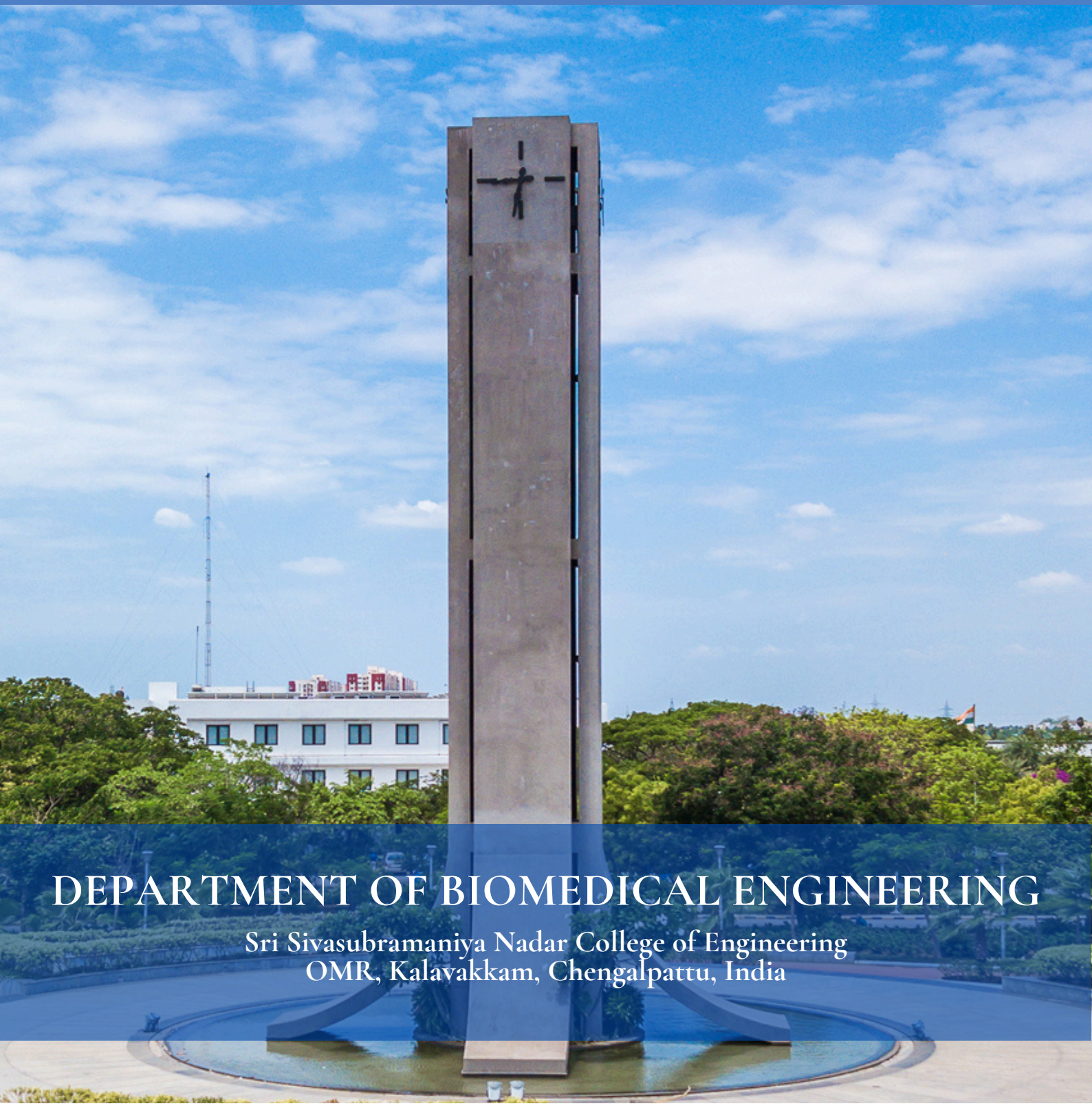
ICBSII 2025

PROCEEDINGS

The XI[th] International Conference on BioSignals, Images and Instrumentation

March 26-28, 2025



DEPARTMENT OF BIOMEDICAL ENGINEERING

Sri Sivasubramaniya Nadar College of Engineering
OMR, Kalavakkam, Chengalpattu, India

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Eleventh International Conference on Biosignals, Images and Instrumentation, ICBSII 2025,
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Proceedings of the XIth International Conference on Biosignals, Images and Instrumentation (ICBSII 2025)

Department of Biomedical Engineering

Sri Sivasubramaniya Nadar College of Engineering

March 26-28, 2025

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From the Chief Patron

Dr. Kala VijayaKumar
President, SSN Institutions

SSN Institutions (SSN) are committed to fostering the holistic development of students. SSN emphasizes not only academic excellence but also essential life skills such as leadership, discipline, teamwork, and time management. Students are encouraged to think critically and creatively, ensuring they are well-equipped for future challenges. SSN takes pride in delivering a well-rounded education that prepares students for both professional and personal success. Biomedical engineering is a rapidly evolving discipline at the intersection of healthcare and technology, playing a pivotal role in revolutionizing medical diagnostics, therapeutic solutions, and healthcare systems.

I commend the Department of Biomedical Engineering at SSN, which in collaboration with the Centre for Healthcare Technologies, is successfully organizing the **Eleventh International Conference on Bio signals, Images, and Instrumentation (ICBSII 2025)** from March 26–28, 2025. The esteemed international speakers for this conference include **Prof. Fong-Chin Su,** Director of the Medical Device Innovation Centre at National Cheng Kung University, Taiwan; **Prof. Hugo from** Universidade Nova de Lisboa, Portugal; **Prof. Pyykko**, Principal Research Scientist at HAMK, Finland; **Dr. Avinash Singh** from the University of Technology Sydney, Australia; and **Prof. Sudesh Sivarasu** from the University of Cape Town, along with distinguished guests from IIT Kanpur, IIT Varanasi and leading medical professionals from renowned hospitals. This array of eminent speakers reflects our steadfast commitment to academic and professional excellence. Their invaluable expertise, ground-breaking research, and diverse experiences will undoubtedly offer fresh perspectives, fostering deeper insights, collaboration, and advancements in the field of biomedical engineering. As the flagship conference of the BME Department, ICBSII 2025 provides an unparalleled platform for students and participants to engage with global experts, enriching their knowledge and professional networks. Conferences of this stature not only encourage academic growth and interdisciplinary collaboration but also provide a broader understanding of the latest innovations shaping the future of healthcare technologies.

I sincerely appreciate the dedication, meticulous planning, and teamwork demonstrated by the organisers and faculty of the Biomedical Engineering Department in making this prestigious event a reality. Their relentless efforts have ensured a high-calibre conference that will inspire meaningful contributions to the betterment of global healthcare.

Dr. Kala VijayaKumar

From the Patron

Dr. S. Radha
Principal, SSN College of Engineering

I am delighted that the Department of Biomedical Engineering of our college, in collaboration with the Centre for Healthcare Technologies, is organizing the Eleventh International Conference on Bio Signals, Images, and Instrumentation (ICBSII 2025) from March 26 – 28, 2025. This event has been meticulously designed to serve the Biomedical Engineering community by fostering collaboration, knowledge exchange, and cutting-edge research discussions. Biomedical Engineering is a dynamic and interdisciplinary field that integrates principles of engineering and medical sciences to develop innovative solutions, including medical devices, diagnostic tools, advanced therapies, and healthcare systems. The department's commitment to diverse academic and research activities, involving both students and faculty has significantly strengthened its foundation, equipping students with a comprehensive understanding of industrial demands and emerging opportunities.

This international conference has been envisioned as a forum to bring together scientists, engineers, and researchers from across the globe. Over the years, it has evolved into a prestigious platform where some of the brightest minds from India and abroad collaborate, exchange knowledge, and contribute toward shared scientific advancements. A special appreciation to the organizing team for their exceptional efforts in bringing both international and national high profile speakers, whose expertise and insights will undoubtedly elevate the quality of discussions at this esteemed conference.

I extend my heartfelt congratulations to the entire team of the Biomedical Engineering Department for their meticulous planning and execution of this event and wish them a great success in making ICBSII 2025 a remarkable and impactful conference.

Dr. S. Radha

From the Conference Chair

Dr. A. Kavitha
Head and Professor,
Department of Biomedical Engineering,
SSN College of Engineering

ICBSII has become an emotion in the Technical arena of the Department of Biomedical Engineering. Since its inception in 2013, we have successfully completed 10 editions so far and we are proud to launch the 11th edition of ICBSII. It is with immense pleasure and enthusiasm that I welcome you to the **11th International Conference on Bio-signals, Images, and Instrumentation (ICBSII 2025)**. This conference brings together researchers, academicians, industry professionals, and students to explore ground breaking innovations and advancements in **Biomedical engineering**—a field that seamlessly integrates healthcare, technology, and engineering.

Biomedical engineering plays a transformative role in revolutionizing medical diagnosis, treatment, and patient care. By combining engineering principles with biological sciences, it has led to the development of cutting-edge medical devices, prosthetics, imaging technologies, and therapeutic solutions, all of which have a profound impact on improving quality of life. ICBSII 2025 serves as a platform to showcase pioneering research, exchange ideas, and foster collaborations that push the boundaries of knowledge and innovation in healthcare. Over the years, **ICBSII has successfully fostered interdisciplinary discussions, inspiring researchers and students to drive meaningful change**. The **Centre for Healthcare Technologies**, a multidisciplinary research initiative, has taken the lead in organizing this prestigious event. Through **workshops, seminars, project exhibitions, and expert talks**, we aim to provide a comprehensive understanding of the latest industry trends, empowering participants to meet the evolving challenges of biomedical engineering.

For over a decade, **ICBSII has served as a hub for knowledge exchange, collaboration, and innovation**. We have hosted highly distinguished speakers from various parts of the globe over the years. As we embark on this exciting journey, let us set new benchmarks, push the boundaries of research, and inspire the next generation of biomedical engineers.

With great confidence and enthusiasm, I welcome you all to **ICBSII 2025 -** a platform where ideas turn into innovations and aspirations transform into achievements. Let us come together to shape the future of healthcare through research, innovation, and collaboration.

Welcome to ICBSII 2025!

Dr. A. Kavitha

From the Organizing chair

Dr.S.Pravin Kumar
Associate Professor, BME
SSNCE

Dr.B.Divya
Assistant Professor, BME
SSNCE

Dr.S.Allwyn
Assistant Professor, BME
SSNCE

We are proud to announce the Eleventh edition of the flagship conference, International Conference on Biosignals, Images, and Instrumentation (ICBSII-2025), a prestigious event that continues to foster academic and industry collaboration in the field of Biomedical Engineering. Biomedical Engineering is at the forefront of revolutionizing healthcare by integrating cutting-edge technology with medical science. Through collaborative efforts, our Biomedical engineers strive to develop innovative solutions that address pressing healthcare challenges, from personalized medicine and AI based diagnosis and therapies to advanced robotic surgeries and wearable health monitoring devices. The IEEE-sponsored Eleventh International Conference on Biosignals, Images, and Instrumentation (ICBSII-2025) is a significant milestone in the field of Biomedical Engineering. We are excited about the opportunities this conference offers to participants worldwide, providing an international platform for researchers, academicians, and industry professionals to share their expertise, collaborate on ground-breaking research, and drive innovation in healthcare.

Conference Highlights: ICBSII-2025 is designed to provide a holistic learning experience through its diverse program, which includes: Workshops and keynote lectures by renowned national and international experts in healthcare research. Parallel technical sessions for students, researchers, academic professionals, and industrialists, offering deep insights into the latest interdisciplinary approaches in Biomedical Engineering. Valuable networking opportunities, enabling participants to connect with distinguished professionals and build collaborations for future research and development. This year, we have received an overwhelming response, with 347 paper submissions. After a rigorous review process, 82 high-quality papers - based on technical merit, content quality, and presentation style - have been accepted for presentation and will be considered for publication in IEEE Xplore, further enhancing their visibility and impact.

Gratitude and Acknowledgments: The success of ICBSII-2025 is a testament to the unwavering support and dedication of various individuals and organizations. We extend our sincere gratitude to: The management of SSN College of Engineering, our President, **Dr. Kala Vijayakumar** (SSN Institutions), and our Principal, **Dr. S. Radha**, for providing us with this incredible opportunity to organize an event of global significance. Our Organizing Chair, **Dr. A. Kavitha**, for her continuous support and invaluable feedback. Our fellow organizers, committee members, supporting staff, and student volunteers from the Biomedical Engineering department, whose meticulous efforts have ensured the smooth execution of this prestigious event. Our external reviewers and contributing authors, whose dedication to scientific rigor has significantly enhanced the quality of the conference. Our sponsors, including **ANRF, Delsys, IEEE Madras Section, IEEE EMBS and Bionics**, for their immense support in making this event a success. With great excitement and anticipation, we warmly invite all attendees to ICBSII-2025. We look forward to an engaging, insightful, and intellectually enriching experience where new ideas will be explored, collaborations will be forged, and the future of Biomedical Engineering will be shaped.

Dedicated to

All the Staff

and

Students

of the

Department of

Biomedical Engineering

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Eleventh

International Conference

on

Biosignals, Images and Instrumentation

(ICBSII 2025)

Keynote Speakers' Profile

Healthcare Innovation on Future of Hospital at Home

About Speaker:

Prof. Fong-Chin Su
Chair Professor & Director
Medical Device Innovation Center
National Cheng Kung University, Taiwan

Prof. Fong-Chin Su obtained a Ph.D. in Mechanical Engineering and Applied Mechanics in 1989 from the University of Rochester. Currently serving as the Executive Director of the Taiwan-Thailand Scientific Research and Technology Innovation Overseas Centre, he is also a University Chair Professor at National Cheng Kung University (NCKU), where he has been a faculty member since 1997. With a distinguished career in biomedical engineering, he has made significant contributions to medical device engineering, motion analysis, orthopaedic biomechanics, sports biomechanics, and rehabilitation. His leadership roles have included serving as Executive Vice President of NCKU, Chairman of multiple research and education foundations, and President of the Academia-Industry Consortium for the Southern Taiwan Science Park. Throughout his career, he has been actively engaged in international academic collaborations, holding positions such as Honorary Editor-in-Chief of the Journal of Medical and Biological Engineering and an advisory member of the International Hand and Wrist Biomechanics Group. His pioneering research in biomedical engineering has led to the successful completion of 69 projects, aligning with the United Nations Sustainable Development Goals (SDGs) to advance global health and innovation.

ABSTRACT

Prof Fong-Chin Su provides valuable insights into the evolution of healthcare through technology, data analytics, and patient-centric care. The Hospital at Home (HaH) model is redefining acute and chronic care by delivering hospital-level treatment in home settings, reducing overcrowding, improving patient outcomes, and lowering costs. Wearable devices and IoT-enabled sensors facilitate real-time health monitoring, while AI-powered early warning systems predict complications for proactive intervention. Telemedicine and AI-assisted diagnostics enhance virtual consultations, making healthcare more accessible and efficient. Robotic automation supports mobility, medication adherence, and rehabilitation, while predictive analytics optimize treatment plans to reduce hospital readmissions. Advanced home therapies, including portable dialysis and AI-driven rehabilitation, accelerate patient recovery and improve quality of life. Block chain technology ensures secure and seamless health data exchange, while smart home integration enhances patient safety through fall detection, voice-controlled alerts, and adaptive home automation. At-home diagnostic kits and biosensors enable rapid testing, facilitating early disease detection and personalized care. By leveraging AI, robotics, and telemedicine, the HaH model is driving a paradigm shift toward data-driven, patient-centred healthcare, ensuring high-quality, cost-effective, and sustainable medical solutions for the future.

Making sense from biosignals

About Speaker:

Dr. Hugo Gamboa
Associate Professor, Physics
Department of Nova School
of Science and Technology
Universidade Nova de Lisboa, Portugal

Dr. Hugo Gamboa obtained his PhD in Electrical and Computer Engineering from Instituto Superior Técnico, Technical University of Lisbon. He is currently a Full Professor at the Physics Department of Nova School of Science and Technology from Universidade Nova de Lisboa. He is the founder and president of PLUX, a company specializing in wireless medical sensors, leading a multidisciplinary team in microelectronics, biosignal processing, and software development. In 2007, he was awarded a grant from the Luso-American Development Foundation, which led him to conduct research at the Pattern Recognition and Image Processing Lab, directed by the worldwide recognized researcher Dr. Anil Jain, at Michigan State University (USA).

From 2000 to 2007, he was a Professor at Escola Superior de Tecnologia de Setúbal, where he taught in the field of Artificial Intelligence and Image Processing. In recognition of his work by the European Biometric Forum, he was among the three finalists of the EBF European Biometric Research Award 2007, which awards PhD works on Biometrics. In 2008, he was the winner of the Portuguese National Award "Futuras Promessas" ISA/Millennium BCP, granted to the best PhD thesis on Physics, Electronics, Informatics or Biomedical Engineering fields. Since 2009, he has been teaching instrumentation at the physics department and set up a research group of 9 (3 researchers and 6 PhD students) devoted to Biosignals within LIBPHYS research centre.

ABSTRACT

From the perspective of collection, processing, feature extraction, and interpretation of biosignals, we will briefly cover the most commonly used biosignals extracted from the heart, brain, hands, muscles, lungs, and voice, among others. We will provide examples and highlight opportunities for generating knowledge and developing applications using biosignals. Additionally, through multivariate biosignal examples, we will demonstrate the extraction of identity, location, activity, and personality based on behaviors reflected in biosignals. Throughout the presentation, we will showcase research examples conducted at Nova University of Lisbon in collaboration with PLUX and Fraunhofer.

Improving healthcare with Artificial Intelligence

About Speaker:

Dr. David Belo
Founder and CEO
SAFE AI [4U], Portugal,
Distinguished Visiting Faculty, SSNCE

Dr. David Belo is a seasoned biomedical engineer specializing in the application of machine learning to biosignal analysis. With a Ph.D. in Biomedical Engineering from Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa, David's expertise encompasses deep learning applications in biosignal processing, particularly in electrocardiography (ECG) and electromyography (EMG). As the Founder and CEO of SAFE AI [4U], he leads the charge in developing responsible AI solutions for healthcare, emphasizing the ethical synthesis of data. David's diverse experience includes serving as an AI and biosignal expert at NASA's Frontier Development Lab (FDL) and managing projects such as AISym4Med under Horizon Europe.

With a focus on promoting responsible AI practices and advancing data synthesis techniques, David is committed to driving innovation at the intersection of technology and healthcare. Currently he has taken an additional role of distinguished visiting faculty at department of BME, SSN college of engineering.

ABSTRACT

Artificial Intelligence (AI) is revolutionizing healthcare by enhancing diagnostics, optimizing treatments, and improving patient outcomes. AI-driven technologies such as machine learning, natural language processing, and computer vision enable precise and efficient medical care. AI significantly improves medical imaging by detecting anomalies in X-rays, MRIs, and CT scans, facilitating early disease diagnosis. Clinical decision support systems analyse electronic health records to predict disease progression, recommend treatments, and enhance resource allocation. AI-powered Chabot's and virtual assistants streamline patient engagement, while AI accelerates drug discovery by identifying promising candidates and optimizing trials. AI is also pivotal in genomics and precision medicine, tailoring treatments based on genetic profiles. Remote patient monitoring via AI-driven wearable's helps manage chronic diseases. Challenges include data privacy, ethical concerns, and regulatory compliance. Collaboration among AI researchers, healthcare professionals, and policymakers is crucial for maximizing AI's potential and creating a more efficient, patient-centred healthcare system.

Neuro Adaptive Brain Computer Interfaces

About Speaker:

Dr. Avinash Singh
Senior Lecturer,
School of Computer Science, University of Technology, Sydney, Australia

Dr Avinash Singh is a Senior Lecturer (~Associate Professor) at the School of Computer Science at the University of Technology Sydney (UTS), Australia. He serves as a co-chair of the IEEE Neuroethics Framework for the Workplace, sponsored by IEEE Brain, a member of the IEEE Standards Committee on Unifying Brain-Computer Interfaces (BCI) and an expert panel on Institute of Neurotechnology and Law, UK. In 2021, he was awarded the Google TensorFlow Faculty Award to support and promote his work in BCI. Additionally, he actively advocates for and supports transhumanism and founded the India Future Society, a think tank. Dr Singh completed his PhD in Computer Science in 2019 at UTS, Australia, collaborating with the Technical University of Berlin, Germany, the University of California San Diego, USA and the US Army Research Lab.

Before earning his doctorate, he received a Master's in Software Systems in 2013 from Birla Institute of Technology and Science Pilani, India. Working at the intersection of machine learning, cognitive neuroscience, and mixed-reality, Dr. Singh is dedicated to designing and developing real-world neuroadaptive BCI systems. His current research interests include integrating artificial intelligence (AI) technologies with cognitive neuroscience knowledge to explore cognitive functions, discover relationships between brain dynamics, evaluate everyday interactions and make decisions to develop robust next-generation neuroadaptive BCIs.

ABSTRACT

Neuroadaptive interfaces are advanced brain-computer interfaces (BCIs) designed to create smooth and efficient interactions between people and external systems like computers, prosthetics, or virtual environments. Unlike traditional BCIs, which simply translate brain signals into commands, neuroadaptive interfaces adjust their functions based on a person's mental state. Using AI, machine learning, and neuroscience, these systems continuously analyze brain activity to personalize responses and improve interactions. In healthcare, they can assist patients by adapting rehabilitation therapies based on cognitive load and engagement. In everyday technology, they help people with disabilities control devices more easily. Beyond accessibility, neuroadaptive interfaces have potential in education, gaming, and work. They can tailor learning experiences, create immersive games that respond to emotions, and optimize workplace productivity by reducing mental fatigue. By making technology more intuitive and responsive, these interfaces are changing how we interact with digital environments.

Synergy of Medicine and Engineering - The Need of the hour

About Speaker:

Dr. Sudhir Ganeshan
Associate Professor and Senior Consultant
Ortho Spine Surgeon
Sri Ramachandra Institute of Higher Education and Research, Chennai, India

Dr. Sudhir Ganeshan is a highly accomplished spine surgeon with over a decade of experience specializing in minimally invasive spine procedures, spinal biomechanics, and degenerative spine disorders. He holds degrees including an MBBS, DNB (Ortho), MNAMS, and FNB (Spine Surgery), having trained at Sir Ganga Ram Hospital (New Delhi), Queen's Medical Centre (UK), and St. Anna's Hospital (Germany). He is the Secretary of the Chennai Ortho Spine Society and an AO Spine Asia Pacific Delegate Council Member, with memberships in prestigious organizations like the North American Spine Society and Association of Spine Surgeons of India. An esteemed researcher, he authored the "Encyclopedia of Orthopaedic Classifications" and contributed to the Springer-published "Advances in 3D Printing & Additive Manufacturing Technologies".

His work has been featured in top journals such as the Global Spine Journal and Asian Spine Journal, focusing on spinal biomechanics, sacropelvic parameters, and surgical techniques. His research includes the role of platelet-rich plasma in spinal fusion, the impact of Type 2 diabetes on intervertebral disc degeneration, and ligamentum flavum hypertrophy correlations. He received multiple accolades, including the AO Spine Asia Pacific Research Grant Award, Tamil Nadu Orthopaedic Association Foreign Fellowship Award, and several Gold Medals for academic excellence and research. He has presented internationally, including at World Spine Essay (WSE) 2019 in China, and has served as a keynote speaker and faculty at major spine surgery conferences. A leader in spinal research, education, and surgical innovation, He continues to advance spine surgery through clinical expertise, mentoring, and cutting-edge research. His vision for integrating engineering, AI, and regenerative medicine in spinal surgery is shaping the future of the field.

ABSTRACT

The synergy of medicine and engineering is revolutionizing healthcare, making interdisciplinary collaboration essential. Dr. Sudhir Ganeshan highlight engineering innovations—AI-driven diagnostics, biomedical imaging, robotics, biosensors, and regenerative medicine—that enhance precision, automation, and data-driven decision-making. Advances like MRI, CT, AI-powered diagnostics, targeted drug delivery, and wearable biosensors are improving early disease detection, treatment, and accessibility. Telemedicine and nanotechnology are transforming care, but challenges such as regulation, ethics, and data security remain. He will stress the need for interdisciplinary education, responsible AI adoption, and policy-driven innovation. The COVID-19 pandemic underscored this urgency, and future progress will depend on research, industry collaboration, and technology-driven solutions to improve global healthcare.

Robotic-Assisted Surgery in Orthopaedics

About Speaker:

Dr.Sivaraman B
Shoulder & Elbow Surgeon,
Apollo Hospitals, Chennai, India

Dr. Sivaraman B is a fellowship-trained expert in Shoulder & Elbow Surgery with over 17 years of experience, including 13 years in the UK's National Health Service (NHS). He has served as a Consultant at Doncaster & Bassetlaw Teaching Hospitals NHS Foundation Trust, specializing in arthroscopic procedures, joint replacements, and complex upper limb trauma surgeries. Passionate about medical education, he has mentored orthopedic registrars and is an Advanced Trauma Life Support (ATLS) Instructor in both the UK and India. A dedicated academician, Dr. Sivaraman has led prestigious workshops, including the Chennai Shoulder Course, and serves as faculty for various national and international orthopedic programs. His research contributions span key topics in orthopedics, with publications in leading journals such as *Injury*, *Musculoskeletal Surgery*, and *International Journal of Shoulder Surgery*. A member of esteemed organizations like the Royal College of Surgeons of Edinburgh, British Orthopaedic Association, and Indian Shoulder & Elbow Society, Dr. Sivaraman is a recognized leader in orthopedic surgery and medical training.

ABSTRACT

Robotic-assisted surgery is revolutionizing orthopaedic procedures by enhancing precision, minimizing invasiveness, and improving patient outcomes. Dr. Sivaraman explores how robotics is transforming joint replacements, spinal surgeries, and fracture fixations, offering greater accuracy than traditional methods. These systems integrate real-time imaging, AI-driven navigation, and haptic feedback, allowing surgeons to plan and execute procedures with sub-millimetre precision. In knee and hip replacements, robotic assistance ensures optimal implant positioning, leading to faster recovery and better joint functionality. Spinal surgeries benefit from enhanced stability and reduced risk of complications, while robotic arms in fracture fixation provide improved alignment and reduced trauma to surrounding tissues. The use of machine learning in surgical planning further refines patient-specific procedures, ensuring personalized treatment strategies. Compared to conventional techniques, robotic-assisted surgeries reduce hospital stays, lower infection rates, and enhance long-term joint function. Despite these advancements, challenges such as cost, training, and accessibility remain barriers to widespread adoption. Dr. Siva Raman will address these issues, emphasizing the need for continued research, interdisciplinary collaboration, and training programs to integrate robotics into mainstream orthopaedic practice.

Smart Wearable Textiles that Foster and Elevate Connections in Esports Teams

About Speaker:

Dr.Satu Jumisko-Pyykkö

Principal Research Scientist at HAMK Häme University of Applied Sciences / CEO at Tuntee Oy / Adjunct prof at University of Lapland, Finland

Dr. Satu Jumisko-Pyykkö is a versatile user experience research professional with over 12 years of expertise in UX, quality of experience, and research methods. Her multidisciplinary background spans computer science, psychology, design, and education, with a strong focus on user-cantered design, service design, and design thinking for data science. She has led research in diverse applications, including AR, VR, mobile 2D/3D video, reading, ecommerce, wearable technology, and cross-device interaction.

With 10+ years in higher education, she has mentored students from bachelor to PhD levels, specializing in UI design, human factors, qualitative methods, and cognitive psychology.

A seasoned industry and academic professional, she has contributed to EU and nationally funded projects, previously serving as UX Research Director at Vincit and adjunct professor at Tampere University of Technology. Currently, she is a Principal Research Scientist in Smart Design at HAMK and an Adjunct Professor at the University of Lapland. With over 70 scientific publications, Dr. Jumisko-Pyykkö continues to drive innovation at the intersection of technology, design, and human experience.

ABSTRACT

Sports teams use touch communication to enhance cooperation and performance. In esports, previous research builds understanding on audiovisual communication and teamwork. Previous mediated touch research focused on close dyadic communication. However, the designing of mediated touch and understanding its impact on multiplayer e sports teams are uninvestigated. The keynote presents a design and evaluation of smart wearable textiles to foster a social connection in esports teams using mediated touch. We develop smart sleeves including textiles with hard and flexible electronics, and a mobile application with wireless communication using human-centered design. A mixed method evaluation study was conducted with CS:GO teams. The results highlight that use of Spiritus Ludi among team members is an elevating and encouraging gesture which strengthens positive emotions, builds connection and team spirit. The structure and performance of the game guides its use. We contribute new understanding on mediated team touch in competitive esports.

Applications of AI in Neuroimaging

About Speaker:

Dr. A. R. Jac Fredo
Assistant Professor
School of Bio-Medical Engineering
IIT (BHU), Uttar Pradesh, India

Dr. Jac Fredo completed his undergraduate degree in Electrical and Electronics Engineering from Anna University (2004-2008), focusing on biomedical signal processing for FPGA devices. In 2009, he earned a Master's in Instrumentation Engineering from Madras Institute of Technology, collaborating on brain signal processing and presenting his research at a conference in Pune.

In 2010, he became a Junior Research Fellow at Anna University, working on brain imaging projects for his Ph.D. under Dr. G. Kavitha. His research identified brain-based markers for autism using imaging tools like SPM8 and Matlab. He published six journal articles and five conference papers while teaching at Anna University.

After earning his Ph.D. in 2015, Dr. Jac worked as a Project Associate at IIT Madras and then as an Assistant Professor at VIT University, focusing on Biomedical Instrumentation. He was awarded a grant in 2016 for postdoctoral research at San Diego State University, developing machine learning models for autism. He later joined Nanyang Technological University, working on brain connectivity and deep learning, followed by research at RWTH Aachen, studying autism traits and neuroimaging. Dr. Jac recently became an Assistant Professor in the School of Biomedical Engineering at IIT (BHU), Varanasi, India.

ABSTRACT

This talk explores advanced machine learning and deep learning approaches for Autism Spectrum Disorder (ASD) diagnosis using neuroimaging data. Topics include comparative evaluations of morphological, volumetric, and connectivity-based features from sMRI, fMRI, and DTI, leveraging wavelet transforms, convolutional neural networks, fractal connectivity, and unsupervised learning for improved ASD classification and subtype characterization.

Artificial Heart: Opportunities & Challenges

About Speaker:

Mr. Sarath S. Nair
Scientist/ Engineer F,
Dept. of Medical Devices Engg.,
Sree Chitra Tirunal Institute for Medical Sciences and Technology,
Govt. of India

Mr. Sarath S. Nair holds an M.Tech in Electrical Engineering from NIT Calicut (2009), where he was a First Rank Gold Medalist, and a B.Tech from TKM College of Engineering (2006). He has extensive professional experience and is currently an Engineer F at SCTIMST. Previously, he served in various engineering roles at SCTIMST (2012–2021), worked as an Advanced Manufacturing Engineer at GE Healthcare (2011–2012), an Assistant Professor at Amrita University (2009–2011), and an Engineer at Larsen & Toubro (2006–2007). Mr. Sarath has received several prestigious awards, including the DST-SERB-INAE APJ Abdul Kalam National Technology Innovation Fellowship (2023), Best Biomedical Technology Innovation Award (2022), SBAOI MAHE Young Scientist Award (2020), and Best Assistive Device Engineering Award at MEDIC 2019. He was also recognized by GE Healthcare, Schneider Electric, and L&T for his contributions.

Actively involved in industry collaborations, he has partnered with companies like KELTRON, en Products, Meril Life Sciences, Agape Diagnostics, and Wipro 3D for the commercialization of medical devices. His research focuses on Total Artificial Heart (TAH), Ventricular Assist Devices (LVAD), implantable pumps, AI-enabled anaesthesia delivery, patient warming systems, and point-of-care diagnostics. Through innovation and industry partnerships, he continues to make significant contributions to biomedical engineering

ABSTRACT

End-Stage Heart Failure is a critical condition affecting over 8 million people globally by 2030, with donor heart shortages highlighting the need for circulatory support solutions. Artificial hearts, including Total Artificial Heart (TAH) and Ventricular Assist Devices (VAD), help maintain blood circulation. While TAH options like Syncardia (USA) and Carmet (France) exist, VADs are more widely used but remain costly and inaccessible in India. Recent advancements in miniaturized LVADs offer minimally invasive solutions, yet affordability and availability remain challenges. SCTIMST is developing Chitra LVAD, a next-generation, magnetically levitated pump, positioning India as the fifth country to achieve this technology. This initiative not only bridges the medical technology gap but also strengthens India's medical device manufacturing sector, paving the way for future innovations and a more robust healthcare ecosystem.

Neuroengineering for Mental Health: Understanding Suboptimal Decision-Making in Anxiety

About Speaker:

Dr. Arjun Ramakrishnan joined the BSBE department at IIT Kanpur in December 2019. He trained as a Research Associate at the University of Pennsylvania and was a postdoctoral associate at Duke University. He holds a Ph.D. in Neuroscience from NBRC, Gurgaon, and a B.E. from BMS College, Bangalore. His research explores how the brain processes information to make decisions, the impact of reward, arousal, and stress, and biomarkers for mental health conditions like anxiety and depression. At IIT Kanpur, he employs a comparative approach, studying humans and nonhuman primates using EEG, eye tracking, pupillometry, heart rate, and neurophysiology techniques. His work integrates neuroscience, psychology, statistics, and economics to gain deeper insights into decision-making.

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Dr. Ramakrishnan is the co-founder of Cogwear Technologies, a neuroscience startup that develops wearable EEG sensors for real-time human experience measurement. He also serves as a scientific advisor at Neuroflow, a digital healthcare startup that leverages biometric data to assess physiological and mental states. Through his research and entrepreneurial ventures, he aims to bridge neuroscience and technology to enhance our understanding of brain function and mental health.

ABSTRACT

Anxiety and depression impair decision-making, yet their neural mechanisms remain unclear. Our research examines patch foraging behaviour—guided by the Marginal Value Theorem (MVT)—to study how individuals balance rewards and costs. Anxiety may disrupt this process, leading to suboptimal choices. We focus on the anterior cingulate cortex (ACC), involved in reward-effort trade-offs, and the locus coeruleus (LC), a key stress regulator. Using a patch foraging game, we track stress responses via cortisol, norepinephrine, pupil dilation, and EEG theta-beta ratios. Anxious individuals tend to leave patches prematurely, correlating with stress biomarkers. In collaboration with Cog wear, we are developing AI-driven EEG models for real-time anxiety monitoring. This non-invasive approach enables early diagnosis and personalized treatment, integrating computational modelling, neurophysiology, and AI to enhance understanding of anxiety and decision-making.

Breaking Barriers in Medical Device Innovation and Translation

About Speaker:

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Prof. Sudesh Sivarasu is the DSI/NRF–SARCHi Research Chair in Biomedical Engineering Innovation and a Professor at the University of Cape Town (UCT). He directs the Biomedical Engineering Research Centre and leads UCT MedTech. As UCT's second most prolific inventor, he holds 65+ patent applications across 21 families, with 26 granted patents globally. His innovations led to three UCT-based start-ups reScribe Therapy, Impulse Biomedical, and VAS MedTech. He founded the Medical Devices Lab, co-founded the Orthopaedic Biomechanics Lab, and developed the FrugalBiodesign™ methodology. His research has resulted in ground-breaking medical technologies, including reScribe, Laxmeter, PatRig, Zibipen, and the FlexiGyn platform, focusing on affordable and accessible healthcare solutions. An accomplished mentor, he has supervised 43 graduates, including 5 Ph.Ds, and currently mentors 18 students.

His work includes 50+ journal papers, 52 conference papers, a book, and 12 book chapters. Prof. Sivarasu has received multiple awards, including the NSTF-South32 TW Kambule Award and the UCT Deputy Vice-Chancellor's Award. A GYA and SAYAS member, he continues to advance biomedical engineering through innovation, research, and entrepreneurship.

ABSTRACT

Medical device innovation is critical to advancing healthcare, yet translating these innovations into clinical practice remains a complex and multifaceted challenge. Key factors influencing this translation process include identifying unmet clinical needs, stakeholder engagement, and developing a robust market strategy. The iterative nature of device development, which involves early feasibility studies and randomised clinical trials, is essential for optimising device design and ensuring safety and efficacy. Additionally, integrating interdisciplinary knowledge from biology, medicine, and materials science is crucial for bridging the gap between basic research and clinical application. Regulatory landscapes and intellectual property considerations also play significant roles in the translation process, as they can either facilitate or hinder the progression of medical devices from concept to market. Furthermore, intrinsic motivation and creative thinking among innovators are vital for overcoming the inherent challenges in medical device development. Collaborative efforts between academia and industry and adequate funding and support are necessary to accelerate the commercialisation of innovative solutions. Addressing these factors holistically can enhance the translation of medical device innovations, ultimately improving patient care and healthcare delivery. The abstract and presentation would highlight some key success strategies from an LMIC perspective.

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TRACK 1

IoT based Gesture-Controlled Mouse System for Individuals with Hand Impairments

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Abstract:

Gesture recognition systems has a broad range of applications across various fields. The ability to control and interact with devices using hand or body gestures is revolutionizing our interaction with technology. The gesture-controlled mouse system presents an exciting alternative to traditional input devices like the mouse and keyboard. However, it also comes with a range of challenges that need to be addressed to make it widely accessible, accurate, and practical. Therefore, this paper focuses on developing a IOT based gesture-controlled mouse system specifically designed for individuals who are hand-impaired or have no hands. The primary goal is to allow users to control a computer purely through hand gestures and movements, without the need for physical touch. The proposed system utilizes an Arduino Uno microcontroller, a gyroscope and servo motors, to create an innovative, hands-free interface for computer interaction. The experimentation demonstrates that low-cost, affordable, and commercially available components, combined with Arduino-based programming are leveraged to create an assistive technology that improves digital accessibility. By enabling hands-free computer use, this gesture-controlled mouse system enables individuals with impairments overcome barriers to digital interaction and participates more fully in online and computer-based activities.

Keywords: Gesture-Controlled Interface, Gyroscope-Based Control, Assistive Technology, Hand Impairment, Arduino-Based System.

Prediction of Epileptic Seizures from EEG signals Using Liquid Time-Constant

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Abstract:

Epileptic seizures significantly affect the health and quality of life of patients. Accurate prediction of seizures using EEG data can provide early warnings and improve intervention strategies. This paper explores the application of Liquid Time-Constant (LTC) networks, a recent innovation in recurrent neural network architectures, to classify epileptic events from EEG signals. The proposed methodology utilizes the Mendeley EEG dataset, and achieves a remarkable accuracy of 98% compared to conventional convolution neural networks (CNN), which signifies the diagnostic potential in a clinical setting and can improve patient safety by minimizing false negatives and ensures timely intervention by the physicians. Experimental results demonstrate the efficacy of LTC networks in seizure prediction tasks, notably in regard to the rapid convergence and flexibility in handling the complex temporal relationships present in EEG inputs.

Keywords: Epileptic seizures, convolution neural networks, liquid-time-constant networks, EEG, seizure prediction, neural networks.

Detecting Schizophrenia through EEG signals using Deep Learning

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Abstract:

Millions of people between the ages of 16 to 30 are diagnosed with Schizophrenia every year. Schizophrenia is a serious mental disorder characterized by abnormalities in the individual's cognition, emotional as well as physical responses. This study examines the detection of schizophrenia using electroencephalogram (EEG) signals collected from the human brain. EEG signals provide valuable information about cognitive responses of an individual and have the potential to serve as a biomarker for diagnosing schizophrenia. This study analyzes a large dataset of EEG signals from people with and without schizophrenia using advanced machine learning and signal processing techniques. We aim to demonstrate a robust and accurate classification model for distinguishing schizophrenic patients from those not affected by it, based on data recorded through Electroencephalogram signals. Various features are extracted from EEG signals, including frequency domain measurements, event-related potentials, and connectivity patterns. These features are then used to train and evaluate various machine learning as well as deep learning algorithms such as convolutional neural networks (CNNs), Ensemble Methods, Support Vector Machines (SVMs), etc. Performance of the deep learning model was evaluated using various statistical metrics like accuracy, sensitivity, specificity, and the area under receiver operating curve (AUC - ROC). It is found that the potential of EEG-based methods for early schizophrenia detection and monitoring, improving clinical diagnosis and treatment strategies.

Keywords: Convolutional neural networks, Deep Learning, Electroencephalogram, Schizophrenia, Healthcare Technology, Mental Illness.

MINDCHRONO: A COMPARATIVE STUDY OF DEEP LEARNING MODELS FOR EEG-BASED DEPRESSION DETECTION

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Abstract:

Clinical depression is a widespread mental health disorder that significantly impacts an individual's quality of life and societal productivity. Traditional diagnostic approaches primarily rely on subjective assessments, including self-reported symptoms and clinical interviews, which can lead to inconsistencies and delayed interventions. To address these challenges, this study explores an EEG-based deep learning framework that automates depression detection, ensuring objective, scalable, and real-time assessment.

This study utilizes the EEG Psychiatric Disorder Dataset, which includes EEG recordings from X depression patients and Y healthy controls, ensuring a well-balanced dataset for model evaluation.. The dataset contains 1149 EEG features, including Power Spectral Density (PSD), Hjorth parameters, coherence, and quantitative EEG (qEEG) variables, capturing brainwave activity across multiple frequency bands. EEG signals undergo a comprehensive preprocessing pipeline, incorporating band-pass filtering, independent component analysis (ICA), and normalization to enhance signal clarity and reduce noise artifacts. Three state-of-the-art deep learning models—Transformers, Recurrent Neural Networks (RNNs), and Long Short-Term Memory Variational Autoencoders (LSTM-VAEs)—are employed to analyze the processed EEG signals. Transformers, leveraging self-attention mechanisms, achieve the highest classification accuracy of 95%, outperforming RNNs (91%) and LSTM-VAEs (89.95%). The superior performance of Transformers is due to their ability to capture long-range dependencies in EEG sequences, improving feature representation and classification accuracy. This study underscores the critical role of model selection in EEG-based depression detection, demonstrating that deep learning techniques can significantly improve diagnostic reliability, automation, and scalability. By reducing reliance on subjective clinical evaluations, the proposed approach paves the way for real-time, data-driven mental health diagnostics, improving accessibility and early intervention strategies.

Keywords: EEG, deep learning, depression detection, Transformers, RNNs, LSTM-VAEs, neuropsychiatric diagnostics, automated mental health assessment.

Adaptive Deep Knowledge Framework for classifying Sleep Stage using Deep Feature Learning

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Abstract:

Conventional wisdom holds that sleep is a universal, simultaneous event that impacts every part of the brain. An electroencephalogram (EEG) is a non-stationary and nonlinear way to monitor brain electrical activity. EEG signals have many applications, from researching the most fundamental parts of the sleep cycle to vital components of medical diagnosis. But up until recently, scientists didn't know much about the specifics of how distinct EEG characteristics relate to the stages of sleep. The feature extraction method was used immensely for accurately classifying EEG data throughout different stages of sleep. This research aims to use the Channel Based LSTM Convolution Network (CLCN) design to improve subject-independent classification accuracy. We compare this model's output to those of three other ML techniques. After comparing the suggested feature extraction method to the other available options, the findings show that it produces the best classification accuracy. Applying the SleepEDF EEG dataset to a five-class classification task yields the best classification accuracy of 95.78%.

Keywords: Sleeping Stage Classification, EEG Signal Processing, EEG Signal Feature Extraction.

Improved Prenatal Brain Anomaly Detection Using Xception Architecture with Attention Mechanisms and region- Based Segmentation

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Abstract:

Neo-natal brain problems complicate prenatal care,which requires prompt and precise diagnosis to ensure proper treatment. Deep learning-based techniques present a viable remedy by automating the identification of prenatal brain anomalies. A novel framework combining the Xception architecture with attention processes improves anomaly detection by giving priority to diagnostically important regions. While depth-wise separable convolutions enhance feature extraction, spatial attention approaches enhance accuracy and interpretability significantly. Important anatomical features are separated using regionbased segmentation in this methodology. The AdamW optimizer ensures improved generalization and training efficacy. In experiments, the accuracy rate 92.5% and computational efficiency of identifying neural tube defects and ventriculomegaly become significantly higher than with traditional convolutional neural networks.

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A Medical Chatbot for Diabetic Patients Using Artificial Intelligence

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Abstract:

The quick rise in diabetes cases globally underscores the essential need for technology-driven, innovative management solutions. The project gives the introduction about the cutting-edge in AI-based chatbot tailored for diabetic patients. The combination of Support Vector Machine (SVM), K-Nearest Neighbors (KNN), results the chatbot to provide highly accurate, personalized recommendations to improve self-management. The added advantage is the inclusion of voice-based interaction which offers enhanced accessibility, especially for the elders and visually impaired persons. This study demonstrates about the ability of the chatbot to interpret the complex health data, delivers the real-time insights, and promote adherence to the treatment plans. The advancement in the fusion of machine learning algorithms and voice interaction secures a dynamic and user-friendly experience for diabetes management.

Keywords: Diabetes Management, Chatbot, Artificial Intelligence, Machine Learning, SVM, KNN, Voice Interaction, Personalized Healthcare.

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TRACK 2

Diabetic Retinopathy From Retinal Imaging

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Abstract:

Retinopathy is a sort of ocular disease that caused by diabetes damages the retina's blood vessels, which holds irreversible impairment or blindness unless treated. The usual mode used for identifying Diabetic retinopathy takes a lot of time and is prone to mistakes made by people. because of the intricacy involved in the anatomy of the eye. Numerous automated techniques have been put forth to identify diabetic retinopathy. from fundus images. However, these methods have limitations with regard to the detection of the subtle features characterizing diabetic retinopathy, particularly in its early phases. In this study, we present a contemporary method for identifying diabetic retinopathy using the CNN-based approach. The proposed network extracts feature by using two different DL architectures, namely Resnet50 and Inceptionv3, and then combines the features. To classify, feed these into the CNN. A dataset of fundus images that are accessible to the public is used to illustrate the effectiveness of the suggested model. The findings of the trial indicate that the suggested CNN model outperforms various models with accuracy 95.84%, sensitivity 98.18%, specificity 97.82%, precision 95.44%, and f1 score of 99.65%.

Keywords: Diabetic retinopathy, IRC, Image enhancement, CNN (IRN CNN).

Particle Swarm Optimization of CNN for Early Parkinson's Disease Detection

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Abstract:

Parkinson's Disease (PD) is a progressive, chronic neurological disease that causes motor dysfunction and for which timely diagnosis is crucial. This study proposes the optimization of Convolutional Neural Networks (CNNs) using Particle Swarm Optimization (PSO) for PD detection based on brain MRI images. CNN models used in the current research trends are typically manually configured, and the process can be time-consuming with the models not being very accurate. This study utilizes PSO, an algorithm that mimics the behavior of swarms, to automate the network architecture optimization for higher diagnosis accuracy. The model was trained on 6166 MRIs of PD patients and healthy controls. PSO also optimally adjusted the hyperparameters during the training phase so that its performance was enhanced. The proposed model gave a classification accuracy of about 98%, a precision of 98% for the healthy class, and a recall of 97% for the PD class. It also shows that the application of PSO makes a great improvement to the CNN architecture, and the following PD detection performs better than previous conventional methods. Therefore, it can be stated that the proposed model can be beneficial for early PD diagnosis and provide clinicians with an effective way of analyzing MRI images without the need for human input.

Keywords: Convolutional Neural Network, Magnetic Resonance Imaging, Parkinson's Disease, Particle Swarm Optimization.

Analysis of Blood flow in Carotid Artery at Various Blood viscosities during Rest and Physical exercise

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Abstract:

Blood viscosity has direct effect on cerebral flow, in the sense higher the viscosity lower is the cerebral blood flow. Hence junction of carotid artery (CA), that is prone to the formation of clog is analyzed for flow parameters like velocity and pressure at different values of blood viscosity. CA is extracted from magnetic resonance images and imported into ANSYS. By assuming two conditions of blood flow; one in physical exercise and another in rest condition, flow parameters are assessed for four different viscosity values. Result of this study shows that the pressure is highest in the bifurcation junction of CA which is found to increase with viscosity value. However, the increase in pressure and velocity is aggravated with physical exercise. Therefore, it can be inferred that subjects with elevated blood viscosity due to an underlying pathological condition may have an increased risk of developing atherosclerosis when undergoing physical exercise. Hence, this study could be useful in providing alerts or recommendations regarding the appropriate level of physical exercise for individuals with a higher haematocrit percentage or any physiological condition that leads to increased blood viscosity.

Keywords: Carotid Artery, Blood flow, Exercise.

Deep Learning-Based Automated Breast Cancer Ultrasound Image Classification: A Study

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Abstract:

Breast cancer is a major public health concern worldwide, and early detection has the potential to improve treatment outcomes. This study evaluates various DL models for their effectiveness in identifying breast cancer using ultrasound images. Data preprocessing, Feature extraction, and binary classification have been thoroughly conducted throughout the study procedure. MobileNet and MobileNetV2 offer computational efficiency, whilst the Xception model excels in feature extraction. The intricate design of VGG16 and VGG19 ensures consistent accuracy and comprehensive feature representation. Among them, VGG19 is the model that has the best categorisation accuracy, exceeding 96%. The performance statistic encompasses accuracy, precision, recall, and F1-score, utilising five-fold cross-validation. This work illustrates the ability of DL to improve clinical decision-making in diagnostic imaging and facilitate early diagnosis of breast cancer.

Keywords: Breast cancer, Ultrasound images, DL, Binary Classification, Detection, ML, Prediction, Early Diagnosis, Technical learning.

Transfer Learning with Deep Convolutional Neural Networks for Esophageal Cancer Classification

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Abstract:

Esophageal cancer is a critical health concern requiring accurate and timely diagnosis. This study investigates the use of transfer learning with pretrained convolutional neural networks (CNNs) for classifying endoscopic images. Six state-of-the-art models EfficientNetB7, VGG19, DenseNet121, ResNet50, InceptionV3, and InceptionResNetV2 were fine-tuned and evaluated on key performance metrics. EfficientNetB7 achieved the highest accuracy of 99.7%, followed by VGG19 (99.7%), DenseNet121 (99.7%), ResNet50 (99.5%), InceptionV3 (98.7%), and InceptionResNetV2 (98.3%). This performance underscores the efficacy of transfer learning in leveraging feature-rich pretrained models for medical image classification. The proposed approach demonstrates its potential as a robust and efficient diagnostic tool for automated esophageal cancer detection, supporting clinical decision-making with high precision.

Keywords: Esophageal Cancer, Endoscopic Image Classification, Transfer Learning, Pretrained Models, Convolutional Neural Networks, Image-Based Cancer Classification.

Hybrid Ensemble Methods for Acute Lymphoblastic Leukemia Diagnosis: Integrating CNN Features with Artificial Rabbits Optimization Algorithm

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Abstract:

Acute Lymphoblastic Leukemia (ALL) is a rapidly advancing blood cancer that necessitates timely and accurate diagnosis for effective treatment. This project presents a hybrid approach for ALL classification by utilizing advanced methods for feature extraction and integration. The DenseNet121, ResNet101 and MobileNet models are employed to extract various features from microscopic blood smear images. Principal Component Analysis (PCA) is used to select the most relevant features, which are then combined using advanced integration techniques to merge complementary information. To further improve the performance of the integrated features, the Artificial Rabbits Optimization (ARO) algorithm is applied to refine the feature set by selecting the most discriminative attributes. The optimized feature set is then passed through Random Forest (RF) and XGBoost classifiers, resulting in precise and reliable predictions. This hybrid framework achieves a classification accuracy of 0.96, demonstrating its potential for accurate detection and differentiation of ALL cells from healthy cells.

Keywords: Acute Lymphoblastic Leukemia, Convolutional Neural Networks, Artificial Rabbits Optimization, Feature Optimization, DenseNet121, ResNet101, MobileNet, Random Forest, XGBoost classifier.

Image Enhancement using linear filters for Rectal Cancer Diagnosis using MR Images

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Abstract:

Computer-aided diagnosis (CAD) is an efficient tool in analyzing medical images for the diagnosis and staging of rectal cancer. Magnetic Resonance Imaging (MRI) plays a crucial role in the detection and evaluation of rectal cancer due to its high-resolution imaging capabilities. This paper discusses the pre-processing methods for MR images of rectal cancer, which facilitate further image analysis for diagnosing the stage of cancer. Pre-processing is a critical step for MR images, aiding in subsequent steps of segmentation and classification. This paper investigates the impact of widely used pre-processing techniques. Initially, pelvic DICOM images are provided as input. By combining three filters—mean, median, and adaptive median filters—the noise is removed from the image. Image enhancement techniques such as Adaptive Histogram Equalization (AHE) and Contrast Limited Adaptive Histogram Equalization (CLAHE) are used to enhance the quality of the image. Statistical parameters like Peak Signal-to-Noise Ratio (PSNR), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Structural Similarity Index Measure (SSIM) are used to evaluate performance. Results indicate that CLAHE provides superior outcomes.

Keywords: Computer-aided diagnosis, Magnetic Resonance Imaging, AHE, CLAHE, PSNR, MSE, RMSE, SSIM.

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TRACK 3

Thermogravimetric Analysis and Tensile Testing of PEEK structures Fabricated via Extrusion and 3D Printing

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Abstract:

Polyether ether Ketone (PEEK) is a thermoplastic polymer with superior chemical resistance, thermal stability, flame retardancy and mechanical properties. It is also known for its biocompatibility. The mechanical properties of PEEK are in the similar range as that of human bone making it preferable over metals for orthopaedic implant fabrication. PEEK is also FDA-approved material for orthopaedic applications. Additive manufacturing has emerged as a efficient method to fabricate complex and customizable structures. The process of extrusion of PEEK into a filament aids in additive manufacturing and hence extrusion of PEEK and 3D printing has to optimized for obtaining desired properties. This work reports the extrusion of PEEK filament from pellets and fabrication by 3D printing. The thermal and mechanical properties of extruded filament and 3D-printed dog bone samples were evaluated respectively. The filament of 1.75mm diameter was produced by extruding PEEK pellets in an extruder with 4-zone heaters at temperatures above the melting point of PEEK. The extruded filament in a spool was immediately used to 3D print the dog bone geometry (as per ASTM D638 Type 1) using the fused filament fabrication (FFF) using appropriate printing parameters. Tensile testing of dog bone samples showed Ultimate Tensile Strength of 44.93 ± 0.41 MPa and Young's Modulus of 1.50 ± 0.07 GPa. Thermogravimetric Analysis (TGA) was also performed (as per ASTM E 1131) on the extruded filament, evaluating the thermal decomposition of PEEK. TGA characterization aids in understanding the mechanism of decomposition of the substance based on mass loss as a function of temperature for a given heating rate. TGA showed that extruded filament was thermally stable up to 600°C above which the mass started to decompose rapidly till 800°C. To summarize, PEEK was successfully extruded and 3D printed. The tensile and thermal properties were evaluated and reported. The applications of these 3D-printed PEEK parts can be found in biomedical, aerospace, marine, and energy fields given their superior mechanical and thermal properties. PEEK also has been used extensively in composites for various applications.

Keywords: Additive Manufacturing, PEEK extrusion, Fused Filament Fabrication, 3D Printing, Tensile Testing, Thermogravimetric Analysis

SOFTWARE FOR CLINICAL SPEECH THERAPY SERVICES

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Abstract:

The Software for Clinical Speech Therapy Services is a platform to help speech therapists manage and track patient progress, Create patient profiles, document sessions, track progress over time, Record weekly sessions, upload for review, and document patient progress during each session. The software generates reports and graphs that visually shows a patient's progress over sessions, so the therapist can see what's working and adjust treatment plans accordingly. This platform is to improve the quality of speech therapy services by providing a centralized tool to manage patient data and track progress. With customization options and advanced reporting the software will help the therapists make informed decisions and deliver patient centred care to each patient. Overall this software will change the face of speech therapy by improving data management and analysis and ultimately better patient outcomes.

Keywords: Computer-aided diagnosis, Magnetic Resonance Imaging, AHE, CLAHE, PSNR, MSE, RMSE, SSIM.

A SMART SHOE FOR DETECTION AND ALLEVIATION OF FOOT ULCERS

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Abstract:

Foot ulceration, a leading cause of mortality in diabetic patients, underscores the urgent need for innovative solutions. This project aims to design and develop an advanced, cost-effective wearable system for plantar pressure measurement, specifically targeting the evaluation of Diabetic Foot Ulcers (DFUs) in everyday settings. Central to this endeavour is the creation of a smart shoe equipped with FlexiForce sensors and an ESP32 processor, which captures the force exerted by the foot against the ground. The data collected is transmitted wirelessly to a mobile application, enabling real-time monitoring and analysis. The initial prototype will test the efficacy of the software and assess the system's design parameters. This smart shoe is envisioned to significantly mitigate the risk of foot ulceration by providing detailed, actionable insights into pressure distribution, thereby enhancing patient care and prevention strategies.

Keywords: Diabetic foot ulcers, foot plantar pressure, wearable system

A Study of Spectral Preprocessing Techniques for Bilirubin Quantification Using DRS

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Abstract:

Spectroscopic studies have gained significant impact in the medical field due to its non-invasive nature. Bilirubin, a key biological chromophore responsible for jaundice, exhibits a unique absorbing peak around 450nm in the visible spectrum. Diffuse reflectance spectroscopy has proven effective in quantifying the bilirubin values by analysing the spectral features. However, the quality of spectral data can be affected by noise, scattering and other environmental conditions, potentially affecting the accuracy of bilirubin estimation. In this work, we applied a few preprocessing techniques to the spectral data and assessed their impact on the accuracy of diffuse reflectance based bilirubin quantification. The results showed that the Multiplicative Scatter Correction method performs well with a mean error of -0.02 mg/dL, root mean square error of 0.52 mg/dL and Pearson's r value of 0.9.

Keywords: Spectral Analysis, Diffuse Reflectance Spectroscopy, Bilirubin, Jaundice, Preprocessing, Non-invasive Method.

Self-Stabilized Gyro Toothbrush For Parkinson's Disease: Enhancing Oral Hygiene Through Real-Time Motion Compensation

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Abstract:

The increasing condition of neuro-degenerative increases the need of assistive device that facilitate the daily activities. Oral hygiene is the aspects of overall health, and the individuals with Parkinson's disease and some with similar condition often struggle with tasks like toothbrushing due to tremor Parkinson's disease is a neurodegenerative disorder caused by the degeneration of dopamine in the midbrain leading to motor symptoms like tremor, rigidity and other motor impairments. In effort to help the people with Parkinson's disease and people with the special needs to maintain their oral hygiene, a "self-stabilized gyro toothbrush" with real time motion compensation technology system is being developed. Often hand tremors making it like a task, and difficult for people to do daily activities like brushing their teeth, which result in poor oral hygiene and oral related problems. To overcome these challenges this paper developing a self-stabilized system that adjust for involuntary motions and make sure for safe and efficient brushing. This method uses real-time motion compensation technology to enhance the quality of life for the peoples those with mobility issues and people with motor impairments, by addressing a critical medical need in a useful-way.

Keywords: Parkinson's Disease , Tremors, Involuntary movements, Self-stabilizing Mechanism, Brush.

TERAHERTZ-BASED BIOSENSOR FOR CHARACTERIZATION OF CANCEROUS CELLS

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Abstract:

This paper presents the development of a highly sensitive terahertz (THz) metamaterial biosensor designed for advanced biosensing applications, specifically for detecting cancerous cells. Utilizing THz-time domain spectroscopy (THz-TDS), the sensor monitors variations in the refractive index and absorption characteristics of tissues, enabling the differentiation between normal and cancerous tissues. The biosensor is optimized through structural parameter adjustments to enhance sensitivity, achieving a remarkable 870 GHz per Refractive index unit (GHz/RIU) sensitivity. The optimized sensor's high accuracy and reliability underscore its potential for early cancer detection, particularly for skin cancer. This study highlights the promise of THz biosensors in revolutionizing cancer diagnostics, offering a radiation-free, rapid, and sensitive solution for improved patient outcomes.

Keywords: THz, Biosensor, Metamaterial, Cancer detection, Refractive index

OPTIVUE - A SMART APPROACH TO EYE HEALTH SCREENING

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Abstract:

The increasing prevalence of refractive eye conditions such as myopia, hypermetropia, and presbyopia highlight the need for early detection and intervention to prevent vision impairment. This paper presents the development of an AI-powered application that utilizes machine learning (ML) techniques to detect and classify common eye conditions in real-time.

The proposed system is trained using a dataset of annotated eye images, allowing it to analyze new images captured and provide instant diagnostic results. The model leverages convolutional neural networks (CNN) and transformer-based architectures to enhance accuracy and robustness in detecting refractive errors. Advanced image preprocessing techniques, including contrast enhancement and noise reduction, ensure reliable input quality for the AI model. The application is designed to provide user-friendly, real-time feedback on whether the captured image indicates a potential eye condition or normal vision.

Experimental evaluations demonstrate the model's high accuracy, sensitivity, and specificity in detecting refractive errors. This innovative solution aims to assist ophthalmologists and healthcare providers in offering early diagnosis and personalized treatment recommendations. Future work will focus on expanding the dataset and integrating additional eye conditions for comprehensive diagnostic capabilities.

Keywords: Eye condition detection, artificial intelligence, machine learning, deep learning, myopia, hypermetropia, presbyopia, convolutional neural networks (CNN), real-time diagnosis, ophthalmology AI, medical image analysis.

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TRACK 4

VLSI Architecture for Modulating Nerve Activity in Parkinson's disease Using STFT Transformation Methods

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Abstract:

The progressive neurodegenerative condition known as Parkinson's disease (PD) mostly impairs motor control and appears as bradykinesia, stiffness, and tremors. The abnormal neural activity that underlies these symptoms is frequently not sufficiently treated by existing medicines, despite tremendous advancements in therapy. It could render traditional signal processing methods unsuitable for continuous, long-term use in implanted or wearable medical devices. The research suggests a novel VLSI (Very Large-Scale Integration) design that uses Short-Time Fourier Transform (STFT) transformation techniques to modulate neural activity in PD. To analyze and modify nerve activity, it makes use of a dataset of electroencephalogram (EEG) signals that show neural activity in PD patients. The dataset includes time-series data and time-frequency characteristics. A band-pass filter was used to preprocess the EEG data in order to eliminate noise and unnecessary frequencies, maintaining the emphasis on the pertinent neural activity. The STFT was then used to extract features, which produced time-frequency representations that capture the EEG signals' phase and amplitude information for additional examination. A Convolutional Neural Network (CNN) is used to determine if a person has PD or not. The CNN uses its capacity to identify intricate patterns to interpret the retrieved STFT characteristics from the EEG data and make precise predictions. The performance for the proposed method is analyzed by accuracy, throughput, latency, and power consumption. The technology can precisely detect and alter the oscillatory patterns linked to PD by applying STFT+CNN to neural signals, thereby providing a way to implement more individualized and successful treatment approaches.

Keywords: Convolutional Neural Network (CNN), Electroencephalogram (EEG), Parkinson's disease (PD), Short-Time Fourier Transform (STFT), Very Large-Scale Integration) (VLSI).

AI Powered HeartRate Monitor Leveraging Skintone

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Abstract:

This project presents a non-contact heart rate monitoring system that utilizes video capture and Arduino integration to provide real-time heart rate measurements. The system employs a camera to record video frames, from which a region of interest (e.g., the forehead) is detected and analyzed for subtle color changes caused by blood flow. These changes are extracted and processed through signal processing techniques to calculate the heart rate accurately. The calculated heart rate is displayed on an LCD via an Arduino controller, powered by an external power supply. The proposed method eliminates the need for physical contact, offering a hygienic, non-invasive, and user-friendly solution for heart rate monitoring.

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Waves Don't Lie: Leveraging Test-Time Training and Kolmogorov Arnold Networks for EEG-Based Biometrics

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Abstract:

There is an increasing interest in the application of EEG signals for user identification within healthcare and Internet of Things (IoT) systems, driven by the need for more secure and reliable biometric authentication methods. One of the challenges in EEG-based identification is the variability in signals due to cognitive states and environmental factors. This study explores the effectiveness of three deep learning models—Kolmogorov Arnold Network (KAN), Test Time Training (TTT)-enhanced models, and Multi-Layer Perceptron (MLP)—for EEG-based biometric authentication. KAN helps in reducing overfitting while, TTT improves the robustness and generalization of EEG-based identification by dynamically adjusting to variations in EEG signals. A publicly available EEG dataset augmented with newly collected data was used in this review to ensure comprehensive and robust model evaluation. The results showed that the TTT-based model outperformed the others, achieving an accuracy of 95.4%, compared to 91% for CNN-LSTM and 92% for CNN-LSTM-KAN, across various trials. These findings demonstrate the potential of TTT as a powerful framework for practical and secure EEG-based biometric authentication.

Keywords: Test-Time Training (TTT), Long-Short Term Memory (LSTM), Kolmogorov-Arnold Networks (KAN), Biometric security, Self-supervised learning, Electroencephalography (EEG)

Evaluation Methods for studying Muscle Fatigue through Physiological Signal Monitoring

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Abstract:

The safety of people in a wide range ofprofessions, such as pilots, spacecraft, drivers, physicians, industrial workers, computer users, etc., is seriously threatened by fatigue. Measuring human weariness is essential for improving workplace productivity, safety, and efficiency. The survey looks at the variety of techniques that have been used to measure and determine a person's level of fatigue. Researchers have used a number of physiological signal features to study human fatigue. Using a variety of physiological markers, this study provides a comprehensive examination of how stress and fatigue might be identified. Additionally, it looks for the best characteristics and techniques for assessing human fatigue and stress.

Keywords: Fatigue, Physiological Signals, Classification Techniques.

Preterm Birth Prediction Using GraphSAGE and Electrohysterogram Data

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Abstract:

Preterm birth (PTB) affects around 15 million infants every year and causes major health issues, making it a worldwide health concern [4]. The demand for precise early prediction methods has motivated researchers to explore the use of Electrohysterogram (EHG) signals. EHG is a promising approach for predicting preterm labor as it is a non-invasive and affordable method for monitoring uterine activity. This study aims to build a strong PTB prediction model with explainable AI using the publicly accessible TPEHG dataset (300 recordings, 38 preterm). The validation of the model is performed with the TPEHGT dataset (13 preterm and 13 term samples). We employed a graph neural network (GNN) that efficiently aggregates local neighborhood information in graphs and is based on the GraphSAGE architecture. The GraphSAGE model achieved 99.2% accuracy by training with stratified 10-fold cross-validation. This was validated through confusion matrices, ROC, and precision-recall curves. In order to guarantee model transparency, the most important factors influencing predictions were found using Shapley Additive explanations (SHAP) analysis, which offered insightful information about the decision-making process. This study emphasizes the value of explainable AI in enhancing clinical decision-making, as well as the possibility of GNNs for PTB prediction.

Keywords: EHG, Preterm, GraphSAGE, ADASYN, SHAP, TPEHG

ESP 32 : SMART SUPPORT EMPOWERING ALZHEIMER'S PATIENTS

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Abstract:

This paper explores the development of smart glasses equipped with an ESP32-CAM module and a supporting mobile application to enhance memory care for Alzheimer's patients. Alzheimer's patients often face challenges related to memory loss and disorientation, which can lead to confusion and emotional distress. The proposed system addresses these issues by combining wearable technology with visual recognition capabilities. The ESP32-CAM module, mounted on the glasses, captures images of the patient's surroundings and recognizes familiar faces, locations, or objects through coded image recognition algorithms. The mobile application, connected via Wi-Fi or Bluetooth, processes this information and delivers real- time prompts to the patient through audio or visual cues in the glasses. These prompts help patients identify people and contextual information, assisting with recall and orientation and providing a greater sense of familiarity and reassurance. This paper aims to improve the quality of life for Alzheimer's patients by enhancing their independence and reducing moments of confusion, ultimately supporting caregivers and improving patient well-being in memory care settings.

Keywords: Smart glasses, Alzheimer's care, ESP32-CAM, memory assistance, visual recognition, wearable technology, cognitive support, mobile application, therapeutic interventions, real-time prompts, image processing, patient well-being, independence, caregiver support, coding, Visual Studio, memory prompts, emotional stability, personalized care, health technology.

Biophysical and Anthropometric Determinants of Muscle Co-activation Patterns during Gait

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Abstract:

Electromyogram (EMG) signals provide significant information about neuromuscular activation of gait patterns specifically with respect to the strength and order of recruitment of lower limb muscles during walking. The Co-Activation Index (CAI) is an important parameter to examine the contribution of specific antagonist and agonist muscle pairs. In this study, the co-activation between knee extensors flexor pair and plantar flexors & dorsiflexors pairs for subjects of different gender, age groups and BMI were compared. The dataset consists of surface EMG signals obtained from Tibialis Anterior (TA), Plantar flexor (Soleus (S), Gastrocnemius medialis (G)), Biceps femoris (BF), Vastus Medialis (VM) from healthy participants between age groups of 6 and72 years. CAI was calculated for TA & S, TA & G and BF & VM muscle pairs. It was observed that CAI for young and old age groups were higher compared to middle age participants. Females were found to have higher CAI (BF & VM=58.9±13.2; TA & G=43.2±10.0; TA & S =49.7 ± 13.7) than male (BF & VM=52.8±9.3;TA & G= 39.5±10.7; TA & S =43.8 ± 9.9). The influence of BodyMass Index (BMI) on CAI was manifested in both male andfemale with significant variation in CAI for female (4.63±4.47) than male (1.59±1.11) participants. Also, the proposed study revealed that CAI corresponding to knee flexors and extensors (BF & VM) is always higher than the dorsiflexors and plantar flexors (TA & S, TA & G) reiterating the prominent role of knee articulators during walking. Therefore, the proposed study contributes to the understanding of the dynamics of CAI and its importance in gait analysis associated with different morphological and pathological conditions of human musculoskeletal system.

Keywords: Surface Electromyogram, Gait, Co-activation index, Knee flexors and extensors, Dorsiflexor, Plantar flexor

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TRACK 5

Predictive Analytics in Dentistry: AI Applications in Frenectomy and Soft Tissue Management

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Abstract:

Artificial intelligence (AI) in dentistry has revolutionized the field, enhancing diagnostics, treatment planning, and patient care. With the ability to analyze vast datasets quickly, AI aids in the early detection of oral diseases, improving overall efficiency and precision in dental practices. The study aims to predict frenectomy techniques using AI, focusing on the labial frenulum, a band of tissue connecting the upper lip to the gums that can cause discomfort or aesthetic issues.

Saveetha Dental College and Hospitals approved a study using 200 intraoral photographs from a database. The study used the Orange Data Mining tool, a machine learning approach that integrates image mining with visual analytics, for interactive data visualizations and model inference.

Naive Bayes effectively predicts frenectomy surgical outcomes with a low accuracy rate of 48%. It outperforms Logistic Regression in all metrics, with a higher accuracy rate of 48%. The F1 score balances precision and recall, with Naive Bayes outperforming Logistic Regression in all metrics.

Artificial Intelligence (AI) is revolutionizing oral healthcare by predicting frenectomy techniques, offering personalized, efficient solutions based on individual patient characteristics, and enhancing decision-making processes.

Keywords: Frenectomy, Deep learning, Machine learning, Laser, Surgery.

A Deep Learning Approach to Multi-Class Skin Disease Identification

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Abstract:

Skin diseases affect more than one-third of the global population and are often underestimated in terms of their severity and consequences. Traditional diagnostic methods, such as visual inspection and biopsy, are time-consuming and dependent on the expertise of dermatologists, limiting their efficiency and scalability. In order to address these limitations, this work proposes the development of a multi-level, multi-class deep learning model for the classification of skin diseases, that can aid the dermatologist. The dataset comprises 31 classes with a total of 8,867 images sourced from databases such as HAM10000, ISIC Archive, Arsenic Healthy Skin, and DERMNET. After applying preprocessing and data augmentation, the dataset was expanded to 12,221 images to enhance uniformity and quality. The classification framework is structured into four hierarchical levels, with each hierarchical level using a different deep learning model designed uniquely to its specific classification task. The hierarchical structure enhances the model's ability to detect slight variations between related classes of skin diseases thereby maximizing classification accuracy and generalization. The proposed multi-level model yielded a combined accuracy of 91.20%, with a specificity of 95.36% and sensitivity of 92.86%, demonstrating its effectiveness in accurately classifying skin diseases. This study also leverages the gradient-weighted class activation mapping (Grad-CAM) technique to identify and to visualize the relevant regions of interest, thereby the proposed system provides a comprehensive evaluation framework.

Keywords: Skin disease classification, Deep learning, Multiclass, Image Analysis, Grad-CAM

Segmentation Of Neutrophil Nucleus in White Blood Cell Images Using Kapur's entropy based Improved Grey Wolf Optimization

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Abstract:

Qualitative analysis of blood disorders is the most challenging job in current medical image. Diagnosing disorders through qualitative analysis relies heavily on approximation. Disorders related to white blood cells (WBC) are notably prevalent in medical practice. Identifying blood disorders leads to classification of various blood related conditions. Hence, the automated identification of blood related disorder allows to bypass the existing complex environment and focus on the complex image insight provided by the images. In this study, the automated segmentation of neutrophil nucleus in white blood cells microscopic through Kapur's entropy multilevel thresholding technique. In the process of an efficient segmentation through Kapur's entropy, the threshold optimal values are required to change the class variance or entropy criteria. To achieve these optimizations, Improved Grey Wolf (IGWO) nature-inspired meta-heuristic algorithms are employed for this study. The experimental test has conducted on standard image using various levels of threshold (2, 3, 4, 5 and 6). The efficacy of Kapur's entropy based improved grey wolf optimization approach has been evaluated and performed with established optimization methods contains Genetic Algorithm(GA), Moth Fly Optimization (MFO), Firefly Optimization, Fire Hawk Optimization and Particle Swarm Optimization (PSO). Results demonstrated that Kapur's entropy based IGWO outperformed for neutrophil nucleus segmentation in microscopic images when compared to other optimization techniques in both quality and consistency.

Keywords: Neutrophil nucleus, Blood Smear Images, Kapur's entropy, Multi-level Thresholding, Improved Grey Wolf Algorithm.

Machine learning prediction of marginal gingival adaptation of direct composite veneering with or without mock-up in Upper anterior

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Abstract:

This research uses machine learning algorithms to automate the detection and adaptation of marginal gingival in direct composite veneering. This approach improves treatment predictability and refines protocols, thereby contributing to the evolution of aesthetic dentistry practices. The study aims to enhance diagnostic accuracy. The application of distinct machine-learning algorithms for automated detection and marginal gingival adaptation of direct composite veneering with or without mock-up in the upper anterior was investigated in this study.

A machine learning tool, orange, was used with an algorithm using squeeze net embedding models. Logistic Regression and naïve bayes were used to predict and classify based on deep learning embeddings, which were trained and tested on 341 images of direct composite veneering with and without mock-up in upper anteriors and evaluated for accuracy.

Logistic Regression outperforms Naive Bayes in predicting marginal gingival adaptation in direct composite veneering. It has a higher accuracy rate and precision in identifying positive cases, minimizing false positives, and identifying cases where good marginal gingival adaptation occurs, thereby enhancing its effectiveness in predicting dental procedures.

Based on the marginal gingival adaptation of direct composite veneering with or without mock-up in the Upper anterior, machine learning algorithms can identify the marginal adaptation of composite veneering with and without mock-up with high accuracy. More studies with bigger sample numbers and additional imaging modalities are needed to corroborate these findings.

Keywords: Deep Learning, marginal gingiva, adaptation, veneers, automatic clinical diagnosis, machine learning.

INDIAN HERBAL FORMULATION FOR REPIGMENTATION OF VITILIGO

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Assistant professor[1], Head of the department[2],
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Abstract:

Non-Segmental Vitiligo (NSV) is an autoimmune skin condition causing depigmented patches due to melanocyte loss. Current treatments like topical steroids and UV therapies carry risks of side effects. This study explores *Psoralea corylifolia* and *Moringa oleifera* extracts as herbal alternatives for repigmentation. Bakuchi, rich in psoralen, stimulates melanocyte activity and DNA repair when combined with UVA light. *Moringa oleifera* contains flavanoids, enhancing melanin synthesis and melanocyte regeneration. Together, these extracts address oxidative stress, melanocyte restoration, and melanin production, providing a natural, effective, and safer alternative for NSV treatment.

Keywords: Repigmentation, Psoralea corylifolia, Moringa oleifera, Psoralen, Flavanoids.

INCORPORATION OF BANANA LEAF EXTRACT INTO COLLAGEN SHEETS FOR FIRE BURN HEALING

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Abstract:

Burn injuries are clinically challenging with significant barriers that can be managed only by innovative therapy solutions. This study focuses on different burn wound healing rates using collagen sheets incorporated with banana leaf extract. Banana leaf extract is a nutritional dense substance which has compounds such as allantoin, antioxidants, vitamins and moisture retention properties which emit therapeutic value. Them technique is also useful for providing a biocompatible framework on to which tissue regeneration can occur and by providing continual moisture in the wound healing process. The blending of banana leaf extract and collagen was believed to improve wound healing, reduced inflammation, and proliferation of tissue. Litmus paper patch tests were used to determine and compare the pH scale. This method has the potential to revolutionize burn wound care and produce improved patient outcomes.

Keywords: banana leaf, collagen sheet, antioxidants, phytochemicals, biocompatible.

Design of Components for a 3D Printed Assistive Robotic Arm Optimized for Precision Surgical Procedures

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Abstract:

In recent years, advancements in medicine have revolutionized the accuracy, dexterity, and security of various medical and surgical procedures. These advancements have paved the way for the development sophisticated robotic arm mechanisms that offer improved capabilities and enhanced performance. The primary objective of this research paper is to create a comprehensive model of a robotic arm mechanism and implement it using a stepper motor while employing an Arduino as the main controller for seamless operation. By integrating these components, the robotic arm system aims to achieve precise and controlled movements in response to external inputs. This research paper presents the design and fabrication of components for a 3D-printed assistive robotic arm optimized for precision surgical procedures. The robotic arm is engineered to enhance surgical outcomes through advanced gesture recognition capabilities, enabling intuitive control and interaction. Key functionalities, such as water spray, cutting, and pick and place maneuvers, have been meticulously designed to meet the demands of the surgical environment. Using 3D printing technology and the .STL file format, the base, rotating base, and arm effectors were fabricated with a focus on durability, strength, and lightweight design. The study showcases the successful development of a multifunctional robotic arm with a remarkable 97 percent accuracy rate in executing predefined tasks.

Keywords: Robotic arm, Design, Gesture Arm, 3D Printing, Fabrication.

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TRACK 6

A Novel & Hybrid Algorithm for Real Time Depression Detection via EEG Analysis

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Abstract:

Depression is among the most common mental health conditions, significantly affecting an individual's well-being and productivity. Detecting depression effectively requires early and accurate identification to enable timely intervention and achieve positive outcomes. This research introduces a hybrid model that integrates multiple Feedforward Neural Networks (FNNs) with a Shallow Neural Network (SNN) for depression detection using electroencephalogram (EEG) data. EEG signals are analysed across key frequency bands including gamma, high beta, beta, alpha, theta and delta. The hybrid architecture employs FNNs to extract complex, nonlinear features from the data, while the SNN leverages these outputs to efficiently identify simpler patterns and improve classification performance. The model's effectiveness is thoroughly evaluated based on its accuracy, precision, recall, F1-score, F2-score demonstrating its effectiveness in detecting neural abnormalities associated with depression. The findings emphasize the proposed hybrid system's potential as a reliable and non-invasive diagnostic tool for mental healthdiagnosis, offering new possibilities for advanced and proactive care strategies.

Keywords: Hybrid Model, Depression Detection, Feedforward Neural Network, Shallow Neural Network, Electroencephalogram (EEG), Mental Health Diagnosis.

Wheat Disease Detection: Bridging the Gap with Deep Learning Approaches

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Abstract:

Wheat is a vital crop for global food security, yet its production faces significant threats from various diseases, leading to substantial yield losses. Traditional detection methods, such as manual scouting and laboratory analysis, are often labour-intensive and inefficient. The advent of deep learning techniques has revolutionized agricultural disease detection, offering more efficient and accurate solutions. We provide a comprehensive overview of common wheat diseases, methodologies, and datasets utilized in recent studies. A critical analysis of the literature reveals performance metrics of various deep learning models compared to traditional methods, Furthermore, the review suggests future research directions, emphasizing the integration of IoT technologies for real-time monitoring and the use of advanced sensors for improved detection accuracy. This synthesis aims to enhance strategies for effective disease management in wheat cultivation.

Keywords: Deep Learning, Wheat Disease, Convolutional Neural Networks (CNN), LSTM, Transfer Learning in Agriculture

IMPROVING HEPATITIS-C DETECTION ACCURACY IMPROVED C5.0 ALGORITHM WITH CHI SQUARE FEATURE SELECTION

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Abstract:

Hepatitis C is a serious global health problem that affects over 50 million people worldwide. One million new cases occur every year, and cirrhosis and liver cancer are associated with significant mortality rates. As the disease often progresses silently, it is essential that early detection methods are accurate. By combining advanced machine learning techniques, specifically the C5.0 decision tree algorithm enhanced with Chi-Square feature selection, this project aims to improve the detection accuracy of Hepatitis-C. Data preprocessing steps such as label encoding of categorical features and normalization of numerical data are employed to enhance the performance of the machine learning model. The Chi-Square method identifies the most relevant attributes, thereby reducing dimensionality and preventing overfitting. Using metric such as Information Gain and Entropy, the C5.0 algorithm constructs a decision tree that is optimized for classification tasks while employing aggressive pruning to improve the generalization of the model. An evaluation matrix was used to calculate metrics such as accuracy, precision, recall, and F1-score, which allowed a detailed analysis of performance. The results show that the C5.0 model outperforms standard algorithms in detecting Hepatitis-C with more accuracy.

Keywords: Chi-square, C5.0 algorithm, Machine learning.

Southern Regional Healthcare Chatbot Using AI and NLP

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Abstract:

The entire thrust of the project is to expand the outreach of southern reginal language speakers by creating a medical chatbot that is capable of interpreting and responding in user queries in languages such as Tamil, Telugu, Kannada and Malayalam with assistance of Natural Language Processing (NLP) technologies. The chatbot is based on a large, well-structured overweight medical support base that provides qualitative and reliable assistance on a great number of health-related topics, including but not limited to, diseases and their treatment as well as health in general. Its interface is comically intuitive, which significantly enhances the overall interaction with the chatbot. The system recalls previous conversations which allows it to adjust its answers to a particular question more specifically in subsequent conversations. Moreover, the chatbot does not only have an extensive, ready-to-use medical encyclopedia but is also capable of fetching the latest relevant information on the subject from the web. With these features, consumers can trust that they are receiving the most current advice and information regarding new trends in medicine. Furthermore the system recommends that Google Translator be used so that the users can easily translate information into other South regional languages and interact with them. This blood clotting medical chatbot brings a broader perspective to those users who are Southern Regional Language.

Keywords: AI, NLP, Healthcare care, Southern Languages.

AI based Decision Support System for body Constitution (Yakkai Ilakkanam) Classification using Minimal Optimized Textual Features

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Abstract:

Accurate prediction of prakriti helps in diagnosing various diseases like diabetes, cancer, arthritis etc based on individualized pathological conditions and providing personalized treatment. Though many advanced signal-based scientific technologies are utilized for prakriti classification, still siddha practitioners highly relyon Agastiar's Yakkai Ilakkanam. However, it is highly dependent onpractitioner's expertise.Further,it is very challenging for mass screening situations due to time consuming manual operationand prone to human error. This paper focuses on developing artificial intelligence-based decision support system to automate prakriti prediction with accuracy and consistency using reduced optimally designed textual data to enhance the comfort of the patients. The proposed methodology involves two stages:-Questionnaire based data are collected from various subjects and optimized features are extracted by carrying out detailed analysis of the textual data in the first stage using machine learning algorithms likerandomforest,support vector machine,XGBoost, Principal Component Analysis.Then these features are given as inputs to the convolution neural network in the second stage for prakriti prediction. To automate prakriti prediction, Convolution Neural Network (CNN) is used. The automated decision support system ensures tridosha classification with more accuracy and less time. It guarantees privacy, eliminates the need for extensive in-person consultations, and enables personalized recommendations. This work automates the traditional Siddha practices showcasing the transformative potential of AI to improve individual and societal well-being.

Keywords: ML algorithm, body constitution, CNN questionnaire, Prakriti prediction, decision support system.

A Study On Cardiovascular Disease Detection In Diabetic Patients

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Abstract:

Cardiovascular diseases (CVD) represent the major cause of mortality and morbidity among the diabetic patients. The risk of developing CVD is significantly higher for individuals with diabetes, being 2-4 times greater compared to those without the condition. The increase in the risk of CVD hangs on numerous factors like hypertension, insulin resistance, dyslipidemia, gender, lifestyle factors and duration of diabetes and hyperglycemia. Healthcare professionals support an integrated approach which addresses all cardiovascular risk factors including the glucose control in patients with diabetes mellitus (DM). This study explores the existing methodologies and tools to examine cardiovascular risk in diabetic patients. The study aims to identify the most effective strategies for the early detection and prevention of CVD in a high-risk population. To achieve this, the study examines various DL and ML approaches for managing diabetic patients at increased cardiovascular risk. It reviews recent developments and highlights the performance of both ML and DL models in CVD risk assessment, focusing on their efficiency, accuracy, and potential clinical impact.

Keywords: Cardiovascular diseases, Diabetes mellitus, Deep learning, Machine learning, Artificial neural network.

Chronic Kidney Disease Prediction using DL: A Comparative Study of CNN, VGG16 and MOBILENET

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Abstract:

This study presents an automated Deep Learning (DL) framework for the identification and diagnosis of chronic kidney disease (CKD) using Computed Tomography (CT) scans, aiming to overcome the challenges associated with traditional diagnostic methods. The research utilizes CNNs (CNNs), Visual Geometry Group (VGG16), and MobileNet to improve accuracy, precision, and recall in CKD classification. Three 2D-CNN models—a six-layer CNN, MobileNet, and VGG16 with 16 layers for detection, along with a four-layer CNN for classification—were trained and evaluated on a Kaggle dataset consisting of 12,445 CT images, with an 80:20 train-test split. The study emphasizes on the comparative assessment of DL models (CNN, VGG16, and MobileNet) for CKD detection, the implementation of an automated classification system to enhance diagnostic accuracy, and the validation of model performance using key evaluation metrics, including accuracy, precision, recall, F1-score, and loss values. Among the models, CNN exhibited better performance, obtaining an accuracy of 82%, outperforming MobileNet (70%) and VGG16 (72%), showcasing its advanced feature extraction capabilities. Performance evaluations further confirmed CNN's effectiveness in CKD classification, exhibiting lower validation loss and greater generalization ability compared to other models. The findings highlight the significant potential of DL-based Computer-Aided Diagnosis (CAD) systems in enhancing early CKD detection, reducing radiologists' workload, and improving decision-making, thereby leading to better patient care.

Keywords: DL, CT-CKD Datasets, Predictive Model, CNN, VGG16 & MobileNet.

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TRACK 7

AUTOMATED DEEP LEARNING SYSTEM FOR EARLY DETECTION OF STROKE USING CNN ARCHITECTURE

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Abstract:

Strokes are a major cause of disability worldwide, with ischemic and hemorrhagic strokes accounting for the majority of cases. In India, stroke remains the second most common cause of mortality. Approximately 75-85% of reported strokes are ischemic, while 15-25% are hemorrhagic. The proposed system focuses on developing an automated deep learning system for stroke detection using a Convolutional Neural Network (CNN) architecture. The CNN model extracts spatial features from 2,311 CT images of the human brain, sourced from Kaggle. To improve the model's robustness, data augmentation techniques, such as rescaling, shear range, zoom-in, and horizontal flipping, are applied. The system integrates the Adam optimizer to enhance training efficiency and employs the ReLU activation function to ensure better model convergence and accuracy. The CNN model, implemented and tested achieves an accuracy of 89.58%, highlighting its potential for fast and non- invasive stroke detection. By addressing challenges like human error and time delays in conventional diagnostic methods, this system provides improved precision while reducing the manual workload. This enhancement aims to create a scalable and efficient solution that advances stroke care by enabling timely medical interventions, particularly in resource-constrained settings.

Keywords: Ischemic Stroke, Hemorrhagic Stroke, Convolutional Neural Network, Adam optimizer, ReLU activation function

Computational Linear Modeling for Human Lung Mechanics

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Abstract:

The respiratory system plays a crucial role in the transportation of oxygen and carbon dioxide. As pulmonary research advances rapidly, mathematical modeling of the respiratory system has become essential for monitoring the causes and effects of various pulmonary diseases. A medical ventilator is a device that provides mechanical ventilation by moving air into and out of the lungs. Ventilator testing and calibration are typically performed using large-scale machines, which need to be miniaturized for greater efficiency.To address this need, ventilator calibration equipment should be designed to simulate lung mechanics and display results based on input parameters. A compact model can be developed using SIMULINK and MATLAB to simulate both normal and abnormal respiratory conditions. This model functions similarly to a pressure-controlled ventilator, where a pressure wave serves as the input. The obtained pressure and flow values—IP = 27 cmH2O, PEEP = 8 cmH2O, and CT = 10 mL/cmH2O—are recorded from a pressure-controlled ventilator. This process is repeated for seven full breathing cycles, lasting approximately 21 seconds. Such simulations are invaluable for pulmonary research, providing deeper insights into respiratory mechanics.

Keywords: Mathematical modeling, ventilator, electrical analogy, computer aided analysis, Pulmonary system, pressure, volume and resistance.

Prosthetic Hand Grasp Recognition Using Residual-Unet Combined with Cross Over Attention

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Abstract:

Grasp pattern recognition plays a pivotal role in empowering prosthetic hands to accurate and effective grip categorization is the foundation of prosthetic hand functionality, therefore facilitating better user experiences and usability. This work presents a custom-built U-Net architecture improved with residual blocks and cross-over attention methods, especially designed for grip categorization tasks. While cross-over attention improves spatial and contextual learning across network layers, the proposed model uses the natural capabilities of U-Net for feature extraction reinforced by residual connections to reduce vanishing gradient problems and increase convergence. Two separate classification scenarios—Whole Category Classification (WCC) and Binary Outcome Classification (BOC)—were followed in experimental assessments. Under WCC, the model attained an accuracy of 83% and under BOC, 79% to show its dependability and flexibility throughout several categorization needs. This study highlights how sophisticated neural network designs might help prosthetic technology to progress and open the path for more responsive and easy artificial limb control systems

Keywords: pattern recognition, U-Net, classification,

Early Detection of Liver Disease and Precise Health Optimization using Advanced Computational Models

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Abstract:

The progressive nature of liver disease makes it a worrying factor globally and is often detected too late, where treatment options are sparse. As with most diseases, early detection makes a significant difference to the outcomes a patient faces and the resources that need to be devoted by the healthcare system. The purpose of this paper is to propose a predictive model for liver disease detection with the implementation of Deep Learning TabNet architecture, which is specialized in analyzing structured data. In contrast to other models, TabNet uses a novel approach that improves feature selection and overall accuracy through the use of attention mechanisms. The system's non-stop surveillance of patient data enables it to report irregularities followed by real-time alerts for timely action to be taken. Additionally, batch data processing allows for a thorough analysis of the data that captures various trends for proactive disease control. The enhancement of deep learning for the predictive factors of liver disease is expected to strengthen preventive medicine and make further strides in AI diagnostics and patient care. The proposed TabNet model achieves a recall of 0.991, precision of 0.992, and an F1 score of 0.991 at a learning rate of 0.0015, demonstrating exceptional performance in accurately identifying liver disease.

Keywords: Liver Disease, Deep Learning, TabNet, Predictive Model, Healthcare AI.

Ergonomically Optimized Wearable Seating Posture Monitoring and Alert System for Mitigating Work-Related Musculoskeletal Disorders

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Abstract:

Prolonged improper sitting posture is a significant contributor to Work-Related Musculoskeletal Disorders (WMSDs) and other health complications, particularly among students and office workers. This paper presents the design and development of a wearable posture monitoring and alerting system aimed at promoting better ergonomic habits and preventing the adverse effects of poor posture. The system leverages four Inertial Measurement Units (IMUs) strategically positioned on the body to detect angular deviations associated with improper posture. Using wireless communication through transmitter-receiver modules, the collected data is processed to provide real-time feedback and alerts, enabling users to self-correct their posture. Key features include the ability to monitor posture duration, filter involuntary movements, and deliver non-intrusive alerts to connected devices such as smartphones or computers. The proposed system not only enhances individual awareness of posture but also eliminates the need for external intervention, making it highly practical for diverse work and study environments. By integrating advancements in wearable technology, wireless data transmission, and real-time analytics, this system aims to contribute to the field of ergonomics and improve long-term health outcomes for its users.

Keywords: Inertial Measurement Unit (IMU), Angular deviations , Pop up notification , Real time analytics

Automated Pneumonia Identification Using Convolutional Neural Network

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Abstract:

Pneumonia is a contagious disease usually caused by a bacterial infection in the alveoli of the lungs. When lung tissue is infected, pus forms in the infected area. Healthcare providers use physical examination and diagnostic procedures like chest X-rays, ultrasounds, or lung biopsies to diagnose whether a patient has pneumonia. Misdiagnosis or wrong treatment can drastically affect the quality of life for a patient. Advances in deep learning assist specialists to arrive at better conclusions concerning the diagnosis. This method utilizes an adaptive and light-weighted model of deep learning, such as a Convolutional Neural Network (CNN) for the identification and prediction regarding whether the patient is infected or not through his chest X-rays. The researchers used a database containing 20,000 images which were formatted at 224x224 pixels within batches of 32 images to check the model performance. The tested model demonstrated 90% accuracy in its performance tests. The study demonstrates its ability to both identify and forecast bacterial along with viral pneumonia from chest X-ray images through evaluation results.

Keywords: Pneumonia, Convolutional Neural Network, Dataset, Lung biopsies, Deep learning

Multimodal Analysis of Hereditary Breast and Ovarian Cancer Syndrome using Deep Learning techniques

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Abstract:

Hereditary Breast and Ovarian Cancer (HBOC) Syndrome is an autosomal dominant genetic condition, necessitating early and accurate detection for effective management. This study aims to develop a deep learning framework to analyze the image and gene data for HBOC syndrome. In this study, the breast ultrasound image dataset is obtained from Kaggle and the real time ovarian ultrasound images are obtained from hospitals. The gene sequence was obtained from NCBI Gene and NCBI ClinVar. The images are preprocessed and features are extracted from the images using transfer learning technique. Based on the comparative analysis, InceptionV3 is found to be the most effective model for feature extraction. An ensemble model based on a voting scheme for classification of breast images into normal, malignant and benign based on the features, is proposed. Similarly, for the classification of ovarian images into normal and abnormal, another ensemble model is proposed. The proposed model demonstrates 98% accuracy for ovarian image classification and 94% acccuracy in breast image classification. The gene sequences are preprocessed and numerical features are extracted. For the classification of normal and mutated genes, an ensemble model of classifiers is used. This prediction is used as a preventive strategy through periodic screening of cancer. The outcome of this study would provide a holistic approach to cancer risk assessment, providing a better diagnostic accuracy.

Keywords: Hereditary Breast and Ovarian Cancer, Ultrasound image, Pre-trained Deep Learning models, Gene sequences, Ensemble model.

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TRACK 8

Detection of Finish Lines In Indirect Ceramic And Composite Veneers Using Clinical Images With The Help of Developed AI-based System

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Abstract:

Artificial intelligence (AI) has shown great promise in dentistry, especially when using clinical photographs to identify and analyze finish lines for indirect ceramic and composite veneers. This study investigates the detection and assessment of finish lines in indirect ceramic and composite veneers by analyzing clinical images. Accurate identification of finish lines is crucial for ensuring the fit, durability, and aesthetic outcomes of dental restorations. We use deep learning to identify, detect, and classify finish lines from composite and ceramic veneers. A study analyzed 125 teeth prepared for indirect veneer restorations using high-resolution intraoral cameras, digital scanners, and magnification tools. Clinical images were captured to visualize finish line designs. The study compared imaging modalities for detecting finish lines, focusing on precision, reproducibility, and statistical differences. Experts annotated and segmented images for different restorations, and deep squeeze net embeddings were performed with 80 percent training and 20 percent test data. The study compares Logistic Regression and Naive Bayes models for predicting ceramic and composite veneer finish lines, finding Logistic Regression superior in precision and F1-score. Clinical imaging techniques offer reliable veneer assessment for optimal restorations, with further research recommended to explore advanced image processing methods and finish line detection accuracy.

Keywords: Artificial Intelligence, Finish line, Ceramic veneer, Composite veneer

Flexural Transducer Based Monolithic Diathermy Probe for Thermo Therapy

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Abstract:

Ultrasound diathermy is one of the most commonly used therapeutic techniques for muscle injuries and chronic pain. However, the traditional machines are large and inconvenient, thus limiting their application. This project will be developed to miniaturize and make a portable ultrasound diathermy probe with all the essential components power source, ultrasound transducer, control unit, and coupling mechanism all in one easy-to-use device. The proposed probe measures approximately 30 cm in length, 4 cm in diameter and weight of 15 gram making it significantly smaller than traditional diathermy units. The objective is the design of a compact, ergonomic probe in which all components have been merged to minimize dimensions, to enhance portability and improve user comfort. The designed system includes a high-frequency generator, power amplifier, and battery management system for optimal heat generation and delivery. The device operates at a frequency range of 1.77 MHz, with a power supply of 3.7V, 1000mAh rechargeable lithium-ion battery, ensuring efficient portability and extended usage. The Monoprobe Diathermy is the improvement over other systems in usability, portability, and therapeutic outcome, overcoming limitations of conventional systems. It will be tested further to establish its feasibility in clinical settings.

Keywords: Ultrasound Diathermy, Miniaturized Probe, Portability, Power Source, Transducer, Treatment Parameters, Ergonomic Design.

CARE-DAQ: Low Cost Open Source Wireless Biomedical Data Acquisition System

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Abstract:

In this work, CARE-DAQ, a low-cost, open source Wi-Fi-enabled multi-channel Data Acquisition (DAQ) system, has been designed and developed for biomedical signal acquisition and telemetry. An ESP32-based, 4-channel, 12-bit DAQ system with Wi-Fi communication capabilities has been developed. The proposed DAQ system is capable of acquiring Photoplethysmography (PPG), Electrocardiography (ECG), Electromyography (EMG), and Phonocardiography (PCG) signals. This work demonstrates the acquisition of PPG and ECG signals using the CARE-DAQ and its analysis. The proposed DAQ system acts as a TCP server and connects with the TCP client application, which retrieves the data from it. A MATLAB GUI application has been developed for remote monitoring and further real-time processing of the acquired signals. The application developed has the capability of deriving the heart rate, R-R interval, and Heart Rate Variability (HRV). The Heart rate derived from CARE-DAQ data has a Root Mean Square Error (RMSE) of 1.32 BPM when compared with a commercial pulse oximeter.

Keywords: Data Acquisition System; Photoplethysmography; Electrocardiography; Remote Patient Monitoring.

REAL-TIME HEALTH MONITORING AND TRACKING SYSTEM

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Abstract:

Health monitoring has become an essential system in modern healthcare for tracking real-time vital parameters. This device offers a cost-effective health monitoring solution with a live tracking feature, using an Arduino Uno (microcontroller) integrated with various sensors, including the DHT11 for temperature measurement, which also tracks the environmental humidity level. Additionally, the system incorporates the GY- NEO6MV2 (GPS module) for location tracking, which is particularly useful for tracking patient with medical condition and the AD8232 (ECG sensor) for continuous heart rate monitoring of the patient. The system features an LED-based alert mechanism, which activates to signal abnormal conditions detected by the DHT11 sensor, particularly temperature-related anomalies. This device also has a panic button which helps the individual to notify the caretakers or healthcare providers when they experience any abnormality. Arduino Uno processes all the data collected from these sensors and presents it effectively. The obtained data is collected by the Thing speak app through real-time. The GPS module also helps to pinpoint the patient's location, making the system ideal for health monitoring applications such as elder care or remote patient management. The system can be monitored remotely, which reduces the frequent visit of the caretaker or healthcare professionals and helps with the update of the patient through real-time. With its portability and affordability, this system stands out as a highly practical and cost-efficient option, enabling easy and continuous patient monitoring from anywhere**.**

Keywords: Health Monitoring, Heart Rate,

Self-Powered Energy Harvesting Wearable Monitor

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Abstract:

One important technological factor that restricts the advancement of wearable devices is their battery life. One possible solution to the problem of wearing electronics' unsteady operation over long periods of time is the idea of self-powered wearable electronics, or SWE. Due to their potential in ordinary life activities, self-powered wearable devices have been gaining growing interest in recent years. Here, we lay forth a fresh strategy for using one's own thermal energy to power electronic devices—by incorporating a thermoelectric generator into wearable gear. Thermoelectric generators that are worn by people are able to transform the temperature differential between their bodies and the surrounding environment into power. The average normal body temperature is 98.6°F. The generated electricity can power various wearable electronic devices, such as health monitors for tracking parameters. This hybrid approach can optimize energy harvesting in various environmental conditions, ensuring a more consistent and reliable power supply.

Keywords: Self-Powered, Wearable, Energy Harvesting and Thermoelectric generator

Smart ICU Revolutionizing Critical Care with Multi- modal Sensing and MIoT- Driven Solutions

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Abstract:

The growing need to monitor patients in real-time within Intensive Care Units has paved the way for the implementation of Medical Internet of Things-based systems. The innovative multi-modal health monitoring system is specifically tailored to both home care environments and ICUs as well. The system is able to accommodate multiple sensors monitoring vital health parameters such as falls, ECG signals, temperature, blood glucose, and emotional stress from facial recognition. On detecting any anomalies, the system generates an audible alert to medical staff on the premises as well as to doctors and family members via WhatsApp. The system is of great help for patients confined to their beds, such as paralysis rehabilitation patients through physical therapy, by enabling remote patient monitoring and thus optimizing the usage of healthcare infrastructure in congested government hospitals.

Keywords: Real-Time Patient Monitoring, Medical Internet of Things, ICU Monitoring, Fall Detection, ECG Analysis, Temperature Monitoring, Blood Glucose Tracking, Emotional Stress Detection, Remote Healthcare.

TheraLink Smart Health Multiparametric Monitoring System with Wireless Data Transmission

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Abstract:

The demand for proactive health surveillance and monitoring is on the rise for the need of early detection of ailments and diseases. With the development of technology, new opportunities are emerging that enable people to manage their health better. Our work, TheraLink – A therapeutic and connected health system seeks to design and build a device that is affordable and simple to allow the effective monitoring of life signs from home or in conditions where any emergencies may arise. The IoT sensors could be used to monitor fundamental aspects such as someone's body temperature, heart rate, quality of breath, strength of a muscle or even electrical signals from someone's heart. Communication technology has also been integrated for the remote transmission of results to a smartphone for monitoring purposes in order to ensure accuracy of results and their variability. Filters have been applied to eliminate the noise resulting from the sensors, thereby increasing the accuracy of the reading. Gives quick access to individual metrics and seamlessly integrates Bluetooth wireless technology. Thus, it is ideal for family members or other caregivers taking care of their loved ones. Due to its portability, it can be easily used at home, in a clinic or during emergencies. It extends the capability of finding health problems in a timely manner as it delivers a vision of combining electronics, signal processing and communication technology. TheraLink makes the user able to monitor health conditions on a day-to-day basis and provide assistance with emergencies.

Keywords: IoT, Bluetooth, Arduino Mega 2560, Health Monitoring System, Piezoelectric.

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TRACK 9

Machine Learning Based Categorization of Heart Sounds for Cardiac Arrhythmia Detection

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Abstract:

Early detection of cardiac arrhythmias is vital for preventing severe cardiovascular conditions and improving patient outcomes. This research focusses on the implementation of machine learning models for classifying heart sounds (HS) to identify arrhythmias effectively. Heart sound signals were analyzed and classified using five machine learning models: XGBoost, Support Vector Machine (SVM), Extra Trees, LightGBM, and Logistic Regression. These models were trained and estimated using benchmarks such as accuracy, precision, recall, and F1-score to judge their performance in discriminating rhythmic and arrhythmic heart sounds. The results indicate that Extra Trees achieved the highest accuracy, followed by LightGBM and Logistic Regression, while XGBoost and SVM demonstrated comparatively lower accuracies.

Keywords: heart sounds, machine learning, cardiac arrhythmia, XGBoost, LightGBM, SVM, ExtraTrees, Logistic Regression.

MaskCycleGAN-based Whisper to Normal Speech Conversion

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Abstract:

Whisper to normal speech conversion is an active area of research. Various architectures based on generative adversarial networks have been proposed in the recent past. Especially, recent study shows that MaskCycleGAN, which is a mask guided, and cyclic consistency keeping, generative adversarial network, performs really well for voice conversion from spectrogram representations. In the current work we present a MaskCycleGAN approach for the conversion of whispered speech to normal speech. We find that tuning the mask parameters, and pre-processing the signal with a voice activity detector provides superior performance when compared to the existing approach. The wTIMIT dataset is used for evaluation. Objective metrics such as PESQ and G-Loss are used to evaluate the converted speech, along with subjective evaluation using mean opinion score. The results show that the proposed approach offers considerable benefits.

Keywords: whispered speech, conversion, mask cycle-GAN, human-computer interaction

Secure Healthcare Network Using VLAN, OSPF, IPsec VPN and ACL

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Abstract:

This proposal supports Sustainable Development Goal 3: Access to Good Health and Well-being by setting up a secure and scalable health infrastructure. It employs several procedures to connect headquarters and branch hospitals, ensuring confidentiality, integrity, and availability of data. These include VLAN segmentation, OSPF routing, and IPsec VPN. VLANs restrict unauthorized access, OSPF gives a low-latency dynamic routing mechanism, and IPsec encrypts the communication to avoid interception. A DHCP server that is installed in-house simplifies IP management. This is a secure and resilient network that forms the foundation for powered health operations safeguarded by patient-oriented data handling.

Keywords: Network infrastructure, VLAN security, OSPF prformance, Hierarchical network design, IPsec VPN, Data confidentiality.

Using Web Mining to Track and Predict the Spread of Diseases

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Abstract:

These days, we're practically swimming in online data—from the quick updates, our friends share on social media to the nonstop flood of news stories and everything else in between. Web mining has turned into a go-to method for digging through all this information and finding patterns that matter. One place where this really proves its worth is in public health, especially when it comes to keeping an eye on infectious diseases and predicting how they might spread in real time. This piece takes a close look at how web mining methods can be used to monitor disease outbreaks. First, it explores different tools and research on web-based surveillance, focusing on how they can quickly catch early warning signs of potential epidemics. Then, it walks through a step-by-step framework for collecting and analyzing data from various online sources in near real-time— think social media signals, location data, and time-based trends. To illustrate these ideas, the study draws on a public dataset from Kaggle and uses features like geolocation and social media activity to train machine learning models that can predict the spread of diseases. The results suggest that when you combine web-scraped information with traditional epidemiological data, early detection and prediction become a lot more accurate. This finding is really important for public health because it shows how big data analytics can guide everything from how resources are allocated to when policies should be put in place. Overall, web mining emerges as a valuable tool for delivering timely insights and interventions, potentially saving lives and optimizing public health strategies.

Keywords: web mining, disease surveillance, predictive analytics, machine learning, public health informatics, online data

Single-Modality Emotion Detection: EEG-Based Feature Engineering and Interpretability

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Abstract:

Emotion recognition plays a vital role in human-computer interaction, offering applications in healthcare, education, and entertainment. This research proposes a single modality paradigm for emotion detection leveraging EEG signals from the DREAMER dataset to predict the valence, arousal, and dominance. Unlike the other approaches that rely on using computationally expensive neural networks, we have utilized lightweight machine learning models and advanced feature engineering methods to achieve accuracies of 98.6%, 96.6%, and 95.7% respectively which are pretty close to the state of art model accuracies while having a relatively much lower inference time of just 9.78 milli seconds. Another highlight of our research is that we were able to determine which EEG channels and characteristics had the greatest influence on each emotional dimension, which further improves the interpretability of our research. Our approach highlights the possibility for scalable and explicable emotion identification systems utilizing EEG data alone by combining high accuracy, efficiency, and interpretability.

Keywords: DREAMER Dataset, EEG Signals, Emotion Recognition, Signal Processing, Feature Engineering, Interpretability, Random Forest.

Realtime Cardiac Health Monitoring Using AI-Powered Embedded Systems

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Abstract:

Arrhythmias is characterized as an irregular heartbeat, which leads to high health risk. It leads to fatal outcomes if it is not detected earlier. Manual detection takes a prolonged time and is expensive. This work employed the single-board computer Raspberry Pi 5 for the classification of arrhythmias, which is cost-effective and portable. MIT-BIH datasets were used to train the CNN model, which attained 99% classification accuracy. The trained model was stored in an H5 file. The work builds a prototype to demonstrate a real- world application of AI in healthcare i.e., heart disease prediction and discusses future enhancement. In a non- hospital environment with normal people, a bio simulator is used to generate abnormal heart rhythms for prediction. The raw ECG signal was extracted from the biosignal simulator. The .h5 file was loaded into Raspberry Pi permanently, and the raw ECG signal was fed into the Raspberry Pi whenever the prediction needed to be done. The developed system showcased the suitability of real-time arrhythmia detection, providing a reliable and usable outcome for early detection and sustained cardiac monitoring.

Keywords: Arrhythmias, MIT-BIH dataset, Raspberry Pi 5, raw ECG signal.

Leveraging Spectral Signatures and Attention Enhanced BiLSTM Network for Comprehensive Respiratory Sound Analysis

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Abstract:

Respiratory conditions, including pneumonia, bronchitis, asthma, and chronic illnesses like Chronic Obstructive Pulmonary Disease(COPD) significantly impact human health, and early detection is crucial for effective treatment. Conventional diagnostic techniques like X-rays and CT scans frequently encounter challenges, such as high costs, lengthy procedures, and limited availability in underserved regions. Although existing approaches commonly use convolutional and recurrent neural networks for automated diagnosis, this study proposes a novel method using a bidirectional long-and short-term memory (BiLSTM) network paired with an attention mechanism to detect and classify respiratory sounds into eight distinct disease categories. The attention mechanism improves classification accuracy by emphasizing critical temporal regions within the respiratory sound signals, ensuring the model focuses on diagnostically relevant features. To address class imbalance and limited dataset size, advanced data augmentation techniques, including the Griffin-Lim algorithm, were employed to generate high-fidelity, diverse audio samples, thereby balancing the representation of disease classes. The proposed BiLSTM-Attention model achieved an impressive classification accuracy of 96% and an F1 score of 96% across eight classes, highlighting its effectiveness as a reliable and accessible tool for the early detection of various lung diseases.

Keywords: Lung disease detection, BiLSTM-Attention network, respiratory sound classification, data augmentation, Mel Spectrogram, MFCC, Griffin-Lim algorithm.

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TRACK 10

Detecting Childhood Austistic Spectrum Disorder And Enhancing Their Reading Skills

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Abstract:

This research study uses advanced machine learning techniques for the early diagnosis of Autism Spectrum Disorder (ASD) in children and the improvement of reading skills. ASD is a neurodevelopmental disorder that affects the communication, social interaction, and sensory processing in children. It uses behavioral analysis, speech processing, and multimodal data including facial expressions, gestures, and physiological signals and integrates BILSTM, CNN (VGG16), Variational Autoencoders, and Deep Belief Networks for the early detection and diagnosis. Personalized, gamified reading programs are built to the pace of the child's learning and include real-time feedback and multi-sensory learning strategies. Emotional and social skill development occurs through emotion recognition and virtual social simulations. Parents and educators have dashboards for tracking progress and long-term development is predicted through predictive analytics. Moreover, learning activities are also disseminated through a special YouTube channel, and the rules are e-mailed to the family members so that support and guidance could be continued with the child. Such an integrated approach benefits the child with ASD cognitively, emotionally, and socially.

Keywords: Autism Spectrum Disorder, Machine Learning, Multimodal Analysis, Gamified Learning, Predictive Analytics.

Machine Learning in Mental Health: Bridging Gaps in Diagnosis and Intervention

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Abstract:

Mental health disorders, such as depression, anxiety, and bipolar disorder, represent a relevant public health challenge affecting close to 970 million people globally. Classical assessments include highly subjective self-reports and clinical assessments, leading often to latency in receiving care, and inaccuracy in care provision. The ML model could avail a good outlook derived from several data sources, including electronic health records, social media information, and sensor data from wearables to improve detection and intervention approaches. This study systematically reviewed 32 seminal works of the ML application in mental health involving algorithms such as SVM, RF, CNN, and deep learning models. In the bicameral model, CNN exhibited about 99% accuracy in detecting bipolar occurrence, and another, involving RF and CNN approaches also yielded 99% precision in PTSD diagnosis. Beyond these breakthroughs, challenges concern data privacy, model interpretability, and the generalizability of the numerous populations. Addressing these through explainable AI (XAI) approaches with measurements of ethical data collection greatly facilitate contributions of ML in mental health diagnostics. The review identifies current development, limitations, and future directions for more reliable, interpretable, and scalable ML-based mental health assessments.

Keywords: Machine Learning, Mental Health, PTSD (Post-Traumatic Stress Disorder), ADHD (Attention-Deficit/Hyperactivity Disorder), Anxiety, Depression, SVM, Random Forest.

Enhanced MRI-Based Brain Tumor Detection Using Deep Learning Architectures and Optimized Machine Learning Techniques

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Abstract:

Early brain tumour detection is essential for better treatment results. Biopsies taken during invasive brain procedures are traditionally used to diagnose brain tumours. Tumour identification and classification can be done non-invasively with computational intelligence approaches. This work uses MRI images to diagnose pituitary gland tumours, gliomas, meningiomas, and normal brain function using two deep learning approaches and six data mining techniques. To improve model performance, preprocessing and augmentation were applied to a dataset of 3000 MRI images. Optimised architectures with numerous convolutional in nature, pooling, and batch normalisation layers were used to create an efficient convolutional auto-encoder network and a unique 2D CNN. The 2D CNN outperformed the auto-encoder model with 95.63% accuracy as well as 94% recall, achieving a training precision of 96.47% and average recall of 95%. For both networks, the ROC-AUC values were close to 1. K-Nearest Neighbours was the most accurate machine learning technique(86%), while Multilayer perception was the least effective(28%). The suggested deep learning models outperformed machine learning techniques, according to statistical assessments (p-value < 0.05). These results demonstrate how sophisticated deep learning frameworks may be used to accurately detect brain tumours early on.

Keywords: Meningioma, Pituitary gland tumor, Early diagnosis, Non-invasive methods, Image classification, Computational intelligence.

Deep Learning for Predicting Invasive Ductal Carcinoma in Histopathological Tissue Images

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Abstract:

Nearly 80% of instances of breast cancer are invasive ductal carcinoma (IDC), the most prevalent and aggressive kind of the disease. Improving patient outcomes requires early detection and accurate diagnosis, but conventional diagnostic techniques rely on pathologists' manual tissue analysis, which is labour-intensive and subject to error. In order to improve diagnostic efficiency and accuracy, this study investigates the use of sophisticated convolutional neural networks (CNN to automate IDC identification and categorisation in histopathology pictures. In contrast to traditional methods, our method optimises extraction of features and classification by integrating a hybrid neural networks architecture that combines transfer learning and attention mechanisms. Our approach classifies tissues patches into three groups: healthy, IDC, as well as various types of breast cancer subtypes, using a dataset of samples of tissues from 162 IDC patients. To enhance generalisation over a range of histopathological abnormalities, the suggested method makes use of a refined CNN architecture, automatic data augmentation, and intensive preprocessing. Our approach performs better than conventional models, providing increased reliability in cancer detection, according to the performance assessment using F1-score with equal accuracy. This method makes use of cutting-edge deep learning developments to produce a more effective and precise diagnostic tool, which is especially advantageous in clinical settings with limited resources.

Keywords: PyTorch Framework, Pathology Automation, IDC Localisation, Tissue Slice Classification, Diagnostic Workflow Optimisation, and Balanced Accuracy.

Voice Assistance for Visually Impaired Persons Using AI and IOT

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Abstract:

The World Health Organization (WHO) states that visually impaired persons constitute a substantial varietyof people global who are unable to handle day to day activities, train and work. Still more than eighty% of human notion is through imaginative and prescient, and visually impaired people face points of access to digital statistics. To resolve this, we current a speech-based totally assistive machine that uses Automatic Speech Recognition (ASR), Text-to-Speech (TTS) synthesis, and AI-IoT integration to make for an easy interaction through herbal talk. There is a microphone (MIC) that collects voice input, that is processed to textual content, and transmitted to a ChatGPT API server. Thus, the usage of a voice processor module converts the response back into speech, which is fed through a speaker in order to perform auditory comments. Furthermore, the grasp ChatGPT processor commands are processed by a slave microcontroller that displays real-time manipulation of commands, path, and feedback status. Initial prototype checking proves promising results and shows that such a system could be a useful assistive generation for visually impaired users by giving them a hand in improved access and independence.

Keywords: Assistive system, ASR, TTS, AI-IoT, ChatGPT, voice interaction, microcontroller, accessibility

An Intelligent Systems for Heart Sound Signal Analysis: A Survey

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Abstract:

Heart failure is the leading factor of mortality worldwide. Cardiac auscultation is one of oldest diagnostic methods to explore the condition of the heart. Mechanical activities of heart initiated by biopotentials generated by the Sino-Atrium (SA) node of the heart causes non-stationery and non-deterministic signals commonly known as Heart Sound Signal (HSS) and the visual illustration of HSS is termed as Phonocardiogram (PCG) while recorded by an electronic stethoscope. For assessing a variety of cardiac anomalies, such as anatomical defects of the heart and valvular cardiac disease, congestive heart failure, and heart rate and rhythm, PCG can offer the most useful diagnostic data. The S1 and S2 heart sounds, which are the two loudest heart sounds, often make up PCG. In both diseased and non-pathological circumstances, the PCG signal may contain murmurs, the S3 and S4 heart sounds as well as other unusual noises including clicks, snaps, and rubs.

Furthermore, in past few years, it was effectively utilized for heart sound analysis. The current study is to attempt a thorough brief to summarize articles on heart sound evaluation with deep learning released in 2017–2023, since the majority of review works on the subject were completed prior to 2017. In addition to providing insights into the developments and potential avenues for upcoming research on deep learning for the analysis of cardiac sounds, thisstudy contrasts deep learning with conventional machine learning.

Keywords: Heart Sound Signal, Phonocardiogram (PCG) signals, Auscultation, Murmurs, etc.

Evolution Scale Modelling For Prediction Of Regulator G Protein Signalling (RGS) Sequences In Oral Cancer

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Abstract:

Oral cancer is a major global health concern, causing significant morbidity and mortality. Despite advancements in diagnostics and treatments, the 5-year survival rate remains low, highlighting the need for novel biomarkers and therapeutic targets. Understanding the molecular mechanisms of oral carcinogenesis is crucial for improving patient outcomes. The G protein-coupled receptor (GPCR) signaling cascade is pivotal in regulating various cellular functions, including cell proliferation, differentiation, and apoptosis. RGS proteins, which regulate the G protein signalling network, are crucial in cancer progression, including oral cancer and their dysregulation is linked to various diseases. This study uses evolutionary scale modeling to predict RGS protein sequences for treating oral cancer.

The data was extracted from the UniProt protein sequence database, normalized, and divided into 80% training and 20% testing. This meticulous process ensured high-quality data for the ESM model, which is crucial for understanding protein data complexities. The model's pre-training on extensive protein datasets improves its performance on specific tasks.

The Evolution Scale Modelling (ESM) protein model underwent training and validation, showing a significant decrease in initial loss and a steady improvement in accuracy. The model's overfitting index is low, indicating good generalization. The learning rate behavior is controlled, and the model achieves high precision and recall in classification tasks. Its versatility in various scenarios is evident.

The study showcases the effectiveness of Evolutionary Scale Modeling (ESM) in predicting RGS protein sequence roles in oral cancer, achieving high training and validation accuracy, precision-recall performance, and stability indicators.

Keywords: Protein sequences, evolutionary scale modelling, oral cancer.

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TRACK 11

MYOELECTRIC CONTROLLED LOWER LIMB PROSTHESIS WITH ACTIVE ANKLE-FOOT JOINT

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Abstract:

The rising prevalence of lower limb amputations necessitates advanced prostheses to restore mobility and independence. This project focuses on designing a myoelectric-controlled lower limb prosthesis with an active ankle-foot joint. EMG signals from the amputee's residual limb are processed to extract patterns, enabling real-time prosthetic control based on user intent. Powered by stepper motors, the active joint ensures smooth, precise movements. A microcontroller handles signal processing and motor control, enhancing functionality and adaptability. By integrating advanced signal processing with precise motor control, this system bridges the gap between user intent and prosthetic action, improving mobility & user-specific control.

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AN ADVANCED SMART GLOVE FOR STROKE REHABILITATION USING IOT

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Abstract:

Stroke is one of the most severe and life-altering medical emergencies globally. Despite advancements in treatment, millions of stroke survivors face challenges accessing physiotherapy due to limited healthcare resources. To address this, our project introduces an innovative smart rehabilitation device designed to restore finger mobility in patients, particularly those who have lost voluntary movement. These state-of-the-art wearable leverages advanced mobile and IoT technology, enabling patients to perform repetitive hand exercises—flexing and extending their fingers—without requiring continuous hands-on therapy. A precision-controlled servomotor facilitates these movements, while real-time motion data is transmitted to a mobile application or a secure web platform. In addition to enhancing mobility, the device functions as a personalized health monitoring system, tracking vital signs such as heart rate, blood pressure, and oxygen saturation (SpO_2). By analyzing heart rate data, the system can detect patient discomfort, allowing for proactive health management. Given that hypertension is a major stroke risk factor, the integration of blood pressure monitoring is crucial, as high BP can lead to blocked arteries, blood clots, and brain hemorrhages. With IoT-driven remote healthcare, doctors can monitor patient progress in real time, access data on glove usage and therapy efficiency, and provide timely interventions. This next-generation rehabilitation technology not only empowers stroke patients with greater independence but also enhances the accessibility and precision of post-stroke care, paving the way for a smarter, more connected future in medical rehabilitation.

Keywords: Stroke rehabilitation, Smart glove, Servomotor, Internet of Things (IoT).

Simulation and Experimental Study of Quartz- Enhanced Photoacoustic Spectroscopy Technique for Human Exhale Breath Gas Sensing

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Abstract:

This article presents the simulation and experimental study of quartz-enhanced photoacoustic spectroscopy (QEPAS) technical. This technique has gained interest in the area of gas sensing in the recent few years due to its highly selective and sensitive measurements offered by the quartz tuning fork (QTF). The experimental study is conducted using a quantum cascade laser (QCL) source operating in 8 μm for measuring acetone (C3H6O), ammonia (NH3), and methane (CH4) in low and high concentrations. The voltage produced for different concentrations of gases by the QTF due to the piezoelectric effect is experimentally obtained and recorded. The Opto-acoustic module consisting of the QTF and the pressure generation by the gas molecules is modelled and designed using the COMSOL Multiphysics software. The photoacoustic pressure generated by gas induces potential in the quartz material and causes the prongs to displace symmetrically. The prong displacement and the potential generated for different concentrations are captured and presented. The proposed system offers ultralow sensitivity in the parts-per-billion (ppb) order, which makes it an ideal candidate for human exhale breath (HEB) gas analysis for non-invasive disease diagnosis.

Keywords: quartz-enhanced photoacoustic spectroscopy, breath gas analysis, quantum cascade laser, quartz tuning fork simulation, non-invasive disease diagnosis.

Injectable hydrogel loaded with copper oxide –curcumin nanosonosensitizer for enhanced antibacterial sonodynamic effect

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Abstract:

Bacterial infections present a significant challenge in wound healing by increasing the risk of complications and delaying the overall healing process. To address this issue an injectable hydrogel combined with sonodynamic therapy was utilized to improve the antimicrobial resistance. In this study, sodium alginate and gelatin matrix- based injectable hydrogel were prepared and incorporated with copper-oxide/curcumin nanoparticles. The morphology and presence of functional groups were examined using SEM and FTIR, which revealed the porous network arrangement of the hydrogel. These hydrogels exhibit excellent, injectability and rapid gelation which was confirmed using inverting and slanting tests. Further, the swelling and degradation profile was analyzed, and was found that CuO-Cur NPs loaded hydrogel exhibited a slower profile compared to SA/GEL hydrogel due to a denser crosslinking network. The incorporation of CuO-Cur NPs with the hydrogel matrix has improved its stability and generated reactive oxygen species upon exposure to ultrasound. This sonodynamic effect of CuO-Cur NPs as a sonosensitizer was analyzed using DPBF. In addition, the hydrogel was tested for antibacterial activity against the Staphylococcus aureus bacterial strain using the spread plate method, where it showed great potential in preventing bacterial infections. Compared to standard or conventional treatments, the CuO-Cur NP-loaded injectable hydrogel stands out as a promising option for wound management as it combines both antibacterial and anti-inflammatory properties.

Keywords: injectable hydrogel, curcumin, copper oxide nanoparticle, antibacterial infection, sodium alginate, gelatin.

I.AFRAMEWORKOFASMARTTHERAPEUTIC INSOLESYSTEM BY MEASURING PLANTAR PRESSURE FOR EARLY DIAGNOSIS OF DIABETIC FOOT ULCERS USING MACHINE LEARNING AND THERMAL IMAGING TECHNIQUES

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Abstract:

Diabetic Foot Ulcers (DFUs) are a significant complication of diabetes, often resulting in severe morbidity, infections, and amputations. Early diagnosis of DFUs is critical in preventing these complications.This paper focuses on the frame work of a smart therapeutic insole system that integrates machine learning and thermal imaging techniques to measure plantar pressure and other foot parameters in diabetic patients. The system leverages pressure sensors, temperature sensors, and gait analysis to provide real-time data on plantar pressure distribution and potential risk areas. In this connection, many researchers have suggested a few techniques for early detection of DFUs. Their proposed works have been reviewed outlining the technological advancements in smart insole systems, their effectiveness in monitoring plantar pressure, and the application of machine learning for predictive analytics. The combination of machine learning models and thermal imaging has showngreatpotentialinenhancing theaccuracyofearly DFU detection, improving patient outcomes, and reducing healthcare costs.This paper proposed a frame work and also discusses the different sensor types, methodologies, and design considerations for early diagnosis of diabetic foot ulcers using machine learning and thermal imaging techniques.

Keywords: Diabetic Foot Ulcers, International Diabetics Federation, Laser Induced Graphene, Infrared thermal imaging, Micro-Electromechanical Systems, Multi-Walled Carbon nanotubes, Polydimethylsiloxane, Internet of Medical Things.

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TRACK 12

Hybrid Deep Learning for Detecting Fake Medical Images and Heart Sounds.

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Abstract:

The rapid development of deepfake technology has raised serious concerns in numerous fields, particularly in healthcare, where manipulating medical data could compromise patient safety and undermine the reliability of diagnostic processes. This study presents innovative methodology for identifying deepfake alterations in medical images and audio, focusing on MRI and CT scans and heart sound recordings. The proposed system integrates advanced image and audio processing techniques to detect synthetic modifications. Medical images undergo pre-processing steps such as resizing, grayscale conversion, noise injection, and data augmentation, while heart sounds are examined using feature extraction techniques like the Zero Crossing Rate. To detect manipulated regions in images, YOLOv8 is employed, followed by classification through deep-learning models like VGG-19 and ResNet-50. Important metrics are implemented to assess the system's performance, namely accuracy 99.7, precision 86.6, recall 92.8, F1-score 89.6, error rate 0.215, and confusion matrix, ensuring comprehensive assessment of its reliability. Outcomes highlight effectiveness of this approach in identifying deepfake medical data with high accuracy 99.7, offering a vital solution for maintaining the integrity of healthcare diagnostics in the face of evolving threats from synthetic data manipulation.

Keywords: Medical deepfake detection, Image processing,Audio processing, Deep learning, Hybrid approach, ResNet-50, VGG-19, Yolov8.

Intelligent Intravenous Drip Stand for Safe Infusions using IOT Integration

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Abstract:

Drip infusion monitoring is a tedious job for nurses or caretakers. At night time, there are chances that the bystanders forget to inform the nurse about the depleted bottle causing inconvenience to the patient. Human negligence can cause back flow of blood, air embolism and many other major/minor problems if bottle is not replenished at right time. There is a need to continuously monitor the bottle. Our project focuses on monitoring and controlling system that provides a solution to the above mentioned problem. The level of bottle is continuously transmitted to nurse's phone improving his/her evaluable presence of all patients. The percentages 100, 80, 50, 20, 10 etc. were found correct in terms of the level observed. The latest technology Internet of Things (IoT) is used to build a bridge between nurse and patient. Non-contact level sensor are used to measure the level and send the data to the nurse station. After initiating the drip infusion, the drop in level can be viewed in nurse's phone. The infusion can be stopped using servo mechanism. This project can bring a change in health care sector and can prove helpful to nurse or caretaker by reducing their workload. Infusions given in a ward or even an entire hospital can be remotely monitored using such systems.

Keywords: IV Fluid bag, Non contact level sensor, weight sensor, Arduino Controller , WIFI module , LCD.

Improved Retinopathy Detection Using ResNet-50 Optimized AI Deep Learning Models

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Abstract:

In this study, we improve a pretrained Resnet, a-50 network to provide a better model for identifying diabetic retinal detachment. The model leverages the strength of Resnet-50's feature extraction capabilities and the potency of transfer learning to enhance performance by modifying the final layers using attention approaches. The model may focus on the most relevant areas of the retina by employing these attention techniques, improving the accuracy and efficacy of its diagnosis. To optimise model performance, several critical factors will be taken into account. High-resolution images are used to first capture the incredibly small features of retinal scanning, which improves the model's ability to detect subtle signs of retinopathy. In order to minimise biases and prevent overfitting, careful data collection techniques are also employed. Extra effort is made to ensure that there is no leakage throughout training and validation sets because sample(replace=True) has the ability to significantly bias model evaluation. Age normalisation is also included in the model pipeline because it has a significant influence on the progression of diabetic retinopathy and must be carefully controlled to ensure accurate forecasts. Combining prepared models, high-resolution data, suitable sampling strategies, and attention processes results in a more reliable and efficient diagnostic tool. By focussing on the most relevant retinal regions and minimising potential errors in the data pipeline, the proposed approach shows promise in enhancing early detection of diabetic retinopathy and, eventually, improving patient care in hospitals.

Keywords: Neural networks, attention-based models, clinical diagnosis, deep learning, model fine-tuning, image preprocessing, and retinal imaging.

Hybrid Deep Learning Models for Early Detection of Chronic Kidney Disease: A 1-D CNN and ResNet 152-V2 Approach

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Abstract:

Chronic kidney disease (CKD) is a gradual and irreversible health disorder that can potentially lead to permanent kidney damage and impaired renal function if untreated. Early prediction and detection of CKD are crucial to enhance treatment outcomes and possibly prevent or delay disease progression. Deep learning (DL) techniques have proven to be reliable in early medical diagnosis. Traditional diagnostic techniques such as, Urine Protein-to-Creatinine Ratio (UPCR) test, Serum Creatinine (SCr) test methods are invasive, time-consuming, expensive, and often detect the disease at the advanced stages. This study proposes a hybrid DL method, combining 1-Dimensional Convolutional Neural Network (1-D CNN) and ResNet 152–V2 for identifying temporal features and spatial hierarchies for improved analysis. The hybrid approach significantly improves CKD detection by effectively analyzing sequential patterns and uncovering complex relationships in the data. The study analyses a dataset of 400 patient samples, each categorized by 37 distinct features comprising clinical parameters and patient profiles. The proposed framework yields 98.95% accuracy, 100% precision, 98.56% recall and 99.34% F1 score, significantly outperforming existing models while effectively reducing false negatives and false positives. The ResNet152V2 model exhibits excellent performance in classifying CKD, offering a valuable tool for physicians to diagnose CKD patients, ultimately enhancing patient outcomes and care.

Keywords: Hybrid model, Deep learning, chronic kidney disease, 1-D CNN, ResNet 152 V2, medical data analysis.

Harnessing Deep Learning For Thyroid Disease Detection: A Systematic Review

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Abstract:

Currently, thyroid disorders are highly prevalent globally, necessitating improved diagnostic methods. Early and accurate prediction of thyroid diseases is crucial for timely and effective treatment, ultimately saving lives. . Machine learning and deep learning approaches are being utilized more and more to identify different forms of thyroid disorders and forecast thyroid issues early on, utilizing technological improvements in data processing and computation. This literature review explores the progress and applications of deep learning methods in detecting and diagnosing thyroid disorders. This review examines studies published between2020 and 2023, reflecting the increasing interest in using DL techniques to evaluate ultrasound images of thyroid nodules. It discusses the methodologies, datasets, and performance metrics employed in various studies, comparing their results and effectiveness. While DL has shown promise in analyzing thyroid nodules, the review also identifies several challenges that to be addressed, such as data limitations, the need for publicly available and validated datasets, and the establishment of standard evaluation metrics. The review also identifies a number of strategies that have been lately put out to address related problems in other domains. Furthermore, it is advised to integrate complementary information from multimodal images to improve the diagnostic accuracy of DL models.

Keywords: Thyroid gland, Machine learning, Hypothyroidism, Deep learning techniques, Hyperthyroidism, Ultrasound images.

EEG-DRIVEN MASSAGE HEADBAND FOR ANXIETY ALLEVIATION

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Abstract:

In this paper, we report on the results of a recently proposed hardware design that uses neurological data analysis to identify and mitigate anxiety. The system uses a feedback-based network for stress relief, which includes a custom-built Electroencephalography (EEG) sensor, a massage motor circuit, Arduino pro mini board and massage motor. The network also includes an RGB LED that turns on when stress is detected. After signal amplification using differential amplifier and filtering, beta waves from the frontal regions can be effortlessly captured by skin electrodes and display on lcd. Three out of four subjects saw a successful reduction in elevated beta wave amplitudes, which are frequently linked to anxiety, by massage motor intervention. The motor smoothly turned on during the experimental sessions when beta amplitudes surpassed predetermined thresholds, encouraging relaxation and facilitating better task performance.

Keywords: EEG Sensor, Arduino Pro mini , predetermined threshold, Anxiety Alleviation, Neurological data analysis.

Histopathological Image Analysis Using Improved Gorilla Troops Optimizer for Lung Cancer Detection

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Abstract:

Among many different modalities, histopathological imaging is one of the important and popular diagnostic technique for lung cancer. Computer aided diagnostic tools that are based on Artificial Intelligence will be very useful in analyzing those images and helps the clinician to take the decision about the disease occurrence and treatment options. In this research work, deep features are extracted from the histopathological images using three popular deep learning techniques namely VGG, DenseNet, and AlexNet. Then Improved Gorilla Troops Optimizer is suggested as feature transformation technique on the deep features extracted from the histopathological images for lung cancer identification. Random Forest algorithm is used for classifying the transformed features. Significance of proposed optimization as feature transform is proved through experimentation on the publicly available LC25000 dataset that contains 3 classes where one class belongs to benign category and another two classes belong to malignant lung lesions namely adenocarcinoma and squamous cell carcinoma. The proposed technique attains 98.2% accuracy in classifying the histopathological images into above mentioned three classes.

Keywords: Lung cancer diagnosis, histopathology, deep learning, optimizer, DenseNet

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Electromyography (EMG) is a technique used to measure the electrical activity generated by muscles during contractions.

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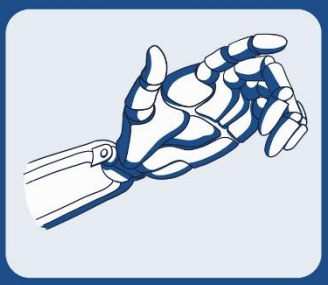
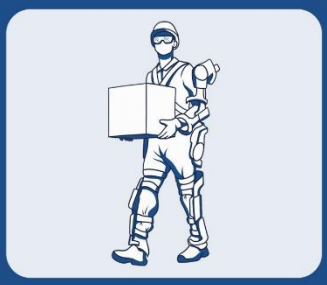
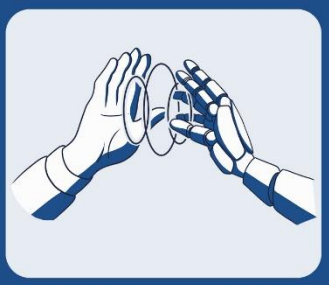
Applications of EMG



Human Machine Interactions



Rehabilitation Robotics



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Glimpses of 2024

PROCEEDINGS OF THE ELEVENTH INTERNATIONAL CONFERENCE ON BIOSIGNALS, IMAGES, AND INSTRUMENTATION

March 26 - 28, 2025

Biomedical Engineering is an interdisciplinary field that seamlessly integrates Medicine and Engineering, emerging as an independent domain dedicated to advancing healthcare through research. The Eleventh International Conference on Bio signals, Images, and Instrumentation (ICBSII-2025) seeks to foster research enthusiasm among students while providing an exceptional opportunity for researchers to showcase their work in various healthcare domains. The conference received research papers from a wide range of fields, including Physiological Modelling, Medical Imaging, Medical Robotics, Biomechanics, Biomedical Instrumentation, and Nanomaterials. After a rigorous review process by the expert committee, high-quality papers demonstrating innovative ideas and impactful research were selected for the final presentation at the conference ICBSII-2025. This prestigious event is the result of the vision and dedication of the Management, Faculty, and Students of the Department of Biomedical Engineering, SSN College of Engineering, in association with the Centre for Healthcare Technologies—a multidisciplinary R&D centre committed to driving advancements in healthcare innovation.

Since its inception in 2005, the Department of Biomedical Engineering at SSN College of Engineering has been at the forefront of biomedical technology, instrumentation, and imaging. Equipped with state-of-the-art infrastructure, experienced faculty, and highly motivated students, the department has established collaborations with renowned institutions such as Medical Device Innovation Centre, National Cheng Kung university (Taiwan), Birmingham City University (UK), Drexel University (Philadelphia), and the University of Bologna (Italy). Additionally, it has forged strong partnerships with leading hospitals and industries, including Rela Hospitals, Kauvery Hospitals, Sri Ramachandra Medical College, Perfint Healthcare, and NIEPMD, among others.

The department is actively engaged in multiple funded projects aimed at advancing healthcare, supported by organizations such as HCL Healthcare, SERB, LSRB, and DRDO. To date, it has successfully hosted ten International Conferences on Bio signals, Images, and Instrumentation (ICBSII) in 2013, 2015, 2017, 2018, 2019, 2020, 2021, 2022, 2023, and 2024, along with two National Conferences on Advances in Biomedical Engineering and Sciences (NCABES) in 2014 and 2016.

With a steadfast commitment to innovation and excellence, the department continues to push the boundaries of biomedical research, making meaningful contributions to the future of healthcare.