3rd International Conference

MAiTRI 2025

MAchine inTelligence for Research & Innovations

August 1 - 2, 2025

कलिंगा इंस्टीट्यूट ऑफ इंडस्ट्रियल टेक्नोलॉजी, विश्वविद्यालय, भुवनेश्वर, ओडिशा, भारत

Kalinga Institute of Industrial Technology (Deemed to-be University)

Bhubaneswar, Odisha, INDIA

SOUVENIR cum Book of Abstracts

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Editors

Prof. Lipo Wang
Dr. Vikas Kumar Jha
Dr. Om Prakash Verma
Dr. Vimal Kumar Shrivastava
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978-93-343-4802-6

Proceedings in

Springer
SPRINGER NATURE



https://maitri.stemrs.in/

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(MAiTRI-2025 Summit)

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Editors:

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978-93-343-4802-6

Third Edition 2025

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Published by: *Self Published*

E-Publication Website: https://maitri.stemrs.in/



Dear Participants and Researchers,

Welcome to the book of abstracts for MAiTRI-2025! In this compilation, we embark on a journey through the diverse realms of soft computing, exploring its profound importance in addressing real-life challenges.

The aim of MAiTRI-2025 summit is to promote the research advancement in the theory and realization of Machine inTelligence covering topics such as Machine Learning, Deep Learning, Quantum Machine Learning, Real-time Computer Vision, Pattern Recognition, Natural Language Processing, Statistical Modeling, Autonomous Vehicles, Human Interfaces, Computational Intelligence, and Robotics. The International Conference is a one of the leading international conferences dedicated to bringing together a significant number of diverse scholarly events for presentation within the conference program. Events will run over a span of time during the conference depending on the number and length of the presentations. With its high quality, it provides an exceptional value for students, academics and industry researchers.

International Conference on MAiTRI aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Applications of Machine InTelligence for Research & Innovations include the development and demonstration of Intelligent and Autonomous Robots (IAR), Unmanned Aerial Vehicle (UAV), Autonomous Underwater Vehicle (AUV), autonomous water surface vehicles (ASVs), Autonomous Land Vehicles (ALV), Swarm Robots, Humanoid Robots, and Autonomous Household Robots.

As you peruse these abstracts, envision the tangible impact of Machine Learning in versatile domains. Witness how these techniques transcend mere theory, actively contributing to solutions for societal challenges.

We extend our deepest appreciation to the contributors whose research showcased here represents a collective effort to bridge the gap between theoretical brilliance and practical application. Together, we forge a path towards a future where soft computing plays an integral role in shaping a smarter, more adaptive world.

Thank you for being a part of this journey.

Best Regards,

Conference Organizing Committee



MAchine inTelligence for Research & Innovations (MAiTRI-2025) is now **Three years** International conference.

The **objective of MAiTRI** is to provide a common platform to researchers, academicians, scientists and industrialists working in the area of machine learning to share and exchange their views and ideas on the theory and application of soft computing techniques in multi-disciplinary areas.

The **aim of the conference** is to highlight the latest advances, problems and challenges and to present the latest research results in the field of soft computing with a link to scientific research and its practical implementation. MAiTRI especially encourages the young researchers at the beginning of their career to participate in this conference and invite them to present their work on this platform.

Previous MAiTRI conference was successfully organized at the following venue

MAiTRI2023:	Dr. B R Ambedkar NIT, Jalandhar, India.	(September 1 - 3, 2023)
MAiTRI2024:	NIT, Srinagar, Jammu & Kashmir, India.	(June 21 - 23, 2024)
MAiTRI2025:	KIIT (Deemed to-be University), Bhubaneswar, Odisha.	(August 1 - 2, 2025)

3rd in the series, MAiTRI-2025 held at National Institute of Technology Srinagar, Jammu & Kashmir, INDIA in hybrid mode during June 21 – 23, 2023.

MAiTRI-2024 is organized in technical collaboration with Dr B R Ambedkar NIT, Jalandhar, Punjab, India; Shobhit University Gangoh, Science, Technology, Engineering and Management (STEM) – Research Society and supported by MeiTY Govt. of India.

The conference had 6 keynote lectures presented by eminent academicians and practitioners from different parts of the world. Totally, 100 technical papers under 16 different themes of the conference were presented during the conference in 18 oral presentation sessions. We are thankful to Springer Plc., for giving us opportunity to publish the proceedings in Lecture Notes in Networks and Systems (LNNS). All papers submitted to MAiTRI2025 had undergone a peer-review process and subsequently revised before being finally accepted.

The credit of the success of the MAiTRI Series, goes to our Mentors, Keynote & Invited Speakers, Chief Guests, Guest of Honor(s), Members of the advisory board (National & International), Program Committee members, Springer Team as a publishing partner (in particular Mr. Aninda Bose, Executive Editor – Interdisciplinary Applied Sciences; Research Publishing – Books), all the Author(s), participants and the reviewer's board. We sincerely appreciate your continued support, encouragement and trust in us. We look forward to have this wonderful support in the coming MAiTRI Series as well.

Looking forward to have your significant contribution in MAiTRI Series.



Message from the Conveners

Dear Colleagues and Distinguished Participants,

It is with great pleasure and enthusiasm that we welcome you to the Third International Conference on Machine Intelligence for Research & Innovations (MAiTRI-2025), to be held at the KIIT (Deemed to-be University), Bhubaneswar, Odisha, India, from August 1 – 2, 2025.

Following the success of the inaugural MAiTRI conference, we are excited to once again bring together leading researchers, academics, and industry professionals from around the globe to discuss and explore the latest advancements in machine intelligence. Our conference aims to foster an environment of knowledge sharing, collaboration, and innovation, pushing the boundaries of research and practical applications in this dynamic field.

MAiTRI-2025 promises an engaging program, featuring keynote speeches from world-renowned experts, insightful panel discussions, and presentations of cutting-edge research. Attendees will have the opportunity to network with peers, gain insights into emerging trends, and explore potential collaborations. The conference will cover a diverse range of topics, including but not limited to artificial intelligence, machine learning, data science, robotics, and their applications across various industries.

We are honored to host this prestigious event in the picturesque region of Odisha, known for its rich cultural heritage and breathtaking natural beauty. We hope that you will not only benefit from the academic and professional interactions but also take the time to enjoy the serene landscapes and warm hospitality that Srinagar has to offer.

We extend our heartfelt gratitude to the organizing committee, sponsors, and all participants for their contributions and support in making MAiTRI-2025 a successful and memorable event. We look forward to your active participation and to a stimulating and enriching conference experience.

Warm regards,

Conveners, MAiTRI-2025



Invited Talks



Prof Wang Lipo
School of Electrical & Electronic Engineering
Nanyang Technological University, Singapore

Prof. Wang Lipo received the Bachelor degree from National University of Defense Technology (China) and PhD from Louisiana State University (USA).

His research interest is artificial intelligence/machine learning with applications to communications, image/video processing, biomedical engineering, and data mining. He has authored 320 papers, of which 110 are in journals. He holds a U.S. patent in neural networks. He has authored 2 monographs and edited 20 books. His work has been cited 7,800 times in Google Scholar.

He was/will be keynote speaker for 40 international conferences. He is/was Associate Editor/Editorial Board Member of 30 international journals, including 4 IEEE Transactions, and guest editor for 10 journal special issues. He was a member of the Board of Governors of the International Neural Network Society (2011-2016), IEEE Computational Intelligence Society (CIS) (2010-2015), and the IEEE Biometrics Council. He served as CIS Vice President for Technical Activities and Chair of Emergent Technologies Technical Committee, as well as Chair of Education Committee of the IEEE Engineering in Medicine and Biology Society (EMBS). He was President of the Asia-Pacific Neural Network Assembly (APNNA) and received the APNNA Excellent Service Award. He was founding Chair of both the EMBS Singapore Chapter and CIS Singapore Chapter. He serves/served as chair/committee members of over 200 international conferences.



Mr. Aninda Bose
Executive Editor
Interdisciplinary Applied Sciences, Computational Intelligence, Energy
Springer Nature London

Mr. Bose is presently working as Executive Editor with Springer Nature. Mr. Bose is part of the Global Acquisition Team at Springer Nature and responsible for acquisition of scientific content across the globe. He



is responsible for acquisition of content in Interdisciplinary Applied Sciences. He has more than 26 years of industrial experience in marketing and different fields of publishing. Mr. Bose has completed Masters in Organic Chemistry from Delhi University and Masters in Marketing Research from Symbiosis Institute of Management Studies, Pune. Mr. Bose has delivered more than 160 invited talks on Scientific Writing and Publishing Ethics in reputed Universities, International Conferences and Author Workshops. He has published books for secondary level in Chemistry and is a member of American Chemical Society, USA.



Dr. Ram Bilas Pachori
Professor (HAG)
Department of Electrical Engineering
IIT Indore, Simrol, Indore

Prof. Ram Bilas Pachori received B.E. degree with honours in Electronics and Communication Engineering from RGPV, Bhopal, India, in 2001, M.Tech. and Ph.D. degrees in Electrical Engineering from IIT Kanpur, India, in 2003 and 2008, respectively.

Before joining IIT Indore, India, he was Post-Doctoral Fellow at Charles Delaunay Institute, UTT, France (20072008) and Assistant Professor at Communication Research Center, IIIT Hyderabad, India (2008-2009). He was Assistant Professor (2009-2013), Associate Professor (2013-2017), and Professor (2017-2023) at Department of Electrical Engineering, IIT Indore, where he has been Professor (HAG) since 2023. He was Visiting Professor at Department of Computer Engineering, Modeling, Electronics and Systems Engineering, University of Calabria, Rende, Italy, in July 2023; Faculty of Information & Communication Technology, University of Malta, Malta, from June 2023 to July 2023; Neural Dynamics of Visual Cognition Lab, Free University of Berlin, Germany, from July 2022 to September 2022; School of Medicine, Taylor's University, Malaysia, from 2018 to 2019. Previously, he was Visiting Scholar at Intelligent Systems Research Center, Ulster University, Londonderry, UK, in December 2014.

His research interests include signal and image processing, biomedical signal processing, non-stationary signal processing, speech signal processing, brain-computer interface, machine learning, and artificial intelligence and internet of things in healthcare. He has supervised 23 Ph.D. theses and is currently supervising 11 Ph.D. theses. He has delivered more than 300 talks and lectures in conferences, workshops, short term courses, and academic events organized by various institutes. He has authored the textbook titled "Time-Frequency Analysis Techniques and their Applications" (CRC Press, 2023). He has 367 publications, which include journal articles (230), conference papers (96), books (11), and book chapters (30). He has also eight patents, including two granted (Australian patent and Indian patent) and six published (Indian patents). His publications have been cited ~19000 times with h-index of 75 according to Google Scholar.



He is Fellow of IEEE, IET, AAIA, IETE, and IEI. He has been appointed as IEEE EMBS Distinguished Lecturer (2025-2026). He was Associate Editor of IEEE Transactions on Neural Systems and Rehabilitation Engineering (2021-2024). Currently, he is Associate Editor of Electronics Letters, IEEE Open Journal of Engineering in Medicine and Biology, Computers and Electrical Engineering, and Biomedical Signal Processing and Control. He is also serving as Handling Editor of Signal Processing and Editor of IETE Technical Review journal.



Prof. G. R. Sinha
Vice Chancellor, GSFC University Vadodara, Gujarat, India

Prof. Dr. G R Sinha (PhD, Fellow IETE, Fellow IEI, SMACM, SMIEEE) is Vice Chancellor of GSFC University Vadodara, Gujarat, India. Prior to this, he was Professor at International Institute of Information Technology Bangalore (IIITB). He served as Professor at Myanmar Institute of Information Technology (MIIT) Mandalay Myanmar on deputation in friendship project between Government of India and Government of Republic of Myanmar. He has been Visiting Professor at University of Sannio Benevento Italy 03 times; and also, in National Chung Hsing University Taiwan. He has been Visiting Professor (Honorary) in Sri Lanka Technological Campus Colombo. He has published 329 research papers, book chapters and books at International and National levels and 27 Edited books in the field of Cognitive Science, Biomedical Signal Processing, Biometrics, Optimization Techniques, Sensors, Machine Learning, Outcome based Education, Data Deduplication with Internationally reputed publishers Elsevier, IOP, Springer, Taylor & Francis, IGI. He owns two Australian patents and one German patent. He is Associate Editor of five SCI/Scopus indexed journals and has been Guest Editor in various SCI journals, such as IET Electronics Letters, Journal of Healthcare Engineering, and International Journal of Biometrics. He has been in top 2% of Scientists and Researchers of the World in the field of Image Processing in Standford and Elsevier database for the last 02 consecutive years. He has teaching and research experience of 26 years. He has been Dean of Faculty and Executive Council Member of CSVTU and currently a member of Senate of MIIT. Dr Sinha has been ACM Distinguished Speaker in the field of DSP (2017-2021). He has been Expert Member for Vocational Training Program by Tata Institute of Social Sciences (TISS) for Two Years (2017-2019); Chhattisgarh Representative of IEEE MP Sub-Section Executive Council (2014-2017); Distinguished Speaker in the field of Digital Image Processing by Computer Society of India (2015). He served as Distinguished IEEE Lecturer in IEEE India council for Bombay section.

He is recipient of many Awards and recognitions: ACM Senior Member Award 2023, Mentor in IEEE India Council 2023, Distinguished Alumnus Award 2022 by National Institute of Technology Raipur; Recognition by



Rector of Myanmar Aerospace Engineering University, The Republic of Union of Myanmar (2022); Honor by Sanatan Samaj Myanmar for Social Services (2022); Certificate of Recognition for Volunteering in ACM Hyderabad Deccan Chapter (20202021); TCS Award 2014 for Outstanding contributions in Campus Commune of TCS; Rajaram Bapu Patil ISTE National Award 2013 for Promising Teacher in Technical Education by ISTE New Delhi; Emerging Chhattisgarh Award 2013; Engineer of the Year Award 2011; Young Engineer 1 Award 2008; Young Scientist Award 2005; IEI Expert Engineer Award 2007; ISCA Young Scientist Award 2006 Nomination; GOLD Medal for first position in university in M.Tech.; Deshbandhu Merit Scholarship for 05 years and received Best Paper Awards in 3 International Conferences.

He has delivered more than 75 Keynote/Invited Talks and Chaired many Technical Sessions in International Conferences across the world such as Singapore, Taiwan, Mauritius, Myanmar, Sri Lanka, Irvine, Italy and India. His Special Session on "Deep Learning in Biometrics" was included in IEEE International Conference on Image Processing 2017. He is also member of many National Professional bodies like ISTE, CSI, ISCA, and IEI. He is member of various committees of the University and has been Vice President of Computer Society of India for Bhilai Chapter for two consecutive years.

He has been Publication Chair in ADCOM 2022 and General Chair of International Conference on Intelligent Commuting and Communication 2022. He is Editorial Board Member of Progress in Biomedical Engineering, IOP Publishing UK.

Dr. Sinha is Director of GUIITAR Council of GSFC University, section 8 company. He is Consultant of various Skill Development initiatives of NSDC, Govt. of India and an upcoming British University in Myanmar. He is regular Referee of Project Grants under DST-EMR scheme and several other schemes of Govt. of India. He received few important consultancies supports as grants and travel support. He has been Expert Member of Professor promotion committee of German Jordanian University Jordan and Project Proposal evaluation committee of UK-Israel Research Grants. He has been appointed as Member of IQAC by MIIT Mandalay, Myanmar (July 2022December 2024) and Member of Board of Examiner in University of Mauritius (2022-2023). He is advisor to upcoming New Next University in Mandalay Myanmar. Dr. Sinha is Academic Council and Research Council Member of many universities. He has travelled to Singapore, Myanmar, Shri Lanka, Mauritius, Italy, UAE, Qatar and UK for his professional contributions. Dr. Sinha has supervised 09 PhD Scholars, 15 M. Tech. Scholars, 100 UG level students. His research interest includes Biometrics, Medical/Biomedical Image Processing, Cognitive Science, Computer Vision, Outcome based Education (OBE) and ICT tools for developing Employability Skills.





Dr. Jagdish Chand Bansal
Associate Professor, South Asian University, India

Prof. Dr. Bansal is an Associate Professor at South Asian University New Delhi and Visiting Faculty at Maths and Computer Science, Liverpool Hope University UK. Dr. Bansal has obtained his Ph.D. in Mathematics from IIT Roorkee. Before joining SAU New Delhi he has worked as an Assistant Professor at ABV- Indian Institute of Information Technology and Management Gwalior and BITS Pilani. His Primary area of interest is Swarm Intelligence and Nature Inspired Optimization Techniques. Recently, he proposed a fission-fusion social structure based optimization algorithm, Spider Monkey Optimization (SMO), which is being applied to various problems from engineering domain. He has published more than 70 research papers in various international journals/conferences. He is the editor in chief of the journal MethodsX published by Elsevier. He is the series editor of the book series Algorithms for Intelligent Systems (AIS) and Studies in Autonomic, Data-driven and Industrial Computing (SADIC) published by Springer. He is the editor in chief of International Journal of Swarm Intelligence (IJSI) published by Inderscience. He is also the Associate Editor of Engineering Applications of Artificial Intelligence (EAAI) and ARRAY published by Elsevier. He is the general secretary of Soft Computing Research Society (SCRS). He has also received Gold Medal at UG and PG level.



Dr. Rajeev Kanth
Principal Lecturer (Yliopettaja- in Finnish)
Savonia University of Applied Sciences, Finland

Dr. Rajeev Kanth received a Doctor of Science (D.Sc.) in Information and Communication Technology from the University of Turku, Finland, in 2013. He has been working as a Principal Lecturer (Yliopettaja- in Finnish) at the Savonia University of Applied Sciences, Finland, where he focuses on teaching and research on the Internet of Things (IoT). He has been an Adjunct Professor at the Department of Computing, University of Turku, Finland, and a Visiting Professor at Hebei University of Environmental Engineering, China. He is currently a senior member of the IEEE. Previously, he worked at the Indian Space Research Organization



(ISRO), Ahmedabad, India, and the Royal Institute of Technology (KTH), Stockholm, Sweden, where he was a researcher and a senior research scientist, respectively. He has over 25 years of experience working in academic and research institutions. His current research interests include the Internet of Things, big-data analytics, artificial intelligence, and wireless cloud and edge computing. He has published more than 95 scientific articles in peer-reviewed conference proceedings and refereed computer science and communication technology journals. Some of the recent and ongoing research and development projects are UCNDRONE (funded by the Finnish Ministry of Education), VLEFACT (EU Erasmus Plus-funded project), and AIQUSEC (Business Finland).



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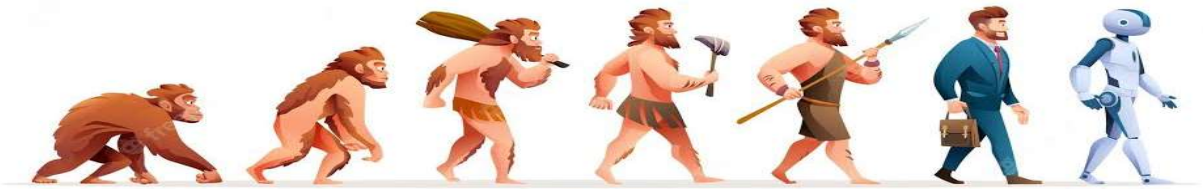
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6	Computational modelling for soil fertility evaluation in IIB-TPLB zone of Rajasthan, India- A step towards efficient soil management	Divya Prakash (Shobhit Institute of Engineering & Technology, Meerut (Deemed to-be-University))*; Jyoti Sihag (Tantia University, Sri Ganganagar, Rajasthan; Shalini Singh (Institute of Biosciences and Technology, Shri Ramswaroop Memorial University, Lucknow
17	Intelligent Skin Disease Diagnosis: A Multi-Class Approach for Monkey Pox Detection Using Image Preprocessing and Ensemble Classification	Senthilkumaran P (Govt. arts and Science College, Theni)*
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494	A systematic Review on Segmentation Techniques for Classifying Thyroid Nodule	Sai Geeta Vaijinath (Department of Computer Science and Applications, Bangalore University, JB campus, Bangalore)*



978-93-343-4802-6

2 Melanoma Skin Cancer Detection Using Transfer Learning and Hybrid Models

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Melanoma is the most dangerous and deadliest type of skin cancer diseases compared to the other skin cancer diseases. Early detection of melanoma and accurate diagnosis of it can improve survival rates. Visually analyzing skin lesions at the time of examination is not an easy task since many lesions appear to be similar. Using dermoscopic images to diagnose skin cancer is challenging because of limitations such as artifacts, blurry boundaries, poor contrast, and variable lesions. In order to speed up diagnosis, computer-aided diagnosis (CAD) models are developed. Deep learning methods are now employed for accurate skin cancer diagnosis. This study examined the different preprocessing techniques, transfer learning, and hybrid models in Convolutional Neural Networks (CNN) with various datasets. It will help the researcher to know about the latest deep learning methods employed for finding skin conditions, and dermatologists can use it to keep up with the latest technological advances in this field.

6 Computational modelling for soil fertility evaluation in IIB-TPLB zone of Rajasthan, India- A step towards efficient soil management

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Soil investigations for nutrient availability and other characteristics relevant for crop productivity are important for identifying the areas of fertility-constraints. The use of computational models for such investigations expedite soil characterization so as to further help in adopting timely and precise actions to maintain soil quality. Here, we used soil fertility management model (hereinafter referred to as SFM) for evaluation of macronutrients (P, K, S and N), micronutrients (Cu, Fe, Zn and Mn) along with other soil fertility indicators like soil pH, electrical conductivity, organic carbon, organic matter, calcium carbonate, bulk density, heavy metals (lead, chromium and cadmium), enzyme profiling. The study area selected was the IIB-Transitional Plain of Luni Basin (IIB-TPLB zone) and soil fertility parameters of both agricultural (farmland) and wasteland samples were evaluated by using soil collected from a depth of 0-30 cm. The model analyzed the nitrogen content in the medium range for 60% of farmland and 40% for wasteland samples. Significantly higher soil organic content was found at FLS compared with WLS. The lead cadmium and chromium were present in the safe/non-toxic range though iron, manganese and Sulphur content were better in farmland samples than wasteland samples. Biochemical activities (as



978-93-343-4802-6

indicated by enzyme profiling) were also better for farmland than wasteland samples, indicating richer micro-flora in the soil. The findings are expected to help in better identification of fertility-constrained areas and better-targeted bio-fertilizer recommendations for nutrient management for the given geographical region.

17 Intelligent Skin Disease Diagnosis: A Multi-Class Approach for Monkey Pox Detection Using Image Preprocessing and Ensemble Classification

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Monkey pox is a viral disease with skin lesions. It is similar to chickenpox and measles, making early diagnosis crucial. Traditional deep learning methods are used for detection but have high computational costs and limited interpretability. This work proposes an innovative method that combines feature extraction with ensemble learning. This work extracts color, texture, and shape features from skin lesion images. It also uses Richardson-Lucy deblurring to improve image clarity. It employs an ensemble learning approach with Random Forest (RF) and Extreme Gradient Boosting (XGB) for classification. This method distinguishes between monkey pox, chickenpox, measles, and normal skin conditions. Experimental results demonstrate that the proposed model exhibits superior accuracy and computational efficiency to traditional models. The utilization of SMOTE enhances performance by addressing class imbalances. This study contributes to AI-driven diagnostic tools, improving accuracy efficiency for real-time Monkey pox detection.

26 ResMLPBrain: A Deep Learning Approach for Brain Cancer Classification Using Gene Expression Data

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Brain tumors are severe forms of cancer, requiring accurate diagnostic tools. In this paper, a computational framework is presented. Analysis of brain tumor gene expression data from dataset Brain_GSE50161 helps categorize subtypes. A dataset containing expression profiles of ependymomas, glioblastomas, medulloblastomas, and pilocytic astrocytomas. This framework uses a Residual Multi-Layer Perceptron (ResMLP) model to classify. Using this approach, classification accuracy is improved by 87%. By outperforming both Support Vector Classifiers and Convolutional Neural Networks. A stringent



978-93-343-4802-6

preprocessing phase minimizes noise and prioritizes interpretability to manage intricate gene expression data. Moreover, a hierarchical clustering method is used to distinguish molecular patterns across tumor subtypes. The insight in this analysis provides valuable understanding of tumor genetic diversity. A significant challenge is addressed by machine learning in this context. Through these methods, precision medicine can be advanced in oncology diagnosis. It provides a reliable and scalable method for classifying tumors, which will aid in identifying biomarkers and tailoring treatments. The article highlights the potential of machine learning to improve brain tumor treatment and understanding.

37 Understanding Customer Purchase Behaviour and Ensuring Loyalty through Machine Learning

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In today's digital economy, understanding customer purchase behavior and fostering brand loyalty are critical challenges for businesses. This study explores the application of machine learning (ML) and artificial intelligence (AI) to predict purchasing intentions and enhance customer retention. By utilizing data analytics, deep learning models, and ensemble learning techniques, businesses can extract meaningful insights from vast datasets to personalize customer experiences effectively. The research also examines the role of fuzzy decision support systems (FDSS) in optimizing travel recommendations for middle-aged and elderly tourists, ensuring inclusivity and accessibility. Key challenges such as data quality, feature selection, and model interpretability are addressed, with solutions that improve predictive accuracy and decision-making. The findings emphasize the importance of innovation in customer engagement strategies, particularly in e-commerce and the tourism industry, to drive long-term consumer loyalty and competitive advantage.

95 AI-Driven Crop Guidance, Disease Monitoring, and Fertilizer Suggestions: A Comparative Study

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Agriculture is crucial, especially in rural areas where many farmers lack the skills to enhance cultivation, control illness, and fertilize crops. Poor knowledge leads to lower agricultural yields and soil nutrient



978-93-343-4802-6

leaching. Using machine learning (ML) to give farmers real-world data insights has benefited them. These methods assist in identify crops that can grow in a location based on soil and environmental conditions, diagnosing plant problems early, and prescribing fertilizer use. Disease detection and interpretation are difficult; hence, ML-based models help with agricultural decision-making. Machine learning algorithms like decision trees, random forests, and neural networks are tested in agriculture. Also, it introduces community-based web apps where farmers can share crop health and practices knowledge. This work provides comparative insights on machine learning-based crop guidance, disease detection, and fertilizer suggestion systems for crop management, disease prevention, and more in this work. This review evaluates machine learning-based agriculture recommendation system knowledge. The literature assessment revealed research gaps that could inform future improvements.

97 Heart Disease Forecasting Driven by Boosting Approach for Feature Optimization

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One of the biggest worldwide health burdens is heart disease, which fuels the urgent need for accurate predictive models that allow for prompt intervention. This study provides insights into the effectiveness of sophisticated machine learning models, with XGBoost, LightGBM, CatBoost, a Stacking Ensemble, and a Feedforward Neural Network (FNN) for predicting the risk of heart disease. The study presents a thorough performance across standard measures using a patient dataset and a robust 10-fold stratified K-fold cross-validation. With models attaining average accuracies in the low to mid-80s (e.g., Tuned XGBoost: 83.13%), proposed results demonstrate good predictive skills. Crucially, the Tuned XGBoost classifier showed an average ROC AUC of 90.02%, demonstrating its remarkable capacity to distinguish between states of health and illness.



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100 Optimization of the Variable Inertia Flywheel Parameters Using A Multi-Run Technique and an Artificial Neural Network Model

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This work simulated a variable inertia flywheel (VIF) based diesel engine to optimize the VIF's parameters in order to make an effective and suitable design of VIF. A set of VIF's parameters is generated using a multi-run simulation technique from SYMBOLS SHAKTI software. Furthermore, an artificial neural network (ANN) model was developed to predict the performance characteristics of the VIF. The ANN model was structured with 6 neurons in the input layer, 15 hidden neurons, and 4 output neurons. It is found that the ANN model effectively predicted the Variable Inertia Flywheel (VIF) performance, achieving a high accuracy (R = 1) across all data subsets.

122 Chronic kidney disease diagnosis by XGB Machine Learning based approach

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Recently, humans have encountered several diseases due to the environment and their lifestyle. The identification of these severe diseases is very necessary at an early stage. There is difficulty in measuring the disease manually by the doctor. So, there is a requirement to create a model that provides accurate predictions. The tar-get of this paper is to identify chronic disease through a machine learning approach. Chronic Kidney disease is extending global health issues; early-stage and accurate diagnosis of the disease enhances the patient's recovery condition. This requirement is for early-stage detection and diagnosis accuracy. Feature extraction processes by PCA and KNN, additionally, various machine learning approaches are demonstrated to detect the chronic disease.



978-93-343-4802-6

158 Overcoming Challenges after Implementing Ethereum Blockchain in the Agri-food Supply Chain

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This study addresses the challenges faced in implementing Ethereum blockchain technology within the agri-food supply chain, focusing on its capacity to enhance transparency, traceability, and efficiency. Key challenges such as interoperability, regulatory compliance, and skill gaps are explored, along with strategies for overcoming these obstacles, including stakeholder collaboration and targeted training. A comparative analysis is conducted between the proposed Ethereum solution and existing frameworks—Hyperledger, Corda, and Polkadot—highlighting their distinct features and suitability for various applications. While Ethereum excels in decentralization and community engagement, Hyperledger offers privacy for enterprises, Corda specializes in financial transactions, and Polkadot facilitates interoperability. The findings underscore that, despite implementation challenges, Ethereum has significant potential to improve agri-food supply chain operations and inform the choice of blockchain solutions tailored to specific industry needs.

159 Realtime Voice Recognition Using Audio Signal Processing and Machine Learning in MATLAB

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Voice recognition serves as a crucial component in advancing human-computer interaction by facilitating intuitive and hands-free communication. This project develops a real-time voice recognition system using MATLAB, combining audio signal processing with machine learning methodologies. The system records live audio input and extracts important features such as Mel-Frequency Cepstral Coefficients (MFCCs), Zero Crossing Rate (ZCR), pitch, and energy to generate a unique voice profile. These features are utilized to train a Support Vector Machine (SVM) classifier organized through Error-Correcting Output Codes (ECOC) for multi-class speaker recognition. A streamlined and interactive Graphical User Interface (GUI), created with MATLAB App Designer, supports easy recording, dataset management, model training, and testing. Real-time identification is performed by evaluating new voice recordings against the trained model. Experimental findings reveal that the system achieves up to 90% accuracy in



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controlled environments. This project illustrates the practicality of building effective, real-time voice recognition solutions in MATLAB for smart applications, assistive technologies, and automation systems.

160 Sign Language into Text & Voice Conversation by Using Deep Learning

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People with hearing impairments often face communication problems be-cause many others do not understand sign language. To help solve this, we developed a real-time system that recognizes hand gestures and converts them into text and speech. The system uses an Arduino UNO and an MPU6050 sensor, which records hand movements through its accelerometer and gyroscope. Five specific gestures—HiFi, NoHiFi, Come, Go, and Bye—were captured and turned into time-series plots. These plots were then classified using a fine-tuned GoogleNet deep learning model. Once recognized, the gestures were converted into text and spoken words using MATLAB's Text-to-Speech (TTS) tool. The system achieved an accuracy of 85% and responded within 1.5 seconds on average. Unlike camera-based methods, this system works well even in poor lighting and offers better portability.

161 Design of Electrical Impedance based Tomography using FE Method for Bone Imaging

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Medical imaging is very important for finding and treating different health problems. However, common methods like X-rays, MRI, and CT scans have some drawbacks, such as being expensive, exposing patients to radiation, and not being easy to move around. Electrical Impedance Tomography (EIT) is a safer, cheaper, and more portable option, especially for imaging bones. EIT is a non-invasive method that creates pictures of the inside of the body by sending small electrical currents through electrodes on the skin and measuring the resulting voltages. Because bones and soft tissues have different electrical properties, EIT can clearly show bone structures and any damage. However, making accurate images from EIT data is difficult because the calculations are complex. To solve this, the Finite Element Method (FEM) is used to model the body and help create better images. This study focuses on designing and simulating an EIT system using FEM for bone imaging. The system measures changes in electrical



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properties and builds detailed images to highlight bone features. Simulation results show that this method can successfully find bone problems and offers a safe, low-cost, and portable alter-native to traditional imaging methods.

162 Vision based controlled pick and place operation of a Delta Parallel Robot

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Parallel robot operations engage multiple actuators to work together to coordinate a traveling platform. One such important parallel robot that has revolutionized industrial manufacturing is the Delta Robot. The precise and high-speed, light weight Delta robots have made a significant place in the pharmaceutical, food, and electronics sectors. This research deals with a comprehensive analysis of a Delta robot, specifically in pick-and-place applications. The experimental test set-up, along with the fundamental kinematics behind the processes, intends to help the readers in understanding the core background of the actuator synchronization. The vision-based classification, automatic calibration, and filter application have become vital in modern-day robotics, as the inverse kinematics records the developments between the initial and the target position accordingly. Furthermore, the insights gained from this study would aid in the design optimization and control of delta robots, potentially expanding their capabilities in industrial and research settings.

171 Enhanced Potato Leaf Disease Diagnosis using Ensemble Transfer Learning Models

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Background: Potatoes (Solanum tuberosum) are a crucial staple crop, vital to global food security and economies. However, potato cultivation faces significant threats from diseases, especially potato leaf diseases like early blight and late blight, which can cause substantial yield losses. Objective: This study aims to explore the application of transfer learning models (TLMs) and ensemble learning techniques for automated identification of potato leaf diseases, addressing the limitations of traditional manual disease detection methods. Methods: Four TLMs—VGG19, ResNet 152, DenseNet 201, and Inception V3—are evaluated for their effectiveness in potato leaf disease identification using the Kaggle potato leaf dataset.



978-93-343-4802-6

The ensemble learning approach combines predictions from these models to enhance classification accuracy. Results: The results indicate that ensemble classifiers significantly improve disease classification accuracy, achieving up to 99.33%, surpassing the highest individual model accuracy of 98.33% achieved by VGG19.

Conclusion: Ensemble methods demonstrate strong potential for enhancing potato crop management and disease control, offering an efficient and accurate solution for potato leaf disease detection.

204 Smart Waste Management: A Machine Learning -Based System for Urban Cleanliness and Efficiency

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Proper segregation of waste is crucial for effective modern waste management and environment conservation. Manual sorting is time-consuming, prone to errors, and inefficient at high capacities. The work in this paper suggests a computer vision based automatic garbage classification with a hybrid model of Convolutional Neural Networks (CNN) and Support Vector Machines (SVM). Different approaches were tested and there working is studied to achieve the best results, starting with simple SVM classifiers with grayscale and RGB images, followed by single CNN architectures, and final-ly ending with a hybrid CNN-SVM model. The CNN model is deployed for deep feature extraction, identification of complex patterns and spatial hierarchies in images, and the SVM with a radial basis function (RBF) kernel as the final classifier. The experimental results show that the proposed CNN-SVM hybrid model outperforms traditional SVM and single CNN methods where small models are employed extensively, with a classification accuracy of up to 80% and with 12 classification classes. The work in this paper shows the potential of the combination of deep learning and machine learning methods to improve the accuracy and efficiency of automated waste classification systems.

211 Deep Learning and Frequency-Domain Based Zero Watermarking Framework for Medical Image Copyright Protection

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The security of electronic health records is of the utmost importance since severe violations, including medical negligence, discrimination, and identity theft, can result from unauthorized access. This research proposes a zero-watermarking technique employing ResNet-101 and RDWT for feature extraction and



978-93-343-4802-6

resilience against such challenges. The RDWT divides the extracted features into four sub-bands. Additionally, Hessenberg Decomposition is utilized on a specific subband to obtain components for embedding, hence optimizing the frequency resolution of the decomposed image and resulting in a P-S decomposed matrix. Conversely, the watermark undergoes scrambling via the Arnold transform, subsequently XOR-ed with a deconstructed matrix of the image to get the zero watermark. The suggested watermarking method is evaluated on various medical images to determine its resilience to attacks and noise. The majority of NC (Normalized Correlation) values are computed to exceed 0.94 after different type of attacks. The proposed method outperforms state-of-the-art methods experimentally, successfully extracting the watermarked image while showing robustness against several attacks.

214 Deep learning for Gestational Diabetes Mellitus Detection with Analysis of Predictive Models to Enhance Patient Outcome Management

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Healthcare is an essential part in life. As different kinds of data like patient‘s records, patient past history, various diseases and essential medicines need to be maintained properly. The diverse requirements of millions of patients have proven challenging for conventional healthcare systems to meet, which has resulted in inefficiencies and less than ideal outcomes. In contemporary medical studies, a multitude of data formats have emerged, including text, image processing, -genomics, digital medical records, and data from sensors. These formats are typically complex, diverse, poorly documented and unorganized. So, to resolve the issues deep learning technology used in healthcare management. The latest advances in deep learning technology offer current, practical paradigms for extracting end-to-end learning models from complicated data. In this article a brief study about healthcare and different technologies used in healthcare described and implement a prediction model based on machine learning to identify the risk of gestational diabetes is another of its main objectives. Apart from that various deep learning models and their applications mentioned. In last part the use of smart phones in healthcare discussed. This survey offers a quick overview of how various technologies, such as deep learning, might be used to solve various healthcare challenges.



978-93-343-4802-6

215 Automated Real-time Billing System Using Object Detection and Computer Vision

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This paper presents an automated real-time billing system that employs object detection and computer vision technologies to streamline retail checkout processes. Traditional billing systems require manual scanning or entry of products, resulting in queues and human errors. Our proposed solution uses a custom-trained YOLOv8 model to automatically identify retail products in real-time from camera feeds, track items over time to ensure accurate detection, and generate bills without human intervention. The system recognizes eight common retail items with high accuracy, demonstrates practical response times suitable for real-world deployment, and features a web interface for monitoring and bill management. Experimental results demonstrate 94.3% mAP@0.5 accuracy, making it a viable solution for practical retail environments.

222 An Improved DV-Hop Localization Algorithm based on Chaotic Human Conception Optimization with Time Varying Acceleration Coe-cients for Wireless Sensor Network

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Wireless Sensor Network (WSN) can be used to sense things, gather data, process it, and send it to other devices. The majority of WSN applications encounter certain challenges related to localization. This article presents an improved DV-Hop localization method utilizing chaotic human conception optimization with time varying acceleration coefficients, to reduce localization issues. The results are validated using simulations. The performance of this improved method is compared with previous methods, showing that localization accuracy improves, while both localization error and variance decrease.



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228 Disease Prediction using Particle Swarm Optimization based Classifiers

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Effective patient care relies heavily on accurate diagnosis and personalized medicine recommendations. This paper proposes an approach to enhance patient care by leveraging machine learning approaches and optimization techniques. A PSO (Particle Swarm Optimization) based classifiers are developed to recommend medicines based on patient symptoms and medical history. The PSO algorithm is used to optimize the feature selection process, improving the accuracy of the classifiers. The proposed system uses Random Forest and Gradient Boosting classifiers as the base model, which are trained on a comprehensive dataset of patient symptoms and corresponding disease. The Experimental results exhibit the effectiveness of the proposed approach, presenting significant improvements in disease prediction accuracy compared to traditional classification methods. The experimental results show that random forest classifier with particle swarm optimizer outperformed for disease prediction with an accuracy and F1 score of 97.45% and 0.98, respectively.

241 A hybrid deep learning framework based fake news detection

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The removal of misinformation is an absolute necessity in order to preserve the trust of the public, democratic values, and social cohesion. Because of its expansion, information is skewed, trust in institutions and the media is lost, and political stability is challenged. All these things are coming about because of the expansion. With the capacity to have direct consequences on health, the economy, and foreign relations, inaccurate information has the potential to have these effects. To anticipate fake information, the fundamental objective of this project is to create a hybrid deep learning model that integrates Bi-LSTM and GRU (HBLSGU). This model will be used to predict fraudulent information. A comparison is conducted between the performance of the proposed model and that of Naïve Bayes, XGBoost, Random Forest (RF), LSTM, Bi-LSTM, and GRU. We carry out this comparison by applying several performance metrics to each of these models. HBLSGU appears to attain an accuracy of 99.6% when compared to other artificial intelligence algorithms that have been developed, according to the findings.



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242 Weather Forecasting and Crop Suitability Analysis using Machine Learning

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Proper weather predictions are essential for enabling effective and timely response to climate-related hazards in urban planning, business operations Due to the lack of attention paid to minute environmental differences, traditional numerical models are inadequate inaccurately forecasting daily maximum and minimum temperatures and rainfall. ARIMA is designed to make predictions in the short-term using external inputs, while SARIMAX captures long-term seasonal patterns. A crop recommendation system is powered by 100-day forecasts that incorporate real-time and historical weather data derived from the Open WeatherMap API, with the aim of protecting farmers from severe weather. Through the use of predicted temperature and rainfall thresholds, the system evaluates 18 crops, Using MSE and RMSE, the trend visualization tool Matplotlib is used to measure and analyze forecast performance. While classical models may be basic in their approach, they are effective for small seasonal datasets.

243 Enhancing LLMs with a Supervisor Guided Multi-Agent Framework for Improved Domain Specificity

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Large Language Models (LLMs) have rapidly transformed the field of Natural Language Processing (NLP) since their inception. While they have remarkable ability to understand the logical syntax and semantics of human vernacular, they contend with difficulties in niche tasks that require real-time data and extensive and particular domain knowledge. This paper introduces an effective, easy-to-integrate agent-based architecture using divide-and-conquer to incorporate domain-specific and real-time data into LLMs, with the Paris 2024 Olympics as a case study. The flow features a supervisor that dynamically selects one of six specialized agents to respond to user queries. These agents, each with their myriad of tools, are tailored to four specific sports — Tennis, Hockey, Skateboarding, and Archery, with the fifth agent for queries related to event schedules, and a sixth general agent. Several emergent LLMs were benchmarked using several metrics under the G-Eval framework, as well as custom-define metrics, which yielded promising results. The GPT-4o Mini model augmented with our architecture (48.1%) outperforms Meta AI (44.5%) and Gemini (45.5%) on the Accuracy metric. Among the open-source models tested, the Qwen series performed best, leading in Faithfulness (88.3%) and Supervisor Accuracy (98.3%).



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245 Comprehensive Analysis of Deep Learning Approaches for Automatic Answer Evaluation

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Assessment is an elemental activity for the evaluators because it enables instructors to find out knowledge gaps and to estimate students' understanding. Answer assessment along with feedback can help students in reflecting on their individual learning, in determining the areas for growth, and in enhancing their problem-solving capabilities and critical thinking. AI assisted assessment technologies have capability to expeditiously and accurately analyse the performance of the student and teachers can get more time to perform other determined endeavours. Automatic assessment systems rely significantly on Natural Language Processing to understand, infer, and construct human language. The paper presents a comprehensive analysis of three deep learning approaches, Long Short-Term Memory, Universal Sentence Encoder and Bidirectional Encoder Representations from Transformers, train and tested on SICK data set using three optimizers, namely, Adam, SGD with momentum and RMSProp. The experimental results show that Bidirectional Encoder Representations from Transformers with Adam optimizer outperformed for answer evaluation with an accuracy and F1 score of 98.45% and 0.98, respectively.

249 A Novel Deep Learning-Based Hybrid Ensemble Approach for Epileptic Seizure Detection

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Epilepsy is a neurological disorder that affects millions of people internationally. Traditionally, epilepsy diagnosis method has relied on human analysis of EEG recordings captured by electronic devices. A model is being developed to enable timely medical intervention, which can save lives through early low grade tumor detection. This improves the patient’s quality of life by permitting stepped-forward management of their condition. The paper conducts a comprehensive study on seizure detection, focusing on the application of advanced hybrid models and ensemble models.An automated epilepsy detection method is proposed,that extracts key features using the PCA, selects using gradient boosting method and an ensemble method in which, Convolutional Neural Network (CNN) combined with Long short-term memory (LSTM) and Gradient Boosting Neural Network, which includes an attention mechanism and achieves an accuracy of 99%. Other types of models are also trained such as random



978-93-343-4802-6

forest classifier and XGB classifier using source data, giving the accuracy rates of 97.96% and 97.98%, respectively. The proposed scheme works for both small and large data. This system provides continuous low grade tumor monitoring and real-time detection. This work improves patient outcomes and also contributes to the advancement of medical technology and the understanding of neurological disorders.

262 Measurement-Based Study of LOS and NLOS Indoor mmWave Channels for Next-Gen Wireless Systems

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The investigation of millimeter-wave (mmWave) frequencies for next-generation wireless communications has been spurred by the growing scarcity of sub-6 GHz frequency bands. Effective network design requires an understanding of mmWave channel propagation properties. This paper presents a complete experimental assessment of indoor mmWave propagation channels, with a focus on key aspects such as multipath component behavior. We compare line-of-sight (LOS) and non-line-of-sight (NLOS) scenarios using a vector network analyzer (VNA) to gather multipath components at various spatial angles. Additionally examined is the effect of ambient elements on signal attenuation and scattering, including indoor geometry and material characteristics. The findings support precise channel modeling and offer information for the advancement of wireless communication systems in 5G and beyond.

263 Unlocking Smarter Energy: Knowledge Graphs Powering Next-Gen Smart Meter Analytics

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The demand for energy worldwide is increasing, and as a result, smart meters have become necessary for monitoring real-time electricity usage and better energy management. Even so, the data from these meters is enormous (typically collected every 15 minutes) and poses challenges in interpreting its meaning, integrating it, and generating valuable action plans. Knowledge graphs are a promising technique that can combine and link different datasets to aid comprehension and thus facilitate informed decisions. This paper investigates how knowledge graphs can be used with smart meter data analytics, focusing on their use in improving energy management systems. Knowledge graphs enhance smart meter data analysis by revealing hidden linkages, improving load management, and aiding demand response. Using case studies on test data obtained from smart meters administered by Tata Power



978-93-343-4802-6

Corporation Limited, the paper showcases how knowledge graphs enhance representation of real-time and precise information for efficient and environmentally friendly practices.

265 Low Cost LED-Based OWPT System for Micro/Milliwatt Medical and IoT Applications

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The proliferation of Internet of Things (IoT) devices, particularly in healthcare monitoring such as Blood Glucose Monitoring (BGM) and Continuous Glucose Monitoring (CGM) systems, has created an urgent demand for efficient, sustainable, and contactless power delivery solutions. This pa-per presents an optimized low-cost Optical Wireless Power Transmission (OWPT) system specifically designed for micro/milliwatt power consumption devices. Our system employs commercially available LED arrays with parabolic reflectors operating in the visible light spectrum for indoor applications. The proposed system demonstrates reliable power delivery up to 50cm distance with output capabilities in the 200-400mW range, sufficient for powering low-energy medical IoT devices. Experimental results show that our OWPT configuration achieved approximately 77% optical system efficiency with a total power feeding efficiency of 6.3%. Unlike laser-based OWPT systems that present safety concerns, our LED-based approach offers a safer alternative while maintaining suitable power output for targeted ap-plications. The system was successfully tested with small electronic medical devices and IoT sensors, confirming its viability as an alternative to conventional batteries for devices requiring continuous operation. This research contributes to advancing sustainable powering solutions for the expanding ecosystem of micro/milliwatt IoT devices, particularly in sensitive healthcare monitoring applications where reliability and safety are paramount.

267 Performance Evaluation of Solar Panels and Transmitters for Optical Wireless Power Transfer under Various Environmental Conditions

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Optical Wireless Power Transfer (OWPT) is becoming a focus of interest as a potential way remotely power wearable health-monitoring devices. In this work, we evaluated the energy-harvesting performance of three different so-lar panels (Silicon, ECS300, and BCS2717B6) in our experimental setup, under two lighting conditions: a 100W tungsten bulb and a 40W LED. Silicon panel consistently provided the most received power and overall efficiency, though it does at a greater expense. In terms of a



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transmitter, the 40W LED proved a better choice because it is more energy-efficient, less expensive to operate, and longer-lasting when compared with the Tungsten bulb. These findings demonstrate the potential of OWPT for wearable applications and emphasize that selecting the right combination of solar panels and transmitters can greatly enhance energy harvesting performance. Future work should focus on how changing light and temperature conditions affect OWPT performance. Combining OWPT with other energy sources and using smart power management can improve reliability, especially in remote or dynamic environments.

269 A Time Series Analysis of India's Infant Mortality Rate Forecast Using ARIMA Model

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Mortality is one of the crucial indicators of socioeconomic development and health identifiers of the community, indicating the development of the country. The present research study aims at the same variable that uses the ARIMA model to forecast India's Infant Mortality Rate from 2021 to 2035. In order to check the stationarity, the Augmented Dickey-Fuller test (ADF) has used Box-Cox transformation for stabilizing variance and model evaluation through residual diagnostics—QQ plots and metrics. The ARIMA (1,1,1) parameters have been used based on the lowest value achieved through AIC and BIC. Hence, the study indicated that IMR gradually decreases from 26.81 in 2021 to 13.48 in 2035 as a result of advancements in health sectors and socioeconomic conditions. Instead, ARIMA ignores external factors such as pandemic and policy for producing accurate predictions. The research finding integrates the concept of time series analysis followed by the machine learning concept and socio-economic variables. Results will aid in the prediction that promotes healthcare strategies and resource allocation.

271 Deep Learning in Finance: Review, Implementation and Analysis

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Deep Learning (DL) has significantly transformed the financial sector by enabling more accurate predictions, trend forecasting, and risk assessment. This paper explores an in-depth review of the diverse applications of DL across key financial domains, including market prediction, portfolio optimization, credit scoring, macroeconomic forecasting, risk management, and exchange rate estimation. The analysis categorizes financial use cases based on the underlying DL models employed, distinguishing DL



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from traditional Machine Learning (ML) approaches that often suffer from limitations in handling complex, non-linear financial data. By addressing these shortcomings, DL offers superior performance and greater adaptability in dynamic market environments. In addition to theoretical insights, this paper presents the implementation and quantitative analysis of DL-driven predictions for various financial instruments such as future gold price, Bombay Stock Exchange (BSE) price, bitcoin price, and US Dollar (USD) price which highlights how economic factors influence these outcomes. The comprehensive review along with prediction and analysis of these financial instruments aims to provide researchers and practitioners with a structured understanding of Deep Learning's capabilities and evolving role in modern finance.

277 A Hybrid ML-XAI Approach for Predicting Soil Fertility and Enhancing Agricultural Sustainability

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Soil fertility and health are crucial for the sustainability of agriculture, especially in alluvial soils, which are rich in nutrients yet prone to degradation. However, existing soil health monitoring and predictive systems face limitations, including inaccurate nutrient deficiency detection, difficulty in identifying early signs of soil degradation, and the lack of location-specific recommendations for crop management. These challenges result in inefficient resource utilization, lower crop yields, and long-term soil depletion, emphasizing the need for a more precise and reliable predictive framework. This study introduces a new perspective on soil fertility management based on an intelligent integrated learning framework. This study uses a combination of Random Forest, Support Vector Machine as base model and Gradient Boosting as a meta-model to predict data. Explainable AI (XAI) is used to provide suggestions like Crop Rotation to improve the soil fertility and health so that it helps the farmers to make informed decisions and ultimately boost crop production. Moreover, precision agriculture tools such as real-time soil analysis and customized nutrient application are integrated into the system to enhance resource efficiency and long-term sustainability. By extending the foundations of ecological prudence and engineering, this study delivers a systemic blueprint for soil health and fertility management so that farmers have the means to keep these natural systems Fertile and Healthy.



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282 Modeling OCC-Based Emotional Rewards in Assistive Robots for Adaptive Interactions

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Developing socially intelligent robots that can adapt to human needs has been made feasible by the promising paradigm of emotion-driven reinforcement learning. An appraisal-based emotion system for the assistive feeding robots grounded in the Ortony-Clore-Col lins (OCC) cognitive appraisal model have been proposed in this work that transforms robotic human interaction signals into human-like emotional signals. The OCC event-consequence branch is operationalized to calculate unexpectedness from robot motion deviations (e.g., abrupt velocity changes) and desirability from goal alignment (e.g., low force, no spills) which act as the key component for the emotion based reward shaping. The task related parameters are taken as proxies for calculating the desirability and unexpectedness appraisals using which the user emotions like joy and distress were modelled in real-time during robot-assisted feeding tasks. The proposed approach promotes emotionally intelligent robot behavior that minimizes human discomfort and improves work efficiency by integrating OCC's fundamental components into the reward signal thereby enhancing interaction quality and satisfaction for users. When compared to baseline model without emotions, experimental results on the FeedingJaco-v1 task in Assistive Gym environment showed enhanced performance in terms of safety, efficiency, and alignment with human-centered objectives.

285 AI-driven Navigation System for the Visually Impaired

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Self-navigating in a sighted world is a dangerous task for the visually impaired, confining their mobility and opportunities. An IoT-enabled wearable device driven by AI-driven navigation, can assist in solving the problem. Even with assistive technologies, end-to-end solutions incorporating obstacle detection, hazard recognition, and real-world navigation are rare. This paper provides a low-budget, AI-enabled mobile app solution combined with an IoT camera module to assist blind people in their environment navigation. The system utilizes Android development, TensorFlow Lite-optimized models, and the ESP32-CAM module to offer real-time object recognition and voice response through the Gemini API. The solution presented is the overcoming of high-computation model limitations by using the EfficientNet Lite family, which is both highly accurate and mobile-deployable. The model is trained with a subset of the COCO dataset that comprises of 1000 labelled objects, those pertraining to common objects that



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surround us while navigating outside. With the help of the Gemini API and Text to Speech functions, audio feedback of a humanized explaination of the visual surroundings is return.

288 Interactive VR and CV Based 3D Organ Visualization from CT scans for Medical Training

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Advancements in virtual reality (VR) and computer vision (CV) technologies offer new opportunities for enhancing medical training. This project aims to develop a novel tool for 3D organ visualization from 2D CT scans using computer vision (CV) and virtual reality (VR) technologies. The proposed system reconstructs high-resolution 3D models of organs, such as the heart, lung and liver, to assist medical professionals in surgical planning, medical training, and simulation of high-risk procedures. The integration of VR provides an immersive environment where users can manipulate the models interactively, enabling actions like zooming, rotating, and slicing to explore complex anatomical structures. The system employs state-of-the-art segmentation techniques for preprocessing CT data and volumetric rendering algorithms for 3D reconstruction. The resulting models are optimized for real-time interaction in VR platforms such as Unity or Unreal Engine. This tool addresses the challenges of interpreting 2D medical imaging data and enhances the precision and effectiveness of medical training and procedure planning. Future work includes expanding organ coverage, improving segmentation accuracy, and exploring AR integration for real-time clinical use.

289 Curriculum Learning-Driven Haematological Anaemia Detection: A Progressive Approach Using CBC Parameters

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This study presents a curriculum learning-based framework for automated anaemia detection using haematological parameters derived from routine Complete Blood Count (CBC) reports. The proposed approach employs a Random Forest classifier trained in progressive phases, where samples are ordered from easiest to hardest based on difficulty scores computed via a logistic regression margin-based confidence metric. The dataset is divided into three cumulative learning phases (30%, 60%, and 100%) based on increasing difficulty, allowing the model to learn decision boundaries incrementally. Each phase



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is trained independently and evaluated using precision, recall, and F1 score on a held-out test set, ensuring robust phase-wise performance monitoring. To evaluate the effectiveness of the learning strategy, we compare curriculum learning with anti-curriculum learning (training from hardest to easiest) and a strong baseline using XGBoost, a widely adopted gradient boosting method. Observed results reveal that curriculum learning significantly improves generalisation performance and achieves perfect classification in early phases, while the anti-curriculum approach steadily improves over time. The proposed curriculum-driven model achieves a final accuracy of 94.52% in the last phase, outperforming traditional baselines and highlighting its potential for integration into medical support systems.

290 Deep Neural Network based Single Channel Speech Enhancement with an emphasis in Phase Spectral Pro-cessing for Time-Frequency Analysis

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In this study, we present a deep learning-based approach for noise suppression in speech signals, utilizing a convolutional neural network (CNN) architecture to process time-frequency representations of audio. The input audio signals are transformed into spectrograms using the Short-Time Fourier Transform (STFT), separating magnitude and phase components. The magnitude and phase spectro-grams are then processed through separate convolutional layers, and the model predicts enhanced versions of both. The model is trained using a composite loss function that minimizes the mean absolute error (MAE) for both magnitude and phase predictions. Experimental results demonstrate the effectiveness of the pro-posed approach in suppressing noise while maintaining the speech quality. The enhanced magnitude and phase spectrograms are then combined to reconstruct the audio signal using the Inverse Short-Time Fourier Transform (ISTFT). This work highlights the potential of phase information processing in speech en-hancement models.

295 An innovative hybrid ensemble approach for handling Class Imbalance Problem

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Class imbalance presents a significant challenge in machine learning classification tasks which often results in poor generalization performance for the minority class. Traditional hybrid ensemble methods such as RUSBoost and EasyEnsemble attempt to address this by combining random undersampling with Adaboost ensemble. However, the inherent randomness in undersampling may lead to the loss of informative majority class instances that adversely affect the model's performance. To overcome these



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limitations, CBBoost—a novel Cluster-Based Boosting technique that integrates K-Means clustering with an adaptive boosting framework is being proposed in this paper. CBBoost strategically preserves representative majority instances by performing cluster-wise undersampling and focuses learning on difficult samples through iterative boosting. Experimental evaluation on the imbalanced Phoneme dataset using six performance metrics (Precision, Recall, F1 Score, ROC-AUC, G-Mean, and MCC) demonstrates that CBBoost significantly outperforms RUSBoost and EasyEnsemble. Statistical tests including the Shapiro-Wilk test and paired t-tests confirm the significance of performance improvements. The proposed CBBoost method offers a robust alternative for handling class imbalance while maintaining the diversity of majority class instances and the sensitivity of minority classes.

298 Design of dyadic wavelet filter bank through lifting scheme for Medical Image Retrieval

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Medical image retrieval is an important component in enabling clinical decisions by quickly and accurately accessing similar cases. It can be optimized, and we introduce a dyadic wavelet filter bank based on the lifting scheme—a scheme that is particularly efficient and flexible for the design of the wavelet transforms. Our method exploits dyadic scaling for multilevel frequency decimation, which enhances significant image features such as texture and edges. Such features are particularly significant for medical imaging, where small variation can be symptomatic. In comparison to fixed wavelet filtering, the lifting design lets the wavelet coefficients be tailored, and thus it is more sensitive to varying contrasts and noise over different sets of clinical data. We evaluated the suggested algorithm using benchmark clinical image collections and found it to bring consistent improvement over retrieval performance. Significant retrieval metrics such as precision, recall, and F1-score outclassed conventional techniques based on wavelets. The lifting scheme also cut down on computational overhead, which resulted in the method being applicable for real-time or large-scale retrieval systems. This work, overall, serves as a demonstration of how an optimized wavelet design can considerably advance retrieval for medical images, leading the way for more effective and responsive image-based diagnostic solutions.



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305 Integration of SLAM and Navigation System with Customized Autonomous Mobile Robot

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This research presents the development of an autonomous mobile robot (AMR) system using the Robot Operating System (ROS) for hospital logistics. The robot platform, Ceterio C-100, integrates a lifting mechanism and dual LiDAR sensors for efficient indoor navigation, obstacle detection, and collision avoidance. The system combines SLAM (Simultaneous Localization and Mapping) and autonomous navigation within a simulation environment, with motion synchronized to the real hardware. The implementation utilizes ROS and Docker containers for scalable and efficient deployment. The integration of 5G connectivity ensures low-latency communication and stable remote control, even in dynamic and demanding environments. During testing, the robot successfully executed navigation tasks, visualized in RViz, and responded in real time using ROS teleoperation tools. The study illustrates the full development cycle of AMRs from model sketching and URDF configuration to LiDAR sensing and real-world synchronization. The results confirm that 5G-connected, ROS-based AMRs reduce manual workloads and support automation in healthcare and smart industry operations.

307 ResNet-50 with Attention Mechanism for Brain Tumor Detection in MRI Scans

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Brain tumors, with their heterogeneous and intricate appearance in Magnetic Resonance Imaging (MRI), represent a great diagnostic challenge. Computer-aided diagnosis is increasingly playing an important role in clinical practice, helping increase the accuracy of diagnosis and assisting practicing radiologists. The work explores ResNet-50, a deep convolutional neural network, and its attention augmented variants in the classification of brain MRIs into no-tumor, glioma and meningioma, and pituitary tumor categories. Attention mechanisms Squeeze-and-Excitation (SE) and Convolutional Block Attention Module (CBAM) are used to fine-tune ResNet-50, which is then tested on 9,087 MRI images acquired on Kaggle and Figshare datasets. Tested on all types of tumors, both ResNet50 and ResNet-50 + SE models achieved splendid values of accuracy 99% with precision, recall, and F1-score 0.99, and the accuracy of 100%, correspondingly, in no-tumor classes. ResNet-50 together with CBAM yielded an overall accuracy of 97 %, and ResNet-50 with SE and CBAM yielded an overall accuracy of 98%. Such results indicate that attention-augmented ResNet-50 is powerful enough to classify brain tumors with confidence and support the introduction of Computer-aided diagnosis into the clinical workflow.



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309 Deep Learning Techniques for Early Prediction of Disaster

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Natural disasters such as earthquakes, floods, wildfires, and cyclones pose se-rious threats to human life and infrastructure. A major challenge in this do-main is the presence of noisy, imbalanced, and partially labeled datasets is-sues that frequently arise in satellite image data due to variable resolution, cloud occlusion, and event overlap. In this study, a novel deep learning framework is proposed that leverages image-based satellite data for effective disaster prediction. The architecture employs MobileNetV2 and SqueezeNet for lightweight and efficient feature extraction, followed by concatenation of the learned spatial representations. These fused features are then processed through a Long Short-Term Memory (LSTM) network to capture temporal dependencies and sequential patterns across time-series image frames. The proposed model achieved high performance metrics, with 97.8% accuracy, precision, and recall, significantly outperforming conventional A comprehensive evaluation using confusion and correlation matrices demonstrates the model's effectiveness in distinguishing between multiple disaster types while also highlighting the influence of structured environmental variables. The results affirm the feasibility of integrating efficient CNN architectures with sequence modeling for real-time, resource-efficient disaster forecasting.

315 Harmonic Clusters: Graph-Based Community Detection from Music Listening Logs

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Analyzing user behavior through music listening patterns can improve recommendation systems and identify hidden communities of listeners. This study introduces Harmonic Clusters, a new graph-based method for community detection. It builds a user-user network from a bipartite graph of user-artist interactions, with edge weights based on shared listening preferences. The approach combines the Louvain and Label Propagation algorithms for initial community detection, followed by a novel Harmonic Clustering technique that applies K-Means clustering to node centrality features such as degree centrality, betweenness centrality, clustering coefficient, and PageRank. The method was tested on the hetrec2011-lastfm-2k dataset, which includes 6,282 users and 22,038 edges. Results show distinct community structures, with an Adjusted Rand Index (ARI) of 0.085 between Louvain and Harmonic Clustering. Visualizations indicate that the identified communities are dense and meaningful,



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outperforming traditional methods by considering both network structure and node importance. This work provides a foundation for improving personalized music systems and suggests future research directions involving temporal data.

318 Impulsive Noise Removal from ECG Signals using VSS-Approximated LHCAF Algorithm

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Impulsive noise refers to abrupt bursts of brief duration. It is created by electronic equipment and electrosurgical noise in biological signals that occur during acquisition. In the past various adaptive algorithms like logarithmic hyperbolic cosine adaptive filter (LHCAF), Maximum Correntropy Criterion-based adaptive filter (MCC), Maximum Versoria criterion-based adaptive filter (MVC), modified Champernowne adaptive filter (CMAF) were developed to eliminate impulsive noise but they rely on a fixed step-size. This work proposes a variable step size algorithm based on Hyperbolic Tangent Function embedded with a novel approximated LHCAF algorithm named VSS-Approximated LHCAF algorithm to eliminate impulsive noise from electrocardiogram (ECG) signals. The suggested algorithm improves the signal-to-noise ratio (SNR) significantly after noise reduction, indicating its effectiveness.

319 Prediction of Breast Cancer by using Random Forest, Decision Tree, SVM and XGBoost

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Cancer is among the deadliest diseases worldwide, significantly contributing to global mortality. Breast cancer ranks among the top causes of cancer-related fatalities in women. As per reports from WHO in 2022, there were approximately 2.3 million cases worldwide with 270,000 deaths. Timely detection and diagnosis can save various lives. According to earlier research and studies, machine learning can be a very useful tool for early diagnosis. The proposed methodology has been processed into four stages: The first stage deals with dataset collection, the second stage with data pre-processing, the third stage with feature selection by using selectKBest and the fourth stage deals with applying classification techniques, namely Random Forest, Decision Tree, SVM, XGBoost on the selected features to evaluate the performance of predictions. The proposed methodology has been implemented on the Wisconsin cancer



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dataset. Among all the implemented classification techniques, Random Forest performed well. These techniques could also be beneficial for detecting other types of medical conditions.

320 Intelligent Metro Surveillance System using Deep Learning for Enhanced Safety and Security

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Metro stations face growing safety issues due to high passenger numbers and unpredictable behavior. Traditional CCTV systems depend on human monitoring, which often misses important events or gives too many false alarms. To solve this, we introduce MetroDualNet, an AI-powered sur-veillance system that works in real time. It uses two main parts: one to de-tect people and another to classify their actions. The first part uses YOLOv8-tiny to find and track people quickly. The second part uses a Vision Trans-former to study their movement over time. Based on how fast someone moves, the system classifies actions as standing, walking, or running. If someone is running in a restricted area, it triggers an alert. The system is trained on two datasets: an improved Urban Metro-Crowd and a custom Mo-tionMetro-2025 with behavior labels. MetroDualNet reaches 87.2% accuracy and reduces false alarms by 6%. It also runs at 30 frames per second on edge devices and protects privacy by anonymzing faces. This makes it a strong tool for metro safety.

323 SE-CNN: A Regularized Convolutional Neural Network with Squeeze-and-Excitation for Neurodegenerative Disease Detection

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Alzheimer's disease (AD) is an irreversible neurodegenerative disease, and currently, once diagnosed, there is no effective curative treatment. Early and accurate diagnosis of Alzheimer's disease is vital, as it enables timely intervention and preventive measures that can potentially delay disease progression, thereby improving patient outcomes. This study presents a novel hybrid model for Alzheimer's disease stage classification using structural MRI scans. The proposed model features a novel Convolutional Neural Network (CNN) architecture that incorporates Squeeze-and-Excitation (SE) blocks, which dynamically recalibrate channel-wise information to refine features further .The model undergoes extensive training and validation on the ADNI (Alzheimer's Disease Neuroimaging Initiative)Dataset,



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which consists of four classes: Non-Demented, Very Mild Demented, Mild Demented, and Moderate Demented. Our SE-CNN model achieved a classification accuracy of 93.4%, showcasing its robustness and generalization capability. Compared to pre-trained models like ResNet50, EfficientNetB4, MobileNetV2, and InceptionV3, our model outperformed their performance while offering lower complexity and improved interpretability. These findings demonstrate the benefits of integrating attention mechanisms and regularization techniques into custom architectures for enhanced neuroimaging analysis. Our approach provides a efficient solution for early Alzheimer's disease diagnosis, making it well-suited for clinical deployment.

324 Thermal Optimization of a Built-in Motor CNC Spindle Using CFD-Based Cooling Design Approaches

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In this study, a Computational Fluid Dynamics (CFD) analysis was conduct-ed to investigate the thermal performance of different cooling channel ge-ometries in a high-power spindle operating at 12 kW and a maximum speed of 4500 RPM. The primary objective of the study is to evaluate the effec-tiveness of the cooling system by analyzing the impact of varying the num-ber of coil windings, employing different cross-sectional geometries, and uti-lizing alternative cooling fluids on the heat transfer coefficients. A validated numerical model based on the realizable k-ε turbulence model was devel-oped using ANSYS Fluent software with appropriate boundary conditions and heat flux definitions. Assuming an operational efficiency of 90% for the spindle running at 12 kW and 4500 RPM, the average heat generation was es-timated to be approximately 1.4 kW.

325 An IoT-enabled Low Cost Force Plate for Balance Monitoring

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Maintaining postural balance is critical for preventing falls. Traditional assessment tools are often expensive and are not suitable for continuous monitoring, creating a need for inexpensive and smart alternatives. This paper presents a low-cost IoT-enabled force plate system to measure postural stability. It includes a custom-made acrylic balance board with four load cell sensors, an ESP32 microcontroller for real-time processing, and wireless data transfer using the WebSocket protocol. The Center of Pressure (CoP) is calculated at 100 Hz and sent in JSON format to a Node.js-based server. Balance tests



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were performed with five healthy adults standing quietly with eyes open. The collected CoP data were used to create stabilograms and statokinesigrams, which showed small, regular sway patterns typical of stable posture. This shows that the system can accurately measure postural behavior. Although this paper focuses on data collection and visualization, it can be expanded in the future with artificial intelligence (AI) or machine learning for tasks such as classification or feedback. By combining sensors, wireless communication, and intelligent analysis, this system supports accessible balance monitoring in both clinics and homes.

342 Analysis of Supervised Machine Learning Algorithms on Polycystic Ovary Syndrome based on Weight Distribution in India

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Polycystic Ovary Syndrome (PCOS) is a hormonal disorder in females during their reproductive age. This leads to several small cysts on the ovaries, irregular menstruation cycles, elevated levels of androgens and the male hormone involved in reproduction. PCOS can be caused by a mix of hereditary and environmental factors. The main symptoms of PCOS in women are excessive weight gain, facial hair growth, acne, hair loss, skin discoloration, and in rare instances irregular periods that can result in infertility. For early-stage detection and prediction, the current approaches and interventions are inadequate. A system is suggested to address this issue that can assist in the early identification and treatment prediction of PCOS based on weight distribution of females. Several machines learning classifiers including Random Forest (RF), Support Vector Machine (SVM) and Logistic Regression (LR) have been employed to determine if a woman has PCOS. SVM has the highest and most consistent accuracy among all of the classifiers. The training and testing dataset has been taken from Kaggle.

345 Comparative Analysis of YOLOv8 and YOLOv11 for Brain Tumor Instance Segmentation

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Brain tumor instance segmentation is a critical task in medical imaging, essential for accurate diagnosis, treatment planning, and monitoring. This work presents a customized approach for brain tumor instance segmentation using YOLO, adapted to perform both detection and segmentation with high precision. Despite the inherent challenges posed by the irregular shape, size variability, and location diversity of



978-93-343-4802-6

brain tumors, our system demonstrates robust performance by leveraging YOLO's real-time detection capabilities extended to instance-level segmentation. The best-performing model in our study achieves strong results in both bounding box and mask-based evaluations. For detection, the system reports a box precision of 86.6%, box recall of 86.4%, mean Average Precision (mAP@0.5) of 89.0%, and mAP@0.5:0.95 of 70.7%, reflecting its effectiveness in tumor localization. For segmentation, it achieves a mask precision of 86.9%, mask recall of 86.8%, mAP@0.5 of 88.7%, and mAP@0.5:0.95 of 70.4%, confirming its reliability in accurately delineating tumor regions. These outcomes highlight the potential of YOLO-based architectures in instance segmentation tasks for medical imaging, offering an efficient and accurate solution for brain tumor analysis that can enhance clinical workflows and support improved patient outcomes.

349 Beyond SIR and Prophet: Leveraging Temporal Graph Networks for Epidemic Prediction

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Modeling the spread of infectious diseases through networks and generating reliable predictions presents a significant challenge, particularly when social interactions evolve quickly. Conventional static compartmental models (like SIR and SEIR) and standard univariate timeseries forecasting techniques such as Facebook Prophet offer initial frameworks but often lack accuracy under dynamic interaction patterns. It has been found that while these models track broad trends, their errors increase during periods of sudden change. To address this, we propose a dynamic graph-based framework leveraging Temporal Graph Networks (TGN), demonstrated here on India's COVID-19 case data. Applying rolling time-series cross-validation on confirmed-case data, the TGN model consistently outperforms both Prophet and compartmental approaches in Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Root Mean Squared Error (RMSE).

350 AI-Based Framework for Delivery Slot Prediction and Dynamic Route Optimization in Last-Mile Logistics

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With the changing paradigm of e-commerce and logistics, precise delivery time slot prediction and delivery route optimization are important in terms of boosting customer satisfaction as well as operation efficiency. In this paper, an AI-based framework integrating machine learning-based prediction



978-93-343-4802-6

ofdelivery time slots with real-time route optimization is proposed for last-mile logistics support. Using a sample dataset of 5,000 delivery records, the system utilizes ensemble learning methods like Random Forest and XGBoost to make predictions regarding the best delivery windows using historical data, traffic patterns, and customer profiles. For route optimization, the framework uses geolocation information and K-Nearest Neighbor (KNN) algorithms for dynamically calculating efficient delivery routes. Experimental outcomes show that the Random Forest model resulted in 96.5 percent accuracy, greatly enhancing delivery dependability and mitigating operation delays. The framework offers a scalable intelligent solution that can work with different logistics contexts, enabling sustainable, affordable, and timely deliveries.

354 Sentiment Analysis of Tweets using Traditional Machine Learning and LSTM-Based Deep Learning Model

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The process of identifying sentiment in tweet content proves difficult because tweets contain brief informal content, which often contains slang words and irregular abbreviations as well as non-standard grammatical structures. This research evaluates tweet sentiment classification through the comparison of traditional machine learning methods against a deep learning system. A pre-annotated tweet dataset underwent preprocessing steps, which included tokenization alongside stemming and stopword removal. The text was converted through a conversion process using TF-IDF to produce feature vectors for training models, including logistic regression, naive Bayes and support vector machines (SVM). The research built an LSTM neural network to analyze tweet text in order to detect sequential patterns. The evaluation of model performance used accuracy together with confusion matrices as evaluation metrics. The results demonstrate that deep learning techniques through LSTM models produce higher accuracy than traditional models in short text sentiment analysis.

359 AssemblyAI vs Whisper AI: Comparative Analysis for Software Development Documentation and Meeting Transcription

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The production of effective technical documentation remains a recurring issue in software development contexts. While speech-to-text technologies offer promising alternatives for developers to document systems and code more effectively, their effectiveness in relation to technical content remains poor in



978-93-343-4802-6

terms of research. This research offers a comparative assessment of two leading speech recognition systems—AssemblyAI and Whisper AI—based on their performance in transcribing programming language syntax, software development terminology, and technical terms. Using a controlled experiment with 28 developers with different levels of experience and linguistic backgrounds, we assess transcription accuracy, usability measures, and system performance. Our results offer significant differences between the systems in terms of handling programming language syntax, API calls, and technical terminology, with AssemblyAI illustrating 18% higher accuracy for technical terminology, while Whisper AI excels in noisy environments. This comparative assessment offers empirical evidence for the choice of appropriate speech-to-text technologies based on technical documentation processes and develops a methodological framework for the assessment of future models in software development contexts.

365 Design and Techno-Economic Analysis of a 15 kWp Grid-Tied Net-Metering Solar Photovoltaic Power Plant Utilizing Half-Cut Monocrystalline-PERC Si Modules with Elevated Rooftop Structure

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The declining cost of photovoltaic (PV) power generation makes on-grid PV plants suitable for residential and commercial applications. The elevated rooftop PV plant installation is an example of a solar plant that generates electricity without disturbing the terrace area. This paper presents the techno-economic analysis of a 15 kWp on-grid power plant placed on the rooftop of Vardhman Hospital with a net-metering scheme located at Durg, Chhattisgarh, India (21°11' N, 81°17' E). The plant rests on an elevated galvanized iron (GI) structure, using half-cut monocrystalline-passivated emitter and rear contact (PERC) cell-based PV modules. The plant's performance parameter and the system losses were calculated using PVsyst simulation software using PVGIS meteorological data. The annual plane of array (POA) irradiation is approximately 2230 kWh/m² at the plant location. The PV energy generation of the plant is 27727 kWh/year, and 27271 kWh/year of energy is injected into the grid. The annual performance ratio of the plant is 81.7 %. The research article also focuses on plant design, electricity consumption, and the net electricity bill of the premises for three consecutive years before and after plant installation. The installation of the plant will be equivalent to planting 738 Teak trees over the lifetime, and carbon dioxide emissions mitigated is 461 tonnes. The payback period for an elevated structured on-grid PV plant is around six years.



978-93-343-4802-6

368 Satellite Image Segmentation Using DeepLabV3+: Ganga River Shrinkage Analysis

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Climate change and rapid urbanization are silently squeezing our rivers—and the Ganga is no exception. In this study, we deep dive into satellite-driven change detection to analyze the alarming shrinkage of the Ganga river between 2014 and 2025. We propose a hybrid approach that combines NDWI-based preprocessing with DeepLabV3+ for multiclass segmentation, enabling precise spatiotemporal analysis of river boundaries using Sentinel-2, Landsat-8, and Dynamic World datasets. In the proposed work, the proposed multi-thresholding approach is combined with DeepLabV3+in order to get the waterbodies to be extracted from the chosen test images. DeepLabV3 is demonstrated to have excellent segmentation performance when it is compared to UNet and SegNet. By exporting time-synced cloud-free composites through Google Earth Engine and training on city-specific samples in Google Colab, we deliver a robust, end-to-end pipeline for binary segmentation of water bodies. Our model armed with BCE + Dice loss, Cosine AnnealingLR scheduling, and early stopping—achieves optimal IoU and F1-scores by epoch 13, demonstrating high generalization across diverse terrains. This work not only reveals the environmental degradation of one of the India's most iconic rivers, but also provides a scalable blueprint for large-scale river health monitoring using Deep Learning Model.

369 Transfer Learning Based Approach for Breast Cancer Detection

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Breast cancer remains one of the most dangerous health challenges worldwide, particularly for women. In 2024, over 310,000 cases of invasive breast cancer were expected in the U.S. alone, highlighting the urgent need for early detection to improve survival rates. When diagnosed early, the five-year survival rate reaches up to 99%. However, disparities persist, such as Black women being more likely to die from breast cancer despite lower incidence rates. Improvements in Artificial Intelligence (AI) and Deep Learning (DL) have shown promise in enhancing diagnostic accuracy and reducing the burden on radiologists. Tools like miONCO-Dx demonstrate AI's ability to detect multiple cancers, including breast cancer, with up to 99% accuracy even before symptoms arise. This study explores AI-driven solutions for breast cancer detection, emphasizing the role of deep learning-based Computer-Aided Diagnosis (CAD) systems. This paper presents a comprehensive analysis of AI models applied to breast cancer detection, comparing the performance of four lightweight, pretrained Convolutional Neural Networks (CNNs):



978-93-343-4802-6

MobileNetV2, EfficientNetB0, ResNet50, and NASNetMobile. Using the Breast Histopathology Images (IDC) dataset, various preprocessing techniques and evaluation metrics—accuracy, precision, recall, and F1-score—were applied. Among the models, NASNetMobile achieved the highest accuracy (0.93) and F1-score (0.88), outperforming the others. The results underscore the importance of model selection and data preprocessing in building effective diagnostic tools. This research supports the potential of AI to aid in early detection and ultimately improve patient outcomes, though further clinical validation is essential for real-world deployment.

371 Assessment of Efforts to Protect Surface Water Quality in Canal Systems: A Case Study of Binh Chanh District

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Binh Chanh District in Ho Chi Minh City, Vietnam is characterised by a complex network of canals. These canals play a crucial role in the local water management and ecology. These canals support agricultural activities, transport and contribute to the urban aesthetics of the area and are vital to the local environment and community. The aim of this work is to imple-ment the theoretical framework for the small proposal and improvement of the quality of canal systems in Binh Chanh district during the dry season. In total, 150 household interviews and 40 surface water sources have been sampled. Water parameters reported from 40 samples (n = 40) were: pH, Chemical Oxygen Demand, 5-day Biochemical Oxygen Demand (BOD5), Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorus (TP) and Coliform. In the results, the survey presented that the water quality affecting the households was about 80% of the opinion of polluted water and 20% of the opinion of contaminated water. The polluted water was influenced by 55% of the opinions of industrial processes, 25% of the opinions of municipal waste water and other causes. The findings showed that water pollution from high nitrogen and phosphorus levels in the Binh Chanh canal system posed significant environmental and health risks. An in-depth study was conducted on a possible solution to provide water services to the district. In conclusion, this manuscript can review the causes, consequences and solutions of nitrogen and phosphorus pollution, with the aim of informing effective management strategies. For example, activities to grow the plants (Luffa cylindrica) on the canal were carried out in An Phu Tay commune. The re-sults can be used to assess the health of surface water resources and protect this canal system by raising awareness among residents, as one of the green solutions in environmental protection to be applied in Binh Chanh District.



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372 Enhanced PSO-Based Geographic Routing for Load Distribution in WSNs

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Wireless Sensor Networks (WSNs) face critical challenges in energy efficiency and scalable data routing. We propose EPSO-GPSR, a novel routing and load balancing strategy that combines Enhanced Particle Swarm Optimization (EPSO) for energy-aware load distribution with Greedy Perimeter Stateless Routing (GPSR) for efficient geographic forwarding. Through ex-tensive simulations, we demonstrate that EPSO-GPSR outperforms traditional methods in terms of network lifetime, energy efficiency, throughput, packet delivery ratio, and delay. The algorithm also shows strong resilience to node failures and scalability issues, indicating its suitability for real-world WSN applications.

381 Comparative Analysis of the YOLO Model for Brain Tumor Detection in MRI Scans

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Brain tumor detection using MRI is critical for early treatment, but the manual interpretation is time-consuming and prone to variability. This study extensively and efficiently evaluates YOLO architectures (v5 to 12) toward autonomous brain tumor detection from MRI scans. The models were optimized to improve detection accuracy and robustness by employing rigorous preprocessing and data augmentation. The findings pinpoint YOLOv11 as the most efficient among all, capable of delivering high-speed, real-time detection with incredible precision. Although YOLOv12 competitively matched YOLOv11 in performance terms, YOLOv5 struggled with low-contrast tumor detection, which reflects the importance of architectural development. Repeated training with stable convergence and few false positives again validates the robustness of the model. Overall, YOLOv11 offers the best, most effective method of transforming the diagnosis of brain tumors and conserving radiologists' time, improving diagnosis, and increasing patients' survival rates, particularly in low-resource settings. With performance as high as a precision of 91.6%, a recall of 91.4%, and a mAP of 92.0%, its clinical applicability demonstrates its application with quick and reliable tumor localization. These standards serve as a critical benchmark for evaluating future AI-based implementations in cancer diagnosis and medical imaging.



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389 An Enhanced Forest Fire Detection Method using Improved YOLOv12

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As global climate change increases, forest fires are a serious threat to human development and biodiversity. The automatic fire detection system is critical for the early identification of burns in forests. YOLO-based fire detection algorithms face various challenges, including poor precision, excessive miss rates in challenging scenery, inefficiencies in instantaneous applications, and problems in detecting tiny fire features in the very beginning phases of a fire incident. This paper proposes a forest fire detection method, built on improved YOLOv12, allows for effective real-time surveillance in scenarios with scarce resources. First, we use the Convolutional Attention Module (CAM) to enhance channel and spatial attention, resulting in greater recognition of tiny fire features that are crucial for early detection. Next, we incorporate an appropriate target detection layer into YOLOv12. The target layer increases sensitivity to narrow firing zones while reducing computing weight and parameters, resulting in enhanced feature recognition without sacrificing efficiency. Findings from the experiment shows the proposed model obtains a mAP of 95.38% on the ADSF dataset and 88.82% on the Wildfire dataset, which is 0.92% and 1.6% higher than other YOLO-based methods on the same datasets.

391 Effective Aspect Extraction in the Travel and Tourism Domain Using Fine-Tuning and Zero-Shot or Few-Shot LLM Techniques

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In the domain of natural language processing, aspect-level sentiment analysis remains a crucial yet underexplored area, particularly within the tourism industry. This study aims to address this gap by extracting aspect terms from TripAdvisor reviews, thereby identifying specific attributes discussed in these reviews. The objective is to enhance customer experiences and uncover competitive advantages within the industry. This research employs large language models such as Google Flan-T5-Large, Mistral-v0.1 7B, and Llama-2 7B to evaluate their efficacy in capturing aspect nuances in tourism-related texts. To determine the most effective Large Language Model for aspect-level extraction in the tourism domain, various prompting techniques are investigated, including zero- shot learning, one-shot learning, and few-shot learning. Apart from these, retrieval-augmented generation and fine-tuning were also



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employed. A comparative analysis of their performance on our dataset is presented, revealing that Mistral-v0.1 7B reached an impressive accuracy of 91% and a Macro F1-score of 68%.

399 Patient-Centric Blockchain-Based Healthcare System Framework

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A safe, transparent, and patient-centered solution for managing Electronic Health Records (EHRs) is necessary due to the sensitive nature of medical data. Conventional systems generally require patients to move records between institutions, compromising efficiency and privacy manually. They are often dispersed and vulnerable to unwanted data sharing. A blockchain-based EHR system that offers patients total ownership over their medical records while guaranteeing traceable and auditable access is proposed in this work. The system keeps encrypted records off-chain, allows one-time access tokens to be withdrawn after each usage, and employs smart contracts to enforce role-based rights for administrators and physicians. Verification and accountability are made possible by the immutable on-chain recording of all access requests and approvals. To provide continuity of care, a secure off-chain permission layer manages encryption, decryption, and key rotation if wallets are lost. As a strong substitute for other centralized EHR systems vulnerable to broker data exploitation, the architecture complies with Indian healthcare data protection laws, including the DPDP Act, DISHA, and SPDI Rules. This decentralized approach ensures that medical records are safe, accessible, and the patient's only property for their life.

402 AI and IoT based Smart Irrigation System

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The agricultural sector is coming under growing pressure to make the most out of resources in the face of threats like climate change, drought, and declining agricultural productivity. This paper introduces an Internet of Things (IoT) and Artificial Intelligence (AI)-based Smart Irrigation System to revolutionize conventional irrigation practices. The system uses real-time sensing data, machine learning, and autonomous control techniques to facilitate smart irrigation decisions. Soil moisture, temperature, humidity, and rainfall are measured as environmental parameters by IoT sensors and analyzed using AI models to make predictions for irrigation requirements. An AI model prediction is used to control a



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Raspberry Pi Pico W microcontroller, which acts as the IoT gateway to manage the pump control automatically. Comprehensive analysis and visualization of environmental data were presented and various machine learning classifiers were compared to select the most efficient classifier. Of them, Random Forest and Gaussian Naive Bayes showed the highest prediction accuracy. The results clearly establish that the system works well in conserving water, minimizing human labor, and maintaining plant health, thus enabling data-driven and sustainable agriculture.

403 An Improved YOLOv5 Model for Kidney Stone Detection and Segmentation in Medical Imaging

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Accurate and prompt detection and segmentation of kidney stones are critical for accurate diagnosis and efficient management. This work proposes a superior version of the YOLOv5 model, especially tailored to detect and segment kidney stones from CT images. We introduced a breakthrough module to the basic building blocks of the YOLOv5 model architecture to boost contextual awareness and feature learning. The context-guided module was experimented with in the backbone, neck, and both, with the optimal performance when used only in the backbone. The recommended model accomplishes an accuracy of 95% and a mean Average Precision (mAP) of 94.3%. It is compact, with a model size of 6.5 MB and a floating-point operation rate of 23.5 GFlops. These results show that the model markedly improves the recognition and segmentation of kidney stones, causing it to be an im-portant tool for fast automated diagnosis in clinical settings.

417 Modified Cat Swarm Optimization Tuned Damping Controller for Grid Integrated Microgrid

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The low frequency oscillations damping for a grid connected micro-grid is going to be a critical challenge for modern inter-connected power system. These oscillations if not damped at early state, may lead to system instability issue. Hydro-Governor is traditionally used for frequency regulation in alternator, but in present work optimal hydro Governor are employed in the micro-grid to control oscillation in power



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system. The gain of hydro governor is optimized by a modified cat swarm (MCSO) optimization based on a multi-objective function. The performance of MCSO being compared with PSO and CSO algorithms. Variation in Solar & wind sources are taken as disturbance and the damping capability of proposed MCSO tuned governor has been investigated in time domain with Eigen value analysis. The optimized governor action is justified to be much efficient to provide sufficient damping torque for oscillation in power-system.

421 Evaluating Classical and Bio-Inspired Path Planners in Dynamic Obstacle Environments

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Path planning is a fundamental problem in robotics, autonomous systems, and computational geometry. This paper presents a comprehensive compara-tive study of seven path planning algorithms like A*, Dijkstra, Rapidly-exploring Random Trees (RRT), RRT*, Probabilistic Roadmaps (PRM), Par-ticle Swarm Optimization (PSO), and Genetic Algorithms (GA) in diverse 2D environments containing multiple obstacles. We evaluate these algorithms across five distinct environments with varying obstacle configurations, measuring performance metrics such as success rate, path length, computa-tional time, node exploration, and path smoothness. Our results indicate that RRT* consistently produces high-quality paths with optimality guarantees, while A* and PRM offer reliable performance in structured environments. PSO and GA, though computationally intensive, demonstrate adaptability in cluttered spaces. Dijkstra guarantees optimality but suffers from high compu-tational overhead, whereas RRT provides fast but suboptimal solutions. This study provides empirical insights into algorithm selection, demonstrating that RRT* offers the best balance of optimality, speed, and robustness, while PSO/GA are viable for complex, static environments. Trade-offs between ef-ficiency and path quality are quantified, aiding practitioners in choosing con-text-appropriate methods.



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423 Improved Beluga Whale Optimization Algorithm-based Workflow Scheduling Mechanism for Edge Computing

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In edge computing environment, the process of efficiently scheduling workflows is challenging for the objective of optimizing resource utilization and reducing the time of completion. This challenge with respect to scientific workflows is mainly realized since they possess multiple tasks which possess dependencies between them. The traditional methods of workflow scheduling are identified to fully not address the necessitated demands of the edge computing scenario. This problem of workflow scheduling results in sub-optimal scheduling which completely increased the execution time and minimized the rate of resource usage. In this paper, Improved Beluga Whale Optimization Algorithm-based Workflow Scheduling Mechanism (IBWOAWSM) is proposed for maximizing the degree of resource utilization and comparatively minimizing workflow completion time. The simulation results of this IBWOAWSM approach confirmed minimized energy consumption and makespan independent to the tasks existing in the workflow considered for execution in edge computing environment.

433 Application of CNN Gate Recurrent Network for increasing visibility of Hazy Image

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Haze removal of a single image using prior knowledge is challenging due to the ill-posed methods of multiple restoration physical models. The previous model was thoroughly analyzed, and the learning-based transmission estimates proved useful and had minimal impact on the final dehazing procedures. Most dehazing method depends on haze-relevant features in transmission maps, which lacks accurate information during image acquisition during bad weather. In this article we introduces a dehazing approach that combines CNN with features learning recurrent modeling. In the regression model, a ranking layer is added to the CNN network model to capture transmission maps, scene depth, and structural features of hazy images simultaneously. Post-processing is done via Fast guided filter. A haze density prediction method may effectively eliminate haziness by identifying its coarse and fine layers based on these characteristics. CNN captures the entire image, while GRN gathers visibility information based on human perception from global to local regions in fine layers. This hybrid model demonstrates the interconnection between coarse and fine layers.



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435 Aging-Resistant Facial Recognition: Leveraging Deep Learning and Data Augmentation for Accurate Identification

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Facial recognition technology has become a crucial tool in various sectors, especially in security and law enforcement, for identifying individuals from digital images. However, as facial features change due to aging, weight fluctuations, or cosmetic alterations, traditional facial recognition systems often face challenges in providing accurate long-term identification. In this paper, we propose an enhanced facial recognition system that utilizes deep learning with data augmentation to address the variability in facial appearance over time. By employing a pre-trained VGG16 neural network for feature extraction and a Support Vector Machine (SVM) for classification, we create a robust framework capable of identifying individuals even after significant changes in their appearance. This system could significantly improve the accuracy of criminal identification over extended periods, assisting police forces in recognizing suspects after years of changes in their physical features

437 Blockchain Network to Share Academic Credentials and Expertise of Academicians and Researchers

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Expertise sharing among academicians and researchers can greatly boost productivity and foster innovation within the academic com-munity. By providing a unified platform for broadcasting technical knowledge, research expertise, and consultation services, institutions can tap into a broader network of experts for specific projects. This approach promotes decentralization in expertise sharing while also creating potential income opportunities for both experts and institutions. Blockchain technology, with its strong data security and resilience against cyber threats, serves as an ideal foundation for such a platform. Its transparency and trust mechanisms align well with the principles of Open Data platforms, where openness and limited privacy concerns are prioritized. In this paper, we propose an enhanced blockchain-based application designed to facilitate the sharing of academic staff information and skills. In addition to enabling seamless and decentralized communication between academic institutions and experts, this system introduces the capability for users to upload their resumes, which are securely stored on the blockchain. The decentralized nature of the platform ensures that contracts between



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institutions and experts can be established and approved directly without the need for intermediaries, streamlining the entire process. Our research utilizes Ethereum, a widely used open source blockchain platform, to develop and test this application. The developed prototype creates a decentralized academic ecosystem that enhances trust, efficiency, and accessibility. By implementing this blockchain-based skills-sharing platform, including resume storage, we aim to revolutionize how academic expertise is accessed and utilized, ultimately driving progress in research and development across the academic community.

438 Optimized K-Means Clustering with AES Encryption in Hadoop's MapReduce Framework

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The proliferation of big data necessitates efficient and secure clustering techniques for effective knowledge discovery. K-Means clustering, while popular for its simplicity, faces challenges in handling large-scale datasets, including high computational overhead, sensitivity to initial centroid selection, and convergence to local optima. Furthermore, the increasing adoption of distributed computing platforms like Hadoop for big data processing introduces critical security concerns, particularly when sensitive information is involved. This paper proposes an optimized K-Means clustering approach integrated with Advanced Encryption Standard (AES) encryption within the Hadoop MapReduce framework. The proposed method leverages Hadoop's parallel processing capabilities to address the scalability limitations of traditional K-Means. Concurrently, AES encryption is applied to ensure data confidentiality during both storage and computation within the distributed environment. Experimental evaluations demonstrate that the proposed secure and parallel K-Means algorithm significantly improves clustering accuracy and convergence rate while maintaining high computational efficiency. Despite the inherent overhead of AES encryption, the system achieves near-linear scalability for large datasets, proving its efficacy for secure and efficient big data analytics.



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446 Heart Failure Prediction Model Based on Kendall's Rank Correlation

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This research aims to make a trustworthy decision-support system for the prognosis of heart failure patients using their medical data and laboratory test findings. In clinical practice, the prediction of events related to heart failure is often quite varied and imprecise. Investigating the mainreasons for heart failure is equally crucial from a therapeutic point of view. Kendall's rank correlation method is used to determine which characteristics are most important for predicting heart failure patients.To this end, we employ machine learning approaches,viz. "Random Forest (RF), Logistic Regression (LR), Support Vector Classifier (SVC), k-nearest neighbour (k-nn), and Gaussian Naïve Bayes (GNB)"to build a model that accurately determines whether patients are at risk. This can assist medical professionals in making well-informed choices about the level of care that a patient needs.We evaluate the applicable algorithms' performances using the following metrics: F-measure, accuracy, precision, recall, and ROC value, demonstrating that Random Forest (RF) yields the best accuracy of 75.03 % after k-fold validation. Consequently, our proposed framework might prove to be a helpful instrument in identifying high-risk individuals and guiding healthcare providers to take the necessary measures.

468 Computational Optimization of Perovskite Materials for Enhanced Light Absorption, Stability, and Efficiency

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Electricity plays an essential role in many facets of modern life. Because of high population density and demand electricity scarcity is major global concern. Solar energy is the most appropriate solution for overcoming the issue of electricity scarcity out of all available energy sources. Perovskite solar cells (PSCs) is photovoltaic device which uses perovskite materials as active layers in cells. Although perovskite solar cell is inexpensive and highly scalable, they are yet in sufficiently effective for commercial use. Additionally, because of led halide, they are susceptible to environmental factor that can reduce their effectiveness. This Study carefully investigated how the preparation method and material characteristics affected the performances of CH3NH3PBI3-xCIx Perovskite solar cells. The results show that the morphological quality and light absorption properties of the perovskite solar film are greatly influenced by active layer production process as well as heat treatment.in subsequent studies we aim to apply machine learning algorithm to compare and analyze the perovskite solar cell performance on the basis of fundamental electrical parameter.



978-93-343-4802-6

478 AI-Driven Field Service Optimization: Redefining Distribution with Smart Automation

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In an era of rapid digital transformation, AI powered field service management is revolutionizing operational efficiency in distribution networks. This study explores the integration of intelligent automation, predictive analytics, and real-time optimization within cloud-based field service solutions. By leveraging advanced scheduling algorithms and IoT-driven workforce tracking, businesses can enhance service delivery, reduce downtime, and maximize resource utilization. Our research investigates the impact of AI-enhanced service platforms on cost efficiency, customer satisfaction, and workforce productivity. Through an in-depth analysis of implementation strategies and technological innovations, we provide insights into how AI-driven field service solutions are shaping the future of the distribution industry. This study highlights the significance of adaptive automation and strategic AI adoption in fostering business agility and long-term growth.

479 AI-Powered CRM Task Automation: Evaluating LLM Agents in Real-World Enterprise Environments

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Customer Relationship Management (CRM) is essential for modern enterprises, enabling businesses to manage customer interactions efficiently. This study introduces CRMArena, a novel benchmark designed to evaluate large language model (LLM) agents in performing real-world CRM tasks. Built on Salesforce Service Cloud schema, CRMArena includes nine tasks covering case routing, policy compliance, and customer trend analysis. I assess various AI models on their ability to interact with Salesforce CRM systems via API calls and UI navigation. Results indicate that current state-of-the-art LLMs struggle to fully automate CRM workflows, with even the best performing models completing less than 55% of tasks accurately. These findings highlight the need for more advanced AI capabilities in function calling and rule-following to enhance CRM automation.



978-93-343-4802-6

485 Real Time Aspect based Sentiment Monitoring from E-Commerce Platform in Multilingual Environments Using Transformer Models

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Consumer feedback from product reviews is important for business decisions, consumer satisfaction, and product development. Since traditional sentiment analysis techniques rely on monolingual data and have poor contextual comprehension, they frequently fail. This paper introduces a multilingual BERT-based real-time sentiment analysis system for dynamically analyzing customer evaluations from Flipkart, a significant Indian e-commerce site. Aspect-based sentiment analysis (ABSA), multilingual support, and real-time web scraping are all integrated into the system through the nlptown/bert-base-multilingual-uncased-sentiment model. By automatically extracting important aspects using the YAKE algorithm, it permits sentiment categorization at both the sentence and aspect levels. BERT performs better than RoBERTa and DistilBERT when it comes to managing a variety of multilingual content. Sentiment distributions are visualized on an interactive dashboard. The framework provides a scalable approach to multilingual sentiment monitoring, which is particularly helpful in markets such as India. It supports use cases in reputation management, customer experience, and product feed-back.

490 LLM-Based Topic Modeling for Unstructured and Multilingual Corpora

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Recent advances in LLMs like GPT-4.0 Mini and DeepSeekR1-Distill-Llama-70B have made topic modeling on unstructured, multilingual data more accurate and efficient. Traditional methods such as LDA, NMF, and clustering techniques often struggle with coherence and redundancy. In contrast, LLM-based Topic Modeling (LTM) uses prompting and iterative distillation to produce high-quality topics with fewer errors. Compared to methods like TopicGPT and PromptTopic, LTM is more scalable—requiring just 80 LLM calls—while delivering superior results, despite occasional LLM inaccuracies and high GPU demands.



978-93-343-4802-6

491 Hybrid Deep Learning Model for DAM Spilling and Early Flood Warning System

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Floods pose significant risks to life, property, and infrastructure worldwide, making early warning systems crucial for disaster preparedness. Work pro-poses a hybrid deep learning methodology which amalgamates Convolution-al Neural Networks (CNN) and Bidirectional Long Short-Term Memory (BiLSTM) networks for enhancing flood prediction in advance considering multivariate time series data. The layer of CNN extract features from environmental parameter such as rainfall, water levels of river, and moisture of soil, while the BiLSTM layers collects complex temporal dependents in for-ward and backward directions. Our model was trained and further evaluated using past hydrological data, and its performance was then compared to various conventional systems, including ARIMA, Random Forest, and GRU. The results reveal that proposed CNN-BiLSTM model significantly reduces the error rate to as low as 0.45% in terms of mean squared error and 4.7% in terms of root mean squared error relative to the compared models. Model achieves coefficient of determination (R^2) of 96.72%. These showcase the superior accuracy and robustness of the proposed model and advocates its employment for the development of early flood warning for more effective and reliable to mitigate flood impacts through timely alerts.

494 A systematic Review on Segmentation Techniques for Classifying Thyroid Nodule

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The thyroid is an endocrine gland that plays a crucial role in regulating the body's metabo-lism. Abnormal cell growth within the thyroid gland is known as nodules. To differentiate between benign and malignant nodules, ultrasonography serves as the primary non-invasive diagnostic modality. Accurate segmentation of these nodules is a fundamental step in thy-roid ultrasound image analysis, as it significantly contributes to the precise detection and characterization of thyroid cancer. As a critical component of image preprocessing, segmen-tation isolates the region of interest (ROI), enabling more effective downstream analysis. Various approaches have been employed for thyroid nodule segmentation, including tradi-tional image processing techniques, machine learning algorithms, hybrid frameworks, and deep learning models. This review presents a comprehensive analysis of the existing seg-mentation methodologies, examining their respective advantages and limitations based on key performance indicators such as Dice Similarity Coefficient (DSC), accuracy, precision, recall and F1-score.



978-93-343-4802-6

Furthermore, it offers an overview of both publicly and privately avail-able datasets commonly used in this research domain.



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