Silicon University

Excellence in Industry Research

SiliconTech | BHUBANESWAR

Why Silicon?

SiliconTech, the engineering institute of Silicon University, is a thriving ecosystem of learning, innovation, and research. Our faculty members are deeply committed to industry-focused research, bringing their expertise to cutting-edge projects that address real-world challenges. Students play a vital role in supporting these efforts, contributing their skills and ideas to develop innovative solutions.

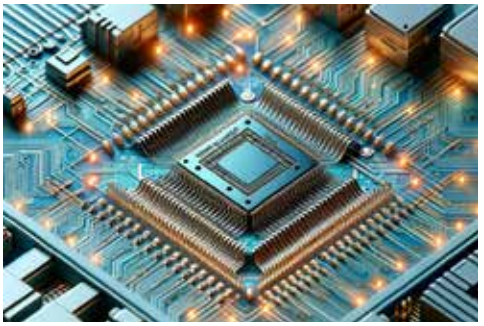
- Cutting-edge technology
- Solving real-world challenges
- State-of-the-art laboratories
- Industry experts' support
- Start-up ecosystem
- Centres of excellence
- Research-oriented faculty & proficient students

Our vision for industry-academia collaboration is centered on fostering partnerships that lead to impactful research and consultancy projects. Through these collaborations, we enable our faculty and students to work on real industry challenges, transforming theoretical knowledge into practical solutions that enhance industrial efficiency and productivity. Our commitment to Industry 4.0 and emerging technologies positions us at the forefront of next-generation research and consultancy services.

Our collaboration with HINDALCO to solve industrial bottlenecks

By partnering with SiliconTech, industries gain access to our pool of talented researchers, innovative minds, and resources that empower them to stay ahead in today's competitive landscape. We invite industries to collaborate with us in creating meaningful research outcomes that drive progress and sustainability across sectors.

Our Research Domains



VLSI Design

Power Electronics & Systems

Optical Sensors

Fluid Mechanics

Wireless Sensor Networks

Signal Processing

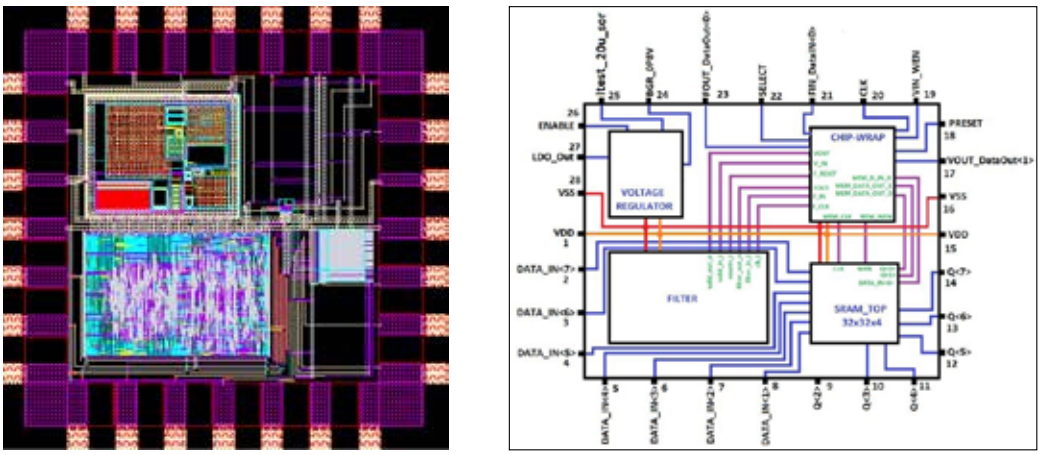
Data Science

Molecular Medicine

Our Research Initiatives

VLSI (VERY LARGE SCALE INTEGRATION) DESIGN

Dr. Saroj Rout has made important contributions to the field of VLSI Design through his consultancy projects, making significant advancements in semiconductor technology. Dr. Santanu Sarangi and Dr. Rout's work with Innatera Nanosystems B.V. in the Netherlands, focused on the development of reference designs for mixed-signal intellectual property (IP) in 28nm CMOS technology. This project involved design and implementation of several critical components, including a Bandgap Voltage Reference for a temperature-independent reference voltage, a temperature-independent current reference, and various nano-ampere current steering Digital-to-Analog Converters. The team at Silicon University delivered a set of turnkey IP blocks to Innatera Nanosystems along with schematics, testbenches, verified layouts, and design review documents.

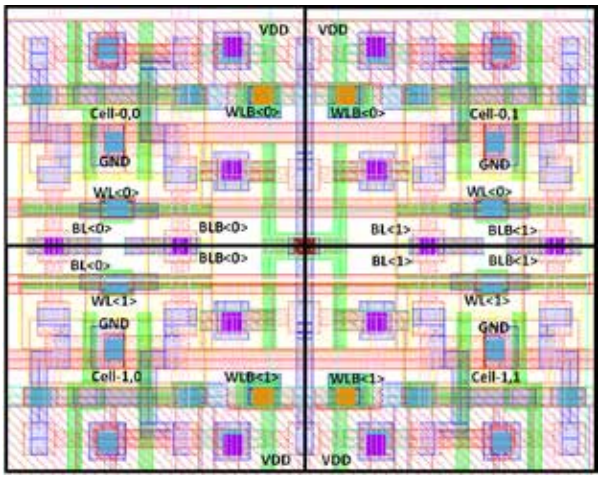


Layouts of the fabricated and tested chip 'Mercury'

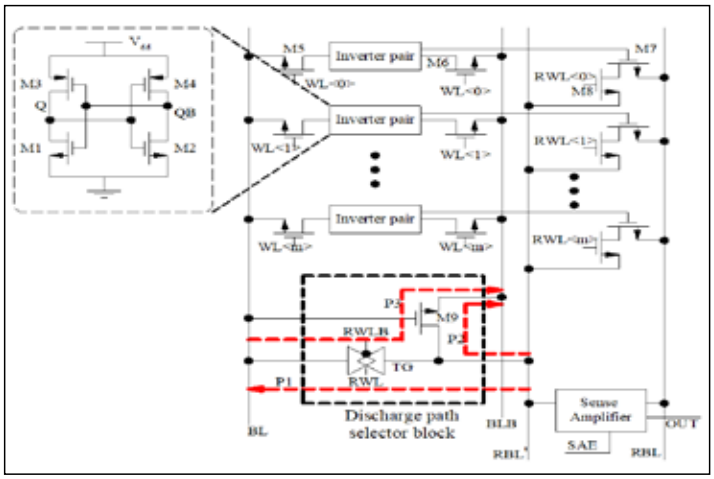
In a collaboration with Boston Microtechnology, USA, Dr. Rout also led the development of reference designs for SPI (Serial Peripheral Interface) accessible calibration IP and bias IP, utilising 180nm CMOS SOI technology. This project included the design of a calibration register, bandgap reference block, low-dropout regulators, current DACs, and related IPs. These projects highlight Dr. Rout's contributions to the field of electronics and VLSI design and ability to lead and execute advanced research and development projects in semiconductor technology.

Dr. Debasish Nayak, has made important contributions towards advancing static random-access memory (SRAM) technology by improving energy efficiency, stability, and performance across various conditions and applications. He has proposed a novel 8T SRAM cell named as low leakage current SRAM cell (LLC-SRAM cell) to offer high energy efficiency. His other novel designs have been shown to address power consumption issues in SRAM cells and improved its stability by implementing a current starving technique. He has also proposed a differential read SRAM cell that minimizes read disturbances, a common issue that affects the reliability of data storage in embedded systems.

Dr. Nayak's research in collaboration with Dr. Prakash Kumar Rout, a faculty at Silicon University, led to the introduction of an 8-transistor (8T) SRAM cell featuring bit interleaving technique to mitigate soft errors, which are transient faults that can lead to data corruption. This design reduces the likelihood of errors caused by external radiation or electrical noise and has numerous applications for memory storage in harsh environments. He also developed an innovative charge recycling technique for 8T-SRAM cells that occurs during read and write operations in 20nm SRAM arrays, leading to improvements in power consumption and access times. Dr. Nayak's research has addressed key challenges related to energy efficiency, stability, and performance of SRAMs, particularly in applications requiring high-speed access, stability and low power consumption.



A portion of the layout array of LLC-SRAM cell



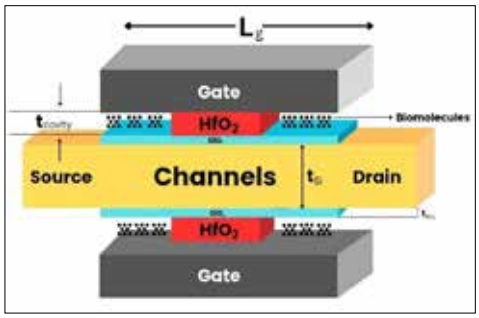
The architecture of charge recycling read write assist technique

Dr. Santunu Sarangi's research in the field of VLSI design has helped to enhance the efficiency and reliability of semiconductor devices. Dr. Sarangi introduced a novel on-chip jitter measurement (OCJM) system to accurately measure the peak-to-peak jitter of data and clock signals using a unique approach that scanned the temporal width of transition region (TR) of a target signal with a synchronous or quasi-synchronous sub-rate clock edge. A significant feature of this invention is its self-calibrating capability, which eliminates measurement errors in real-time. This architecture has useful applications in high-speed communications, ensuring accurate jitter evaluation without the need for off-chip components, thus reducing noise and electrical anomalies. Dr. Sarangi proposed a new architecture for voltage-controlled delay cell (VCDL) that forms the core of ring-type VCOs (voltage-controlled oscillators). Traditional VCO designs suffer from limited tuning ranges, large area consumption, and sensitivity to supply noise. The proposed architecture mitigated these issues through innovative control over the delay mechanism, including the adoption of a hysteresis delay cell for improved tuning range and incorporating differential mode operation to enhance noise immunity. Dr. Sarangi worked in a consultancy project with Sevya Multimedia Technologies Pvt. Ltd. to enhance the core skills of engineers in circuit and CMOS VLSI design. The Advanced VLSI Laboratory's CAD and IT infrastructure at Silicon University was used to provide training on practical tasks, including the design, simulation, and layout of industry-standard mixed-signal blocks like operational amplifiers and data converters.

POWER ELECTRONICS AND SYSTEMS

Dr. Sudhansu Mohan Biswal led a consultancy project at Silicon University to improve the smelter unit at Bharat Aluminium Company Ltd. (BALCO), Chhattisgarh. The team addressed major issues such as dust spillage, communication faults in the variable-frequency drive (VFD), and productivity inefficiencies. A dust-tight cone valve system was proposed for dust-free handling from the silo to the Pot Tending Machine (PTM) hopper. To solve communication faults in the VFD, an ON/OFF delay timer was implemented across the K17 relay. The detection of defective rods entering the casting station and the inability to measure real-time molten cast iron temperature were identified as causes for productivity loss and rework. To address these, an eddy current testing system was introduced for surface crack detection, and delete cameras were used for non-contact temperature measurement. The use of thermocouples at the induction furnace was recommended for better process control, leading to reduced breakdowns and enhanced productivity.

Experimental setup of water quality and quantity regulating system



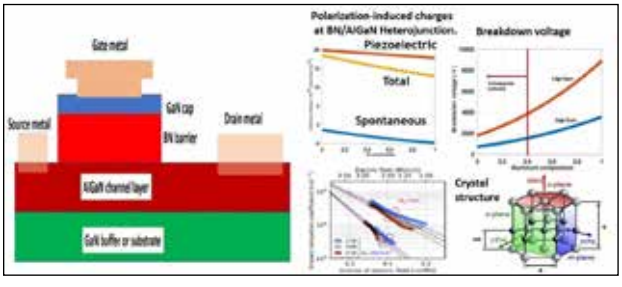
3D structure of gate stack DGMOSFET Biosensor

Dr. Biswal also spearheaded a team of students to develop a Water Quality and Quantity Regulating System (WQQRS). Integrating sensors for pH, total dissolved solids (TDS), turbidity, and water levels, the system ensures real-time monitoring and control. The ESP32 microcontroller acts as the central hub, collecting and analyzing data with feedback mechanisms for autonomous regulation. The pH sensor monitors acidity/alkalinity, and the TDS sensor measures dissolved solids, ensuring water quality for various uses and promoting sustainability. Additionally, Dr. Biswal is engaged in research on the thermal influence on Double Gate MOSFET Biosensors with gate stack configurations, enhancing sensitivity by analyzing temperature-induced changes in electrical properties for biomolecule detection.

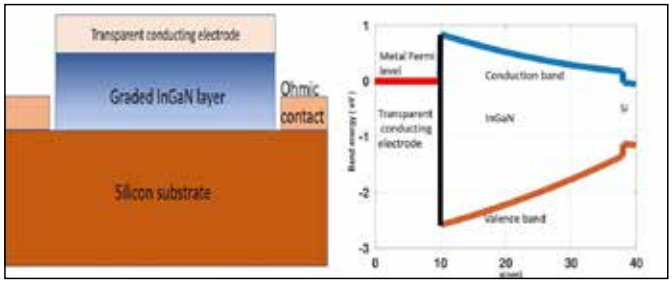
Dr. Ambarish G. Mohapatra, has executed significant consultancy projects in industrial automation and software development. Collaborating with Bharat Aluminium Company Ltd. (BALCO), they optimized coal handling by implementing a pneumatic spike system, automating paddle feeders, and using ceramic and PU liners to prevent chute jams. They introduced conveyor belt putty and an Automatic Belt Tracker to prevent spillage and damage, boosting safety, speed, and productivity while cutting demurrage costs. For Acrolect Solutions Pvt. Ltd., Noida, Dr. Mohapatra developed a Wifi localization scheme enhancing automation in vehicle servicing for improved customer experience. He also delivered an NI LabVIEW-based welding simulator for Nishtula Innovation Pvt. Ltd., simulating MMA, MIG, and TIG welding to advance training and skill enhancement.

Dr. Ramaprasad Panda is a distinguished electrical engineer, complemented by extensive involvement in industry-focused research and consultancy. Dr. Panda specializes in power electronics, renewable energy integration, and voltage stability in grid-connected systems, particularly concerning FACTS devices. Dr. Panda's consultancy projects have spanned various critical assignments for high-profile clients, including NALCO, L&T, HINDALCO Industries Limited and State Utilities. Additionally, he undertook projects for the Biju Pattnaik International Airport and Indian Metals & Ferro Alloys Ltd. His notable contributions include power evacuation studies for hydro and solar power projects, integrated network planning for large-scale irrigation projects, and transformer and transmission loss assessments in industrial complexes. Through these projects, Dr. Panda has leveraged advanced analysis tools like MiPower, PSCAD, and MATLAB to address power system reliability, voltage stability, and load flow management.

Dr. C.J. Praharaj has provided technical expertise to IIT Bhubaneswar for setting up a lab that focuses on wide band gap semiconductor power electronic device modelling. He is investigating the use of wide band gap materials like aluminium gallium nitride (AlGaN) and boron nitride (BN) for applications involving enhancement mode high electron mobility transistors (E-HEMTs) and power heterojunction bipolar transistors (HBTs). These materials have the potential to enhance on-state current /off-state breakdown voltage combinations which are critical for power electronic applications. The research examines material composition and the effects of spontaneous and piezoelectric polarization on the characteristics of power electronic devices. He is part of Silicon University's consultancy team that is working with Hindalco Aluminium to provide them with robust sensor, tracking and robotics solutions.



BN/AlGaN E-HEMT with polarisation charges and showing high breakdown voltage

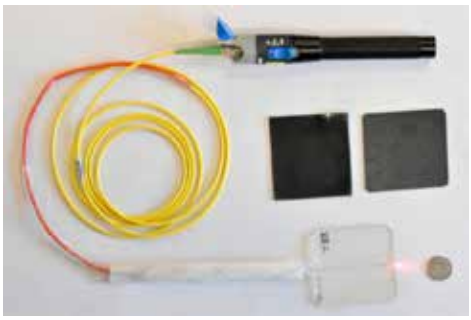


InGaN on Silicon Solar Cell showing Graded Semiconductor Band Diagram

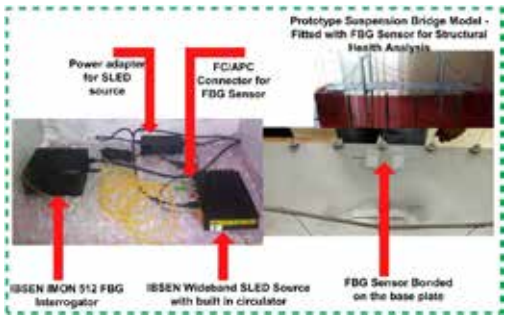
Dr. Praharaj is also supported by Silicon University for a research project that explores the use of indium gallium nitride (InGaN) for developing high-efficiency solar photovoltaic cells.This research is focused on characterizing the effect of polarization and materials composition grading on quantum efficiency and power conversion efficiency of these devices. His contributions are pivotal for improving the efficiency and reliability of power electronic components and making significant advancements in semiconductor device modelling.

OPTICAL SENSORS

Dr. Ambarish G. Mohapatra's research at Silicon University has advanced Fiber Bragg Grating (FBG) sensor design. Collaborating with Dr. Somanath Tripathy (IIT Patna) and funded by TEQIP-III BPUT CRIS, he developed an FBG-based sensing method for real-time cardiac and respiration monitoring during MRI tests. He also fabricated a metal-packaged FBG temperature sensor by embedding an FBG sensor within a Polydimethyl Siloxane (PDMS) polymer encased in a stainless-steel probe. Funded by the SRPS scheme, Dr. Mohapatra explored the use of FBG sensors for Structural Health Monitoring (SHM) in association with Dr. Palas Biswas (Principal Scientist, CGCRI Kolkata), focusing on strain and load distribution in suspension bridges. His research combined FBG optical sensing with machine learning to create virtual sensors that accurately estimate load positions, enhancing safety and predictive maintenance in civil infrastructure. In association with Mr. Remco Nieuwland (CEO, Somni Corporation B.V., Delft, Netherlands), condition monitoring in rotating machines using FBG vibration sensor is developed. This work highlights his significant contributions to sensor technology and real-world applications.



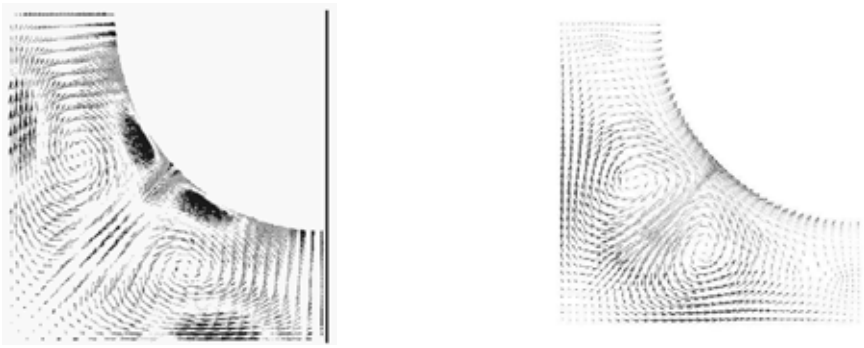
FBG-based physiological sensor element sandwiched between PDMS polymer material



Experimental setup and load calibration model of an FBG sensor for monitoring cracks in civil engineering applications

FLUID MECHANICS

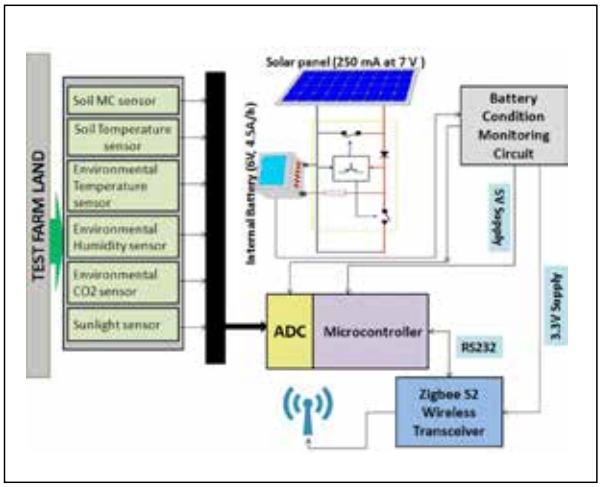
Dr. Kamalakanta Satpathy is working with Professor Prasad Patnaik BSV (IIT Madras) to improve the safety of Fast Reactors (FRs) by enhancing heat extraction from fuel rod bundles. Funded by the TARE Fellowship, his research bridges sub-channel analysis and detailed CFD simulations. By employing limited CFD calculations and a thermal resistance network, it refines modelling constants to optimize safety and reliability. The study uses scale-down experiments to establish correlations and addresses "what-if" scenarios in rod bundle design, ensuring better critical heat flux margins and reactor safety in India.



Comparison of secondary flow cells in1/8th of the square sub-channel at an iso-surface between reported design (left, Cheng and Tak, NED, 2006) and the present study (right)

WIRELESS SENSOR NETWORKS

Dr. Ambarish G. Mohapatra led the research and development of IoT-enabled Wireless Sensor Network (WSN) for optimizing agricultural processes, funded by AICTE under the CAYT (Career Award for Young Teachers) scheme. The WSN framework is equipped with various sensors to monitor soil moisture, soil temperature, environmental temperature, humidity, CO_2 levels, and daylight intensity. An innovative irrigation control scheme is developed using neural networks that predict soil water requirements up to an hour in advance. Dr. Mohaptara's comprehensive approach to precision agriculture demonstrates the potential of IoT and advanced data analytics to enhance irrigation efficiency and support sustainable farming practices.



Integration of the WSN system with soil moisture content (MC) and soil N-P-K content decision support systems

Dr. Anita Mohanty and **Dr. Ambarish G. Mohapatra** of Silicon University secured a UK registered design (design number 6328235) for an innovative IoT-based robot for air conditioner duct cleaning. The robot features a specialized brush mechanism to navigate varied duct angles, ensuring comprehensive cleaning, and includes a camera module for real-time monitoring to enhance precision. It can be remotely operated, making it versatile for different HVAC systems. Its modular design suits various duct sizes and types, and it can traverse diverse topologies. The real-time monitoring improves efficiency and safety, allowing users to observe and adjust cleaning parameters, ensuring a thorough and adaptable cleaning solution.

IoT-based AC Duct Cleaning model

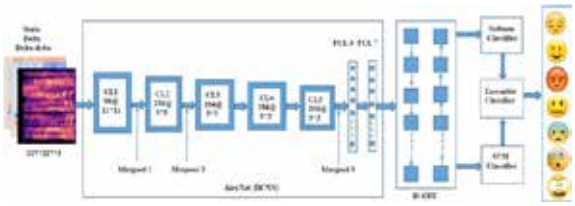
Dr. Soumya Ranjan Samal, conducts extensive research on heterogeneous wireless networks, focusing on coverage analysis, interference management, and mobility optimization in 5G technologies. His analysis of n-interacted transmission nodes in heterogeneous networks provided key insights into ensuring coverage across diverse environments. Dr. Samal has developed techniques to mitigate interference in small cells, enhancing network performance in dense areas. His work emphasizes effective mobility management to conserve power and reduce delays in k-tier HCN architectures. He also proposed dynamic coverage adaptation to meet the fluctuating demands of dense 5G user environments, significantly advancing cellular network efficiency and adaptability.

SIGNAL PROCESSING

Dr. Biranchi Narayan Rath is researching adaptive active noise regulation using deep learning regression. Collaborating with IMMT and funded by SERB's TARE program, his work combines signal processing and machine learning to enhance noise control in specialized settings. Using data-driven strategies, Dr. Rath improves noise attenuation flexibility by focusing on selective noise reduction. His approach employs deep learning to fine-tune systems for adjustable acoustic management, optimizing anti-noise sources' placement and characteristics through discrete point measurements for effective noise control solutions.

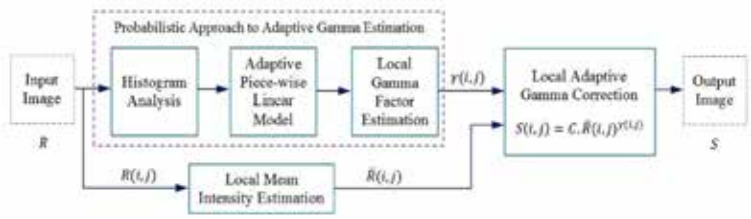
Experimental setup for active noise cancellation

Dr. Manorama Swain's research at Silicon University focuses on interpreting emotions in Odia dialects via mobile applications, funded by DST, Govt. of India. The project documents dialects, creates an emotional speech database, and designs algorithms for emotion classification. By analyzing mobile conversation trends, the team developed apps for automated emotion detection. They compiled SITB-OSED, the first Odia emotional speech database, with 12,110 utterances in five dialects recorded by 20 professional speakers. The developed app accurately recognizes emotions, advancing NLP models for automated emotional understanding in the Odia language.



The framework of a model for speech emotion recognition in Odia language

Dr. Aditya Acharya addresses limited human vision under darkness with real-time image enhancement for night driving. High beams impair drivers' ability to detect obstacles like potholes and speed breakers, risking accidents. Existing algorithms often over-enhance bright regions, losing detail in dark areas. Dr. Acharya proposes a novel piece-wise adaptive gamma correction method using a multi-linear transfer function to enhance darker objects without affecting bright regions or creating artefacts, significantly improving processed images' quality for safer night driving.

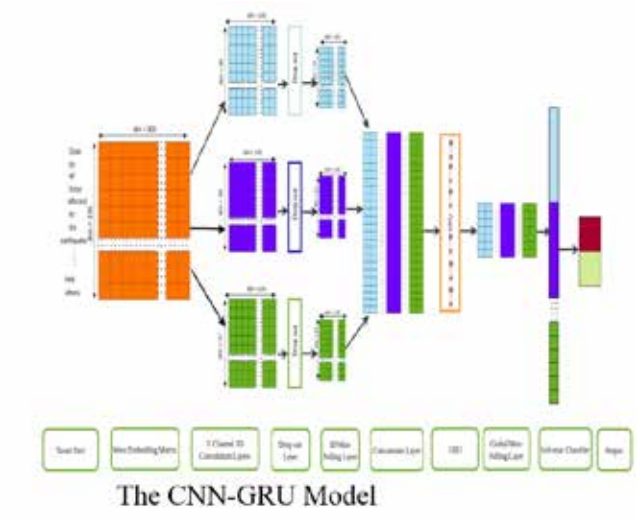


Block diagram of the proposed adaptive piece-wise linear gamma correction (APLGC) method

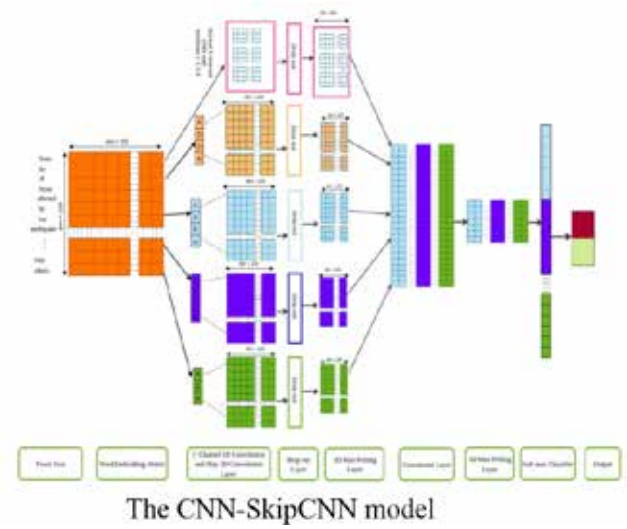
Dr. Rekha Sahu focuses on understanding customer needs by analyzing decision-making behavior during uncertainty. Neural signals from brain regions like AF3, AF4, F3, F4, and others exhibit patterns linked to emotions. Using the Emotiv Epoc+ sensor, she collects EEG signals as customers view products. A machine learning model embedded in the device analyzes these signals to predict customer preferences. This innovative approach ensures better insight into genuine customer needs and enhances satisfaction by interpreting their emotional states.

Channel Gel Wireless EEG Head Cap System for collecting high-density EEG signals and 14-Channel Wireless EEG Headset of EMOTIV's industry.

Dr. Nayan Ranjan Paul has significantly advanced the field of crisis informatics. His research focuses on automatically identifying disaster-related social media posts and analyzing shared information during crises. Platforms like Twitter play a crucial role in real-time crisis communication, but the vast data volume poses challenges for accurate extraction. Dr. Paul addresses this by developing hybrid deep neural network models combining CNN and GRU to improve post identification accuracy and CNN with SkipCNN for advanced data analysis. His work enhances situational awareness for the public and response teams, enabling more effective disaster preparedness and management.



The CNN-GRU Model



The CNN-SkipCNN model

MOLECULAR MEDICINE

The JBS Haldane Centre for Molecular Medicine at Silicon University, is dedicated to advancing the field of molecular sciences through both research and education. Under the leadership of **Dr. Biren Banerjee**, a distinguished figure with profound expertise in molecular and genetic biology, the Centre stands at the forefront of developing cutting-edge diagnostic platforms. Dr. Banerjee's prolific research career is highlighted by over 51 publications in internationally renowned journals, reflecting his remarkable contributions to understanding the molecular basis of various diseases. The Centre's broad research initiatives encompass critical topics such as molecular oncology, molecular fertility, pediatric genetics, haematoncology, and genetic wellness. These initiatives are undertaken in collaboration with inDNA Life Sciences Pvt Ltd, a DNA-based clinic and a molecular platform for genetic diagnostics and personalised medicine.

The current research endeavours at the JBS Haldane Center are focused on two significant areas. The first area involves developing predictive tools for the recurrence of breast cancer within the first five years following diagnosis, aiming to improve patient outcomes through early intervention. The second area of focus is on understanding and addressing Recurrent Pregnancy Loss (RPL), which involves the failure to continue pregnancy after conception. Both these conditions pose a substantial challenge to affected individuals and families and would benefit greatly from accurate diagnostic solutions and effective management strategies.

The Centre's teaching faculty comprises esteemed scholars and researchers from prestigious institutions, including Baylor College of Medicine, Johns Hopkins University, and Rockefeller University. The diverse team brings expertise in a range of domains, such as point-of-care diagnostics for infectious diseases, neurodegenerative diseases, and cancer biology, significantly enriching the Centre's research landscape.

Dr. Divya Sriram, has made noteworthy contributions to the field of developmental biology, infectious disease therapy, and molecular cell research. Her work includes discovering a novel brain-specific isoform of C3G, evaluating the complex interaction and regulation between GSK3β and C3G, and assessing clofazimine as a therapeutic for pulmonary M. abscessus infection.

Dr. Pradeep K. Singh's research focuses on identifying novel therapeutic targets for Alzheimer's disease, emphasizing the role of the contact activation system and vascular factors. Dr. Singh, a faculty member of Silicon University, proposed the contact activation system as a potential alternative target for Alzheimer's therapy. His research has demonstrated a significant correlation between elevated plasma bradykinin levels and cognitive impairment in Alzheimer's patients. Dr. Singh's work suggests innovative pathways in treatment strategies for Alzheimer's disease.

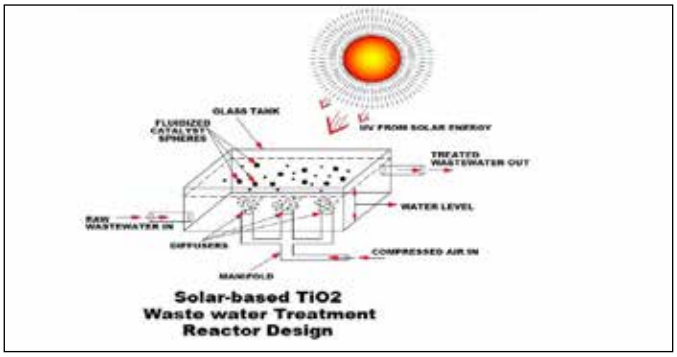
Dr. Nirmalya Ghoshal, has conducted research on the adaptive responses of Plantago ovata to cadmium stress and radiation, focusing on the roles of metallothioneins and metal content. His work demonstrates pre-exposure to low doses of gamma rays can induce cross-adaptation to cadmium stress. Dr. Ghoshal has also studied the alterations in the transcriptome and proteome related to metallothioneins after oxidative stress caused by sublethal doses of cadmium and gamma rays. His work makes important advances to our understanding of plant resilience mechanisms to environmental stressors.

The JBS Haldane Centre for Molecular Medicine strives to serve as a beacon of excellence in molecular medicine research and education. Through its groundbreaking research projects, distinguished faculty, and collaborative initiatives, the Centre not only advances scientific understanding but also holds the promise of developing novel diagnostic and therapeutic strategies to tackle some of the most pressing medical challenges of our time.

Patents

Dr. Jaideep Talukdar, Dr. Debi Prasad Datta, and Prof. Bipin Bihari Tripathy developed a patent on the solar photocatalytic process for sustainable wastewater treatment granted as:

- **Indian Patent (Patent No. 442435)** – Solar photocatalytic process for wastewater treatment using a titanium dioxide (TiO2) photocatalyst and a novel three-phase fluidized bed photo-reactor, reducing operational costs, enhancing efficiency, and offering potential for large-scale rural and urban sewage treatment applications using renewable energy.



The following U.S. patents by **Dr. Saroj Rout** highlight his contributions to advanced MEMS sensor technologies:

- **U.S. Patent (US11128260B2)** – Advanced trans-impedance amplifier (TIA) with capacitance isolation for MEMS gyroscopes, enhancing signal quality, power efficiency, and system response.
- **U.S. Patent (US9939290B1)** – Calibration method for time-multiplexed sensors, allowing multiple MEMS devices to share a single analog block, reducing size and cost while improving accuracy.
- **U.S. Patent (US9702898B1)** – Real-time quadrature error correction system for MEMS gyroscopes, ensuring high precision and reliability for navigation, automotive, and aerospace applications.

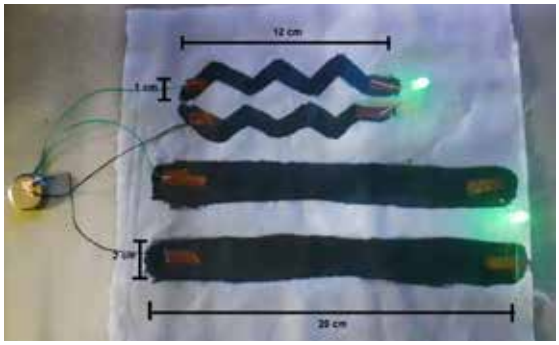
The following U.S. patents by **Dr. Santunu Sarangi** highlight his contributions to high-speed electronic systems and clock management technologies:

- **U.S. Patent (US11956713B2)** – On-chip jitter measurement system for high-speed data and clock signals, using substrate clock edge sampling and scanning edges for precise timing detection, improving reliability and reducing power and space requirements in telecommunications and advanced computing.
- **U.S. Patent (US12012547B2)** – High-speed voltage-controlled current mode logic delay cell, enhancing tuning range and silicon efficiency in ring-VCO-based clock generation systems, with improved methods to adjust delay for better frequency stability and reduced noise sensitivity.

Test and measurement structure to test the On-Chip Jitter

Dr. Debangana Das has developed a sustainable conductive paint formulation for flexible electronics, granted as:

- **Indian Patent (Patent No. 519310)** – A formulation of Eco E-Paint for flexible electronics, made from natural materials like carbon black from household waste, gum arabic resin, and natural oil-based plasticizers, offering excellent conductivity, durability on fabric and walls, and promoting green technology with potential for wide commercial and domestic applications.



Lighting of an LED using the developed conducting paint

Grant Highlights

AICTE IDEA LAB

Funding Agency: All India Council for Technical Education (AICTE)
Sanctioned Budget: ₹1.1 crore
Duration: 2 years
Chief Mentor: Dr. Jaideep Talukdar, Professor & Vice-Chancellor
Faculty Coordinator: Dr. Ambarish G. Mohapatra, Associate Professor, Electronics Engineering
Faculty Co-Coordinator: Dr. Sudhansu M. Biswal, Associate Professor, Electronics Engineering

The AICTE IDEA Lab aims to foster creativity, innovation, and hands-on learning in STEM. The lab will facilitate research, prototype development, and industry-academia collaboration in line with NEP 2020.

RESEARCH PROJECT ON TARGETING EARLY VASCULAR DYSFUNCTION IN ALZHEIMER'S DISEASE ASSOCIATED DEMENTIA FOR THERAPEUTIC DEVELOPMENT

Funding Agency: Anusandhan National Research Foundation (ANRF)- Prime Minister Early Career Research Grant (PMECRG)
Sanctioned Budget: ₹60 lakhs
Duration: 3 years
Principal Investigator: Dr. Pradeep Kumar Singh, Associate Professor, JBS Haldane Center of Molecular Medicine
This research aims to investigate cross talk between amyloid protein and blood clotting factors in Alzheimer's disease. This project is approved for funding in the scheme of the Prime Minister Early Career Research grant-2024 for validating vascular pathways as novel therapeutic targets in Alzheimer's disease.

Contact Us

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