosen story is further refined using a grammar correction model based on T5. The final production is well-structured with clear paragraphs and natural dialogue. This approach improves the quality of the story for educational, entertainment, and creative writing. The evolution of Generative AI has opened new avenues in creative writing and content generation. This "GenAI-driven Storyteller" project presents an intelligent system that automatically generates engaging and grammatically correct short stories based on user-provided prompts. The system integrates the strengths of multiple language models—GPT2 and DistilGPT2—to produce diverse narrative outputs. These stories are evaluated using BERTScore for semantic relevance and a coherence

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scoring mechanism to measure logical flow. A weighted ensemble approach determines the most compelling version among the generated outputs. The selected story is then refined for grammar and fluency using a fine-tuned Google T5-small model. This hybrid architecture ensures that the final story is not only contextually aligned with the user's prompt but also polished in structure and readability. The project highlights the potential of combining generation, evaluation, and correction models to enhance automated storytelling systems.

Keywords: Generative AI, GPT2, Hybrid Model, Story Generation, BERTScore, Coherence Scoring, T5, Natural Language Processing.

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---

29 Obstacle Avoiding Arduino Controlled Bipedal Robot

Paper ID V11I2-1286 · Pages 181-185 · Robotics

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This paper presents the design and development of an Arduino-controlled bipedal robot with integrated obstacle avoidance. The robot simulates human walking using servo motors and executes real-time path adjustments based on ultrasonic sensor input. Inverse kinematics principles guide the movement, and the structure is fabricated using PLA-based 3D printing for lightweight and modular design. The system demonstrates efficient coordination of mechanical, electronic, and software elements for autonomous walking and navigation in dynamic environments.

Keywords: Arduino, Bipedal Robot, Obstacle Avoidance, Inverse Kinematics, Servo Motor

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30 Power in Every Step: A Piezoelectric Staircase Solution

Paper ID V11I2-1277 · Pages 186-190 · Electronics

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Coal, along with other fossil fuels, is still the major source of power generation. However, with a rapid consumption speed, these fossil fuels will be exhausted in the future. Also, the use of fossil fuels for power generation causes air pollution and the greenhouse effect. So, to deal with these problems, we need a greener solution. This project mainly aims to build a power generator using the piezoelectric sensor. The sensor converts the pressure into an electrical charge. When pressure is applied to piezoelectric sensors, an electric charge is generated. This generated output in the form of alternating current (AC) is then converted into Direct current (DC) to store for further use. This generation technique can be used in more vibration-producing areas, mainly staircases in public places (like railway stations), for lower power applications.

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Keywords: Sustainable Power Generation, Piezoelectric Staircase, Footstep Energy Conversion, Smart Cities, Energy Storage and Utilization

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31 The Transformative Role of Artificial Intelligence in Healthcare: Current Applications, Challenges, and Future Directions

Paper ID V11I2-1274 · Pages 191-194 · Artificial Intelligence In Healthcare

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Artificial intelligence (AI) revolutionizes healthcare by enhancing diagnostic accuracy, optimizing treatment protocols, also streamlining administrative workflows. This review synthesizes recent advancements in AI applications across disease prediction, medical imaging, robotic surgery, personalized medicine, and healthcare analytics, while critically evaluating ethical, legal, and technical challenges. A systematic literature review of 75 peer-reviewed articles (2013–2023) from IEEE Xplore, PubMed, and ScienceDirect reveals that convolutional neural networks (CNNs) and natural language processing (NLP) are driving innovations in medical imaging and clinical decision support. Case studies, like Google DeepMind's retinal disease detection and IBM Watson for Oncology, underscore AI's potential to reduce diagnostic errors by 30–50%. However, challenges persist in algorithmic bias, data privacy, and model interpretability. Federated learning and explainable AI (XAI) are emerging solutions that fill these gaps. Finally, future directions include the integration of AI with wearable devices to provide proactive care with aid from genomic data. Multidisciplinary collaboration for creating the standard frameworks of AI governance is argued in this paper to ensure equitable and ethical AI deployment in the global healthcare systems. Medical applications of AI can increase the efficiency of decision-making and management of care operations. We serve to review recent literature on AI applications in healthcare to deal with their potential ethical, legal, and technical challenges. The literature review was conducted systematically, using peer-reviewed articles (2019-2023) published from IEEE Xplore, PubMed, and ScienceDirect. Studies related to the use of AI in healthcare were included in the criteria. Studies about cybersecurity, AI in business, or non-English languages were excluded from the criteria. Studies that did not provide enough information to be included in the analysis were excluded. The review focused on applications of AI in predicting diseases, aiding medical imaging, assisting robotic surgery, enabling personalized medicine, and supporting healthcare analytics. We also explored the ethical, legal, and technical challenges of AI in healthcare. CNN and NLP are driving innovations in medical imaging and clinical decision support.

Keywords: Artificial Intelligence in Healthcare, Medical Imaging, Personalized Medicine, Ethical AI, Predictive Analytics, AI-Assisted Surgery

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32 Design and Implementation of IoT-Based War Spying Robot with Wireless Night Vision Camera

Paper ID V11I2-1367 · Pages 195-199 · Electronics And Communication Engineering

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The goal of this project is to create a robot that uses a wireless night vision camera and an Android app to monitor human activity over Wi-Fi. The user receives real-time visual data transmissions from the robot. It ensures constant surveillance by transmitting live video even in dimly lit areas. The robot can move in the following directions: forward, left, right, backward, and stop when controlled by Wi-Fi. Operation from distant locations is made possible by sending data to a remote IoT cloud database. The system offers a reasonably priced alternative for remote surveillance because it is constructed with a low-cost microprocessor. Since the robot's video can be broadcast to a PC, it can be used for remote surveillance applications like inspections, reconnaissance, and monitoring.

Keywords: Internet of Things, Integrated Development Environment, Wireless Fidelity, Infrared.

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33 Heart Disease Prediction

Paper ID V11I2-1364 · Pages 200-202 · Word

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Heart disease remains one of the leading causes of mortality globally. new diagnosis gets importantly better endurance rates and cuts discourse costs. In the research, we explore Machine learning techniques to predict heart disease based on clinical Information. exploitation associate in nursing open-source dataset we apply and value respective sorting Procedures, including logistical regression, decision trees, support vector machines (SVM). Our results demonstrate that machine learning can effectively identify potential heart disease cases, providing a promising tool for healthcare Uses.

Keywords: Heart Disease Prediction, Machine Learning, Clinical Data, Logistic Regression, Decision Tree, Random Forest, Support Vector Machine (SVM), Feature Selection, Data Pre-processing, Hyperparameter Tuning, UCI Heart Disease Dataset, Model Evaluation, Accuracy / Precision / Recall / F1-Score, ROC-AUC, Healthcare Analytics, Non-Invasive Diagnosis, Risk Assessment, Predictive Modeling , Ensemble Methods, Cross-Validation

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34 Synthesis, Structural and Optical Characterization of Pure And Cobalt Doped Zinc Oxide Nanoparticles By Sol-Gel Method

Paper ID V11I2-1159 · Pages 203-212 · Materials Science

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This study uses the sol-gel method to synthesize and characterize pure zinc oxide (ZnO) and cobalt-doped zinc oxide (Co-ZnO) nanoparticles. ZnO, a wide-bandgap semiconductor, is known for its optical transparency, high exciton binding energy, and antimicrobial properties, making it valuable for various applications in optoelectronics, sensors, and biomedical fields. Incorporating cobalt as a dopant modifies ZnO's structural and optical characteristics, enhancing its functionality in photocatalysis, spintronics, and magnetic storage devices. X-ray diffraction (XRD) analysis confirmed the hexagonal wurtzite structure for ZnO and Co-ZnO. However, Co doping led to decreased crystallite size, increased strain, and higher dislocation density, indicating lattice distortions. UV-Vis spectroscopy showed a shift in the absorption edge for Co-ZnO, suggesting bandgap narrowing, improving its visible-light absorption capabilities. This modification enhances the photocatalytic efficiency of Co-ZnO, making it highly suitable for environmental remediation and solar energy applications. The findings demonstrate that while pure ZnO is preferable for UV-blocking, optoelectronic applications, and sensors, Co-ZnO exhibits superior performance in photocatalysis and magnetic-based technologies. The study concludes that cobalt doping enhances ZnO’s properties, expanding its potential applications in energy, environmental, and electronic industries.

Keywords: ZNO, Co-ZNO, Crystallite Size, Dislocation Density, Strain, X-Ray Diffraction, Uv-VIS Spectroscopy

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35 Plant Irrigation Water Sprinkler Robot for Agriculture

Paper ID V11I2-1369 · Pages 213-218 · Electronics And Communication Engineering

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Efficient irrigation is a key factor in modern agriculture, where the goal is to boost crop yields while preserving water resources. This project introduces an automated Plant Irrigation Water Sprinkler Robot designed to streamline the irrigation process using smart technology. The system is built around a microcontroller and equipped with soil moisture sensors that constantly monitor moisture levels in the soil. Based on the sensor data, the robot determines when irrigation is needed and activates the sprinkler system accordingly. This ensures that water is applied only when necessary, reducing waste and promoting healthy plant growth. By combining automation and intelligent sensing, the system offers a low-cost, energy-efficient solution for precision farming. It supports sustainable agriculture by minimizing water usage and labour requirements while maximizing productivity. The robot not only improves irrigation accuracy but also helps in conserving water, a

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critical need in many agricultural regions. This innovative approach to irrigation highlights the role of technology in advancing farming practices. The use of real-time data and automated control makes this system a valuable tool for enhancing crop management, supporting food security, and promoting environmentally responsible agriculture.

Keywords: Smart Farming Technology, Sustainable Agriculture, Eco-Friendly Irrigation, and Irrigation Accuracy.

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36 Health Monitoring and the Tracking Systems for Soldiers Using IoT

Paper ID V11I2-1370 · Pages 219-223 · Electronics And Communication Engineering

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Soldier safety is a primary concern in the modern world since military tactics play a significant role in national security. Hazardous gases, snow slides, severe weather, and unexpected health problems like heart difficulties or body temperature fluctuations are just a few of the many risks that soldiers encounter in combat zones. The inability to efficiently communicate with the control room in an emergency is one of the main obstacles. To track the soldier's precise location and critical health data, this idea suggests a real-time monitoring system. By doing this, quick steps may be taken to protect them, enhance communication, and speed up reaction times in dire circumstances—all of which can eventually save lives on the battlefield.

Keywords: Health Monitoring and Tracking System, Global System for Mobile Communications, Global Positioning System, Electrocardiogram, Electromyogram, Light Emitting Diode, Transmission Control Protocol / Internet Protocol, Artificial Intelligence

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37 Using New Age Technology for Customer Gratification: A Review of Contemporary AI Use

Paper ID V11I2-1336 · Pages 224-229 · Marketing

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Technological improvements upgraded many sectors, and among them, marketing strategies have been shaped significantly. Growing competition among brands has vitalised the importance of customer satisfaction in gaining loyalty and retention. Artificial Intelligence is incorporated by brands, allowing for improvement in their services that helps to improve the customer experience. Brands employ AI to predict precise demand and enhance customer experience using chatbots. Inventory management using AI models reduced stockout occurrence and overstocking. Product availability is essential for customer retention, and when customers learn that their requirements will be met, they consequently prefer to re-buy from the brand. The human intelligence given to AI using machine learning and natural language processing allows chatbots to carry out multiple tasks

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for a brand. Chatbots interact with customers, understand queries, and provide answers, promising security and privacy of data. AI has helped to enhance and upgrade the service level of brands, alongside giving a competitive edge. Marketing was a concept of selling products and earning profit that evolved to focus more on customer satisfaction, their needs, and integrating innovation into the business. It is now at the place to direct customer decision-making in favour of the business by showing its presence in the form of suggestions and advertisements on websites and social media.

Keywords: Artificial Intelligence, Customer Satisfaction, Customer Loyalty, Inventory Management, Chatbots, Personalisation

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38 Ku-Band Microstrip Antenna Array: A Design Approach for Satellite Communication

Paper ID V11I2-1378 · Pages 230-237 · Antennas

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This work presents the design and simulation of a microstrip single patch element and two distinct array antenna configurations intended for Ku-band applications, specifically operating at a frequency of 17.16 GHz. The antennas are designed using an FR-4 substrate material with a dielectric constant of 4.3 and a substrate height of 13 mm. Two different two-element array configurations are developed to evaluate the impact of array geometry on antenna performance. The designs are modeled and simulated using CST Microwave Studio. The simulation results demonstrate that both directivity and gain improve significantly as the number of patch elements increases in the array structure. Comparative analysis between the single-element and array configurations reveals that array antennas offer enhanced radiation characteristics, making them more suitable for high-frequency satellite communication systems. This study highlights the importance of array design in achieving better antenna performance, especially in applications requiring high gain and narrow beamwidth.

Keywords: Satellite application, dual-band, patch antenna, Antenna Type, Frequency, Bandwidth and CST.

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39 Smart Blind Stick Using Arduino

Paper ID V11I2-1380 · Pages 238-242 · Electronics And Communication

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Blindness is the lack of vision caused due to physiological or neurological factors, resulting in visual disability. Blindness can be temporary or permanent, and partial or complete blindness, causing a person to become

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dependent on others for help. In today's world, even disabled people want to be independent and do not want to seek help from others. Smart Blind Stick is an innovative device that is an initiative to help blind people resolve the problems faced by they face in their daily life. Smart Blind Stick is a system device that incorporates several features, namely- obstacle detection, navigation, panic button, and moisture detector. The main objective of the device is to help blind people walk with complete relief and self-dependency. The blind stick is integrated with three ultrasonic sensors, a panic switch, a navigation switch, Bluetooth, and a soil moisture detector along with Arduino UNO. The Smart Blind Stick automatically detects the obstacles in front of the person by using sensors present in the system, It also incorporates moisture detection at its bottom to detect the moisture of the soil or ground so that the person will be aware if it's feasible to walk on that particular ground.

Keywords: Smart Blind Stick, Arduino Uno, Ultra Sonic Sensor, Infrared Sensor, Soil Moisture Detector, Buzzer, GPS, Android App

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40 An Intelligent Banking Management System with Fraud Detection

Paper ID V11I2-1373 · Pages 243-249 · Financial Technology

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Digital banking has transformed the financial industry, offering unparalleled convenience to customers while introducing heightened risks of digital fraud. This paper presents a robust banking management system aimed at enhancing security through real-time fraud detection and prevention. Developed using Java, Swing for an intuitive user interface, and MySQL for efficient database management, the system leverages rule-based algorithms to identify suspicious transaction patterns, such as more than five transactions or cumulative amounts exceeding ₹50,000 within a one-minute window. Employing a sliding window algorithm, the system ensures real-time monitoring, minimizes false positives, and provides timely alerts for potential threats. The research underscores the balance between robust security and a seamless user experience, offering insights into combating financial fraud in an increasingly digital-first ecosystem.

Keywords: Fraud Detection, Digital Banking, Sliding Window Algorithm, Transaction Monitoring, Banking Security. Fraud Detection, Digital Banking, Sliding Window Algorithm,

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41 A Real Time Driver Safety for Preventing Drowsiness Using Ear Algorithm and Truck Load Monitoring Alcohol Detections & Alert System

Paper ID V11I2-1244 · Pages 250-253 · Electrical &

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This study presents a real-time driver safety system that integrates drowsiness detection, alcohol impairment prevention, and truck load monitoring. The system employs an Eye Aspect Ratio (EAR) algorithm to detect driver fatigue by analyzing eye movement patterns, triggering alerts when drowsiness is detected. Additionally, an alcohol sensor prevents vehicle ignition if alcohol is detected, and load cell sensors monitor truck weight to prevent overloading. A GSM-based alert mechanism enhances communication by sending real-time alerts. The system aims to reduce road accidents by integrating these technologies into an intelligent safety framework. Experimental results demonstrate the effectiveness of the system in enhancing road safety.

Keywords: Drowsiness Detection, Ear Algorithm, Alcohol Detection, Load Cell, Truck Load Monitoring.

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42 Comparing AC vs DC Systems for Electrocoagulation of Microplastics in Waterbodies – An Innovative Solution

Paper ID V11I2-1377 · Pages 254-263 · Environmental Engineering

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The efficiency of the removal of microplastics from water by using the generated EC from AC and DC systems is theoretically examined through this experiment. Microplastics are among the most frequently known environmental polluters that threaten aquatic life and human health. Electrocoagulation seems to be a promising method for the considerable removal of pollutants by exploiting the coagulative properties through electrochemically produced ions. The paper compares the efficacy of coagulation, energy consumption, and water quality after the treatment in AC and DC setups suggesting innovation to optimise the efficiency as well as sustainability of removal.

Keywords: Electrocoagulation, Environmental, Microplastics, Alternating Current, Direct Current

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43 PowerLift: Generating Energy through Gym

Paper ID V11I2-1381 · Pages 264-272 · Mechanical Engineer

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As the need for sustainable energy solutions increases, this study investigates a new method for combining fitness with renewable energy production. The suggested system transforms human physical effort in exercise into electrical energy by utilizing a lat pulldown machine linked to a pneumatic energy collection device. A piston-cylinder apparatus compresses air while the user raises and lowers weights, storing it in a pressure tank. The compressed air is subsequently expelled through a turbine that powers an alternator to produce alternating current (AC) electricity. The produced AC is converted to DC, stored in a battery bank, and subsequently transformed back to AC with an inverter for distribution to the grid. The generated energy is saved in batteries or capacitors and can be used to power the gym's lighting, HVAC systems, or even fed back into the local power grid. A power tracking system is incorporated to oversee electricity generation, connecting energy output to specific users via RFID or biometric verification. Users are motivated by a reward program, where energy contributions result in reduced gym fees. This system encourages physical exercise while also improving energy sustainability by decreasing the gym's dependence on traditional power sources.

Keywords: Energy Conversion, Gym Machine, Electricity Generation Through Gym Machine

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44 The Balance of Powers in Modern Democracies

Paper ID V11I2-1397 · Pages 273-275 · Law

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The Constitution of India, adopted in 1950, reflects an intricate balance between flexibility and rigidity, designed to adapt to evolving socio-political realities while preserving the foundational values of democracy, federalism, and rule of law. This research paper examines the constitutional amendment process under Article 368, the role of Parliament and Judiciary in maintaining constitutional balance, the evolution of the 'basic structure' doctrine, and comparative approaches from other federal systems. It critically analyses the challenges posed by political motives, judicial interpretations, and the need to protect fundamental constitutional ideals, offering recommendations for strengthening constitutional integrity.

Keywords: Governance, constitution, Polity, India, Power, Democracy, Judiciary, Executive, Legislature

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45 Automated Home Security and Intruder Detection System using IoT

Paper ID V11I2-1390 · Pages 276-281 · Iot

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This paper addresses how sensor networks and machine learning create disruptive synergies in intruder detection due to targeted improved accuracy, minimized false positives, and real-time optimization. A literature review is offered on how the methodologies of intruder detection systems changed, with emphasis on the prime symbiosis that machine learning algorithms share with sensor networks. Methodologically, various sets of datasets has been utilized in training with strong preprocessing techniques utilized for enhancing data. The discriminative features that are useful in intrusion detection restrict the feature selection with emphasis on such features. The central task, here, is machine learning models formulated and implemented in the sensor network scenario. Hence, the mechanism of anomaly detection, adopted in the intrusion detection algorithm, provides intruder identification in real time with negligible latency in both time and accuracy. The test platform is relentlessly pounded into all the situations applicable to actual authentication parameters of the system, e.g., precision, false alarms, and elapsed time, under heavy scrutiny. The effects encompass tremendous enhancement in detection efficiency, grossly minimized false alarms, and excellent improvements in real-time response. An Innovative one from the intruder detection system viewpoint enters the educational world when talking about an implementable solution which highly likely can revolutionize physical security. It is flexible to different situations and even finds itself capable of being put inside already available structures, and thus it brings the prospect of being an immensely revolutionary point in this arena that would continue further with machine learning and sensor network incorporation for smart provisions of security.

Keywords: Machine Learning, Intruder Detection, Real Time, Sensor Network

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46 Experimental Study On Stabilization of Subgrade Soil And Pavement Design

Paper ID V11I2-1392 · Pages 282-286 · Civil Engineering

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This paper presents an experimental study aimed at stabilizing black cotton soil using a sustainable and cost-effective combination of steel slag and seashell powder. The objective is to enhance its engineering properties, particularly the California Bearing Ratio for applications in road construction. The untreated black cotton soil, having a CBR of 5.8%, showed a significant improvement with the addition of 25% stabilizer mix, achieving a peak CBR value of 11.6%. The study emphasizes the dual benefits of improving soil properties while utilizing industrial and marine waste materials, promoting eco-friendly construction practices.

Keywords: Black Cotton Soil, Sea Shell Powder, Steel Slag, Pavement Design.

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47 Non-Invasive Glucometer Using IoT

Paper ID V11I2-1393 · Pages 287-291 · Internet Of Things

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Continuous blood glucose monitoring is necessary for the management of diabetes mellitus, and this is typically accomplished using intrusive finger-prick techniques, which can be uncomfortable and inconvenient. In order to provide real-time, continuous glucose monitoring in an approachable way, this project suggests creating a non-invasive glucometer that is integrated with Internet of Things (IoT) technology. Without taking blood, the system measures glucose levels through the skin using optical sensors like near-infrared (NIR) spectroscopy. After being processed by embedded devices, the measured data is sent over Bluetooth or Wi-Fi to a cloud platform. Through a web dashboard or mobile application, users and healthcare professionals can access the data, enabling trend analysis, alarms, and improved diabetes control.

Keywords: Non-Invasive glucose monitoring, Near-Infrared spectroscopy, Internet of Things, Wearable health devices

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48 Case Study Diabetes Mellitus

Paper ID V11I2-1414 · Pages 292-294 · Medical

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Diabetes mellitus is a group of metabolic disorders that leads to High blood glucose levels, resulting in excessive urination, increased thirst, blurred vision, tingling, sweating, loss of weight, general weakness, and many other symptoms. Acute conditions include diabetic ketoacidosis and nonketotic hyperosmolar coma, while long-term conditions result in stroke, kidney failure, and cardiovascular disease.

Keywords: Diabetes, Cardiovascular Disease, Diabetes Mellitus

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49 Multiverse Theories and Predictions

Paper ID V11I2-1432 · Pages 295-301 · Physics

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This thorough review explores multiple present-day multiverse theories along with their special theoretical underpinnings and different empirical predictions, in addition to multiple potential implications for basic

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physics. We assess how well Boltzmann, Quantum, and M-theory frameworks, which are multiple multiverse models, explain cosmological fine-tuning, vacuum state dynamics, and quantum decoherence. The paper combines several recent improvements in observational cosmology, high-energy particle physics, and quantum gravity. This combination is done to evaluate the evidentiary support for multiverse hypotheses. Possible observational signs and the methodological issues involved in assessing theories about areas beyond immediate empirical access are given consideration.

Keywords: Multiverse, Cosmic Inflation, Quantum Mechanics, String Theory, M-Theory, Boltzmann Brains, Vacuum Decay, Fine-Tuning, Cosmological Constants, Observational Constraints

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50 Springless Suspension Using Bevel Gears

Paper ID V11I2-1436 · Pages 302-306 · Mechanical Engineering

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This paper presents an innovative approach to vehicle suspension by replacing conventional coil spring mechanisms with a springless system based on bevel gears. Traditional suspension systems, while effective, often suffer from drawbacks such as component fatigue, frequent maintenance, and suboptimal energy efficiency, especially under rugged terrain conditions. To address these limitations, the proposed suspension design introduces a compact and mechanically simplified set-up comprising bevel gears positioned at right angles, a rotating shaft for torque transmission, and independent 12V DC motors for each wheel. This arrangement not only improves power transmission efficiency but also enables smoother and more responsive terrain adaptability, offering better control and improved ride comfort. The study includes a detailed system design, component selection, working principles, and analytical calculations to validate the feasibility of the concept. Simulations and prototype tests were carried out to assess suspension performance compared to traditional spring-based configurations. Key performance indicators such as vibration damping, mechanical wear, and torque distribution were analyzed to determine the practical advantages of the gear-based system. The results indicate a notable reduction in maintenance needs and mechanical complexity, along with increased durability under variable load conditions. Designed primarily for off-road and military grade applications, this suspension system demonstrates significant promise in terms of robustness, reliability and efficiency. In addition, the paper outlines the potential for future improvements, including noise reduction, long-term material durability, and the integration of intelligent feedback systems. In general, this study contributes to a forward-thinking solu- tion to the field of automotive engineering by introducing a low-maintenance high-performance alternative to traditional suspension designs.

Keywords: Bevel Gears, Springless Suspension, Mechanical Design, Power Transmission, Automotive Engineering.

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51 Design and Development of an Automated Hydroponics System Based on IoT with Data Logging

Paper ID V11I2-1275 · Pages 307-314 · Machine Learning

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Integrating the Internet of Things (IoT) with hydroponic farming offers a powerful solution to the limitations of traditional hydroponic systems by introducing automation, real-time monitoring, and data-driven decision-making. Sensors continuously track environmental parameters, triggering automated adjustments to maintain optimal conditions. Data logging and analysis enable farmers to identify patterns, predict issues, and refine growing strategies. Remote access and control enhance scalability and reduce labor. This fusion aligns with precision agriculture principles, minimizing resource waste and promoting sustainable practices. The potential extends to large-scale commercial operations, where AI and machine learning can further optimize productivity. Ultimately, IoT-based hydroponics represents a significant advancement towards a more efficient, sustainable, and resilient agricultural future.

Keywords: Hydroponics, IoT (Internet of Things), Smart Farming, Precision Agriculture, Automation, Real-time Monitoring, Data-driven Agriculture, Remote Control, Predictive Analytics, Artificial Intelligence (AI), Machine Learning.

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52 Movies Recommendations System

Paper ID V11I2-1422 · Pages 315-321 · Engineering

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Each of us needs entertainment to recharge our spirits and energy in this fast-paced world. Our confidence for work is restored by entertainment, and we work more ardently as a result. We can watch our favorite movies or listen to our favorite music to reenergize ourselves. Since finding chosen movies will take more and more time, which one cannot afford to waste, we can use more reliable movie recommendation algorithms to watch good movies online. In this paper, a hybrid approach that combines content-based filtering, collaborative filtering, using Support Vector Machine as a classifier, and genetic algorithm is presented in the proposed methodology. Comparative results are shown, showing that the proposed approach shows an improvement in the accuracy, quality, and scalability of the movie recommendation system than the pure approaches in three areas: accuracy, quality, and scalability. The advantages of both approaches are combined in a hybrid strategy, which also seeks to minimize their negative aspect

Keywords: System, ML (Machine Learning), Switching, Hybrid Filtering, Collaborating Filtering, Content-Based Filtering, RNN (Recurrent Neural Network), NLP (Natural Language Processing).

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53 High-Frequency Capacitive Wireless Charging Using a 4-Plate Structure

Paper ID V11I2-1444 · Pages 322-329 · Electric Vehicles

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Electric vehicles (EVs) are traditionally charged in a stationary position using wireless power transfer (WPT) systems. However, dynamic charging—where EVs are charged while in motion—offers a more flexible and efficient alternative. Most current dynamic charging systems are based on Inductive Power Transfer (IPT), which, despite its maturity, is limited by high costs and considerable eddy current losses associated with inductive coils. To address these limitations, this study proposes a high-power dynamic charging system utilizing Capacitive Power Transfer (CPT) for electric vehicle applications. The research focuses on the design and implementation of a capacitive-coupled WPT system, particularly emphasizing the significance of mutual capacitance in the coupler design. Mutual capacitance directly influences the power transfer capability and overall efficiency of the system. By exploring various coupler configurations and optimizing the capacitive plate design, the study aims to enhance the practicality and cost-effectiveness of dynamic EV charging through CPT technology.

Keywords: Electric Vehicle, Capacitive Coupling, Mutual Capacitance, Power Transfer

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54 Machine learning assisted Optical-SAR Radar for Target Classification

Paper ID V11I2-1454 · Pages 330-337 · Computer Science

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A new era of Synthetic Aperture Radar (SAR) has begun in recent years. Convolutional neural networks (CNNs) have garnered a lot of interest lately for their ability to analyze SAR data. This paper thoroughly studies the main subfields of SAR data analysis that CNNs have addressed, including segmentation, change detection, object identification, automatic target recognition, land use and land cover classification, and image denoising. Particular attention has been paid to useful methods like transfer learning and data augmentation. To overcome the issues of a high false alarm rate and the challenges of attaining high-performance detection using traditional approaches, a deep learning-based SAR target identification and classification method is proposed for target detection tasks in complex backdrops. An optical based approach is presented in this study for enhancing the security feature. A machine learning-based radar with better performance is suggested in light of the deep learning-based target models' problems with a high parameter count and memory usage. Even though there have been some significant advancements, deep learning research in radar is still mainly being tested in lab settings and is still in its theoretical stage. There are still a number of obstacles and

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potential restrictions in the application, including issues with dataset adequacy, robustness of the model, and electromagnetic modelling fidelity. Nonetheless, it is undeniable that deep learning technology will significantly advance radar. As a result, it is wise to recognize the field's current difficulties and potential future paths. Furthermore, it is hoped that this review will give readers fresh opportunities to investigate appropriate deep learning-based methods for radar applications. In this study, Long Short-Term Memory (LSTM) and SqueezeNet model are used for enhancing the accuracy of system designed.

Keywords: Long Short-Term Memory, Machine Learning, Synthetic Aperture Radar, SqueezeNet

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55 AI-Generated Art and Intellectual Property: Navigating the Landscape of Ownership, Authorship, and Copyright

Paper ID V11I2-1450 · Pages 338-343 · Intellectual Property

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This paper evaluates the implications of artificial intelligence (AI) on traditional concepts of authorship, ownership, and copyright under intellectual property (IP) law, drawing comparative insights from the European Union and China. In consideration of the recent court decisions and the January 2025 U.S. Copyright Office report re-emphasizing the “human ‘creator’” requirement, this work studies how different systems of copyright can respond to creativity aided by AI without undermining the protection of human creators. The paper calls for an approach that separates AI developers from users and allocates rights depending on the amount of human contribution involved. In the end, it offers more IP-centric solutions in response to the challenges of new technologies, policies that enable creation while preserving IP principles in the digital age.

Keywords: Artificial Intelligence, Copyright, Human Authorship, Intellectual Property, AI, Art

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56 Detection of Insurance Fraud Using Machine Learning: A Data-Driven Approach for Accurate Classification

Paper ID V11I2-1428 · Pages 344-349 · Machine Learning

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Insurance fraud exerts a considerable economic strain on both insurers and policyholders, eroding the foundational trust that sustains the insurance industry. This study presents the development of a robust, scalable machine learning framework tailored for the detection of fraudulent claims. To mitigate the prevalent issue of class imbalance in fraud detection, a synthetically balanced dataset was constructed using the Synthetic Minority Oversampling Technique (SMOTE). The methodological approach incorporates a Random Forest classifier, augmented with domain-informed feature engineering—such as income-to- liability metrics and other fiscal indicators—designed to enhance discriminative power. Model performance is rigorously assessed through a suite of evaluation criteria, including accuracy, precision, recall, F1-score, confusion matrix,

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and both ROC-AUC and precision-recall curves. The experimental outcomes reveal exceptional classification efficacy, with the model achieving near-flawless predictive accuracy on the balanced dataset. When benchmarked against baseline models, the proposed system demonstrates superior detection capability, particularly in minimizing false negatives. This research underscores the effectiveness of ensemble-based algorithms in the fraud analytics domain and sets the stage for practical deployment in operational insurance environments. Prospective advancements may involve the integration of deep neural networks and real-time anomaly detection using streaming architectures to further enhance scalability and responsiveness.

Keywords: Insurance Fraud Detection, Machine Learning, Random Forest, Classification, Smote, Imbalanced Data, Feature Engineering, Fraud Analytics, Predictive Modelling, Roc-Auc Curve, Ensemble Learning, Data Preprocessing, Supervised Learning, Automated Detection Systems, Financial Fraud.

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57 A Smart Medicine Reminder System Using React Native and Timezone-Aware Notifications for Personalized mHealth Assistance

Paper ID V11I2-1359 · Pages 350-354 · Mobile Health (mhealth) Technology

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Medication non-adherence contributes to nearly 125,000 preventable deaths annually and accounts for approximately 10% of hospitalizations globally. While existing mobile health (mHealth) solutions provide basic reminders, they often overlook key factors such as time zone differences, dosage schedules, and UI accessibility. This paper presents a cross-platform medicine reminder system built using React Native, with time zone-aware scheduling and personalized notification logic. The system leverages a Node.js backend with MongoDB for dynamic user and medicine tracking, and cron-based scheduling for precision delivery. Early-stage testing indicates significant improvement in reminder accuracy across different time zones and positive user feedback on usability. This work contributes a scalable, open-source solution aimed at enhancing medication adherence for diverse populations.

Keywords: Medicine Reminder, Healthcare Technology, Mobile App, User Interface Design, Notifications, React Native, MongoDB, Express.js, Scheduling Algorithms.

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58 The Effect of Dollarization on the Argentine Economy- A Global Analysis

Paper ID V11I2-1396 · Pages 355-373 · Economics

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This research paper looks at the possible social and economic impacts of the implementation of the American Dollar in Argentina, through the use of a comparative analysis, between 5 different countries that have implemented numerous forms of dollarization. After an analysis of the socio-economic factors of El Savador, Ecuador, Cambodia, Panama and Zimbabwe, the researcher makes a conclusion on the benefits and harms of the implementation of the dollar. The historical analysis provides insight into the various policy reformation decisions made by different countries across the globe, to combat one major problem, inflation, all with the

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desire to achieve economic stability. This research paper looks at the applicability of the dollar in the Argentine economy, white analyzing and evaluating economic policy decisions throughout Argentine history. The research paper also finds out that economic prosperity is not a byproduct of simply the geographic location, natural resources or its culture, but rather the effectiveness of the political and economic institutions that govern the country.

Keywords: Dollarization, Argentine Economy, Economic History, Javier Milei, Inflation, Monetary Policy.

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59 Survey Paper on Advancements in Dysarthric Speech Recognition Systems

Paper ID V11I2-1282 · Pages 374-380 · Automatic Speech Recognition (asr)

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Dysarthria, a motor speech disorder resulting from neurological injuries, severely impairs intelligibility, making automatic speech recognition (ASR) a vital tool for enhancing communication. Over the years, significant research has explored computational approaches to improve ASR performance for dysarthric speech, from early rule-based models to deep learning architectures. This survey presents a comprehensive review of the evolution of ASR techniques tailored to dysarthric speech, categorizing methods by architecture type (HMM, DNN, CNN, LSTM, Transformers), learning paradigm (supervised, self-supervised, meta-learning), and input modality (audio-only, multimodal). The study examines the role of acoustic features like MFCC, PLP, and raw waveform-based learning. It compares key models, including Wav2Vec2.0, TDNN, and UTran-DSR, across UA-Speech, TORGO, and CommonVoice datasets. A critical evaluation of strategies like speaker adaptation, transfer learning, end-to-end pipelines, and contrastive learning is provided, along with their impact on accuracy and generalization. The paper highlights emerging trends such as emotion-aware ASR, multimodal fusion, and personalized adaptation, while addressing persistent challenges including data scarcity, speaker variability, and real-time deployment. This survey aims to provide a clear roadmap of the progress and ongoing efforts in dysarthric ASR, guiding future research toward more inclusive and intelligent speech interfaces.

Keywords: Dysarthric Speech Recognition, Automatic Speech Recognition (ASR), Model Adaptation, Speech Synthesis, Data Augmentation, Deep Learning for Speech Disorders

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