

Indian Institute of Technology Bombay Celebrates International Day of Yoga 2020 Online

International Day of Yoga is celebrated throughout the world every year on June 21 to raise awareness about the benefits of yoga in daily life. Yoga brings balance between body, soul and mind. It helps us to understand the purpose of life and teaches us how to survive in the changing environment. Yoga is a 5,000-year-old physical, mental and spiritual practice that originated in India. **Yogastha, IIT Bombay** organizes regular yoga sessions, workshops, yoga competitions and various lecture sessions at IIT Bombay campus. The events are organized to help students, faculty and campus residents to live stress-free and develop healthy lifestyle. The sessions also help to nurture the yogic practice among the IIT Bombay community

Following events were organized by the Yogastha team in the run-up to International Day of Yoga:



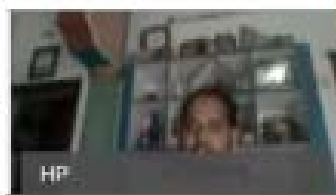
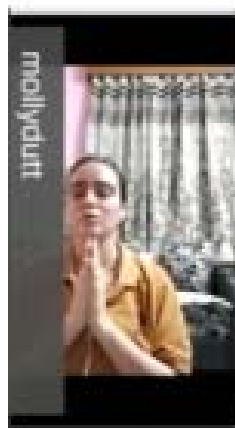
An “**Advanced Yoga Workshop**” was conducted during March 7-9, 2020 by Shammi'sYogalaya. **Ms. Shammi Gupta**, a lifelong yoga practitioner, has a M.A. in Yoga Shastra, Diploma in Yoga, Advance Diploma in Yoga and is director of Shammi'sYogalaya. The workshop covered various aspects of yogic management for joint pain and a special session on use of yoga props was also conducted which helps in improving flexibility, posture, build strength and balance. All the regular yoga practitioners learnt advanced yoga asanas during this workshop which will further be practiced in the regular morning sessions conducted by Yogastha. The workshop witnessed nearly 200 participants.

Yogastha organised a 3-day “**Ashtanga Vinyasa Yoga**” workshop from March 13, 2020. This workshop was based on the traditional Mysore style of ashtanga vinyasa method with the focus on asana alignment, technique, adjustments, back bending postures, hip postures, twisting postures, strength and yoga, meditation and pranayama. More than 150 persons participated in the workshop.



Due to lockdown imposed by competent authorities to fight Covid-19 pandemic, the following events were conducted online by Yogastha team using social media and other technologies:

- An “**online quiz series**” was conducted on the theme ‘origin of yoga and IDY’ during June 3-20, 2020 and several members of IIT Bombay community participated in it.
- A “**2-minute Yoga Challenge series**” was conducted during June 5-20, 2020. The participants were requested to post their pictures and videos of standing, sitting and on-spine asanas on social media platforms.
- “**Best yoga pose**” competition was conducted during June 15-20, 2020 consisting of balancing and stretching asanas. This event saw active participation from family members of students, faculty and staff members. The event comprised solo pose and group/ family pose categories to encourage the theme ‘Yoga with family’.
- A webinar series was conducted during June 19-20, 2020. **Dr. Raghavendra Balakrishna** conducted a webinar on June 19, 2020 on the topic “**Pranayama: principles, practice, and relevance during Covid 19 pandemic**”. Dr. Raghavendra Balakrishnan holds degrees in Naturopathy and Yoga (Dr. MGR Medical University) and Yoga and Molecular Biology (SVYASA Yoga University). The workshop begun with the physiopathology of COVID-19, and various exercises to help improve lung health, capacity and function. Different techniques of breathing exercises like ‘Anulom-Vilom Pranayam’, ‘Kapal Bharti’, ‘Bhramari’ and more were discussed.
- On June 20, **Dr. Madhusudhan Penna** conducted a webinar on “**Yoga @ home to boost immunity**”. Dr. Madhusudan Penna is a doyen of yoga philosophy, recipient of Sahitya Academy award from the Government of India, and an honorary D. Litt by the National Sanskrit University for his work in Yoga, Vedanta and Sanskrit Literature. A comprehensive talk on holistic practice of yoga was followed by in-depth discussion of eight limbs of Ashtanga Yoga and its benefits.
- **Slogan competition** on the themes **Yoga@Home** and **Yoga with Family** was conducted and



participants were encouraged to share their slogans on their social media platforms.

- **Poster making competition** on the themes **Yoga@Home** and **Yoga with Family** was conducted where the participants submitted either digital or painted/ sketched posters and were also encouraged to publicize them on their social media sites. School children of IIT Bombay employees actively participated in this event.
- IIT Bombay celebrated the sixth International Yoga Day on June 21, 2020. The event witnessed online participation of all the members of the IIT Bombay community including faculty, students, staff and their family members. **Common Yoga Protocol (CYP)** was organised in the morning (7:00 am - 8:00 am). This event started with the messages from the IIT Bombay Director **Prof. Subhasis Chaudhuri** and **Prof. T. Kundu**, Dean (Student Affairs) of the Institute. The flagship event of Yogastha on the eve of IDY, **Yogathon: 108 Suryanamaskar Challenge** was organised in the evening. Though the events were organized online, IIT Bombay community members participated enthusiastically and proved that fitness cannot take a back seat during tough times. The participants were encouraged to upload their videos to social network sites.

To continue the yoga related activities to the IIT Bombay community, a **Yogathon** cooldown session was conducted on the next day of IDY. The Institute and the Yogastha club are working towards virtual yoga classes after celebrating IDY.

The link to access photos of events is:

https://drive.google.com/drive/folders/1oIO_eCMf3C4CVISSOBo7ADXq8qJZkhz_?usp=sharing

All the recorded videos can be found at Yogastha's official youtube channel:

<https://www.youtube.com/channel/UCbQdsBUcM8bV2hMtI1PW42g>

QS Ranks IIT Bombay First In India



The Indian Institute of Technology Bombay (IIT Bombay) has secured the first position in India and 172nd rank in the Quacquarelli Symonds (QS) World University Rankings (2021) this year.

The results were released by QS, a British company on June 10, 2020. IIT Bombay ranks first in India, with an overall score of 46 out of 100. The Institute has a score of 50.4 in academic reputation, 74.2 in employer reputation, 53.1 in citation per faculty, 36.2 in faculty-student ratio, 3.9 in international faculty, and 1.6 in international students, all scores out of a maximum of 100 points. Among these six parameters, Employer Reputation is the strongest one for IIT Bombay.

Speaking about the ranking, the Director of the Institute **Prof. Subhasis Chaudhuri** said, *"While IIT Bombay is pleased to have retained the number one position in India, we strive to be competitive globally. The drop in global rankings is certainly something we are concerned about and it appears to be linked to the Academic Reputation (AR) portion of the rankings which constitutes 40% of the weight. AR is based on some kind of global survey done by QS. One is expected to show an improvement every year to keep at the same rank. IIT Bombay's AR score remained close to that of the past year resulting in a drop in ranking. IIT Bombay will explore ways of improving the AR score."*

He added, *"Additionally, there seems to have been a drop in faculty to student ratio, which we speculate may have been caused by an enhanced student intake last year related to the EWS reservation. As the trend of increased student intake via EWS will continue next year also, we are interested to see the effect of this on the rankings in subsequent years. Finally, while IIT Bombay appreciates the value of the data used for rankings, regardless of the actual ranking by any agency, we will continue to strive for excellence."*

IIT Bombay Continues To Impress in NIRF Rankings 2020



The Indian Institute of Technology Bombay (IIT Bombay) has secured fourth position in 'Overall' category, third position in 'Engineering' category and 11th position in 'Management' category of the National Institutional Ranking Framework (NIRF). The result of NIRF rankings was announced by the Hon'ble Minister of Human Resource Development, Government of India Dr. Ramesh Pokhriyal 'Nishank' on June 11, 2020.

The Institute obtained a score of 80.75, 85.08 and 65.76 in the Overall, Engineering and Management category respectively of the NIRF 2020. The parameters used for NIRF rankings include Teaching, Learning & Resources, Research and Professional Practice, Graduation Outcomes, Outreach and Inclusivity, and Perception.

The Director of the Institute **Prof. Subhasis Chaudhuri** said, *"IIT Bombay is pleased that we have been ranked as number 1 in India by the QS rankings and number 4 in India by the NIRF rankings. While rankings are one way to benchmark oneself, at IIT Bombay, we will continue to strive towards overall excellence and provide a valuable educational experience to our students"*.

Last year, the Institute was ranked 4th, 3rd and 10th in Overall, Engineering and Management category respectively of NIRF. The NIRF rankings were initiated by the Ministry of Human Resource Development, Government of India in 2015.

Students Make Face Shields And Masks For Mumbai Police

IIT Bombay salutes the corona warriors doing their duty in the time of the pandemic. A team of IIT Bombay students under the guidance of **Prof. Tapanendu Kundu**, Dean (Student Affairs) and **Prof. George Mathew**, Associate Dean (Student Affairs) donated face shields and masks to Mumbai Police on April 13, 2020. The face shields were created by students residing in hostel 10 and student task force members. This contribution in the time of need was a small gesture of gratitude from the institute to the frontline fighters protecting Mumbai city from the covid virus. The students who contributed to this drive include Nisha Chikkara, Gurpreet Singh Dhillon, Akshay Nair, Siddhant Patil, Sushil Kumar, Radhik Rammohan from the student task force and Amita Rawat, Twedeja Tariku, Jennifer Joseph and Ragini Saraswati from hostel 10.



Students making face shields and masks in the institute



Face shields made by IIT Bombay students



IIT Bombay students team donates face shields and masks to Mumbai Police

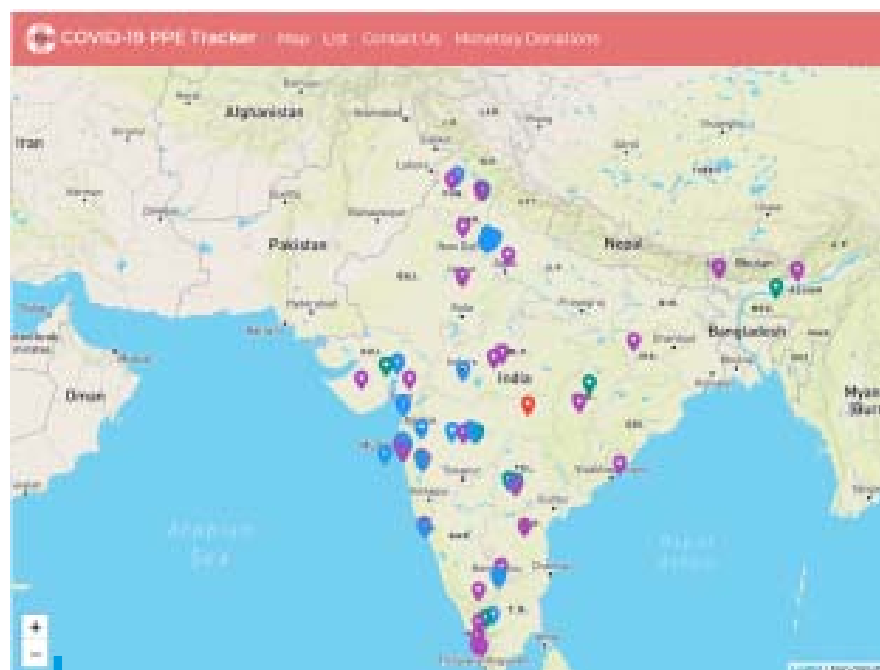
Students Develop Nation-Wide PPE Tracker Website

Looking at the overwhelming response of IIT Bombay's PPE (gloves and masks) donation drive, a team of students developed a website to provide a common platform in order to track PPE requirements and availabilities for the healthcare workers facing the scarcity of PPE. It has the details of the manufacturers of PPE along with donors.

The students registered at Coronathon 'India's COVID-19 online hackathon' and gave a demo to over 300 viewers with live streaming on Youtube. During the Hackathon, one of the panelists Dr Biju Jacob, India Director, UN Healthcare Innovation Exchange also addressed the audience about the PPE scarcity issue all over the world.

The website is initiated by three IIT Bombay students and one college resident. After the demo session, few other IIT Bombay students and few Coronathon participants joined the team.

Link to PPE tracker website: <https://www.ppecovid.in/>

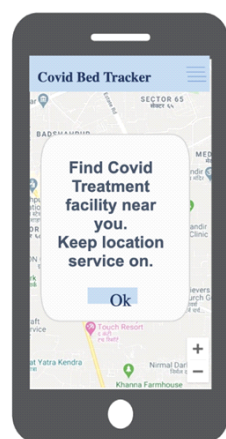


Screenshot of the website developed to track PPE kits requirement and availabilities

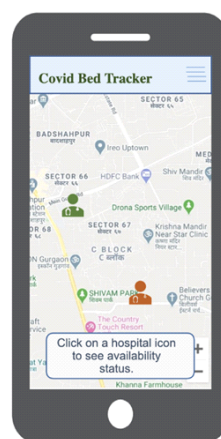
Hackathon On COVID-19 Helps Develop App For Public Use

A National Level Bio Informatics Online Hackathon on COVID-19 (Coronathon) was organised in May 2020. Students and faculty from all disciplines, start-ups, and all full stack developers in app and mobile responsive web development across India participated in the Hackathon to showcase their initiatives in digital technology to fight against the virus.

Anna University joined hands with the Spoken Tutorial project at IIT Bombay for the Hackathon initiative. All participants are expected to release their App for public use, but need not share their source code.

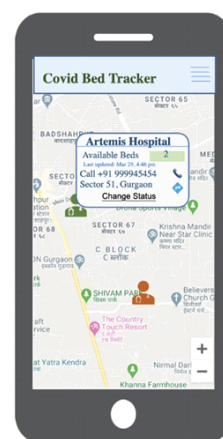


Home Screen



Covid-19 treatment facilities

Green color icons indicate facilities with available beds near the user.



Details about clicked icon

Lists bed availability status, essential info with clickable icons to call/see directions.

Hospital Availability Tracker to check which hospitals in near vicinity have facilities available and are not full.

The other organisers of the Hackathon were Madras School of Social Work, Derbi Foundation, Bangalore and Climate Smart Technology, Coimbatore. This activity is supported by AICTE, NSDC, Skill India, Startup India, Ministry of Skill Development and Entrepreneurship and Pradhan Mantri Kaushal Vikas Yojana (PMKVY).

IIT Bombay Researchers Develop Portable UV Sanitizer To Battle With COVID-19



UV sanitizer can be easily transported from one place to another to disinfect virus

A team of researchers from the Indian Institute of Technology Bombay (IIT Bombay) have developed a portable UV sanitizer to disinfect large areas where liquid based chemical disinfection methods cannot be used because of the presence of delicate items and electronic devices.

The UV sanitizer made by the researchers can be easily transported from one place to another to cover the entire area as well to cover shadow zones for complete inactivation of pathogens.

Prof. Ambarish Kunwar and **Prof. Kiran Kondabagil** from the Department of Biosciences and Bioengineering have developed this prototype and validated it for inactivation. The developed prototype has been given to IIT Bombay's hospital for sanitizing various objects used in the hospital. It can be used in an empty room/ area either by a remote operator or by an operator wearing personal protective equipment required for protection from UV radiation.

Further, Prof. Kunwar and Prof. Kodabagil along with other colleagues in Systems and Control Engineering Department and Industrial Design Center also plan to develop a robotic version of the portable UV sanitizer, which will be more efficient in disinfecting passenger seats of aircrafts as well as public transport systems such as buses and metros after disembarkation. It will be very useful for public places with high traffic such as airports, shopping malls, hotels etc.

NSS Initiates Mental Health Counselling During Lockdown

During the time of stress, maintaining good mental health is very important. A team of NSS started an initiative – QuarantENSIONed during the time of lockdown. The initiative was started in collaboration with Ms. Shivani Manchanda, Counsellor, to provide assistance to people suffering from any kind of mental depression or sickness due to a number of factors like uncertainty about their future as well as that of their loved ones, emotional disconnect with their friends etc.

Through this initiative, the team aimed to help people overcome mental stress which they may be facing during quarantine. The team advises people to make judicious use of social media and encourages them to utilize this time at home in the maximum productive manner possible. It was organized through the social media handles of NSS IIT Bombay.

Judicious use of social media and improving mental health: During the times of social isolation, staying connected electronically is the need of the hour for emotional well-being. It is very important to limit one's consumption of crisis news as these kinds of news can give stress and anxiety. It is best to fact check before forwarding news of any kind. Indulging in online board games is a great way to reconnect emotionally. Life is about building loving bonds with our friends and family.

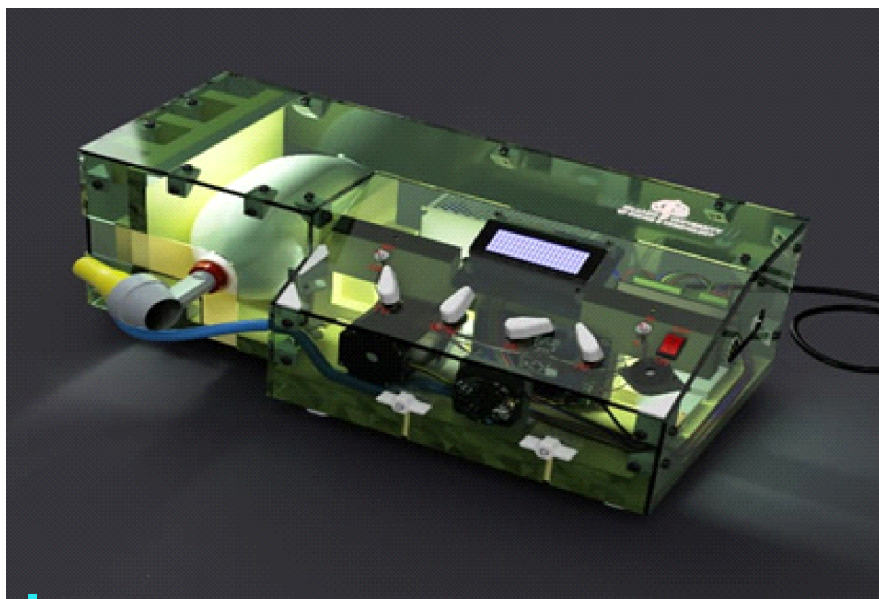


NSS initiates QuarantENSIONed to maintain good mental health during the lockdown

Productive utilization of summers by redefining one's routine: We are surrounded by boredom because we see learning as a chore, thinking innovatively as something we will do when we have that awesome job. Look at the world afresh and see how you can create a magical time for yourself. There are two ways of looking at learning – either a monochromatic way where we only do what we are required to plump our resumes or the other approach is to view learning in more diverse and eclectic (broad-ranging) ways. Instead of thinking like a victim at this point, it may be worthwhile to look around at the various learning opportunities around you and pursue them to the best of your capabilities.

IIT Bombay Students Make Ventilators In Kashmir Valley

Shortage of ventilator facilities for Covid patients remains a major concern. When IIT Bombay's student Zulqarnain went back to his hometown in Kashmir during the lockdown, he was concerned about the shortage of ventilators in Kashmir Valley. Zulqarnain formed a group of his batchmates from IIT Bombay and few others from DIC of Islamic University of Science and Technology in Awantipora to create a low-cost ventilator, which can be made using local materials. The first aim was to replicate some tried and tested design with locally-available material and this journey led in creation of their own design of ventilator.



Low-cost ventilator made using local materials in Kashmir

Along with IIT Bombay's student Zulqarnain, who headed the project, other students involved in the project are PS Shoib, Asif, Shakar Nehvi from Islamic University of Science and Technology in Awantipora and Majid Koul from National Institute of Technology, Srinagar.

Gloves And Masks Donated To BMC Hospitals

A team of students led by the office of Dean (Student Affairs) collected gloves and masks to donate them to Brihanmumbai Municipal Corporation (BMC) hospitals. On March 30, 2020, over 7600 gloves and 2990 masks were donated to the medical fraternity of BMC.

The collection drive was started in March by the Student Task Force members (Radhik Rammohan, Akshay Nair and Gurpreet Singh). Other students including Ms. Bhavya K and Ashwini G (PhD Students, Electrical Engineering Department) also contributed to the drive while being at home. Many faculty members contributed gloves and masks available from their labs and some family members of the faculty came together to hand stitch cotton masks.



Gloves and masks donated to BMC hospitals

The Dean of BYL Nair Hospital, Mumbai was contacted by the DoSA office to offer the collected PPEs. The medical fraternity appreciated the gesture and arranged for the pickup of the gloves and masks from IIT Bombay campus.

NSS IIT Bombay Breaks Language Barrier In E-learning

With an aim to eradicate language barrier in online learning, the team of NSS IIT Bombay initiated Open Learning Initiative (OLI), a YouTube channel in 2015. While the channel was open for the primary, secondary and higher secondary students to learn in nine different languages, it completed five years on May 8, 2020.

According to the team, they noticed that major learning material on digital platforms are available in English and a few in Hindi. The channel ideated by Yash Sanghvi, an Activity Associate of NSS, IIT Bombay, aims at providing free and quality education irrespective of the language barrier. The Youtube channel OLI has proved to be helpful for teaching in remote regions of the country. Through its dedicated efforts, it has become the first and the only Youtube channel in IIT Bombay to reach 100k subscribers milestone, the current count being over 113k. OLI

videos have also featured in Diksha app, an initiative supported by MHRD and led by NCTE in India.

The E-learning YouTube channel has a collection of over 350 videos from classes 6th to 10th in the subjects of Mathematics and Science in nine different languages - Hindi, Marathi, Gujarati, Kannada, Telugu, Malayalam, Tamil, Odiya, Bengali. It has been used as mediums of instruction to help students overcome the obstacle of language in learning. All the videos of the channel are under Creative Common Licence, implying they are free to use, share and modify.

The NSS, IIT Bombay team expressed, *"We are happy to see the love and response we got from the people over the years. We are currently planning to expand our playlists which will help students prepare for various competitive exams as well."*

IDC Innovates UV Sanitiser And Makes Masks To Fight Covid 19



A double-layered cotton mask used by security staff at the Institute's campus

With an aim to fight the coronavirus, the faculty and students from the Indian Institute of Technology Bombay (IIT Bombay)'s Industrial Design Centre (IDC) School of Design have developed a portable UV sanitiser and made double-layered cotton masks. The UV sanitiser can sterilize wallets, purses, and other small items that are passed on from hand to hand. According to IDC, the portable UV sanitiser is made using stainless steel kitchen containers and aluminium mesh.

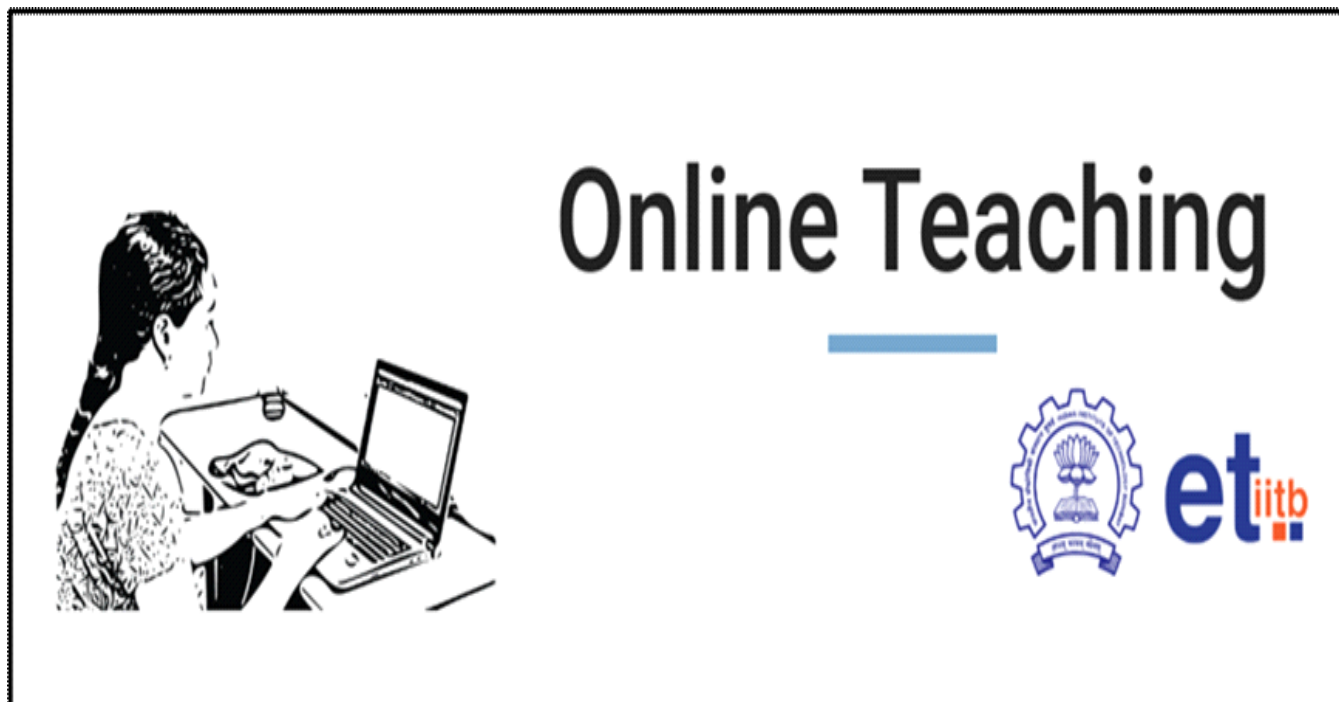
The cotton masks made by the IDC team to protect against the virus are double-layered and washable. The cotton masks were distributed among the IIT Bombay's security and hospital staff.

The portable UV sanitiser was made by **Prof. Ambarish Kunwar**, **Prof. Kumaresan** and **Prof. Purba Joshi**. The prototype was made using UV lamp, stainless steel and aluminium mesh and then tested. They took about 4 hours to make it. They have two prototypes currently and would like to scale it as much as possible.



A portable UV sanitizer made to sterilize small items

IIT Bombay Takes Steps Towards E-Learning Classes



As academic universities shift from face-to-face learning to e-learning mode during the COVID-19 pandemic, it is important that the e-learning mode is made effective and beneficial to the students. The Interdisciplinary programme in Educational Technology at IIT Bombay has created a self-paced course titled '*Online Teaching*' which will benefit faculty across the nation in understanding the intricacies of online teaching.

To address the questions of what, why and how of effective online learning, the course highlights on some key principles, concepts, tools and self-check questions to go beyond the mere online delivery of content. Research and practice-based evidence have been recommended for effective teaching and learning in this new medium of education.

The course is structured into multiple modules mapping to the possible actions of an instructor while creating and offering an online course. Realising one of the challenges of a faculty about how to exploit the power of the online medium and utilize it to promote effective student learning, the course talks about adapting the teaching style of the instructor in the online medium. A comprehensive plan is elaborated to aid the faculty in making critical decisions on synchronous vs. asynchronous modes, using his/her own teaching preferences on the online platform.

The course team introduced the participants to a learner-centric MOOC (LCM) model, which forms a

suitable conceptual basis of online learning. Mapping the components of face-to-face teaching with online instructions, the model comprises four key elements, including learning dialogs (classroom lectures), learning by doing (exercises and practice problems), learning extension trajectories (resources and references) and learner experience interactions (discussions and interactions). These elements make the E-learning more engaging and interactive for the students who are at the receiving end of this process.

Along with the pedagogical concepts, the course also entails varied technology tools with elaborate guidelines on online content creation, content delivery, interacting with students and assessment strategies. Additionally, the course allows an open discussion platform where faculty can share their queries, thoughts, experiences, resources to brainstorming on ideas, crowdsourcing of resources and learn from each other.

Attempting to assist thousands of faculty members to move to a new online medium in an effective manner is rather a challenging goal. However, the instructors of "Online Teaching" are off to a good start; the course website has had 16K page views (from 5K users) within days of its being announced. Thus, IIT Bombay is contributing to creating an effective world of online learning in academic institutes in India through such important national initiatives.

IIT Bombay Start-ups Develop Tech To Battle COVID-19



24X7 helpline to provide ambulance for COVID-19 patients

A few start-ups from the Indian Institute of Technology Bombay (IIT Bombay) have developed several novel technologies for frontline professionals and workers to effectively battle with the COVID-19 virus. Few of the technologies developed include contactless detection, hot spot monitoring, smart trolley for hospitals, real-time monitoring of logistics, rapid ambulance service and pregnancy care. Most of these technologies were developed during the nation-wide lock-down.

Dr. Aparna Rao, co-ordinator of various courses by Desai Sethi School for Entrepreneurship (DSSE) at IIT Bombay said, *"More than 25 start-ups including Augle, Adapt, CareNx, Faclon, HelpNow, JanYu, Phabio, R2MI and others were started by IIT Bombay students, who were inspired and empowered through DSSE courses and mentoring programs. We are proud to see them rising to meet the COVID challenges with fresh thinking and effective solutions."*

Developed technologies:

1) Tracking and detection in populated areas

Two start-up companies Augle AI and Faclon Labs have devised solutions for detection, tracking and localization in a densely-populated city. The

temperature sensing system developed by Augle AI skims through hundreds of people moving in public places. Tejendu Monali Kothappalli, head of the tech team stated, *"We are integrating this with our existing facial recognition system to strengthen the safety and security in offices, government buildings, public places, malls – any place where people gather in large numbers."* They also provide drone-based crowd analytics for quarantined areas for increasing the safety of police officials and health workers. Faclon Labs is working closely with BMC to install automatic plug and play screening devices that can be mounted on wall or tripod. They capture thermal snapshots of individuals and activate alarms upon detecting those with fever.

2) Robotic trolley to supply medicines in isolated wards

A robotic smart trolley with racks designed by the start-up JanYu Technologies is being tested in local hospitals. Dr. Om Singh of Lifecare Hospital, Vasai recommends the trolley with its WiFi-connected tablet screen and in-built camera for patient's interaction through live audio-visuals. These trolleys can be remotely operated for taking food, medicine, clothing and other critical supplies between isolation wards and supply units. *"Our company develops robots for hazardous workspaces. We modified these to meet the current requirements, and are delivering*

trolleys to hospitals in Hyderabad, Lucknow and Delhi,” said Sai Hemanth, founder of the company.

3) Customize PPE for frontline workers

Routetomarket Media India, which offers sales, distribution and media management services, is manufacturing customisable personal protection equipment (PPE) for healthcare professionals, law and order personnel and other frontline workers. Harsh Jain, one of the founders of R2MI says, “We are manufacturing about 5,000 PPEs per day and have pledged to donate 50% of them.”

4) Manufacturing face shields

Adapt Ideations provides Cloud-based platforms for real-time monitoring of logistics and delivery. They utilized their network to manufacture face protection shields with BSL-2 compliance for use by doctors, health workers and enforcement officials. 200 face shields were donated to Thane traffic police and 1250 were supplied to Aastha Pratishthan for Ratnagiri Police. More are in production to meet the requests from Andhra Pradesh police, Telangana medical authorities and Dharavi residents in Mumbai.

5) App to provide information on containment zones

A PhD student Farha Menon joined hands with Sukanya, founder of a bioplastics start-up called Phabio, to develop a community engagement project. Their Spot.Corona app provides a map for informed decisions on contaminant zones, by predicting the number of hidden and reported cases. It uses multiple sets of data including symptoms, detection, travel history and contact tracing to identify infection hotspots. This helps in deciding about increased tests, optimal isolation zones and localized lockdown.

6) Video series to counsel pregnant women

The pandemic poses questions for a vast range of people with various medical conditions, including expecting mothers and their families worried about

routine check-up, delivery and infection of new-borns. The CareNx team developed a video series and webinars called ‘Don’t Panic, Protect’ in partnership with renowned gynaecologists, doctors and counsellors. Their app is used by frontline workers to counsel more than 10,000 pregnant women in remote areas.

7) App to provide sanitized ambulance with ventilator facilities

The HelpNow start-up team developed an app called MedCabs, reducing the time required to get an ambulance to under 15 minutes. They are aggregating ambulances, mobilizing Uber drivers and giving them AHA-certified training as well as protective equipment. More than 350 such vehicles are currently moving on Mumbai roads, and have serviced over 9000 calls for help. The team launched a 24x7 helpline to provide sanitized ambulances with ventilators for COVID-19 emergencies and are helping the government to sanitize public places like CST, BKC and Dharavi.



Robotic trolley to supply medicines, food, clothing in isolated wards

Helpline For New Moms By IIT Bombay

A new initiative to guide mothers during the time of COVID-19 pandemic and lockdown situation was initiated by IIT Bombay. A toll-free helpline number 1800-267-7782 was started for millions of mothers who are stuck at home due to the coronavirus. The helpline was initiated to give expert guidance related to premature babies and undernourished infants, child nutrition, breastfeeding, mother's nutrition, complementary feeding.

All the queries are answered by doctors, nutritionists and field officers with more than 10 years of experience. The new 'Maa Aur Shishu Poshan' helpline number is initiated in different languages such as Hindi, Marathi, Tamil, Gujarati and English. An initiative of the Spoken Tutorial Project, IIT Bombay, this project is funded by the Ministry of Human Resource Development, Government of India in association with The Wheels Foundation.



माँ और शिशु पोषण हेल्पलाइन
Mother and Child Nutrition Helpline
Toll free (टोल फ्री)
1800-267-7782
Advice on maternal nutrition, lactation, child's nutrition by a team of doctors, nutritionists and field officers with 10 plus years of experience!
Health - Spoken Tutorial Project IIT Bombay
YouTube Channel: Health Spoken Tutorial - IIT Bombay
<https://health.spoken-tutorial.org>

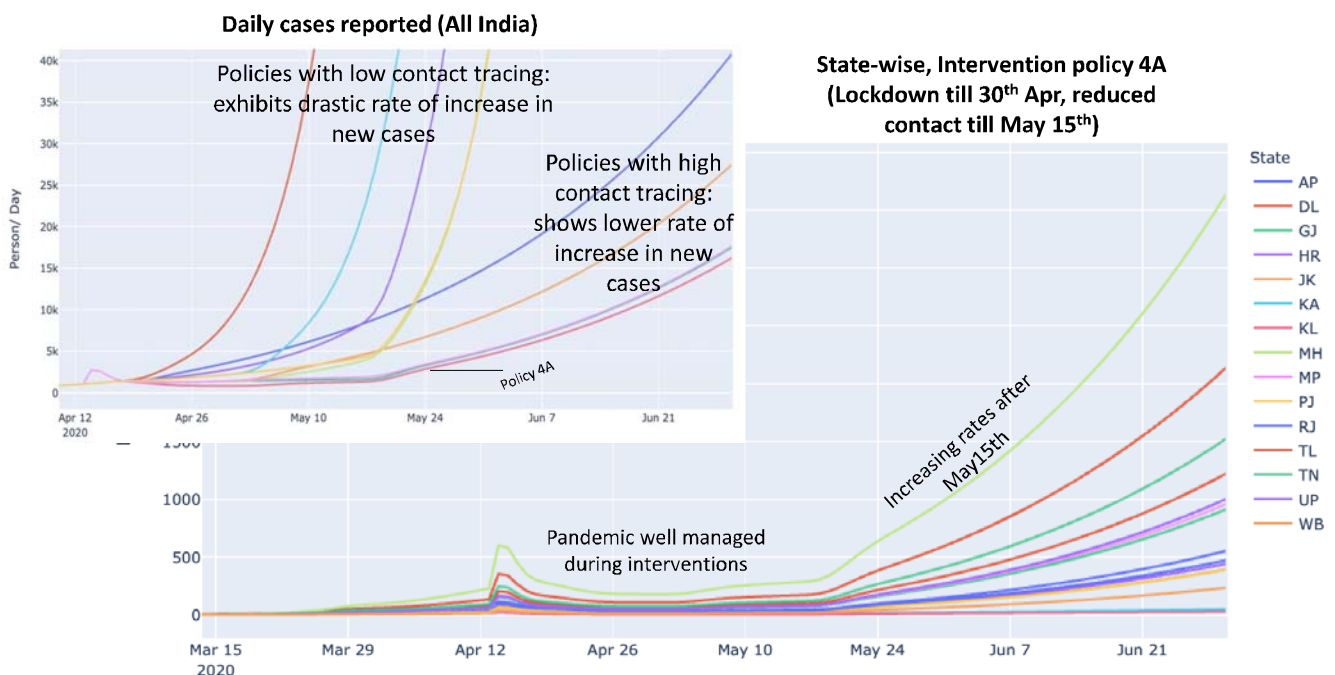
Studying Multi-Model Analysis Of Infectious Diseases

As per the suggestions made by the Additional Secretary of MHRD, Government of India, multiple research groups of IIT Bombay along with their collaborators came together to work on epidemiological prediction models and to understand the impacts of different interventions such as lockdown, increased rate of testing, etc. There is a

huge uncertainty across model outputs in terms of numbers, as expected. However, all models agree that lockdown helps when we have an increased rate of testing, tracing, and isolation.

The outcomes of the activities are summarized at <http://www.civil.iitb.ac.in/~covid19india/>

Effect of interventions



Estimating The Cost Of Lock-down Due To COVID 19 On Indian economy

COVID-19 has brought the entire country to halt and normal life has been hit. Given the nature of infection and uncertainty regarding the number of cases in India, social distancing and lockdown are the immediate solutions to save lives and hardships. However, this has huge repercussions on the Indian economy especially due to loss in livelihoods due to lack of economic activity. As the extent of uncertainty is large, a team of researchers looked into the impact of the lockdown on Indian economy at district level under various scenarios. The direct impact of COVID 19 is estimated on a) the marginal workers (casual labourers and workers involved in MNREGA), b) the consumption expenditure and c) the state domestic product (SDP). For the first two, latest rounds of NSSO survey data had been used. For the third, CSO data giving state-wise GSDP (gross state domestic product) estimates had been used. The estimates suggested that for an Indian economy of the size of Rs. 140.78 lakh crore (2018-19 estimates), the lost income to marginal workers is nearly Rs. 96,000 crore (0.68% of GDP) for two weeks lockdown. The impact would soar to Rs. 4,30,000 crore (3% of GDP (Gross domestic product) if lockdown persists for 2 months. The corresponding figures for lost

consumption expenditure is 0.56% and 2.24% respectively. Regarding lost GSDP due to lockdown, the figures are 2.87% of GDP and nearly 11% of GDP for a lockdown of 2 months.

To estimate foregone consumption expenditure, suitable assumptions have been made - complete drop in expenditure for entertainment, and travel and reduced expenditure for some activities. For calculation of loss in GSDP, some sectors would be affected immediately (hotel and restaurants), some with somewhat lag (manufacturing, financial services) and some will not be affected (public administration or utilities).

Author:

- 1) **Haripriya Gundimeda**, Professor, Humanities and Social Sciences, Indian Institute of Technology Bombay
- 2) **Vinish Kathuria**, Professor, SJM School of Management, Indian Institute of Technology Bombay

(with inputs from Nitin Lokhande, Gowtham M, Dhanyashree Bhuvandas. Research scholars, Indian Institute of Technology Bombay)

IIT Bombay Joins Hands With University Of Alberta For PhD Program

The Indian Institute of Technology Bombay (IIT Bombay) along with the University of Alberta, Canada has signed a Memorandum of Understanding (MoU) for a joint PhD program on January 31, 2020. The MOU was signed by **Prof. Subhasis Chaudhuri**, Director, IIT Bombay, and **Prof. David H. Turpin**, President, and Vice Chancellor, University of Alberta. The MOU will facilitate academic and student exchange where the participating students from both

institutions will be working on joint research projects for their doctoral degrees.

The program will lead to a renewed academic engagement between the two universities when the global pandemic eases up. Until then, IIT Bombay and the University of Alberta will continue to maintain professional links through digital platforms.

School Children Participate In Science Workshop



The Indian Institute of Technology Bombay in collaboration with Macmillan Education, Springer Nature India in partnership with KV IIT Powai conducted 'Science Communication Workshop & Budding Scientist Award' for school children at VMCC, IIT Bombay on February 1, 2020.

Prof. Sanjeeva Srivastava, convener of the event, delivered a lecture on 'Precision Medicine'. **Prof. Anil Kumar** delivered a lecture on 'Magic and Science'. Further, 10 teams selected from over 850 entries, including KV IIT Bombay team (Madhav Pillai, Tanisha Srivastava & Ishana Mukherjee) presented their projects and displayed innovative science and technology projects.

Two IITs Study The Changes In Travel Patterns During Pandemic

Researchers from IIT Hyderabad and IIT Bombay joined hands to study the changes in travelling patterns during the COVID-19 crisis. The study made via an online survey revealed that the awareness level about the pandemic is higher in Tier-1 cities as compared to Tier-2 and Tier-3 cities.

More than 1,900 participants participated in the study. Researchers have studied the impact of COVID outbreak on daily commuting during the transition phase between pre-lockdown and the lockdown period. According to the researchers, the lockdown decision taken by the Central Government has decreased risk of exposure to the coronavirus, as there is a decrease in crowded settings observed in public transport such as buses, metro and trains. This study is useful in understanding the decision-making behaviour of commuters while selecting their preferred mode of transport during a pandemic like COVID-19.

This study analyzed travel and visit behaviour changes that occurred during the third week of COVID-19 outbreak in India. The data related to daily commute and visit behaviour was collected through an online questionnaire survey.

According to the study, in Tier-1 cities, around 12% of the respondents switched from public to private mode during the third week of COVID-19. This modal shift was about 9% in Tier-2 cities and about 7% in Tier-3 cities. Moreover, nearly 48% of people said that they did not travel to work during the third week of March, whereas 28 percent had the same frequency of travel to work. When enquired about cancellation of trips between the cities using major mode of transportation, around 18% said they cancelled their flights whereas 20% of respondents cancelled train journeys. This indicates that the

awareness about COVID-19 is higher in Tier-1 cities, followed by Tier-2 and Tier-3 cities.

Emphasizing on the importance of the study in shaping relevant policies related to COVID-19, **Dr. Digvijay S. Pawar** said, *"Given the uncertainties in the minds of the commuters regarding their travel behaviour due to social distancing, it is important for policymakers and local transport authorities in general to understand the change in travel pattern."*

The researchers received a majority of their response from Tier-1 cities (63.6 percent) followed by Tier-2 (20.6 percent) and Tier-3 cities (15.8 per cent). The research team comprised **Dr. Digvijay S. Pawar** and **Dr. Pritha Chatterjee**, Assistant Professors, Department of Civil Engineering, IIT Hyderabad and **Prof. Nagendra Velaga**, Department of Civil Engineering, IIT Bombay and **Mr. Ankit Kumar Yadav**, research student, IIT Bombay.

Elaborating on the upcoming studies being planned, **Dr. Pritha Chatterjee** said, *"We are also trying to understand the effect of COVID-19 on transportation-related emissions. The data on reduction in vehicle miles travelled and vehicle type will be used to quantitatively model the reduction in traffic related emissions."*

The respondents were also enquired about their safety perception towards the use of public and private modes of transport, where 93% said that private mode of transport is safer compared to the public mode. The researchers recommended spreading more awareness about the ill-effects and spread of COVID-19, especially among the weaker sections of the society. The rapidly changing diaspora of this pandemic is a threat to public health and is making human life more challenging.



Dhruva – IIT Bombay's New Navigation Star

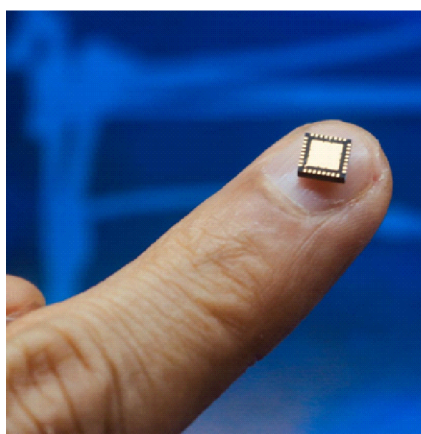
In the era of smart devices and IoTs, navigation is one of the essential features that we use in various commercial and personal applications. It has changed the way we travel from one place to another and the way we explore an unknown neighborhood.

A team of researchers from IIT Bombay have designed *Dhruva*, a navigation receiver RF front-end integrated circuit (IC, chip) primarily targeted for Standard Positioning Service (SPS) in civilian applications provided by NAVIC and GPS.



Team Dhruva

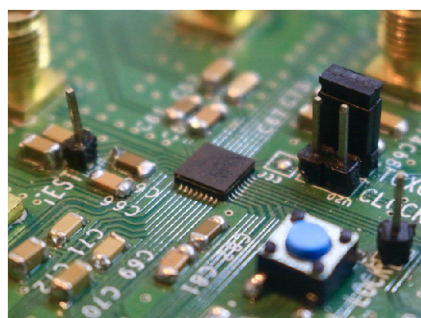
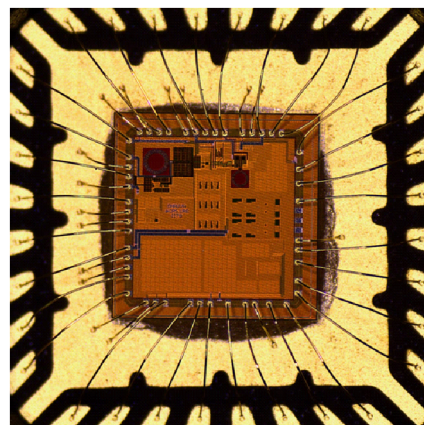
Since the satellites are far away from the Earth (Ex, NAVIC 36,000 km), the received signals are extremely weak compared to the ambient noise floor. This chip can clean up all the interfering signals, sifting out the weak desired navigation signals. The digital data from *Dhruva* can then be further processed by any standard digital signal processor to determine one's location accurately.



The *Dhruva* IC is capable of tuning to the navigation signals transmitted at multiple frequencies. Further, the IC can be tuned to frequency bands occupied by other worldwide navigation systems, making it a truly universal solution. The chip with die-size 1.8 mm x 1.8 mm, is developed as a production-level IC with ESD protection, on-chip testing, and reference circuits operating from -40 to 100 °C. The chip can be programmed by an external controller through the SPI interface.

Dhruva chip is entirely designed by Ph.D. and M.Tech. students working with **Prof. Rajesh Zele** at IIT Bombay. As part of the class project, he floated design topics that will make an impact for India.

The goal was for students to gain insights into advanced RF/Analog IC design using the best industry practices. The students showed tremendous excitement following which the NAVIC RFIC design team was initiated. The team members included - Vijay Kanchetla (team leader), Santhosh Khyalia, Ajinkya Kharalkar, Shubham Jain, Swetha Jose, Jeffin Joy, Syed Hameed, Mukul Pancholi, Sumit Khalapure, Amitesh Tripathi, Pawan Khanna and Sakshi Vastrad.



It took about 18 months to design the complete IC from the ground up incorporating various innovative ideas and to send it for fabrication in 65nm CMOS technology. Just before lockdown started, the IITB team was able to successfully verify the IC functionality with GPS signals.

The project is funded by the Ministry of Electronics and Information Technology (MeitY), India, with SAMEER as nodal agency. The team has been interacting with SAC-ISRO for specifications of the IC. The future plan of the project is to develop an advanced version of *Dhruva* with many additional features and a substantially smaller footprint. Once the Indian government mandates the use of NAVIC, *Dhruva* can be integrated into mobile and commercial applications.

BDPM-2020 Workshop Held At IIT Bombay



Group photo after the BDPM 2020 event

The advancements in omics and big data analysis have been phenomenal over the last decade with several promising high-throughput technologies emerging at the forefront of various applications. Owing to the rapid advancements in state-of-the-art omics technologies and introduction of machine learning tools, continuous expansion of our scientific understanding, and challenges associated with data analysis, it has become essential to keep up with current trends and advances in the field. In this light, Big Data and Precision Medicine

workshop (BDPM-2020) was conducted at IIT Bombay from March 3 to March 7, 2020. Scientists and researchers from India and UK shared their expertise to build new collaborations and partnerships between both the countries in translational research.

The conveners of the event were **Prof. Sanjeeva Srivastava**, IIT Bombay, India and **Prof. Graham Roy Ball**, Nottingham Trent University, UK. Clinicians contributed to the issues being faced currently in various cancers like ovarian, breast, cervical, brain and others, along with infectious diseases like tuberculosis and malaria. This provided researchers and scientists great ideas to work on various collaborative projects on infectious diseases and cancers.

Hands-on sessions for proteomics sample preparation, Mass spectrometry-based label-free, labeled (TMT/iTRAQ) and targeted proteomics sessions were intensive but very useful. Participants were given training for metabolomics, genome sequencing basics and data interpretation.

Further, an Indo-UK brainstorming session was conducted to bring great minds of the fields (researchers, academia, industry, clinicians and policymakers) together to conceive collaborative project(s) and initiatives to make a common database for big data handling, which could be shared with the community.



Workshop conducted to train young faculty and researchers during BDPM 2020

Research in focus

A Hardware Neuron To Help 'Brain-like' Computers Solve Difficult Problems

Researchers develop a powerful stochastic neuron, like those in our brain, using random access memory to aid breakthroughs in artificial intelligence

In 2013, Amazon, the world's biggest online retailer, announced its Amazon PrimeAir service, where drones, flying to your doorstep, would deliver your package in under 30 minutes of ordering. Fascinating? If reports are true, this service could be only a few months away. Advances in machine learning technologies have made innovations like automated drones, which need no human intervention, a reality. While software engineers are coding artificial intelligence into computer programs, building the 'brain' behind such technologies, hardware engineers are revolutionising the silicon chips on which these robust programs run.

An active field of research in machine learning is neural networks — a set of algorithms that work like the neurons in our brain and recognise patterns in data. While these algorithms are powerful, they have some limitations. "Today, a lot of neural networks are focussed on software that runs on the cloud, which have ample energy to work as they are supported by dedicated server farms. However, when these algorithms are used in building self-driving cars or drones, these neural networks have to work on small, mobile devices and have to be energy efficient. This puts focus on neural network hardware," says Prof Udayan Ganguly from the Indian Institute of Technology Bombay.

In a recent study, Prof Ganguly, his students, and collaborators from Intel Microarchitecture Labs, Bengaluru, have designed one such hardware, a type of Random Access Memory (RAM), for neural networks. The study, published in the journal APL Materials, was funded partly by the DST Nano Mission and Ministry of Electronics and IT (MeitY). The work had contributions from a mix of undergraduate and postgraduate students and faculty at IIT Bombay, as well as R&D engineers at Intel.

Most computer hardware designed in the past few decades have a set of circuits whose outputs are deterministic and digital — either a '0' or a '1'. An example of this could be a logic gate, used in most digital circuits, where if you know the input, the output can be determined accurately. This type of hardware served well with simple programs like counting. However, complex problems, such as searching for an optimal route for a drone, need programs that are stochastic. They need to estimate each possible output with some statistical probability. The hardware, in accordance, also needs to switch from being digital to analog to provide that stochastic ability.

In the current study, the researchers have proposed the design of resistive random access memory (RRAM) to enable stochastic neurons. They have considered a theoretical framework of neural networks called a Boltzmann machine, which consists of a network of such neurons. "A Boltzmann machine can enable everyday tasks like image, voice and pattern recognition," says Prof Ganguly. "The stochasticity in a Boltzmann machine results in the ability to statistically estimate the output, which is unnatural for deterministic machines," he explains.

The new RRAM, built using a crystalline manganite ($\text{PrxCa}_{1-x}\text{MnO}_3$), is called PCMO RRAM or a memristor. It is essentially a memory device, whose state is stored in its resistance. For example, the PCMO RRAM could be a resistor with either a high resistance state or low resistance state. A positive voltage causes the resistance state to switch from high to low. This switching is random, and depends on the voltage provided. What is fascinating here is that the neurons



in our brain too work similarly. They fire, or send an impulse probabilistically, based on the potential difference between the cell membrane and the axon or the tail. Such a neuron, designed as a hardware, enables a Boltzmann machine.

The researchers then tested their PCMO RRAM by solving a class of search optimization problems that are thought to be difficult to solve computationally. "The possible number of solutions for such problems grows very steeply as the size of the problem increases. For example, given 'n' number of persons, finding how many social groups of different sizes can exist is a difficult problem," explains Prof Ganguly.

Conventional computers, which are deterministic in nature, would need to evaluate every possibility to find the best solution. The larger the number of possibilities, the more tedious the search task. In comparison, the Boltzmann machine has all the stochastic neurons connected in parallel. When they exchange information by spiking randomly, they eventually reach a specific steady state spiking pattern that indicates an optimal solution, like finding the ultimate answer without the need for a full search. The specific steady state spiking is the lowest energy state of the network. Hence, the network spiking always finds ways to reach this state. This is akin to water flowing downhill or bubbles floating up, where there is a spontaneous change to reduce energy. "To harness this process, we can set the interactions of these neurons in a specific manner such that the steady-state is the solution to a specific problem," says Prof Ganguly.

The study compared the performance of the newly-designed PCMO RRAM with that of a conventional silicon-based hardware, which produces analog and digital signals, in solving the optimisation problem. They found that their hardware design solves the problem with 98% accuracy and needs just one-tenth of the area of conventional semiconductor-based hardware. Its power efficiency was also four times better. "This implies that a Boltzmann machine chip, based on PCMO RRAM, may be computationally more powerful and energy-efficient," says Prof Ganguly.

The study demonstrates the cutting-edge research work underway in India's institutes. The researchers have also filed for a patent on this work. "The devices are in the experimental state presently, but the chip design needs to be implemented. Such systems are of great commercial interest and would be interesting for high-tech start ups," says Prof Ganguly, before signing off.

Article written by: Spoorthy Raman

Link to the article: <http://www.iitb.ac.in/en/research-highlight/hardware-neuron-to-help-%E2%80%99brain-%E2%80%99computers-solve-difficult-problems>

Research At IIT Bombay Recommends Decentralized Infrastructure Approach And Low-cost Interventions To Improve Piped Water Supply In India

Indian cities and rural areas are currently facing challenges with having adequate water both in terms of water quality and quantity. Over all 70% of households in India have tap water connections and only 18.33% of the rural households in the country have tap water connections. The water supply to these taps is intermittent which ranges from 30 minutes to 12 hours of supply duration throughout the country whether it's a rural or urban area. As per the Ministry of Housing and Urban Affairs benchmarks water is expected to be supplied as 135 liters per capita per day in a 24x7 continuous manner in urban areas.

To improve this situation, the Government of India is making tremendous efforts through various programs for infrastructure development in urban areas such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Smart Cities Mission. While in rural areas recently, the Ministry of Jal Shakti, Government of India announced Jal Jeevan Mission (JJM) to provide functional tap water to every rural household by the year 2024 (JJM, 2019).

Although these programs are targeted to improve the water supply infrastructure there is no big change in the way basic issues in these infrastructures are being addressed considering prevailing intermittent water supply. Such intermittent supply of water leads to problems such as unequal pressure and hence distribution of water, increased leakages, increased wear and tear of the system and negative pressures leading to increased chances of microbial contamination. There are many causes of intermittent water supply which can be categorized in to political, social, economic, natural, and technical. The major drawback of intermittent water supply in India is a deterioration in the water quality and increased Non-Revenue Water (NRW), which is water that is taken (through gravity or pumping) in to the system but not accounted for. Many cities in India have NRW of about 30-45%, out of which 20-30 % is an actual physical loss. Hence, some efforts are being made by few of the cities and towns in India to convert the intermittent water supply to 24x7 Continuous Water Supply.

In this context, the research group of Prof. Pradip Kalbar at the Centre for Urban Science and Engineering (CUSE), IIT Bombay has focused the research on identifying problems in the water supply systems in India and identifying interventions for the improvements of intermittent water supply and then developing strategies for achieving 24x7 Continuous

Water Supply in low investment. The main finding of the research is that the design assumptions do not match with ground reality and there is a practice of centralized infrastructure creation. To address this Prof. Kalbar has recommended a decentralized infrastructure approach and low cost interventions such as shafts, manifolds, and masterpieces which will help in fixing the operational problems.

The interventions recommended by Prof. Kalbar do not require major investments and hence recently these interventions are adopted by the Ministry of Jal Shakti for implementing in the Har Ghar Jal program under Jal Jeevan Mission in rural and pri-urban areas. The research is conducted by collaborating with government officers and city water supply departments. These recommendations also need to be taken up by all the cities and towns as these interventions are also very useful for improving water supply systems in urban areas.

However, rather than focusing on fixing the basic problems in the water infrastructure through such low-cost interventions, cities and towns in India are attempting to achieve 24x7 Continuous Water Supply directly with huge investment through various state and central government funds. The deteriorated status of the water supply infrastructure in Indian cities is not encouraging for directly going for a 24x7 Continuous Water Supply. Indian cities trying to achieve a 24x7 Continuous Water Supply need to have some basic preparation such as the reduction in physical losses less than 15% and NRW less than 20%, improvement in supply hours, reliable revenue generation. These basic achievements will be conducive to the conversion. However, some cities are in such a state that the problem of the depressurization of the system, along with an intermittent water supply, is highly prevalent. There is uncontrolled water withdrawal from the consumers, hence consumers tend to consume (or even waste) as much quantity of water as received from the household connection. The wastage of water from the consumer end happens because in many cities telescopic water tariff policy is not being implemented, and for higher income group households the water charges are not pinching.

Without considering these facts, the Indian and foreign consultants, automation solution provider companies, electro-mechanical equipment manufactures, and commercial software solution

providers keep convincing the politicians, governmental bodies and city administrations in India to directly implement 24x7 Continuous Water Supply. The solutions proposed by them do not consider the ground reality and such efforts are destined to fail. All these players do get business with such an exercise of pilot/full scale efforts of 24x7 Continuous Water Supply; however, the situation on the ground does not improve, as most of the cities and rural areas are not prepared from the infrastructure status and consumer behaviour points of view.

One of the main reasons for not being able to achieve the 24x7 continuous water supply in India is that the water supply systems are not operated as designed i.e., there exists a gap between the demand pattern considered for the design and the one that actually gets applied during the operation. This causes pushing towards operating the system in intermittent water supply mode. The intermittent water supply leads to unbalanced pressure in the distribution network, hence unequal provisioning of water. Also, there will be increased wear and tear of the system causing higher leak rates, consumers are forced to store more water and forced to start mal-practices such as using small pumps on the service connections as system reliability decreases.

Hence, the government and cities should first focus to achieve consumer satisfaction through improved intermittent water supply and bringing equitable distribution, rather than going directly for 24x7 Continuous Water Supply.

One of the major reasons for the failure of urban water supply in India lies in creating centralized infrastructure, in particular, large-scale storage tanks. For example, typically, the sizes of the storage tanks in cities vary from 10 –100 Lakh liters or even larger in metro cities. Sometimes, these storage tanks are located in the same location in the city, as land is not made available for these tanks which are of critical purpose. This creates two issues. First, the operator, over a period of time, assumes that there is infinite storage for utilization and any convenient operational schedule can be used to operate the zones. Second, as a huge amount of storage is available in one place, the city engineers/administrators start expanding the

network in any direction indiscriminately. Often, local politicians interfere with the operation schedule and demand for expansion of the network. This creates a huge unmanageable network under each of the storage systems in most cities in India.

The unmanageable and untraceable water distribution network created under such conditions leads to illegal connections, mixing of operational zones of storage tanks, an increase in leakages owing to the difficulty of maintaining and tracing the leaking pipes, rise in NRW. This shows that the large-scale centralized infrastructure approach leads to the failure of water supply systems in India.

To overcome this situation Prof. Kalbar has proposed a decentralized infrastructure approach through the use of small multi-outlets tanks, shafts, and manifolds. This work is recently published in the international peer reviewed journal and demonstrates that tank sizes of 1 to 10 Lakh Liters depending up on population density are sufficient in most of the cities in India. Specifically, small scale multi-outlet tanks offer segregation of service zones and the same pressure is available at the start of each outlet. If creating a small-scale tank at the center of the serving areas is not possible then another low-cost intervention such as shaft can be used to resolve this problem. Shafts will serve as hydraulic separators between subzones. Further manifolds can be used at the transmission side or outlet of storage reservoirs to match the design flows and improve the service delivery. Manifolds will achieve a controlled water supply at various stages of the water supply systems. These simple low-cost interventions will help to achieve water supply operations with minimal need for human intervention and will avoid the current trend of use of costly automation. The proposed decentralized approach of infrastructure creation will help in achieving successful water supply systems in India, in intermittent as well as 24x7 continuous modes.

Let's hope that these low-cost interventions recommended by the IIT Bombay encourage urban and rural areas in India to improve the water supply situation in India.

Author:

Dr. Pradip Kalbar, Assistant Professor, Centre for Urban Science and Engineering (CUSE), Indian Institute of Technology Bombay, Powai, Mumbai

Research Paper reference:

Kalbar, P., & Gokhale, P. (2019). Decentralized infrastructure approach for successful water supply systems in India: use of multi-outlet tanks, shafts and manifolds. *Journal of Water Supply: Research and Technology-Aqua*, 68(4), 295-301.
<https://doi.org/10.2166/aqua.2019.158>

Drop In Rainfall, Not Rising Temperature Behind Recent Crop Loss In Marathwada

A study led by IIT Bombay reports recent rainfall deficit rather than temperature rise, and cultivation of cash crops as the primary reason behind agrarian crisis linked with farmer suicides in Marathwada.

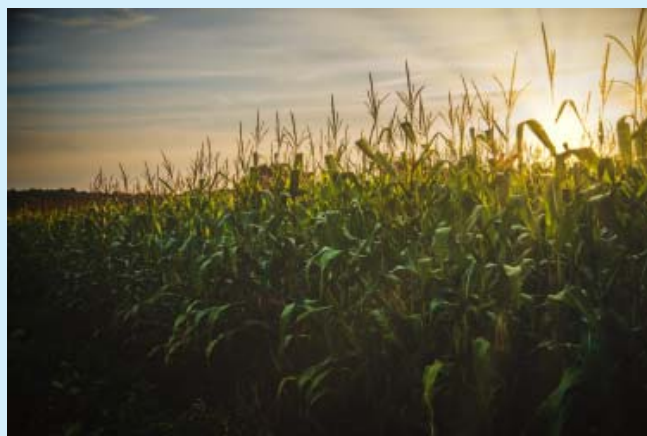
Maharashtra's Marathwada continues to remain a hotspot of agrarian crisis in India with rising number of farmer suicides every passing year. More than a hundred farmers ended their lives this year in May, while the rest of the world was reeling with the coronavirus pandemic. Earlier, severe droughts in 2014 and 2015 had led to massive crop loss resulting in a spike in farmer suicides in the country, with the state leading the numbers. A recent study led by the Indian Institute of Technology Bombay looked at the possible causes of such crop loss in recent years. The study reveals rainfall deficit, and not rising temperature as the primary driver, along with increasing tendency among farmers to grow profit-earning cash crops as opposed to drought-resistant food crops native to the region. Two such cash crops of the Kharif season are sugarcane and soyabean, large consumers of water. The study is published in the prestigious international journal *Environmental Research Letters*.

"There was a study in 2017 by a USA-based researcher that claimed rising temperatures as the foremost cause of farmer suicides in India. While that study was important, its overarching conclusion needed to be validated regionally, using more robust statistical and process-based crop models," says Arpita Mondal, lead investigator, Civil Engineering, IIT Bombay. "It is startling to note that cultivated areas under water-intensive cash crops such as sugarcane and soyabean have gone up in recent years that also coincide with low rainfall", added Mariam Zachariah, PhD student in Civil Engineering, IIT Bombay. "To understand the sensitivities of fourteen different crop types to rainfall and temperature, we used both advanced statistical models, as well agricultural process-based crop models," Mariam added. The study uses publicly

available district-wise agricultural data from government sources and meteorological data from the IMD and international consortium of climate models. Sorghum and pearl millet, the two native drought-resistant food crops are being cultivated less in recent years, the data shows.

"It is important for us to investigate which of rainfall or temperature would play a major role as we move further into a warmer future under climate change. Therefore, we not only study the recent past, but also consider future scenarios of 1.5 and 2 degree Celsius warming above pre-industrial levels – the two targets from the Paris Accord", explained Arpita. Though the study reports rising temperatures in future in this region, they are not expected to go beyond crop damaging thresholds. "Our study brings back the focus on rainfall and its supreme importance in governing agriculture in India, even in the context of global warming," she added. Whether the decline in rainfall is linked with global warming needs to be investigated further. "Nonetheless, strategies on promoting food crops in the region with correct agricultural practices offer a potential way forward for the crisis-ridden Marathwada region. Such actions will be beneficial for addressing immediate farmer concerns on one hand, and impending threats to food security in the long-term on the other hand", the researchers concluded.

About the authors: **Mariam Zachariah** is a research scholar in the Department of Civil Engineering at IIT Bombay, Mumbai. **Arpita Mondal** works as an Assistant Professor in the Department of Civil Engineering and Interdisciplinary Program in Climate Studies at IIT Bombay. Other authors include **Mainak Das**, Research Scholar in the Interdisciplinary Program for Climate Studies, IIT Bombay; **Subimal Ghosh**, Professor, Department of Civil Engineering and Interdisciplinary Program in Climate Studies, IIT Bombay and **Krishna Mirle Achuta Rao**, Professor, Centre for Atmospheric Sciences, IIT Delhi.



Prof. Saurabh Lodha Receives Young Career Award in Nano Science And Technology For 2020

Professor Saurabh Lodha from Electrical Engineering, IIT Bombay has received the Young Career Award in Nano Science & Technology for 2020 instituted by the Department of Science and Technology (DST), Government of India. This award recognises his pioneering contributions in the development of logic transistor technologies beyond silicon and nano electronic devices based on two-dimensional *Van der Waals* materials.

Prof. Lodha's recent work in the area of advanced transistors has been driven by strong industry partnerships. He has worked closely with Applied Materials Inc., the world's largest semiconductor equipment manufacturer, for the last eight years on technological challenges plaguing beyond-silicon transistors - the workhorse device that fuels over 90% of all electronics. Specifically, he has developed new materials and processes to improve the thermal stability and reliability of the heart of the transistor- its thin (1-2 nm) gate dielectric, to lower the resistance of metal contacts to the transistor and also to achieve higher levels of electrical impurities while keeping leakage currents under check.

These advances help future electronic devices such as mobile phones, servers, desktops and laptops to perform tasks faster, consume less power and last longer with lower failure rates. Prof. Lodha's work has not only been presented at top device conferences across the globe but has also been incorporated in semiconductor equipment for advanced transistor

technologies. Working closely with industry, collaborators has helped his research group bring solutions to cutting-edge problems of practical significance with shorter time-to-market innovations and broader scale of impact.

Prof. Lodha's group has also been working with recently discovered 'flat' two-dimensional materials analogous to graphene. The ultra-thin (less than a nm thick) nature of these Van der Waals materials bestows them with extraordinary optical and electronic properties along with high mechanical flexibility. From a technological perspective, it makes them less power-hungry and ideal for Internet-of-Things (IoT) sensor networks as well as flexible and wearable electronics. At the same time, their two-dimensional nature poses unique and fundamental challenges in building electronic and optoelectronic devices such as transistors and photodetectors. Prof. Lodha and his students have helped identify and solve some of these problems.

Prof. Lodha, an alumnus of IIT Bombay and Purdue University, USA, plans to leverage the capabilities and expertise in his group for developing power electronic transistors based on wide bandgap semiconductors such as silicon carbide and gallium oxide. These transistors can alleviate efficiency and reliability bottlenecks in diverse applications ranging from high voltage power grids, electric trains, renewable power conversion and storage to strategic defense, medical and industrial instrumentation. Wide bandgap power electronics has seen tremendous progress worldwide, but national efforts are lacking. Prof. Lodha hopes to provide critically-needed momentum for power transistor research in the country.

Notification

Prof. Santanu Banerjee has been appointed as Head of the Department of Earth Sciences w.e.f. May 8, 2020

Prof. Madhu Vinjamur has been appointed as the Head of the Department of Chemical Engineering w.e.f. May 12, 2020

Prof. Ravindra Gudi has been appointed as the Professor-In-Charge in the IITB Research Park w.e.f. May 15, 2020

Prof. Sudarshan Kumar has been appointed as Head of the Department of Aerospace Engineering w.e.f. May 16, 2020

Prof. Anand Rao has been appointed as Head, Centre for Technology Alternatives for Rural Areas w.e.f. May 18, 2020

Prof. S. N. Rao has been appointed as Head of Shailesh J. Mehta School of Management (SJMSOM) w.e.f. June 17, 2020

Prof. Kushal Deb has been appointed as Head of the Department of Humanities and Social Sciences w.e.f. June 22, 2020

Prof. K. V. K. Rao has been appointed as Head of the Department of Centre for Urban Science and Engineering w.e.f. June 22, 2020

Prof. S. Sreedhara has been appointed as Head of the Department of Mechanical Engineering w.e.f. July 1, 2020

IIT Bombay Releases CORONTINE App For Contact Tracking

A dedicated team at IIT Bombay headed by **Prof. Ganesh Ramakrishnan**, Department of Computer Science and Engineering and **Prof. Manjesh Hanawal**, Department of IEOR, along with some professional and experienced alumni, have built a platform CORONTINE to track potential/suspected (asymptomatic) carriers. CORONTINE is flexible, comprehensive, scalable and

ready-to-use. The CORONTINE platform and app can be helpful to authorities to register the asymptomatic carriers and track them to check if they confine to their quarantined zones.

CORONTINE allows to geo-fence and automatically generates alerts (sms, email, etc) if users move out of the quarantined zone. The CORONTINE platform provisions for organizing zones

into regions and several other such features. It is extremely customizable to the needs of the agencies.

Details about the CORONTINE app and the admin platform, along with the user manual, etc, can be found at <https://corontine.in>. Only an authorized person can login as admin to access the full features of the CORONTINE platform.

IIT Bombay Develops SAFE App

A team led by **Prof. Bhaskaran Raman** and **Prof. Kameswari Chebrolu** of the Dept. of Computer Science & Engineering, IIT Bombay has developed the SAFE app, which can potentially be used by officials for checking quarantine adherence.

a) SAFE has 3 dimensions of verification: location, identity, and time. SAFE is capable of detecting cases where the person may leave the phone and go outside quarantine himself/ herself (this is unlike a few “new” solutions for quarantine checking).

b) Also, SAFE is time-tested: it has been in use since the last 5 years, and has been used for classroom attendance by thousands of students in various courses.

An outline of how SAFE can be used for checking quarantine adherence is here: <https://bit.ly/safecheckq>

Direct link: https://docs.google.com/presentation/d/143cBiTHjA4hQBX4UXd5yJKRSSngCr1J7bCgH9nPN_6M/edit?usp=sharing

World Wide Help (WWH) To Link Patients With Health Providers

A team led by **Prof. Kameswari Chebrolu** of the Dept. of Computer Science & Engineering has developed the WWH (World Wide Help) platform, that can connect people requiring help (e.g patients) with those providing help (e.g. health care providers, doctors). It helps in managing load at the help provider (e.g. doctor/hospital), by managing a virtual queue of requests from help seekers. In WWH, help-requests as well as help-responses are supported both via phone calls and Whatsapp messages. It allows the provision of help remotely to the extent feasible: this is essential during high load and/or lockdown. This is a much cheaper and scalable alternative compared to call centers.

A few example scenarios in which WWH can be used:

1) Hospitals setup helplines to connect patients with doctors to avoid unnecessary travel and contact.
2) The government sets up helplines for purposes such as: (a) to provide information on Covid or (b) provide information on govt schemes/packages that are being initiated to help bottom of the pyramid

during lock-down, or (c) handle complaints from citizens.

3) Survey-based collection of information from patients for modelling Covid spread

A slide deck is available at <https://tinyurl.com/rregaez>

e-Yantra Robotics Competition (eYRC-2019-20)



30th June – 5th July 2020, ONLINE : For the past 8 years, e-Yantra's National Robotics Competition has grown from 4,500 registrations in 2012 to 34,500 registrations testifying to the growing wave of education moving online. The competition is actually a robotics MOOC (Massively Open Online Course) that teaches hardcore engineering skills through a competition. The first stage teaches practical engineering skills and the second stage tests participants on specified problems modelled as "themes". e-Yantra provides the kit, training and guidance and even a travel allowance and boarding/ lodging at IIT Bombay for the duration of the Finals at IIT Bombay.

This year's competition features 148 students as 37 finalist teams over six themes or problem statements. The much-coveted prize is a six-week paid summer internship with e-Yantra where participants get to work on ambitious technical projects and get exposed to geo-politics, money & investing, soft skills, theatre workshops, meditation sessions, lectures on history, heritage visits to monuments and so on. These experiences seek to broaden the outlook of our students to make them more sensitive to the rapidly transforming world of opportunities around them. We observe that the students who are touched by the competition are rendered more employable and encouraged to be more ambitious in their career choices and to even consider innovation and entrepreneurship.

e-Yantra usually holds its Finals at IIT Bombay during end-March every year. However, this year was a bummer when lockdown in mid-March brought the entire country to a halt. But there turned out a silver lining to the cloud. The internship went online - with

four times as many interns because now physical resources were no more a limitation. 133 students participated in a "remote internship" from their homes across the country. From the suburbs of Jodhpur (Rajasthan) to the backwaters of Alleppey in Kerala and to Bhutan, in the NE of the country, e-Yantra used online collaboration technology to provide a "virtual campus" to interns - along with lectures, special talks and collaborative activities. More importantly, to give closure to the participants, e-Yantra is hosting the finals of its Robotics Competition online this year - a first. Whereas participants cherish being grilled by IIT Bombay faculty at the finals - the same experience moves online this year. The finals are being hosted online during 30th June to 5th July 2020 at about 4:00 pm - 6:30 pm daily. The online medium now means that many more people will be able to witness the genius of our youth in robotics.

When COVID-19 gave the e-Yantra team a lemon - they made lemonade to serve the community.

Prof. Kavi Arya, the Principal Investigator of e-Yantra reflected that he felt the competition had come of age when his mother called him up to remark that she saw the entire proceedings the previous day from start to end. She even left some comments about the design of the robots. *"This was really the dream. That 'aam aadmi' (citizens) get interested in asking questions such as this. To enquire why, when we know the problems and have the skills, do we not solve our own problems ourselves! Changing our attitude from that of a 'knowledge consumer' to a 'knowledge creator' is the only way to become 'Atmanirbhar' (self-reliant). This is the driving vision behind the e-Yantra project of IIT Bombay,"* he said.

Capturing Complex Chemical Reactions On Video



chemicals and drugs. So far, the changes in charge distribution could only be expressed mathematically but it was not possible to view them via experiments.

In a recent study, **Prof. Gopal Dixit** of IIT Bombay and his group, along with researchers from Germany and France, have shown, for the first time, that it is possible to capture a video of the change in charge distribution in a chemical reaction while it is happening. In this study, published in the journal *Physical Review Letters*, the researchers show that sequential static images of atoms and electrons, captured using short X-ray pulses, contain information about the magnitude and direction of the change in charge distribution. Using analytical tools they demonstrated how this information could be used to visualise the electronic flux, a quantity that indicates the change in charge distribution.

Atoms, which are about ten-millionth of a millimetre, have electrons that revolve around a dense nucleus. X-ray scattering is a technique used to capture images of these tiny electrons moving at ultrafast speed. A very short X-ray pulse, which lasts about a billion billionths of a second, is shone on atoms or molecules, and the scattered light is captured. An image of the moving electron is then constructed using a mathematical analysis of the captured signal, resulting in a static picture of the electron, akin to a photo. To make a video of moving electrons, researchers use time-resolved X-ray scattering. Using a laser pulse, they excite the electrons in an atom or molecule and make it unstable. While the

electron is stabilising, they use the short X-ray pulses repeatedly and capture the successive scattered signals. A collective analysis of these signals results in a video of the electron movement.

The researchers show mathematically that the data obtained from the time-resolved X-ray scattering contains information about the charge distribution as well as the evolution of this distribution. They show how the scattering data can be used to create a visual of this distribution. To demonstrate this, they used computer models to generate X-ray scattering data. In the computer simulation, they used a laser pulse to excite the electrons in a benzene molecule and collected the scatter data of simulated time-resolved X-ray scattering, while the electrons became stable again. They used the generated X-ray scattering data to construct videos of the electron movement and the electric flux.

The real-time insight into electric flux, while the electron movement is happening, opens the possibility of tracking the flow of electrons during a chemical reaction. In future, it could help researchers design chemical reactions or choose efficient catalysts to obtain desirable compounds.

The way ahead is for researchers to image the flux in experiments. In practice, the probing of fast reactions may be limited by how short the X-ray pulses are, and how fast we can fire those. "We hope that this work will motivate scientists to carry out experiments and capture the electronic flux data," concludes Prof. Dixit.

Awards and Distinctions

Prof. Dipti Gupta, Department of Metallurgical Engineering and Material Sciences and **Prof. Parag Tandaiya**, Department of Mechanical Engineering have been recognized as "Outstanding Reviewers of the year 2019" award from "Flexible and Printed Electronics" and "Modelling and Simulation in Materials Science and Engineering" respectively.

Prof. Nagamani Jaya Balila, Department of Metallurgical Engineering and Material Sciences, has received "Acta Materialia and Scripta Materialia" Outstanding Reviewer Award for 2019.

Prof. Pradip Kalbar, Centre for Urban Science & Engineering (CUSE), has received the 2nd prize in PRISMA (Performance and Policy Research in Sustainability Measurement and Assessment) awards for research work published along with his collaborator Prof. Monio Neiro (Aalborg University, Denmark). The prize was awarded in an online ceremony at Dresden Nexus Conference 2020 on June 4, 2020.

Prof. Devang Khakhar, Former Director, Department of Chemical Engineering has been selected to receive 'Shri Om Prakash Bhasin Award 2019' in the field of Engineering, Energy and Aerospace.

Prof. Sanjeeva Srivastava, Department of BSBE has been elected as a fellow of Royal Society of Chemistry (FRSC) and also as a fellow of Royal Society of Biology (FRSB).

Prof. Vivek Agarwal, Department of Electrical Engineering has been elected as Fellow of Indian Academy of Sciences (FASc), Bangalore.

Prof. Irishi N. N. Namboothiri, Department of Chemistry has been elected as Fellow of Indian Academy of Sciences (FASc), Bangalore.

Prof. Rinti Banerjee, Department of Biosciences and Bioengineering (BSBE) has been elected as Fellow of Indian Academy of Sciences (FASc), Bangalore.

Prof. Pushpak Bhattacharyya, Department of Computer Science and Engineering has received the prestigious Abdul Kalam Technology Innovation Fellowship for a period of 3 years from February 1, 2020.

Prof. Subhananda Chakrabarti, Department of Electrical Engineering has received the prestigious Abdul Kalam Technology Innovation Fellowship for a period of 3 years from February 1, 2020.

Prof. Rohit Srivastava, Department of Biosciences and Bioengineering (BSBE) has received the prestigious Abdul Kalam Technology Innovation

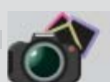
Fellowship for a period of 3 years from February 1, 2020.

Prof. Amit Agrawal, Department of Mechanical Engineering has been elected as a Fellow of the "International Society for Energy, Environment and Sustainability". The fellowship was conferred during the Annual Conference of the Society held at NEERI, Nagpur on November 27, 2019 and he has also been conferred the prestigious 'Chairman's Distinguished Award'.

Prof. Chetan Solanki, Department of Energy Science and Engineering has been awarded "Outstanding Green Activist-Jury Choice Awards" by Indian Federation of Green Energy. The award was given on December 16, 2019.

Prof. Sahana Murthy, Interdisciplinary Programme in Educational Technology has received the AECT Robert deKieffer International Fellowship Award for 2019. This award is presented to her in recognition of her Professional Leadership in the field of Educational Communication and Technology. She is the first recipient of this award from India.

Prof. Udayan Ganguly, Department of Electrical Engineering has been selected to serve on the Editorial Board of IEEE Electron Device Letters for a period of 3 years.



In the Wilderness

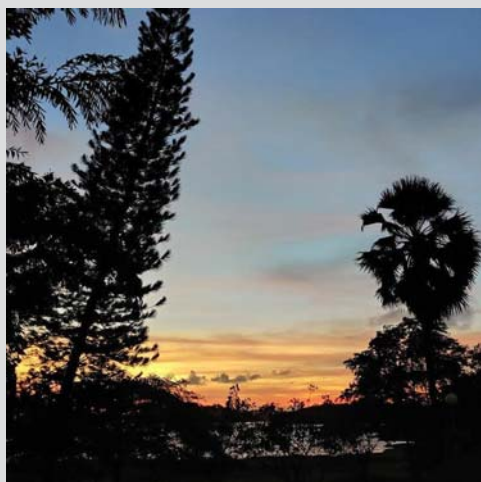
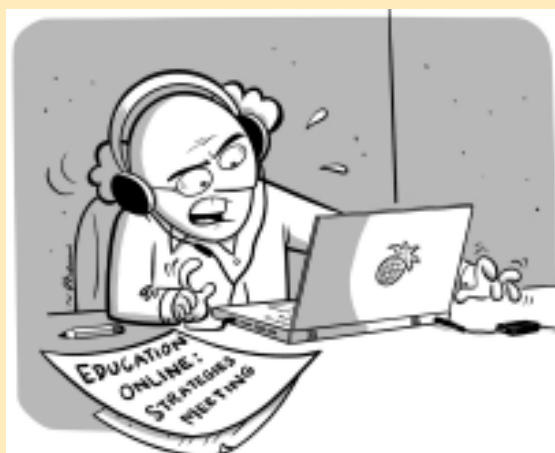


Photo Credit :
@nature_iitb @djainam9

Sait'n Pepper

by Professor Phani Tetali



"How many times do I have to tell you?
It is 'Education Online' and not
'Education on the line', okay??"

Retirements on April 30, 2020

Prof. S.S. Pande, Department of Mechanical Engineering, retired after 38 years of service



Mr. Ravindra V. Surve, Jr. Tech. Superintendent, Energy Sc. & Engineering, retired after 37 years of service



Mr. Ekanath R. More, Jr. Tech. Superintendent, C.T.A.R.A., retired after 32 years of service



Retirements on May 31, 2020

Prof. Sourav Pal, Department of Chemistry, retired after 5 years of service



Mr. Hemant D. Rane, Assistant Technical Officer, Department of Civil Engineering, retired after 38 years of service



Mr. Chandrashekhar G. Samant, Assistant Technical Officer, Estate Office, retired after 37 years of service



Mr. Prakash G. Sawant, Superintendent, Administration, retired after 37 years of service



Mr. Krishna Bahadur S. Singh, Sr. Messenger, Department of Electrical Engineering, retired after 35 years of service



Mr. Appa M. Kadam, Sr. Multi Skilled Assistant, Guest House, retired after 39 years of service



Mr. Fukirbhai V. Patel, Sr. Multi Skilled Assistant, Electrical Maintenance Division, retired after 38 years of service



Mr. Kantilal H. Solanki, Sr. Multi Skilled Assistant, Electrical Maintenance Division, retired after 39 years of service



Mr. Raiji D. Solanki, Sr. Multi Skilled Assistant, Public Health Office, retired after 32 years of service



Ms. Shanta H. Purani, Sr. Multi Skilled Assistant, Public Health Office, retired after 32 years of service



Mr. Babu R. Bummakanti, Multi Skilled Assistant, C Estate Office, retired after 24 years of service



Retirements on June 30, 2020

Mr. Ashok I. Kamble, Sr. Lab. Assistant, Department of Physics, retired after 30 years of service



Mr. Vithal K. Garad, Sr. Multi Skilled Assistant, Electrical Maintenance Division, retired after 39 years of service



Mr. Janardhan S. Kavale, Sr. Multi Skilled Assistant, Dy. Director (Finance & External Affairs), retired after 30 years of service



Mr. Babu D. Tare, Sr. Multi Skilled Assistant, Department of Mechanical Engineering, retired after 38 years of service



Ms. Kantabai A. Kirtane, Multi Skilled Assistant C, Hospital, retired after 21 years of service

