INTEGRATED SMART MASK

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Abstract **- As the deadly Corona virus is continuing to infect the whole population of the planet, right protection against the novel virus has become extremely critical. In this paper, we present the design of an integrated smart mask which can cleanseitself. The UV LEDs interfaced in the mask helps in the sanitization process. It is integrated with various sensors which can collect real time body parameters viz. (body temperature, oxygen saturation, air quality sensor) which are connected through a single application on the user's mobile phone. The oximeter module measures the oxygen saturation of the user, this body parameter is crucial to identify a viral attack in theuser. The reports on undesirable amounts of face masks disposal are increasing and it is high-priority to identify this developing environmental threat and substitute disposable face masks with the reusable face masks.**

Keywords - Integrated smart mask, COVID-19, temperature sensing, air quality, oximeter, UV LED, mobile application.

I. INTRODUCTION

The relevance of face masks, eye protection, physical separation, and to prevent explicit transmission of SARS-CoV-2 was established in a systematic review published by the World Health Organization, which found that "use of face mask could result in tremendous lowering of the risk of infection." According to the review, only three mask studies were used outside of health care settings, all of which were of SARS, not SARS-CoV-2, one of them was incorrectly categorized, and the other one found that no homes wearing masks had illnesses, but it was too low-powered to draw any conclusions.The rest of the study indicated that wearing a mask before going out was quite protective, with a risk reduction of 70% for persons who always wore a mask before going out, but it didn't look at how masks affected transmission from the user. The extent to which other viruses linked to SARS-CoV-2 have been studied is unknown. The relative risk of using various types of masks was not focused during the study. The science around the usage of masks by the people to restrain COVID-19 transmission is improving expeditiously. In this narrative review, we arrive at an analytical framework to analyse mask usage, synthesizing the appropriate literature to notify extensive fields such as user protection, effect of population transmission properties, control at the origin, implementation, performance analysis and sociological considerations. A fundamental path of transmission of COVID-19is through the respiratory particles, and it is recognized to be transmissible from paucisymptomatic (exhibiting few symptoms), presymptomatic and asymptomatic people.

Commuting the spread of disease demands two things: restricting contacts of infected person through physical distancing, wearing mask and minimizing the probability of transmission per contact. The prevalence of evidence signifies that wearing mask decreases transmissibility per contact by lowering transmission of the infected respiratory particles in both clinical and laboratory subject. The act of wearing mask by public is majorly successful at minimizing spread of the virus when conformity is high. Given the limited stocks of medical masks, we suggest the acquirement of 'INTEGRATED SMART MASK', as source control of legitimate form, in synchronicity with prevailing hygiene, contact tracing, and distancingapproaches [1].

An immediate recommendation regarding the usage of mask from general occupants is required by the policy makers as a tool in battling severe acute respiratory Syndrome CoronaVirus 2 (SARS-CoV-2), which is the respiratory virus triggeringCOVID-19.

Masks have been of crucial importance during this pandemic to save human lives, but at the same time they are proving a threat for wildlife, marine bodies entrapped in the surplus amount of trashed facial maskslittering animal habitats. Use and throw surgical masks have been strewn around pathways, canals and beaches globally, since the nations initiated commanding their use in public domain to decline the spread of infection. This project could be a solution for the above mentioned precardiment. Covid illness 2019 (COVID-19) is an infectious sickness brought about by extreme intense respiratory disorder Covid 2 (SARS-CoV-2). The infection has since spread around the world, prompting a continuous pandemic. Side effects of COVID-19 are variable, yet regularly incorporate fever, hack, migraine, weariness, breathing troubles, and loss of smell and taste. Side effects may start one to fourteen days after openness to the infection. At any rate 33% of individuals who are tainted don't foster recognizable manifestations. Of those individuals who foster observable side effects enough to be classed as patients, generally (81%) create gentle to direct manifestations (up to gentle pneumonia), while 14% foster extreme indications (dyspnea, hypoxia, or over half lung contribution on imaging), and 5% endure basic indications (respiratory disappointment, stun, or multiorgan brokenness). More established individuals are at a higher danger of creating serious side effects. A few group keep on encountering a scope of impacts (long COVID) for quite a long time after recuperation, and harm to organs has been noticed. Transmission of COVID-19 happens when individuals are presented to infection containing respiratory beads and airborne particles breathed out by a contaminated individual. Those particles might be breathed in or may arrive at the eyes, nose, or mouth of an individual through contacting or direct statement. The danger of disease is most elevated when individuals are in closeness for quite a while, however particles can be breathed in over longer distances, especially inside in inadequately ventilated and swarmed spaces. In those conditions little particles can stay suspended noticeable all around for quite a long time to hours. Contacting a tainted surface or article may prompt disease albeit this doesn't contribute generously to transmission.

Individuals who are tainted can send the infection to someone else as long as two days before they, when all is said and done, show indications,

as can individuals who don't encounter manifestations. Individuals stay irresistible for as long as ten days after the beginning of indications in moderate cases and as long as twenty days in extreme cases. So to stay away from the spread of infection it is important to wear the veil and ensure us and others.

The worldwide interruption brought about by the COVID-19 has achieved a few consequences for the climate and environment. Because of development limitation and a critical stoppage of social and financial exercises, air quality has improved in numerous urban areas with a decrease in water contamination in various pieces of the world. Also, expanded utilization of PPE (e.g., face veil, hand gloves and so on), their heedless removal, and age of an enormous measure of clinic squander contrarily affects the climate.

II. OBJECTIVES

- The main objective of this project is to reuse the mask by sanitizing it using UV radiation.
- To integrate sensors into the mask in order to retrieve various body parameters for infection detection.
- The parameters include blood oxygen saturation using reflectance pulse oximeter sensor, body temperature detection, and air quality detection around the subject wearing the mask.
- Reusing the mask is economically beneficial for the poorer.
- It has a huge impact on the environmental effects of medical/single use/polysynthetic masks as every mask that is saved from being used is one saved from affecting the environment.
- This project also focuses on sustainable solution for a global problem.
- A safe and effective method to sanitize the mask without change the composition and state of the materials on the mask.
- Since the mask comes in direct contact with the face (which is the most sensitive part of the body with various sensory organs) we have used the safest available battery at the time i.e. lithium polymer battery.

III. BLOCK DIAGRAM

The present concept is represented in the appended schematic diagram. We term it as “Integrated Smart Mask”. Wearing a protective gear during any of pandemic conditions will help us to overcome the risk of transmission of the infections. Mask is of the important protective gear during these conditions. The usage of the mask increases with the increase in the infection. Durability of the mask plays an important role during these conditions.

The idea of this project is to build a mask which is user- friendly, durable and protective from such pandemic situations. The integrated masks will be designed with three layers. In the first layer, the temperature sensors are mounted near the nostrils to measure temperature of inhaled and exhaled air. The second layer of the mask contains the UV LEDs to sanitize the mask to virus lethal temperature of 65°C. The third layer is for external coating for protection of the mask material. The mask is also designed to hold an oximeter module to measure the oxygen saturation.

The wireless charging concept of the mask is based on Faraday’s law of electromagnetic induction; i.e., Any metal in a magnetic field induces electricity, given either one of them is moving. Similarly here we have two coils acting like an air core transformer. When electricity is applied at one end, the other end induces potential difference, but the resonance of both the coils has to be same and the current has to be altered in a periodic interval. The number of turns of the coil will provide information about the amount of voltage to be induced at the secondary. This process requires alternating current and therefore direct current can not be used in the process of wireless power transfer. To convert direct current to alternate current, we have to introduce a frequency to switch on and off the current, hence making it alternate current. A similar alternator is used in invertors. The frequency used should be same as the secondary coil to maintain the resonance.

Every conductor has an electric field around it and when the coil is used, the field gets intensified at the center. When power is applied at the first coil, it creates an electric field with an alternating current and when the secondary coil is used into this field, it will induce voltage.

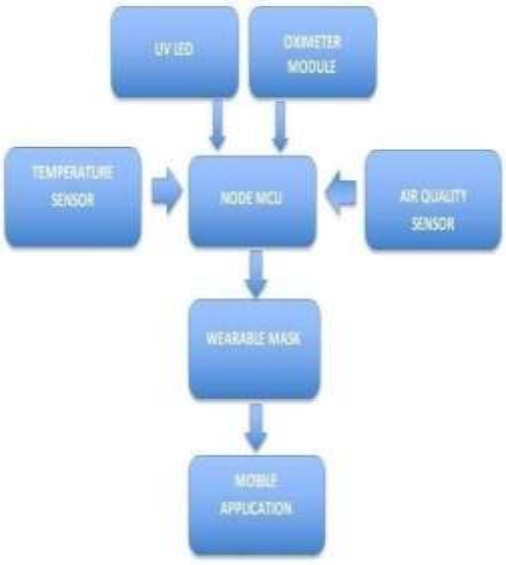

Figure 1: Block diagram of Integrated Smart Mask

IV. IMPLEMENTATION

A. Software Implementation

Kodular Creator is the software that is used to implement Integrated smart mask. Kodular is a web application that allows you to create apps without having to know how to code. Kodular Creator is an MIT-developed Inventor distribution app, which implies it is based on the open-source App Inventor project. Compared to App Inventor, Kodular Creator is a tremendous step forward. However, Kodular Creator is not an open-source project, and the source code will be stored on GitHub in a private repository. However, other Suite-related repositories will be accessible.

At first glance, the Kodular Creator App appears to have more components, as well as greater granular control over the application. This package, among other things, includes an online app store that competes with Google Play and an extensions IDE that allows sophisticated users to create additional Kodular components. Kodular Creator creates a Kodular account for you to manage all of your services. Kodular Account is a solution that allows you to manage all of your services from one location.

B. Hardware Implementation

The mask is three layered made up of one N95 mask and one surgical mask combined together [2]. Node MCU, microcontroller is used to receive inputs and outputs from various components. Node MCU is the open source IoT platform as well as low cost. Node MCU at first included firmware which runs on the Wi-Fi module ESP8266 Wi-FISoC produced by Espressif Systems. The hardware of Node MCU is based on ESP-12 module.

UV-C LED OF 504UVC2E-Q5C is used for sanitization of the virus, which is also known as hortwave UV light and has a wavelength thin the range of from 200 nm to 500 nm. UVC radiation has been proven to destroy the protein coat of the SARS-Coronavirus. This protein coat is present on the outer layer of the SARS- Coronavirus. The destruction of the protein layer will lead to death of the virus [3].Temperature sensor used is LM35, whose operating temperature range is -55°C to150°C. The air quality sensor which we have used is MQ135 which is highly sensitive to Ammonia, Sulfide and Benze steam. MQ135 is also sensitive to smoke as well as other harmful gases. MQ135 sensor is available at low cost and it is particularly suitable in the applications of air quality monitoring [4]. MAX30100 Oximeter module is used to measure the blood oxygen saturation level in the body, which is an important factor for the detection of COVID-19 disease. The operating range of the module is from 1.8V to 3.3V. Li-Polymer battery is used for charging and HC- 05 is the Bluetooth module used for interfacing the hardware to the mobile application. It is used for wireless serial connection setup [5]. HC-05 module is a simple to utilize Bluetooth Serial Port Protocol module, intended for straightforward remote sequential association arrangement is used.

C. Wireless charging concept

Wireless charging has a great influence in the medical sector in the context of being able to charge implants and sensors long term that are located beneath the skin. Researchers have been able to print wireless power transmitting antenna on flexible materials that could be placed under the skin of patients. This could imply that under skin gadgets that could screen the patient status could have a more drawn out term life and give long perception or observing periods that could prompt better analysis from specialists. These gadgets may likewise make charging gadgets like pacemakers simpler on the patient as opposed to having an uncovered part of the gadget pushing through the skin to permit corded charging. This innovation would permit a totally embedded gadget making it more secure for the patient. It is hazy if this innovation will be supported for use — more examination is required on the security of these gadgets.

Figure 2: Wireless charging of the smart mask

V. APPLICATION BUILDING

Firstly, the layout of the app has been layered. There are two screens in this app. One for authentication and one for dashboard. For authentication we have used Gmail account selector. Once the account is selected figure print authentication is prompted. Once that's done the dashboard is opened. In dashboard we have three variables getting constantly updating. SpO2 temperature and air quality. For self-cleaning of mask the button is given in the app. In dashboard first the Bluetooth should be turned on and then the desired Bluetooth ID should be selected. Once it's connected the data will start getting updated. And the UV mask cleaning button will be enabled. The following the screenshots of the app and steps to connect the mask to the mobile phone:

Step 1 – Open the mobile application the phone.

Figure 3: Smart Mask Application

Step 2 – Select a google account from the list.

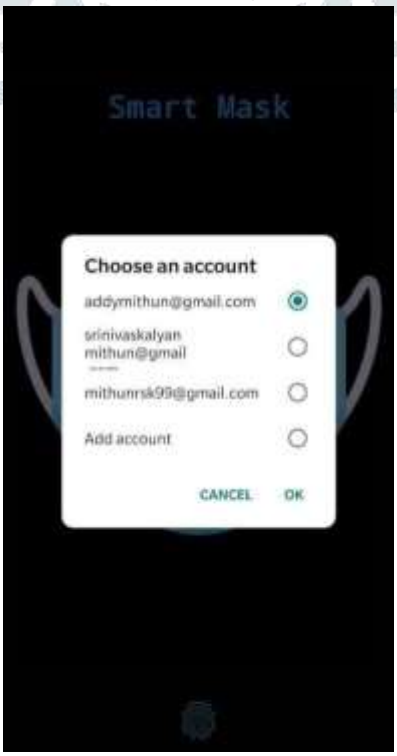

Figure 4: Gmail account authentication

Step 3 – Click ok and scan the fingerprint for verification.

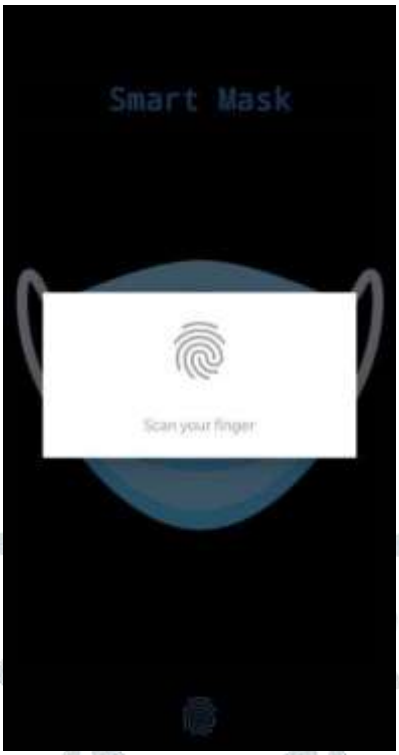

Figure 5: Finger print authentication

Step 4 – Select the Bluetooth name of the mask (in this case HC – 05).

Figure 6: Selection of Bluetooth module

Step 5 – The mask will be connected and the parameters will be displayed.

Figure 7: Dashboard with three variables

VI. OUTCOMES

The mask is well designed to sanitize the virus using Ultra Violet LEDs which emits UV radiation. It also incorporates essential features like the body temperature sensing, air quality sensing and oxygen saturation measurement. This project emphasis on the concept of reusability of the mask, by heating it up to a virus lethal temperature and thereby reducing the need to purchase masks frequently. This also helps in rapid reduction of usage of plastic masks, which is hazardous to the environment. This project is cost-effective as it helps in avoiding frequent investment in mask.

Figure 8: Various sensors, oximeter module and UV led interfacing with NodeMCU , integrated with N95 mask.

The mask can be reused by sanitizing it using UV radiation. The sensors were successfully into the mask in order to retrieve various body parameters for infection detection. The parameters include blood oxygen saturation using reflectance pulse oximeter sensor, body temperature detection, and air quality detection around the subject wearing the mask. Reusing the mask is economically beneficial for the poorer. It has a huge impact on the environmental effects of medical/single use/polysynthetic masks as every mask that is saved from being used is one saved from affecting the environment.

This paper also focuses on sustainable solution for a global problem. This is a safe and effective method to sanitize the mask without changing

the composition and state of the materials on the mask.

Since the mask comes in direct contact with the face (which is the most sensitive part of the body with various sensory organs), we have used the safest available battery at the time i.e. lithium polymer battery.

The application shows the parameter values of Oxygen saturation, Body temperature , Air Quality sensor. The normal oxygen saturation level for an individual is 95%-100%. For a typical adult, body temperature can be anywhere from 97 F – 99 F. The air quality index standard measurements are: 0-50 is good air, 51-100 is satisfactory air quality, 101-200 is moderate quality of air, 201-300 is poor, 301-400 is very poor and 401-500 is severe bad quality of air. The app is connected to mask using Bluetooth.

The mask was experimented on five different subjects and the following are the parameters obtained from the mobile application of all the subjects:

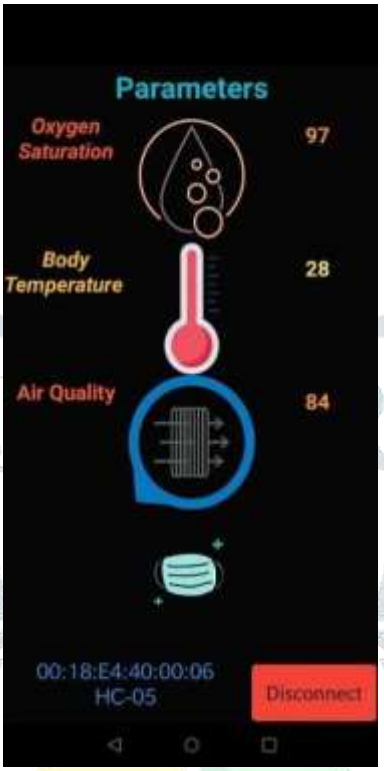

Figure 9: Readings from subject 1

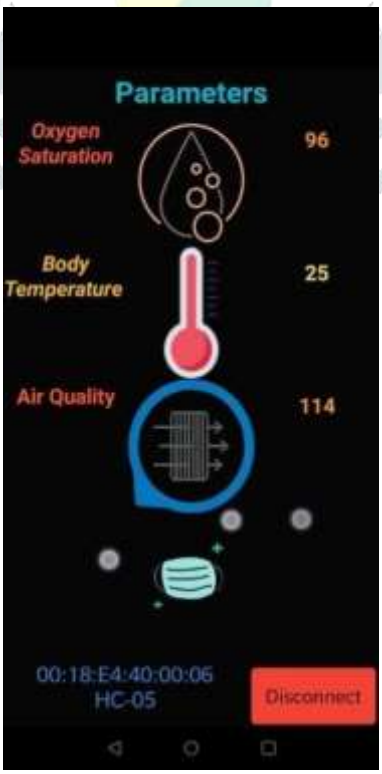

Figure 10: Readings from subject 2

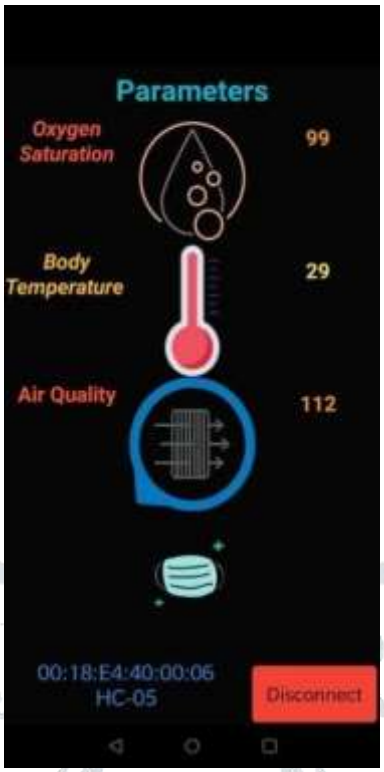

Figure 11: Readings from subject 3

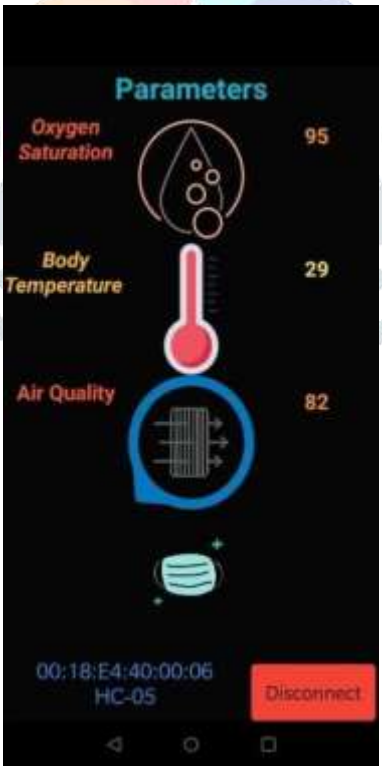

Figure 12: Readings from subject 4

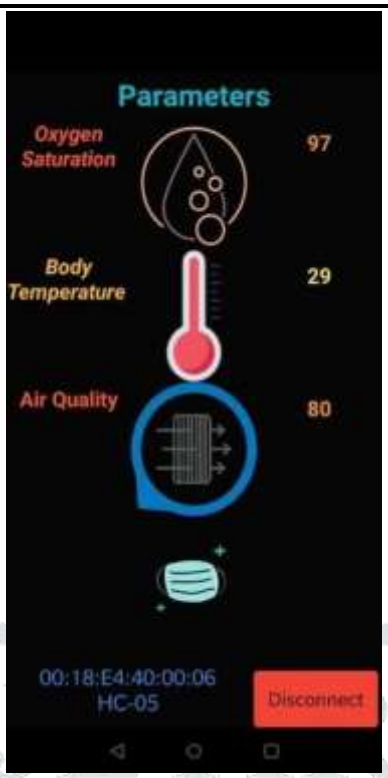

Figure 13: Readings from subject 5

VII. RESULTS AND TABLE

The application shows the parameter values of Oxygen saturation, Body temperature , Air Quality sensor. The normal oxygen saturation level for an individual is 95%-100%. For a typical adult, body temperature can be anywhere around 37°C (97 F – 99 F). The air quality index standard measurements are: 0-50 is good air, 51-100 is satisfactory air quality, 101-200 is moderate quality of air, 201-300 is poor, 301-400 is very poor and 401-500 is severe bad quality of air. The app is connected to mask using Bluetooth.

Subject	Oxygen saturation readings in percentage(%)	Body temperature in degree celsius(°C)	Air quality in parts per million(ppm)
1	97 - Normal	28- Normal	84 – Satisfactory quality
2	96- Normal	25- Normal	114 – Moderate quality
3	99- Normal	29- Normal	112– Moderate quality
4	95- Normal	29- Normal	82– Satisfactory quality
5	97- Normal	29- Normal	80– Satisfactory quality

VIII. FUTURE SCOPE

The project can be made into a plug and play model, such that it can be attached to wearable mask. The user of the mask can attach or detach the mask upon any type of face mask according to his convenience.

The mask could be designed with a ventilation which uses an in-built air motor, to drive the pivot on wind cavity, which can gasp air and exhaled gas will be expelled through the outlet at the bottom. This idea can generate air with great effectivity and diligently relinquish fresh air.

IX. DISCUSSION AND CONCLUSION

The integrated smart mask will be a one-step solution for multiple problems ranging from viral spread to being environment friendly. Worn once, the thin protective materials can take hundreds of years to decompose. Experts now estimate that each month, 129 billion face masks and 65 billion gloves are used and disposed of globally. With a surgical mask weighing roughly 3.5g, that would equate to 451,500 tonnes of masks a month and, when placed next to one another, cover an area roughly three times the size of Singapore. Conservationists and non-governmental organisations are increasingly concerned that a lot of the plastic waste, especially pandemic-related waste, is ending up in landfills, waterways and oceans, adding to the millions of tonnes of plastic waste already dumped into the world's oceans every year.

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