

# THE FLEET STREET

The official student media body of IIT Palakkad

## Heroes In The War Against COVID-19

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Amidst the unexpected scenario that the entire world has come to face, it is also crucial as engineers and researchers to stay calm and assess the situation, understanding what we can do to help. The first case of COVID-19 in India was confirmed in Thrissur District (~70kms from our campus) in Kerala on the 30th of January 2020. This resulted in an alert being sent out throughout the state and the coming months saw a rise in the spread of the SARS-CoV-2 virus causing the disease.

Since March, just when the COVID-19 was starting to engulf our nation, IIT Palakkad has been testing out ways to help the community, policy makers, and fellow researchers. The initiatives include both actual device implementations to data-backed case study explorations/visualisations. A team of faculty and staff, both on campus and outside, has been set up for the same. The entire initiative is headed by Dr. S Kanmani Subbu appointed as Nodal Officer, coordinating the various activities and forming the interface with the collaborating industries that we partner with to create the products.

### ***What has been done so far? What are the achievements of our champions?***

This article is an overview of all the efforts (initiatives, projects, case studies) taken by the institute and an update on the latest developments.

### Preparation and Distribution of Hand Sanitizer:

This is one of the longest running projects that had started even before the lockdown began. The Chemistry Department under the leadership of Dr. Shanmugaraju has been producing hand-sanitisers for use not only in the Institute but also in the Palakkad District Hospital and Ahalia hospitals as well. The in-house sanitizers are made in bulk quantities with chemicals like isopropyl alcohol (available from the Chemistry Dept labs which already has permission for its use). The institute has already produced 330 litres of hand sanitizers till date.

### Making reusable Respiratory Masks:



Kooper Medical Technology Pvt Ltd signs the MoU with IIT Palakkad

One of the most significant contributions that IIT Palakkad is trying to make are the Reusable Respiratory Masks for the public. The indigenously developed mask and filter can be used by medical professionals and the first line of health workers. In addition, it is expected to have the mask and filter affordable for common people to use, especially those living in close proximity regions. The product is being developed by a group of researchers from various departments: Dr. Arvind Ajoy (EE), Dr.

Dinesh Jagadeesan (Chemistry), Dr. S Kanmani Subbu (ME), Dr. Krishna Sesha Giri (ME), Dr. Mintu Porel (Chemistry), Dr. Samarjeet Chanda (ME), Dr Sushabhan Sadhukan (Chemistry), Dr Revathy Padmanabhan (EE)

The mask has been designed with ease of use in mind and can be reused by changing the filter upto a maximum of 4 times. The filter is being indigenously developed using a heat-sealing process of layered materials and is expected to last for 8 hrs of use. The filter is aimed to provide N95 protection (95% efficiency in filtering particles larger than 3 microns). The mask is expected to have N95 certification from Indian Council of Medical Research (ICMR).

An initial prototype has already been tested and the team has signed an MoU with Kooper Limited to enable mass production. The cost is estimated to be around Rs 120 (commercially available N95 masks are about Rs. 200-400 a piece) for a set of one mask and four filters. IIT Palakkad will also be donating 5k masks and 20k filters to the public for free.

There have also been separate works focused on mask development that have further progressed to independent projects: Dr. Dinesh Jagadeesan is working on producing replaceable filters that can be reused after washing. Dr. S Kanmani Subbu and Dr. Samarjeet Chanda have developed a Breathability Setup to test ease of breathing of the masks. The breathability is measured using the pressure drop created by the filter.

### Portable Emergency Ventilator:



One of the interesting developments that has been gaining momentum is the low cost Mobile Ventilator hardware project led by Prof. Vinod along with Dr. Afzaal and Dr. Sreenath. The design is space efficient and capable of catering to the breathing requirements of two patients simultaneously, providing an independent control for each of them. An agreement has

been signed between the Institute and Kanjikode Industries Forum for developing and testing the prototype from the design.

### Foot-operated Hands-free Sanitizer Dispenser:

[Video link to the demonstration of the above project \[click here\]](#)

Another simple and cost effective idea was to build a hands-free hand sanitizer dispenser. The idea was proposed by Dr. Anand and put into motion at the mechanical lab. It was demonstrated the same day at the Nila campus and is now available for use at the workshop building. The net cost is about Rs 100 and can be made without the need for any specialized equipment using a blood pressure bulb, few plastic tubes and a used bottle.

### Pulse Plethysmograph Instrument for Continuous Monitoring of blood pulse, heart rate and oxygen saturation of patients in ICUs:



A plethysmograph is an instrument for measuring changes in volume within an organ or whole body (usually resulting from fluctuations in the amount of blood or air it contains) which is essential for patients in Intensive Care Units (ICUs) . Normal plethysmographs are usually expensive and require bedside monitoring which is difficult in the current scenario. This project aims to develop a low-cost pulse plethysmograph that has the

capability to transmit vital parameters of patients to the nurse-station especially when alarming conditions occur. This project is undertaken by Prof Vinod Prasad (EE) and an MoU for manufacturing has been signed between IIT Palakkad and ITI Limited Palakkad (Public Sector Undertaking) for manufacturing. The project along with the Portable Mobile Ventilator (Dr. Afzaal, Dr. Sreenath), Rapid Testing Kits (Dr. Shanmugaraju), and Software Tool for Crowd Sensing and Localization (Dr. Lakshmi N Theagarajan) have received CSR funding of Rs. 35 lakhs from Federal Bank.

### Affordable Rapid Testing Kits:



To aid in the rapid screening of COVID19 patients, this project, taken up by Dr. Shanmugaraju Sankarasekaran (Assistant Professor, Chemistry), aims to develop affordable easy-to-use kits using a paper strip-based visual testing method. The driving notion behind this is to bring the test conveniently and immediately to the patient. The method involved is very specific and requires only ~10-15 minutes. It is actually based on immunoassay which is a biochemical test to recognise antibody-viral antigens. This is similar to how pregnancy tests work. The test strips will be filter paper coated with specific antibodies functionalized with gold nanoparticles. The antibodies selectively recognize nCoV-SARS viral proteins while the gold nanoparticles provide a visual color change (red to blue or grey for an infected person depending on the conditions).

### Models and analysis making use of Machine Learning:

Dr. Mrinal Kanti Das and Dr. Sahely Bhadra, CSE Dept faculty researching in the field of Machine Learning, are tackling two different projects.



#### 1) COVID19 Learner Simulator (LeSi)

Taking into consideration the data available on *hospitalized*, *mortality rates*, *patients cured*, the objective is to estimate the epidemiology parameters. The ML based method is used to train a 10-compartment epidemic model considering that factors like *hospitalization period* would be the same across regions whereas mortality rates, effective social distancing achieved are region-specific in nature. It is also intended to forecast the growth of several statistics. The simulator will be

put up as a web app hosted by the iitpkd server to allow for a large number of people to have access to it.

Furthermore, a collaboration with the Indian Institute of Science (IISc) has also been established to build an agent-based simulator for Kerala. The faculty led project also includes two research scholars, namely Gaurav Jain (MS, CSE), and Shikha Mallick (MS, CSE).

## 2) A Rapid Large-scale Covid Detection Tool through Classification of X Rays using Deep Learning (xDet)

Based on the assumption that X-Ray images of COVID19 patients have distinguishable features/traits compared to X-Ray data pertaining to other diseases, this project aims to predict COVID19 by classifying the X-Ray samples. The X-Ray data is presently obtained from an open source dataset via Kaggle, the popular Machine Learning Community platform, and used after significant dataset pre-processing and the team is eagerly waiting for other datasets to arrive to test their model. The team involved include research scholars Rimmon Bhosale (MS, CSE) & Shikha Mallick (MS, CSE) and BTech final year student Nikhil Yadav (CSE, Btech 2020). The team has built several models, and put them in an "mixture of experts" framework. It has been named xDet and is currently able to achieve 99.5% accuracy (on the dataset).

This tool will also be available as a web app to enable access to a larger audience. Further, the team is also gearing up to participate in a competition on COVID detection using X-Ray images which is to be hosted by the PanIIT Alumni Association at a global level.

## Panchayat Level Vulnerability Map:



This project, undertaken by Dr. Sarmistha Singh from the department of Civil Engineering, looks at the population vulnerability to the COVID-19 pandemic at the Local Self Government Level (LSG) i.e. Panchayats/Municipalities. Certain groups of people are at high risk to the COVID 19 and might need hospitalisation facilities during the pandemic. This study maps the region's population with such risks. Using the data available on the demographics of each LSG, the project assesses details like age distribution (% population with age>60), people categorised with diabetes and other comorbid diseases along with the density of population to make out the extent of which population centers are

disproportionately exposed to risks from onset of the pandemic. Note that this vulnerability map is unlike the Govt's present classification of Red/Orange/Green Hotspots. It is an indicator of the enhanced risks in patients and is not related to the actual number of cases made with the objective to enable authorities to prioritize the allocation of medical resources.

### COVID19 Kerala Training Pattern: A Spatio-temporal simulation for covid19

Dr. Deepak Rajendraprasad of CSE Dept is a part of the team of researchers (of other institutes), software developers, and individuals from Local Self Governing Departments (LSGDs) that have come together to develop a web portal depicting the spread of the COVID19 epidemic across the state of Kerala at the panchayat level using SEIR model for each panchayat (~1036). The spread is modeled and provided in a color-coded GIS Map made using the Gravity Model (popular from the domain of transportation analysis). The tool is being developed and intended towards policy makers who will be able to test out strategies to proceed in reopening the state. In this regard, the tool can be configured with mitigation parameters like Break the Chain, Complete lockdown, Blocking District Boundaries and can also be fed panchayat level data on Red/Orange/Green districts manually.



### Lung Ultrasound Imaging for Monitoring COVID-19 patients:



Currently, Computer Tomography and X rays scans are used to track the progression of lung/respiratory conditions in diseases such as the COVID-19. But, repeated exposure to harmful radiation is not viable for continuous monitoring where patients are monitored (daily) over a period of time. Moreover, these above mentioned facilities are not easy to accommodate and also not economically feasible to scale up to large numbers in hospitals/wards/ICUs. Hence, a novel alternative method is the use of ultrasound for testing and tracking the spread of COVID-19. This project is undertaken by Dr. Mahesh Raveendranatha Panicker who focuses on extracting useful information from Lung Ultrasounds of patients admitted with coronavirus. The ultimate motive is to automate the whole process end-to-end using learning algorithms and perform clinical trials in association with the Sree Chitra Tirunal Institute for Medical Sciences & Technology (SCTIMST) for patients in India. The

team has secured lung ultrasound scan data from University of Trento to build their algorithms.

### Pool Testing Strategies:



Dr. Lakshmi N Theagarajan, Assistant Professor, Electrical Engineering Department, has published an article ([available at arXiv \[click link here\]](#)) on the methodologies that can be adopted to have pool testing or group testing in COVID19 diagnosis. Group testing is a method in which multiple samples are pooled together in groups and fewer tests are performed on these groups to discern all the infected samples. The number of tests performed is considerably smaller in contrast to the individual swab testing (PCR test) done one at a time. The article compares various group testing algorithms and provides guidelines that could be adopted into test plans for testing centres and enable increased diagnosis without increasing PCR tests. The article also analytically shows that upto 57 samples can be pooled together without any loss in the reliability of the test. The report has been submitted to the PSA of GoI and forwarded to ICMR for review and necessary action.

### Crowd Sensing and Localization:

Dr. Lakshmi N Theagarajan is also working to develop a software tool to estimate the number of people in a given area, predict crowding, violation of social-distancing and quarantine using data transmitted from mobile phones through cellular network protocols. The tool will be able to achieve this using the data received by the base stations of mobile phone users. The main objective of the software tool is to inform authorities when the population density of a region crosses a certain threshold.

### Note of thanks:

TFS would like to take this moment to appreciate all our champions and thank them for taking the time to talk to us despite their busy schedules. A special note of thanks to Dr. Deepak Rajendraprasad and Dr. S Kanmani Subbu for meeting with us and clarifying various details. We hope to keep you updated with the details of these projects in the near future.

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Annexure:

Sl. No.	Tentative Title	Faculty and staff members
1	<b>Respirator with disposable filters for the medical professionals and general civilian population.</b>	<p>Dr. Arvind Ajoy, Assistant Professor, Electrical Engineering.</p> <p>Dr. S. Kanmani Subbu, Assistant Professor, Mechanical Engineering.</p> <p>Dr. Samarjeet Chanda, Assistant Professor, Mechanical Engineering.</p> <p>Dr. Krishna Sesha Giri, Assistant Professor, Mechanical Engineering.</p> <p>Dr. Dinesh Jagadeesan, Assistant Professor, Chemistry.</p> <p>Dr. Mintu Porel, Assistant Professor, Chemistry.</p> <p>Dr. Sushabhan Sadhukhan, Assistant Professor, Chemistry.</p> <p>Dr. Revathy Padmanabhan, Assistant Professor, Electrical Engineering.</p> <p><b>Other team members:</b></p> <p>Mr. Rajendran, Ph.D scholar, Chemistry.</p> <p>Mr. Ananthu, Electrical Engineering.</p> <p>Mr. Visant P V, Mechanical Engineering.</p> <p>Mr. Somasundaram, Mechanical Engineering.</p> <p>Mr. Mejo A. J., Electrical Engineering.</p> <p>Mr. Pramod S, Ph. D. scholar, Mechanical Engineering.</p>
2	<b>Preparation and Distribution of Hand Sanitizer to hospitals and Institute</b>	<p>Prof. K. V. G. Kuty, Professor, Chemistry.</p> <p>Dr. Sushabhan Sadhukhan, Assistant Professor, Chemistry.</p> <p>Dr. Shanmugaraju Sankarasekaran, Assistant Professor, Chemistry.</p>
3	<b>Development of hands-free sanitizer/soap dispensers to contain COVID 19</b>	<p>Dr. Samarjeet Chanda, Assistant Professor, Mechanical Engineering.</p> <p>Dr. S. Kanmani Subbu, Assistant Professor, Mechanical Engineering.</p> <p>Dr. Anand T.N.C., Associate Professor, Mechanical Engineering.</p> <p><b>Staff Member:</b> Mr. Visant P V</p>
4	<b>Development of breathability test setup for mask/respirator filters</b>	<p>Dr. Samarjeet Chanda, Assistant Professor, Mechanical Engineering.</p> <p>Dr. S. Kanmani Subbu, Assistant Professor, Mechanical Engineering.</p>

		<b>Staff Member:</b> Mr. Visant P V, Mechanical Engineering.
<b>5</b>	<b>Models and Analysis making use of Machine Learning</b>	Dr. Sahely Bhadra, Assistant Professor, Computer Science Engineering. Dr. Deepak Rajendraprasad, Assistant Professor, Computer Science Engineering. Dr. Sarath Sasi, Assistant Professor, Mathematics. Dr. Mrinal Das, Assistant Professor, Computer Science Engineering.
<b>6</b>	<b>Rapid Large-scale Covid Detection Tool</b>	Dr. Mrinal Das, Assistant Professor, Computer Science Engineering. Dr. Sahely Bhadra, Assistant Professor, Computer Science Engineering.
<b>7</b>	<b>Prediction of COVID-19 hotspots in Kerala</b>	Dr. Sarmistha Singh, Assistant Professor, Civil Engineering.
<b>8</b>	<b>Low Cost Testing Kit</b>	Dr. Shanmugaraju Sankarasekaran, Chemistry, Assistant Professor.
<b>9</b>	<b>Crowd Sensing Strategies</b>	Dr. Lakshmi Narasimhan T, Assistant Professor, Electrical Engineering.
<b>10</b>	<b>Portable Emergency Ventilator</b>	Dr. Afzaal Ahmed, Assistant Professor, Mechanical Engineering. Dr. Sreenath V., Assistant Professor, Electrical Engineering.
<b>11</b>	<b>Lung Ultrasound Imaging for Monitoring covid-19 Patients</b>	Dr. Mahesh Raveendranatha Panicker, Assistant Professor, Electrical Engineering.
<b>12</b>	<b>Pulse Plethysmograph Instrument for Continuous Monitoring</b>	Prof. Vinod A Prasad, Electrical Engineering.