# 1st International Conference on

## Emerging Trends in Biomedical Engineering, Science and Technology (ICETBEST) 2024

# Abstract Book

## ICETBEST

Organized by

**Department of Biomedical Engineering**
**Faculty of Engineering**

## SALIM HABIB UNIVERSITY

**February 28–29, 2024**

# Conference Booklet

ICETBEST

Organized by

**Department of Biomedical Engineering**
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## SALIM HABIB UNIVERSITY

**FEBRUARY 28 - 29, 2024**

Chartered by the Government of Sindh - Recognized by
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# OVERVIEW OF THE CONFERENCE

The Department of Biomedical Engineering, Salim Habib University, is pleased to welcome you to the 1st International Conference on Emerging Trends in Biomedical Engineering, Science and Technology (ICETBEST) 2024, being held at Salim Habib University, Karachi, from February 28 to 29, 2024.

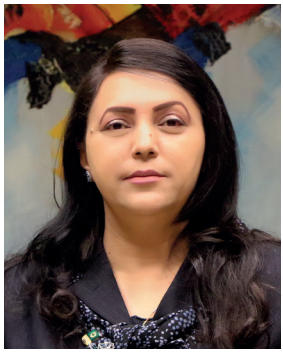
ICETBEST 2024 aims to facilitate knowledge exchange, promote research collaborations, showcase advancements, provide networking opportunities, and hold informative scientific sessions related to the field of Biomedical Engineering, Science and Technology. The objective of the conference is to bring people from academia and the business world closer in order to share the latest developments in relevant fields.

ICETBEST 2024 is a one-of-its kind conference in the field of Biomedical Engineering to be held in Karachi, with oral presentations, poster presentations, project demonstrations, technical sessions, and the opportunity for selected studies from the conference proceedings to be published.

Potential thematic areas of ICETBEST 2024 cover all areas related to Biomedical Engineering, Science and Technology and include, but are not limited to, the following:

- Bioinstrumentation
- Biomaterials
- Biomechanics
- Biomedical Electronics
- Biosignal Processing
- Genetic Engineering
- Medical Image Processing
- Medical Robotics
- Neural Engineering
- Rehabilitation Engineering
- Tissue Engineering
- Computational Mathematics
- Biological Sciences
- Bioinformatics
- Biostatistics
- Biotechnology
- Computational Mechanics
- Drug Delivery Design
- Applied Mathematics
- Neuroscience
- Biochemistry
- Molecular Biology
- Artificial Intelligence
- Machine Learning
- Big Data
- Internet of Things
- Modeling & Simulation
- Regenerative Technology
- Telemedicine Systems
- Wearable Technology
- Nanotechnology
- Automation Technologies
- Brain-Computer Interface

# MESSAGE FROM THE CHANCELLOR OF SALIM HABIB UNIVERSITY



Assalam Alaikum to all distinguished guests, esteemed colleagues, and passionate students,

It is a great honor and joy as I welcome you all for Salim Habib University's 1st International Conference on Emerging Trends in Biomedical Engineering, Science, and Technology (ICETBEST) 2024. In my capacity as the Chancellor of Salim Habib University and the Patron-in-Chief of this pioneering event, I am delighted to witness the convergence of brilliant minds spanning diverse disciplines, all driven by a shared objective: to push the frontiers of knowledge and innovation in the life sciences.

Today, Biomedical Engineering finds itself at a critical crossroads. Rapid advancements in genomics, biomaterials, Artificial Intelligence, virtual medicine, 3D printing in healthcare, and other cutting-edge technologies are reshaping our understanding of human health and well-being. This conference offers an invaluable platform for the exchange of groundbreaking research, fostering collaboration, and sparking inspiration in the next generation of changemakers and innovators.

At Salim Habib University, we firmly believe that education transcends the mere acquisition of knowledge; it encompasses the cultivation of critical thinking, empathy, and an unwavering commitment to improving the lives of others. The 1st ICETBEST 2024 encapsulates this spirit perfectly, serving as your platform to shine, challenge the status quo, and dream big about the future of Biomedical Engineering.

I am confident that the discussions and connections formed at the 1st ICETBEST 2024 will transform the world of healthcare. To our young researchers and aspiring entrepreneurs, I encourage you to engage actively with confidence and curiosity, share your knowledge with open hearts and minds, and build bridges across disciplines and borders.

May Allah keep us in the right direction, and bless us with honorable success.

Warm regards,

**Dr. Iram Afaq**

**Patron-in-Chief, ICETBEST 2024**
Chancellor, Salim Habib University, Karachi
Chief Executive Officer & Founding Member, The Salim Habib Education Foundation
Deputy Chairman, Barrett Hodgson Pakistan Pvt. Ltd.

# MESSAGE FROM THE CHAIRMAN SINDH HEC

Esteemed colleagues, researchers, and students,

I extend my warmest greetings to all participants of the 1st International Conference on Emerging Trends in Biomedical Engineering, Science and Technology (ICETBEST) 2024. This event, organized by the Department of Biomedical Engineering, Salim Habib University, represents a significant milestone in advancing science and fostering collaborations between national and international experts, and I commend Salim Habib University, the conference organizers, and collaborators for their dedication to organizing this exceptional conference.

I look forward to the cutting-edge innovation and groundbreaking ideas that will undoubtedly be a result of ICETBEST 2024 and the unique platform that it is providing for sharing the latest developments in research, fostering dialogue, and exploring solutions to address pressing healthcare challenges.

May this conference be a resounding success, marking a significant step forward in the field of biomedical engineering.

Good luck to all!

Sincerely,

**Prof. Dr. S. M. Tariq Rafi (T.I)**
**Chairman**
Sindh Higher Education Commission

# MESSAGE FROM THE PATRON

I am pleased to extend a warm welcome to all the participants of the 1st International Conference on Emerging Trends in Biomedical Engineering, Science, and Technology (ICETBEST) 2024. I feel proud to be associated with this important event that unites experts, researchers, and scholars worldwide, fostering the exchange of knowledge and insights into the latest advancements in Biomedical Engineering.

The conference theme, "Emerging Trends in Biomedical Engineering, Science, and Technology," holds particular significance in our contemporary world, where rapid technological progress is reshaping healthcare and medicine. I am optimistic that the discussions and presentations during this event will substantially contribute to enhancing the fields of Biomedical Engineering, Science and Technology, leading to new discoveries and their potential implications.

I express my heartfelt appreciation to the faculty and staff of the Department of Biomedical Engineering, Salim Habib University, for organizing this conference and enriching it by inviting a bouquet of researchers, keynote speakers, and participants.

I wish the organizers and participants best of luck.

**Prof. Dr. Shakeel Ahmed Khan**
**Patron, ICETBEST 2024**
Vice Chancellor, Salim Habib University, Karachi

# MESSAGE FROM THE CONFERENCE CONVENER

I am thrilled to launch our inaugural conference, a milestone in advancing knowledge and fostering collaborations in Biomedical Engineering. The conference covers diverse areas, providing a platform for impactful discussions.

On behalf of the organizing team of the ICETBEST 2024, I would like to express our sincere gratitude to our esteemed partners and sponsors, whose support has been instrumental in making ICETBEST 2024 a reality. Our special thanks to Sindh Higher Education Commission (Sindh HEC), Pakistan Engineering Council (PEC), The Institution of Engineers Pakistan (IEP), and The Institution of Electrical and Electronics Engineers Pakistan (IEEEP), for their valuable contributions and collaboration.

I believe wholeheartedly that ICETBEST 2024 is a unique opportunity to share insights, build collaborations, and contribute to the advancement of Biomedical Engineering, Science and Technology and I encourage all participants to actively engage in the wide range of sessions it features, network with other guests and stakeholders, and take full advantage of the opportunities presented during this groundbreaking conference.

Let us collectively contribute to the advancement of Biomedical Engineering, Science, and Technology, leaving an indelible mark on the landscape of academic and industrial progress.

Regards,

**Prof. Dr. M. Zeeshan Ul Haque**
**Conference Convener, ICETBEST 2024**
Dean, Faculty of Engineering
Salim Habib University, Karachi

# MESSAGE FROM THE EXECUTIVE ADVISOR

I am honored to welcome you to the 1st International Conference on Emerging Trends in Biomedical Engineering, Science, and Technology (ICETBEST 2024), a groundbreaking event that Salim Habib University and its Department of Biomedical Engineering are thrilled to host.

As Executive Advisor, I have been invested in the efforts that have gone into ICETBEST 2024 since its inception and am proud of the SHU faculty, staff, and students for laying the foundations and then working with persistence and determination for months to build and strengthen the premise of this incredible event that reflects Salim Habib University's commitment to education, scientific advancement, youth empowerment, and most of all, our unwavering resolve to better the future of Pakistan.

I believe that the unique environment at Salim Habib University, our top-of-the-line infrastructure designed to support groundbreaking research and idea generation, and our exceptionally dedicated people, will ensure that all participants have a once-in-a-lifetime experience at ICETBEST.

Together, let us ensure that ICETBEST 2024 is a launchpad for breakthroughs that rewrite the very definition of human potential.

Best of luck for the conference!

Sincerely,

**Dr. M. Hussain Habib**
**Executive Advisor, ICETBEST 2024**
Executive Director Education, Marketing. HR & Administration
Salim Habib University, Karachi

# MESSAGE FROM THE CONFERENCE SECRETARY

It is with immense pleasure and great gratification that I welcome you to the 1st International Conference on Emerging Trends in Biomedical Engineering, Science and Technology (ICETBEST) 2024. This conference stands as a testament to the unwavering commitment of our esteemed institution, Salim Habib University, towards fostering innovation and knowledge exchange within the dynamic field of Biomedical Engineering, Science and Technology.

I extend my heartfelt gratitude to the esteemed members of the organizing committee, our esteemed speakers, reviewers and panelists, and to all the authors who have contributed their valuable work to this volume and for their unwavering dedication and contributions towards making this conference a resounding success.

I invite you to embrace the boundless opportunities for learning, collaboration, and inspiration that await us. Together, let us pave the way for a brighter future in Biomedical Engineering, Science and Technology, one that holds the promise of transforming lives and shaping a healthier world for all.

With warm regards and best wishes,

**Engr. M. Shaheer Mirza**
**Conference Secretary, ICETBEST 2024**
Lecturer, Department of Biomedical Engineering
Salim Habib University, Karachi

# ABOUT SALIM HABIB UNIVERSITY

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

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

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

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

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

# MEMBERS OF ORGANIZING COMMITTEE

| | |
|---|---|
| Patron-in-Chief | Dr. Iram Afaq |
| Patron | Dr. M. Shakeel Ahmed Khan |
| Convener | Dr. M. Zeeshan Ul Haque |
| Executive Advisor | Dr. M. Hussain Habib |
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| Procurement Committee | Mr. Kamran Sabir<br>Mr. Zain Ishfaq |

# HANDS-ON WORKSHOPS

# HPC/CFD HANDS-ON WORKSHOP ON CLOUD

**Introduction**

This basic workshop is designed for beginners who are interested in knowing how to use cloud resource for Computational Fluid Dynamics (CFD) application. The workshop will cover high level information about high performance computing (HPC) such as: parallel & distributed computing, Amdahl's law, and strong scalability. The attendees will then:

- Perform a hands-on strong scalability study on a CFD application to see the benefit of parallel computing.

**Learning outcomes**

Using an open source CFD solver – OpenFOAM, the attendees will:

- Create a model of a blood flow problem
- Perform simulation on cloud,
- Visualize data using an open-source code - ParaView

# BUILDING TRANSFORMER MODELS FOR TRAINING ON TIME SERIES DATASETS

**Introduction**

Time series is an order sequence of collection of data points indexed with respect to time series. In the real world, from scientific computing to enterprise, time series is one of the most common types of data collected and analyzed. In certain situations, the shear size of time series data is a motivation enough to look into automated analytics and extract value from it. Transformers are deep learning models responsible for revolutionizing the AI landscape in classical Deep Learning and Generative AI in particular. It is a building block for very large language models (LLMs) such as ChatGPT (2-4). Recent investigations in applying transformers to ordered datasets such as time series have shown promising results. In this workshop, we will dive into understanding what transformer models are and how we can use it to train them on time series datasets. This workshop will be composed of theoretical and hands-on sessions on compute resources in the cloud.

**Learning outcomes**

After the workshop, the participants will:

- Be able to understands the basics of Generative AI and the role of Transformers as the basic unit.
- Be able to train transformer model on a GPU resource.
- Be able to use special transformer models for time series datasets for forecasting data points in finite future.

# LIST OF KEYNOTE SPEAKERS

## International

Dr. Stephanie Willerth, University of Victoria, Canada

Dr. Heidi Haavik, New Zealand College of Chiropractic, New Zealand

Dr. Peng Du, University of Auckland, New Zealand

Dr. Ilkka Korhenon, Tampere University, Finland

Dr. Nidal Kamel, Vin University, Vietnam

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

Dr. Rooh ul Amin Khurram, King Abdullah University of Science and Technology, Saudi Arabia

## National

Dr. B.S. Chowdhary, Mehran University of Engineering and Technology, Jamshoro

Dr. Ali Raza Jafri, NED University of Engineering and Technology, Karachi

Dr. Zia Mohy Uddin, Air University, Islamabad

Dr. Syed Ather Enam, Aga Khan University Hospital, Karachi

Dr. Toufique Akbar Soomro, QUCEST, Larkana

Prof. Dr. Shahana Urooj Kazmi, Center for Non-Communicable Diseases (CNCD), Karachi

Dr. Aqeel Ahmad, Salim Habib University, Karachi

Dr. Majida Kazmi, NED University of Engineering and Technology, Karachi

# ABSTRACTS

# KEYNOTE SPEAKERS

# 1st ICETBEST 2024 KEYNOTE-1

## 3D PRINTING PERSONALIZED TISSUE MODELS

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

3D bioprinting can create living human tissues on demand based on specifications contained in a digital file. Such highly customized, physiologically-relevant 3D human tissue models can screen potential drug candidates as an alternative to expensive pre-clinical animal testing. The Willerth lab has developed a novel fibrin-based bioink called TissuePrint for bioprinting neural tissues derived from human induced pluripotent stem cells (hiPSCs), which can become any cell type found in the body. Our group has bioprinted a range of functional human tissues for a variety of applications, including modeling neurodegenerative diseases like Alzheimer's and for screening potential cancer drugs. Here I will discuss the latest work from our group as well discuss our award-winning spin-off company - Axolotl Biosciences – that sells novel reagents for bioprinting human tissue models.

# 1st ICETBEST 2024 KEYNOTE-2

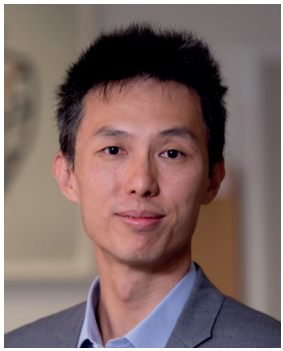
## HOW BIOMEDICAL ENGINEERING HAS CONTRIBUTED TO PROGRESS IN UNDERSTANDING THE IMPACT OF SPINAL FUNCTION ON BRAIN FUNCTION

Dr. Heidi Haavik
Vice President Research and Dean of Research
New Zealand College of Chiropractic,
New Zealand

Resent scientific studies are revealing a new understanding about how the function of the vertebral column, the spine, impacts the central nervous system (CNS). Dr Heidi Haavik, a chiropractor and PhD trained neurophysiologist has spent over 20 years studying the changes that occur in the CNS following various perturbation to the spine, for example, what occurs after high-velocity, low-amplitude (HVLA) thrusts that are directed at dysfunctional spinal segments. In the literature this CNS perturbation is sometimes referred to as spinal manipulation and/or spinal adjustments. Dr Haavik will share with you some of the ways her and her team at the New Zealand College of Chiropractic have contributed to this research field and what they have discovered. Advances in biomedical engineering has played a vital role in developing this body of research and Dr Haavik will share this during her presentation. Key progresses in this filed will be discussed, and future directions will be outlined.

# 1st ICETBEST 2024 KEYNOTE-3

## A JOINT EXPERIMENTAL-MODELLING APPROACH TO GASTROINTESTINAL ELECTROPHYSIOLOGY AND MOTILITY



Dr. Peng Du
Associate Professor, Engineering Science
University of Auckland, New Zealand

Gastrointestinal (GI) tract is comprised of a series of interconnected muscular organs that are governed by intrinsic electrophysiological activities (slow waves), as well as tightly regulated by neurohumoral factors. Degradations of the pacemaker cells and nerves in the GI tract due to aging and disease can have a significant impact on the digestive functions and lead to profound clinical challenges. In this talk, I will highlight the recent advances in high-resolution bioelectrical mapping of the GI tract and how important physiological questions can be addressed through a combination of experimental and mathematical modelling approach. In particular, he will focus on the relationship between loss of the intrinsic pacemaker cells and development of GI slow wave dysrhythmias. In addition, he will share the recent work done on the development of a wearable multi-channel body-surface mapping device for recording of gastric slow waves.

# 1st ICETBEST 2024 KEYNOTE-4

## WEARABLE SENSORS FOR IMPROVING HEALTH MONITORING INSIDE AND OUTSIDE THE HOSPITAL

Dr. Ilkka Korhenon
Adjunct Professor
Tampere University, Finland

Wearable health sensors have been developing tremendously during last 15 years. Today, smart watches are equipped with health sensors which may monitor your physical activity, heart rate, blood oxygenation, sleep, skin temperature, and other physiological data. Recently, similar capabilities have been embedded in smart rings or earphones, making the technology still smaller, less obtrusive, easier to use and adopt, and more affordable. Currently, research pushes the technology boundaries even further to monitor such vital signs as blood pressure. These sensors offer means to monitor key parameters related to risk of several chronic conditions, especially cardiovascular disease and diabetes, and allow tools for designing both primary and secondary prevention of these diseases. Thanks to increasing accuracy and reliability, and superior usage comfort, wearable sensors are also arriving on hospital settings, freeing patients from cables connected to bedside monitors, and allowing them increased mobility and continuity of monitoring throughout the hospital stay. In this talk, I will present development of wearable sensors during last 15 years, their status today, discuss some remaining challenges, and make some forecasts to the coming years.

# 1st ICETBEST 2024 KEYNOTE-5

## DEEP LEARNING MODELS FOR SEVERITY ASSESSMENT OF SOCIAL ANXIETY DISORDER USING EFFECTIVE CONNECTIVITY IN DEFAULT MODE NETWORK

Dr. Nidal Kamel
Associate Professor, Electrical Engineering
Vin University, Vietnam

Social Anxiety Disorder (SAD) is a prevalent and debilitating mental health condition that significantly impacts the lives of millions worldwide. While traditional diagnostic methods and treatment approaches have provided valuable insights, the exploration of neurophysiological markers using EEG signals has emerged as a promising avenue for gaining a deeper understanding of SAD. In this study, the Default Mode Network (DMN) involvement in SAD-related changes in brain connections, is validated using the effective connectivity (EC) throughout eight regions of interest. Next, a deep learning model is established using the causal connections within the DMN regions combined with a deep convolutional neural network (CNN) and the long short-term memory (LSTM). Three different deep learning (DL) models represented by CNN, LSTM, and CNN + LSTM are trained and tested in different EEG bands using data collected from 22 healthy control (HC) subjects, 22 mild, 22 moderate, and 22 severe SAD subjects, respectively. The results show that the (CNN + LSTM) model outperforms the other two models in SAD diagnosis and severity assessment with the highest accuracy of 92.86%, 92.86%, 96.43%, and 89.29%, for severe, moderate, mild, and HC, respectively. The fundamental contribution of this study is to ascertain the essential involvement of the DMN in SAD and the capacity of the causal connections to train DL models for efficient assessment of the SAD severity.

# 1st ICETBEST 2024 KEYNOTE-6

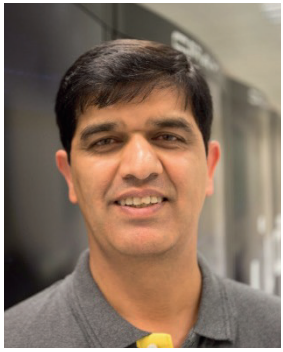
## ACCELERATING GENERATIVE AI MODELS ON HIGH PERFORMANCE COMPUTING RESOURCES

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

The exponential increase in the size of data and the requirement of automated analytics has motivated the research in Generative AI and large language models (LLMs). The first breakthrough of these models started with a few 100s of millions of parameters e.g. BERT. After only 5 years, these models have become significantly larger and deeper, amounting to 1.76 trillion in the case of GPT-4. This talk will catalog the trending techniques to train LLMs on high performance computing resources. We will discuss the parallel programming paradigms and the impact of scale of computational resources for enabling training LLMs in rational timescales.

# 1st ICETBEST 2024 KEYNOTE-7

## THE ROLE OF HPC IN CFD APPLICATIONS



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

High performance computing (HPC) is pivotal in applying numerical models for real world engineering applications. Computational fluid dynamics (CFD) applications, in particular, benefit from scalable codes and scalable infrastructure, especially for highly turbulent wall bounded flows that require accurate capturing of boundary layers. This talk will cover various large scale CFD applications and demonstrate how HPC is mandatory for solving engineering problems.

# 1st ICETBEST 2024 KEYNOTE-8

## EFFECTIVE ROLE OF VERTICALLY INTEGRATED PROJECTS IN ACHIEVING ACADEMIC EXCELLENCE THROUGH MULTIDISCIPLINARY EXPERIENTIAL LEARNING

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

Simon Fraser University defines experiential learning as "the strategic, active engagement of students in opportunities to learn through doing, and reflection on those activities, which empowers them to apply their theoretical knowledge to practical endeavors in a multitude of settings inside and outside of the classroom." This presentation focuses on the real-life experience of classroom teaching based on four dimension of knowledge learning in an engineering program by creating thrust of Project Based Learning (PBL). In addition, it is established that the projects executed during study as part of curriculum provide students sufficient exposure required to enable them boarding on real-world industrial application development projects. To validate this claim, a case study of students is demonstrated showing the impact of experiential learning, whose basic semester level projects turned out to be innovative and the impact of this experiential learning becomes remarkable for future career and our industry which desperately needs modernization. In addition, this presentation also covers various aspects of the Vertically Integrated Projects (VIP) Program that can provide an opportunity for students to earn academic credit while engaging in authentic and extended research and design projects related to active research areas and contribute towards developing collaborative projects to get national and international fundings.

# 1st ICETBEST 2024 KEYNOTE-9

## ROBOTICS, AI AND HEALTHCARE

Dr. Ali Raza Jafri
Professor, Department of Automotive & Marine Engineering
NED University of Engineering and Technology, Karachi

In recent years, the intersection of robotics, artificial intelligence (AI), and healthcare has revolutionized the way medical services are delivered and improving patient outcomes. Robotics and AI technologies are increasingly integrated into various aspects of healthcare, ranging from diagnostics and treatment to patient care and administrative tasks. One of the significant contributions of robotics in healthcare is the development of surgical robots that enhance precision and minimize invasiveness. Surgeons can now perform complex procedures with greater accuracy and efficiency, leading to reduced recovery times and improved patient safety. Additionally, robotic exoskeletons have been employed to aid rehabilitation, assisting patients in regaining mobility and strength after injuries or surgeries. AI plays a pivotal role in healthcare by analyzing vast amounts of medical data to assist in diagnosis and treatment planning. Machine learning algorithms can identify patterns and trends in patient information, enabling early detection of diseases and personalized treatment plans. AI-driven chatbots and virtual assistants have also become valuable tools for patient engagement and support, offering information, scheduling appointments, and providing emotional assistance. Furthermore, the collaboration between robotics and AI has facilitated the development of robotic prosthetics and exosuits, enhancing the quality of life for individuals with physical disabilities. These advancements not only showcase the potential for technology to improve healthcare outcomes but also highlight the importance of ethical considerations and data security in the integration of robotics and AI into the medical field. As research and innovation continue to progress, the synergy between robotics, AI, and healthcare promises a future where technology plays a central role in advancing medical practices and improving overall well-being.

# 1st ICETBEST 2024 KEYNOTE-10

## 3D VIRTUAL BIOMEDICAL INSTRUMENTATION OF THE EDUCATIONAL SYSTEM OF PAKISTAN

Dr. Zia Mohy Uddin
Professor & Head of Biomedical Engineering Department.
Air University, Islamabad

Biomedical Engineering is a relatively new field in Pakistan. Few experts are available to teach the courses related to biomedical Engineering. The most difficult aspect of biomedical engineering is the conceptualization of devices. Another issue is the unavailability of medical devices in an educational setup, as the price of the biomedical system is very costly. Therefore, there is a need to develop a system that helps students understand biomedical instrumentation. In this research, a 3-D virtual educational application was developed for biomedical engineers to uplift the educational system. This application has all the 3-D models, working animations, and details of biomedical Instrumentation devices that can provide a virtual educational environment, especially for Radiological systems that are mostly unavailable in educational institutions. The incorporation of 3-D biomedical virtual environments in the educational system will significantly enhance learning ability. It will also help students to increase focus in the online classes.

# 1st ICETBEST 2024 KEYNOTE-11

## IMPROVING CANCER CARE IN LOW- AND MIDDLE-INCOME COUNTRIES (LMICs) THROUGH AI-BASED RADIO GENOMICS

Dr. Syed Ather Enam
Professor, Department of Surgery
Aga Khan University Hospital, Karachi

The integration of artificial intelligence (AI) with radiogenomics offers a transformative approach to healthcare in Low- and Middle-Income Countries (LMICs), aiming to bridge healthcare disparities by providing advanced and affordable diagnostic and prognostic solutions. The potential of AI-based radiogenomics to revolutionize medical practices in LMICs, where access to genomic testing is limited, personalized medicine is costly, and specialized medical expertise is scarce.

Radiogenomics is proving to be an invaluable asset, facilitating the non-invasive extraction of genomic data from medical imagery. This process enables comprehensive and cost-efficient genomic profiling. AI algorithms, particularly those in the domains of machine learning and deep learning, excel in deciphering complex patterns within radiographic data.

However, the path to integrating AI-driven radiogenomics in LMICs is fraught with challenges, including data quality, the digital divide, and the imperative for strengthening local capacity. The importance of collective action cannot be overstated, necessitating global partnerships, the involvement of local entities, and the backing of international funding bodies to create an environment conducive to the adoption of this technology and the bolstering of local capabilities.

In an era marked by a deluge of molecular information, because of advanced biotechnology, AI-based algorithms are set to play a pivotal role. They will not just sift through vast data sets to pinpoint crucial insights but will also empower medical professionals to choose personalized medicine and explore innovative approaches like virtual and liquid biopsies. The true value of AI in radiogenomics lies in its potential to drastically reduce the expenses associated with medical and surgical care, making it a game-changer for healthcare systems, particularly in LMICs.

# 1st ICETBEST 2024 KEYNOTE-12

## ADVANCING LIFE SCIENCES: INSIGHTS FROM MEDICAL IMAGING ON RETINAL AND BRAIN MRI CASES

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Associate Professor & Chairman,
Department of Electronic Engineering
Quaid-e-Awam University of Engineering,
Science & Technology (QUCEST), Larkana

The analysis of medical images poses a significant challenge, particularly in tasks such as extracting vessels from color retinal fundus images and detecting and classifying brain tumors in MRI images. Various image-processing strategies have been employed to aid in diagnosing eye diseases and identifying brain tumors. This presentation delves into image processing and AI-based methodologies, including convolutional neural network (CNN)--based deep learning for retinal vessel segmentation and brain MRI imaging. The proposed segmentation methods demonstrate superior performance compared to existing approaches, particularly on widely used databases. This conference talk also explores the intersection of AI and medical images within the context of Sustainable Development Goals (SDGs). Key themes include the role of AI in medical imaging, its contribution to 21st-century well-being, transparency, automated decision-making, personal profiling of patients, and the assessment of the impact of digitalization and artificial intelligence (D&AI) in the health system. Central to this talk conference's focus is recognizing and prioritizing closing the research gap across academic research, funding agencies, and the medical industry. The overarching goal is to move beyond the isolated development of AI within specific sectors and to comprehensively understand the societal, environmental, health, and economic implications of these advancements.

# 1st ICETBEST 2024 KEYNOTE-13

## GENETIC ENGINEERING FOR EFFECTIVE VACCINES AGAINST VIRAL PATHOGENS

Prof. Dr. Shahana Urooj Kazmi
Center for Non-Communicable Diseases-Korangi, Karachi

Genetic engineering for vaccine development is the expression of genes of pathogens which encode surface antigens in microbial cells. Specific gene products are capable of inducing neutralizing antibodies in the host against the pathogen involved. This procedure has been exploited successfully for development of a vaccine against hepatitis B virus (HBV) that is now widely used. Similar approaches have been used to produce biological products for immunization against several other animal and human diseases. In majority of cases, genetic manipulations for vaccine development have concentrated mainly upon envelope proteins, the immunological importance of other viral components is now being increasingly recognized. Hepatitis B virus is an example where recombinant DNA technology was first time used to develop subunit vaccines and to illustrate their value in studies of other viral proteins with particular emphasis on the role of the core antigen in providing protection against viral infection. Current biotechnological strategies like genetic engineering and cell culture allows us to produce effective and economical vaccines against many pathogens. By using recombinant DNA technology antigen of any pathogen can be produced in a nonpathogenic E. coli or Yeast cells. Vaccine is a biological product which is given to individuals to strengthen their immune system to protect them against attacks of bacteria, viruses and other pathogens. Vaccine may consist of whole pathogen that has been weakened or antigen components of that particular pathogen, usually a surface protein or a viral particle which can be recognized by the antibody in the immune system. In addition to genetic manipulation, efforts are in progress for the development of gene-based - DNA, RNA vaccines for pathogens like COVID-19 so that the production of antigen can occur in the bodies of vaccinated hosts. Conventionally, vaccines are produced by growing pathogens on a specific growth medium or in live cells and harvested

pathogens are then attenuated or killed using different methods such as by heating or the use of certain chemicals. There is an underlying risk that the pathogen can become active again and cause infection., For protein-based vaccines, the coding gene of the protein can be inserted into the plasmid and transformed into the host cell (e.g. E. coli or mammalian cells) which can then express that gene into protein. The protein produced is then harvested, purified and formulated into vaccine. The production of gene-based vaccines is simpler due to the arrangement of DNA and RNA that can be adjusted to specific needs and multiplied quickly and easily based on the concept of genetic replication. Gene based mRNA vaccines have been successfully used for protection against COVID-19. mRNA vaccines carry genetic material that teaches cells to make "spike protein," which is found on the surface of the SARS-CoV-2 virus. Genetic material from the vaccine is destroyed by our cells once copies of the spike protein are made and it is no longer needed. Cells display this piece of spike protein on their surface, and an immune response is triggered inside our bodies. This produces antibodies to protect us from getting infected if the SARS-CoV-2 virus enters our bodies. That immune response, which produces antibodies, is what protects us from getting infected when the real virus enters our bodies. The advantage of mRNA vaccines is that they are not produced using infectious antigens. This is not a new technology, it has been studied for decades in vaccine trials for influenza, Zika, rabies, and cytomegalovirus. Beyond vaccines, cancer research has used mRNA to trigger the immune system to target specific cancer cells. In case of protein vaccine production, we have to ensure that the final product meets international standards; they must be free from production medium residues, components of production host cells and external contaminants. On cell-based or pathogenic particles-based vaccines, attenuation and inactivation must be accurate and effective in order to avoid reactivation of pathogen and to stop side effects in vaccinated individuals. There are still many diseases that are difficult to target, therefore new technologies are being developed and used on trial bases. Past successes have been largely due to elicitation of protective antibodies based on predictions made from the study of animal models, natural infections and sero-epidemiology. Due to an explosion of new strategies for vaccine development based on genetic engineering, we hope that systems biology and structural biology will help us in identifying the genes which must be down regulated and what antigenic constructions are needed to achieve a protective immune response.

# 1st ICETBEST 2024 KEYNOTE-14

## IMMUNODIAGNOSTIC TECHNIQUES

Prof. Dr. Aqeel Ahmad
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Immunodiagnostics has progressed rapidly and extensively. Various techniques, based on the specific antigen-antibody reaction, are developed to identify, quantify, or isolate the specific molecule of interest. It also helps in determining the exposure of foreign agents or cancer antigens. These antigens provoke some levels of immune response, which can be detected by various techniques. Immunodiagnostics tests like agglutination, precipitation, neutralization, and complement fixation are used to detect the desired antigen or antibodies. However, these tests are time-consuming and have poor sensitivity and specificity. Currently, highly sensitive and specific tests such as ELISA, RIA, and IF are used to isolate and identify antigens or antibodies of interest. In these assays, antibodies are used that are commonly labelled with enzymes, radioactive isotopes, or chemiluminescent substances. Various antibodies such as polyclonal and monoclonal can be commercially produced using advanced molecular biological techniques like the production of hybridomas, phage display, and cell culture. The one-step immunochromatographic test (ICT) using gold nanoparticles has been widely used in certain fields. This method is rapid, easy, and convenient to use. Recently, an immunochromatographic (ICT) was developed for the detection of mycoplasma antibodies. Briefly, 150 kDa protein was purified and used in the development of an ICT kit for the detection of antibodies against M. synoviae using gold nanoparticles coated with polyclonal antibodies. Low levels of antibodies were detected by the developed ICT kit, which has 88% sensitivity with 92% specificity.

# 1st ICETBEST 2024 KEYNOTE-15

## AI-ENABLED ACCESSIBLE AND AFFORDABLE DIABETIC RETINOPATHY SCREENING FOR REMOTE UNDERPRIVILEGED AREAS

Dr. Majida Kazmi
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Diabetic Retinopathy (DR) poses a critical health concern, affecting millions of individuals globally, particularly in light of the increasing prevalence of diabetes. Early diagnosis and treatment can prevent vision loss in up to 95% of DR patients. However, the shortage of ophthalmologists, coupled with the limitations of traditional DR diagnostic methods, necessitates innovative solutions to provide timely and accessible DR screening and diagnosis, especially in underserved regions. In this study, we present a deep learning (DL) based framework for DR screening, with a specific focus on its suitability for resource-constrained edge devices. Our methodology is built upon addressing five key research questions to enhance the model's accuracy, ensure scalability, establish robustness, optimize computational complexity, and provide a thorough performance comparison with existing models. The developed framework attains a very high accuracy of 98.4%, accompanied by a sensitivity of 95.6% and a specificity of 98.6%. It not only exhibits efficient resource utilization, with a 40-fold improvement in the accuracy-to-size ratio, but also excels with minimal CPU and GPU inference times, and low memory requirements. Our proposed framework combines enhanced accuracy and faster inference times with a lean DL model. Its adaptability facilitates inferences on edge devices in remote areas, even when cloud connectivity is intermittent. Looking forward, our focus will be on enhancing model generalization through cross-validation and hybrid databases, integrating security through federated learning, and implementing adaptive learning to ensure the model's continued relevance in evolving healthcare scenarios. This work represents a significant contribution to the field of DR screening, providing an accessible and efficient solution for mass screening, particularly in regions with limited access to healthcare resources.

# ABSTRACTS

# ORAL PRESENTATIONS

# ICETBEST-OR-24001

## ANTIMICROBIAL RESISTANCE AND SURVEILLANCE OF INFECTIONS USING WHOLE-GENOME SEQUENCING THROUGH MOLECULAR TYPING OF PROTOZOAN NAEGLERIA (PAKISTANI STRAIN)

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Monitoring and surveillance of infections, their classification, and data types, as well as phylogeny and antibiotic resistance screening, are all important topics for public health and medical practitioners. This covers veterinary medicine, the environment, pharmaceutical firms, private laboratories, and organizations that undertake diagnoses, research, or observation. The thermo tolerant amoeba is a free-living amoeba that can survive in extreme temperatures. These amoebae can be found in moist soil and waters all over the world, and they multiply in the warmer months when the temperature rises. It then infects the central nervous system via the neuroepithelium, resulting in a deadly infection that looks like acute bacterial meningitis. Molecular Evolutionary Genetics Analysis (MEGA) is computer software for conducting statistical analysis of molecular evolution and for constructing phylogenetic trees. Mega software used to analyze and interpret the phylogenetic tree of Naegleria strains. The conclusion is that each of the strains has some evolutionary links with one another. Pairwise distribution and additional tools used, such as alignment tools, to analyze data effectively. This analysis involved 21 nucleotide sequences. In this project there were calculated a total of 60870 positions in the final dataset. The PubMLST is a database to address the issue relating to molecular typing for investigation of Naegleria fowleri genomic sequence to find a match to bacteria (BACT000033) and origin the locus in a plasmid HCM1_116.Antimicrobial drugs are antibiotics that are used to treat or prevent pathogen. Antimicrobials are used in practically all modern medical technologies. Antimicrobial resistance occurs when resistance genes in these microorganisms undergo random mutations over time. Comparative genomic features that indicate convergent evolution of genomes connected to amoebae resistance and growth is important. Most important concerns are in treatment and prevention management. It is possible that Naegleria fowleri infections will become more common because of climate change and Resistance can only be prevented Antimicrobial resistance will continue to be a big threat. Global collaborative effort is required for medical, agricultural, and veterinary sectors. Another approach could be to develop predictive models using machine learning algorithms to forecast the spread of Naeglaria infections and potential resistance patterns.

# ICETBEST-OR-24002

## COMPUTATIONAL MODELING FOR HEMODYNAMIC ANALYSIS OF STENOSED CAROTID ARTERY

**Laiba Junaid, Tayaba Naz, Natasha Mohsin, Arham Saddique, Muhammad Abrar Baig, Syed Muddusir Hussain, Dr Faisal Amin**
**Department of Biomedical Engineering, Riphah International University, Islamabad, Pakistan**

Atherosclerosis is the accumulation of lipids, cholesterol, and other substances inside and on the arterial walls known as plaque. Atherosclerosis can constrict the arteries and obstruct the blood flow. Additionally, the plaque may rupture the artery and clots blood. Blood flow patterns and hemodynamic parameters in the carotid artery have been widely associated with the onset and progression of atherosclerosis. Depending on the severity, stenosis in the arteries may lead to abnormal Blood flow conditions that can result in heart attack or stroke. A 2D model of the Carotid Artery has been studied representing Blood flow changes in the carotid artery along with the obstruction faced by Blood due to plaque which is formed by the deposition of fat and cholesterol on the side walls of the carotid artery. This study created a workflow for analysis utilizing a 2D model of the carotid artery with a total length of 60 mm and a diameter of 4.3 mm to estimate the carotid artery hemodynamics. COMSOL Multiphysics 6.0 has been used to construct and simulate the model of a blood vessel, along with the deposition of plaque, stenosis, sequential obstruction of outlets, and load application on it. The simulations showed that the lumped parameter model produces hemodynamic parameter values that are consistent with physiological reality. The simulation experiments demonstrate that hemispherical carotid artery blockages are extremely precarious and may be a factor in an impending ischemic stroke or cerebrovascular accident. The main goal is to evaluate scenarios reflecting changes in blood flow velocity and pressure, due to the narrowing of the artery, plaque formation, and the effect of closing any of its openings, between a healthy artery and an artery with disease.

# ICETBEST-OR-24003

## DEVELOPMENT OF A COST-EFFECTIVE PLASMA THAWER: A POTENTIAL GAME-CHANGER IN BLOOD TRANSFUSION TECHNOLOGY

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Plasma thawers are vital in healthcare, ensuring safe thawing of frozen plasma for life-saving transfusions. To address challenges such as specialized operator training and high initial costs in low-resource settings, we developed a cost-effective and efficient plasma thawer in Pakistan. The functional prototype was developed at NED university, Pakistan in 2023. The device consisted of two compartments: one dedicated to thawing plasma and equipped with a water-filled heater, a continuous temperature sensor, and an agitating frame for plasma bags, and the other housing the control box. Optimized thawing conditions were defined. The regulation of temperature and control of motors were coordinated through an Arduino microcontroller and relays which allowed users to set temperature limits through push buttons. Our device was able to thaw frozen plasma, accurately maintaining water temperature between 37-40°C. The samples were clear of solid and gelatinous particles, indicating no protein denaturation or overheating. A buzzer signaled the completion of each cycle. The microcontroller cut off power to the heater if the temperature exceeded the upper limit. Relays activated heater to maintain water temperature above the lower limit and activated DC motor which converted rotational motion into linear motion through gears. The device was 85% cost-effective compared to commercially available alternatives. We demonstrated that plasma can be thawed using our prototype without any negative influence on the plasma quality, presupposed that optimized settings defined for this plasma product are used. We plan to further assess plasma coagulation, inhibition activity and hemostatic potency.

# ICETBEST-OR-24004

## BLUE LIGHT THERAPY: A SKIN TREATMENT MASK USING BLUE LIGHT TO CURE SKIN DISORDERS

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Skin acne and disease are the most common medical conditions that lead from mild to moderate if not treated in time. There are several treatments such as Chemical peel, Dermabrasion, and many others these hyped techniques have proven to be extremely beneficial for improving and smoothening the skin texture, through treatments with chemicals and devices. Unfortunately, such techniques have various side effects such as redness, scabbing, irritation, and swelling, which do not provide a better medical treatment. These treatments require continuous medical examination and an expert opinion. Light therapy can be used non-invasively to overcome such side effects and treat a large number of skin damages. Blue light exhibits tons of advantages to human skin by reducing sebaceous glands' activeness so that they produce low amounts of oil that ultimately hook into the pores of the skin and result in skin breakouts and acne popping. Blue light can cure severe skin conditions such as sun damage, fine lines, wrinkles, acne scars, blemishes, and a lot more. Blue light therapies are generally used to treat the conditions, that are present superficial and under the skin surface. In this research, the face mask has been designed and incorporated with the Blue light strips to provide the blue light on the facial skin. The microcontroller has been programmed to control the intensity and time during the therapy session. This skin treatment mask has proven to be a pain-free and effective procedure to make the skin look healthy and beautiful. The results have been incredible and satisfactory in improving the skin conditions of the user.

# ICETBEST-OR-24005

## ELECTROENCEPHALOGRAPHY BASED STRESS ANALYSIS USING MACHINE LEARNING

**Humna Saeed, Laiba Junaid, Zahra Zia, Mashal Fatima, Saadullah Farooq Abbasi, Zia Ur Rehman**
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Stress significantly impacts mental and physical health, and accurate stress measurement is crucial for effective intervention Electroencephalography (EEG) technology identifies biomarkers using machine learning approaches, providing insight into brain activity associated with stress. University students live in different environments and lead different lifestyles than people in other age groups. This study contributes to the understanding of how stress affects university students before and after their exams, their electrical activity of the brain was recorded. Several classifiers, including quadratic SVM, logistic regression, linear SVM, and decision trees, were evaluated based on factors such as accuracy, precision, sensitivity, specificity, and F1 score. With an accuracy of 99.80%, the fine Gaussian SVM classifier proved to be the most effective for university students, according to the study. Moreover, impressive precision and accuracy values exceeding 99% were demonstrated using linear SVM classifiers and logistic regression. Decision tree and quadratic SVM classifiers also attained excellent accuracy scores of more than 99%. According to this research, EEG signals can be utilized to monitor university students' stress levels. EEG-based stress evaluation has the potential to revolutionize customized stress analysis and the facilitation of customized stress management solutions.

# ICETBEST-OR-24006

## A SYSTEMATIC REVIEW ON COMPARATIVE STUDY OF AI TECHNIQUES FOR CLASSIFICATION OF BRAIN TUMOUR

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This paper explores advancements in machine learning algorithms for brain tumour detection by using MRI images. Even though several algorithms were used in earlier studies, there were differences in terms of effectiveness, dependability, computational complexity, and execution time. Enhancing treatment results and patient survival for brain tumours requires an early and precise diagnosis. With an emphasis on their successes in the detection, image segmentation, and classification of tumour images, the paper offers a thorough analysis of both established machine learning and recently developed deep learning algorithms for brain tumour diagnosis. It also covers current developments in tumour grade classification and segmentation, emphasizing how machine learning, digital image processing, and medical knowledge work together to improve diagnosis accuracy. The evaluation intends to provide a guide for further investigations in the developing field of brain tumour diagnostics.

# ICETBEST-OR-24007

## TREATMENT OF POST VIRAL VAGAL NEUROPATHY VIA VAGUS NERVE STIMULATION

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The nervous system and the immune system maintain close bidirectional communication under physiological and pathological conditions. The connection between the brain and the immune system is the inflammatory reflex mediated by the vagus nerve, which is characterized by an anti-inflammatory effect. Post-viral vagal neuropathy (PVVN) is a clinical diagnosis characterized by laryngeal complaints initiated by an upper respiratory tract infection (URI). The vagus nerve is the tenth cranial nerve, which is the longest cranial nerve in the human body, innervating many organs of the body from the brain to the abdomen and providing them with parasympathetic responses. Postviral vagal neuropathy (PVVN) could be treated via VNS through electrodes embedded in biocompatible stents placed in a close proximity artery to the vagus nerve in COMSOL MULTIPHYSICS software. A modeled solution in which a potential in the stent is stimulated to the nerve nearby. Vagus nerve stimulation (VNS) has the potential to improve the accuracy and efficacy of this treatment method. Neuroimaging and biomarker studies are anticipated to lead to a better understanding of VNS processes, allowing for more accurate prediction of individual responses. VNS's neuroimmunomodulation impact is mediated via the cholinergic anti-inflammatory pathway, which regulates immune cells and reduces pro-inflammatory cytokine levels.

# ICETBEST-OR-24008

## DESIGN AND DEVELOPMENT OF EMG ACQUISITION SYSTEM FOR THE MONITORING OF JAW CLENCHING TO DETECT BRUXISM

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Adequate sleep aids the brain's processing of emotional information. Amongst many diseases that cause obstructive sleep, Sleep Bruxism (SB) is the most common. This study aims to develop an in-depth understanding of oral health in association with sleep patterns. Sleep bruxism is an aggravated form of normal rhythmic masticatory muscle activity (RMMA) that occurs during sleep. It is associated with tooth grinding sounds, stronger electromyography (EMG) contractions and an activity of frequency greater than 1 Hz. In this study, highly conductive facial electrodes are utilized to capture EMG signals from the cheek muscles. The acquired data is regulated and transmitted wirelessly through the controller module after passing through the exclusively designed EMG amplification circuit and the detection of bruxism is done by a threshold mechanism. For convenience and protection, the whole system is integrated into a smart pillow. The bruxism detection and alert generation module has been tested successfully on several subjects belonging to different genders and age groups. It provides a cost effective and comfortable strategy to train the bruxer patient so that the duration as well as episodes of bruxism tends to decrease with time.

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ICETBEST-OR-24009

# ENHANCING SHOULDER MOBILITY: A TWO DEGREE OF FREEDOM ASSISTIVE DEVICE FOR ADHESIVE CAPSULITIS REHABILITATION

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Adhesive Capsulitis (AC), or frozen shoulder, is a condition causing shoulder joint pain and restricted mobility due to inflammation. While its origin is unclear, potential triggers include injury, surgery, or medical issues like diabetes. Conventional treatments involve corticosteroid injections and rehab exercises, but challenges such as injection discomfort and missed sessions due to time and cost constraints persist. This paper proposes a solution for AC through a 2-degree of freedom (DOF) exercise autonomous device designed for the indigenous population. The device facilitates crucial rehabilitation movements, offering patients a direct or physiotherapist-assisted approach, reducing session costs, and ensuring consistent exercise application. The device focuses on flexion extension and abduction-adduction DOFs. At high speed, average flexion-extension angles were (101.9° ± 11.3) for flexion and (64.5°± 14.4) for extension. At low speed, they were (103.1°± 8.5) and (65.03°± 14.05), respectively, with a lower standard deviation in low-speed flexion, indicating more consistent performance. For abduction-adduction, high-speed averages were 102.91° for abduction and 72.15° for adduction. Low-speed averages were 102.56° and 65.03°, respectively. The device's adaptability and consistent performance across speeds underscore its potential for tailored and effective rehabilitation. These findings represent a significant advancement in AC treatment, addressing challenges and offering a promising avenue for enhancing patient care and quality of life.

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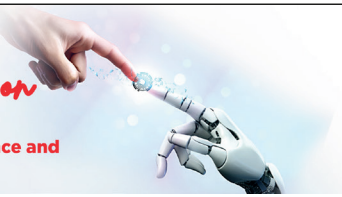

ICETBEST-OR-24010

# A COMPUTATIONAL MODELING APPROACH IN COMSOL: DESIGN AND OPTIMIZATION OF A NOVEL STENTRODE FOR PERIPHERAL NERVE STIMULATION

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Peripheral nerve stimulation (PNS) is an effective and emerging neuromodulation technique for treating various neurological disorders like Intractable epilepsy and Depression. Endovascular neuromodulation has emerged as an area of great interest because of its minimally invasive approach to the treatment of intractable epilepsy and its potential for the management of several neuropsychiatric conditions. Recent advances in endovascular approaches have led to more precise and targeted nerve stimulation with better response and the advent of neurostimulation stents. To obtain the best stimulation response, it is necessary to optimize the electrode design and parameters. In this study, we investigated the efficacy and feasibility of endovascular PNS using a neurostimulation stent. We compared different electrode areas and inter electrode distances to optimize the design of neurostimulation stents for optimal nerve stimulation. The computational model includes a 3d model of the jugular artery and peripheral nerve passing through the vertebral levels T1 to C1. The artery was implanted with a gold electrode-mounted stent. We evaluated different electrode configurations and stimulation parameters in COMSOL Multiphysics. This model successfully characterized neural activation to understand the underlying mechanism of PNS action. Our stentrode design with 1.6 mm interelectrode distance and 0.5 mm² electrode area elicited the highest stimulation-evoked potential (SEP), the lowest SEP recorded at 0.1 V still exceeds the threshold required to activate vagal fibers. This clear link between lead configuration and SEP underscores the potential for optimizing future stentrode designs for effective vagus nerve stimulation. The results of this study have important implications for the development of PNS methods. The potential for precise and targeted neuromodulation is greatly enhanced by combining computational models with endovascular approaches. The results show maximum potential at serve as a basis for further research and development of new electrode array designs and stimulation protocols, ultimately leading to more effective treatment strategies for neurological disorders.

# ICETBEST-OR-24011

## BALANCE ANALYSIS IN VIRTUAL ENVIRONMENT: A STUDY UTILIZING FORCE PLATFORM AND ELECTROMYOGRAPHY OF THE LOWER LIMB

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Fundamental to human movement, balance is crucial for stability and navigating different environments. This study focuses on observing and analyzing balance within virtual reality (VR), using force platforms and EMG to assess postural stability, weight distribution, and muscle activation patterns. The study analyzes variations in normal and parallel forces, aiming to establish posture stability and identify muscle activation patterns. Even within a virtual environment, the body stabilizes itself during motion, leading to fluctuating forces and distinct muscle activation. This analysis aids individuals in adapting to various motions, addressing issues like motion sickness through repetitive exposure that promotes bodily adaptation and identifies coping mechanisms.

# ICETBEST-OR-24012

## INVITRO ANTIBACTERIAL ACTIVITY OF CINNAMON AGAINST STAPHYLOCOCCUS AUREUS IN MINCED MEAT

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Spices as food preservatives has gained considerable attention to extend the shelf life of food products and to combat foodborne pathogens. Among several spices cinnamon has been widely used as a food preservative to control food spoilage. The current study was designed to evaluate the antibacterial activity of cinnamon against Staphylococcus aureus in minced meat as an efficient food preservative. For this purpose, ethanolic extract of cinnamon was prepared and agar well diffusion assay was used to determine the antibacterial activity of cinnamon. Moreover, the Minimum Inhibitory Concentration (MIC) was also calculated using tube dilution method. After this the cinnamon extract was utilized as a bio preservative in minced meat infected with staphylococcus aureus at 4ºC for different time intervals. The results showed significant antibacterial activity that is 36.0 mm zone of inhibition against staphylococcus aureus. Furthermore, MIC of cinnamon was found to be 12.5 mg/ml. In addition, Cinnamon was significantly controlled the growth of Staphylococcus aureus and other microorganisms up to 10 days at 4°C. It also preserved the meat with its original color, texture and pH without any spoilage at refrigeration temperature. Therefore, cinnamon could be a better choice as compared to chemical preservatives for the preservation of meat as a natural preservative to enhance the shelf life of meat products.

# ICETBEST-OR-24013

## LITERATURE REVIEW ON IMAGING PROCESSING METHODS FOR OF BRAIN TUMOR DETECTION

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This comprehensive review examines many image processing techniques in the field of biomedical engineering, focusing on their application to brain tumor detection through medical image segmentation. The financial burden of brain tumors includes significant direct costs, including treatment and supportive care, as well as significant indirect costs such as lost productivity, lost income, and medical costs. This economic impact underlines the need for effective strategies and health policies to alleviate economic pressures on individuals, families and society as a whole. The review focuses primarily on MATLAB applications, focusing primarily on magnetic resonance imaging (MRI) as the primary imaging modality, with selected studies extending to alternative techniques such as electron microscopy. Different algorithms have been used for MRI-based brain tumor detection, each with distinct characteristics in terms of detection efficiency, reliability, computational complexity, and execution time. Algorithms include widely used classifiers and algorithms such as region growing, K-Means clustering, fuzzy C-Means clustering, support vector machines, and deep learning approaches such as artificial neural networks and convolutional neural networks. The synthesis of findings not only illuminates different methods, but also identifies common challenges in the field. Tumor heterogeneity and image noise are common obstacles that highlight the need for innovative solutions to improve detection accuracy. Highlighting the strengths and weaknesses of current approaches, this analysis aims to contribute to the development of more accurate and computationally efficient algorithms in the field of image segmentation in medical terms for brain tumor detection. The presented insights will contribute to a deeper understanding of the complex landscape and promote advances that meet the evolving challenges of biomedical imaging in brain tumor diagnosis.

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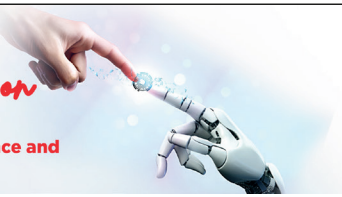

ICETBEST-OR-24014

# SECURITY AND PRIVACY ALGORITHMS IN INTERNET OF VEHICLES – A TECHNICAL ANALYSIS

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The Internet of the vehicle is a branch of IoT that is taking a significant shift in the vehicle industry, collaborating vehicle manufacturers with tech giants has never happened before. Numerous technological progresses took place in this ranging from vehicle interiors to exteriors. Nevertheless, the key area common in intra or external communication of modern IoV is the consideration and stringent focus on security and privacy as IoV is connected to the internet its mediums that play a key role for communication both intra and external level, and the end-users. Attackers could use the information and affect the end-users. In this regard, security and privacy algorithms for fortifying intra and external communication have been offered by diverse experts and professionals in the prior decade. In this paper, the authors have done a technical analysis first to understand what those algorithms and schemes are doing and secondly, what limitations and concerns exist in the existing algorithms and schemes that could hinder the privacy and security of IoV and its communication. The proposed paper adopts the qualitative research method and is supported by secondary data collection.

# ICETBEST-OR-24015

## S.P.ENSER- A SYMPTOM BASED SMART PILL DISPENSER

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First-aid medicinal boxes are a necessity everywhere and to make them user friendly and automatic many researchers have designed medicine vending machines that can dispense the medicine you want or need. However, for people who are unaware about which pills should be taken for their symptoms, especially the elderly, an automatic machine that could quickly dispense the required medicine(s) would rather be a better choice. Therefore, we designed S.P.ENSER (smart pill dispenser), a device that uses logic gates such as AND, OR, NOT, and XOR as well as electromagnetic switches to help provide individuals with the medicines of their need. Users can flip the switch(es) according to their symptom(s) and an over-the-counter pill to cure their symptom(s) will be dispensed out of the machine for them. When placed in offices or old age homes, it can assist people who are suddenly feeling unwell and need medications for that. The users will also be able to check their temperature and heart rate on an LCD by using the respective sensors placed in the machine. This device can be extremely helpful to those who have no prior knowledge of overthe-counter medicines as well as the elderly in any household.

# ICETBEST-OR-24016

## SMART BIOMEDICAL MATTRESS FOR MONITORING AND PREVENTION OF PRESSURE ULCERS

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Pressure ulcer is a skin-related secondary disability due to prolonged pressure on soft tissues over bony prominences, inhibiting blood and oxygen supply. It is essential to change the bed-ridden patient's body position at frequent intervals to prevent pressure ulcers. The most common practice involves caretakers performing repositioning, increasing their physical and mental burden. Conventional methods include water-surface mattresses, active support mattresses, and alternating inflatable air-pressure mattresses. These methods relieve the body pressure; however, the water surface mattresses produce a sea-sick feeling due to the wave-like motion of water surfaces, whereas the pressure mattresses are seldom subjected to punctures leading to air leakage from the chambers. In this paper, we have proposed an electrical stimulation-based smart mattress that can sense continuous pressure points through the FSRs of patients lying in supine and lateral recumbent positions. The pressure is sensed from the regions susceptible to pressure ulcers to generate a repositioning signal by providing electrical stimulation via stimulation electrodes of Graphene Nano Platelets GNP embedded in an adjustable array. The stimulator circuit regulated the blood circulation, as confirmed through ultrasound examinations of the radial recurrent artery. The stimulator results were further validated upon comparison with the market-available Transcutaneous electrical nerve stimulation unit, showing a cross-relation of 0.99462. The dry conductive GNP electrodes were designed to deliver these stimulation pulses, which were found to be conductive and hypoallergenic when subjected to direct contact with skin.

# ICETBEST-OR-24017

## DESIGN AND DEVELOPMENT OF COST-EFFECTIVE ARRHYTHMIA DETECTOR

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Sudden Cardiac Deaths (SCD) pose a global health threat, resulting in numerous fatalities annually. According to WHO, 90% of sudden deaths are due to cardiac arrhythmias WHILE 20% causes of arrhythmias caused by Heart Block or Bradycardia, 80% by Ventricular Fibrillation frequently initiated by ventricular Tachycardia. Accurate detection of cardiac arrhythmias is crucial for preventing SCD and facilitating long-term cardiac healthcare. However, existing solutions like ECG and Holter Monitors face performance, accessibility, and continuous monitoring limitations in daily routines, necessitating cost-effective, user-friendly alternatives for uninterrupted monitoring. Employing AD 8232 and ADS 1115 ECG modules integrated with a Raspberry Pi 4, along with signal conditioning filters and the Pan-Tompkins peak detection algorithm, this study explores the efficacy of deep learning, specifically 1-D Convolutional Neural Networks (CNN), in categorizing five cardiac arrhythmia classes. Utilizing MIT-BIH arrhythmia database signals, the 1-D CNN model exhibits robust performance, achieving a training accuracy of 98.93% and validation accuracy of 98.37%. Testing accuracy on validation data reaches 98.88%, with a remarkable 99% on test data, accompanied by high precision, recall, and F-1 score. Notably, the 1-D CNN model outperforms the VGG model, particularly excelling in recall for class L. Despite the VGG (CNN) model's 98% accuracy and good recall for most classes, it demonstrates lower recall for class V. Internal testing on normal subjects yields a 99% accurate result for class N. In conclusion, the integration of cost-effective hardware with advanced 1-D CNN deep learning proves a reliable strategy for precise, continuous identification of cardiac arrhythmias, surpassing conventional methods and offering promise for enhanced real-world cardiac health monitoring.

# ICETBEST-OR-24018

## HOW TO PROTECT VIRTUAL WORLD FROM CYBER ATTACKS

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We can see Metaverse as an early instance of Virtual World or titling IR4 as "Cyber Physical World". So, there is still a long journey to see the occurrence of Virtual World in full swing. We can break this time period in 3 parts Physical-Digital-Virtual. A human profile can be seen as Persona, Avatar. So, similarly a factory in Physical World is converted to its digital twin in Digital World then what shape it will take in Virtual World is still to be explored or arrived. Exists parallel to the physical world and is accessible through digital devices. As the concept of thin clients may be substantial and effective inside the Virtual world architecture to connect 3 worlds simultaneously. Thin clients may change in the context of the growing virtual world ecosystem to adapt to and support the different and immersive experiences that users demand. As the virtual world continues to grow and expand, cyber security concerns have become increasingly important. Overall this paper highlights the importance of cyber security in the virtual world and the need for ongoing vigilance and innovation to ensure the safety and security of users in this virtual world.

# ICETBEST-OR-24019

## A CENTRALIZED PATIENT MONITORING SYSTEM FOR WARD PATIENTS

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Patient monitoring is an essential practice in healthcare settings to assess well-being and medical conditions. This study proposes a central patient monitoring system enabling healthcare personnel to have a comprehensive perspective of multiple patients' health state from a central location. The proposed prototype enables healthcare providers to detect and respond to changes in patients' condition efficiently. The project contains multiple patient monitoring units with each measuring temperature, ECG, SpO2, and heart rate along with a display on a centralized screen. The hardware of monitors is placed at each patient bed connected with all the patients and the result of each patient can be seen from the general ward counter. Different sensors are used to design monitoring units and are connected with node MCU through different pin connections. Node MCU sends the information gathered from sensors to the Raspberry pi unit using Wi-Fi. The real-time data of patients are being displayed and saved using server "thing speak". There are different options on the server window to switch between different patients' real time results to monitor them. The proposed prototype uses computer technology to monitor the vital signs of multiple patients on a single monitor from a centralized location using internet which may eventually reduce the time and workload of medical staff leading to improved patient care.

# ICETBEST-OR-24020

## IoMT SOLUTIONS FOR REMOTE PATIENT REPORTING AND MONITORING

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The Internet of Medical Things (IoMT) is the network of Internet-connected medical devices supported by IoT, hardware infrastructure, and software applications used to connect healthcare information technology. The healthcare practices are successfully transformed in the field of biomedical engineering especially in-patient reporting and monitoring. The aim of this research paper is to identify the for Remote Patient reporting and monitoring. We will focus on the accuracy and efficiency of remote patients reporting mechanisms, which was seen in its full swing during COVID-19 pandemic. This work will actually become the solution for the people living in the rural areas, remote areas and unreachable regions; as they have lack of healthcare staff and allied services. This paper is putting forward an IoT based intelligent system that helps in sensing patient's condition, displaying and storing their data on the internet (or on cloud) and let doctors be informed about the patient's health condition in real time. This solution will be helpful in saving lives with the help of doctor providing quick remedy to the remote patients. A complete healthcare model will be elaborated further and will be enabling remote health monitoring of patients so that they could collect daily with a frequency of data and signals gathered from one's home and transmit them to the caretakers with the help of IoMT. Remote monitoring of the patients has improved healthcare system by connecting real-time IoT applications along with smart phones to save and to improve their lives. This paper highlights the latest trends in healthcare systems by implementing IoT in the system. We can launch a bio wearable tracker that helps in collecting, transmitting and analyzing data directly from and to the healthcare network. The sensors are connected to a network on the IoT cloud via smart phone agents, where data of the patients are stored, processed, analyzed and transferring data real-time to different locations such as hospital, doctor's office and emergency room and even alerting the families. These wearable trackers help in measuring heart rate, stress levels, glucose levels, sleep cycle, blood pressure, etc. that helps in monitoring patient health. With the help of this IoMT system the time of both patients and doctors are saved as doctors are able to help patients in an energy as much as possible. Embedding artificial intelligence on top of it will help in including a layer of android web for mobile phones over IoT technology, which will make our system more robust. Other functionalities can have a layer of wearable IoT sensors and a cloud layer that helps in storing the information in the database for quick actions, reactions and notifications. So, we can see new IoMT products and solutions as the time reveals the future to humanity.

# ICETBEST-OR-24021

## TRACING VEINS USING NEAR INFRA-RED IMAGING TECHNIQUES

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Venipuncture is widely used in hospitals for a variety of treatments like drug administration, supplying nutrients, drawing blood samples etc., on a daily basis. Phlebotomists use tourniquets and skin palpitation for detecting and locating the site of venipuncture that results in a significant error rate due to peripheral difficult venous access (PDVA) which is often a result of dehydration, baby veins, and dark skin complexion, etc. This can lead to hematoma, nerve damage, extravasation, and arterial puncture that can be lethal. This research proposes a vein locating device that aids in reducing this error by clearly drawing out the venous patterns. It uses the ability of near infra-red (NIR) to be absorbed by deoxygenated blood whilst reflected by the peripheral structures to capture vein patterns. MATLAB and various Python libraries were used to preprocess images which were further subject to segmentation with the help of filters like Frangi Vesselness, Sato, and Meijering etc. Convolutional Neural Networks (CNN) are applied to a U Net architecture and is used to produce an elaborate model that is integrated with a Raspberry Pi camera module to trace a pattern that assists phlebotomists during venipuncture. The resulting pattern was depicted on the screen which gave a 94% testing accuracy over 18 epochs. Validating the result on an R-score metric exhibited 70% similarity, denoting significant reduction in the error of interpreting the venous patterns.

# ICETBEST-OR-24022

## AUTOMATED DIAGNOSIS OF ALZHEIMER'S DISEASE: A MOBILENETV1-BASED APPROACH WITH MRI DATA

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One of the most prevalent neuro-pathological disorders, Alzheimer's disease effects about 46.8 million people worldwide, having an adverse effect on their caretakers as well as the economy. Various studies have been carried out which recognize Alzheimer's as a degenerative disorder and concluded that early diagnosis is crucial for initiating timely interventions. While cognitive tests are common for early identification, MRI brain analysis remains the primary diagnostic method. Numerous studies have investigated abnormal brain conditions and the detection of Alzheimer's and dementia states using features derived from medical images. The study utilizes the Alzheimer's Disease Neuroimaging Initiative (ADNI) dataset, comprising 6400 MRI images categorized into non-demented, mildly demented, moderately demented, and very demented classes. Deep learning approaches for brain structure segmentation and AD classification have gained prominence due to their effectiveness over large datasets, surpassing traditional machine learning methods. A novel deep learning and image processing technique for MRI-based Alzheimer's diagnosis was proposed using a CNN architecture integrated with depthwise separable convolutions inspired by MobileNetV1 principles. The model demonstrated an accuracy of 98% on a test dataset, showcasing its efficacy in distinguishing between different classes associated with Alzheimer's progression whilst the average test loss was remarkably low at 0.0543, underscoring the model's proficiency in minimizing the discrepancy between predicted and true values. Furthermore, the precision scores of 0.95, 0.97, 1.0 and 1.0 indicate a high degree of accuracy in positive predictions; whilst both macro and weighted averages being 0.98, denote the consistency of the model's performance across all classes.

# ICETBEST-OR-24023

## BARTIFICIAL INTELLIGENCE BASED ECG FOR EARLY DETECTION OF DYSRHYTHMIA

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Dysrhythmia refers to an abnormal heartbeat. There are many types of arrhythmia. The condition may be silent aka no obvious symptoms. Echocardiography (ECG) is a graphical representation of electrical signal from the heart. Generally, a medical expert's report reveals the presence of cardiac disorder. This fact compels to the development of artificial intelligent (AI) based ECG in this research work. AI is a rapidly advancing technology that has the potential to revolutionize healthcare. In this study, we focus on the use of AI for an early detection of dysrhythmia through analyzing ECG signals. The AI-based ECG dysrhythmia detection system has three essential elements: Feature extraction, classification, and data preprocessing. The decision support system eases the task of a medical doctor. In addition, this study focuses at how the AI-driven dysrhythmias detection system may be integrated into clinical practice. The findings show that the AI-based method has the ability to identify dysrhythmias with high accuracy early on, allowing for prompt intervention and better patient outcomes.

# ICETBEST-OR-24024

## A NOVEL TECHNIQUE FOR THE MEASUREMENT OF CHEST WALL KINEMATICS USING LOW COST STRETCH SENSORS

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Measurement of breathing patterns and thoracoabdominal movement (chest wall kinematics) is essential in studying patients with chronic obstructive pulmonary diseases (COPD), patients with neuromuscular diseases, critical patients in intensive care units and in healthy subjects during exercise. Currently, these measurements are being performed using optoelectronic plethysmography, which requires a number of motion detection cameras and large amount of three-dimensional vector field computation. In this study we have designed and implemented a novel method of measuring breathing patterns using low-cost stretch sensors. For this purpose, three stretch sensors were attached to belts around torsos. Each sensor was calibrated by stretching it for different lengths and measuring the change in resistance and voltage caused by this change in length of the sensor. An equation of voltage was calculated for each belt as function of length of the belt. 20 healthy subjects of both genders, aged 23 ± 1.5 years participated in this study. Belts were tied around all subjects at pulmonary rib cage (RCp), abdominal rib cage (RCa) and the abdomen (AB). Data was collected during normal breathing for 1 minute i.e. 60 seconds for each subject. The sensors were analyzed using MATLAB to distinguish between thoracoabdominal and abdominothoracic breathing patterns and correlation between signals was computed. Results showed that the correlation values indicate a delay of 0.5 ± 0.1 ms between pulmonary rib cage RCp and abdomen AB signals. For the subjects with abdominothoracic breathing patters the delay was 0.3 ± 0.09 ms between abdomen AB and pulmonary rib cage RCp signals. The simplicity and affordability of this approach offer a promising alternative to current complex methodologies, making it a valuable tool for studying respiratory dynamics in various clinical scenarios and healthy subjects during exercise.

# ICETBEST-OR-24025

## ARTIFICIAL INTELLIGENCE BASED VITAL SIGNS MONITORING SYSTEM

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This paper presents development of an artificial intelligence (AI) based vital signs monitor technology. The culmination of this effort is a working prototype, an AI biomedical device that monitor vital signs and seamlessly transmit health information to emergency services and record it in a hospital's medical database system. Such systems have profound implications and are expected to improve patient care through timely and accurate data transmission. A comprehensive review of existing research literature highlights the critical importance of monitoring vital signs, especially in situations where immediate intervention can be lifesaving. This research work conceptualizes the idea and develops a detailed architecture and the process flow. The proposed architecture of the AI-based vital signs monitoring system includes a sophisticated framework for data processing, analysis, and transmission.

# ICETBEST-OR-24026

## EVALUATION OF ANTIBACTERIAL EFFICACY OF PAKISTANI HONEY IN COMBINATION WITH BLACK SEED AGAINST FOOD BORNE PATHOGENS

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Honey has been used for a multitude of purposes since the dawn of human civilization thousands of years ago. It has been used topically to treat wounds and burns due to its antibacterial properties. There are several combinations of Honey and other organic components have been investigated for food borne pathogens to assess their antibacterial efficacy. Black seeds (Nigella sativa) are an example of an organic substance with the ability to suppress the growth of food-borne pathogens. This study aims to evaluate the antibacterial potential of different variants of Pakistani honey in combination with black seeds against foodborne pathogens. For this purpose, the antibacterial activity of different honey (Acacia honey, Ziziphus honey, and Sidr honey) was evaluated alone and in combination with black seed using an agar well diffusion assay. Moreover, the Minimum Inhibitory Concentration (MIC) of the honey and black seed was also determined using the tube dilution method. Results revealed that among all honey varieties, the combination of Ziziphus honey and black seeds showed the most significant antibacterial effect such as 25.0, 28.0- and 30.0- mm zones of inhibition against Escherichia coli, Salmonella typhi, and Staphylococcus aureus respectively. The inhibition zone of the synergistic antibacterial effect of honey and black seed extracts against foodborne pathogens was significantly larger than the extracts used separately. Therefore, the present finding supports the traditional use of these different honey variants in combination with black seed for treating food borne pathogens. These natural extracts could be used as a food preservative and as a therapeutic agent to promote good health without any side effects on human health.

# ICETBEST-OR-24027

## INCORPORATING A NOVEL BIOMATERIAL TO PROPOSE A BATTERY LESS CARDIAC PACEMAKER

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Honey Prolonged Cardiac arrhythmias are deadly to human health. To overcome this life-threatening problem, pacing devices are inserted, which provide electrical pulses to maintain a regular heart rhythm. The drawback of current battery-dependent systems includes replacements and increased cost. To overcome this issue, a battery-less cardiac pacemaker is proposed in which energy is harvested from polyvinylidene fluoride (PVDF) to operate the device. The approach involves designing a structure with an imbalanced mass using an oscillating generator and piezoelectric transducer. Moreover, a layer of polydimethylsiloxane (PDMS) is used to externally coat the device to ensure biocompatibility within the body. The design of the pacing probe eliminates the requirement for inserting leads into veins. Thorough testing aims to achieve an energy output of 4.2 mW, sufficient for cardiac pacing. This methodology bypasses traditional devices by focusing on production aspects, thereby expediting the innovation process. The wireless and leadless design represents a change in care focusing on meeting patients' needs. The expected outcome signifies the beginning of an era of medical device innovation, bringing us closer to a dependable solution for cardiac pacing

# ICETBEST-OR-24028

## DESIGN AND DEVELOPMENT OF A BIOMATERIAL BASED ARM PATCH FOR INTRAVENOUS MEDICAL SIMULATION AND TRAINING

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This study focused on the development of a biomaterial-based arm for intravenous (IV) medical simulation and training. With the utilization of easily available biomaterials, the study aimed to create a realistic and cost-effective training environment for healthcare professionals. The selection of suitable biomaterials involved evaluating factors such as durability, biocompatibility, and fabrication ease. Incorporating some basic anatomical features, such as realistic veins and skin texture, enhances the effectiveness of the simulation tool. The outcomes of this research include the creation of a biomaterial-based arm that allows healthcare practitioners to practice essential IV skills, improving their proficiency and confidence. By reducing reliance on live patients, this arm contributes to patient safety and ethical considerations in medical education, ultimately enhancing healthcare quality.

# ICETBEST-OR-24029

## COMPARATIVE EVALUATION OF THE PROPERTIES OF PEEK, PMMA AND TITANIUM FOR CRANIAL IMPLANT

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The rising demand for implant devices in recent years, ascribed to worldwide life expectancy increases, has encouraged a wide range of technologies, including pacemakers and cardiovascular stents, as well as drug delivery systems and brain prostheses. However, the sophisticated design of load-bearing implants has received a great deal of attention and research. This paper discusses current cranioplasty material research, specifically the comparison of PEEK, titanium, and PMMA. The goal is to offer a thorough analysis of the surgical and patient outcomes related with these materials, with a focus on investigating the possibilities of PEEK in cranial reconstruction. The primary goal is to correct significant cranial anomalies while ensuring stability, usefulness, and cosmetic appeal. To improve the usability of PEEK implants, the study discusses ways for increasing bioactivity, porosity, biocompatibility, antibacterial properties, and cost-effectiveness while maintaining mechanical integrity. Recognizing the hazards associated with standard cranial repair treatments such as bone transplants, PMMA, and conventional cranial implants, the study calls for the use of patient-specific cranial implants made of materials similar to cranial bone, which promotes safety and better outcomes. Furthermore, the study investigates various biomaterials utilized in cranial implants, including titanium and its alloys, polymeric polymers, and PMMA. Integrating pertinent facts on implant devices highlights their extensive acceptance, which is a direct result of the increasing number of people living longer lives. This review's distinguishing features include a complete investigation of 3-D printed PEEK, biomaterials, a comparative analysis, cranial implants, cranioplasty, PMMA, Ti6AI4, and titanium alloys. To further prove the validity of the results, a t-test was conducted for each of the tests performed, comparing the values of human bone and PEEK. Despite these advantages, the abstract recognizes the importance of improving the clarity of its problem description, emphasizing the importance of fine-tuning this component to promote better understanding.

# ICETBEST-OR-24030

## BREAST CANCER DETECTION AND CLASSIFICATION USING DEEP LEARNING

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Breast cancer remains a leading cause of mortality among women globally, with countries like Pakistan facing challenges in early detection due to the lack of automated systems, and reporting over 83000 cases annually [15]. Our research introduces a groundbreaking model for breast cancer diagnosis using mammographic images, contrasting traditional methods with our advanced deep-learning approach. Our model, named DenTnet, is built on DenseNet and employs transfer learning with a 5-fold cross-validation technique. We utilized the Curated Breast Imaging Subset of Digital Database for Screening Mammography (CBIS-DDSM) dataset that contains 2,620 scanned film mammography, and data augmentation was applied to the initial dataset of 1,229 benign and 900 malignant cases, expanding it to 9,832 benign and 7,200 malignant cases. This approach significantly improved the training and validation process. The DenTnet model achieved a remarkable accuracy of approximately 92.41% indicating that it correctly identified the presence or absence of cancerous tissues, with a precision of around 90.81%, reflecting the model's ability to accurately label cases as malignant, recall 94.38% reflecting that it correctly identifies actual cancer cases, and specificity of around 90.44% indicating the model's ability to correctly identify non-cancer cases. The next phase of the research is to integrate XAI for the model's interpretability and explainability. What sets our model apart from existing models is its combination of high accuracy and planned integration of Explainable Artificial Intelligence (XAI), making its decision transparent and explainable.

# ICETBEST-OR-24031

## MULTIFACETED APPROACH TO VENTRICULAR TACHYCARDIA ABLATION: COMPUTATIONAL MODELLING

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Cardiac radiofrequency ablation, a technique wherein electrical currents are applied through an electrode placed near to the target tissue, causing resistive heating and subsequent damage to the tissue. This emerged as a pivotal treatment for various arrhythmias, revolutionizing the management of tachyarrhythmia. Rapid evolution in catheter ablation techniques, particularly radiofrequency ablation, has established it as a first-line therapy for patients experiencing recurrent symptoms. The computational simulation analyses the impact of different catheter tip shapes— flat, spherical, and cone—on the volume of tissue in contact during Ventricular Tachycardia Ablation. The volume of the lesion covered by catheter tips is statically calculated and compared with the previous work. The catheter tip that induces a larger ablation lesion, potentially enhances the procedure's efficacy. Safety parameters, including temperature and electrical potential distribution, remained within clinically relevant limits. The research focuses on understanding how variations in catheter tip geometry impact the contact surface and, consequently, the volume of tissue in contact during ablation. By exploring these thermal dynamics, the investigation seeks to unveil nuanced connections between catheter design, contact surface, and the overall efficacy of Ventricular Tachycardia Ablation.

# ICETBEST-OR-24032

## FABRICATION OF SODIUM ALGINATE MICROPARTICLES EMBEDDED IN PVA HYDROGEL FOR TISSUE REGENERATION

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This proposed study aims to inspect the scope of fabricating sodium alginate micro particles embedded in polyvinyl alcohol (PVA) hydrogel for tissue regeneration. Hydrogels with enhanced mechanical properties and variable degradation rates are being produced by integration of sodium alginate and PVA. This research comprehensively evaluates the optimum conditions needed to formulate sodium alginate particles and inspects the properties of size, shape, and mechanical properties. The method employed for preparation of the specimen is freeze-thaw. To assess the chemical and physical properties of the scaffolds, this study also includes certain characterization tests such as moisture content, scanning electron microscopy (SEM), contact angle analysis, degradation test, pH sensitive analysis, gel fraction, tensile strength analysis and water vapor transmission rate (WVTR). Through the results of this study, the potential of sodium alginate micro particles embedded in PVA hydrogel for wound healing is being thoroughly evaluated. The incorporation of SA micro particles into the scaffolds has caused an increase in physiochemical and mechanical properties but a decrease in WVTR. However, in comparison to the PVA hydrogel their moisture content remained unaffected. By aligning our results with prior research, we strengthen the credibility and relevance of our investigation. This validation aims to be a significant contribution for highlighting the research's scope in the advancements of tissue engineering and wound healing. If successful, this constructed SA embedded PVA scaffold can significantly prove to be a modernistic option for tissue regeneration.

# ICETBEST-OR-24033

## OPTIMIZING AGRICULTURAL PREDICTIONS: A COMPARATIVE EVALUATION OF REGRESSION MODELS AND ENSEMBLE APPROACHEST

**Priha Bhatti**
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Agriculture, being the backbone of many economies, requires advanced technological interventions to optimize crop yield predictions. In this study, we present a comprehensive approach to predicting crop yields utilizing machine learning algorithms. The project involves the analysis of a dataset encompassing various agricultural and climatic parameters, with a focus on deploying Random Forest Regressor, Gradient Boosting Regressor, and Support Vector Machine Regressor. We meticulously handle missing values, conduct feature selection, and standardize data for uniformity. The models are evaluated using standard regression metrics, and their individual performances are compared through scatter plots. An ensemble model, crafted via a Voting Regressor, amalgamates the strengths of the individual models. The methodology provides a robust framework for predicting crop yields, essential for informed decision-making in agriculture. Results indicate that the ensemble approach outperforms individual models, promising advancements in precision agriculture and sustainable farming practices. This work contributes to the synergy between technology and agriculture, fostering improved crop production and economic growth.

# ICETBEST-OR-24034

## MODERNISING LOGISTICS - ACCESSIBLE ROBOTIC SOLUTIONS FOR AUTONOMOUS INDOOR DELIVERIES

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Industry 4.0 is the automation of digital systems that are used in everyday scenarios in the modern world. It uses the idea of integrated modern technologies like robotics, additive manufacturing, and so forth to enable automation of any industrial task. Often times small items have to be delivered to a new location in close quarters such as warehousing, food deliveries, medicines and so on, which becomes difficult when social distancing has to be maintained such as in the Coronavirus pandemic. The primary objective of our project is to present a prototype of an automated delivery system based on the industry 4.0 paradigm, with the motivation of helping society run itself with minimal human interactions wherever needed. Several components go into the development of this system. It utilizes a physical robot and its counterpart web and mobile applications. Data such as item details and the location of the robot is communicated using IoT. The robot itself utilizes various technologies such as the Light Detection and Ranging (LiDAR) sensor and Robot Operating System (ROS) for indoor maneuverability in order to operate autonomously in a predefined map. The applications are created using modern application development frameworks. The presented prototype as a proof of concept is capable of delivering food in an indoor space such as a university cafeteria.

# ICETBEST-OR-24035

## OPTIMIZATION OF ELECTRODES FOR DEEP BRAIN STIMULATION OF PATIENTS WITH PARKINSON'S DISEASE -A SIMULATION-BASED STUDY

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Parkinson's disease is a progressive brain disorder affecting the nervous system of the patients, causing slow and/or loss of movement. As it is caused due to defects in a region of the brain called Globus Pallidus internus (GPi), one of the common treatments includes deep brain stimulation (DBS), which involves stimulating the GPi to improve motor performance. The conventional method of DBS is performed by inserting a rod consisting of four electrodes (Quadripolar system) in the brain invasively. Although it is an effective method, battery depletion due to QP system as well as activation of neighboring fibers in the brain pose a problem in its longterm use. In this research, a sagittal view of the brain was modeled including the Putamen and Globus Pallidus on COMSOL, and simulated it using different numbers and placements of electrodes. Almost the same level of stimulation as QP systems was observed using tripolar system. However, using bipolar ring-shaped electrodes to stimulate GPi produced even better results than QP systems. This can solve the battery depletion problems in the DBS procedures used today and can be more effective for treating Parkinson's disease.

# ICETBEST-OR-24036

## INNOVATIVE CARDIAC HEALTH MONITORING: SMART CARDIO STETHOSCOPE SYSTEM

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This study presents a novel Smart Cardio Stethoscope System that uses sophisticated sound and frequency analysis to identify heart anomalies. The basis for this research is a thorough analysis of the body of literature on smart stethoscopes, cardiac abnormality detection, and developments in telemedicine technology. Prior research has mostly concentrated on enhancing the precision and effectiveness of cardiac diagnostics, with little attention paid to real-time analysis and remote monitoring. Initial testing of the Smart Cardio Stethoscope demonstrates a promising accuracy rate of 96% in distinguishing between normal and abnormal heart sounds. The technique entails a methodical procedure that begins with the hardware's assembly and moves on to the machine learning algorithms' use for sound analysis. Thorough testing verifies the accuracy of the system through cross-validation and comparison with current techniques. Comparative data with conventional methods underscore the system's potential in early detection. The portable device uses a digital stethoscope and a computer-based decision-making unit as two interconnected subsystems to fill up important gaps in existing cardiac diagnosis. The latter captures, processes, and digitalizes the heart sounds of patients, sending information to the computer for comprehensive analysis. In keeping with the changing field of telemedicine, this technology, in contrast to conventional stethoscopes, allows for real-time analysis and remote monitoring. Notable performance metrics for the model include an F1-score of 0.74%, support of 78, recall of 0.7125% and precision of 0.725%. Visual representations of the results include BPM, PCG graphs, and outputs that are easily classified. Using current smartphones, the corresponding mobile application uses machine learning to analyze cardiac sounds accurately.

# ICETBEST-OR-24037

## ASSISTIVE NAVIGATION GLOVES FOR HURDLE FREE AMBULATION OF THE VISUALLY IMPAIRED INDIVIDUALS

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Visual impairment is a disorder that adversely affects human life. To help those individuals performing daily tasks, various navigation devices, a white cane, guide dogs, and blind sticks are in practice. Moreover, the induction of ultrasonic sensor-based devices has remodeled these devices with their design and implementation. In this research, ultrasonic sensor-enabled gloves with LED as indicator, vibrator and its secondary components have been proposed for individuals with visual impairments to facilitate seamless navigation within their surroundings. These gloves feature an ultrasonic sensor employing sound waves to discern objects and obstacles, utilizing a P-controller for optimal performance. The sensor emits ultrasonic pulses and precisely measures the echo time, delivering crucial distance information with the help of a vibrator integrated as vibrations are generated once the ultrasonic sensor detects the obstacles. This instantaneous feedback empowers visually impaired individuals to make judicious navigation decisions. The seamless integration of the ultrasonic sensor into these smart gloves efficiently augments the mobility and independence of individuals with visual impairments. This innovative technology ensures they navigate with heightened confidence and safety, marking a significant leap forward in assistive solutions.

# ICETBEST-OR-24038

## ESP 32 CAMERA MODULE: A BREAKTHROUGH IN VEINS LOCALIZATION TECHNOLOGY

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Accurate vein identification is crucial in medical diagnostics, especially for challenging demographics like the elderly, infants, and compromised health individuals. Our cost-effective vein detection device overcomes these challenges without sacrificing functionality. This research highlights the device's significance, design intricacies, and potential to enhance diagnostics, especially where vein identification is elusive. The device integrates advanced technologies, using the ESP32 camera module and employing infrared and computer vision techniques for real-time, high-resolution imaging. Ongoing advancements will enhance its versatility and economic feasibility, positioning it in high-visibility medical environments and outpatient departments (OPDs) and contributing to more efficient healthcare delivery. Its low cost ensures accessibility, making it a practical inclusion in first aid kits across diverse healthcare settings. The device's adaptability to high-visibility areas and emergencies underscores its potential to democratize access to critical healthcare technologies, representing a breakthrough in medical care. This cost-effective vein detection device is transformative, addressing gaps in vein identification and contributing to advancing medical diagnostics, fostering enhanced patient care, and improving outcomes in varied healthcare context.

# ICETBEST-OR-24039

## COMPARATIVE ANALYSIS OF MATERIALS FOR CORONARY ARTERY STENTS: A COMSOL MULTIPHYSICS STUDY

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An extensive examination of the mechanical properties of the different materials used in the fabrication of coronary artery stents is necessary because of their critical role in the treatment of cardiovascular illnesses. A robust finite element analysis program called COMSOL Multi-physics is used in this study to compare various materials that are frequently used in coronary artery stents. Each of the materials being considered has been chosen for its distinct mechanical and biocompatible capabilities, and they include platinum, gold, stainless steel, nickel, titanium, and cobalt-chromium alloys. Analysis is done for hemodynamic variables, deformation, and stress distribution under different physiological circumstances. This study aims to provide significant information for improved coronary treatments by determining the ideal material in terms of mechanical strength, biocompatibility, and fatigue resistance.

# ICETBEST-OR-24040

## MULTI-PARAMETRIC VITAL SIGN EXTRACTION FOR SEARCH AND RESCUE OPERATIONS

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The study developed a drone with biosensors to collect vital signs from individuals in remote areas. The drone, equipped with biosensors measuring pulse rate, temperature, and blood oxygen level, was tested in a simulated environment. The drone collected accurate data, demonstrating its potential for applications in telemedicine, disaster management, disease surveillance, and environmental monitoring in developing countries with limited access to healthcare facilities.

# ICETBEST-OR-24041

## AUTOMATIC ESTIMATION OF 10M WALK TEST USING SMART ROLLATOR

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The 10m walk test is a widely used assessment tool for evaluating gait speed, which is an indicator of balance and mobility. It has been shown to have high reliability and validity for assessing gait speed in various populations, including older adults, stroke survivors, and individuals with Cerebral Palsy. Restricted mobility while walking can have a negative impact on a person's quality of life. However, current clinical solutions for gait analysis techniques are often expensive, time-consuming, and only available in certain environments, preventing many individuals from regularly assessing their gait. This study proposed a smart rollator with sensors in handlebars and a wheel encoder for automatic estimation of a 10m walk test. 10m walk test parameters were extracted from signal captured by force sensors embedded in the handlebars of a rollator and wheel encoder. The smart rollator was tested on five healthy participants and on eight participants having gait disabilities due to stroke, cerebral palsy, amputation, fracture. The collected data was stored in PASCO Capstone software and exported to excel to estimate 10m walk test to detect progress in gait patterns of rollator users during gait retraining. The system's performance was evaluated on basis of dataset of healthy and impaired individuals. Participants without gait disabilities demonstrated a greater gait speed compared to those with gait disabilities. This disparity emphasizes the potential efficacy of the smart rollator in precisely assessing and differentiating gait variances among these two cohorts. Future research on smart rollator technology should focus on enhancing applications and expanding its utilization by using larger and more diverse participant cohorts to improve generalizability.

# ICETBEST-OR-24042

## SMART GLOVE: DESIGNING OF HAND MOTION TRANSLATOR FOR DEAF & DUMB

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A hand gesture serves as a non-verbal mode of communication, involves finger's bending to convey information. Therefore; to lessen the barrier and to boost the confidence of such individuals, there have been developed a few technologies to bridge the gap between normal and disable person. In this project, our aim is to create a cost-effective electronic hand for gesture recognition using flex sensors and an ESP32 microcontroller. The working principle of Flex sensors is detecting changes in internal resistance, capturing the angle formed by the user's finger. Various finger movements combine to create unique gestures, which can be translated into signals and displayed as text on a screen and audio through speaker. This system assists in recognizing human sign language, enabling machines to execute tasks or identify words based on hand gestures and respond accordingly.

# ICETBEST-OR-24043

## TELEMEDICINE AS A MEANS FOR MEDICAL TREATMENT DURING POLITICAL CONFLICTS

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Under political turmoil, civilian casualties outnumber doctors and nurses available to treat them. However, medical support system readily available in the form of telemedicine could connect them with patients and save lives. This study aims to examine how effective telemedicine and remote healthcare efforts in Gaza and other war-afflicted areas have and how to improve on them as a case study of telemedicine use. The data collection consists of journal articles reporting on telemedicine and remote healthcare that date 2021-2023 and research articles. Existing frameworks on telemedicine are also explored from WHO. Data analysis reports on how current telemedicine frameworks function with relation to Doctolib through comparison. Recommendations for an ideal framework are suggested such as the integration with hospitals, sustainability of practices, and others. The study showed that COVID-19 paved the way for telemedicine frameworks and procedures but telemedicine still lacks in several ways which limits the quality provided to patients. Current telemedicine practices recruit doctors and healthcare workers through social media and current frameworks depend on WHO's guides such as the Consolidated Telemedicine Implementation Guide. Doctolib's practices are in line with WHO telemedicine frameworks though for practices uses in war-afflicted areas there is less focus placed on medicolegal factors and data security. News articles mainly reported on obstacles faced by doctors, global efforts and projects, and doctor recruitment but not much upon how telemedicine which would otherwise help organize global efforts to improving telemedical structures. Overall, telemedicine offers promising prospects but requires better implementation and evaluation to be more helpful to patients.

# ICETBEST-OR-24044

## SMART HAND GLOVE WITH OBSTACLE DETECTION

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Some peoples, born without the ability to see, hear, or speak, rely on alternative communication like sign language. This poses a barrier when interacting with those unfamiliar with sign language, impacting people with hearing and speech impairments. The primary goal of the proposed system is to create a low-cost system that can provide a voice to the voiceless people through the use of Smart Gloves. The basic idea behind hand recognition is that a glove having flex sensors is implemented to capture the hand gestures of a user. The flex sensors output a stream of data that varies with degree of bend. The analog outputs from the sensors are then fed to a microcontroller. It processes the signals and perform analog to digital signal conversion. The gesture is recognized and the corresponding text information is identified. Speakers are attached with the glove to give output as an audible speech. It means that by using smart gloves, communication will no longer be a barrier between two different communities, and they will be able to communicate easily with ordinary people. Simultaneously, in order to help blind people, navigate, ultrasonic sensors are placed to identify obstructions in their way. The sensors give real-time distance information about closest barriers by sending and receiving sound waves. The user may more securely and freely examine their surroundings because to the glove's usage of haptic feedback and other tactile signals. The data collection process proved that the hand glove prototype is both extremely marketable and successfully communicates the user's message. It was also determined that the prototype was more practical to use because it integrated speech and text output. The average accuracy of all gestures was found out to be 85.75% while 4 out of 6 gestures had 100% accuracy. Hence majority of the gestures were accurately recognized in all of the 20 testing trials. This innovative Smart Hand Glove addresses the unique communication and mobility challenges faced by deaf and dumb individuals as well as the blind.

# ICETBEST-OR-24045

## LOW COST MINI VENTILATOR

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Our design, AmbuBox, is a clinically viable ventilator that can be quickly deployed during pandemics and mass casualty events. It uses a standard manual resuscitators (AmbuBag) and a controllable pneumatic enclosure. The AmbuBox requires minimal assembly and manufacturing. By providing an easy-to install and simple-to-operate device with a long lifespan and high-precision flow control, the AmbuBox is designed to answer the current issues found in the existing low-cost ventilator designs. A lack of access to medical equipment such as a ventilator during the pandemic has been indicated by the catastrophic losses caused by the global spread of COVID-19. As an illustration, Bangladesh, a country with a large population, is unable to provide for the needs of its COVID-19 affected residents, who require ventilators. Because of the increased cost. Due to lack of availability and manufacturing flaws, the majority of medical professionals cannot afford to buy this ventilator, which results in horrible passing due to a respiratory issue. In each of these situations, a mechanical ventilator that will aid in anticipating COVID-19 affected individuals and increased ventilator costs. With the use of electromechanical tools, a lightweight prototype was readily transportable and equipped with an automated digital feedback system ventilator that provides oxygen when needed. Delivering breaths via the ventilator Having a pivoting cam arm, compressing a traditional bag-valve mask (BVM), removing the for the BVM to require a human operator. The first prototype, made of acrylic and measuring9 lbs (4.1 kg) and measuring 11.25 x 6.7 x 8 inches (285 x 170 x 200 mm). It's powered by an electric motor with an adjustable tidal capacity up to 750 cc, driven by a 14.8 VDC battery. Tidal volume and breaths per minute are controlled by simple input controls. Additionally, the prototype has an alarm to signal over pressurization of the system and an assist-control mode. In further generations, the apparatus will incorporate a controlled an LCD screen, a pressure release valve, PEEP capability, and an inspiration to expiration time ratio. At a mere $420 for prototyping, the ventilator's bulk manufacturing cost is thought to be lower.


# ICETBEST-OR-24046

## DEVELOPMENT OF A MACHINE LEARNING-BASED SYSTEM THAT ASSISTS SPEECH THERAPY IN THE URDU LANGUAGE

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Language certainly has a very significant social purpose since it is used primarily in communication, which helps people to evolve in life. But sadly, not every individual is privileged enough to communicate on daily basis, as they suffer from some form of speech disorder. In Pakistan, a significant number of the population suffers from speech and communication disorders. Since access to speech therapy clinics is not easily available to patients, especially in rural areas, they have to make regular clinical visits. Technology, based speech therapy is being used worldwide to improve speech therapy. A lot of such work has been done for other languages. The objective of this study is to develop software that assists speech therapy in the Urdu language that ensures to be user friendly and eliminates the requirement to visit speech therapy clinics regularly. 26 subjects (15 females, 11 males, average age 20) participated in this study having fluency in speaking Urdu with predominantly Punjabi-speaking parents. Recording sessions were done using a microphone which took about 15 minutes for each subject. Voice signals were analyzed for preprocessing and then classified. The sounds of each word recorded were first converted into a time-frequency pattern using spectrogram transformation. Next Mel Frequency components, with 40 filter banks were calculated. The Mel-Frequency coefficients were used as features for each word, where each word had 64 frames, and 14 coefficients per frame, i.e. 64 x 14 = 896 features per word. Classification results were calculated using four classification techniques: KNN, Support vector Machine (SVM), Simple tree, and Complex tree. Accuracies of 92.66%, 94.56%, 91.06% and 90.91% were achieved for the four classifiers respectively. Conclusively, the very promising results indicate that Urdu words can be classified with high accuracy measures using Mel coefficients. Moreover, with more training data this system can help many Urdu-speaking children with some form of speech defect.

# ICETBEST-OR-24047

## HAND-E-SSIST: A ROBOT FOR UPPER EXTREMITY REHABILITATION

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Individuals with motor impairments often develop hand and wrist contractures, hindering independence and quality of life. In addition to stroke, conditions such as multiple sclerosis, traumatic brain injury, and spinal cord injury can also result in motor impairment of the hand. Rehabilitation plays a significant role in the recovery of hand function; however manual therapy exercises can be prone to human error. Traditional physiotherapy methods exhibit limitations, prompting the exploration of innovative technologies to provide more personalized and portable solutions. While previous research has demonstrated the significance of using exoskeletons and EMG monitoring for rehabilitation, a notable research gap exists in the integration of these technologies into an accessible solution for patients with motor impairment of the upper extremity of the body. This research primarily focuses on designing a 3D-printed exoskeleton integrated with remote electromyography (EMG) monitoring capabilities to enhance rehabilitation outcomes enabling accessibility to customize the rehabilitation procedure and revolutionize rehabilitation engineering. The Hand-E-ssist project leverages these technologies to create a portable and personalized upper extremity exoskeleton, addressing the limitations of traditional rehabilitation methods. Integration of EMG monitoring allows for objective assessment and tracking of muscle activity during rehabilitation, offering valuable insights into neuromuscular processes. Overall, this robot represents a promising approach in addressing the rehabilitation needs of individuals with motor impairments in lowresource settings.

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# ICETBEST-OR-24048

## DESIGN & DEVELOPMENT OF COST-EFFECTIVE PATIENT SIMULATOR

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According to research, almost 440,000 people lost their lives every year due to obviated medical errors. All these preventable medical errors are mainly caused due to lack of practice of medical students, doctors, and nurses. To reduce preventable medical errors and to improve the clinical practice of doctors and nurses Simulation-Based medical education (SBME) can be an effective technique. SBME is a rapidly evolving technology, used widely by medical universities to improve patient safety. This research work focuses on the development of a human patient simulator with Electrocardiogram and Cardiopulmonary resuscitation (CPR) parameters. This simulator provides realistic and effective training to medical doctors, nurses, and clinicians, helps them identify different healthy and non-healthy ECG signals and practice CPR without the need for real patients. The ECG simulator was created using real patient data, mimicking heart conditions. It used an oscilloscope, microcontroller, and algorithm to craft accurate ECG waveforms, validated by patient monitor which is able to detect different heart conditions. Our CPR simulator focuses on correct compression, aided by a feedback system. This system uses LEDs, turning green for good and red for adjustments. This follows the American Heart Association's (AHA) guidelines for CPR depth, 2 inches. A sensor detects pressure changes for instant response. Both simulators aid in medical education. The ECG simulator shows different heart conditions like Tachycardia and Bradycardia. The CPR simulator ensures proper compression with clear visual cues. The simulator leaves room for additional parameters which can be transformed into more advanced and cost-effective version of patient simulator. These innovations could transform how medical skills are learned. They are simple, precise, and stick to AHA standards. By making training accessible and reliable, they might change the medical field for the better.

# ICETBEST-OR-24049

## CLUSTER ANALYSIS OF COVID-19 THROUGH GENOME SEQUENCES

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The SARS-CoV-2 pandemic, also known as COVID-19, has resulted in the identification of thousands of genetic variants among patient isolates. It is crucial to understand the impact of COVID-19 variants in different regions of the world. This study aims to analyze the diverse effects of COVID-19 on different countries. For example, countries like Brazil and the USA have higher confirmed cases and mortality rates, while India and Pakistan have an average death rate during the same period. Similarly, the European Union and China have comparatively higher confirmed cases but lower death rates. The study used clustering techniques on a large dataset and found that cluster 2 of China and the EU have TTG, ATG, ATT, GTT, and CAA codons in common, whereas CTT, ATT, GTT, and ACA are common in India and Pakistan and TTG, CTT, CAA, and TAG codons are common in Brazil and the US. The study also analyzed the frequent codons per cluster in the results.

# ICETBEST-OR-24050

## ADVANCING SOFT TISSUE ENGINEERING: SIMULATION OF SELF-HEALING BIOPOLYMERS USING ANSYS

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The frontier of soft tissue engineering is poised for transformation with the development of self-healing biopolymers. This study embarks on synthesizing and simulating these innovative materials, aiming to bridge the gap between synthetic materials and the dynamic nature of biological tissues. Leveraging the capabilities of ANSYS, a leading computational simulation software, the research focuses on designing biopolymers that exhibit intrinsic self-healing properties, essential for long-term durability and functionality in tissue engineering applications. The research initiates with the synthesis of novel biopolymers, integrating both natural and synthetic polymers. These materials are engineered to exhibit reversible bonding mechanisms, enabling self-repair upon mechanical damage. The intrinsic self-healing capability is a critical feature, simulating the regenerative capacity of natural tissues. The synthesized biopolymers' compositions are meticulously designed to balance mechanical strength, flexibility, and biodegradability. Utilizing ANSYS, the study conducts detailed simulations to analyze the mechanical properties of these biopolymers. The software's advanced modeling capabilities allow for the assessment of tensile strength, elasticity, and self-healing efficiency under simulated physiological conditions. This step is crucial in predicting the in vivo behavior of the biopolymers, ensuring their suitability for medical applications. Furthermore, the project explores the biocompatibility and potential toxicity of the biopolymers through simulated cellular interactions. ANSYS provides a platform to model the biopolymers' interactions with human tissue cells, evaluating their safety and efficacy as implantable materials. This aspect is paramount in mitigating risks associated with tissue rejection and adverse biological responses. The study also employs ANSYS for environmental impact assessment, evaluating the sustainability of the biopolymers. The simulation encompasses the entire lifecycle of the materials, from synthesis to degradation, ensuring an eco-friendly approach in medical material development. This research not only contributes to the advancement of soft tissue engineering but also sets a precedent in the utilization of simulation software for biomaterial development. The expected outcomes include a new class of biopolymers with tailored properties for specific tissue applications, comprehensive data on their mechanical and biological behavior, and insights into their environmental impact. This work symbolizes a significant step towards sustainable, efficient, and safe solutions in regenerative medicine.

# ICETBEST-OR-24051

## DESIGN AND IMPLEMENTATION OF 4D SYNTHETIC HUMAN PULSE GENERATOR

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This work designs and implements a fourth dimension (4D) synthetic human pulse generator device. The proposed design integrates both software and hardware in the form of a biomedical application. The proposed algorithm at the core of the design implements a mathematical model of the cardiac cycle. A real-time synthetic human pulse is produced in the form of a periodic data generation for accurate time-domain equivalent signal that mimics a photoplethysmogram. The design accepts external input from a Photoplethysmography (PPG) sensor. The compute engine is a software module that combines both synthetic and real-time data to form a new representation of the cardiac information for 4D visualization. This work aims to develop a future technology with numerous benefits to be explored with time. The anticipated benefits include medical education, research, and clinical support, to name a few. The integrated with artificial intelligence in embedded form is another benefit and contribution towards success of practice of medicine in clinical settings in future direction.

ICETBEST-OR-24052

# DIFFERENTIAL FORCE-TIME DYNAMICS IN STANDING VERTICAL JUMPS: A COMPARATIVE STUDY OF ATHLETIC AND NON-ATHLETIC GROUPS

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This research aims to delve into the realm of biomechanics to uncover variations in force-time dynamics exhibited by university students during a standing vertical jump. Employing a comprehensive Force-Time Analysis, our study categorizes participants into 'Athletic' and 'Non-Athletic' groups. The analysis reveals a notable variation in the force exerted by individuals from the dedicated two groups during the execution of a standing vertical jump. Participants affiliated with the 'Athletic group' demonstrate a capacity for a standing vertical jump with considerably lower applied force compared to their counterparts in the 'Non-Athletic group.' This variation highlights the potential bio-mechanical advantages gained through athletic training, providing valuable insights into neuromuscular efficiency and athletic performance. The study contributes to the understanding of how force-time analysis can serve as a reliable marker for assessing lower-body strength and may inform tailored training programs to adapt measures for enhancing physical capabilities in diverse student populations.

# ICETBEST-OR-24053

## VEIN PATTERN VISTA (VPV): PROVIDING AN EASE FOR DIFFICULT INTRAVENOUS ACCESS

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Venipuncture is an everyday approach in healthcare units. It is most common invasive clinical procedures performed in hospitals worldwide. Mostly Older Adults and children that visit hospital for Intra Venous (IV) procedure or Peripheral Intravenous Catheters (PIVC), are reported to have Difficult Intravenous Access (DIVA) which evoke anxiety, pain, discomfort and can cause harmful injuries in excessive attempts. Keeping in view all the circumstances that consequential figure of patients who reported multiple attempts to gain venous access and reported DIVA, it was very important to reduce the problem of locating the vein and minimize the time required for pinpoint it. The project, Vein Pattern Vista (VPV), has been designed to ease the access. It is based on the principle of non-invasive NIR imaging (real time) i.e. the NIR rays captured by the NIR camera which displays the outcome on LCD. Furthermore, image of the vein taken via VPV device is processed in laptop for the processing in modulus (MATLAB) for further medical and diagnostic study of vein pattern. This project would consider the main objective to make it low cost (comparatively cost effective than any other market vein detector device), effective, efficient, easily handled device, high acceptance and accuracy rate, and also for further medical and diagnostic study of veins pattern.

# ICETBEST-OR-24054

## NEUROSCIENCE IN FOCUS: A PARADIGM SHIFT FROM BRAIN TO WELL-BEING

**Shamoon Noushad**
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This talk will cover the transformative role of neuroscience in reshaping mental health research through psychophysiological interventions. As global awareness of mental health importance grows, there's a notable shift towards incorporating neuroscientific principles into the study and treatment of psychological disorders. The rising popularity of psychophysiological interventions, such as neurofeedback and mindfulness-based techniques, takes center stage in both research and clinical settings. These interventions leverage the bidirectional relationship between mind and body, recognizing the impact of mental states on physiological responses and vice versa. The discussion will be focused on how techniques like biofeedback empower individuals to actively engage with and regulate their physiological responses, ultimately fostering improved mental health outcomes. Moreover, the presentation emphasizes the advantages of incorporating psychophysiological measures into mental health research, providing a more comprehensive understanding of individuals' experiences. By combining neuroscience and psychology, this integrated approach offers promising avenues for personalized and effective strategies to enhance mental well-being. Illustrating the practical application, we examine a case where a patient with chronic anxiety benefits from neurofeedback sessions. Traditional therapeutic approaches often focus solely on cognitive and behavioral strategies. However, integrating neuroscientific insights allows researchers and clinicians to employ real-time data from the patient's brain activity. This bidirectional feedback loop enables the patient to gain conscious control over their physiological responses, fostering a sense of agency and empowerment.

# ICETBEST-OR-24055

## THE SECRETS OF TIMELESS MINDS: A MULTIFACETED APPROACH TO TRANSFORM ACCELERATED BRAIN AGING INTO RESILIENCE

**Sadaf Ahmed**
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As people age, the brain naturally undergoes transformations, but in certain instances, these changes occur at an accelerated pace, resulting in cognitive decline and neurodegenerative disorders. This talk emphasizes the imperative of a holistic understanding of brain aging, considering cellular and biochemical mechanisms, physical well-being, psychological health, and lifestyle choices. recent research has identified specific biomarkers associated with cognitive decline, opening avenues for targeted therapies that preserve and restore cognitive function. Additionally, physical interventions, exemplified by tailored exercise regimens, showcase their potential to promote neuroplasticity, augment cerebral blood flow, and counteract the structural and functional impacts of aging on the brain. Psychological factors are crucial contributors to brain aging, underscoring the pivotal role of mental health in fortifying cognitive resilience. Examples of psychological interventions, such as cognitive training programs and mindfulness practices, are discussed as integral components of a comprehensive strategy to decelerate the aging process of the brain. Lifestyle interventions, including concrete examples such as adopting brain-healthy diets, optimizing sleep patterns, and implementing stress management techniques, are scrutinized for their potential influence on brain health. By proactively addressing lifestyle factors associated with accelerated aging, individuals can potentially mitigate cognitive decline and enhance the overall resilience of their brains. Nutritional interventions, such as brain-healthy diets rich in fruits, vegetables, and whole grains, are examined for their potential impact on brain health. By addressing nutritional factors associated with accelerated aging, individuals may mitigate cognitive decline and enhance overall brain resilience. In conclusion, this talk advocates for a holistic and integrative approach to address accelerated brain aging, highlighting the significance of cellular, biochemical, physical, psychological, nutritional, and lifestyle interventions. Recognizing the interconnected nature of these factors offers a more nuanced and effective strategy for promoting healthy brain aging, bringing hope for a future where age-related cognitive decline can be slowed, halted, or even reversed through comprehensive interventions.

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# ICETBEST-OR-24056

## THERAPEUTIC VALIDATION OF FATP5/SLC27A5 USING LOSS-OF-FUNCTION VARIATION IN HUMANS

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FATP5 (SLC27A5) is a fatty acid transporter, expressed almost exclusively in the liver, which facilitates uptake of long-chain fatty acids in hepatic cells and is required for recycling of bile acids. Deletion of FATP5 in mice has shown to lower triglyceride levels in the liver and protect against obesity, through a reduction in food intake. Importantly, knocking out FATP5 in mice with diet induced NASH, has also shown to reverse the NASH phenotype and improve glucose homeostasis. Given the increasing disease burden of NASH and obesity worldwide, pharmacological inhibition of FATP5 could be an attractive therapeutic target. Here, we used a human genetics approach utilizing whole exome and whole genome data of the Pakistan Genetic Resource (PGR) and other publicly available UK Biobank (UKB) and Biobank Japan (BBJ) to assess therapeutic validity of FATP5, and associated benefits/risks for metabolic syndromes. To further strengthen the associations observed in the large-scale biobanks, we are conducting genotype-based recall studies (study ongoing). We contacted 4 probands, from which we were able to enroll 47 total participants (21 heterozygous pLoF carriers and 1 homozygous pLoF carrier). All 4 families had a history of young on-set of myocardial infarctions (average age = 44) Our initial results from our on-going callback studies suggest pLoF carriers in FATP5 have higher levels of glucose, cholesterol and triglycerides, moreover we don't observe any association with serum AST or ALT levels. In total, despite promising preclinical mouse studies, human studies of FATP5 pLoF carriers are likely to result in worsening of cardiometabolic outcome. Human genetics data suggest inhibition of FATP5 is associated with worsening of cardiometabolic biomarkers. We are continuing to enroll patients in callback studies to perform deep phenotyping of study participants and confirm the observed trends.

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# ICETBEST-OR-24057

## ADVANCED TELECOMMUNICATION-ENABLED PATIENT MONITORING SYSTEM FOR REMOTE CONSULTATION

**Taha Mushtaq Shaikh, Saad Jawaid Khan, Hareem Rizwan Ahmed, Shehzeen Fatima, Hassan Arif**
**Department of Biomedical Engineering, Ziauddin University, Karachi, Pakistan**

Extensive research is being conducted in various fields such as utilizing sensor networks, medical devices, wireless communication, middleware software, and software applications to optimize healthcare systems. Telemonitoring is a healthcare method that utilizes various information technologies to remotely monitor patients. To offer teleconsultation services, we have developed a telehealth monitor that allows for real-time monitoring of body temperature, oxygen saturation, and pulse rate. This is achieved using a touchscreen LCD, ensuring accurate telemonitoring outcomes. The telemonitoring system that we have developed has replaced the traditional vital sign monitoring equipment. We created a telehealth system that can monitor body temperature, heart rate, and oxygen saturation. If any of these numbers deviate from the usual range, the system can initiate a remote consultation with the patient. The design of this telehealth monitor has an LCD touchscreen panel. The Raspberry Pi is affixed to the rear of the LCD panel alongside the remaining components. The sensors are located underneath the touchscreen LCD on the front side. The Android graphical user interface (GUI) application is thereafter provided with the patient's data. Despite its recent rise in popularity, home telemetry has generated a substantial wealth of accessible knowledge for policymakers and healthcare professionals has expanded significantly. According to our literature review, the adoption of home telemonitoring for chronic diseases stands out as a hopeful approach in patient care, delivering accurate and dependable data. This method empowers patients, triggers behavioral changes, and has the potential to enhance their medical conditions. The telehealth monitor actively monitors the patient's heart rate, oxygen saturation, and body temperature to prevent potential life-threatening situations proactively. Moreover, teleconsulting services are accessible. The graphical user interface (GUI) Android application facilitates the visualization of patient parameters and camera status.

# ICETBEST-OR-24058

## GLUCOSE MONITORING WITH HEART RATE DETECTION: A NON-INVASIVE SOLUTION FOR DIABETES MANAGEMENT

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Acetone's production or degradation can occur through multiple pathways, leading to the realization that it is not just a metabolic waste. Secondly, technological advancements now allow the detection of acetone in human breath, making it an alternative to blood and urine samples in research. The normal acetone level in blood and urine is under 0.6mmol/L. The procedure involves using an Arduino Mega board along with a TGS822 gas sensor, SEN-11574 Pulse Sensor, DHT22 humidity and temperature sensor, and a TFT display to measure the acetone level in a human exhalation . The results that the concentration of acetone in the breath of diabetic patients exceeded 1.7 parts per million (ppm), while it remained less than or equal to 1.6 ppm in normal breathing, suggests that the presence of acetone can serve as a diagnostic tool and biological marker for diabetic patients. Breath analysis with acetone offers a non-invasive and sensitive approach to detecting and monitoring various clinical conditions, including diabetes.

W = 14.5 cm

H = 21 cm

# ABSTRACTS

# PROJECT PRESENTATIONS



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

# ICETBEST-PR-24001

## UNDERSTANDING THE IMPACT OF LOAD WEIGHT AND ERGONOMICS ON MUSCULOSKELETAL STRAIN AND PRODUCTIVITY IN INDIVIDUALS WITH KYPHOSIS

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**Department of Biomedical Engineering, Ziauddin University, Karachi, Pakistan**

The prototype device the we have designed is used to detect kyphosis early on and explores the impact of lifting heavy weights on spinal health, emphasizing the importance of ergonomics for promoting safe practices in weight-bearing activities. Kyphosis is a condition where the upper back becomes rounded or hunched. Productivity refers to the efficiency of individuals handling weight-lifting tasks. Some individuals may develop postural kyphosis due to spine malformation. Our research focuses on early kyphosis detection with applications in Workplace Safety & Training, Healthcare Interventions with statistical analysis on SPSS software. Establishing a connection between an EMG sensor and node-MCU facilitates the monitoring of muscle activity. Then established a connection of gait sensor with a node-MCU and attached gait sensors on each leg of the subject on the knee and thigh for angle measurement. These sensors are interfaced with the EMG sensor, which is placed on spinal muscles for the diagnosis of kyphosis. Using the Graphical User Interface (GUI) application, will help as primary platform for presenting and navigating through the results of our study emphasizing the crucial role of ergonomics in optimizing musculoskeletal health and productivity.

# ICETBEST-PR-24002

## MACHINE LEARNING BASED SYSTEM FOR PREDICTING FINGER MOVEMENT OF THE ROBOTIC HAND USING SMART GLOVE

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In robot-assisted surgeries, robots are familiar with performing many complicated surgeries with minimal invasiveness and flexibility. This research paper aims to propose a machine learning (ML)-based method for predicting finger movement of the robotic hand. The method utilizes Smart gloves with Light Dependent Resistor (LDR)-based sensors to control Robotic hand-finger movements. The ESP-WROOM-32 microcontroller, connected via Arduino IDE and Jupyter software, records real-time finger movements, including flexion and extension, refined by the microcontroller before real-time integration between the Smart glove and robotic hand. The data generated corresponds to different movements of different fingers involved in multi-learning problems, which deal with scenarios requiring the synchronous prediction or analysis of multiple outputs, such as in multi-output regression. To address this problem, we used the ML algorithm (K-nearest neighbors regressor). This regressor has the inherent property of handling the multiple output regression problem. The regressor used was estimated to predict finger movements concerning Root Mean Square Prediction Error (RMSPE). After implementing this algorithm in real-time integration of the Smart glove and robotic hand, our robotic hand has successfully moved the finger toward the smart glove. The proposed method improves control precision, reduces latency, and improves the user experience, potentially revolutionizing artificial limb control and remote robot operation.

ICETBEST-PR-24003

# DESIGN AND DEVELOPMENT OF SEMICONDUCTOR BASED CAPNOGRAPHY DEVICE

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This paper provides a comprehensive evaluation and implementation of a capnography device, with a specific emphasis on two prominent semiconductor type carbon dioxide (CO2) sensors, namely MG811 and MQ315. Capnography is an essential medical diagnostic and patient surveillance tool that measures the levels of exhaled carbon dioxide (CO2) to evaluate respiratory disorders such as COPD and CO2 retention. These devices, which are characterized by their substantial weight and high cost, are only employed within the confines of ICUs and CCUs. The capnography equipment prototype for research incorporates the MG811 and MQ315 CO2 sensors, which have been meticulously chosen and installed, making it compact and portable for situations in emergency and ambulance settings. Comparative studies assess key performance parameters such as sensitivity and accuracy in diverse settings. The enhancement of sensor accuracy and reliability is achieved through the implementation of calibration techniques. This work contributes to the comprehension of the capabilities and constraints associated with the use of MG811 and MQ315 carbon dioxide sensors in the context of capnography. The gadget, offers a dependable and economically efficient option for the continuous monitoring of CO2, and Temperature of body, hence providing advantages to the medical field. This study further elucidates prospective advancements and future possibilities in capnography technology, enhancing medical diagnoses and fostering innovation in patient care.

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# ICETBEST-PR-24005

## OCULAR DISEASE DETECTION USING MACHINE LEARNING

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Machine learning is crucial in helping medical professionals identify diseases early. Ophthalmic disorders are often not life-threatening, but when they advance over time, they may have a major influence on the patient's quality of life. Early detection is essential for avoiding serious consequences and for enhancing patient outcomes. Ocular diseases such as cataract, glaucoma, and diabetic retinopathy are the main causes of visual impairment. Traditional diagnostic methods often rely on subjective assessments by clinicians, prompting the need for automated, accurate, and timely solutions. The proposed system is designed to easily facilitate the detection of cataract, glaucoma and diabetic retinopathy among patients. Decision tree, Random forest, K-Nearest Neighbor, Support vector machine and Convolutional Neural Network algorithms have been used for detection. These algorithms were employed to assess their individual strengths and weaknesses and carry out comparison via cross validation to ensure result reliability. The dataset used consists of 5000 instances. The goal is to determine whether or not the patient has one of these diseases, Diabetic retinopathy, cataract, glaucoma by making predictions based on the features. To ensure optimal performance, blood vessel patterns and optic disc characteristics, dataset underwent a variety of preprocessing techniques that involves image cleaning, image modification and normalization. The unique aspect of this system lies in the application of transfer learning techniques, allowing the model to achieve high performance even when provided with limited labeled data. Rigorous testing, including cross-validation showcases the robustness and superior efficacy of proposed system. The user-friendly interface facilitates the seamless interaction between doctors and the system, and its sensitivity, specificity and accuracy make the model the best among diagnostic processes. The successful implementation of this system will significantly impact public health outcomes and will help people to get the proper treatment of the aforementioned diseases at an early stage thus reducing the percentage of blindness being caused.

# ICETBEST-PR-24009

## COST-EFFECTIVE PORTABLE CENTRIFUGE

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Centrifuges are crucial in biomedical engineering for separating and studying mobile components, such as DNA, proteins, and organelles, facilitating advancements in diagnostics, drug development, and clinical research. They enable particular separation and evaluation of biomaterials vital for expertise illnesses, developing healing procedures, and improving affected person care. Centrifuges offered in the market tend to be prohibitively expensive. The more budget-friendly options lack the capability for adjusting RPM settings, whereas those that offer this feature are exorbitantly priced and not readily accessible. We have developed a centrifuge that not only addresses the challenge of cost-effectiveness but also offers portability, making it accessible for testing in remote areas worldwide. The test results indicate that our centrifuge can achieve a maximum speed of 8,000 RPM, making it suitable for the efficient centrifugation of various components such as blood, plasma, nucleic acids, and proteins.

# ICETBEST-PR-24012

## EASEWHEEL ACCESS

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A wheelchair is a crucial need for people with partial or complete inability to walk independently. And due to any disorder, disease, or medical procedure, its usage might be permanent or temporary. As per the availability of wheelchairs in today's market, there are manual wheelchairs, costing minimum around Rs. 16, 000 (Pakistani Rupees) ($ 56.66), and there are electronic wheelchairs available, costing minimum around Rs. 134,000 (Pakistani Rupees) ($ 474.55), and these price ranges may exceed as per the quality. Which clearly is not easily approachable for people particularly those belonging to low income families. Also, the electronic wheelchairs available at this high price, usually just provide access to an attached joystick, enabling easy mobility, but no additional smart features. Therefore, in order to bring a cost effective, easily accessible, and smarter version of an already existing wheelchair, we developed a prototype of an electronic wheelchair, which is joystick controlled, and rechargeable, limiting the regular investment of money towards replacing batteries after they discharge completely. It also provides 3 smart features especially designed for individuals who are blind, or both blind and deaf, and people who are bedridden. In the case of if the user is blind, that user will be prompted by an audio alarm for an obstacle in front of him/her/they while using our designed wheelchair. On the other hand, if the user is both blind and deaf, then the user will be prompted for an obstacle in front of him/her by a feeling of vibration from a comfortable belt around his/her wrist. And lastly, for bedridden people, our designed wheelchair prototype, possesses a mechanical feature, providing ease in the transfer to and from the wheelchair. And all these 3 smart features aim to aid towards significantly towards the lives of the above described user types.

# ABSTRACTS

# POSTER PRESENTATIONS

# ICETBEST-PO-24004

## BIODEGRADABLE ECO-FRIENDLY BIO PLASTIC

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Plastics are now becoming a vital part of our modern day lives, developing industries and enhancing opportuneness in everyday tasks. Their versatility has no doubts improved our lifestyles. However, the universal use of plastics poses environmental threats, contributing to pollution that demands urgent attention and eco-conscious alternatives. In response to the increasing environmental concerns associated with these plastics, this research highlights a unique approach to synthesize a biodegradable and flexible bioplastic using potato as a primary raw material that offer an environmental friendly solution. The methodology involves the modification of potato starch through the incorporation of vinegar, glycerin, and distilled water, followed by a controlled heating process until the desired consistency was achieved. The resulting mixture was then exposed to controlled conditions in an oven to obtain the desired flexible and degradable bioplastic. The assessment of our bioplastic's hardness involved the utilization of the Rockwell hardness test, which determined its resistance to permanent indentation. In addition, the hydrophilic nature of our bioplastic was determined through a contact angle test, indicating the substance's high affinity for water and the likelihood that aqueous fluids would easily wet it due to a contact angle less than 90 degrees. The study showcases the practicality of creating a sustainable material with applications in healthcare. The methodology employed in this study demonstrated the successful fabrication of an environmental friendly, bio-degradable, bio-compatible, and eco- friendly material. The synthesis of this material emphasizes its potential for contributing to a more ecological future along with the practicality of creating a sustainable material. Moreover, potato starch-based bioplastics offer a range of advantages in healthcare, including biocompatibility, reduced environmental impact, and versatility. Their potential applications in drug delivery, wound care, and medical devices position them as promising materials for contributing to a more sustainable and eco-friendly healthcare landscape. Additionally, the production process for potato-based bioplastic is relatively simple and cost-effective, making it a viable alternative for large-scale production. This research underscores the importance of exploring innovative materials aligned with sustainability principles, and it suggests future directions for advancing bio-plastics in various health sectors.

# ICETBEST-PO-24005

## ADVANCES IN MORGAGNIAN CATARACT TREATMENT: CATARACT REMOVAL SYSTEM

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Cataract is a type of eye disease that is blinding and attracts worldwide attention. This study will look at the depth of Morgan's cataract, a high type of cataract characterized by liquefaction of the central lens and major blindness. Conventional surgical techniques, including femtosecond laser surgery and phacoemulsification, are widely used. In response to the problems caused by Morgagnian cataracts, this study launched the Cataract Removal Morgagnian precision system, which uses advanced femtosecond laser technology for precise incision and intraocular lens implantation. Although Morgagnian cataract statistics are limited, there is limited information about Morgagnian cataracts worldwide. Cataracts often highlight their economic impact, affecting millions of people each year. Direct costs include diagnosis, treatment, and surgery, while indirect costs include loss of productivity and reduced quality of life. This study provides a comprehensive review of the work involved in Morgagnian cataracts, highlighting the unique challenges of this advanced stage. Drawing on existing data and international statistics, the study explores direct and indirect costs and highlights their impact on productivity and quality of life. In addition, the study also demonstrates the potential economic benefits of the Cataract Removal Morgagnian Precision System, demonstrating its ability to reduce complications, improve surgical outcomes, and reduce costs associated with cataract treatment.

# ICETBEST-PO-24006

## INCUSENSE: A BABY INCUBATOR

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In the United States, the rate of premature births has been on a steady rise, increasing from 10.1% in 2020 to 10.5% in 2021. An estimated 10,000 to 15,000 infants develop Broncho pulmonary Dysplasia (BPD) annually, necessitating proper lung care through gentle ventilation to manage persistent pulmonary hypertension. BPD is a common complication of prematurity, affecting up to 45% of infants (29 week's gestational age). The occurrence of Preterm birth with oxygen saturation concerns emphasizes the necessity for smart baby incubator. The manual regulation of oxygen therapy in incubators does not meet the standard, hence can lead to oxygenation irregularities like hypoxia and hyperoxia. All these considerations underscore the need for developing smart incubators capable of automatically regulating oxygen levels to sustain optimal conditions, ultimately enhancing the survival and well-being of premature infants. Given that, a dedicated work is conducted by the team to design and develop the state-of-the-art baby incubator, introduced as INCUSENSE. INCUSENSE is equipped with advance monitoring and control capabilities for regulation of ambient temperature, ambient humidity and oxygen saturation levels of premature infants. The system incorporates sensors to continuously monitor the ambient temperature, humidity and oxygen saturation level in the baby's blood. Real-time data from these sensors is processed by an intelligent control system using EPS32, for the maintenance and regulation of the environmental parameters and saturation level of the infant to the desired set level. The incorporation of feedback control mechanism ensures rapid and accurate adjustments to provide a stable and nurturing environment for the infants. Through this smart incubator system, a controlled thermal environment along with desired saturation level is maintained. Hence two systems are designed for the INCUSENSE i.e. A baby Incubator. Specifically, a system to automatically adjust the flow of oxygen during oxygen therapy of premature infants and a system to control the thermal environment i.e. ambient temperature and humidity for premature babies placed inside the incubator.

# ICETBEST-PO-24007

## A SOFT PNEUMATIC ROBOTIC GLOVE FOR HAND REHABILITATION FOR HEMIPLEGIC PATIENTS AFTER STROKE

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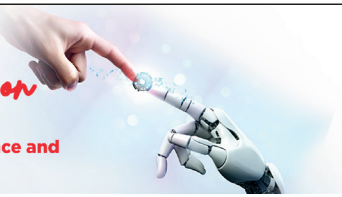
There's limited data about stroke rates in Pakistan, but it's estimated that about 250 out of 100,000 people have a stroke each year and according to patient distribution of stroke globally, around 73.30% experience hemiplegia following the stroke. For individuals with hemiplegia and hand dysfunction, daily life becomes more demanding. Based on recent studies, a significant proportion of individuals' worldwide experience reduced hand function, which has a profound impact on their overall quality of life. In 2023, Kladovasilakis et al. developed a fully functional SEG device that uses additively developed components for a modular architecture and real-time control. The electromagnetic valve system regulates each actuator's operation. The device has 15 valves on a PCB, with an MCU controlling the entire system. The control glove's PCB and battery are kept in a 3D-printed glove cover. However, current hand rehabilitation therapies are expensive and not easily accessible. They require extensive time commitments and constant therapist supervision to address this issue, a soft pneumatic robotic glove has been developed that enables patients to undergo hand rehabilitation at home without constant supervision, and at. The glove is designed to fit over the patient's impaired hand and utilizes soft pneumatic air valves to apply controlled pressure and movement to the fingers and fist. A control unit allows therapists to customize the pressure and movement of the tubes based on the patient's specific needs and progress. The robotic glove prioritizes comfort and non-invasiveness, ensuring that patients can wear it for extended periods without discomfort. For a comprehensive approach to hand rehabilitation, the glove can be used with other techniques such as physical and occupational therapy. One of the main advantages of using a robotic glove for stroke patients is that it will provide mirror therapy which an assistive glove will be worn on the healthy hand and the impaired hand mimics the activities of the healthy hand giving patients a fast recovery to restore hand mobility. In order to meet the varied needs of patients and guarantee successful rehabilitation, the flexibility of the design for a pneumatic robotic glove intended for hand rehabilitation in hemiplegic individuals must take into account features such as flexibility, ease of use, broad range of movement interface design, sensor integration, and modularity. Ultimately, the goal of the robotic glove is to assist patients in regaining independence and restoring hand function, enabling them to perform previously challenging daily activities with greater ease with the cost effective and easy-to-use device.



# ICETBEST-PO-24009

## THE DEVELOPMENT AND CHARACTERIZATION OF BIOMIMETIC SKIN PATCH FOR IV INSERTION ON MEDICAL SIMULATOR

**Misha Ajaz, Amna Ayaz, Usama Javed**
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Medical simulators are used to create real life scenarios that provide a realistic and risk-free environment for users to hone their clinical expertise. Training of IV insertion is a crucial part of medical training which remains unsuccessful in practical application due to the training done on plastic manikins. While, teaching skills with silicon-based arm is an expensive procedure. This research presents the successful fabrication and characterization of an artificial skin patch designed for simulating intravenous (IV) insertion on a simulator. The developed patch is a budget friendly blend of gelatin, gel wax, silicon glue, glycerin, and color pigments which can be molded in any desired shape. The material was carefully chosen to replicate specific mechanical and chemical properties of human skin, contributing to its efficacy as a reliable training tool for medical professionals. For the evaluation of the performance and feasibility of the artificial skin, comprehensive swelling tests were conducted. The results indicate minimal swelling, ensuring the patch maintains its structural integrity during simulated IV insertion scenarios. The hydrophobic nature of the artificial skin was validated through contact angle measurements, demonstrating resistance to moisture and bodily fluids. Crucially, the artificial skin exhibited a negligible reaction to the bodily environment, confirming its biocompatibility. It establishes its suitability for repeated use in medical training scenarios. This research signifies a significant advancement in bio-simulation technology, presenting a hydrophobic artificial skin patch that closely mirrors real world conditions. The durability and compatibility with biological systems inherent in the patch enhance its effectiveness as a dependable training tool for medical professionals. Its incorporation into simulators enhances the authenticity of IV insertion simulations, with effective training environment near to silicon patches giving a comfortable and realistic touch to the users.

# ICETBEST-PO-24011

## EMG BASED PROSTHETIC HAND

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People who are adjusting to life without hands encounter a range of challenges. Losing hands can occur for a number of causes, such as trauma, illness, congenital defects, or damage. This loss has a significant psychological and social impact that renders the victim feeling helpless and disabled in addition to its physical effects. Each and every issue in modern life has a technological remedy. The suggested technique takes into account both the properties of the human body and the distinctive characteristics of data collected via EMG. Each one of the five fingers will carry out its distinct task in accordance with the recorded EMG signals, instructing the amputee to do particular activities. The loss of a hand can be treated with the assistance of an advanced technology known as a 'prosthetic hand'. A prosthetic hand could prove to be the ideal substitution for a lost human hand. The proposed device combines myoelectric sensors, which can sense electrical impulses generated by the body and cause muscle contraction, with a microprocessor. The impulses from the body are captured by the MayoWare muscle sensor, which then assesses each signal in accordance with the microcontroller's programming. It subsequently completes the corresponding task that was detected by the microcontroller programming as being performed by a typical human hand and it is accountable for restoring to the amputee all of the typical hand functions, such as holding, grasping, and gripping items. It is committed that inclusivity drives us to provide a solution that breaks down financial barrier, ensuring that individuals in need of a prosthetic hand can access advanced technology without compromising their budget. We have succeeded in producing a prosthetic hand that is affordable without sacrificing quality by putting an emphasis on design and production efficiency. The proposed prosthetic hand project boasts a suite of cutting-edge features that redefine the landscape of assistive technology. The key features of our projects are Individual finger movement, Sensory feedback, DOF (Degree of freedom), Rehabilitation support, Portable and easy to use.

# ICETBEST-PO-24015

## POSTURESYNC SYSTEM: A TECHNOLOGICAL PARADIGM FOR BIOMEDICAL ENGINEERING

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This study introduces the Posture-Sync System, a groundbreaking fusion of orthopedic principles and cutting-edge technology. Addressing the pervasive issue of poor posture, the system employs a DC gear motor, Arduino micro-controller, and accelerometer to provide real-time monitoring and corrective measures. A vibrational feedback mechanism alerts the wearer to sub-optimal posture, followed by an automatic remedial phase utilizing precision DC gear motors. This phase enacts minor posture corrections without requiring conscious human intervention. Our research delves into the economic burden associated with poor posture, emphasizing the potential cost savings through effective posture management. The presented solution not only monitors but actively participates in posture repair, making it a transformative approach for cultivating better.

# ICETBEST-PO-24016

## SMART PORTABLE VACCINE BOX

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Vaccines are essential part of healthcare and their effectiveness is highly dependent upon the proper storage conditions. Key challenges in global health logistics involve inadequate cold chain infrastructure, difficulties in reaching remote areas, and temperature control during transportation. Existing solutions, including traditional storage methods, often struggle with maintaining precise temperatures and real-time tracking, especially in areas lacking electricity and refrigeration. The Smart Vaccine Box tackles these issues by integrating a Peltier cooling system controlled by an Arduino. The methodology encompasses the utilization of key components: a microcontroller, humidity and temperature sensor, GSM module, and a GPS module. This combination will facilitate the real-time monitoring and secure storage within the critical temperature range of 2-8°C. The Peltier cooling system, comprising of Peltier module, heat sink, and exhaust fan dynamically controls the internal temperature of the vaccine box, thus ensuring that vaccines remain viable throughout the transportation process. The heatproof cover and battery powered design enhance adaptability to environments lacking conventional infrastructure of the remote areas. The proposed mechanism will convey the temperature and humidity levels from inside the vaccine box and will maintain the temperature between 2-8°C which is essential for vaccine storage. Real-time tracking and continuous monitoring enhance reliability, addressing global health logistics challenges. The significance of this innovation extends to healthcare logistics, particularly in remote areas where access to electricity and refrigeration is limited. By addressing global health logistic challenges, such as inadequate cold chain infrastructure and difficulties in reaching remote areas, this solution contributes to reducing vaccine wastage, improving immunization accessibility with adherence to Sustainable Development Goals (SDG 3, 9 and 13).

# ICETBEST-PO-24018

## BIOINSTRUMENTATION INNOVATION FOR FRAGRANCE CREATION: INTRODUCING THE HASHT ESSENCE EXTRACTOR

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Pakistan's perfume industry struggles with dependence on imported essential oils, limiting creativity and profitability. HASHT addresses this challenge with a novel bioinstrumentation technology: the HASHT Essence Extractor. This compact, user-friendly machine leverages domestic expeller technology for efficient and energy-saving extraction of high-quality essential oils from indigenous herbs. Reduce dependency on imported oils: Enhance economic resilience and creative freedom by enabling domestic essential oil extraction. Unlock local floral potential: Explore diverse fragrance profiles from indigenous flora like jasmine, rose, and tuberose for unique olfactory experiences. Promote environmental sustainability: Minimize energy consumption and waste generation through eco-friendly design and practices. Methods: The HASHT Essence Extractor employs a user-friendly domestic expeller technology featuring: Efficient steamer: Releases aromatic compounds from herbs. Powerful expeller: Extracts essential oils with minimal pressure and energy. Compact condenser: Facilitates rapid cooling and oil condensation. Integrated filtration system: Ensures purity and high quality of extracted oils. This design allows for easy operation and adaptability to various herbs, fostering diversification and creative exploration. Results: Preliminary testing demonstrates successful extraction of high-quality essential oils with preserved aroma and chemical composition. Initial cost-benefit analysis indicates significant reductions in production costs due to decreased import reliance. Diverse fragrance profiles: Create unique perfumes for both male (HUNAIN) and female (FARA) lines. Beyond perfumes: Extract essential oils for aromatherapy, incense, personal care products, and home fragrances. Promote local agriculture: Expand opportunities for cultivating herbs specifically for essential oil extraction. Conclusion: HASHT signifies a paradigm shift towards a sustainable and self-sufficient future for Pakistan's perfume industry. By empowering local production, celebrating Pakistani flora, and prioritizing bioinstrumentation innovation, HASHT holds immense potential for economic, creative, and environmental impact. Keywords: Bioinstrumentation, domestic expeller, sustainable fragrance, herbal oil extraction, local flora, economic empowerment, HASHT Essence Extractor.

# ICETBEST-PO-24019

## MACHINE LEARNING BASED HEART ATTACK PREDICTION MODEL

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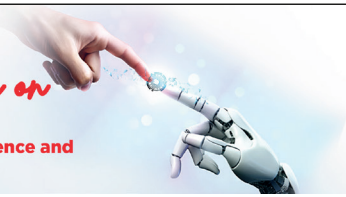
**[2] Department of Computer Science, Salim Habib University, Karachi, Pakistan**

Cardiovascular disease (CVD) remains the leading cause of mortality globally. There is a lack of cardiac expertise in developing countries leading towards inaccurate diagnosis. This study leverages the predictive power of supervised machine learning algorithms to analyze symptoms and data patterns associated with heart attacks. Unlike other studies that used numerous features for the prediction of cardiac arrest, this study predicts heart attack based on the scores of significant and specific features using Weighted Associative Rule Mining technique. By training various algorithms on existing datasets, we have developed a predictive model that employs the K-Nearest Neighbors (KNN) algorithm integrated with a graphical user interface, having testing accuracy of 89%, precision, recall and F1 score value of 0.89. This model interprets user-input parameters to predict the likelihood of a heart attack thus providing an accessible, user-friendly and reliable tool for early detection and potentially life-saving interventions.



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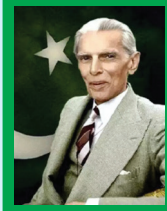
## FATHER OF THE NATION

### "Quaid-e-Azam Muhammad Ali Jinnah"

Message on the occasion of Foundation Stone Laying Ceremony of the Institute of Engineers Pakistan, Headquarters at Dacca on 30th May, 1948



"If Pakistan is to take its proper place among the progressive nations of the world, it will have to take up a good deal of leeway in the realm of scientific and technical education which is so necessary for the proper development of the country and the utilization of its resources. The establishment of institution like the Institute of Engineers will greatly stimulate technical research and help in disseminating available information.

The Institute of Engineers will not only benefit the engineers themselves by improving their technical knowledge but also bring lasting benefits to public services which they are called upon to perform.

I wish the Institute every success"

## A BRIEF ABOUT IEP

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The Institution of Engineers Pakistan was founded with the blessing of the Father of the Nation, Quaid-e-Azam Muhammad Ali Jinnah, in 1948 with its Headquarter at Dhaka. In 1972 the Headquarter was shifted to Lahore. Presently IEP has 11 Local Centres at Islamabad, Karachi, Lahore, Peshawar, Quetta, Hyderabad, Sukkur, Multan, Faisalabad, Gujranwala & Gilgit. IEP also has 3 International Centres at Saudi Arabia, Bahrain & USA. Beside various Webinar/ Workshop/Symposium organized regularly, every year IEP Karachi Centre and NED University of Engineering & Technology, Karachi in collaboration with PEC Accredited Engineering Institutions of Karachi & Balochistan organizes seven International Conferences on Civil, Mechanical, Electrical, Biomedical, OHSE, Sustainable Engineering & Development and Advance Material & Processing Engineering. In these conferences International & Local researchers, academicians & Distinguish Engineers from Industry actively participate and present their papers / research / achievements.

## IEP IS AN ACTIVE MEMBER OF FOLLOWING INTERNATIONAL ORGANIZATIONS

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3. Federation of Engineering Institution of South & Central Asia (FEISCA)
4. The Asian Civil Engineering Coordinating Council (ACECC)
5. Common Wealth Engineering Council (CEC)
6. Collaboration Agreements with more than 40 National Engineering Bodies of various Contries.

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**(i)** Photo Copy of Matric Certificate **(ii)** Photo Copy of B.E. Degree Certificate
**(iii)** Photo Copy of Pakistan Engineering Council Member Certificate **(iv)** Copy of CNIC **(v)** Two Passport size photographs
**(vi)** Rs.1350/= by cash or pay order / cross cheque in favor of **The Institution of Engineers Pakistan, Karachi Centre**

4. Submit these documents to **The Institution of Engineers Pakistan, Karachi Centre**, 4th Floor, IEP Building, Opp: Hotel Regent Plaza, Shahrah-e-Faisal, Karachi. Tel: 32780233, 32781492, WhatsApp: 0311-2277721, E-mails: main@iepkarachi.org.pk, iepkc1948@gmall.com, Web: www.iepkarachi.org.pk

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