Abstract Book

26th INMIC
International Multi Topic Conference 2024

Organized by

Department of Biomedical Engineering
Faculty of Engineering

SALIM HABIB UNIVERSITY

in collaboration with IEEE KARACHI SECTION

December 30-31 2024

26th INMIC
International Multi Topic Conference 2024

December 30-31 2024

Abstract Book

26th INMIC 2024

30-31 December 2024 - Karachi

Organized by

Department of Biomedical Engineering
Faculty of Engineering

SALIM HABIB UNIVERSITY

in collaboration with IEEE Karachi Section

DECEMBER 30 - 31, 2024

Chartered by the Government of Sindh - Recognized by
HEC, Sindh HEC/CIEC - Accredited by PCP, PEC & NCEAC

TABLE OF CONTENTS

S. NO.	CONTENT	PAGE #
1	Overview of the Conference	3
2.	Message from the Patron	4
3.	Message from the Conference Chair	5
4.	Message from the Conference Co-Chair	6
5.	Message from the Honorary Chair	7
6.	Message from the Conference Secretary	8
7.	Message from the Program Secretary & Publication Chair	9
8.	About Salim Habib University	10
9.	Members of Organizing Committee	11
10.	List of Keynote Speakers	14
11.	Abstracts - Keynote Speakers	15
12.	Abstracts - Oral Presentations	34

OVERVIEW OF THE CONFERENCE

The Department of Biomedical Engineering, Faculty of Engineering, Salim Habib University, is pleased to welcome you to the 26th International Multi Topic Conference 2024 (INMIC 2024), being held in collaboration with the Sindh Higher Education Commission (SHEC), IEEE Karachi Section, and Liaquat University of Medical & Health Sciences (LUHMS), Jamshoro, from December 30-31, 2024, in Karachi, Pakistan.

INMIC 2024 aims to provide a premier platform for researchers, scientists, and industry experts to share their advanced research findings, innovations, and experiences. The objective of this multi-disciplinary event is to bring together experts from academia and industry to share the latest developments in emerging technologies, promote research collaborations, and showcase innovation in various fields. The conference features a range of technical sessions, keynote lectures, workshops, scientific posters and project competitions covering a wide range of topics related to evolving technologies in diverse fields.

The scope of INMIC 2024 includes, but is not limited to, the following tracks:

Track 1.
Electrical and Electronics Engineering
- Control Systems and Robotics
- Microelectronics and VLSI Design
- Power Systems and Automation
- Renewable Energy Systems
- Signal Processing and Communication

Track 2.
Computer Science and Engineering
- Artificial Intelligence and Machine Learning
- Big Data and Data Analytics
- Cybersecurity and Information Assurance
- Internet of Things (IoT)
- Software Engineering and Systems

Track 3.
Biotechnology and Biomedical Engineering
- Bioinformatics and Computational Biology
- Biomechanics and Biomaterials
- Medical Imaging and Instrumentation
- Telemedicine and Healthcare Systems Engineering

Track 4.
Materials Science and Engineering
- Advanced Composite Materials
- Materials for Energy Applications
- Metallurgy and Corrosion
- Nanomaterials and Nanotechnology
- Polymers and Plastics

Track 5.
Interdisciplinary and Emerging Areast
- Emerging Technologies and Innovation
- Engineering Education and Pedagogy
- Ethics and Social Responsibility in Engineering
- Smart Manufacturing and Industry 4.0
- Sustainable Engineering Practices

MESSAGE FROM THE PATRON

It is my honor to serve as the Patron of the 26th International Multi Topic Conference (INMIC 2024), organized by the Department of Biomedical Engineering, Faculty of Engineering, Salim Habib University, in collaboration with the IEEE Karachi Section.

INMIC 2024 is the convergence of healthcare, information technology, quantum computing, neuroscience, genetics, nano-technologies, artificial intelligence and other technologies which have disrupted the silos of business, technology, engineering, psychology, health, medicine, and other disciplines. The conference reflects Salim Habib University's commitment to improving the wellbeing and sustainability of future generations through multi-disciplinary education, research, practice and innovative solutions that create impact on the society, industry, and economy.

I am pleased to see the conference bring together researchers, scientists, and industry experts from around the world to share their latest research findings and innovations while encouraging experiential learning, problem-based learning and project-based learning and the need to utilize these learnings to build entrepreneurial skills and become self-sustainable.

I wish the conference organizers and participants all the best and look forward to a productive and enriching experience.

Sincerely,

Prof. Dr. Syed Irfan Hyder
Patron, INMIC 2024
Vice Chancellor
Salim Habib University, Karachi

MESSAGE FROM THE CONFERENCE CHAIR

It is with great pleasure that I welcome you to the 26th IEEE International Multi-Topic Conference 2024 (INMIC 2024).

I am proud to present the Abstract Book for INMIC 2024, a compilation of cutting-edge research and innovations being shared during this multi-disciplinary event.

INMIC reflects the interconnectedness of modern research and the importance of collaboration across traditional boundaries. I am confident that the intellectual discourse and exchange of knowledge during this conference will foster the kind of creativity and innovation needed to shape the future of our industries and societies.

I would like to extend my heartfelt gratitude to the Sindh Higher Education Commission (SHEC), IEEE Karachi Section, and Liaquat University of Medical & Health Sciences (LUHMS), Jamshoro, for their support and collaboration. I am also thankful to all the authors who have contributed their work, the reviewers who have provided their valuable feedback, and our dedicated organizing committee and volunteers for all their hard work in making this conference a resounding success.

I look forward to the exciting discussions and discoveries that will emerge from our time together.

Sincerely,

Prof. Dr. M. Zeeshan Ul Haque
Conference Chair, INMIC 2024
Dean, Faculty of Engineering
Salim Habib University, Karachi

MESSAGE FROM THE CONFERENCE CO-CHAIR

With great pride and enthusiasm, I welcome you to the 26th International Multi-Topic Conference (INMIC) 2024, a flagship event that exemplifies the spirit of innovation, collaboration, and knowledge-sharing within the IEEE community. This conference serves as a vital platform for researchers, practitioners, and industry leaders to present their groundbreaking work, exchange ideas, and explore emerging trends across diverse engineering and technology fields.

As Chair of the IEEE Karachi Section and Co-Chair of this prestigious conference, I am privileged to witness the collective efforts of professionals and students in advancing technological frontiers. This year's INMIC promises to be a truly remarkable experience, showcasing cutting-edge research and fostering dialogue on topics shaping our world's future.

I extend my heartfelt gratitude to the organizing committee, reviewers, and volunteers for their unwavering commitment to excellence in making this event a success. I am also deeply thankful to our esteemed speakers, authors, and participants whose contributions enrich the technical rigor and significance of this conference.

Let us embrace the opportunity to learn, innovate, and inspire one another as we chart a path toward a brighter and more connected future. I look forward to the impactful discussions, collaborations, and advancements that will emerge from this year's conference.

Regards,

Prof. Dr. Tariq Rahim Soomro
Conference Co-Chair, INMIC 2024
Chair, IEEE Karachi Section
Rector
Institute of Business Management, Karachi

MESSAGE FROM THE HONORARY CHAIR

With great pleasure and immense pride, I welcome all the delegates to the 26th International Multi Topic Conference 2024 (INMIC 2024), an esteemed event jointly organized by the IEEE Karachi Section and Salim Habib University.

As the Honorary Chair, I am honored to stand alongside some of the most brilliant minds in the fields of electrical and electronics engineering, computer science and engineering, biotechnology and biomedical engineering, material science and engineering, and interdisciplinary areas to share groundbreaking research, foster knowledge exchange, and inspire innovation. This conference is a unique platform for thought leaders, industry experts, and passionate researchers worldwide to collaborate and discuss the most pressing challenges and emerging opportunities in our field. We live in an era of rapid technological advancements, and gatherings like this play a crucial role in networking and shaping the future of emerging technologies.

I want to extend my deepest gratitude to the organizing committee, sponsors, speakers, and all volunteers who have worked tirelessly to make this event possible. Your dedication ensures that this conference remains a flagship event in the IEEE community and a beacon for excellence in research and technology.

I am confident that the 26th INMIC 2024 will provide you with an enriching experience, and I look forward to stimulating discussions and collaborations that will emerge from our time together.

Thank you for your participation, and I wish you all a productive and inspiring conference.

Warm regards,

Prof. Dr. Bhawani Shankar Chowdhry, S.I
Honorary Chair, 26th INMIC 2024
Professor Emeritus, MUET
Former Chair, IEEE Karachi Section

MESSAGE FROM THE CONFERENCE SECRETARY

It is my privilege to welcome you to the 26th International Multi-Topic Conference 2024 (INMIC 2024), an event that serves as a beacon of innovation, collaboration, and excellence in scientific and technical research.

Organized by the Department of Biomedical Engineering at Salim Habib University in collaboration with the IEEE Karachi Section, INMIC 2024 will highlight groundbreaking research and foster invaluable international connections, promoting collaborative efforts across diverse research areas, countries, and industries.

At Salim Habib University, we, in line with our Honourable Chancellor Dr. Iram Afaq's ***CBA (Conceive It, Believe It, Achieve It)*** philosophy, believe in pursuing big ideas and turning dreams into reality. Through INMIC 2024, we aim to not only celebrate innovation but also empower participants to explore new horizons and contribute to shaping a brighter, more sustainable future.

As Conference Secretary, I am immensely proud of all our team's efforts that have led to this esteemed event being a reality today, and I extend my heartfelt appreciation to the organizing committee, keynote speakers, participants, and all contributors for their dedication to making this event a success.

May INMIC 2024 ignite inspiration and pave the way for innovative breakthroughs that shape the future of science.

Sincerely,

Dr. M. Hussain Habib
Conference Secretary, INMIC 2024
Registrar
Salim Habib University, Karachi

MESSAGE FROM THE PROGRAM SECRETARY & PUBLICATION CHAIR

It is an honor to contribute to INMIC 2024 as the Program Secretary and Publication Chair. This conference brings together brilliant minds to exchange ideas and push the boundaries of innovation.

My role has been to ensure the seamless coordination of the technical program and the publication of high-quality proceedings that reflect the hard work and dedication of our contributors. I extend my heartfelt thanks to the organizing committee, reviewers, and authors for their invaluable efforts in shaping this conference.

I hope INMIC 2024 inspires new perspectives, fosters meaningful collaborations, and paves the way for future advancements in technology.

Sincerely,

Engr. M. Shaheer Mirza
Program Secretary & Publication Chair, INMIC 2024
Lecturer, Department of Biomedical Engineering
Salim Habib University, Karachi

ABOUT SALIM HABIB UNIVERSITY

Salim Habib University (SHU) is a not-for-profit institution of higher learning committed to providing quality university education to the Pakistani youth, no matter what their financial constraints. Established through a charter granted by the Provincial Assembly, Sindh, in 2015, Salim Habib University is supported by The Salim Habib Education Foundation (TSHEF), a not-for-profit organization founded with the aim of providing the people of Pakistan with safe and easy access to international standard educational and healthcare facilities. At present, TSHEF's large-scale projects in Pakistan include the Salim Habib Education Complex, Toba Tek Singh, Salim Habib University, Karachi, and the upcoming Fatima Business School, Karachi. Salim Habib University, was found by the dynamic Dr. Muhammad Salim Habib (Founder of TSHEF and Life Chairman, SHU), and the charismatic Dr. Iram Afaq (CEO and Founding Member, TSHEF, Deputy Chairman, Barrett Hodgson Pakistan, and Chancellor, SHU), is located at Korangi Creek, Karachi, and spans over six acres of lush landscaping. It boasts ultra-modern infrastructure featuring a five-story academic block with thirty-three state-of-the-art labs, an exceptional four-tier library designed to stimulate creativity and inspire students to learn, and world-class recreational facilities.

The University offers global-standard programs with innovatively designed curricula in the fields of Pharmacy, Engineering, Science, Information Technology, and Management Sciences. It is chartered by the Government of Sindh and recognized by the Higher Education Commission. Its programs are accredited by the Pakistan Engineering Council (PEC), the National Computing Education Accreditation Council (NCEAC), and the Pharmacy Council of Pakistan (PCP).

Each aspect of life at Salim Habib University prepares its graduates to meet every demand of the rapidly developing job market and succeed at all they set out to accomplish. In addition, the University endeavors to maintain a vibrant campus life by encouraging students to participate in a wide range of cocurricular activities and events organized by student societies. With its dedicated Career Placement & Industrial Liaison Office, Center of Learning and Teaching, ideal learning environment, and emphasis on experiential learning and industry exposure, the University ensures that its students emerge as well-rounded, competent individuals who harbour the passion to engage in continual professional and personal growth and can give back to society.

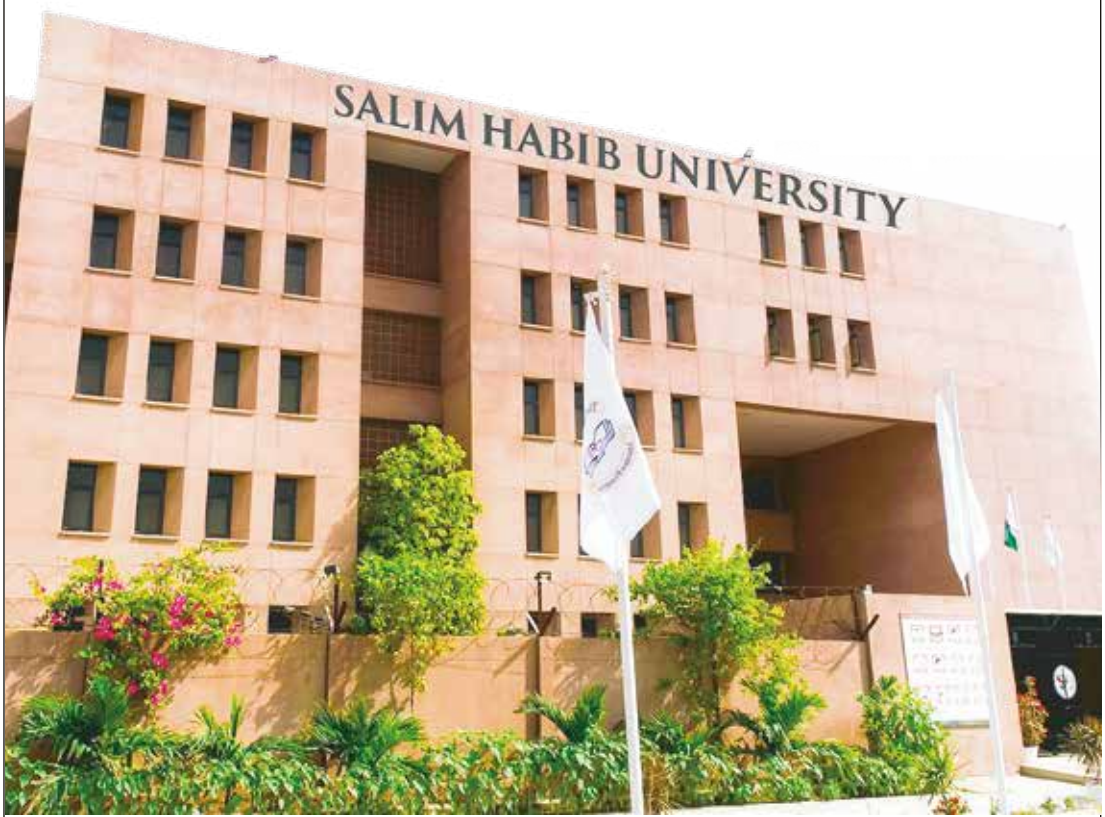
Salim Habib University is proud to say that its students are now spreading their light globally. They have won both local and international competitions of renown and have secured places in multiple global exchange programs. SHU alumni have obtained job placements in top organizations, and continue to inspire with their achievements.

Under the capable leadership of its founders Dr. Muhammad Salim Habib and Dr. Iram Afaq, its Board of Governors, its Vice Chancellor Prof. Dr. Syed Irfan Hyder, and its Deans and Directors, Salim Habib University holds steadfast in its goal of turning the ambitions of every student into reality, transforming their dreams into opportunities, and paving the way to a better. brighter tomorrow for Pakistan.

MEMBERS OF ORGANIZING COMMITTEE

Patron	Prof. Dr. Syed Irfan Hyder
Conference Chair	Prof. Dr. M. Zeeshan Ul Haque
Honorary Chair	Prof. Dr. B. S. Chowdhry
Conference Co-chair	Prof. Dr. Tariq Rahim Soomro Mr. M. Wasim Munir
Conference Secretary	Dr. M. Hussain Habib
Program Secretary & Publication Chair	Engr. M. Shaheer Mirza
Program Committee Chair	Dr. Syed Mehmood Ali
Technical Program Committee Chair	Dr. Irfan Ahmad Usmani
Organizing Committee Chair	Prof. Dr. Shahid Sheikh Engr. Tooba Khan
Organizing Committee	Dr. Asim ur Rehman Khan Dr. Khalid Bin Muhammad Dr. M. Faisal Khan Dr. Umair Ahmed Korai Dr. Samita Bai Engr. Parkash Lohana Engr. Hanan Daudpota Engr. Abdul Moiz Engr. Muhammad Aamir Engr. Hassan Ali Engr. Amna Sheikh Ms. Madiha Imdad
Coordination/Logistic Committee	Mr. Umer Farooq Mr. M. Ammad Khan Mr. Noman Ali Mr. Waseem Mustafa

Media & Marketing Committee	Mr. Muhammad Ali Engr. Hassan Ali Mr. Umer Farooq Mr. Saad Zafar Khan Ms. Sibgha Raza Mr. Muhammad Shahroz Mr. Danish Ishaque
Procurement Committee	Mr. Sheikh Jawwad Jamil Engr. Tooba Khan Mr. Kamran Sabir Mr. Zain Ishfaq
Finance Committee	Mr. M. Ammad Khan Engr. Gul Munir
ICT Infrastructure Committee	Mr. Syed Abid Ali Mr. M. Wasim Munir Mr. Abdul Rehman Mr. Ghulam Asif Mr. Farhan Akbar Mr. Azhar Ali Mr. Muhammad Haider Mr. Humayun Ahmed Mr. Affan Bin Masood



SALIM HABIB UNIVERSITY

LIST OF KEYNOTE SPEAKERS

- Prof. Dr. Joseph Stokes, Ireland
- Dr. Inam Ul Ahad, Ireland
- Prof. Dr. Stephanie Willerth, Canada
- Prof. Dr. Mohamed Kheir, Denmark
- Prof. Dr. Raed Mesleh, Jordan
- Prof. Dr. Takako Hashimoto, Japan
- Dr. Muhammad Hanif, Swedan
- Dr. Rooh Khurram, Saudi Arabia
- Dr. Mohsin Ahmed Shaikh, Saudi Arabia
- Dr. Jawad Ahmad, Saudi Arabia
- Dr. Sana Ullah Jan, UK
- Prof. Dr. Ciro Rodriguez R. , Peru
- Prof. Dr. Muhammad Zeeshan Shakir, UK
- Prof. Dr. B. S. Chowdhry, Pakistan
- Dr. Noman Naseer, Pakistan
- Dr. Furqan Shaukat, Pakistan
- Prof. Dr. Zia Mohy Ud din, Pakistan
- Prof. Dr. Pardeep Kumar, Pakistan

Abstracts Keynote Speakers

26th INMIC 2024

30-31 December 2024 - Karachi

Organized by Department of Biomedical Engineering, Faculty of Engineering
SALIM HABIB UNIVERSITY

26th INMIC 2024 KEYNOTE-1

HELPING BONES TO GROW AND EXTEND HIP IMPLANT LONGEVITY! OPTIMIZING PLASMA-SPRAYED HYDROXYAPATITE COATINGS

Prof. Dr. Joseph Stokes
Professor, School of Mechanical & Manufacturing Engineering
Dublin City University, Dublin

Hydroxyapatite (HA) coatings on titanium implants have revolutionized hip replacement surgery by promoting osteointegration—the process where bone grows directly onto the implant surface. This bioactive coating mimics the mineral composition of natural bone, accelerating bone ingrowth and ensuring a stronger, more durable bond between the implant and surrounding bone tissue. However, the deposition of HA onto titanium using plasma thermal spray technology presents significant challenges due to the complexity of the process. Plasma thermal spray involves multiple parameters, such as spray distance, gas flow rate, and powder feed rate, each influencing the microstructure, adhesion strength, and overall performance of the coating. The intricate relationship between these variables makes it difficult to produce consistently high-quality coatings without a systematic approach to optimization. Design of Experiments (DOE) software, such as Design Expert, offers a robust solution by enabling researchers to study the interactions between different spray parameters efficiently. Through DOE, we can identify the optimal conditions for producing superior HA coatings, enhancing implant performance and longevity. Optimized coatings not only improve the initial fixation of the implant but also prolong its lifespan, reducing the need for revision surgeries. This keynote will explore the critical role of HA coatings in hip replacements, the complexity of the plasma thermal spray process, and how DOE tools can be used to optimize the coating process for improved patient outcomes and longer-lasting implants.

26th INMIC 2024 KEYNOTE-2

SHAPING CURRENT AND FUTURE PRODUCT DESIGN AND MANUFACTURING USING INDUSTRY 4.0/5.0 TECHNOLOGIES

Dr. Inam Ul Ahad
Assistant Professor, School of
Mechanical & Manufacturing Engineering
Dublin City University, Dublin

Manufacturing sector is progressively incorporating Industry 4.0 and 5.0 technologies, driven by pursuit of innovation and the need to remain competitive. This adoption can be characterised by smart factories, advanced digital manufacturing and cyber-physical systems have redefined product development and manufacturing processes. This keynote speech is focused on defining the key technologies and establishing their foundational roles in reshaping the product design and manufacturing landscapes. Digital Manufacturing Design (DMD) is central to this transformation, bringing the principles of Industry 4.0/5.0 to implement customer focused innovations and efficiency both in product and production. These principles can be characterised by the rapid product development and increased workflow speed, resulting in reduced time and cost for bringing innovations to market. Case studies on the use of Industry 4.0 on product design and development and use of digital tools for process development and optimisation will be presented.

26th INMIC 2024 KEYNOTE-3

3D BIOPRINTING COMPLEX HUMAN TISSUES

Dr. Stephanie Willerth
Professor, Mechanical Engineering
University of Victoria, Canada

3D bioprinting can create living human tissues on demand based on specifications contained in a digital file. One of the benefits of using this additive manufacturing technique is the ability to generate complex constructs containing a variety of cells that mimic structures found in the human body. Such highly customized, physiologically relevant 3D human tissue models can screen potential drug candidates as an alternative to expensive pre-clinical animal testing as well as hold the potential to regenerate diseased and damaged tissues. Over the past few years, the Willerth lab has been a leader in the 3D bioprinting space. The Willerth lab has developed a novel fibrin-based bioink called TissuePrint for bioprinting human tissues that has been commercialized through her award-winning spin-off company – Axolotl Biosciences. We have developed several tissue models using TissuePrint, including constructs derived from human induced pluripotent stem cells (hiPSCs), which can become any cell type found in the body. More recent work has focused on developing our "smart" bioinks that contain drug releasing microspheres produced using microfluidics as a way to improve the reproducibility of the bioprinting process. Using our novel, patent-pending BrainPrint bioink, we have generated tissues with chemical and electrical properties similar to that of the brain and spinal cord.

26th INMIC 2024 KEYNOTE-4

AI/ML FOR EMI SIMULATIONS AND TROUBLESHOOTING

Prof. Dr. Mohamed Kheir
Associate Professor, Institute of Mechanical and Electrical Engineering, Denmark

Electromagnetic interference and compatibility (EMI/EMC) are crucial aspects for electronic devices. There are many standards that are strict about the emission levels allowed out of any electrical device. Conformance with such standards is mandatory for these products to be permitted into markets. EMI simulations play an essential role during product design for investigating EM emission before manufacturing and testing. These tools suffer from several problems that make them complicated and not environment-friendly. For instance: 1) the long simulation time. 2) the computational complexity and 3) the high energy consumption. All these issues make EMI simulations nongreen and costly. One potential solution to all these problems could be utilizing Machine Learning (ML) algorithms to offer a green alternative to ordinary simulations. The proposed talk aims to focus on novel applications of Physics-Informed Machine Learning (PIML) that accelerate EMI/EMC simulations and troubleshooting.

26th INMIC 2024 KEYNOTE-5

ELEVATING CONNECTIVITY: UAVS, IOT, AND 5G IN MOVING CELLS AND REMOTE SENSING

Prof. Dr. Raed Mesleh
Professor, Electrical Engineering
German Jordanian University, Jordan

In an era marked by rapid technological advancement, Unmanned Aerial Vehicles (UAVs) are emerging as a transformative force, particularly in the context of moving cells and remote sensing applications. UAV communication and their role in IoT (Internet of Things) are poised to revolutionize our interactions with the environment. UAVs offer unparalleled potential in a wide array of applications. In the realm of IoT, they enable seamless connectivity by facilitating data exchange between various IoT devices. This connectivity extends beyond smart homes, reaching precision agriculture, where UAVs play a pivotal role in optimizing crop yields and resource utilization. Additionally, in the domain of remote sensing, UAVs are invaluable tools for collecting high-resolution data in remote or inaccessible areas. To fully unlock the capabilities of UAVs in IoT and remote sensing, robust wireless connectivity is essential. This is where 5G technology, the fifth generation of wireless communication, steps in as a vital enabler. With its exceptional speed, ultra-low latency, and the ability to support a massive number of device connections, 5G is poised to connect not only UAVs but also a myriad of IoT devices, ranging from autonomous vehicles to healthcare wearables. As we embark on this UAV-driven future, it is imperative to confront the opportunities and challenges that lie ahead. Addressing security and privacy concerns in UAV communication, ensuring equitable access to 5G technology, and fostering collaboration among academia, industry, and policymakers will be pivotal in harnessing the transformative power of UAVs, IoT, and 5G. The digital revolution is in full swing, and UAVs, in partnership with 5G, are at the forefront. Together, they are shaping a world where connectivity is ubiquitous, intelligence is embedded, and the possibilities are limitless. It's a future that holds immense promise and one that we should eagerly embrace and actively participate in.

26th INMIC 2024 KEYNOTE-6

STRUCTURING TOPICS ON LARGE-SCALE SOCIAL MEDIA FOR DISCOVERING PEOPLE'S PERCEPTIONS

Prof. Dr. Takako Hashimoto
Professor, Director of International Center,
Chiba University of Commerce, Japan

X(Twitter) is currently one of the most influential microblogging services on which users interact with messages. It is imperative to grasp the big picture of Twitter through analyzing its huge stream data. In this study, we develop a two-stage clustering method that automatically discovers coarse-grained topics from Twitter data. In the first stage, we use graph clustering to extract micro-clusters from the word co-occurrence graph. All the tweets in a micro-cluster share a fine-grained topic. We then obtain the time series of each micro-cluster by counting the number of tweets posted in a time window. In the second stage, we use time series clustering to identify the clusters corresponding to coarse-grained topics.

We evaluate the computational efficacy of the proposed method and demonstrate its systematic improvement in scalability as the data volume increases. Next, we apply the proposed method to large-scale Twitter data (26 million tweets) about the COVID-19 Vaccination in Japan. The proposed method separately identifies the reactions to news and the reactions to tweets.

26th INMIC 2024 KEYNOTE-7

TOWARDS A DATA-DRIVEN PUBLIC SECTOR : ASSESSING MATURITY OF DATA FOR PRODUCTIVE, INCLUSIVE AND TRUSTWORTHY GOVERNANCE

Dr. Muhammad Hanif
Assistant Professor, Department of Informatics,
School of Business, Orebro University, Sweden

In the digital era, data is a cornerstone for innovation in the public sector, helping governments to design policies and deliver services that are more efficient, inclusive, and citizen-centric. But the road to a data-driven public sector involves more than access to volumes of information; it calls for a structured approach to assessing data maturity. This talk explores some critical dimensions of data maturity in governance, focusing on the productivity, inclusiveness, and trustworthiness that are integral to securing sustainable development.

Through our proposed framework and evidence-based insights, this talk will review how governments can improve their data capabilities in driving better outcomes for citizens. From overcoming data silos, ethical considerations, and interoperability issues to leveraging data in participatory governance and equity in policy outcomes, this session endeavors to provide actionable strategies toward building resilience in the data ecosystem.

This talk will explore the best practices and create a discussion on the transformative potential of data that can help policymakers, technologists, and other stakeholders reimagine governance not only driven by data but also with the principles of equity and accountability at its core.

26th INMIC 2024 KEYNOTE-8

COMPOSABLE HPC INFRASTRUCTURE FOR CONTINUUM MECHANICS WORKLOADS

Dr. Rooh Khurram
Computational Scientist, King Abdullah University of Science and Technology, Saudi Arabia

High-performance computing (HPC) applications like computational fluid dynamics are often compute intensive, but not all scientists have access to such powerful supercomputers. Cloud computing is a viable alternative for running these applications on the cloud without needing large capital expenditure (CAPEX) in high-end parallel computing systems. However, transitioning from a managed supercomputer to a self serviced public cloud is not straightforward for researchers from engineering disciplines. Moreover, the novice user lacks a priori knowledge of performance for continuum applications on cloud. This preparatory phase can sometimes be rather expensive due to unpredictable costs of cloud computing. The aim of this paper is to provide guidelines for running typical continuum mechanics workflows on HPC clusters in the public cloud. The selected use cases are: CFD, CSM, EM, crash analysis, atmospheric science, and geoscience. We will also provide the performance comparison of public cloud and supercomputer for all benchmarks selected from a wide range of applications at various spatial/temporal resolutions. We hope to provide guidelines to individual researchers, faculty groups, academic departments and SMEs for selecting specifications for their respective workloads. These specifications include: compute instances, storage, interconnect, RAM, scheduler, software environment and data management. We believe that unbiased reporting of HPC workloads on cloud is essential for policy makers for making long term planning for HPC infrastructure. A cloud alternative to a managed on-premise supercomputer provides an option to convert capital expenditure to operational expenditure.

26th INMIC 2024 KEYNOTE-9

ON-DEMAND HPC PLATFORM FOR ACCELERATING AI WORKLOADS

Dr. Mohsin Ahmed Shaikh
Computational Scientist, King Abdullah University of Science and Technology, Saudi Arabia

Distributed Deep Learning is a critical component of training/fine-tuning models. Large datasets, complexity in model architecture, and hyperparameter tuning are use cases most commonly enabled by distributed DL. This talk walks through the convergence of the hardware, software and the inherent parallelism in algorithms and demonstrates the gains for the pain of refactoring deep learning workflows to enable model training in a rational time. The talk also addresses the scaling characteristics and introduces an on-demand HPC environment with flexibility to choose the resources appropriate for the use-case with cost-efficiency in mind.

26th INMIC 2024 KEYNOTE-10

COMPOSABLE HPC INFRASTRUCTURE FOR CONTINUUM MECHANICS WORKLOADS

Dr. Jawad Ahmad
Assistant Professor, Prince Mohammad Bin Fahd University, Saudi Arabia

With the advent of digital communication, the security of digital images during transmission and storage has become a major concern. Traditional Substitution Box (S-Box) replacement algorithms frequently fail to successfully conceal information inside highly auto-correlated parts of an image. The security challenges raised by three popular S-box substitution methods—single S-box, multiple S-boxes, and multiple rounds with multiple S-boxes—particularly when dealing with images with highly auto-correlated pixels and lower grey scales will be addressed in this talk. We will discuss a novel technique known as SRSS (Single Round Single S-Box encryption scheme) that overcomes the existing methods' latency and large computing requirements. To effectively encrypt the plaintext image, SRSS uses a single S-box for substitution in just one round. Furthermore, this work introduces a new method CROSS (Chaos-based Random Operation Selection System), which eliminates the need for several S-boxes, lowering the complexity of the encryption system.

26th INMIC 2024 KEYNOTE-11

SENSOR FAULT DIAGNOSTICS USING MACHINE LEARNING

Dr. Sana Ullah Jan
Assistant Professor, School of Computing, Engineering, and the Built Environment, UK

Cyber-Physical System (CPS) or Internet-of-Things (IoT) appears as a potential avenue for enhancing applications including object-to-object, human-to-human, and human-to-object communications in both the real and virtual worlds. Smart Grids (SG), Wireless Sensor Networks (WSN), and transportation networks are a few examples. However, the pervasiveness of sensors presents additional challenges to the systems, such as intrusions from external agents and failures originating from within network nodes. Generally, these internal failures are referred to as faults. It is important to design intelligent solutions that can detect the abnormality in time to avoid any unwanted circumstances. In addition, the ideal system be aware of the environment to identify environmental affect against the unwanted abnormal situation. Artificial Intelligence, or Machine Learning, provides pathways to achieve these goals within the intrinsic properties, such as limited resources, of sensors.

26th INMIC 2024 KEYNOTE-12

AI TECHNIQUES FOR THE DESIGN OF SPECIFIC SHORT FEMORAL STEMS IN PATIENTS WITH PRIMARY HIP ARTHROPLASTY

Prof. Dr. Ciro Rodriguez R.
Professor, National University of San Marcos, Peru

A novel approach is presented to improve the effectiveness and personalization of hip arthroplasty, concentrating on a short prosthesis design specifically adapted to individual patient requirements, particularly for the femoral stem. The employed technology entails data acquisition via a meshless program that quantifies the stress/strain shielding resulting from femoral insertion. Automatic pre-processing utilizes clustering techniques to segment the data into anatomical regions of the body. Subsequently, machine learning techniques ML, including random forests and stacking, are trained to predict the shielding effect produced by the stem precisely. The predictions are derived from design characteristics associated with the patient's femoral cavity dimensions and its correlation to stem size, quantified by dimensionless parameters that function as model inputs. This method offers rapid and economical evaluations for medical professionals and engineers, and the outlined strategy can be effectively adapted for the design of additional arthroplasty prosthesis, including shoulder and knee implants. This study addresses the increasing demand for hip replacement HR among a younger demographic facing hip joint pathologies by enhancing the femoral component, specifically the stem, of the implant. The approach involves a low-human intervention design strategy that leverages ML tools to expedite the design process. The personalization remains in the process, beginning with a stem shaped according to the proximal femur PF cavity and then defining its parameters to be adapted by the anatomic zones. Moreover, the PF morphology is analyzed by clustering algorithms that enhance the ML process by segmenting anatomically the outputs to guide a deeper understanding of the PF mechanical response once the implant is fixed.

26th INMIC 2024 KEYNOTE-14

ADVANCING COLLABORATIVE TECHNOLOGICAL EDUCATION: DIGITAL TWIN IN EDUCATION AND INDUSTRY 4.0

Prof. Dr. B. S. Chowdhry
Professor Emeritus,
Mehran University of Engineering and Technology, Jamshoro

Progressed manufacturing strategies are revolutionizing the industry and transforming how products are designed, produced, and delivered. With the advent of the 4th Industrial Revolution, which created a virtual replica connected to the physical asset, digital twins give smart manufacturers the real-time insights they need to make production decisions quickly. Digital twins have become the basis for the planning, simulation, and validation of manufacturing processes from an early planning phase to the virtual commissioning of the production line as a pillar of Industry 4.0 in education. Such practice has taken deep roots in the academia and industry of developed nations. The technology readiness level is such that there will be a massive gap in a recession-hit world where the modern world stands at one end of the continuum and the Next Eleven (N-11) nations are struggling at the other.

Pakistan is a developing country experiencing a long-term economic crunch that has deeply affected developmental projects. The country's prosperity is based on skill development through higher education, aided by industrial development. As mentioned earlier, developed countries worldwide have used Virtual Reality (VR) in their education systems and industries as an alternative way to make educational and industrial systems more sustainable.

This presentation will review several collaborative projects in addition to the recently approved EU CBHE proposal "Capacity Building in the Teaching of AR/VR (CATCH-VR)." The objectives of CATCH-VR are to achieve innovative aspects in developing a workforce of students and teachers to strengthen the capacity in the teaching and application of AR/VR technology through training, seminars, conferences, and a graduate degree program that will especially benefit countries like Pakistan and third-world countries to overcome the challenges of the fourth industrial revolution for less developed nations

26th INMIC 2024 KEYNOTE-13

DIGITAL CONNECTIVITY FOR SUSTAINABLE FUTURES: TRANSFORMING SOCIETY, ECONOMY, AND INDUSTRY

Prof. Dr. Muhammad Zeeshan Shakir
Professor, School of Computing, Engineering and Physical Sciences, UK

The digital transformation of society, economy, and industry is essential for addressing the challenges of the modern era and achieving sustainable development goals. Emerging digital technologies such as 5G/6G, the Internet of Things (IoT), and Artificial Intelligence (AI) are set to revolutionize automation and enable real-time interventions across various applications, including climate change mitigation, health and well-being, and advanced manufacturing.

This keynote presents key outcomes from funded research projects, highlighting successful academic-industry partnerships, international collaborations, and capacity-building initiatives. It underscores how these innovations contribute to sustainable futures, offering practical insights and a forward-looking perspective on the role of digital connectivity in global progress.

26th INMIC 2024 KEYNOTE-15

NEUROROBOTICS AND BRAIN COMPUTER INTERFACE FOR ROBOTIC REHABILITATION

Dr. Noman Naseer
Chairman, Department of Mechatronics and Biomedical Engineering
Air University, Islamabad

Neurorobotics is the combined study of neuroscience, robotics and artificially intelligent systems. It can be used to provide a means of communication for people suffering from severe motor disabilities or with limb amputation. This talk with focus on development of electromyography (EMG)-based control of prosthetic arm and electroencephalography (EEG)-based control of external devices including a wheelchair for rehabilitation of mobility in paralyzed individuals. Details of a recently developed functional near-infrared spectroscopy (fNIRS) system for brain-imaging and its application for brain-computer interface will be presented. All necessary steps involved in developing EMG-, EEG- and fNIRS-based neurorobotics interfaces including bioinstrumentation, filtering, pattern recognition and control command generation will be discussed. Some recent works done at Neurorobotics Research Group at Air University, Islamabad will be presented as well

26th INMIC 2024 KEYNOTE-16

EMERALDS: ELECTRONIC MEDICAL RECORDS DRIVEN AUTOMATED LUNG NODULE DETECTION AND CANCER RISK STRATIFICATION

Dr. Furqan Shaukat
Associate Professor, Department of Electrical Engineering, University of Engineering and Technology (UET), Taxila

Lung cancer has been one of the major threats to human life for decades. With the lowest survival rate following diagnosis, it is the leading cause of cancer deaths worldwide and is a matter of concern globally. Early detection of lung cancer can therefore play a pivotal role in reducing patient mortality. However, detecting lung cancer at an early stage is challenging due to a lack of symptoms in most patients until cancer has advanced to an incurable stage. Given the large volume of data in thoracic computed tomography (CT) images and the typically small size of lung nodules, this leads to large intra- and inter-rater variability and a large number of false positives and negatives. These issues could be resolved with the design of robust, generalizable and scalable CADe systems designed using state-of-the-art machine learning techniques.

Integration of electronic medical records (EMRs) with CT image data, can also improve the developed nodule detection system. Furthermore, image-derived and other clinical risk factors available through such integration can be used to guide the development of a cancer risk stratification scheme. that can be employed in two clinical settings – (i) for lung cancer screening in developing communities; and (ii) for facilitating incidental nodule discovery and effective patient management in developed communities. The developed tool can also provide socio-economic benefits being a cost-effective solution for local hospitals. It also has the potential to improve the quality of life of patients by assisting with early diagnosis, reducing misdiagnoses, and facilitating more informed follow-up recommendations..

26th INMIC 2024 KEYNOTE-17

RESEARCH INNOVATION IN PAKISTAN

Prof. Dr. Zia Mohy Ud din
Professor, & Head of Biomedical Engineering Department, Air University, Islamabad

Our projects focus on developing innovative solutions, such as wearable devices for bruxism and scratching detection, portable six-channel ECG systems, and body imbalance prediction tools using VR. We have also pioneered advanced biomedical instruments, including electrogastrography and electrohysterography systems, and successfully launched the "Digital Mualij Health Pod," now operational at PIMS Hospital. These initiatives contribute to improving healthcare outcomes and position Air University as a hub for cutting-edge research and product innovation, bridging academia with impactful real-world applications.

26th INMIC 2024 KEYNOTE-18

THE IOT AND DIGITAL TWIN TWO DIFFERENT YET COMPLEMENTARY TECHNOLOGIES

Prof. Dr. Pardeep Kumar
Professor, & Head, Department of Software Engineering, Quaid-e-Awam University (QUEST), Nawabshah

The Internet of Things (IoT) is rapidly turning futuristic ideas from Sci-Fi movies into reality by connecting physical and virtual objects to the Internet. This evolution is shaping the future Internet and providing guidance on how 'smart things' can enhance business, information, and social processes, ultimately improving human life. Furthermore, Digital Twins, virtual replicas of physical data or systems, can work alongside IoT to monitor real-time behavior and address challenges promptly, benefiting businesses and consumers alike.

By utilizing data from IoT-enabled devices, digital twins can monitor the behavior and status of a system in real-time, enabling companies to promptly address potential challenges. This mutual relationship between digital twins and IoT enhances their effectiveness and hence are beneficial for both businesses and consumers.

The talk will begin by providing a comprehensive look at the evolution of computational technology throughout history. Following this, the introduction and challenges of IoT and Digital Twin will be thoroughly examined. The discussion will also delve into the distinctions between these two technologies and how they complement each other. Lastly, recommendations and future research directions will be explored.

Abstracts Oral Presentations

26th INMIC 2024

30-31 December 2024 - Karachi

Organized by Department of Biomedical Engineering, Faculty of Engineering
SALIM HABIB UNIVERSITY

PAPER ID # 04

UNMANNED AERIAL VEHICLE FOR HUMAN SURVEILLANCE USING MULTI-FEATURES AND NEURO-FUZZY CLASSIFIER

Laiba Zahoor, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

In recent years, drones have seen expanded use across various domains such as drone imagery, human activity recognition (HAR), search and rescue (SAR), and surveillance, due to their bird's eye view capabilities. However, this advantage also presents challenges, including the dynamic nature of backgrounds and obscured perspectives. This study presents a novel approach to addressing these challenges in HAR using drone videos. The method begins with extracting frames from drone videos, followed by preprocessing steps such as gamma correction and background removal. YOLO is employed for human detection, followed by keypoint extraction to capture critical human joint locations. Comprehensive features are extracted using different feature extraction techniques. Full-body features are extracted using BRIEF and 3D point clouds, and keypoint features are extracted using spin images and USC feature descriptors. These features are then optimized using kernel Discriminant Analysis (KDA) and the neuro-fuzzy classifier to classify different actions. The proposed mode is evaluated on two benchmark datasets: UAV human and Drone Action datasets. The model achieved notable accuracies of 55.4% on the UAV human dataset and 85.5% on the Drone Action dataset.

PAPER ID # 05

ROBUST HUMAN POSE ESTIMATION AND ACTION RECOGNITION OVER MULTI-LEVEL PERCEPTRON

Muhammad Hanzla[1], Wasim Wahid[2], Ahmad Jalal[1]
[1] Department of Computer Science, Air University, Islamabad, Pakistan
[2] Department of Creative Technology, Air University, Islamabad, Pakistan

Human posture estimation and recognition are crucial for analyzing human activity and enhancing life logging. This research introduces a novel approach that integrates human pose estimation (HPE) and sustainable event classification (SEC) with advanced skeleton and context-aware feature extraction, leveraging machine learning techniques for precise activity recognition. Unlike traditional SOTA methods, our approach enhances posture and activity event identification in daily life by seamlessly combining individual detection, skeletal framework establishment, and sophisticated feature extraction techniques. Our workflow includes converting video footage to images, applying sliding window techniques for gradient-magnitude images, and performing background removal in pre-processing. Human detection is achieved using Otsu's thresholding, while key points are detected with the Shi-Tomasi algorithm. The pose estimation process achieves human skeletonization, with features extracted using color histograms, Harris corner detection, and Speeded-Up Robust Features (SURF), followed by optimization with Hill Climbing. Classification, performed using a multi-level perceptron on UCF-101 and Sports Videos in the Wild (SVW) datasets, yields accuracies of 86.7% and 86.4%, respectively. This method's unique integration of advanced techniques positions it as a significant advancement over existing SOTA approaches, with promising applications in augmented reality, service bots, e-health fitness, and security surveillance.

PAPER ID # 06

MULTIPLE VEHICLE DETECTION AND TRACKING VIA RETINANET WITH KLT TRACKER

Muhammad Ovais Yusuf, Muhammad Hanzla, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

This study presents a novel approach to vehicle detection and tracking using the RetinaNet architecture integrated with the KLT tracker. The proposed method achieves a detection accuracy of 93% and tracking accuracy of 89%, demonstrating significant improvements over traditional methods. Our approach is validated through extensive experiments, highlighting its robustness and applicability in real-world scenarios. The contributions of this research lie in the innovative combination of deep learning and tracking algorithms, offering a scalable and effective solution for real-time vehicle monitoring. This hybrid framework addresses challenges in occlusion, varying lighting conditions, and multi-object detection, making it a promising advancement in the field of intelligent transportation systems.

PAPER ID # 07

A NOVEL DEPTH SCENE CLASSIFICATION WITH VISION TRANSFORMER AND RESNET MODEL

Muhammad Waqas Ahmed, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

Scene classification in indoor environments is a challenging task with numerous applications in robotics, augmented reality, and smart environments. In this paper we propose a novel scene classification model for indoor RGB-D images that combines unsupervised segmentation, vision transformers, convolutional neural networks, and conditional random fields. The pipeline commences with segmenting the input RGB-D data using DBSCAN, followed by feeding these segmented images into a Vision Transformer (VT) for feature extraction. The VT model incorporates two distinct branches: a feature extraction branch that captures fine-grained local patch representations, and a relation modeling branch that models long-range dependencies between patches through self-attention maps. These extracted features are subsequently fed into a ResNet-18 architecture for multiobject classification, providing a comprehensive understanding of the scene's contents. Finally, the classified objects and the contextual information from the VT's relation modeling branch are integrated into a Conditional Random Field (CRF) framework for scene classification.

PAPER ID # 11

ROBUST DEEP INTERACTION RECOGNITION FRAMEWORK WITH MULTI-STAGE FEATURE ANALYSIS

Tanvir Fatima Naik Bukht, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

Computer vision and pattern recognition have been interested in human interactions on images. It is indeed that interaction recognition is an area of interest in most research areas. If this is the case, the research proposed uses a Deep Neural Network to design an activity recognition system. An HSI color transformation is integrated at the initial stages of the system to improve the clarity of the video frames. Additionally, we apply Gaussian filters to minimize noise interference. MOT and statistical methods are used to silhouette extraction. The extraction process uses the Texton maps, FAST, and Local Intensity Order Pattern (LIOP) technique. The Gray Wolf algorithm is then used to discriminate the features, and then the most meaningful independent content that describes the data structure is identified. Finally, the ANN is fed the last feature and classified into relevant human interactions. This approach is tested with the SBU Interaction dataset and the recognition rate attained is 92% through the experimental method.

PAPER ID # 12

REMOTE SENSING BASED TRAFFIC MONITORING VIA SEMANTIC SEGMENTATION AND DEEP LEARNING

Ghulam Mujtaba, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

The rapid evolution of traffic monitoring demands innovative solutions capable of handling the complexity and scale of modern urban environments. Unlike traditional systems dependent on fixed roadside cameras, our approach leverages aerial platforms' flexibility and expansive coverage to offer a more dynamic and scalable solution. The framework begins with a novel preprocessing pipeline utilizing Gaussian noise reduction to enhance image quality and preserve critical vehicle features. Vehicle detection is powered by RetinaNet, a state-ofthe- art detector that excels in challenging real-world conditions. Semantic segmentation with DeepLabV3+ further refines vehicle delineation, ensuring precise boundary identification. We implement an optical flow-based matching algorithm to address the challenges of occlusions and frame-to-frame consistency, enabling seamless tracking. For counting, an R-CNN-based framework delivers highly accurate traffic volume estimates with remarkable scalability. vehicle tracking is achieved using a particle filter, maintaining robust and continuous trajectories. Rigorous validation on the Aerial Car Dataset demonstrates outstanding performance, with a detection accuracy of 92% and tracking accuracy of 89%. This framework not only outperforms existing methods in both precision and scalability but also sets a new benchmark for intelligent traffic systems, smart cities, and next-generation aerial surveillance, pushing the boundaries of what is achievable in automated traffic monitoring.

PAPER ID # 13

VIDEO AND INERTIAL SENSORS FUSION FOR ACTIVITY RECOGNITION: A MACHINE LEARNING APPROACH

Iqra Aijaz Abro, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

Human activity tracking analyzes mobility using data from several sensors. This paper presents a multisensor model for fall detection and activity recognition utilizing inertial and RGB data. Inertial data was filtered with a Kalman filter for smoothness, extracting characteristics like GMM and Parseval's energy, while RGB data was preprocessed using a bilateral filter and gave features like geometric features, full-body curve and full-body ridges. Results were fused with multimodal survey fusion, optimized with Naive Bayes, then classified using AdaBoost. The proposed model was tested on the UR Fall Detection (URFD) dataset, the model achieved 89% accuracy.

PAPER ID # 15

IMAGE ENCRYPTION USING DNA ENCODING, SNAKE PERMUTATION AND CHAOTIC SUBSTITUTION TECHNIQUES

Waleed Ahmed Farooqui[1], Jawad Ahmad[2], Nadeem Kureshi[3], Fawad Ahmed[1], Aizaz Ahmad Khattak[4], Muhammad Shahbaz Khan[4]

[1] Department of Cyber Security, PNEC NUST, Karachi, Pakistan

[2] Cybersecurity Center, Prince Mohammad Bin Fahd University, Alkhobar, Saudi Arabia

[3] Department of MIS, PNEC NUST, Karachi, Pakistan

[4] School of Computing, Engineering and the Built Environment, Edinburgh Napier University, Edinburgh, UK

Securing image data in IoT networks and other insecure information channels is a matter of critical concern. This paper presents a new image encryption scheme using DNA encoding, snake permutation and chaotic substitution techniques that ensures robust security of the image data with reduced computational overhead. The DNA encoding and snake permutation modules ensure effective scrambling of the pixels and result in efficient diffusion in the plaintext image. For the confusion part, the chaotic substitution technique is implemented, which substitutes the pixel values chosen randomly from 3 Sboxes. Extensive security analysis validate the efficacy of the image encryption algorithm proposed in this paper and results demonstrate that the encrypted images have an ideal information entropy of 7.9895 and an almost zero correlation coefficient of -0.001660. These results indicate a high degree of randomness and no correlation in the encrypted image.

PAPER ID # 17

A HYBRID NEURAL NETWORK WITH SMART SKIP CONNECTIONS FOR HIGH-PRECISION, LOW-LATENCY EMG-BASED HAND GESTURE RECOGNITION

Hafsa Wazir[1], Jawad Ahmad[2], Muazzam A. Khan[1], Sana Ullah Jan[3], Fadia Ali Khan[4], Muhammad Shahbaz Khan[3]

[1] 1CESCO Chair for Big Data Analytics and Edge Computing, Quaid-i-Azam University, Islamabad, Pakistan

[2] Cybersecurity Center, Prince Mohammad Bin Fahd University, Alkhobar, Saudi Arabia

[3] School of Computing, Engineering and the Built Environment, Edinburgh Napier University, Edinburgh, UK

[4] Department of Computer Science, HITEC University, Taxila, Pakistan

Electromyography (EMG) is extensively used in key biomedical areas, such as prosthetics, and assistive and interactive technologies. EMG signals measure the electrical activity of muscles during different motions. EMG signals play a key role in gesture recognition studies, such as hand gesture recognition. This paper presents a new hybrid neural network named ConSGruNet for precise and efficient hand gesture recognition. The proposed model comprises convolutional neural networks with smart skip connections in conjunction with a Gated Recurrent Unit (GRU). The proposed model is trained on the complete Ninapro DB1 dataset. The proposed model boasts an accuracy of 99.7% in classifying 53 classes in just 25 milliseconds. In addition to being fast, the proposed model is lightweight with just 3,946 KB in size. The fast inference time and lightweight architecture of the proposed model makes it suitable for resource constrained IoT devices. Moreover, the proposed model has also been evaluated for the reliability parameters, i.e., Cohen's kappa coefficient, Matthew's correlation coefficient, and confidence intervals. The close to ideal results of these parameters validate the models performance on unseen data.

PAPER ID # 18

A LOW PROFILE X-BAND SLOTTED WAVEGUIDE ARRAY ANTENNA FOR RADAR APPLICATIONS

Muhammad Abdur Rehman Hashmi
Department of Electronics and Power Engineering, PNEC NUST, Karachi, Pakistan

An X-band low profile slotted waveguide array antenna measuring just over a foot has been designed for surface navigation and air traffic radars. At 9.41 GHz, the horizontally polarized antenna provides a realized gain of 17.3 dBi and half power beamwidths of 4.7° and 110° in E and H planes respectively. The antenna offers a front to back ratio of above 20 dB from 9-12 GHz and a total efficiency of 96.11% at 9.41 GHz. Through parametric studies, a non-linear relationship between the length and performance parameters including reflection coefficient, gain, beamwidths, and front to back ratio of an SWA has been established. The proposed design contains 20 slots arranged over two rows in a single waveguide section and offers an optimum tradeoff between size profile and antenna performance.

PAPER ID # 19

SMART DIAGNOSTIC SYSTEM FOR CLASSIFICATION OF COPD AND HEALTHY SUBJECTS FROM LUNG SOUND ANALYSIS

Ahmed Ali Saif[1], Syeda Zainab Mousavi[1], Haris Anwar[1], Syed Arslan Mustafa[2], Muhammad Faraz[1], Syed Zohaib Hassan Naqvi[1]

[1] Department of Electronics Engineering, University of Engineering and Technology, Taxila, Pakistan

[2] Department of Internal Medicine, Rubina Hospital Kuthyala Sheikhan, Mandi Bhauddin, Pakistan

World Health Organization statistics depicts pulmonary abnormalities as one of the fatal disease classes. Chronic Obstructive Pulmonary Disease (COPD) is a prominent death cause in both adults and infants. In 2019, it was ranked at the 3rd position which contributed around 3.5 million fatalities to the worldwide mortality rate. The main objective of the research work is to devise non-invasive techniques to classify COPD and healthy subjects from Lung sound analysis by keeping in view about the WHO's Global Alliance against CRDs (GARD) vision "a world in which all people breathe freely". The scheme is designed through Digital Signal processing and machine learning methods. The lung sound (LS) of healthy and COPD subjects are used from publicly available ICBHI's LS database. Lung sound data of 35 Normal and 631 COPD subjects are used in the research. To denoise the acquired LS signal, the wavelet decomposition technique is applied at the preprocessing stage for denoising. Daubechies5 is used as the mother wavelet. The capability of Mel Frequency Cepstral Coefficients (MFCC) and various time/spectral domain features of acquired signals are investigated in the classification of the normal and COPD subjects. Imbalanced classes are balanced through the ADASYN technique. Various classification models have been experimented after performing the feature engineering, but K-nearest neighbors (KNN) classification method has outperformed with the accuracy of 97.20% on Mel Frequency Cepstral Coefficients as key features. 10-Folds Cross Validation (CV) technique has validated the system accuracy of the proposed model. The simulation was performed on MATLAB 2019a software.

PAPER ID # 23

PHOTOVOLTAIC SYSTEM BASED BORDER MARKETS

Muhammad Muneeb Khan[1,2], Sana Ullah Bhatti[2], Muhammad Aamir Shafi[1]
[1] Department of Electrical & Computer Engineering, COMSATS University, Islamabad, Pakistan
[2] Department of Electrical Engineering & Technology, Institute of Southern Punjab, Multan, Pakistan

Borders often separate regions where economic growth is scarce, particularly in South Asian countries like Pakistan. Pakistan's political and economic instability hinders the development of remote and border areas. The Taftan border in Balochistan, a key route for pilgrims and tourists to Iran and Turkey, suffers from poor conditions and frequent power outages. However, Pakistan has significant solar energy potential, especially in Balochistan. This study proposes a 104.0 MWp grid-connected photovoltaic system for the Drum Bazar near the Taftan border, which has optimal conditions for solar energy production. The system aims to provide affordable, clean energy, improving both local livelihoods and facilities for tourists. With a performance ratio of 84.7% and a solar cell efficiency of 20.50%, the system is expected to address power shortages and contribute to economic growth in the region.

PAPER ID # 25

IDEAL TILT ANGLE OF A PHOTOVOLTAIC SYSTEM FOR SUSTAINABLE ROOFTOP SOLARIZATION IN KARACHI

Muhammad Muneeb Khan[1,2], Sana Ullah Bhatti[2], Muhammad Aamir Shafi[1]
[1] Department of Electrical & Computer Engineering, COMSATS University, Islamabad, Pakistan
[2] Department of Electrical Engineering & Technology, Institute of Southern Punjab, Multan, Pakistan

Developing nations like Pakistan need reliable energy to sustain economic growth. As residential areas expand the conventional power industry which contributes to CO2 emissions and global warming, faces increased demand. Traditional buildings rely on these polluting energy sources for daily operations exacerbating the greenhouse effect. This article proposes a cost-effective renewable energy solution for sustainable green buildings in Karachi. Solar energy, the fastest-growing energy source worldwide, shows significant potential in Pakistan, with average daily solar radiation of 5.5–6.5 kWh/m² on a solar plane surface. Rooftop solar power generation (RTSPG) offers a clean and green energy source for sustainable development. Using PVSyst modeling software, the ideal tilt angles for RTSPG systems were determined, optimizing performance ratios and minimizing losses, and the power generation through conventional plants also adds CO2 and pollutes the environment. The system, designed to meet maximum demand, utilized rooftop space and a grid-connected setup, allowing for future expansion. Optimal tilt angles of 11°–13° for summer and 40°–45° for winter maximize solar irradiation. Performance ratios recorded from 87.3% in December and January and with an annual average PR recorded 84.8% for Karachi. The system's power generation saved 19242879.896 tons of CO2 emissions for 1827702 MWh. This study supports the global development of grid-connected solar systems, reducing reliance on conventional power sources and lowering carbon emissions.

PAPER ID # 28

ENHANCED SYNTHETIC IMAGES CLASSIFICATION WITH VISION TRANSFORMERS AND EFFECTIVE DATA AUGMENTATION TECHNIQUES

Khadija Haider[1], Muhammad Sohail Abbas[1], Asif Muhammad[2], Muhid Qaiser[1]
[1] Department of Artificial Intelligence and Data Science, National University of Computer and Emerging Sciences, Islamabad, Pakistan
[2] Department of Software Engineering, National University of Computer and Emerging Sciences, Islamabad, Pakistan

Synthetic images have made significant advancements, resulting in highly realistic and high-quality visuals generated at an unprecedented speed. However, the proliferation of synthetic images raises growing concerns regarding their potential misuse, ethical implications, and associated risks in various sectors. This study focuses on leveraging data augmentation techniques to enhance the accuracy and reliability of synthetic image detection. In our study, we fine tuned a Vision Transformer (ViT) on the CIFAKE dataset, comprising real and synthetic images, augmented using various techniques such as transformations, color adjustments, geometric changes, and noise addition. The best results were obtained with ViT fine-tuned by distortions and noise augmentation, achieving an accuracy rate of 98.66%, demonstrating that sophisticated augmentation techniques improve performance. Data augmentation plays a crucial role in handling the increasing realism and sophistication of synthetic images, contributing to more effective content moderation, digital forensics efforts, and the mitigation of potential risks associated with synthetic media.

PAPER ID # 31

ESTIMATING GREEN ENERGY SOLUTIONS FOR CITY CENTERS TO MITIGATE CO_2

Muhammad Muneeb Khan[1,2], Muhammad Saad Khan Khosa[3], Muhammad Aamir Shafi[1]

[1] Department of Electrical & Computer Engineering, COMSATS University, Islamabad, Pakistan

[2] Department of Electrical Engineering and Technology, Institute of Southern Punjab, Multan, Pakistan

[3] Department of Electrical Engineering, The Islamia University of Bhawalpur, Bhawalpur, Pakistan

Increasing demand for electricity and daily work routines convert the life of a common man into complex activities that a person cannot do without the help of machines. Machines mostly operate on conventional fossil fuels like coal, oil, and natural gas that produce harmful gases and are an open threat to the lives of modern cities. Mostly work through the electric machines that electricity produces by burning conventional fossil fuels that cause pollution. Global warming hits very badly to the whole world, and especially South Asian countries are in danger of floods and rises in temperature both in summers and winters. Modern sources of power generation like solar power generation are the best option to produce energy at an affordable price and get rid of costly and global warming-produced electricity. Current research is estimating a grid-connected photovoltaic power generation option of 55 MWp in the city center of Quetta, Pakistan, that injected 101630 MWh of energy into the grid and saved 1079029.225 tons of CO2 and provided daytime free energy with zero running cost. The annual average performance ratio is recorded at 85.4%, which shows the estimation of green solution reliability. This study will be helpful to install solar power generation options in city centers and markets, and using these power generation sustainable options will definitely contribute to planet saving from disasters.

PAPER ID # 33

ENHANCING BRAIN TUMOR CLASSIFICATION USING CNN: IMPACT OF DATA AUGMENTATION ON MODEL GENERALIZATION AND PERFORMANCE IN FEDERATED LEARNING

Zia Ur Rehman[1], Syed Nasir Mehmood Shah[1], Uzair Hassan[1], Saif Ul Islam[2]
[1] Department of Computer Science, Institute of Space Technology, KICSIT, Kahuta Campus, Islamabad, Pakistan
[2] WMG University of Warwick Coventry, UK

This paper presents an empirical evaluation of convolutional neural networks (CNNs) for brain tumor classification in a federated learning environment, comparing model performance with and without data augmentation. Federated learning ensures data privacy by keeping MRI datasets distributed among institutions while enabling decentralized model training across several compute nodes. Our experiments use CNNs trained on original and augmented MRI images, demonstrating significant improvements in test accuracy, precision, recall, and F1 score when data augmentation is applied, with the highest test accuracy reaching 95.51%. Augmented CNN models exhibit enhanced generalization across compute nodes, reducing training time and improving robustness in detecting brain tumors. The findings highlight how crucial data augmentation is to enhancing CNN models' scalability and performance in federated learning, especially in medical imaging contexts where data variability is critical for accurate diagnosis and generalization across diverse datasets.

PAPER ID # 34

A REVIEW ON ARTIFICIAL INTELLIGENCE BASED SMART ELECTRICAL POWER SYSTEMS

Unzila Mahar, Muhammad Amir Raza, Abdul Karim, Muhammad Azan, Khan Muhammad, Sarmad Soomro
Department of of Electrical Engineering, Mehran University of Engineering and Technology, SZAB Campus, Khairpur, Pakistan

This article provides a guide for making smart electrical power system using artificial intelligence (AI). The applications of AI are evaluated with respect to electrical power generation, transmission and distribution. Power generation monitoring through helps to the challenges like generation forecasting, predictive maintenance, control operational efficiency, manages smart grid with huge data, detect faults and diagnosis effectively, helps renewable energy integration and energy trading which ultimately enhances the overall power generations systems security. AI in electrical power transmission and distribution sector facilitates the sustainable operation by detecting faults and diagnosis it automatically and suggests the predictive maintenance. Further, AI monitors the power quality and control the voltage and frequency automatically. AI helps in energy demand forecasting, distributed system planning, load balancing, renewable energy integration, energy theft detection and it minimize downtime, improve grid resilience, and enhance overall efficiency. Finally, the observations, challenges, and new perspectives are described in detail.

PAPER ID # 36

OGAR: AUGMENTED REALITY APPLICATION FOR ASSISTING WORKERS IN THE OIL AND GAS INDUSTRY

Fahad Alsubaiei, Ahmed Alhendi, Khalifa Alkhalifa, Shaheen Alsharaf, Abdulaziz Alfoudari, Muhammad Nadeem
College of Engineering and Technology, American University of the Middle East, Kuwait

This paper presents the design and implementation of a mobile augmented reality application, OGAR, to assist workers in the oil and gas industry. The application integrates GPS navigation and QR code scanning to provide instant access to vital information, improving productivity and safety. OGAR enhances the maintenance tasks by context-ware, on demand information through an intuitive user interface. The application was tested in a reallife setting with 14 participants. A paper-based questionnaire developed using Technology Acceptance Model (TAM) frame was used to get their perception on application's effectiveness. The results showed positive reception, indicating the application's relevance and ease of use. The study highlights the potential of AR technologies in transforming workflows and identifies areas for future improvement.

PAPER ID # 38

A GENERATIVE AI-DRIVEN CTI FRAMEWORK FOR IDS USING MACHINE LEARNING AND KNOWLEDGE GRAPH

Qazi Khalid Amin, Syed Hussain Ali Shah Gillani, Syed Nasir Mehmood Shah, Altaf Hussain
Department of Computer Science, Institute of Space Technology, KICSIT, Kahuta Campus, Islamabad, Pakistan

The rapid evolution of cyber-attacks has significantly increased the demand for improved cybersecurity defenses. Large enterprises are increasingly relying on various attack detection systems and cyber threat intelligence to detect attacks and introduce a robust strategy against malicious attacks. However, this also has its limitations i.e., cybersecurity professionals require a lot of time to analyze the attacks detected by an intrusion detection system (IDS) and generate appropriate reports. Therefore, we need to automate this process to improve efficiency. Generative AI plays a crucial role in generating efficient automated reports. Large Language Models (LLMs) in Generative AI, which can be tuned to complex datasets, have demonstrated their capabilities in various applications that use transformers such as image-to-text, text-to-image, and text generation. In this paper, we propose a Cyber Threat Intelligence (CTI)-based intrusion detection system (IDS) that combines honeypots, machine learning-based IDS, and LLMs in combination with a knowledge graph. Specifically, we use fine-tuned pre-trained models on custom datasets based on CVE information. This improves the system's ability to detect threats and provide more in-depth analysis.

PAPER ID # 41

FINITE ELEMENT ANALYSIS OF BIORESORBABLE LAE442 MAGNESIUM ALLOY INTRAMEDULLARY NAIL FOR INTERNAL FEMORAL FRACTURE FIXATION

Muhammad Taha Bin Athar, Hafsah Sohail, Zainab Ali, Syeda Shifa Mannan Gilani, Nizam Uddin
Department of Biomedical Engineering, HITEC University, Taxila, Pakistan

Conventional internal bone fixation methods use titanium or stainless-steel implants which require a second or multiple surgeries for removal, increasing the risk of infection that can be reduced by using bioresorbable implants. This study investigates the mechanical properties of LAE442 Mg Alloy for internal femoral fracture fixation using the Finite Element Analysis (FEA) technique. Four femoral models—Normal femur, Intertrochanteric, Subtrochanteric, and Shaft-fractured—were analyzed under a normal gait scenario. The maximum von Mises and shear stresses for the normal femur were 17% and 19.8% while for intertrochanteric, subtrochanteric, and shaft fractures were 38.9% and 43.5%, 47.2% and 51.6% and 35.6% and 38.7% respectively, compared to the yield strengths of LAE442 Mg alloy (193 MPa compressive, 90.8 MPa shear). The total deformations were also within a normal range of up to 2 mm, indicating that the alloy is fairly suitable for femoral load-bearing during a normal gait cycle.

PAPER ID # 42

IN-SILICO APPROACH FOR FINDING CONSISTENT DELETERIOUS NON-SYNONYMOUS SNPS IN DIABETES MELLITUS

Rahemeen Khan
Department of Software Engineering, Bahria University, Karachi, Pakistan

Diabetes mellitus is a metabolic disorder in human beings. Genetic mutation affects the body to resist the production of insulin inadequate amount, abnormally glucose level becomes very high than normal. As a result, body organs and tissues can be damaged, which has a severe effect on human health if it is not treated properly. Genetic mutations are present in DNA among the genes and Single Nucleotide Polymorphism is one of the forms of mutation. The occurrence of SNPs within a gene may lead to a direct role in disease development and altering gene functionality, allowing scientist to easily identify the genes associated with specific diseases. In this study, the most consistent deleterious nsSNP's associated with 'Diabetes Mellitus' are identified using an in-silico approach. A variety of computational analysis tools are combined to provide a more comprehensive and reliable analysis by integrating each method's strengths and cross-validating across platforms. The results indicates that the list of 44 genes with their selected number of nsSNP's have a strong association with Diabetes Mellitus risk as it remains common in all analysis tools used in the identification of deleterious non-synonymous single nucleotide polymorphism.

PAPER ID # 43

MISOGYNISTIC CONTENT DETECTION IN ROMAN URDU TWEETS BASED ON TRANSFORMER MODELS

Waseem Ullah Khan[1], Salman Ahmed[1], Safdar Nawaz Khan Marwat[1], Yousaf Khan[2], Aftab Khan[3], Shafi Ullah Kamran[4]
[1] Department of Computer Systems Engg, University of Engineering & Technology, Peshawar, Pakistan
[2] Department of Electrical Engg, University of Engineering & Technology, Peshawar, Pakistan
[3] Department of Computer Science, Allama Iqbal Open University, Islamabad, Pakistan
[4] Zong CMPak, Islamabad, Pakistan

Facebook, Instagram and Twitter serve as influential social media platforms for individuals where they express and share their thoughts, skills, knowledge and talents with a broad audience. However, these platforms are also used to disseminate offensive content including trolling and content that targets a person's gender, religion, or race. When women become the targets of such content, it is often manifests as misogyny. In recent years, the growing prevalence of racial and verbal abuse directed at women on social media has drawn considerable attention to the issue of online misogyny and women based offending, by making the automatic detection of such offensive content an urgent priority. Moreover, many researchers have addressed misogyny detection in high resource languages i.e., English, Italian, Arabic, Hindi, and more, tackling this issue in low resource language like Roman Urdu presents a significant challenge. In this paper, a framework is proposed for detection of misogynistic content from Roman Urdu tweets. This paper leverages well known transformer models such as BERT, RoBERTa, GPT-2, and XLNet to train and evaluate misogyny detection performance. The research findings reveal that RoBERTa surpasses the other models in misogyny detection, by achieving the highest accuracy, precision, F1-score and recall i.e., 90.87%, 90%, 89%, and 91%, respectively.

PAPER ID # 47

A LIGHTWEIGHT FEDERATED LEARNING-BASED INTRUSION DETECTION MODEL FOR INTERNET OF THINGS

Noshina Tariq[1], Mamoona Humayun[2], Ghadah Naif Alwakid[3], Bushra Almas[4], NZ Jhanjhi[5], Muhammad Zakwan[6]

[1] Department of Artificial Intelligence and Data Science, National University of Computer and Emerging Sciences, Islamabad, Pakistan

[2] School of Arts, Humanities and Social Sciences, University of Roehampton, London, United Kingdom

[3] Department of Computer Science, College of Computer and Information Sciences, Jouf University Sakakah, 72341, Al Jouf, Saudi Arabia

[4] Institute of Information Technology, Quaid-i-Azam University, Islamabad

[5] School of Computer Science, Taylor's University Selangor, Malaysia

[6] Department of Avionics Engineering, Air University, Islamabad, Pakistan

The advancement of sophistication in botnet intrusions on Internet of Things (IoT) systems and the resources required by traditional IDS make strong security solutions necessary, which reduce resource usage while enhancing detection capability. Therefore, this paper tests the performance and performance comparison of classification models based on lightweight Federated Learning (FL) for IoT botnet intrusion detection using Random Forest (RF), XGBoost, and LightGBM classifiers. Utilizing a large-scale dataset from IoT traffic, the three models were tested in metrics such as confusion matrices, ROC curves, and Precision-Recall curves. The results show that the RF and XGBoost classifiers achieve high AUCs of 1.00, thereby, there is no trade-off between sensitivity and specificity. On the other hand, LightGBM scored a low of 0.58 AUC. The results show that robust ensemble methods can be applied to handle complex and imbalanced datasets commonly presented in IoT traffic in FL environments.

PAPER ID # 52

E2A TRANSLATE: AN ENGLISH TO ARABIC RULE-BASED TRANSLATION FRAMEWORK

Ghadah Naif Alwakid[1], Najm Us Sama[2], Mamoona Humayun[3], NZ Jhanjhi[4], Bilal hassan[5]

[1] Department of Computer Science, College of Computer and Information Science, Jouf University Sa-kakah, 72341, Al Jouf, Saudi Arabia

[2] School of computing and engineering, University of Derby, Derby, DE22 1GB, United Kingdom

[3] School of Arts Humanities and Social Science, University of Roehampton London, SW15 5PJ, United Kingdom

[4] School of Computer Science, Taylor's University Subang Jaya, Malaysia

[5] Northumbria University UK, London Campus

E2A Translate is designed to allow users to provide customized responses during communications in Arabic-speaking countries. The proposed work discusses the structural and semantic differences between English and Arabic. Additionally, examine how the two languages relate to each other in terms of different parts of speech. This paper offers a framework for translating English into Arabic based on common grammar rules in both languages. The framework also supports tracking and evaluating exceptions to grammar rules in both languages. Furthermore, it is used to implement a Windows application, which takes advantage of .NET C#, and an Android application, which uses Java. The ultimate purpose of E2A Translate is to provide grammatically correct translations of statements comprising textual and aural tourism-related terminology. English-speaking tourists are the target audience, and the application's goal is to help people speak and understand Arabic the right way, using the right grammar and the right pronunciation. and enunciation. Tests and evaluations compare the accuracy of the translator's translation with that of Google Translate and Bing. The results show that the translation of E2A Translate is 88% successful and 100% meaningful.

PAPER ID # 97

SMART TRAFFIC MONITORING WITH EFFICIENTNET AND NEURO-FUZZY CLASSIFIER VIA AERIAL SURVEILLANCE

Ghulam Mujtaba, Muhammad Hanzla, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

The growing challenges of urbanization and increasing traffic volumes pose significant risks to global mobility, environmental sustainability, and urban health. To address these issues, this research proposes an innovative aerial surveillance framework that leverages advanced machine learning techniques and intelligent systems for vehicle monitoring. The process begins with robust preprocessing of aerial imagery using histogram equalization, followed by vehicle segmentation via Fully Convolutional Networks (FCN) and accurate detection through Faster R-CNN, ensuring adaptability to complex and varying traffic scenarios. A hybrid feature extraction approach integrates Gabor Filters and Local Binary Patterns (LBP) with deep features from EfficientNet, providing a comprehensive and nuanced representation of vehicle characteristics. These features are then optimized through a Genetic Algorithm to maximize detection accuracy and efficiency. The final classification, achieved with a Neuro-Fuzzy Classifier, reaches an impressive accuracy of 92.38%, validated on the VAID dataset, a benchmark in aerial traffic analysis. This framework not only improves vehicle detection but also offers real-time, scalable solutions for urban mobility, providing a vital tool for mitigating traffic congestion and enhancing the sustainability of future cities. This research lays the groundwork for next-generation intelligent traffic monitoring systems, capable of addressing the evolving challenges of modern urban transportation.

PAPER ID # 99

BACKSCATTERING IN NANOPARTICLES FOR ENERGY HARVESTING APPLICATIONS

Adnan Shafi Minhas[1], Muqadas Javed[2], Ahsan Irshad[3], Ghulam Asghar[3], Akif Safeen[3], Mehboob Alam[2], Syed Hassan Mujtaba Jafri[1]

[1] Department of Electrical Engineering, Mirpur University of Science and Technology (MUST), Mirpur, Pakistan

[2] Department of Electrical Engineering, University of Poonch Rawalakot, Rawalakot, Pakistan

[3] Department of Physics, University of Poonch Rawalakot, Rawalakot, Pakistan

Recent interest in nanotechnology has focused on enhancing energy harvesting efficiency from sustainable sources, with nanoparticles playing a key role due to their unique properties and applications. A major obstacle to optimal performance is nanoparticle backscattering in metasurfaces over solar cells, which reduces efficiency and undermines the benefits of advanced nanotechnology designs. Current methods for analyzing nanoparticle backscattering involve using an infinite series expansion of the Mie solution or employing computationally intensive numerical field solvers. This work develops simplified analytical models to analyze backscattering and determine the impact of nanoparticle and material selection on enhanced energy harvesting. The results are compared with the Mie solution to validate the model's findings. The proposed solution improves the performance of nanoparticle-based energy harvesting devices, aligning with global efforts toward a clean and renewable energy future.

PAPER ID # 101

DESIGN AND IMPLEMENTATION OF A LOCALIZATION APP TO ACHIEVE SUB-METER LEVEL ACCURACY USING SUPARCO'S PAK-REHBER PRECISE POSITIONING SERVICE

Muhammad Jazzel Mehmood, Syed Muhammad Muslim Hussain, Syed Asghar Abbas Zaidi, Farhan Khan
Dhanani School of Science and Engineering, Habib University, Karachi, Pakistan

For location-based systems like smart agriculture and cadastral mapping to function at their best, great accuracy must be achieved. Conventional GPS systems are insufficient for these particular applications because of their 5–3 m accuracy range. In order to overcome this constraint, this study presents an application that improves the sub-meter precision of the global positioning system (GPS) on Android handsets. In order to significantly increase the accuracy of GNSS location, the created software integrates Real-Time Kinematics (RTK) technology with stationary base-station, using raw global navigation satellite system (GNSS) data that is accessible on Android Nougat and later versions. The approach discussed uses raw GNSS data and combines advanced algorithms for multipath reduction and ambiguity resolution with precise error and by addressing the shortcomings of existing methods, such as long convergence times and the need for extra hardware, the method outperforms PPP and PPP with Ambiguity Resolution (PPP-AR). The application integrates smartphone RTK-GNSS measurements and uses Suparco's Pak-Rehber RTK service to achieve precision up to 10 centimeters. The traditional methods like Single Point Positioning (SPP) has lacks maximum precision and the RTK based systems requiring industry grade expensive antennas and equipment. The study shows location-based services in industries that need unparalleled and centimeter level accuracy by introducing a novel way to achieve precision in Android GPS and establishing a standard for integrating state-of-the-art GNSS techniques into smartphones.

PAPER ID # 108

ENHANCING OBJECT DETECTION IN LOW LIGHT ENVIRONMENTS USING IMAGE ENHANCEMENT TECHNIQUES AND YOLO ARCHITECTURES

Syed Muhammad Ammar Ali Jaffri, Munim ul Haq, Muhammad Farhan
Dhanani School of Science and Engineering, Habib University, Karachi, Pakistan

This study analyzes how YOLO structures and image enhancement techniques can improve object detection in low light conditions. In order to overcome the difficulties caused by glare, noise, and dim lighting, the study makes use of the Exclusively Dark (ExDark) dataset, which covers a wide variety of low light situations. The research showed significant enhancements in object detection precision through the utilization of Convolutional Neural Networks (CNN) and pre-processing techniques. A comparative analysis of YOLO versions v7, v8, and v9 is included in the paper, highlighting the superior performance of YOLO v7 when combined with Enlighten GAN, achieving a mAP 0.5 of 73.7%. The results demonstrate how useful preprocessing methods are when used with YOLO algorithms to provide reliable object detection in difficult low-light situations.

PAPER ID # 112

DESIGN AND IMPLEMENTATION OF A LOW-COST LOW-POWER COMPACT NODE FOR LONG DISTANCE IOT APPLICATIONS

Manaal Khan, Aleem Mushtaq
Pakistan Navy Engineering College, (NUST PNEC), Karachi, Pakistan

This paper presents a low-cost, low-power IoT node that can function accurately over long distances for extended periods. The solution has been achieved by implementing data acquisition from sensors, data aggregation and communication protocols on a low-cost, ultra-low power microcontroller. The communication link is designed on a high frequency range, achieves long range of 5 km and a data rate of 2 kbps. Results are presented for power consumed and bit error rate achieved with various parameter settings of the built-in data link layer protocol and node distance from the hub. The designed IoT device is for temperature sensing and transmission while being ideally, suitable for multiple applications such as air-quality monitoring, smart agriculture, transportation, etc.

PAPER ID # 113

AUDIO DEEPFAKE DETECTION: END-TO-END TRAINING WITH POWERFUL PRETRAINED ASR

Kh Hamad Mansoor, Mehreen Alam
Fast School of Computing, National University of Computer and Emerging Sciences, Islamabad, Pakistan

The advancements in audio deepfake generation raise significant concerns about its potential misuse, with implications ranging from personal reputation damage to global repercussions. While efforts are being made to mitigate this threat, the results so far are not particularly impressive. Many proposed solutions falter when tested on datasets that differ substantially from the ones on which they were trained. In our approach, we utilize Meta's MMS-300m pretrained ASR model as a feature extractor and train it end-to-end (E2E) alongside various classifiers (ResNet-18, MesoNet, AASIST, MLP, and SLP). We train on a small subset of the widely recognized ASVSpoof2021 DF dataset and conduct cross-dataset evaluations on the In-The-Wild (ITW) dataset, a standard benchmark. The E2E training of the robust ASR model yields a significant improvement, with all our models surpassing the current state of the art. Our best-performing model achieves an Equal Error Rate (EER) of 0.0342%, representing an impressive 55.48% improvement.

PAPER ID # 116

A COMPREHENSIVE ANALYSIS OF CHRONIC KIDNEY DISEASE PREDICTION THROUGH MACHINE LEARNING: INSIGHTS FROM DECISION TREE MODELING

Priha Bhatti[1], Maria Kainat[2], Munsif Ali Jatoi[3], Iqra Heer Bhatti[4], Asadullah Munir[5], Muhammad Ather Ameen[6]

[1] Department of Computer Science, Muhammad Ali Jinnah University, Karachi, Pakistan

[2] Department of Computer science, University of Agriculture, Faisalabad, Pakistan

[3] Department of ORIC, Salim Habib University, Karachi, Pakistan

[4] Department of General Surgery Ziauddin University Karachi, Pakistan

[5] Pakistan Navy Shipping Corporation, Karachi, Pakistan

[6] Department of Information Technology, Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi, Pakistan

This study uses a multidimensional dataset to evaluate the possibility of Decision Tree modeling for predicting chronic kidney disease (CKD). The procedure entailed methodically assembling a dataset of patient demographics, clinical characteristics, and test results. This data was subsequently used to train the Decision Tree model, which identified important predictors of CKD. The results show that the model is effective in CKD prediction, with an accuracy of 0.85. Furthermore, Decision Trees gave a clear and understandable structure for comprehending the model's decision-making process. Serum creatinine levels, age, and blood pressure are all important predictors of CKD. These findings show that the model could be useful in clinical settings to help patients make decisions about their care. However, limits exist due to the dataset's size. To solve this and increase the model's generalizability, future research should focus on collecting larger datasets, studying more features, and experimenting with alternative AI techniques to improve prediction accuracy. Overall, this study advances CKD prediction by proving the potential of Decision Trees and underlining the need for interpretable models in healthcare applications. It lays the path for future research targeted at

PAPER ID # 117

IMPEDANCE-BASED CRACK DETECTION IN CHEMICAL TANKS: ENHANCING PREVENTIVE MAINTENANCE WITH EDDY CURRENT TECHNIQUES

Syed Muhammad Muslim Hussain[1], Tariq Mumtaz[1], Syed Muhammad Ali Naqvi[2]
[1] Department of Electrical Engineering, Habib University, Karachi, Pakistan
[2] Department of Computer Science, Habib University, Karachi, Pakistan

Maintaining the structural integrity of chemical storage tanks is critical for ensuring operational safety and protecting the environment. This research examines the use of the Eddy Current Method (ECM) for detecting surface cracks in chemical tanks, to improve preventive maintenance strategies.We investigate mathematical modeling of impedance measurements using eddy currents, which form the foundation for accurate crack detection. Our approach includes exploring analytical and numerical models to predict impedance variations caused by cracks, supported by detailed simulations. The crack is modeled using practical electrical, magnetic, and spatial parameters to explore various scenarios. We provide valuable insights into the behavior of the coil's resistance and inductance in the presence of cracks by iterating through different parameters. Our findings reinforce the idea that integrating ECM into preventive maintenance offers an effective solution for early crack detection.

PAPER ID # 118

PERFORMANCE AND LOSS ANALYSIS OF WIDE BANDGAP POWER MODULES FOR HIGH-CAPACITY POWER CONVERTERS

Tehseen Ilahi, Saad Izhar, Tausif Zahid, Muhammad Zahid, Ibadullah Safdar, Shehan Latif
Department of Electrical Engineering, Riphah International University, Lahore, Pakistan

Wide bandgap (WBG) technology-based Silicon Carbide (SiC) modules have emerged as an essential technology for power electronics converters. The SiC modules stand out for their improved efficiency, power density, and thermal stability in power converters. This is due to its remarkably low on-state resistance, temperature tolerance, and power loss reduction compared to traditional MOSFET and IGBTs. This research analyzed the characteristics of the latest 1200 V, 760 A, SiC power Module using mathematical and simulation models. The research proposes a 1 MW capacity-based efficient power converter using a proposed SiC module. PLECS simulation tool is used to compute the power loss analysis of the converter. The results improved the efficiency of the high-capacity power converters by 99%. The high-capacity converter can be used for various energy source applications, such as renewable energy, EV chargers, industrial power supply, HVDC, battery storage, power grids, etc.

PAPER ID # 119

RECONFIGURABLE CRYPTOPROCESSOR DESIGN FOR RSA AND RABIN-P CRYPTOSYSTEMS

Zain Ahmed Usmani[1], Mohit Rai[1], Farhan Khan[2]
[1] Department of Computer Science, Habib University, Karachi, Pakistan
[2] Department of Electrical & Computer Engineering, Habib University, Karachi, Pakistan

With recent advances in computing and the accessibility of hardware design, there has been an increase in cryptoprocessors being used as hardware accelerators for encryption and other security measures. However, as demands increase so do the strains on the hardware production supply and the need to be sustainable, coupled with the rising popularity of reconfigurable systems. This paper introduces a reconfigurable cryptoprocessor that provides encryption and decryption using the RSA cryptosystem and a more efficient, but less widely adopted Rabinp cryptosystem. The proposed design is more efficient than other Rabin cryptosystems as it leverages the Rabin-p variant, enabling decryption without the additional step of identifying correct quadratic residues. This reconfigurable cryptoprocessor can perform operations for RSA and Rabin-p cryptosystems within one piece of hardware, enabling compatibility with RSA and providing access to the improved security of Rabin-p. In this paper, we share the implementation signatures and features of this cryptosystem.

PAPER ID # 121

DRONE BASED TRAFFIC SURVEILLANCE USING SEMANTIC SEGMENTATION AND DEEPSORT

Ghulam Mujtaba, Ahmad Jalal
Department of Computer Science, Air University, Islamabad, Pakistan

The rapid pace of urbanization and the growing complexities of modern traffic networks necessitate innovative and adaptive solutions to tackle critical challenges such as congestion, safety, and sustainability. Integrating advanced technologies like aerial imagery and deep learning becomes essential for optimizing traffic management as cities evolve toward smart infrastructure. This study introduces a cuttingedge aerial-based vehicle detection and tracking framework, utilizing the AU-AIR and Aerial Car datasets to achieve exceptional performance. The framework begins with preprocessing, employing adaptive histogram equalization to enhance image quality and retain key vehicle features. Segmentation is performed using PSPNet, leveraging its multi-scale feature representation to accurately delineate vehicle boundaries. Vehicle detection is powered by YOLOv8, providing unparalleled speed and accuracy in dynamic, traffic conditions. Vehicle matching is facilitated by a robust optical flow-based algorithm, ensuring consistent tracking even under occlusions. Vehicle counting is achieved using a Transformerbased model, offering precise and scalable traffic volume estimation. Vehicle tracking is optimized with a Kalman filter, maintaining smooth and reliable trajectories across frames. Finally, the trajectories of tracked vehicles are analyzed, yielding valuable insights into movement patterns and traffic flow dynamics. The proposed system demonstrates remarkable performance, with 97% detection accuracy and 93% tracking accuracy, establishing a new benchmark for aerial traffic monitoring. This framework has profound implications for the future of smart cities, intelligent transportation systems, and sustainable urban mobility.

PAPER ID # 123

MALWARE DETECTION IN NETWORK TRAFFIC DATA FOR INTERNET OF THINGS

Rawish Butt[1], Noshina Tariq[2], Mamoona Humayun[3], Ammara Ishaq[1]
[1] Department of Avionics Engineering, Air University, Islamabad, Pakistan
[2] Department of of Artificial Intelligence and Data Science, National University of Computer and Emerging Sciences, Islamabad, Pakistan
[3] School of Arts, Humanities and Social Sciences, University of Roehampton, London, United Kingdom

The expansion of Internet of Things (IoT) places an immediate need for strong security measures, particularly in malware detection. This research was done by using IoT-23 dataset to implement machine learning techniques for malware detection in an IoT network traffic. Random forest and gradient descent were selected and applied to pre-processed data to evaluate its effectiveness in differentiating benign and malicious traffic. Feature reduction was performed using principal component analysis (PCA) and both models were evaluated and tested using cross-validation. Random forest have scored an accuracy of 99.78%. with perfect precision Recall and F1 scores for both classes While gradient boosting achieved 99.45% accuracy and slightly lower precision and recall for non-hazardous traffic. The results indicate that random forest is more suitable for dataset which shows higher accuracy and consistency. The study highlights the efficacy of ensemble learning in malware detection within an IoT environments and emphasizes the importance of proper pre-processing and feature reduction to improve model performance.

PAPER ID # 124

EARLY BEARING FAULT DETECTION OF INDUSTRIAL FANS BASED ON VIBRATION ANALYSIS USING INTERPRETABLE DEEP LEARNING FRAMEWORK

Ali Saeed[1], M. Usman Akram[2], Muazzam A. Khan[1], M. Belal Afsar[3]
[1] Department of Computer Science Quaid-i-Azam University, Islamabad, Pakistan
[2] Department of Computer and Software Engineering National University of Sciences & Technology Islamabad, Pakistan
[3] Faculty of Electrical Engineering and Information Technology Otto-von-Guericke University Maddeburg, Germany

The global market of machine condition monitoring is projected to grow at a rate of 8.3% in next five years. The recent technological advancement in IoTs and AI has driven predictive maintenance to be one of the most effective approach in this domain. Vibration analysis is the most efficient technique used to carry out predictive maintenance, using advanced datadriven intelligent approaches. The vibration data carries most significant information regarding the health state of machine components especially bearings. The proposed hybrid framework utilizes CNN and transformer utilizing the complex weightsharing capabilities of CNNs, combined with ability of transformer to capture the broader context of spatial relationships in large-scale patterns, making it suitable for datasets of varying sizes. A fault detection accuracy of 98.86% is achieved through experimentation on a run-to-failure real-industrial environment dataset composed of vibration data of large-scale coaxial fans.

PAPER ID # 126

COMPREHENSIVE FEATURE INFORMATION LEARNING FOR MULTILABEL TEXT CLASSIFICATION

Anaum Hamid, Muhammad Rafi
FAST School of Computing, National University of Computers and Emerging Science, Kaarchi, Pakistan

Multilabel text classification (MLTC) enables the discrimination of objects by establishing associations across multiple labels through various dimensions. In the context of data mining tasks, the supervised learning approach in MLTC plays an essential role in enhancing predictive accuracy. The main focus of this research is to exploit the relationship between relevant and correlated features in multilabel text and to select the dimensionality of the vector space to be comprehensively reduced while preserving the performance of the classifiers.We proposed a novel feature selection technique called Comprehensive Measurement Feature Selection (CMFS) in multi-label text categorization to address these issues. Evaluates the significance of the feature using an intercategory and an intracategory relation. We evaluated CMFS on two reference document collections, that is, Reuters and 20Newsgroup. Our approach incorporates both correlation information and class deviation for effective feature selection. Encouraging results are obtained.

PAPER ID # 127

DETECTION AND MITIGATION OF DDOS ATTACKS ON IOT NETWORKS USING MACHINE LEARNING

Akram Rashid[1], Syed Muhammad Khaliq-ur-Rahman Raazi[2], Shayhaq Ali[1]
[1] Department of Computer Science, Univeristy of Gwadar Gwadar, Balochistan, Pakistan
[2] Department Computer Science, Mohammed Ali Jinnah University Karachi, Pakistan

Smart homes, cities, and healthcare are just a few examples of how the Internet of Things (IoT) simplifies daily life. With the rise of 5G, the number of connected IoT devices is rapidly increasing, expected to surpass 75 billion by 2025. However, this growth also brings significant security risks, particularly the vulnerability of IoT Network to Distributed Denial of Service (DDoS) attacks, which can overwhelm networks. In this research, we applied machine learning techniques on the CIC-DDoS 2019 dataset to detect and mitigate DDoS attacks on IoT devices. The results show high accuracy across several models: Logistic Regression (88%), Decision Tree (93%), Random Forest (94%), KNN (93%), Naive Bayes (72%), and SVM (89%). These findings suggest that machine learning is an effective approach for real-time DDoS attack detection and mitigation in IoT networks.

PAPER ID # 130

OBSERVER-BASED ADAPTIVE SLIDING MODE CONTROL OF A SWITCHED-BOOST CONVERTER FOR PV SYSTEM

Shahab Shahid[1], Iftikhar Ahmad[1], Muhammad Rizwan Chughtai[1], Daniyal Durrani[2], Sadia Zafar[3], Badar Dar[3]

[1] NUST School of Electrical Engineering and Computer Science (NUST-SEECS), Islamabad, Pakistan

[2] NUST School of Mechanical and Manufacturing Engineering (NUST- SMME), Islamabad, Pakistan

[3] Bahria University (BSEAS), Islamabad, Pakistan

The energy from the sun is a natural resource that is abundant globally. The decreasing cost of the photovoltaic (PV) modules has made solar PV a viable option for producing clean energy. However, the voltage produced by the panels is intermittent and cannot be used to power loads directly. The panels must be interfaced with a power electronic converter for power regulation. The switched boost converter (SBC) is a hybrid ac/dc topology that can operate like the conventional DC-DC boost converter. In this paper, an observer-based adaptive sliding mode control (ASMC) has been proposed for enhancing the voltage stability of the system. The adaptive mechanism makes the system insensitive to the parametric uncertainties and bounded disturbances. The PI structure sliding surface with a power rate reaching law has been used. A stability analysis has been performed rigorously using the Lyapunov method. The simulations in Simulink demonstrate that the system exhibits robustness by using ASMC.

PAPER ID # 132

COMPARATIVE ANALYSIS OF BERT AND TF-IDF FOR TEXTUAL SEMANTIC SIMILARITY ASSESSMENT

Syed Muhammad Hasan Danish, Syed Muhammad Ejaz Hasnain, Hamza Ashraf, Rukaiya Rukaiya
Department of Computer Engineering, Sir Syed University of Engg. & Technology. Karachi, Pakistan

The paper presents an investigative analysis between two techniques BERT (Bidirectional Encoder Representations from Transformers) and TF-IDF (Term Frequency-Inverse Document Frequency) combined with cosine similarity. Text comparison, in general, is a fundamental aspect of NLP, plays a crucial role in a variety of applications, such as search engines, plagiarism detection, and question-answering systems. The objective is to evaluate efficiency of techniques in comparing similarity between text and to identify which one performs better. The experiments demonstrate that while BERT excels in understanding context-dependent meanings and subtle linguistic nuances, TF-IDF with cosine similarity offers computational efficiency and interpretability for specific task. Findings provide insights into the strengths and limitations of each approach, offering guidance for researchers and practitioners in selecting appropriate methodologies for content relevance assessment in diverse scenarios.

PAPER ID # 135

EVALUATION OF PREDICTIVE AND HEURISTIC CONTROL TECHNIQUES FOR BUCK CONVERTERS USING MPC, PID, AND FUZZY LOGIC

Laksh Rathi[1], Muhammad Ayaz[2,3], Dur-e-Zehra Baig[1], Shazil Ejaz[1], Marrium Dawood[1], Muhammad Armughan Ul Haq[1]
[1] Faculty of Electrical Engineering GIKI Topi,Swabi, Pakistan
[2] Faculty of Engineering Sciences & Technology Pak-Austria Fachhochschule
[3] Institute of Applied Sciences and Technology Mang, Haripur, Pakistan

In power electronics, the performance of buck converters is crucial for efficient and effective voltage regulation and power management. Conventional Techniques in Control Systems includes Proportional Integral Derivative (PID) that are highly popular for their simplicity and efficiency but advanced intelligent techniques in control systems include Model Predictive Control (MPC) and Fuzzy Logic Control (FLC) as well. This study evaluates and compares these three control strategies—PID, FLC, and MPC—based on main performance metrics: rise time, settling time, overshoot, undershoot, and peak time. The PID controller demonstrated balanced performance with a rise time of 3.7444×10−4 s, settling time of 0.0152 s, and overshoot of 57.7626%. FLC showed improvements, particularly in minimizing overshoot (47.8383%) and maintaining a faster settling time of 0.0148 s. MPC exhibited the fastest response with a rise time of 1.9157×10−4 s and settling time of 0.0078 s, but faced challenges with a significant overshoot of 105.3098%. Results suggest that MPC is highly effective in achieving rapid response and stabilization, FLC excels in minimizing overshoot and providing precise control, while PID maintains a good balance but with slower response and higher overshoot. These findings underscore the importance of selecting appropriate control strategies based on specific performance requirements in buck converter applications.

PAPER ID # 137

PNEUMONIA DETECTION IN CHEST X-RAY IMAGES : HANDLING CLASS IMBALANCE

Wardah Ali, Eesha Qureshi, Omama Ahmed Farooqi, Rizwan Ahmed Khan
Department of Computer Science, Salim Habib University, karachi, Pakistan

Pneumonia affects individuals all around the world, although the highest fatality rates occur in Sub-Saharan Africa and South Asia. Despite immunizations and medications, pneumonia incidence and fatality rates have increased, highlighting the need for improved prevention and treatment. Researchers have explored frameworks for reliable pneumonia detection, diagnosis, and analysis, but AI progress is hampered by a lack of sufficient and balanced data. In this paper, we provide a novel framework for addressing class imbalance that employs a mix of Deep Convolutional Generative Adversarial Network (DCGAN) and Wasserstein GAN with gradient penalty (WGAN-GP) for minority class augmentation and Random Under-Sampling (RUS) for majority class. Validation on the massive ChestX-Ray8 dataset using transfer learning on ResNet-50, Xception, and VGG-16 produces results that outperform existing benchmarks.

PAPER ID # 144

DYNAMIC FINANCIAL TIME SERIES MODELING WITH RAPID ADAPTATION VIA META LEARNING

Kubra Noor, Ubaida Fatima
Department of Mathematics, NED University of Engineering &Technology, Karachi, Pakistan

The Meta learning framework for financial time series forecasting is proposed here, which can adapt to new financial market datasets efficiently with minimal retraining. This methodology includes two phases: the first one is crossfinancial time series training on a meta-model and the second adapts this meta-model using recent data to novel market conditions. This approach of dynamic feature augmentation enhances model adaptability across a wide range of financial instruments. The performance results show that the adjusted model has higher accuracy and flexibility compared to the baseline methods. In summary, the contributions of this paper offer a robust flexible model for use in forecasting outcomes for various financial instruments and address several challenges in traditional machine learning models when applied in complex and dynamic financial markets. The proposed framework achieves a 67.33% directional accuracy (DA) in the stock market, significantly outperforming baseline models with a DA of 43.82%.

PAPER ID # 145

DESIGN AND IMPLEMENTATION OF ELECTRO-WET CUP FOR ELECTRICAL STIMULATION IN CUPPING THERAPY

Ayesha Noor, Hadia Fatima, Zia Mohy Ud Din
Department of Biomedical Engineering, Air University Islamabad, Pakistan

A supplementary therapy called cupping therapy uses cups to apply localized suction to the skin. By incorporating focused healing assistance through the integration of phototherapy, electrical stimulation, and temperature control approaches, this study seeks to increase the efficacy of cupping therapy. The objective is to offer an advanced therapeutic option for patients suffering from chronic pain and related conditions. In this study cups are modified with electronic suction, blue light therapy for cleansing, thermal therapy to block pain receptors and relax muscles, and electrical stimulation for pain relief and massage effects. Using Solidworks and fused filament 3D printing, these modifications enable precise customization of the cups. Additionally, a specialized suction device was developed to complement the therapy. Cupping therapy traditionally promotes healing by improving circulation, reducing inflammation, and relieving pain. This study introduces innovations that elevate cupping therapy's potential, offering personalized and enhanced treatment options for patients, thereby expanding therapeutic applications and opening new research avenues.

PAPER ID # 148

ENHANCED BONE FRACTURE DIAGNOSIS IN X-RAYS USING FINE-TUNED DENSENET169 DEEP LEARNING MODEL

Ali Orangzeb Panhwar[1], Shahzad Memon[2], Lachhman Das Dhomeja[1], Mukesh Prasad[3], Asghar Ali Chandio[4]

[1] Dr. A. H. S. Bukhari Postgraduate Centre of Information and Communication Technology, University of Sindh, Jamshoro, Pakistan

[2] Department of Computer Science and Digital Technologies Scool of Architecture, Compuing and Engineering, University of East London, United Kingdom

[3] Faculty of Engineering and Information Technology, University of Technology Sydney, Australia

[4] Department of of Artificial Intelligence Quaid-e-Awam University of Engineering, Science and Technology (QUEST), Nawabshah, Pakistan

The classification of bone fractures from radiographs is an important yet challenging task in clinical diagnosis. Diagnosing fractures through X-rays remains difficult for orthopedic specialists due to image quality issues, which can result in errors, misalignments, and potential harm to patients. However, recent advancements in artificial intelligence (AI) and deep learning have revolutionized medical imaging, with state-of-the-art methods now capable of handling 2D and 3D images. This study focuses on deep-learning approaches for the classification and detection of bone fractures in radiograph images and aims to analyze and compare various deep-learning algorithms and techniques used in fracture detection. It also highlights current cutting-edge approaches in this field, providing insights and guidance for future research and practical applications. In this paper, the application of Finetuned DenseNet169 for the automated classification of bone fractures in X-ray images is explored. By using deep learning approaches, our method seeks to enhance the accuracy and efficiency of fracture detection. We trained and evaluated the DenseNet169 model on the MURA Stanford dataset and achieved 83% accuracy in distinguishing fractured and nonfractured elbow bones. The model's performance highlights the potential of DenseNet169 to assist radiologists in clinical settings, promoting better patient outcomes through prompt and reliable fracture diagnosis.

PAPER ID # 149

LEVERAGING SYNTHETIC MINORITY OVER-SAMPLING TECHNIQUE FOR CLASS IMBALANCE IN MACHINE LEARNING-BASED BREAST CANCER DIAGNOSIS

Noor Fatima[1], Noman Naseer[2], Zia Mohy-ud-din[1], Hedi A. Guesmi[3]
[1] Department of Biomedical Engineering, Air University Islamabad, Pakistan
[2] Department of Mechatronics Engineering, Air University Islamabad, Pakistan
[3] Department of Electrical Engineering College of Engineering, Qassim University, Saudi Arabia

In this research, we conducted a comprehensive analysis of the diagnosis of breast cancer tumors as benign or malignant employing machine learning algorithms. The publicly available breast cancer diagnosis dataset was taken from the UCI repository of 569 breast cancer patients. The class imbalance in the dataset of 63% benign and 37% malignant cases was first handled by employing the synthetic minority oversampling technique. Then, a comparative analysis of six different machine-learning algorithms was done. The performance evaluation of all six models showed that the logistic regression model outperforms the other models. We evaluated it with recall, precision, and f1-score which was found to be 98.68%, 97.40%, and 97.90%, respectively. To ensure the scalability and generalization of the logistic regression model for the breast cancer dataset, a learning curve was obtained, which offered a reliable and interpretable solution for the classification of breast cancer tumors.

PAPER ID # 151

AI-BASED LUNG CANCER PREDICTION: DEVELOPMENT, COMPARISON, AND EVALUATION OF MACHINE LEARNING MODELS

Anusha Ishtiaq[1], Noman Naseer[2], Zia Mohy-ud-din[1], Alina Akhlaq[3], Hedi A. Guesmi[1], Anum Rashid[1]

[1] Department of Biomedical Engineering, Air University Islamabad, Pakistan

[2] Department of Mechatronics Engineering, Air University Islamabad, Pakistan

[3] Department of Electrical Engineering College of Engineering, Qassim University, Saudi Arabia

Artificial intelligence plays an important role in early diagnosis of various pathological disorders. This research has precisely focused on comparing three machine learning models, Decision Tree, k-Nearest Neighbors, and Naïve Bayes, for the prediction of lung cancer. Data has been preprocessed and divided into test and train subsets. Machine learning models are designed from scratch and tested on train and test subsets. Cross-validation and the analysis of train and test accuracies are used to confirm the consistency of results. Furthermore, evaluation parameters vary in their applications and emphasis is to minimize the chance of any false negative predictions, hence recall has been selected as an appropriate assessment tool for this three-class classification problem. K-NN has outperformed with 0.998 train accuracy, 0.995 test accuracy, and 0.990 recall. Moreover, consistent results in cross-validation and only 0.3% difference between the test and train accuracies, have outcasted the chance of overfitting. Lung cancer prediction using machine learning is important because it increases survival rates. As we embark on this study, it helps to define a healthy lifestyle to minimize the risk of lung cancer. In future, this classification model could be deployed in personalized treatment strategies, which could improve patient outcomes.

PAPER ID # 154

DESIGN AND DEVELOPMENT OF PROSTHESIS FOR ULTRASHORT KNEE STUMP

Muhammad Faiq Nasir, Muhammad Waleed Tariq, Hammad Nazeer, Noman Naseer, Hassaan Iqbal
Department of Mechatronics Engineering Air University Islamabad, Pakistan

In this paper, an abstract is provided for a novel prosthetic suspension system designed, developed, and evaluated for ultrashort knee stumps. Some of the major drawbacks of already available prosthetic solutions are socket slippage, pressure discomfort, and limited range of motion for those who have ultrashort stumps. In this work, a vacuum-assisted suspension system (VAS) significantly increases the comfort, stability, and prosthetic fit. The system uses a loop control system which regulates pressure to a microcontroller and uses machine learning to improve the real-time control for human activity recognition with 95.13% accuracy and 2% error for pressure regulation. This solution offers potentially encouraging advances in prosthetics technology for those with transtibial amputations.

PAPER ID # 157

DEEPFAKE URDU AUDIO DETECTION USING SPECTRAL FEATURES FOR AUTOMATIC SPEAKER VERIFICATION

Zulkaif Sajjad, Hassan Alam, Nouman Ahmed, Areeba Shahzad Raja, Junaid Mir, Furqan Shaukat
Department of Electrical Engineering, University of Engineering and Technology Taxila, Pakistan

Deepfake audio detection for automatic speaker verification in Urdu is a significantly underexplored area. This paper presents a deep learning-based deepfake audio detection method for low-resource language Urdu. As the Urdu language has different phonetics than English, the efficacy of spectral features extracted from 1D and 2D audio signal representations is assessed for spoofed Urdu audio detection. Towards this, four Deep Convolutional Neural Networks (DCNNs) are trained to learn spectral features from 2D spectrogram and scalogram images generated from a recently released specialized Urdu deepfake audio dataset. Also, a support vector machine classifier is trained on Mel-frequency cepstral coefficients extracted from 1D audio signals. Results reveal that the EfficentNetV2-B0-based DCNN classification model trained on spectrograms surpasses the tested models in deep fake audio detection for the Urdu language.

PAPER ID # 160

A QUALITATIVE STUDY OF BIBLIOGRAPHIC DATA SOURCES AND RETRIEVAL MECHANISMS FOR COMPUTATIONAL RESEARCH

Aiza Imran, Muhammad Qasim Pasta
Dhanani School of Science and Engineering, Habib University, Karachi, Pakistan

In the era of big data, selecting appropriate bibliographic data sources is crucial for researchers. However, differences in database functionalities, accessibility, and ease of use pose challenges for large-scale bibliometric analysis. APIs are key for automating data retrieval, but their varying performance and availability complicates selection. This study provides a comparative analysis of eight data sources—Scopus, Web of Science (WoS), Dimensions, OpenAlex, Semantic Scholar (SS), Google Scholar (GS), Scite.ai, and Open Research Knowledge Graph (ORKG)—and their APIs. We examine accessibility, search functionalities, metadata availability, and ease of use. Our results show that while each API supports core research needs, OpenAlex and SS offer the most user-friendly experiences with minimal technical requirements, while the GS API is the most cumbersome. These insights help researchers and developers select appropriate bibliometric data sources for computational research.

PAPER ID # 162

REMOTE SENSING-BASED VEHICLE MONITORING SYSTEM USING YOLOV10 AND CROSSVIT

Ghulam Mujtaba, Ahmad Jalal Department of Computer Science, Air University, Islamabad, Pakistan

Rapid urbanization and vehicular traffic growth have significantly strained traditional traffic management systems, exacerbating issues such as congestion, safety hazards, and environmental degradation. This paper presents a novel deep learning-based framework designed to address these challenges by enhancing vehicle detection, tracking, and classification in urban traffic settings. The proposed system utilizes Gaussian Blur for effective image preprocessing, followed by DeepLabv3 for accurate vehicle segmentation. Vehicle detection is performed using the YOLOv10 architecture, which excels in detecting vehicles in complex and occluded environments. For vehicle counting, we employ CenterNet, an efficient method that leverages keypoint detection to estimate vehicle counts. Optical flow techniques are applied to track vehicle motion and improve counting accuracy in dynamic traffic conditions. The system's feature extraction pipeline incorporates deep convolutional networks to capture critical vehicle characteristics, while vehicle classification is enhanced by the CrossViT model, which excels at handling varying vehicle types and scales. Evaluation on the VAID dataset reveals a vehicle detection accuracy of 90%, tracking accuracy of 88%, and classification accuracy of 91%. These results underscore the potential of the proposed framework to offer a scalable, efficient solution for intelligent transportation systems, enabling comprehensive urban traffic monitoring and management.

PAPER ID # 164

ML-DRIVEN DISTRIBUTION NETWORK AGGREGATION CONSIDERING LOAD AND INVERTER-BASED RESOURCES

Manal Hasan[1], Batool Zehra Ladha[2], Rubab Shah[1], S. M. Hur Rizvi[2]
[1] Department of Computer Science, Habib University, Karachi, Pakistan
[2] Department of Electrical and Computer Engineering, Habib University, Karachi, Pakistan

The integration of distributed generation sources, such as photovoltaic (PV) systems and battery energy storage systems (BESS), is revolutionizing traditional power distribution networks, presenting new challenges in grid management due to the dynamic and bidirectional flow of electricity. Accurate estimation of power system parameters is essential for optimizing performance and maintaining grid stability; however, existing methods often suffer from inadequate datasets that fail to reflect the complexities introduced by these advanced technologies. This research addresses this gap by leveraging modern machine learning (ML) techniques to enhance the accuracy of parameter estimation for network aggregation in active distribution networks. Using the IEEE 33-bus system and incorporating control modes as defined under the IEEE 1547 standard, we developed a robust data generation framework. This framework utilizes OpenDSS simulations and automated data extraction methods to create comprehensive and diverse datasets, represented as rank-3 tensors of inhomogeneous shape. These datasets were employed to train ML models capable of predicting key parameters, including voltage per unit, active power loss, reactive power loss, new ZIPV parameters, and power bases across various operational scenarios. Our findings demonstrate that the ML models achieved a mean squared error (MSE) as low as 0.015 for the loadsonly model and 0.014 for the PV-BESS system, highlighting the potential for high prediction accuracy in real-world applications.

PAPER ID # 167

PREDICTING EFFECT OF STUDY TIME AND EDUCATIONAL SUPPORT ON ACADEMIC SUCCESS AND FAILURE THROUGH MACHINE LEARNING

Hunaina[1], Mehwish[2], Hira[1]
[1] Department of Mechatronics and Biomedical Engineering, Air University Islamabad, Pakistan
[2] Department of English, Faculty of Social Sciences Air University Islamabad, Pakistan

Using machine learning, the present study explored the potential to predict student success or failure based on two key factors: the amount of time students dedicate to their studies and the type of educational support they receive. By analyzing a dataset containing information on students' study habits and support systems, the researchers developed a predictive model capable of identifying students at risk of academic difficulties. Amongst the utilized classifiers, Linear Discriminant Analysis (LDA) predicted academic grades with a 91.1% accuracy and academic failure with an 84.8% accuracy. The prediction models for both success and failure, based on students' study time and educational support, demonstrated promising results, suggesting that machine learning can be a valuable tool in identifying and addressing students' needs early on, leading to improved academic outcomes. The outputs of such prediction models can help in enhancing learning experiences for students and eventually, help in reducing dropout rates.

PAPER ID # 168

SEGLINK: AN ADVANCED LANE DETECTION NETWORK WITH MINIMAL COMPUTATIONAL OVERHEAD USING SEMANTIC SEGMENTATION

Madiha Shabir Shaikh[1], Sadia Muniza Faraz[1], Yawar Rehman[2]
[1] Department of Electronic Engineering NED University of Engineering & Technology, Karachi, Pakistan
[2] AI4B Seoul, South Korea

With the growth of global population and increasing number of road vehicles the driving safety has become crucial. To cater this problem, an efficient lane detection system is proposed by using semantic segmentation-based encoder -decoder convolutional neural networks with reduced filter size. For this, three networks named as SegLink-v1, SegLink-v2 and SegLink-v3 are proposed where features generated at different hierarchical levels of encoder are connected to corresponding decoder layers. Each decoder layer performs convolution on the resultant of corresponding encoder layer and previous decoder layer. In comparison to benchmark SegNet our networks demonstrated improved test accuracies of 1%, 1.01% and 1.5% respectively. Whereas SegLink-v2 and SegLink-v3 networks achieved 43.44% and 75% reduction in computational parameters. Due to their high accuracy and less computation parameters, they may be used for designing efficient driving assistance system.

PAPER ID # 171

INVESTIGATING EFFECTS OF VARIATION IN EVALUATING DIALOGUE QUALITY USING LARGE LANGUAGE MODELS

Amna Irum, Mirza Omer Beg
Department of Computer Science, National University of Computer and Emerging Sciences, Islamabad, Pakistan

Evaluating dialogue systems is important to increase the capability and reliability of conversational models. Automatic metrics are needed because human evaluation tends to be expensive. Large language models (LLMs) have recently shown potential in evaluating various natural language generation (NLG) tasks. This work explores how well LLM evaluators assess open-domain dialogue tasks. We also investigated the sensitivity of LLMs in detecting and evaluating small changes in dialogue quality parameters. By introducing perturbations in dialogue responses, we aim to understand the sensitivity of LLM evaluators, which plays an important role in understanding the LLM-based evaluators' systems.

PAPER ID # 172

A DEEP LEARNING MODEL FOR DETECTION OF LUNG PATHOLOGIES BY IMAGE PROCESSING OF X-RAY IMAGES

Eman Shahid[1], Amna Tariq[2], Sharjeel Bin Rauf[1], Muhammad Ali Nauman[2], Farhan Yousaf[2], Muhammad Abdullah[2]

[1] Department of Biomedical Engineering National University of Sciences & Technology, Islamabad, Pakistan

[2] Department of Biomedical Engineering University of Engineering & Technology, Lahore, Pakistan

Lung pathologies including viral pneumonia, covid-19, lung opacities and tuberculosis are among the most widely spread lung infections. The primary detection of these lug pathologies is done by the examination of the chest radiographs from which the structural abnormalities are observed to diagnose the lung disease. With the increase in cases of lung pathologies and the reduced number of radiologists and diagnostic labs available for x-ray examination, diagnosing these diseases has become worrisome. In this paper, an automated deep learning model designed using Matlab 2021a which proved very helpful for accurate and quick radiograph examination has been proposed. The data obtained from the online database Kaggle is trained using transfer learning approach for training a pretrained convolution neural network ResNet50 model that can efficiently classify x-ray images into 4 distinguished classes of viral pneumonia, covid-19, lung opacities and normal radiographs based on structural changes in the lungs caused by the respective pathology. 80% of data is used for training the model and 20% for model testing. The trained model classified the radiographs with a high accuracy of 94% which provide us with a highly accurate model for radiograph examination. The results were displayed in the form of a confusion matrix, occlusion sensitivity figure and class activation map. ResNet50 model showed better performance as compared to excessively opted deep transfer learning models. Graphical user interface is developed using this approach to make the model user-friendly.

PAPER ID # 176

ML-ENHANCED IOMT-BASED ELECTROCARDIOGRAM MONITORING SYSTEM FOR PATIENT-CENTRIC SOLUTION

Sundus Ali, Muhammad Imran Aslam, Zaryab Ahmed Khan, Asma Khalid, Arhamna Ayub Khan, Hania Ali Shaikh
Department of Telecommunications Engineering NED University of Engineering and Technology, Karachi, Pakistan

Cardiovascular health is a global concern today, with Pakistan as no exception. Traditionally, electrocardiogram (ECG) tests are very cumbersome and performed mostly at hospitals. This leaves many people, especially in remote areas, unable to get timely access due to insufficient healthcare facilities. In addition, the discomfort that usually comes with conducting conventional ECGs makes people shy away from repeat screenings. In this paper, we have presented a machine learning (ML) enabled Internet of Things (IoT) based ECG monitoring system to provide accessible, portable, and real-time heart health monitoring. This paper discusses how we have integrated ECG sensor, IoT, and ML technologies to detect anomalies within the ECG signal in real time so that low-cost healthcare provisioning in regions can be achieved. The high accuracy of the system based on the BMD101 sensor in terms of the detection of ECG anomalies shows that it can also be used as a large-scale ECG monitoring device. The work presented in this paper demonstrates comparison between the two convolution neural network models, where two convolutional layers and a filter size of 64 results in better training and testing accuracy whereas a filter size of 128 results in better anomaly accuracy. Overall, this work is a step forward to the development of Internet of Medical Things (IoMT) systems for realizing ease in patient monitoring.

PAPER ID # 177

DECODING STOCK MARKET PREDICTIONS: INSIGHTS FROM EXPLAINABLE AI USING LAYER-WISE RELEVANCE PROPAGATION

Hira Tanveer, Seemab Latif
School of Electrical Engineering and Computer Science (SEECS), National University of Sciences and Technology (NUST), Islamabad, Pakistan

The growing use of AI models in financial markets demands both accuracy and transparency to build trust in highly regulated environments. Explainable AI (XAI) addresses the ”black-box” nature of AI, providing insights into model decision-making, which is crucial for investors and regulators. This study builds on our previous work on market stability prediction using Layer-wise Relevance Propagation method to interpret our Conv1D-BiLSTM model, achieving 83% accuracy. Our experiments revealed that a 10-day look-back period optimally predicts one-day market stability. The outcome explanation with LRP highlights moving averages of local and foreign investors and open interest rates as the key economic indicators driving the AI model's predictions. These insights deepen our understanding of market dynamics, particularly in the Pakistan Stock Exchange. We validate the robustness and scalability of our XAI framework, offering actionable insights for short-term investors and policymakers.

PAPER ID # 183

FAULT DETECTION AND CLASSIFICATION IN ELECTRICAL POWER DISTRIBUTION NETWORK THROUGH MACHINE LEARNING

Muhammad Azan, Muhammad Amir Raza, Hizbullah Odho, Hamza Arain, Rana Ahmed, Zuhaib Ali
Department of Electrical Engineering Mehran University of Engineering and Technology, SZAB Campus, Khairpur, Pakistan

This article used Support Vector Machines (SVM), Random Forest (RF), Decision Tree (DT), Extra Trees (ET), and Extreme Gradient Boosting (XGBoost) for fault detection and classification in electrical power distribution network. The study covers the detection and classification of different fault conditions like line to ground fault, double line fault, double to ground fault and three phase faults along with normal condition (no fault). The experimental results demonstrated that ensemble methods, particularly RF, XGBoost, and ET, significantly outperformed the individual models, achieving high accuracy rates exceeding 99%. The ET model emerged as the best performer, showcasing exceptional precision, recall, and F1-scores, with very few misclassifications as evidenced by the confusion matrices.

PAPER ID # 185

OPTIMIZING GAZE ESTIMATION: A COMPARATIVE STUDY OF LOSS FUNCTIONS AND DEEP ARCHITECTURES

Samiya Ali Zaidi, Unaiza Ahsan
School of Science and Engineering, Habib University, Karachi, Pakistan

Eye tracking, particularly gaze estimation, is becoming increasingly important in HCI, healthcare, and VR applications, as it provides deeper insights into visual behavior. In this paper, we conduct a comprehensive ablation study to analyze the architectural changes that affect gaze estimation performance. Furthermore, we experiment with different loss functions to determine if using a combined loss significantly changes the model performance. Our findings reveal that since the combined loss function offers only marginal improvement over using a single loss function alone (0.02 degrees), a single loss function may suffice in specific contexts. Additionally, transformer-based models demonstrate superior performance, offering smoother optimization and better results under challenging conditions. These insights highlight the potential for optimizing gaze estimation models by balancing loss function complexity and leveraging modern transformer architectures.

PAPER ID # 188

LLM-GUIDED SPEECH PROCESSING FOR 3D HUMAN MOTION GENERATION

Muhammad Hasham Qazi, Sandesh Kumar, Farhan Khan Department of Electrical and Computer Engineering, Habib University, Karachi, Pakistan

This paper proposes a novel approach for generating 3D human motion from speech input using Large Language Models (LLMs). The system processes spoken language to derive motion generation prompts, which are then used by a 3D human motion generation engine to generate the corresponding 3D animations. This method eliminates the need for predefined action sequence text prompts and instead offers a dynamic approach towards motion generation. By utilizing a GPT model, the system produces body motions aligned with speech. Results demonstrate the system's capability to generate various types of motions in response to diverse speech inputs. Despite challenges in handling complex sentences, motion continuity, and realtime performance, this approach lays the groundwork for applications in education, virtual reality-based training, and gaming environments, where naturalistic agent interactions are essential. Future improvements include optimizing the system for real-time applications and addressing challenges related to complex sentences and motion continuity.

PAPER ID # 189

VISUAL QUESTION ANSWERING BASED ON OBJECT DETECTION AND RECOGNITION

Areesa Ashfaq, Muhammad Ehatisham-ul-Haq, Fiza Murtaza
Department of Creative Technologies Air University, Islamabad, Pakistan

Visual question answering (VQA) is a relatively recent research area that infers answers to image queries. Significant work is proposed because of its numerous realworld applications and growing interest. However, there is still a lack of object-based study for VQA. To bridge this gap, we proposed a novel VQA framework based on object detection and recognition. The presented methodology works on the selectively target visual regions of an object. The proposed VQA covers the four subproblems: object detection, object recognition, attribute detection, and counting. In this research, we performed VQA based on the three different perspectives of object detection, attribute detection and top hierarchy generation. YOLOv8 is used for object detection and k-means for attribute detection. The experiments are conducted with humans interacting with common objects named HICO dataset. The training set is used to generate elements of top hierarchy and the test set is used to evaluate the proposed method. Our proposed work attained the performance of 84%.

PAPER ID # 193

A COMPARATIVE ANALYSIS BETWEEN VISUAL LANGUAGE AND LARGE LANGUAGE MODELS TO MONITOR CONTAMINATED WATER IN THE FACE OF CLIMATE CHANGE

Maaz Imam[1], Ayesha Irshad[2], Ashad Qureshi[1], Muhammad Farrukh Shahid[2]
[1] Department of Computer Science, FAST National University of Computer and Emerging Sciences (NUCES), Karachi, Pakistan
[2] Department of Artificial Intelligence, FAST National University of Computer and Emerging Sciences (NUCES), Karachi, Pakistan

In recent years, Artificial Intelligence (AI) has advanced at an unprecedented rate, showing promising potential in transforming industries and individual lifestyles. Our research focused on a comparative analysis between three approaches to report generation based on prompts using the Visual Language Model (VLM) Llama-3.2-11b-vision-preview and the Large Language Model (LLM) Llama-3.1-8b-instant. The VLM processed images, and the LLM handled text prompts. Both models were later combined for an innovative report-generation approach. The study indicated that the combined approach proved superior due to the integration of both visual and textual features. However, it is important to note that the performance of AI models heavily depends on factors such as data quality, computational resources, and prompts. By addressing these factors, this research also facilitates advanced monitoring of water quality, supporting sustainability efforts, and enhancing climate resilience.

PAPER ID # 196

RESEARCH ON ASSESSING FAULT IMPACTS ON POWER QUALITY IN MODERN SMART DISTRIBUTION SYSTEMS WITH RENEWABLE INTEGRATION

Zunaira Huma[1], Abid Ali[1], Yuanqing Xia[1], Muhammad Fahad Zia[2], Akhtar Hussain3, Tayyab Manzoor[4]

[1] School of Automation Beijing Institute of Technology Beijing, China

[2] Department of of Electrical & Computer Engineering, American University in Dubai, Dubai, UAE

[3] School of Electrical Engineering Minhaj University Lahore Lahore, Pakistan

[4] School of Automation & Elect. Engg Zhongyuan University of Technology, Zhengzhou, China

Incorporating renewable energy sources into conventional power distribution systems has gained prominence due to their capacity to enhance clean, secure, and sustainable energy, alongside facilitating environmental conservation. This study evaluates the effects of integrating photovoltaic (PV) and wind energy (WE) systems on power quality (PQ) and system stability (SS). We employ the NR method to achieve accurate results, which is noted for its reliability and rapid convergence. This study assesses system faults via load flow analysis to ascertain steady-state operational behavior and utilizes transient stability analysis using the stochastic adaptive NR method to evaluate voltage profiles and stability during transient conditions. Results demonstrate that RES's uncoordinated and arbitrary integration poses considerable challenges to centralized power distribution systems, potentially imperiling system reliability and equilibrium and measures to alleviate adverse effects on PQ and SS.

PAPER ID # 197

DEVELOPMENT OF FACILE PRESSURE SENSORS FOR PREVENTION OF PRESSURE ULCERS IN PARALYSIS PATIENTS

Samra Shaheen, Munawar Arshad, Muhammad Farhan, Azmat Saleem, Abdul Hanan Taqi, Muhammad Qasim Mehmood
Department of Biomedical Engineering University of Engineering and Technology, Lahore, Pakistan

The development of a robust prototype of pressure sensors that can be integrated into assistive devices for paralyzed patients without disrupting their flow. Also, this outlay illustrates the application of green sensing technologies, which reduce environmental effects. Copper tape-based pressure sensors have a sandwich structure with cloth in between equal pieces of copper tape to be placed on the critical points of the paralysis patient's body. The probe combination aims to diagnose pressure fluctuations, preventing skin harm. The system triggers an alarm when pressure exceeds the set maximum, showing a buzzer sound, recording the results in a paired mobile app, and then turning the buzzer off as pressure is lowered. This enhances timely positional changes and comfort for patients, reducing pressure ulcers. Thus, the abovementioned project, which thrives on sustainability, affordability, and durability as the main pillars, can go a long way in serving the importance of patient care.

PAPER ID # 199

DESIGN OF A LOW-NOISE, HIGH-QUALITY VARIABLE GAIN PRE-AMPLIFIER FOR ACOUSTIC APPLICATIONS

Saqib Ali[1], Umar Hamid[2], Khurram Shehzad[2], Talha Saeed Irshad[2], Arwa Aamir[2], Shahid Ali[2]

[1] Department of Electrical Engineering and Computer Science (SEECS), National University of Sciences and Technology (NUST), Islamabad, Pakistan

[2] Department of Electrical and Computer Engineering, COMSATS University, Islamabad, Pakistan

This paper presents the design of a low-noise, high-quality pre-amplifier optimized for an acoustic application related to high frequency underwater imaging. The proposed low-noise pre-amplifier (LNA) design is focused on amplifying low-power signals while maintaining a minimal signal-to-noise ratio (SNR) degradation. Noise reduction is achieved through careful selection of components, configurations, and operating points within the operational bandwidth. Key design goals, including impedance matching, variable gain (20-80 dB using 0-5 VDC control signal), a central frequency of 400 kHz, and a 10 kHz bandwidth, are met. The proposed pre-amplifier features a two-stage, adjustable gain of 80 dB, followed by a four-stage, 8th order filter using a multiple feedback topology. This design demonstrates significant improvements, achieving an input-referred voltage noise of 0.048 $\mu V/\sqrt{Hz}$, a bandwidth of 9.8 kHz, and a quality factor of 41, surpassing conventional LNA designs.

PAPER ID # 202

REINFORCEMENT LEARNING-BASED MULTI-ROBOT PATH PLANNING AND CONGESTION MANAGEMENT IN WAREHOUSE ORDER PICKING

Muhammad Shahab Alam[1], Muhammad Umer Khan[2], Ahmet Gunes[2]
[1] Defense Technologies Institute Gebze Technical University Kocaeli, Turkey
[2] Department of Mechatronics Engineering Atilim University Ankara, Turkey

This paper addresses the multi-robot path planning problem in a warehouse environment using reinforcement learning. The warehouse layout comprises of a grid map with multiple robots for retrieval and delivery of orders, inventory pods for storage, and pick stations for receiving outbound orders. The robots are required to pick and deliver orders from target shelves to their corresponding pick stations by navigating in a complex network of aisles. Q-learning algorithm computes optimal paths for the robots, while avoiding congestion in the aisles. Simulation results demonstrate the efficacy of the proposed method in optimizing both travel time and travel distance, thus enhancing the overall operational efficiency of the warehouse.

PAPER ID # 209

ENHANCING BREAST CANCER DIAGNOSIS IN MAMMOGRAPHY: EVALUATION AND INTEGRATION OF CONVOLUTIONAL NEURAL NETWORKS AND EXPLAINABLE AI

Maryam Ahmed, Tooba Bibi, Rizwan Ahmed Khan, Sidra Nasir
Department of Computer Science, Salim Habib University, Karachi, Pakistan

The Deep learning (DL) models for diagnosing breast cancer from mammographic images often operate as ”black boxes,” making it difficult for healthcare professionals to trust and understand their decision-making processes. The study presents an integrated framework combining Convolutional Neural Networks (CNNs) and Explainable Artificial Intelligence (XAI) for the enhanced diagnosis of breast cancer using the CBIS-DDSM dataset. The methodology encompasses an elaborate data preprocessing pipeline and advanced data augmentation techniques to counteract dataset limitations and transfer learning using pre-trained networks such as VGG-16, Inception- V3 and ResNet was employed. A focal point of our study is the evaluation of XAI's effectiveness in interpreting model predictions, highlighted by utilising the Hausdorff measure to assess the alignment between AI-generated explanations and expert annotations quantitatively. This approach is critical for XAI in promoting trustworthiness and ethical fairness in AIassisted diagnostics.

PAPER ID # 217

UNVEILING UTOPIA OF FALSE INFORMATION IN THE DIGITAL ERA THROUGH THE LENS OF BIBLIOMETRIC ANALYSIS

Mahaningl Indrawaty Wijaya, Suzanna, Widodo budiharto, Diana Utomo, Jane Ivana
School of Information System Bina Nusantara University Jakarta, Indonesia

With the rapid development of technology and wide exchange of information, false information or fake news can easily be spread. The challenge not only comes from content that is easily created and manipulated using AI technology such as the Deep fake algorithm, but the presence of social media can spread misinformation throughout the world in a matter of seconds. There are various motivations for creating fake news, susch as economic gain and politics. This paper aims to analyze current research on false information using bibliometric methods. Trends in research, as well as links between studies, are evaluated in depth. Emerging research themes is also elaborated. Based on the analysis, the trend on the theme of fake information is currently increasing. Various research are published to understand the phenomenon and to find the potential solutions. Generally two research streams are emerged in this topic. The first stream is focused on the human factors such as educating society to be more critical in responding to the information, and studying human behavior towards the fake news. The second stream is focused on how technology able to help to tackle fake news. Several technologies are often mentioned, such as blockchain to store and trace the spread of fake news, artificial intelligence to categotize true and false information automatically, and social network analysis to analyze chain and distribution of fake news. Based on the literature study, a framework of solution built that combined both human and technological measure to combate the fake news.

PAPER ID # 222

EDGE COMPUTING-ENHANCED MACHINE LEARNING FRAMEWORK WITH ANOMALY DETECTION-AWARE PREDICTIVE MODELLING IN IOT HEALTHCARE SYSTEMS

Maram Fahaad Almufareh[1], Zulfiqar Ahmad[2], Aisha Pervez[3], Mehreen Iftikhar[2]
[1] Department of Information Systems, College of Computer and Information Sciences, Jouf University, Al Jouf, Saudi Arabia
[2] Department of Computer Science and Information Technology, Hazara University, Mansehra, Pakistan
[3] Department of Telecommunication, Hazara University, Mansehra, Pakistan

The implementation of IoT in healthcare systems allows for continued patient monitoring; however, issues such as latency, data privacy, and efficient anomaly detection arise. To solve these problems, this study presents an Edge Computing Enhanced Machine Learning Framework and an Anomaly Detection-Aware Predictive Modeling solution to expedite and effectively process patient data with security at the network edge. Anomaly detection is done using Z-score and DBSCAN methods, and the results show high detection accuracy using the mean absolute error (MAE) and root mean square error (RMSE) metrics: MAE of 0.1396 and RMSE of 0.3737 for the Z-score; and MAE of 0.0003 and RMSE of 0.0184 for the DBSCAN. For predictive modeling, Random Forest (RF) and Support Vector Machine (SVM) were used; RF offers a better approach to the anomaly classifications with 0.97 of precision, 0.95 of recall, and 1.00 AUC than SVM with 0.91 of precision, 0.77 of recall, and 0.97 AUC. These outcomes verify that the proposed framework is efficient in quickly detecting health abnormalities and estimating risky situations, which makes it perfect for such healthcare applications.

PAPER ID # 223

LEVERAGING RECURRENT NEURAL NETWORKS IN VIRTUAL REALITY-BASED DIGITAL TWIN MODELS FOR ENHANCED PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINES

Hamad Razzaq, Muhammad Jazzel Mehmood, Farhan Khan
Computer Engineering Program (DSSE), Habib University, Karachi, Pakistan

Digital twin technology has given rise to smart manufacturing in Industry 4.0. Especially with the help of virtual reality, digital twin technology aims to provide an immersive experience by integrating the physical and cyberspace worlds synchronously in real time. One of its key features is the ability to perform predictive maintenance, to help prevent a product from any possible faults in the future. The existing literature has explored the traditional predictive maintenance strategies for forecasting the future state of machines such as simple regression and ARIMA models. However, the potential of machine learning, especially recurrent neural networks (RNNs) is not yet fully investigated for predictive maintenance in digital twin models. The complex nature of industrial operations gives rise to nonlinearities in its modeling which can be addressed with the help of neural networks. Therefore, this research aims to investigate the potential of RNNs in the predictive maintenance of an industrial machine use case by performing comparative analysis with simple regression and ARIMA Models. It also highlights the significant improvement RNNs make over the aforementioned strategies. This research also proposes an extension of the existing virtual reality-based digital twin architecture to incorporate automated predictive maintenance of the machine. Moreover, the proposed digital twin architecture acts as a basis for automated predictive maintenance of any product

PAPER ID # 224

FPGA BASED ARTIFICIAL NEURAL NETWORK ACCELERATOR

Eeman Fatima[1], Muhammad Fahad[1], Hiba Abrar[1], Haroon Waris[2]
[1] Department of Electrical Engineering, Pakistan Institute of Engineering and Applied Sciences, Islamabad, Pakistan
[2] Centers of Excellence in Science & Applied Technologies, Pakistan

In modern applications, Convolutional Neural Networks (CNNs) are popular for their adaptability and high classification accuracy. Field-Programmable Gate Arrays (FPGAs) are considered suitable platforms for CNNs due to their quick development and configurability. To optimize CNN accelerators, research focuses on network designs, data formats, and FPGA resource utilization. Recent studies explore low-precision data types through quantization to enhance speed and resource efficiency without significant accuracy loss. Network design optimization enhances resource utilization, parallelization for reduced latency, and increased memory access bandwidth. This study investigates a fixed-point data type-based CNN accelerator with multiple approximation accumulation units. It applies the LeNet-5 CNN architecture to classify the MNIST handwritten digit dataset and employs a high-level synthesis tool to create the accelerator on a Xilinx FPGA.

PAPER ID # 232

AI-POWERED CYBERCRIME: A SURVEY ON EMERGING THREATS, TOOLS & TECHNIQUES FOR COUNTERMEASURES

Mumtaz Hussain[1], Tariq Rahim Soomro[2]
[1] Member IEEE, Karachi Section
[2] Institute of Business Administration, Karachi, Pakistan

In an era marked by the proliferation of social media platforms and the rapid advancement of artificial intelligence (AI), the convergence of these technologies has given rise to a novel and concerning phenomenon—Artificial Intelligent Cyber-Enabled Crimes (AICEC). This research paper delves into the intricate interplay between Cybercrime and AI, exploring how advance AI technology serves as tool for the commission of cybercrimes. This study uncovers the multifaceted nature of AICEC, encompassing identity theft, deepfake propagation, voice cloning, and more. This study investigates the mechanisms and strategies employed by malicious actors to exploit human cognitive biases by implementing social engineering techniques, leveraging AI-driven tools for deception, fraud, and manipulation. To combat this evolving landscape of AI powered cyber-enabled crimes, this study proposes a multi-pronged approach involving technical countermeasures, policy interventions, and public awareness campaigns.

PAPER ID # 234

DIGITAL TWIN-DRIVEN HYBRID CONTROL FOR MADNI STABILITY IN ADVERSE CONDITIONS

Cara Rose[1], Abbas Shah[2], Robert McMurray[1], Muhammad Usman Hadi[1]
[1] School of Engineering Ulster University Belfast, UK
[2] Department of Electronics Engineering Mehran University of Engineering Technology, Jamshoro, Pakistan

This paper presents a novel integration of Digital Twin (DT) technology with hybrid control systems to improve Unmanned Aerial Vehicle (UAV) stability under adverse conditions like high winds. The DT framework enables real-time simulation, monitoring, and optimization, providing predictive insights for flight stability. Traditional controllers, such as Linear Quadratic Regulator (LQR), are combined with Reinforcement Learning (RL) techniques like Deep Deterministic Policy Gradient (DDPG) to develop hybrid strategies. Results reveal that hybrid approaches balance the adaptability of RL with the stability of LQR, outperforming standalone methods. The LQR with Particle Swarm Optimization (PSO) and the DDPG-LQR-PSO hybrid achieve the lowest gradient of -0.14 radians and settling times of 2 seconds for pitch, roll, and yaw. This research pioneers UAV resilience advancements, enabling superior performance in complex, rapidly changing environments.

PAPER ID # 236

NONLINEAR MPPT OPTIMIZATION FOR PV SYSTEM VIA RNN AND CONDITION-BASED SUPER-TWISTING SLIDING MODE CONTROLLER

Omar Zeb, Iftikhar Ahmad
Department of Electrical Engineering, SEECS, National University of Sciences and Technology (NUST), Islamabad, Pakistan

As the demand for energy rises and concerns grow over dwindling fossil fuel reserves and carbon emissions, it is increasingly critical to develop sustainable and efficient energy solutions. Solar energy has captured significant interest within the renewable energy sector, given its vast potential. However, the efficiency of photovoltaic (PV) systems remains heavily influenced by changing weather and load conditions, which present challenges to consistently harvesting maximum energy. To address this, maximum power point tracking (MPPT) techniques are widely applied to optimize PV output. Since PV systems exhibit nonlinear characteristics, advanced nonlinear control methods are well-suited for MPPT applications. Traditionally, popular methods for MPPT include Perturb and Observe (P&O). Recent advancements in artificial intelligence, have led to the adoption of controllers such as Artificial Neural Networks (ANN) to enhance MPPT. However, this study introduces a Recurrent Neural Network (RNN) controller, leveraging its memory-based architecture to adaptively track the PV system's power reference point under fluctuating environmental conditions. To ensure robust MPPT performance, this research integrates the RNN controller with a condition-based super-twisting sliding mode control (C-STSMC) strategy, aiming to manage nonlinearities and enhance resilience to changing climatic factors. This paper details the design and implementation of the proposed RNNbased MPPT controller, alongside comparisons with traditional MPPT method P&O and Fuzzy logic controller. Experimental results for hardware in loop (HIL SETUP), confirm the real-time capabilities and enhanced accuracy of the proposed controllers. This comparative analysis demonstrates the improved precision and reliability of the RNN-based MPPT method in optimizing PV efficiency under dynamic conditions.

PAPER ID # 237

DETECTION OF SINUS BRADYCARDIA WITH ELECTROCARDIOGRAM USING MACHINE LEARNING TECHNIQUES

Sitara Khan[1], Salaar Khan[2], Zulqarnain Asghar[1], Haseeb Iqbal[1]
[1] Department of Biomedical Engineering, University of Engineering & Technology, Lahore, Pakistan
[2] School of Science & Engineering, Lahore University of Management Sciences, Lahore, Pakistan

Cardiovascular Diseases (CVDs) are a group of diseases related to the heart or blood vessels. The diagnosis and subsequent treatment of CVDs poses significant challenges and necessitates accurate detection methods. In this study, we implement seven different machine learning techniques to determine the most suitable approach for detecting sinus bradycardia, a manifestation of CVD, using Electrocardiogram (ECG) signals. We present a comparative assessment in order to show diagnostic superiority of our proposed artificial neural network (ANN) model on a publicly available dataset using only 94 records. The proposed light-weight ANN model emerges as the most effective method with 95.2% accuracy in circumstances where data is limited. Plausible accuracies of over 90% are shown by KNN (K=3), Support Vector Machines and Random Forest which underscore the potential of machine learning algorithms in facilitating clinicians for effective diagnosis of sinus bradycardia.

PAPER ID # 238

AN EXPLORATORY STUDY OF ENTREPRENEURIAL MARKETING IN MEDICAL SUPPLIES PURCHASE DECISION MAKING: THE CASE OF ULTRASOUND GEL IN PUBLIC HEALTHCARE AGENCY

Wachira Ponboon, Panita Rachapaettayakom
School of Management, Mae Fah Luang University, Chiang Rai, Thailand

According to the 2023 Thailand Health Report, musculoskeletal disorders remain in the top three disease categories driving OPD visits nationwide. To diagnose this condition, ultrasound gel is widely used in healthcare settings. However, the prevalent ultrasound gel formulation, primarily composed of Glycol and Glycerin, has been associated with adverse skin reactions in certain individuals. Given the potential limitations of current ultrasound gel formulations, there is a need to explore alternative options. However, market entry for novel medical products can be challenging. Thus, this study aims to 1) describe the current usage of ultrasound gels among healthcare professionals who make purchasing decisions; and 2) study the factors affecting purchasing decisions. Qualitative research, employing in-depth interviews with nineteen respondents with a diverse range of expertise, was adopted. This insight of this study may be applied in the product innovation for market penetration.

PAPER ID # 240

INDIGENOUS DEVELOPMENT OF HIGH-PRECISION MAGNETOMETER DATA ACQUISITION SYSTEM FOR GEOMAGNETIC OBSERVATIES IN PAKISTAN

Taha Amjad[1], Syed Riaz un Nabi Jafri[1], Hashim Raza Khan[1], Alishba Arshad[2], Muhammad Ibtisam Zaidi[2], Huzaif Sami[3]

[1] Department of Electronic Engineering NED University of Engineering & Technology, Karachi, Pakistan

[2] Department of Telecommunications Engineering NED University of Engineering & Technology, Karachi, Pakistan

[3] Department of Industrial Manufacturing Engineering NED University of Engineering & Technology, Karachi, Pakistan

This paper presents the indigenous development of a cost-effective Data Acquisition (DAQ) circuit for magnetometers, designed to meet the needs of geomagnetic field monitoring in Pakistan. The DAQ system utilizes a fluxgate sensor for high-resolution measurements, an ESP32 Dev module for parallel processing, and an ADS1256 ADC for precise signal conversion. The GPS module provides real-time location and timestamp, while an SD card stores data and a temperaturehumidity sensor monitors environmental conditions. Kalman filtering is employed to minimize noise and improve accuracy. Rigorous testing at the Sonmiani Geomagnetic Observatory demonstrated the system's robust performance and high accuracy in field conditions. The integration of GPS and storage made this design advanced and featured in comaparison with imported system. By developing this local solution, we aim to reduce reliance on expensive imported DAQs and contribute to the advancement of scientific research infrastructure in Pakistan.

PAPER ID # 241

FLEXIBILITY ENHANCEMENT IN HEAT PUMP-BASED INDOOR TEMPERATURE MPC

Crescenzo Pepe, Mir Farooq Ali, Silvia Maria Zanoli
Dip. Ing. dell'Informazione (DII) Univ. Politecnica delle Marche Ancona (AN), Italy

A Model Predictive Control strategy for heatpump based indoor temperature control is proposed in this paper. The controller has been included in an Advanced Process Control system that also contains a block that aids to enhance flexibility on control specifications. A linear model of the relationship between heat pump power/outdoor temperature and the considered rooms' temperatures has been exploited for the developed process simulator and as internal model of the developed model-based controller based on Model Predictive Control strategy. Different flexibility features have been ensured in the design of the control system; bad conditions are detected and users' defined specifications are handled by the control system. Tailored simulations based on significant scenarios show the reliability of the proposed approach in guaranteeing a satisfactory performance on the assigned process variables constraints and, at the same time, an optimized management of the heat pump power.

PAPER ID # 243

APPLICATION OF GENERALIZED STOCHASTIC PETRI NETS FOR PERFORMANCE ANALYSIS OF A PRODUCTION PROCESS

Alessandro Di Biase, Luca Caponi, Federico Catalini, Crescenzo Pepe, Silvia Maria Zanoli
Dip. Ing. dell'Informazione (DII) Univ. Politecnica delle Marche Ancona (AN), Italy

The increasing complexity of modern manufacturing systems, combined with the continuous need of performance improvements, requires tools to assess the metrics and the quality of possible solutions. This paper focuses on the application of the Generalized Stochastic Petri Net (GSPN) for performance analysis of a production process. To solve the problem of increasing computational burden for large-scale GSPNs, the proposed approach exploits a partition of the overall plant model in several submodules. The challenge is to integrate the results of the analysis of all of the submodules, considering the effect of each one on the previous and subsequent submodules, thus achieving information on the performance of the whole GSPN. The method is applied to evaluate the performance of an automotive lead acid battery production chain, demonstrating its effectiveness in managing complexity and enhancing computational efficiency.

PAPER ID # 246

DESIGN AND IMPLEMENTATION OF AN ELECTRIC BICYCLE USING BLDC MOTOR WITH OPTIMIZED SVPWM TECHNIQUE

Muhammad Asif, Haseeb Hussain, Uzair zafar, Tanzeel ur Rehman, Abaid Ur Rehman, Mudassar Usman
Department of Electrical, Electronics and Telecommunication Engineering, UET, Lahore, Pakistan

This paper details the design and development of an ecofriendly electric bicycle tailored for urban transportation. Driven by a need for sustainable solutions, it integrates a Brushless DC (BLDC) motor into a conventional bike frame. The study outlines design, simulation, and implementation, focusing on efficiency, user experience, and performance. A BLDC motor with a threephase inverter enables variable speed control, enhancing ride quality over traditional pedal bikes. Using Space Vector PWM (SVPWM), motor torque and speed are optimized, reducing harmonic distortion to 43%, a marked improvement over SPWM techniques. A battery management system (BMS) handles power regulation. Results demonstrate a successful electric bike prototype, with recommendations for solar charging integration to extend range. This project supports the shift to cleaner transportation.

PAPER ID # 249

EXPERIMENTAL VALIDATION OF NONLINEARITY MITIGATION IN ANALOG RADIO OVER FIBER FOR UPCOMING 6G NETWORKS USING MSA-BASED DIGITAL PREDISTORTION

Muhammad Usman Hadi[1], Abbas Shah[2], Muhammad Ijaz[3]
[1] School of Engineering Ulster University Belfast, United Kingdom
[2] Department of Electronics Engineering, Mehran University of Engineering and Technology, Jamshoro, Pakistan
[3] Department of Engineering, Manchester Metropolitan University. Manchester, M1 5GD United Kingdom

Analog Radio over Fiber (A-RoF) technology is a pivotal enabler for 5G and 6G networks due to its ability to support high data rates, ultra-low latency, and seamless connectivity by providing a cost-effective optical fronthaul solution. However, the nonlinearities inherent in A-RoF systems, including signal distortions caused by optical and electrical components, limit performance, particularly in highfrequency applications. In this study, we present an experimental setup integrating Digital Predistortion (DPD) with enhanced magnitude-selective affine (MSA) method, implemented in a hybrid fiber-wireless (Fi-Wi) architecture. This setup is tested in a supercell and femtocell scenario, using RF signals at 3 GHz and 10 GHz, transmitted over a 10 km standard single-mode fiber (SSMF) link. A 1550 nm laser-driven dual-drive Mach Zehnder Modulator (DD-MZM) is used, and post-processing includes predistortion with the MSA method to mitigate nonlinearities. Compared to traditional methods such as GMP and CPWL, our MSA method achieves the lowest Error Vector Magnitude (EVM) at 1.84% and the highest spectral regrowth suppression at -44 dBc compared to the EVM of GMP at 5.4% and CPWL at 1.85% thereby, demonstrating enhanced efficiency and robustness. Future work will focus on optimizing computational complexity and further improving system performance through a hybrid MSA approach.

PAPER ID # 250

A MULTI-AGENT DEEP REINFORCEMENT LEARNING FRAMEWORK FOR PERSONALIZED CANCER TREATMENT DECISION SUPPORT IN DYNAMIC CLINICAL SCENARIOS

Madeha Arif, Usman Qamar, Mehwish Naseer
Department of Computer & Software Engineering, College of Electrical and Mechanical Engineering, National University of Sciences and Technology (NUST), Islamabad, Pakistan

In the field of artificial intelligence, deep reinforcement learning (RL) has grown to be one of the most talked-about issues. It has a extensive range of applications, that may include end-to-end control, recommendation systems, robotic control and systems for natural language communication. In this paper, we have critically reviewed model-based and model-free deep reinforcement models for the treatment of cancer patients and evaluated each model based on some parameters. Based on the evaluation, a critical discussion is carried out highlighting the limitations and drawbacks of all the existing models. The analysis also gives suggestions and marks the key indicators of future needs in this domain. In the end, a solution model is proposed that tries to cover all the shortcomings and addresses the issues encountered in the existing models.

PAPER ID # 251

AI-POWERED DENTAL CARIES DETECTION

Hira khuwaja[1], Ahsan Ali Khidri[1], Rabeea Jaffari[1], Shehwar Javed[2]
[1] Department of Software Engineering Mehran University of Engineering and Technology, Jamshoro, Pakistan
[2] Altamash General Hospital, Karachi, Pakistan

Tooth decay, or dental caries, is a prevalent global health issue that underscores the need for early detection and diagnosis to effectively prevent serious dental problems. Our research, "AI Powered Dental Caries Detection" seeks to address this challenge by utilizing Artificial Intelligence (AI) for early detection of dental caries. This research focuses on analyzing intraoral images taken via smartphone cameras. Our research harnesses state-of-the-art deep learning (DL) object detection models such as YOLO (You Only Look Once), EfficientDet, MobileNet and resNet-50 to deliver a highly effective solution for detecting dental caries in the early stages. In addition to improving dental care's effectiveness, this kind of technology also lowers costs and increases accessibility, especially for people living in lowand middle-income areas where traditional dental services could be out of reach. Our research goal is to make proactive management of oral health possible, which will eventually enhance general health and quality of life. Our research indicates that ResNet-50 is the most effective model, while MobileNet serves as a strong alternative. The study introduces YOLOv8 and ResNet- 50 for dental caries detection in mobile app. These findings have substantial implications for enhancing dental care practices and potentially increasing accessibility to early detection across various demographics.

PAPER ID # 255

DESIGN AND DEVELOPMENT OF DECENTRALIZED SWARM NETWORK WITH SELF-REACTING CAPABILITY

Naqash Ahmad[1], Hammand Nazeer[1], Hussian Abbas[2], Sana Asrar[1], Sohaib Ahmad[1], Mamoon Ahmad[1]

[1] Department Mechatronics and Biomedical Engineering Air University Islamabad, Pakistan

[2] Center of Excellence in Sciences and Technology (CESAT), Islamabad, Pakistan

This paper presents the design and development of a decentralized swarm network for autonomous agents, capable of real-time self-reacting behaviors within a dynamically changing environment. Unlike conventional systems relying on centralized controls, this study leverages ESP32 microcontrollers, Firebase for data management, and a robust mesh network architecture to achieve seamless, self-organizing communication across agent robots. Utilizing the A* algorithm and wheel odometry, each robot adapts to environmental changes and coordinates effectively to accomplish collective goals, demonstrating resilience in adverse scenarios such as node failures or connectivity disruptions. Our results reveal the network's ability to maintain robust operation, ensuring adaptability and continuity in tasks such as surveillance, agriculture, and search and rescue missions. The proposed system stands out by reducing setup costs, enhancing scalability, and minimizing human intervention, pushing the boundaries of swarm robotics applications. Proportion of task load evenly distributed 85% with standard deviation 10% across all nodes while Average latency per node 0.2 seconds for 10 nodes, scaling to 0.35 seconds for 50 nodes. The decentralized nature of the system ensures that it adapts quickly to node failures or disruptions, leading to minimal recovery time and high connection stability. By leveraging ESP32 microcontrollers and Firebase, our system offers a more efficient and scalable solution, which contrasts with more conventional, centralized approaches that typically involve higher costs and complex setup.

PAPER ID # 256

BRAIN TUMOR SEGMENTATION AND BOUNDARY DETECTION USING IMAGE PROCESSING TECHNIQUES IN MATLAB

Muhammad Omar Cheema[1], Hedi A. Guesmi[2]
[1] Department of Biomedical Engineering Air University, Islamabad, Pakistan
[2] Department of Electrical Engineering, College of Engineering, Qassim University, Saudi Arabia

Medical image processing is now the most demanding and expanding field. It is widely used for brain tumor detection and segmentation at healthcare settings and research labs. In this research, we have used medical image processing technique to identify and isolate brain tumors from patient's MRI images. Our method incorporates conversion of image to grayscale and then its conversion to black and white image, application of median filter, threshold-based segmentation, and boundary detection. We used median filter as it preserves the edges after removal of noise from the image. Conversion of greyscale representation into black and white image played the fundamental role in segmenting of the brain tumor by highlighting the cancerous portion of brain as white and healthy part of brain as black. Hence, it is very helpful in next step that is the boundary detection of the brain tumor. Identification and removal of tumor from MRI images of the brain has been done by using MATLAB software.

PAPER ID # 260

TABLE TALK

Farhan Dhanani, Muhammad Rafi
Department of Computer Science, National University of Computer and Emerging Sciences (FAST-NUCES), Karachi, Pakistan

Recent advancements in Natural Language Processing and Deep Learning have significantly transformed questionanswering (Q/A) systems. However, Tabular Q/A remains a persistent challenge due to the prevalence of structured data in tabular formats. The hardware needs to deploy transformerbased language models in a production environment scale linearly with the size and number of tables. The methods based on the Retrieval Augmented Generation (RAG) techniques have improved computational efficiency in designing Q/A systems. However, choosing an appropriate value of "K" to retrieve the "K" number of most relevant records based on the user queries in a real-time production environment remains a notable challenge among all RAG-based approaches. This paper proposes a novel solution that enhances traditional RAG using Bi-Encoders and the Silhouette Method. It targets Non-Semantic Free-Form Closed-Domain Tabular Q/A, achieving an average precision of 63% and an average recall of 55%.

PAPER ID # 262

ENHANCING SECURITY IN SMART HOME IOT NETWORKS: VULNERABILITY ANALYSIS AND MITIGATION STRATEGIES

Huzaifah Ahmed, Syed Asghar Abbas, Tariq Mumtaz
School of Science and Engineering, Habib University, Karachi, Pakistan

The rapid technological advancements of the Fourth Industrial Revolution (IR 4.0) have driven the widespread adoption of the Internet of Things (IoT), profoundly affecting numerous societal domains. This paper examines the smart home, a pivotal element of the IoT landscape, which has experienced significant growth due to modern communication technologies. The integration of smart devices into home environments presents considerable security challenges, including risks of privacy breaches, financial losses, and physical harm. This research simulates a smart home network to identify and analyze key security vulnerabilities. Additionally, it implements and evaluates various mitigation strategies to assess their effectiveness in bolstering the security of smart home systems

PAPER ID # 263

USING TECHNOLOGY TO IMPROVE AWARENESS, CONVENIENCE, AND COMMUNICATION ABOUT NEURODIVERGENCE IN HIGHER EDUCATIONAL INSTITUTES IN PAKISTAN

Ushna Batool[1], Areeb Adnan Khan[2], Urooj Siddiqui[3], Neelma Bhatti[1]
[1] Department of Computer Science, DSSE, Habib University, Karachi, Pakistan
[2] Department of Electrical and Computer Engineering, DSSE Habib University, Karachi, Pakistan
[3] Department of Social Development & Policy, AHSS Habib University, Karachi, Pakistan

Awareness of neurodiversity in higher education is at the rise but institutions struggle to set up comprehensive frameworks that can effectively accommodate neurodivergent students. This deficiency undercuts attempts to establish inclusive learning settings, leaving students to deal with issues like academic stress, social isolation, and a lack of resources. This study peruse creative ways to bridge this gap by using technology to promote inclusivity, facilitate communication, and improve the accommodation process. We created an app prototype using a human-centered design methodology with the goals of raising awareness, easing accommodations, and boosting faculty-student communication. The findings provide beneficial data for educators, policymakers, and developers intending to use technology to build supportive and equitable learning environments.

PAPER ID # 265

SARCASM DETECTION IN MULTILINGUAL TEXT THROUGH EMBEDDING-ENHANCED LANGUAGE MODELS: BERT VARIANTS

Muhammad Islam[1], Muhammad Azhar[2]
[1] College of Science and Engineering, James Cook University Cairns, Australia
[2] University Institute of Information Technology PMAS Arid Agriculture University, Rawalpindi, Pakistan

The rise of social media has amplified sarcastic content, where literal and intended meanings often diverge. Sarcasm poses significant challenges for sentiment analysis due to its subtle linguistic nuances. Traditional models struggle with sarcasm detection because of their limited contextual understanding and reliance on handcrafted features. This study curates a large dataset of English headline news, translated into Urdu to create a multilingual dataset. BERT variants, such as mBERT and UrduBERT, are employed to capture context and learn relevant features using deep learning architectures. The study compares the performance of these BERT variants on the dataset and evaluates traditional algorithms for classifying sarcastic and nonsarcastic headlines. Model performance is rigorously assessed using precision, recall, and F1-score metrics. Results indicate that fine-tuned mBERT outperforms other BERT variants and traditional models in sarcasm detection by effectively capturing complex semantic patterns. The dataset and code are publicly available on GitHub. https://github.com/MislamSatti/Sarcasam-detection-with-code

PAPER ID # 266

THE EARLY PREDICTION OF CHRONIC DISEASES THROUGH DIVERSE MACHINE LEARNING TECHNIQUES

Saba Naz, Ubaida Fatima
Department of Mathematics, NED University of Engineering & Technology, Karachi, Pakistan

Advancements in healthcare analytics offer significant benefits for both healthcare providers and patients. The application of analytics in healthcare plays a crucial role in early disease detection and diagnosis, contributing to enhanced healthcare quality and improved patient outcomes. Machine learning models play a pivotal role in identifying patterns within data, enabling the generation of predictions for disease diagnosis, prognosis, and treatment. With continuous advancements in algorithms and technology, these models have become increasingly effective in providing optimal patient care. This research focuses on utilizing various machine learning algorithms to predict the diagnosis of chronic disease. The study aims to assess and compare the effectiveness of these models by evaluating their prediction accuracy, as well as other performance metrics such as precision, recall, and F1 score. Four different chronic disease datasets considered which includes diabetes, stroke, cardiovascular disease, and Chronic Kidney Disease. Among the investigated models, Random Forest emerged as the most effective, achieving an impressive accuracy rate of 70 to 99% depends on the dataset.

PAPER ID # 267

DESIGN AND DEVELOPMENT OF A LOW COST SYSTEM FOR ACQUISITION OF ECG, EOG, EMG, EEG

Hafiz Muhammad Hammad, Muhammad Aqil, Muhammad Shahid Nazir
Department of Electrical Engineering, Pakistan Institute of Engineering and Applied Science, Islamabad, Pakistan

This research paper proposes a system that can acquire multiple biopotential signals. The main difference between Electromyography (EMG), Electroencephalogram (EEG), Electrocardiogram (ECG), and Electrooculography (EOG) signals lies in their frequency and amplitude ranges. The proposed system contains two parts i.e. analogue and digital. To make the proposed system general purpose, the analog part of the circuit is made common by introducing two low-pass filters. One of the two low-pass filters has to be selected to address high frequency range (below 500Hz) signals (EMG) or low frequency range (below 40Hz) signals (ECG, EOG and EEG). The digital filters are implemented in microcontroller for customized filtering of biopotential signal. Infinite impulse response (IIR) digital filters were designed for EOG, ECG, EMG and EEG. An embedded system with this hybrid analogue-digital filtering made the proposed solution a general purpose biopotentials acquisition system. This proposed system has potential biomedical applications for multiple biopotential measurements.

PAPER ID # 269

DIGITAL FORENSICS ACROSS MULTIPLE ANDROID VERSIONS USING THE MOBILE EDIT FORENSIC TOOL

Kohal Deep Maheshwari[1], Pardeep Kumar[2], Najma Imtiaz Ali[3], Imtiaz Ali Brohi[4], Dua Agha[5]

[1] Department of Computer Science & IT, NED University of Engineering and Technology, Karachi, Pakistan

[2] Department of Software Engineering, QUEST University, Nawabshah, Pakistan

[3] Institute of Mathematics and Computer Science, University of Sindh, Jamshoro, Pakistan

[4] Department of Computer Science, Government College University, Hyderabad, Pakistan

[5] Department of Software Engineering, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Android devices are open-source, as the mobile devices become common, opportunities and Open-source Android smartphones present both opportunities and difficulties for forensic investigators as they become more widely used. Advancements in Android security, encryption, and storage features necessitate newer forensic methods. The performance of MOBILedit Forensic across several Android versions will be covered in this article, with a concentrate on those running the Android 4.x version series. Data extraction, file recovery from deletion, and examination of call logs, messages, multimedia, and social media activity were among the main forensic activities carried out using this program. The tool's performance was evaluated on data from locked or corrupted devices, including its ability to decrypt information. The findings indicate that while MOBILedit Forensic is compatible with many Android versions, the speed and effectiveness of data extraction depend on the particular security measures used on each version. Newer Android models with advanced encryption and secure boot processes require more complex recovery techniques compared to older models, which recover data more quickly due to fewer security mechanisms. MOBILedit Forensic is still helpful in mobile forensics despite its flaws, but only partially understanding of encrypted data. This study also provides a more thorough understanding of the tool's functionality across different Android versions, which can help forensic investigators make better decisions about the best evidence extraction methods. Regular updates to forensic tools are crucial to adapt to evolving Android security measures.

PAPER ID # 270

BENCHMARKING PERFORMANCE ANLAYSIS OF OPTICAL CHARACTER RECOGNITION TECHNIQUES

Muhammad Ali Naqi[1], Maria Gul[1], Maqbool Khan[1], Ghadah Naif Alwakid[2], Noor Zaman Jhanjhi[3]

[1] Pak Austria Fachhochschule-Institute of Applied Sciences and Technology, Haripur, Pakistan

[2] Department of Computer Science, Jouf University, Skakah, 72341, Al Jouf, Saudi Arabia

[3] Taylor's university, Malaysia

Optical Character Recognition automates the extraction of printed and handwritten text from documents; it thus is very vital in digitalizing records. This research benchmarks seven optical character recognition (OCR) engines: PaddleOCR, EasyOCR, Keras-OCR, Pytesseract OCR, OpenCV OCR, PyMuPDF OCR, and DocTR OCR, on 200 diverse CBC patient reports. The metrics taken into consideration for evaluation included execution time, accuracy, Character Error Rate, and Word Error Rate. Finally, PaddleOCR is the one that performs best: 67.28% in accuracy, 0.43 in character error rate (CER), and 0.66 in word error rate (WER). Meanwhile, Keras OCR records the highest error rates among all. The findings make an insight into picking an appropriate OCR tool, which is bound to have tremendous implications for healthcare, legal documentation, and historical preservation in guiding future OCR advancements.This research will be baseline for further research in OCR.

PAPER ID # 271

ADVANCED TRIPLE-INPUT SOURCE MODELLING FOR ELECTRIC BYCYCLE PROPULSION SYSTEM

Asmatullah Khan, Muhammad Rauf
Department of Electronic Engineering, Dawood University of Engineering and Technolgy, Karachi, Pakistan

Metropolitan cities usually accounts for a high level of pollution due to the large density of combustion engines. Congestion in such cities is another challenge for daily urban commutation. Electric bicycle with a user friendly options is capable of addressing the challenges. This paper presents a design of hybrid bicycle with renewable solar energy as renewable source for propulsion and the pedaling energy as a backup energy source. The innovative solution of this research work is a dedicated three way charging circuit model that is capable of receiving input source from three different sources, and switch as per the need of the consumer. The simulation modelling is performed for each block of the input that is finally combined using a main controller unit. The tailored solution for conventional E bike presented in this paper have the potential to address not only the congestion and environmental challenges but also motivating the single commuters towards a healthy activity in the urban environment.

PAPER ID # 282

COMPARATIVE STUDY OF TRANSFER LEARNING WITH VGG16 AND VGG19 FOR BREAST CANCER CLASSIFICATION

Sumra Khan, Fatima Tuz Zahra, Amber Asif, Sheeraz Arif, Uzma Fatima
Department of Computer Science, Salim Habib University, Karachi, Pakistan

Cancers among women globally, with countries like Pakistan facing considerable challenges in early detection. A major obstacle in these regions is the lack of automated diagnostic systems that could help identify the disease at an earlier stage. This study introduces a new approach for detecting breast cancer by analyzing mammogram images, comparing it to traditional diagnostic methods, and incorporating deep learning techniques. The research utilized two models, VGG16 and VGG19, both of which rely on transfer learning, and employed a 5-fold cross-validation approach for testing. The Curated Breast Imaging Subset of Digital Database for Screening Mammography (CBIS-DDSM) was used as the training dataset. The VGG19 model achieved an accuracy of 70.79%, with an AUC of 79.52%, precision of 67.90%, recall of 78.89%, and an F1 score of 72.98%. Meanwhile, the VGG16 model showed slightly higher accuracy at 72.78%, with an AUC of 81.68%, precision of 75.62%, recall of 67.22%, and an F1 score of 71.18%. These results emphasize the importance of transfer learning in enhancing the performance of deep learning models for breast cancer detection, offering promising potential for improving diagnostic accuracy in areas with limited resources.Keywords— Breast Cancer Diagnosis, Transfer Learning, Mammography, VGG16 , VGG19.

CONFERENCE PARTNERS

Sindh HEC

IEEE Karachi Section

Liaquat University of Medical & Health Sciences (LUMHS) - Jamshoro

IEEE SHU Student Branch

Redstart Technology Solutions

REDSTART TECHNOLOGY SOLUTIONS
INNOVATE AT WILL

Herbion

Herbion
NATURALS

PharmEvo

PharmEvo
Our dream, a healthier society

Biomed 5.0

BIOMED 5.0

Undergraduate

OUR PROGRAMS

BS Computer Science | BS Software Engineering | Doctor of Pharmacy | BS Cosmetic Sciences | BS Biosciences

BS Microbiology | BS Biotechnology | BE Biomedical Engineering | BS Robotics & Intelligent Systems

BS Accounting & Finance | BBA | BS Business Analytics | BS Supply Chain Management | BS Fintech

BS Actuarial Science & Risk Management | BS Content Development & Virality | BS Psychology

BS Digital Arts & Creative Design

Visit us:
www.shu.edu.pk

SHU.Pakistan | SalimHabibUniversityOfficial

SHUPakistan | shu.pakistan | Salim Habib University

NC-24, Deh Dih, Dr. Salim Habib Road, Korangi Creek, Karachi 74900

WhatsApp: 03162754504 | Phone: (+92-21) 35122931-5 | UAN: (+92-21) 111-248-338