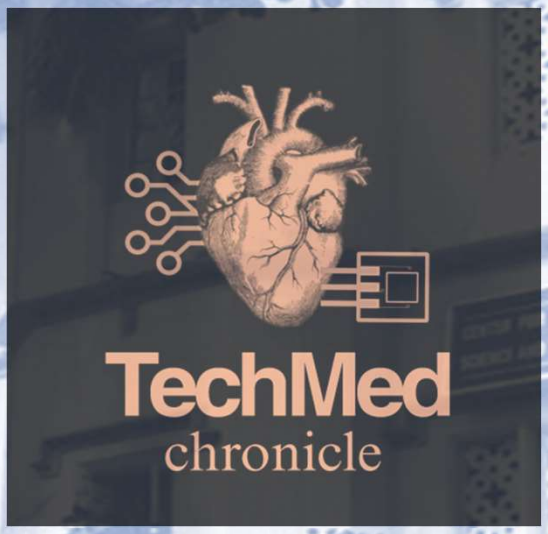
Indian Institute of Engineering Science and Technology, Shibpur
An Institute of National Importance
भारतीय अभियांत्रिकी विज्ञान एवं प्रौद्योगिकी संस्थान, शिवपुर

Centre for Healthcare Science and Technology

Innovating Health through Science and Technology...



A Biannual Newsletter
October, 2024 - March, 2025

Indian Institute of Engineering Science and Technology, Shibpur
An Institute of National Importance
भारतीय अभियांत्रिकी विज्ञान एवं प्रौद्योगिकी संस्थान, शिवपुर

Centre for Healthcare Science and Technology

Message from HoD's Desk

Dr. Ananya Barui
Assistant Professor

It gives me great pleasure to present the second issue of TechMed Chronicle, showcasing the recent developments and achievements of the Centre for Healthcare Science and Technology (CHST) at IIEST, Shibpur. Since its inception in 2010, CHST has remained dedicated to fostering interdisciplinary research and training across biotechnology, medicine, engineering, and the physical sciences to address critical challenges in biomedical science and public health.

Our vision is to drive cutting-edge research and innovation in healthcare, with a strong emphasis on affordability, sustainability, and translational outcomes. Through collaborative efforts with academic departments, industry partners, and healthcare institutions, we aim to evolve into a Centre of Excellence in biological and biomedical engineering. This issue reflects the Centre's academic and research vibrancy—highlighting our ongoing projects, state-of-the-art infrastructure, and impactful publications. I am especially pleased to note the growing enthusiasm among our students and faculty in contributing popular scientific articles for this newsletter, making it an engaging platform for scientific communication. I extend my sincere thanks to all members of the CHST community for their continued dedication and collaboration. I hope you find this edition insightful and inspiring.

Warm regards,

Courses offered

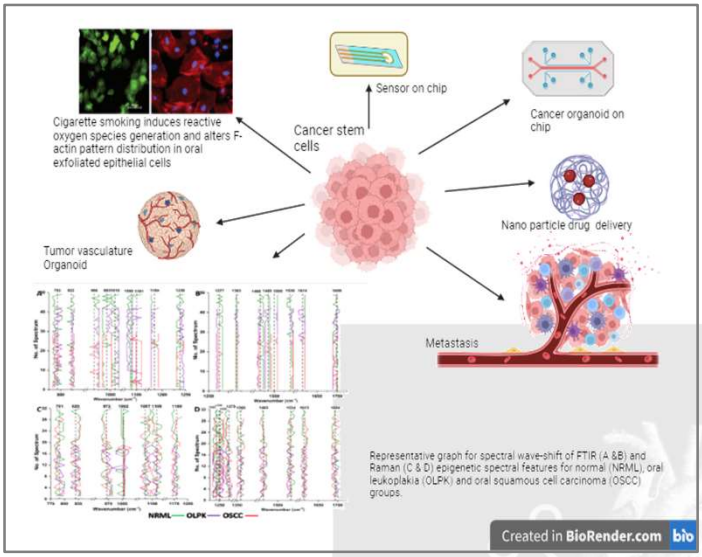
- **M.Tech in Biomedical Engineering**
- **Ph. D. in Biomedical Engineering & Biotechnology**

Thrust Areas

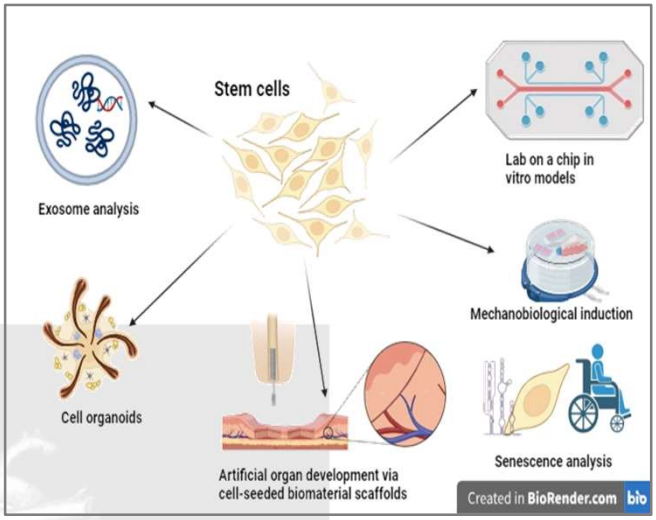
- **Tissue engineering**
- **Cancer biology**
- **Neurotherapeutics.**
- **Biosensor and bioelectronics**
- **Protein engineering and structural biology**

RESEARCH OVERVIEW

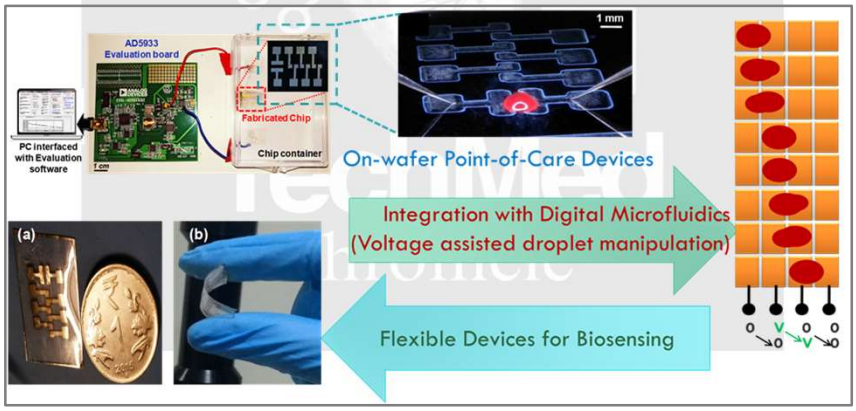
TRANSLATIONAL CANCER DIAGNOSTICS LAB



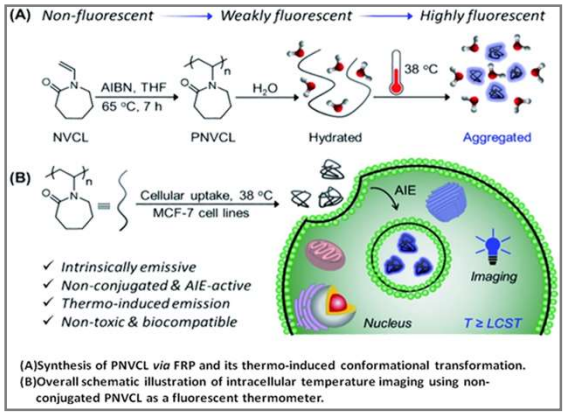
REGENERATIVE ENGINEERING AND MECHANOBIOLOGY LAB



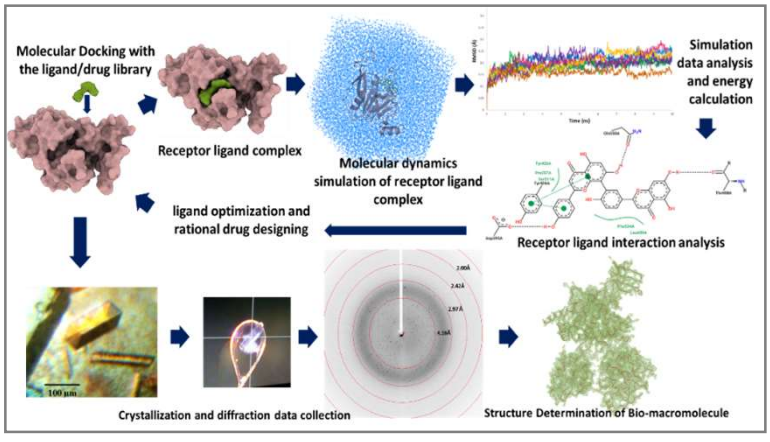
BIOSENSOR AND BIOINSTRUMENTATION LAB



NEURO-BIOTECHNOLOGY LAB



PROTEIN ENGINEERING AND STRUCTURE BIOLOGY LAB



DR. BHOLANATH CHAKRABORTY MEMORIAL FUNDAMENTAL RESEARCH LABORATORY OF HOMEOPATHY

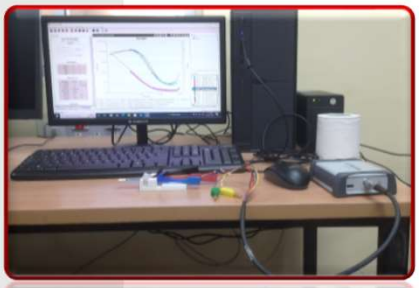
Funded by Central Council for Research in Homeopathy (CCRH), Ministry of AYUSH, Govt. of India

The laboratory as an integral part of the Centre aims to investigate and standardize the nature of homeopathic substances in terms of its composition, molecular structure, and physical characterization.

Major Equipment present in the lab

CONFOCAL MICROSCOPE WITH TIRF

ELECTROCHEMICAL WORKSTATION

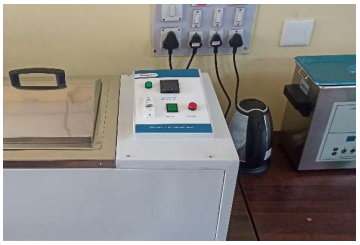


RAMAN SPECTROSCOPE

Dynamic Light Scattering & Particle Size Analyser

HIGH FREQUENCY IMPEDANCE ANALYZER

Minor Equipment present in the lab



Research Outcome

- Developing fundamental knowledge-base and technologies for Bioengineering.
- Collaborating with industry, academia and healthcare organizations.
- Drawing extramural funds from different government agencies.
- Training manpower in the capacity of MTech and PhD students.

R&D projects @CHST

The Centre for Healthcare Science and Technology at IIEST Shibpur has been steadfast in its mission to emerge as a national hub for impactful research and development in the domains of biomedical science and public health. It is driven by a strong emphasis on interdisciplinary collaboration, combining expertise from engineering, biological sciences, materials science, and clinical practice to address real-world healthcare challenges. The Centre particularly focuses on developing sustainable, affordable, and contextually relevant healthcare solutions, tailored to meet the needs of the Indian population.

Over the years, the Centre has successfully executed several research and translational projects supported by prominent national and international funding agencies. These projects have led to the development of indigenous technologies, generation of intellectual property, and publication of high-impact scientific articles. Currently, the Centre is executing five major ongoing projects with a cumulative funding of over ₹15 crore, spanning diverse areas of biomedical engineering.

In addition to the ongoing work, multiple research proposals have been submitted to various funding bodies and are currently in the pipeline, reflecting the Centre's active engagement with the broader research community and commitment to continuous growth. Through these concerted efforts, the Centre continues to build a vibrant innovation ecosystem aimed at transforming biomedical research into tangible societal benefits.

Funding Agencies

Recent Significant Publications

Issue 6, 2025

From the journal:
Biomaterials Science

Coculture to vascularization transition in bioengineered skin grafts through VEGF-associated pathways tracked by exosomal biomarkers†

Shalini Dasgupta [a] and Ananya Barui *[a]

This study demonstrates that a coculture of mesenchymal stem cells (MSCs) and dermal fibroblasts on a bioengineered CCF-D3 scaffold promotes MSC endothelial transdifferentiation (MEnDoT) and vasculogenesis via the VEGF–eNOS pathway.

Multimedia Tools and Applications (2024) 83:88469–88504
https://doi.org/10.1007/s11042-024-19686-8

1233: ROBUST ENHANCEMENT, UNDERSTANDING AND ASSESSMENT OF LOW-QUALITY MULTIMEDIA DATA

Check for updates

VMAC: overlapping cervical cell segmentation from label-free quantitative microscopy images

Shreya Adhikary[1] · Ayushman Chakraborty[1] · Sayan Seth[2] · Seema Das[3] · Tapan Kumar Naskar[4] · Santi P. Maity[5] · Ananya Barui[1]

This study presents a non-invasive method for early detection of cervical cancer using unstained DIC images. It introduces a Voronoi-based mixed-breed active contour (VMAC) technique to accurately segment overlapping cervical cells, addressing the limitations of staining and subjective interpretation.

Collaborative Research Cover Feature: Reusable Iron-Copper Catalyzed Cross-Coupling of Primary Amides with Aryl and Alkyl Halides: Access to N-Arylamides as Potential Antibacterial and Anticancer Agents (Chem. Eur. J. 10/2025)

Keya Roy, Anay Saha, Bijay Saha, Subhrajyoti Banerjee, ***Chitrangada Das Mukhopadhyay***, Sumanta Kumar Sahu, Laksmikanta Adak*

Journal of Molecular Modeling (2025) 31:84
https://doi.org/10.1007/s00894-025-06301-2

ORIGINAL PAPER

Check for updates

Molecular dynamics simulation shows enhanced stability in scaffold-based macromolecule, designed by protein engineering: a novel methodology adapted for converting Mtb Ag85A to a multi-epitope vaccine

Ditipriya Hazra[1] · Shakilur Rahman[2,4] · Manisha Ganguly[3] · Amit Kumar Das[2] · Amlan Roychowdhury[3]

This study presents a novel protein engineering approach using molecular dynamics simulations to design a stable scaffold-based macromolecule by converting Mtb Ag85A into a multi-epitope vaccine. The simulations reveal enhanced structural stability of the engineered construct, supporting its potential as a robust vaccine candidate against tuberculosis.

Contents lists available at ScienceDirect

Journal of Molecular Liquids

journal homepage: www.elsevier.com/locate/molliq

ELSEVIER

Molecular-level analysis of alkyl chain dependent voltage-induced microfluidic alcohol droplet actuation on Teflon/Pt/glass substrate: Revealing the unconventional directional movement

Debopam Bhattacharya [a], Subhadip Chakraborty [b], Ditipriya Hazra [c], Amlan Roychowdhury [b], Anupam Karmakar [a], Sanatan Chattopadhyay [a,d,*]

This collaborative study explores voltage-induced actuation of alcohol droplets on a Teflon/Pt/Glass substrate, revealing that longer alkyl chain alcohols show increased wetting and deeper surface penetration. Combining experiments and molecular dynamics simulations, it offers valuable insights for designing digital microfluidics in lab-on-a-chip applications.

Contents lists available at ScienceDirect

Biomedical Engineering Advances

journal homepage: www.journals.elsevier.com/biomedical-engineering-advances

ELSEVIER

Gingival fibroblast seeded bioengineered scaffolds for treatment of localized gingival recession

Rajul Chordia [a,1], Aritri Ghosh [b], Shalini Dasgupta [b], Sayandeep Saha [b], Tirthankar Debnath [a], Ashit Kumar Pal [a], Ananya Barui [b,*]

This study develops bioengineered chitosan-gelatin scaffolds (1:3 ratio) seeded with primary gingival fibroblasts as a noninvasive graft for treating gingival recession. The scaffold showed excellent porosity, biodegradability, and fibroblast compatibility, with enhanced cell migration, F-actin expression, and FGF-2 upregulation, along with antibacterial properties—highlighting its potential for periodontal tissue regeneration.

Human : A Circuit with Life

Mr. Siluveru Raja Viveka Vardhan
Student, MTech 2nd Semester

The human body and an electronic circuit are worlds apart in composition, yet strikingly similar in function, as if nature itself drafted a blueprint later borrowed by engineers. Let me take you on a creative journey through this parallel universe.

In the realm of human biology, neurons serve as shimmering highways of information, their electric impulses zipping along like data packets traveling through copper wires in a circuit. The axons, the long arms of neurons, are insulated by myelin sheaths—much like the plastic insulation protecting wires from short-circuiting. And those synapses? Tiny junctions where chemical sparks leap across the void to transmit data, akin to the connectors or solder points where wires meet on a circuit board.

The heart, our rhythmic power source, pulses endlessly like a well-calibrated oscillator, sending waves of energy through arteries and veins just as an alternating current flows through a circuit. The sinoatrial node, the natural pacemaker, mirrors a timing chip, ensuring precision in every heartbeat. The lungs are capacitors, storing and releasing oxygen in rhythm, regulating the flow of energy much like capacitors store and release electrical charge. Each breath is a cycle, maintaining the delicate balance of input and output essential to the system's function.

The brain, our central processor, reigns supreme as a multi-core CPU. It processes sensory inputs—visual, auditory, and tactile—just as a computer processes signals from sensors. The billions of neurons are its transistors, switching and amplifying signals at lightning speed, enabling thoughts, emotions, and creativity.

Meanwhile, the digestive system is an energy converter, akin to a rectifier in a circuit. It transforms raw materials (food) into usable forms of energy (glucose), which powers the entire system. The liver, like a voltage regulator, ensures that energy is distributed in just the right amounts.

The muscles are actuators, converting electrical signals from the nervous system into mechanical movement. Each contraction and relaxation mirrors the action of a solenoid or motor turning electrical energy into kinetic energy.

The skin acts as an insulating layer and protective shield, comparable to the casing of a circuit. It ensures that no external elements disrupt the delicate internal operations.

Finally, the immune system is the firewall, constantly scanning for intruders and deploying countermeasures—white blood cells as the antivirus software of the body—protecting this intricate biological machine from harm.

Imagine yourself as the system administrator of this marvelous biological-electronic hybrid. Just as a circuit's efficiency depends on flawless wiring and perfectly functioning components, your body thrives when its neurons fire synchronously, its organs hum in harmony, and its systems adapt dynamically to changing conditions. Both the circuit and the human body remind us that connectivity, balance, and maintenance are the keys to an efficient and sustainable design.

Faculty Speaks

'Sensible' Sensors in Diagnostics and a Ride with a Purpose

Dr. Subhadip Chakraborty

Memoires of once a PhD student on finding a purpose

Prologue

"Baba, you have come after a long gap this time." Mohin dada asked looking behind from the pilot seat of his rickshaw which I always refer to as Mohin's aircraft.
"Yes, almost six months from my last homecoming." I replied.
Mohin dada always picks me up from the railway junction and takes me home through the beautiful tree gardens, crossing a couple of bridges over small rivers. The soothing greenery and the sounds of river flow create a lovely ambience here.
"How's life going on dada?" I asked him.
"Your dada is getting older. Health issues have already started knocking the door." He sighs.
"No way." I replied.
"You are still the little boy." He smiled and said, "I went to the doctor and he suggested various blood tests."
"What are the complications?" I asked.
"Doctor said I have sugar problem. Also, blood amount is less in body and few other things." He replied.
"Did he say hemoglobin, CBC kind of things?" I was trying to be sure about the condition.
"Yes baba, he said these things. In fact, I have brought the prescription and report papers to show you." He handed me the papers. He had type 2 diabetes mellitus along with low hemoglobin level.
I got a bit depressed since these complications may lead him to severe diseases, particularly chronic kidney problems. Hiding my worries I said, "You'll be fine. Don't worry. Get in touch with your doctor. We know him and will talk to him regarding your case. He will help you in every possible way."
Mohin dada smiled dryly and said "Thanks. But you know the main problem here is the blood tests. Doctor tells to have regular routine tests. We don't have any laboratories around. You have left the place many years ago baba, for your studies. You hardly know the situation. First, the distance and then comes the cost of those tests. How can people like us afford those things routine wise? There is a clinic five kilometers from here where the owner himself collects the blood and takes that to a private laboratory in the town. He charges very high for this."
"I know these things Mohin dada. In fact, my work is related to these things." I told him.
"Really? You do these tests in your college in Kolkata?" He asked me.
"Not only us dada, a large number of scientists are working in this area. In our laboratory, we try to develop instruments for different types of blood testing and other things. Our aim is to make the pathological tests low-cost, which can be easily afforded by the people of all financial status." I replied.
"Does one have to go the laboratory for the tests? The owner of the clinic I mentioned was telling one day that there is a small sugar checking machine available. But baba, that is too very costly to afford." Mohin dada went deeper into the conversation.

"Glucometers. Yes, those are available but as you said the cost still matters. Regarding our devices, I mean test instruments, those are also portable and have point of care facility, i.e., you can measure those anywhere and get the result in a very short time. You know Mohin dada, very recently we have developed such an instrument for measuring hemoglobin level. As per our estimation the cost for each test will be only 30 rupees. Some of these devices are also designed on flexible plastic sheets. We are now working hard to further reduce the cost. Before this, we have also worked on diabetes, cholesterol as well as several types of cell count which is written on your prescription." I explained my research area to dada. We, the research scholars never miss an opportunity to explain our research to others.

"Baba, you will make me proud. That little boy has grown up so fast and now, he is trying to make things which we, the people of low income in remote areas utterly need." His words were overflowing with affection and pride.

Truly speaking, I love to hear his words but at the same time felt a sense of guilt for us not having that drive enough for widespread commercialization of our research products.

He continued, "You see, I won't be able to understand these things, but believe me I have become very interested after hearing what you people have been doing in laboratory."

I told him, "It's not that complicated Mohin dada. Have you ever seen Raju, the electrician of our locality, checking capacitors of fans?"

He laughed and said, "Yes baba, I know that much. He has meters for checking capacitors, measuring currents etc."

"Bravo. We also design capacitors, obviously not like the ones used in fans, then place blood samples on them and check the output. We also measure current and several other things. We get readings in the meters and we observe how the readings change with your blood sugar level, hemoglobin and other parameters. Speaking more precisely, we can estimate those things from the readings of the electrical meters. Suppose you have less hemoglobin than mine, then the current output will be larger for your sample, i.e., more the hemoglobin, less is the current. Similarly, you can relate these with capacitance also." I tried to brief the fundamental aspect of electronic biosensors to Mohin dada.

"Baba, please bring some of those modern instruments here for once and we will organize blood test camp in the local tea gardens. Is it not possible that one gives sample at once and gets reports for sugar, cholesterol and hemoglobin simultaneously?" He asked.

Mohin dada was taking me into one of the most promising aspects of biomedical engineering. Development of Lab-on-a-chip [LOC] biosensors for clinical diagnosis has attracted a great deal of interest in recent years. In our lab also, we have designed, modeled and fabricated on-chip electronic bio-sensing devices for detecting and/or estimating several biological constituents in different samples. Such devices are connected to computer interfaced software controlled compact integrated circuits [ICs] to demonstrate point of care measuring features. One very important and interesting aspect of this work is that the fabricated micro-scale devices can be integrated with digital microfluidic scheme for superior performance, enabling voltage driven movement, splitting, mixing and manipulation of blood sample droplets. In this technique, one has to place a single drop of sample in micro-liter range on the device and then apply appropriate sequential voltage on patterned electrode arrays to move the droplets towards predefined sensing zones for respective detection of deferent bio-constituents. In this context, a long-term plan can be conceived to integrate on-chip solar cell units on the same integrated chips so that it can be self-driven anywhere without electricity. Hence, the entire work of one or more laboratories can be performed in a single portable chip, which justifies the term "Lab-on-a-chip". The entire concept can be summarized in a block diagram as shown in Fig. 1.

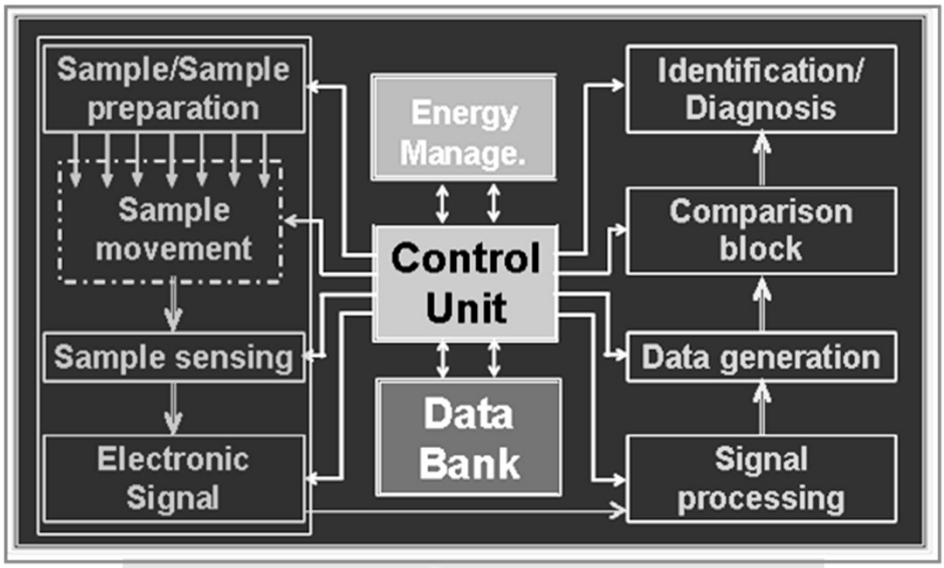


Fig. 1. Schematic of an LOC.

"Yes, it is possible. People are also working on that. Not only those three you mentioned, but also several other things can be measured simultaneously. Our dream is to provide a facility for diagnostic testing where at least ten different tests can be performed within a minute having a cost under 20 rupees." I told.
"Take my words, you'll succeed." His tone mixed science with emotion.
My destination had arrived. As I went on to pay him for the ride, he smiled and said, "Instead of this give me a free blood test in future with the instrument you are developing. Stay blessed."

Epilogue

It has been almost a month since I returned to university from home. My thesis writing is almost done and at present I am checking the 'Conclusion and Future Scope' part. I am looking at the "Key Contribution" sub-section appearing on the computer monitor and the words of Mohin dada are reverberating in my mind.
"Let me recapitulate the contribution of my student's work."
I feel a tender tap on my head. I haven't even realized my supervisor is standing behind me.
"Oh, Sir, sure." I offer him the chair.
"No need man" He looks on the screen and after completing the text he says, "Fine. Please finalize it and send me for a final evaluation from my side. Okay?"
I nod affirmatively "I will send you by tomorrow."
Only one major thing remains now. I have to include one name in the acknowledgement section. I had an aim of research, but this man unveiled its true purpose to me a month ago. The purpose, which not only leads us in future endeavors, but also makes us believe our own works. Yes, I thank Mr. Mohin Kumar Das.

The story got awarded with DST AWSAR Award (2020) as a popular scientific communication.

Participation in the CBDE Program

The faculty and students of the Centre for Healthcare Science and Technology (CHST) at IIEST Shibpur are actively participating in the Capacity Building on Design and Entrepreneurship (CBDE) Program to foster innovation and entrepreneurial skills. Students are engaged in hands-on activities such as deconstructing and reassembling digital biomedical devices like glucometers and blood pressure monitors, working towards developing simple functional prototypes.

Dr. Mita Tarafder recently visited the Centre to observe these activities. She interacted with the students, reviewed their work, and encouraged them to further innovate based on real-world healthcare needs. Her mentorship has been instrumental in motivating the students and guiding the projects.

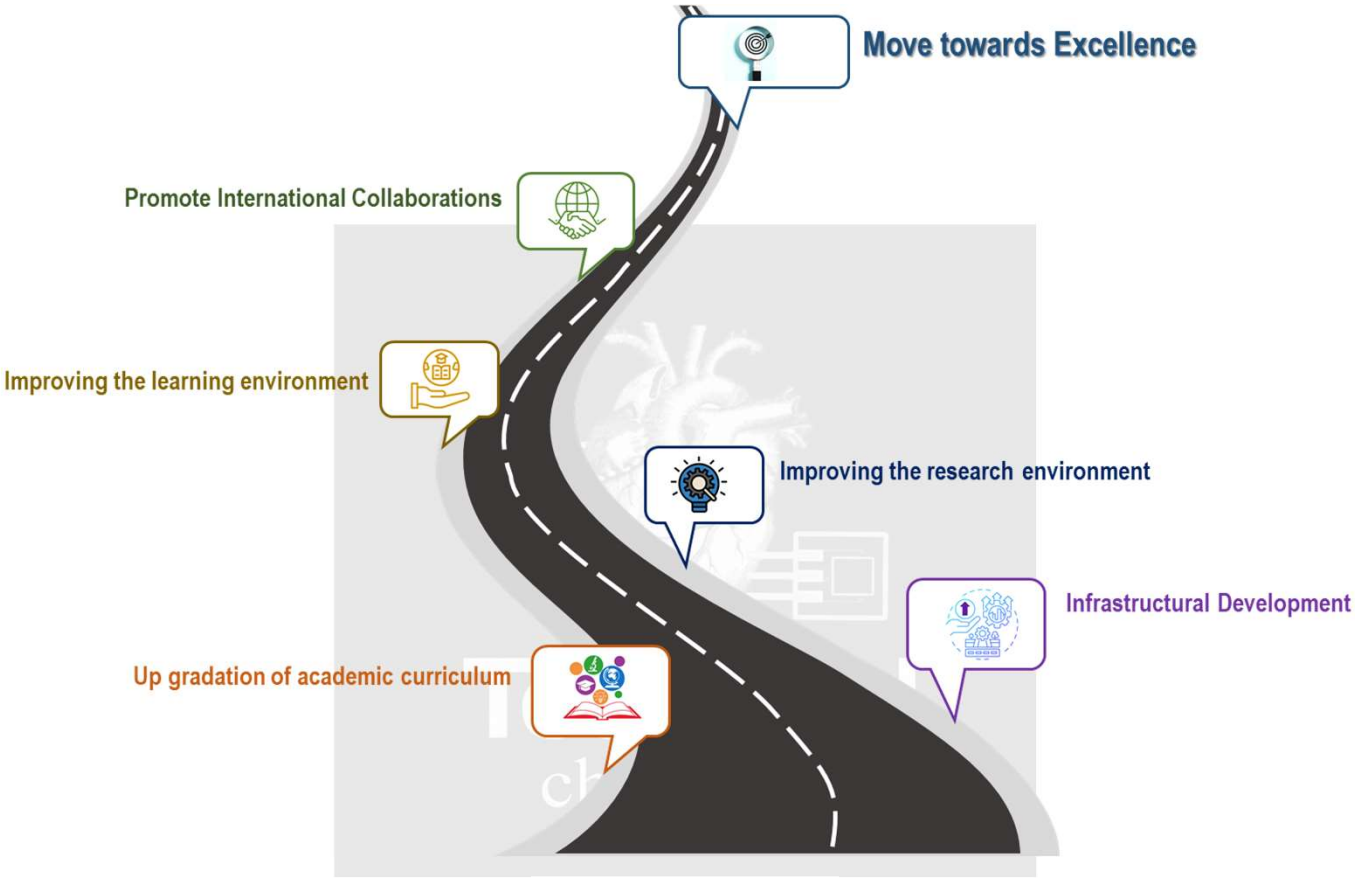
Faculty members have proposed pedagogical changes to existing courses, emphasizing a Learning by Doing (LBD) approach. Discussions with CBDE mentors are underway to incorporate more practical, design-focused activities into the curriculum.

Interactive session with CBDE Mentor Dr. Mita Tarafder.

Students have presented their progress through demonstrations of reassembled devices, concept notes for innovations, and early-stage prototypes. The initiative has enhanced student confidence, technical skills, and problem-solving abilities. Moving forward, there are plans to further mentor the students, integrate IoT-based healthcare solutions, and expand hands-on design activities in the academic framework.

The CBDE Program at CHST is steadily building a vibrant culture of innovation, hands-on learning, and entrepreneurship among the students and faculty.

Our Roadmap



Editorial Team

We cordially thank all the students, scholars, fellows, staffs and faculty members associated with the Centre for their support.