Issue No. 24

TURNING POINT

Tata Centre
Technology and Design, IIT Bombay

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Imparting healthcare training in the digital age

HEALTHCARE

The project aims to train healthcare workers in remote areas to create public awareness for cancer through customized awareness modules.

Screenshots of female health awareness modules

Technology advancements in healthcare are on the rise, but it is still a long way to make the technology available to a society devoid of resources and yet make living better. Keeping this problem in mind, Priyanka Nandy's team from Prof. Santosh Noronha's group from the Dept of Chemical Engineering, has aimed to work on building solutions which require technology to suit the remote areas.

It has been very clear that creating new clinical tools have had multiple legal barriers and hence developing pathology and imaging tools to be used as documenting and screening devices has been the objective. TATA Memorial Hospital is known for its efforts at community screening for oral, cervical and breast cancers. However, the doctors and their teams have had to travel long distances to train the health workers, which has resulted in less time being given to their clinics and OPDs. In this perspective, the project team looked at Gynaecam as one of the promising tools of telepathology, where the cervix sample is recorded and sent further for screening, to overcome this problem. An awareness module was created of a set of 10 videos in which one video was for the health worker to create cancer awareness and the remaining nine videos were to be shown to the community by the health workers. The training modules were so well-taken that they are also being incorporated by the State Government of Kerala in the Malayalam language, where trained health workers would deploy them in their neighbourhoods.

The major challenges that the team has tried to overcome have been the lack of knowledge about the medical terms and processes and in translating the modules into the local language. Social taboo about these health issue and poverty have been an inherent problems. The Government of India is working on rolling out non-communicable disease programs to tackle oral, breast and cervical cancer. The team from this Tata Centre project is hoping that these awareness modules will be the perfect blend to the supplementing the technologies that have been developed.

Vrushali Gardare,
Tata Fellow 2018-20

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Assessing MSW biogas plants

WASTE MANAGEMENT

The project team has tried to understand the challenges faced by biogas plants through a data collection exercise from field visits in Mumbai and Pune regions of Maharashtra.

Collection of biogas samples from the biogas plant at IIT Bombay

Checking the pH of digested/effluent in outlet tank of anaerobic digester

India is facing a major issue of municipal solid waste management due to urbanization and population explosion. Organic waste is a major fraction of municipal solid waste (MSW) and when dumped into landfills it has led to serious issues such as deterioration of water bodies with the leachate formation, and massive fires from the emission of methane as a result of anaerobic conditions and outbreak of diseases. Anaerobic digestion (AD) is considered as one of the most suitable treatment technologies for organic fraction of municipal solid waste (OFMSW) in India. A few biogas plants have been installed in India for treatment of OFMSW but the efficiency and working conditions of these plants are debatable.

Prof. Munish Kumar Chandel, Centre for Environmental Science & Engineering, and his team started to assess the performance of MSW based biogas plants in India, by data collection from the biogas plants through field visits in Mumbai and Pune regions of Maharashtra. The novelty of the project is that a standard protocol had been made for this assessment study which covers all the operational parameters. Apart from data collection, sample collection and laboratory analysis have also been done. The main objective here was to understand challenges faced by these plants or technologies, in particular, and try to come up with feasible solutions.

The major challenge for the project team has been inaccessibility to the operational data of the MSW based biogas plants and the lack of knowledge of the plant operators about the technology and standard operating procedures in judging the plant's working efficiency. The project team is simultaneously working on a laboratory scale semi-continuous anaerobic reactor to establish an optimum recycling ratio to reduce the freshwater requirement.

Since quite a few technologies have been covered in the field visits, a comparative study of these technologies and their suitability could be established considering various aspects such as cost, scale, local availability and maintenance. The outcome of this project - a white paper - could be further referred to while selecting the design for setting up new biogas plants, based on the technologies compared, or for designing an entirely new technology for anaerobic digestion.

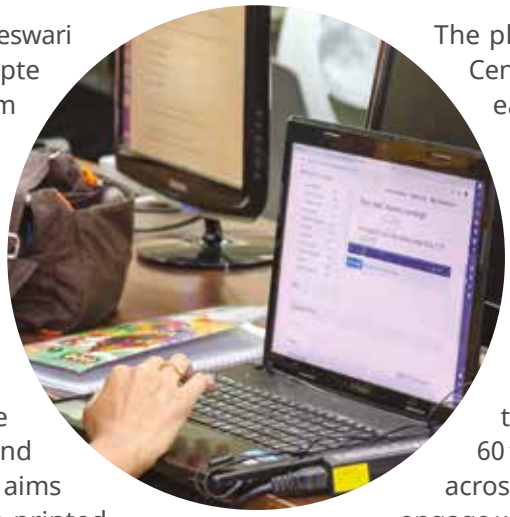
Shraddha Vekhande,
Tata Fellow 2017-19

Learning under the BodhiTree

EDUCATION

A virtual platform for improving learning outcomes using online interactive courses and assessed labs hopes to mirror the classroom environment

In a highly competitive job market, the state of engineering education in the country is reported as dismal with outdated curriculum to add to it. The engineering institutes have been known to be following a program of study that is rigid, static and less adapted to different learning environments.

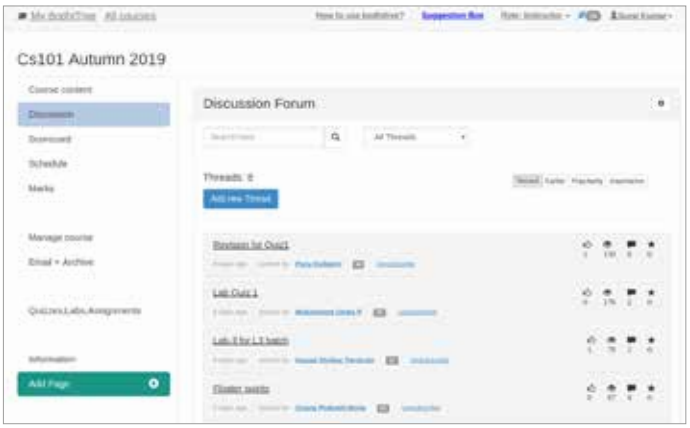


To make a difference to this, Prof. Kameswari Chebrolu along with Prof. Varsha Apte and Prof. Bhaskaran Raman and team from the Dept. of Computer Science & Engineering, are working on developing BodhiTree - a platform which is aimed at providing quality content while virtually mirroring a traditional classroom environment.

The core motive has been to present content that is relevant, can be updated and used by the faculty and absorbed by the students. The team aims to move the academic study from printed textbooks to multimedia books that will have updated syllabi, include assessment, and can be adapted to various teaching styles. Today, flipped classrooms are becoming a common feature worldwide, but the BodhiTree platform follows a method where there is a flipped classroom along with teachers taking classes and conducting activities in classroom as well. The teachers can feed in content from various open sources and create their own modules while the students can access, pause, assess and revisit the content as per their study styles and schedules. There is a feature where the TAs can review and grade the submissions. Overall, the entire ecosystem built here is inclusive as well as customizable for each user.

The platform has been supported by Tata Centre since 2017, even when work started earlier in 2014. Since then it has been used within the IIT Bombay campus across 20 courses as well as in some other institutes like NIT, Goa, VJTI, Mumbai and SVNIT, Surat. The team is now aiming at scaling up the platform and keeping it robust while course content is being added to the current framework. Recently, the project team selected and invited 60 faculty members from various colleges across India to a workshop in IIT Bombay to engage with the tool. More than 40 participants expressed interest in using it within their classrooms post the workshop and there have been about 150 signups since then. This interest has been encouraging and more such workshops are being planned shortly.

Sanjana Nanodkar,
Asst Manager, Media



Screenshot of the BodhiTree platform

A recent workshop for faculty members in IIT Bombay

Detecting Parkinson's early

HEALTHCARE

The project aims to develop a robust blood-based assay to detect the disease even before any movement or behaviour symptoms are seen.

Prof. Samir Maji, Department of Biosciences & Bioengineering, IIT Bombay

In an interview with Prof. Samir Maji Department of Biosciences and Bioengineering, he speaks of his project – Development of a sensitive blood-based biochemical assay for diagnosis of Parkinson's disease at the pre-motor stage

Q.1. Could you please give us your brief background about this project?

A. Parkinson's disease and Alzheimer's are already red-zoned in India and pose a big problem in the world too. Currently, imaging techniques such as MRI or behavioural symptoms are used to detect the disease. However, these imaging techniques are expensive while behavioural changes are seen at a much later stage. Hence, we aim to develop a blood-based assay in which Parkinson's disease can be detected at an early stage by a blood test.

Q.2. How does Parkinson's disease occur and what is your technology about?

A. Parkinson's disease happens due to a toxic protein aggregate named as α-synuclein deposited in the brain. These protein aggregates kill the neurons cells in the brain which lead to the disease. The protein aggregates α-synuclein cross the brain and enter the blood stream in small amounts and are thus difficult to detect. In our technology, we have developed a substrate which only aggregates in the presence of α-synuclein. So, we take the blood sample in a test tube and add our substrate to it. If the blood sample contains α-synuclein, only then will the

substrate amplify it. This is the novelty of our technology. As the protein aggregate amplifies, we can easily measure it and thus detect the presence of Parkinson's disease. We have tested six blood samples of patients diagnosed with Parkinson's disease and all of them have shown positive correlation till now.

Q.3 What are the challenges that you see at this juncture?

A. The first challenge is testing the assay on a greater number of patients. We want to test the samples of 40-50 Parkinson's disease patients for which we are collaborating with KEM hospital, to get a large number of samples. The next challenge is to work on the robustness of the technology on a lab scale. Currently, a series of assay tests are done where people have to work continuously for five to six days. The automation of this technology will require contribution from other engineering fields. Another challenge is to figure out whether the assay can be used for other neurological diseases such as Alzheimer's and multiple sclerosis or if it needs to be specific to Parkinson's disease only.

Q.4 How does this technology benefit the BoP segment?

A. Currently the available imaging techniques are very expensive. While our technology involving a blood-based assay may seem expensive now, once the technology is automated, it can be used by any local pathology lab and the costs will be significantly lower. The technology also works on the early stage detection of the disease. Patients usually reach the hospital when they face severe movement issues and nothing much can be done at that stage. However, if a blood test is available, a person taking a simple health check-up will be able to know if he/she has Parkinson's disease or not instead of opting for the expensive imaging techniques. As Parkinson's disease may cause a huge socio-economic burden to the family, the early diagnosis will not only help the patients to start their treatment early and halt further progression but also help the patient's family to plan better for the future.

Q.5 What are the action plans in the near future?

A. We look forward to testing of more blood samples of Parkinson's disease patients to test the robustness and specificity of the assay and whether it tests false positive for diseases like Alzheimer's. An important task in the future is the automation of the technology to make the technology simpler and cost-saving.

Vrushali Gardare,
Tata Fellow 2018-20

"The first challenge is testing the assay on a greater number of patients. The next challenge is to work on the robustness of the technology on a lab scale. Another challenge is to figure out whether the assay can be used for other neurological diseases such as Alzheimer's, multiple sclerosis or if it needs to be specific to Parkinson's disease only."

Setting up reaction mixture for PMCA assay

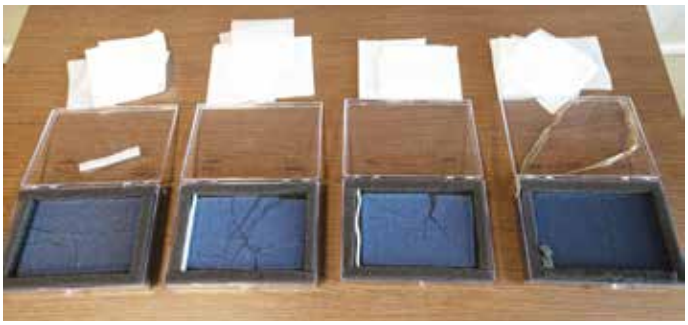
Substrate addition for PMCA reaction

Analysis of western blot assay

Generating steam using aerogel

ENERGY

The team looks forward to targeting the industrial steam requirement and surgical instrument sterilization with the use of aerogel in solar energy collection system.



Transparent aerogel for solar energy-based application

Recording experimental data using a data logger

Prof. Anish Modi and Prof. Shireesh B. Kedare from Department of Energy Science and Engineering, together with their students, have been working on using aerogel in solar energy-based applications. These include steam generation for industrial users and sterilization for surgical equipment. Aerogel is a light material and is about 95 per cent transparent in the solar radiation and opaque in the infrared region.

The technology works in the following manner: Solar radiation from the sun is absorbed by a flat plate collector which heats the plate up to 60-70°C. The reason for such low heating is that the amount of incident energy is almost equal to the losses encountered which are in the form of conduction, convention and radiation. The conduction losses are negligible and are typically prevented by using glass wool on the sides and bottom of the plate. A tempered glass with a high transparency of around 90 per cent is placed above the flat plate collector which creates an air gap between them. When the plate is heated, the air also gets heated which increases the convection losses. In order to prevent the convection and the radiation losses, the air gap is replaced by aerogel. Since both the glass and aerogel are highly transparent, the convective and radiative losses are reduced and the flat plate can be heated to high temperatures.

The typical heating temperatures required on the industrial scale range from 100°C to 250°C. Using the aerogel application, the team is currently looking to develop a system, which can generate steam or pressurized water up to 180 °C in industries. So, both the boiler and the solar based system can be used interchangeably depending on the seasonal conditions. The second major application that the team looks forward to work on is the sterilization equipment mainly for the off-grid areas and the refugee camps and disaster areas. Currently, for sterilization in areas with no reliable electricity, a cooker based system is used where boiled water is used to clean the surgical instruments. Unsafe in the long run, the target is to develop a sterilization unit based on aerogel application where saturated steam can be generated at 121 °C and 2 bar pressure which is required to kill the microorganisms.

Due to the daily and seasonal movement of the sun, it becomes necessary to track the solar radiation to capture maximum heat. Therefore, the team is also working on developing a compound parabolic structure for collection in which no or little tracking is required. However, the fabrication of this structure is a major challenge due to fewer suppliers. Another challenge encountered is the hydrophobic nature of the aerogel, and the interaction with moisture which causes it to collapse. Hence, an air-tight sealing system would be another challenge to overcome in order to avoid interaction with rain, moisture or any other source of water.

Vrushali Gardare,
Tata Fellow 2018-20

Accolades for Tata Fellows

Two Tata Fellows won accolades for work done in their respective projects and were suitably lauded.

Rohan Ohri wins Manudhane Best Thesis Award

Rohan Ohri, Tata Fellow from 2017-19 batch, Dept of Chemical Engineering, received the Manudhane Award for Best M.Tech. Thesis of the Chemical Engineering Department, as he completed his master's degree at IIT Bombay. His thesis was about a study on the jaggery making industry currently operating in a plant at Kolhapur, which utilises the floc-flotation method for sugarcane juice clarification. Rohan's work spoke of how the floc-flotation method is a batch process which has high dependency on labor and limits the scalability of the jaggery making process. The study on product and process development has enabled the use of the floc-settling method, a continuous process of sugarcane juice clarification, which reduces the dependency on labor and enhances opportunities for scale-up. A scaled-up plant for jaggery making offers the Indian sugarcane farmers an alternative mode to sustain their livelihood. The reduction of extreme conditions in the process of jaggery making gives the labourers involved better working conditions. To put the thesis report to shape, Rohan had planned to structure his research work, about three to four months before time. Constructive criticism from the peers and proofreading the final draft polished the thesis. Rohan believes writing is an art which develops from practice and writing articles for Tata Centre helped play a vital role in improving his skills.

Rohan Ohri, Tata Fellow 2017-19

Moiz Khan receives PhD Research Excellency Award

Moiz Khan, Associate Tata Fellow since 2017, received PhD Research Excellency award for the project on Process design for the reclamation of waste sand at the 3rd Youth Conclave organized by the Indian National Academy of Engineering. There were five broader categories, and among these categories he received the award in the Waste to Wealth category. The selection process for the award was quite rigorous with various screening levels based on presentations and interactions with the judges. This prestigious award looks for projects with potential in lab to industry translation. This award gives more emphasis to application-based projects that can have a larger impact on the industry. Along with this award, Moiz also received prize money worth 100 Euros that he could spend on books that would enrich his learning.

Moiz Khan, Tata Fellow 2017-19

Sneha Iyer,
PhD Tata Fellow 2018-21

News & Updates at Tata Centre

Reviews of ongoing projects completed:

The domain experts and EC members completed a comprehensive exercise of reviewing all 54 ongoing projects that have been supported by TCTD. The list of projects include seed, translational and white paper research projects. This exhaustive process has resulted in the updating of the Solution Readiness Level (SRL) chart, giving a better idea of the progress of most TCTD projects.

New patent applications:

Four new patent applications from TCTD projects have been reported in the past quarter of 2019. These come from the Centre's Food & Agriculture projects - Feasibility study of Jaggery making and related products (2) and Value Addition of Cashew Apple through Processing and Preservation, and Water project - Humidification dehumidification desalination system. A trademark application for the logo and word `Hindi Shabdamitra' has been made for the Education project - A digital aid for language (Hindi) teaching and learning.

TCTD Executive Committee retreat:

The members of the Executive Committee met over a day-long session to deliberate upon the progress of the Centre. The meeting included brainstorming on the vision for 2021 and 2024 that the EC had for TCTD, and the mission that would help achieve them. Various other agenda items were discussed over the day which included streamlining the Tata Fellows' selection process, restructuring of the ProSeminar curriculum, sensitizing the faculty members to work along with the TCTD mandate, modifying the Solution readiness level chart based on the recent completion of project reviews and effective use of the Centre's lab, media, outreach and administrative resources.

Workshop held on Tribal education:

As a part of the Policy to Practice Series, the next workshop titled - Tribal Education: Gaps in Current Policy and Practice – was organised in August, at IIT Bombay, by the Centre for Policy Studies, CTARA and Tata Centre. The main objective of this event was to identify the challenges in tribal education and translate then into research problems. With important speakers and august panelists, it was a well-attended event.

TCTD staff retreat:

The Centre staff went on a day-long retreat to share ideas on what could be action plans for change. The discussions and team-building activities brought a lot of thought to the table, and the staff is just raring to go.

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