

1. Personal Protective Care Equipment

- ➔ Project Title : The motivation is to make an alternative to N95 masks for the general civilian population. N95 is not recommended for a wide use by the general population due to limited availability, cost and less breathability. Standard N95 masks available for purchase filter out with 95% efficiency particles/aerosols which are larger than 0.3 microns. These are critical for medical professionals and the first line of health workers. In the event of a major spike of COVID-19 cases in India, we may need to have an alternative to N95 masks that are of good quality, abundant in availability and safe to use in order to minimize the community spread. More importantly, they should be made of readily available raw materials. Hence, IIT Palakkad is attempting to make indigenously designed masks and filters. The filters shall be made of layers of non-woven PP (polypropylene) materials and textile material coated with known antiviral nanomaterial. The layer of materials in the filter shall be sealed by thermal sealing process. The masks shall be made by an injection moulding process and the fabricated filters will be attached with a mask for testing.
- *Expected Outcome : The masks and filters can be made in a high throughput manner and can be distributed to the general public who live in closer proximity such as in high density residential areas where social distancing is practically not feasible and to essential service personnel. The masks shall provide good protection and minimize the community spread.*
 - *Expected Timeline : The prototype and material testing shall be completed by the mid of April 2020. The design shall be ready for manufacturing as soon as approval, if any, is obtained.*
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- ➔ Project Title : The filter material for the mask that we are working on is melt blown polypropylene. It is essential to coat the outer layer with an antiviral agent to prevent the passage of virus either from the atmosphere or from the person using the mask. Citric acid is a well-known antiviral agent which works by lowering the pH to rupture the viral envelope protein. We are trying to coat the melt blown polypropylene filters with citric acid. In brief, we are coating the polypropylene material with aqueous solution of citric acid with the help of ultrasonication followed by air drying/in oven. The coated material is being characterized by fourier-transform infrared spectroscopy (FT-IR) as well as other

analytical techniques. The final material will further be tested from authentic government agency prior to real applications.

Expected Outcome : After successfully coating the melt blown polypropylene (the mask material) with citric acid (antiviral agent), the mask will be effective to kill the virus. Hence, the mask will be more appropriate to work against COVID-19.

Expected Timeline : We have already done our first trial on coating the polypropylene material with citric acid. After analytical characterization, we will further optimize the method. We hope to get the method optimized and ready for scaling-up within 10 days.

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- ➔ **Project Title : Personal Protective Care Equipment** :Massive efforts to develop filters coated with antiviral materials for use in masks to contain spread of COVID 19 is underway. The fabric coated with the antiviral material is generally sandwiched between two layers of 25-30 gsm thick non-woven polypropylene sheets. The whole assembly needs to be sealed tightly, so that the filter material remains packed inside the polypropylene sheets properly, thereby preventing the whole filter assembly from losing its integrity and functionality. To this end, an effort to develop a thermal sealing technique and an associated prototype is proposed. The work shall involve the design and development of a thermal sealing apparatus capable of creating an air-tight seal of required seam width. To achieve this, it is proposed to develop the heat-sealing setup prototype with both circular as well as prismatic dies heated to the required temperature through Joule heating. The system shall have a closed loop control, so that the required temperature and pressure, apt for creating the seal is automatically controlled and applied. The design shall be optimized to make it suitable for mass production.

Expected Outcome : The heat-sealing setup prototype shall be made and tested. The required process parameters shall be optimized for air-tight sealing. The technology shall be automated and technology shall be transferred to the industry for aiding the mass production of the filters for masks.

Expected Timeline : 4 Months

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2. Testing Kit

- Project Title : IIT Palakkad is aiming to develop a low-cost test kit for the rapid screening of COVID-19 patients. We are particularly interested in constructing a paper strip-based visual testing method that can be used at point-to-care analysis in a community setting. The testing method that we intend to develop is based on an immunoassay involving the antibody-viral antigen recognitions. The basic concept of immunoassay-based testing is similar to how a pregnancy test works. We first prepare a filter paper-based test-strips coated with specific antibodies that selectively recognize the COVID-19 viral proteins. Before this, the antibodies are functionalized with gold nanoparticles that indicate COVID-19 infected person through visual colour changes from red to blue or grey depending on the conditions. This testing method is very specific and one full test can be run within ~10-15 minutes.

Expected Outcome : The expected outcome is to develop affordable, easy to operate testing kit in large numbers for the rapid screening of COVID-19 patients.

Expected Timeline : 3-4 Months

Remarks : The process already initiated, and a joint proposal submitted for funding.

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3. Sanitization

- Project Title : IIT Palakkad is preparing alcohol-based hand sanitizer to kill the Coronavirus along with other microorganisms. The hand sanitizer has been prepared following the World Health Organization (WHO) guidelines. The composition of the hand sanitizer is 75% Isopropanol (IPA), 1.45% Glycerol and 23.55% deionized water. Few drops of essential oil can be added for fragrance. Glycerol and water were first mixed thoroughly before adding into isopropanol. The final solution was homogenized before aliquoting in smaller bottles.

Expected Outcome : We are regularly preparing bulk quantity of IPA-based hand sanitizer and supplying to IIT Palakkad community as well as various hospitals at Palakkad for sanitization purpose.

Expected Timeline : This is already being prepared in regular basis.

Remarks : This hand sanitizer is strictly for external use. Please consult doctors if someone swallows the liquid or the liquid is sprayed in eyes.

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4. Medical Equipments

→ Project Title : Plethysmography and Pulse Oximetry are non-invasive circulatory assessment methods used in blood flow monitoring and oxygen level (oxygen saturation) of the blood. Monitoring of blood pulse, heart rate and oxygen saturation is essential for patients in Intensive Care Units (ICUs). The pulse plethysmograph instruments currently used in hospitals are costly (ranges from Rs 18,000 to Rs 30,000). Moreover, currently available plethysmographs do not have communication feature with nurse-station and hence the nurses will have to perform bedside monitoring of vital parameters, which is a difficult task in an ICU where several patients are treated. In this project, we will 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.

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

Expected Timeline : 4 Months

Remarks : An MoU has been initiated between IIT Palakkad and ITI Limited Palakkad (Public Sector Undertaking) for manufacturing.

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→ Project Title : IIT Palakkad is aiming to develop an affordable emergency portable ventilator for COVID-19 patients. The emergency portable mechanical ventilation system can be used to assist in inhalation and exhalation of a patient who is physically unable to breathe, or breathing insufficiently due to any acute respiratory deficiency syndrome (ARDS) such as COVID-19. The proposed ventilator assembly consists of the following components: lead screws, servo motors and bellows mounted on top of an aluminium platform. The potential assist control modes of the proposed ventilator are: 1. Volume Control: ventilator delivers a breath of a fixed volume; 2. Pressure Control: ventilator delivers a breath until a certain pressure is reached and stops, does not take delivered volume into consideration; 3. Triggered Breaths: when the vent detects the beginning of inhalation, it delivers a breath. The ventilator needs to provide control over respiratory rate, pressure, tidal (breath) volume, inspiratory time, expiratory time and ventilator modes. The ventilator will be designed with space constraints in mind and is capable of addressing the breathing requirements of two patients simultaneously.

Expected Outcome : The expected outcome is to develop affordable, easy to operate portable emergency ventilator for COVID-19 patients.

Expected Timeline : 3-4 Months

Remarks : The designing process has been initiated and an MoU has been signed with Kanjikode Industries Forum (KIF) for prototype development and testing.

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5. Surveillance

- ➔ Project Title : We aim to create a software tool that uses data received at the base stations from mobile phone users to predict user locations and count the number of users in a given area. This tool shall alert the enforcement agents whenever the density of people crosses a certain threshold. The mobile phone users will not be required to install any specialized application or transmit specific information (such as GPS information) for this purpose. The tool shall perform the sensing operation purely based on the data that is already transmitted by existing protocols in cellular networks to establish and maintain mobile links.

Expected Outcome : A software tool for law enforcement agents that indicates crowd locations.

Expected Timeline : 3 Months

Remarks :

URL :

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6. Data Analytics, AI to model epidemic patterns and disease dynamics

Project Title : COVID-19 hotspots in Kerala will be identified based on the following data: population density, number of confirmed patients, patient's travel history, climate (temperature), age, pre-existing conditions (diabetes, cancer patients, etc.). A GIS based analysis will be performed that will help identify the regions in Kerala vulnerable to COVID-19. It will lead to need based allocation of resources. A first round of this analysis was done for Thrissur district with the data that was available. Moreover, CORONA care centres and hospitals have also been mapped across Kerala. We are also in touch with the Health Department of Kerala regarding this.

Expected Outcome : The regions in Kerala vulnerable to COVID-19 will be identified.

Expected Timeline : Depends on data availability

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→ Project Title : We are working in modeling Covid19 using variants of SEIR type compartment models. We are planning to use a detailed modeling considering India specific scenario to more accurately model the case in India. Our plan is to estimate the parameters from existing datasets to train the model, and then we will apply them for predicting the future possibilities.

Expected Outcome : Forecasting the spread of Covid19, analysis of factors contributing to the spread of Covid19, policies to reduce the spread of Covid19 in India trading off with societal factors.

Expected Timeline : 2 months

Remarks :

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