# Multifunctional Electronic Mask with inbuilt Parameters to Fight against Infectious Diseases

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## Abstract

*On 11th March 2020, the World Health Organization quoted the COVID-19 outbreak as a Pandemic. The electronic mask has been designed and developed at that moment for protection from inhaling coronavirus, influenza virus, and very small microbes that are transmitted from the air. The SARS-CoV-2 has become an imperil, at the present moment causing remarkable demands on health technologies across the globe. The present work demonstrated a wearable mask equipped with an active sensor that would continuously monitor the health parameters of the person. In the wearing mask, a mist maker module is used to give protection to the user. This electronic mask- is integrated into sensors, battery, and sanitizer spray. This is an ecosystem aiming to prevent and control the spreading of respiratory viruses. Our product has more filtration efficiency than other ordinary face masks as a three-layer filtration system is present. With the comparison between the market-available mask and our product, our product shows 99.97% efficiency. It automatically measures body temperature and it has sufficient accuracy to control the presence of $CO_2$. It is a new type of mask with active air supply and breathing and it can also detect some physical parameters.*

***Keywords*- Coronavirus, SARS-CoV-2, protection equipment, filtrations, temperature measurement, mist module spray.**

## Introduction

The coronavirus disease COVID-19 or SARS-CoV-2 virus was first reported to the World Health Organization (WHO) in Wuhan, China, in December 2019. Based on their sizes, the respiratory droplets can be separated into two primary groups: aerosols that are less than 5 μm in diameter and droplets that are greater than 5 μm [1]. Droplet transmission is distinct from airborne transmission, which involves the existence of microorganisms within droplet nuclei [2]. Droplets typically settle within 1-2 meters due to gravitational forces, although lighter aerosols can travel for extended distances of several meters. The virus is spread through respiratory droplets that are produced when an infected person sneezes, coughs, or even speaks. These respiratory droplets transmit the virus. While direct contact with an infected person who is coughing or sneezing and transferring the infection to any surface that could distribute it to other people is the primary way that the virus spreads [3]. The new coronavirus can be transmitted by both tiny and big droplets, with small droplets posing a greater risk than large droplets since they may remain airborne for longer periods [4]. Many nations passed legislation regulating the use of masks [5,6], and masks have become a daily requirement, even in people's social life. In early 2022, there was a widespread belief that the COVID-19 virus, like common cold flu viruses, could become endemic [7]. The lack of expertise and insufficient understanding of COVID-19 hampers current improvements in the respirator and face mask research, product development, and production [8]. Wearable gadgets called electronic masks can take the place of standard, disposable hygiene masks. By observing how users interact with masks in various settings, the job was developed. The wearability of the electronic mask is being evaluated for the first time, and this approach to evaluation could increase user convenience [9]. The previous 10 years have seen a variety of studies on face mask appliances. Numerous more good works have been completed, including disclosing novel treatment regimens, evaluating the efficacy, introducing and contrasting different anchoring systems, and many others [10]. However, the pandemic has exposed significant shortcomings in the capacity to produce and increase global manufacturing of effective surgical-grade face masks. Many researchers have thus concentrated their attention on the creation of inexpensive, smart, and efficient face coverings [11]. Many people are involved in providing smart healthcare, including individuals, hospitals, and research organizations. It is an organic totality that encompasses several aspects, including hospital administration, health decision-making, illness prevention and monitoring, diagnosis, and treatment [12]. A quick fix is required to stop the virus from spreading, and this can be accomplished by adhering to WHO guidelines that call for wearing face masks and avoiding close contact with others [13]. The WHO anticipated in early March 2020 that 89 million masks will be required each month for medical purposes alone, underscoring the need of focusing the availability of medical masks and respirator-type masks for medical usage [14]. Examples of common passive devices that reduce the transmission of suspended infections include surgical masks, N95 masks, and face coverings. These passive devices place an aerosol-filtering barrier between the user's nasal and mouth cavities and the environment. Our product cut the limitations of passive masks by using sensors, HEPA filters, and mist spray modules. The present solution determines ambient air quality using an onboard controller. The application also gives users the option, if necessary, to bypass the onboard control system and manually operate the mist generator module. This smart electronic mask triggers a piezoelectric actuator to produce a mist spray if necessary [15]. The initial and greatest import of this humanitarian

effort is filtering based on the face mask. The use of automatic temperature detection is the second and equally significant phase. Arduino UNO board and temperature sensors are used to detect the temperature. For instance, the buzzer sounds like a warning if someone with a body temperature greater than 38 degrees. The sanitizer mist module is integrated into our electronic smart face mask. So, the person who used this mask can sanitize himself or herself automatically.

## Methodology

### 1.1 Block Diagram

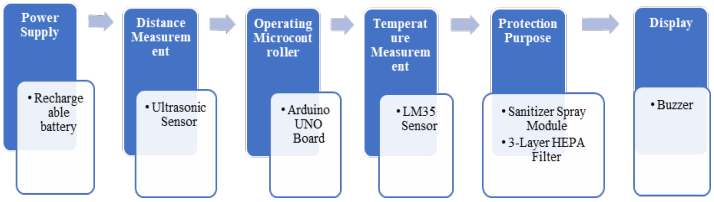


**Figure 1. Block Diagram of an Electronic Smart Face Mask**

The ultrasonic sensor, buzzer, and 5V relay are just a few of the components that receive power when the Arduino board is powered by a USB connection. There are three batteries: the first powers the relay, the ultrasonic sensor, the Arduino board, and the buzzer. The sanitizer sprayer machine is powered by the second source and the temperature detector by the third. When the ultrasonic sensor (HC-SR04) is turned on successfully, it begins to broadcast ultrasonic waves using the transmitter, and if it encounters any obstructions within a predetermined distance as specified in the program, it reflects the receiver. When the sound is received again, it sends a signal to the Arduino UNO Board for additional processing. After the board processes the signal, it triggers the necessary circuit according to the program; if the range is 3 feet, the buzzer will be triggered, and if it is 20 cm, the 5v relay will be triggered. The 5v relay is connected to the Arduino board, the common pin is connected to the negative supply of the secondary battery, and the normally open pin is connected to the negative terminal of the battery. The buzzer will activate if the signal is reflected from the item at a distance of three feet, and the sanitizer dispenser unit will activate if the signal is reflected at a distance of twenty centimeters. Using a mist maker, the sanitizer in the container is transformed into mist before being released for sanitization. In the second section of the mask, which is worn at all times, a temperature detector has been employed to measure our body temperature. When the mask comes into touch with our bodies, a sensor inside the mask measures our body temperature and transmits the data to the processing and display portion, where the temperature is shown. This function allows others to promptly take protective measures by alerting them to any changes in their body temperature. Additionally, the mask has a three-layer filtering mechanism that aids infiltration. This autonomous, rechargeable mask has a few cutting-edge features. The sanitizer dispenser battery may be charged via the micro-USB connector. We may also use a power bank with the mask for a prolonged duration of work to improve the experience. Even though the preceding description and the figures that are linked to this document have been used to describe the present invention, new ideas, and techniques may lead to alterations. To make our invention as capable of solving problems in the real world as possible, these will occasionally be incorporated. We may also utilize a power bank of 5 volts in conjunction with the mask for extended periods to improve the experience. Even though the preceding description and the figures that are linked to this document have been used to describe the present invention, new ideas, and techniques may lead to alterations. To make our innovation as capable of fixing issues in the actual world as possible, these will occasionally be integrated.

### 1.2 Schematic Diagram

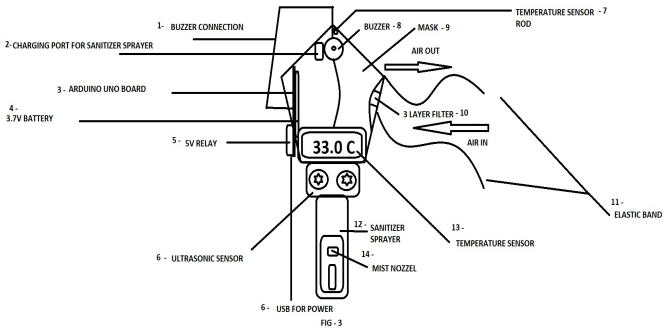


**Figure 2. Schematic Diagram of an Electronic Smart Face Mask**

### 1.3 Overall Framework

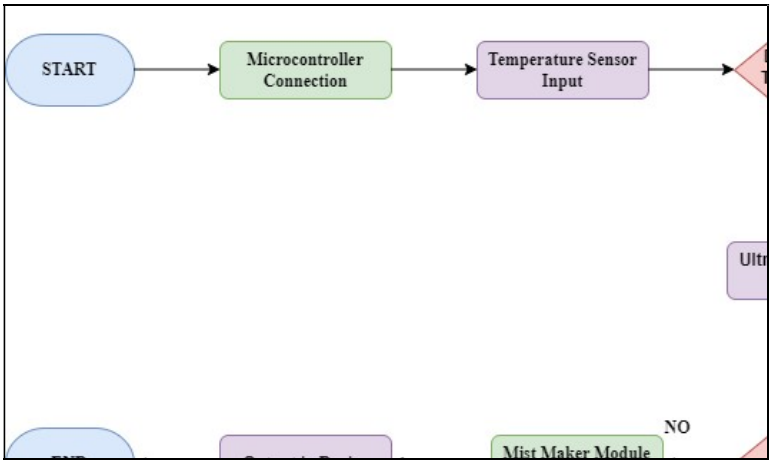


**Figure 3. Working Flowchart of Electronic Smart Face Mask**

### 1.4 Operational Principles

The Arduino board controller is used to connect to and manage the LM35 sensor, which has an operational temperature range of -55 °C to +150 °C. By merely connecting the sensor to the analog pin on the Arduino board controller—which already has an internal ADC—we can simplify our additional computation problem. This configuration is positioned within the mask such that the sensor faces the nostrils. The air particles in the hallway allow the sensor to detect the wearer's body temperature, and the sensor's linearity property allows it to translate the analogous voltage into the desired electrical quantity [16]. Since the average human body temperature ranges between 97- and 99 degrees Fahrenheit (36.1 and 37.2 degrees Celsius), any changes or modifications can be a major sign that certain vital parameters are abnormal. Maintaining a distance of at least one meter between people so that they do not come into touch with one another is known as social distancing and is a tried-and-true method for efficiently stopping the transmission of the virus [17]. The ultrasonic sensor in this block diagram detects the object; the output of the ultrasonic sensor is applied to the LM38, a non-contact IR temperature sensor built on a high voltage analog temperature sensor; and the electric output of the LM38 is fed to the Arduino UNO. If the temperature of a person is higher than normal, the buzzer begins to buzz. The Smart Mask's energy management system is a key component. Customer satisfaction depends heavily on battery life. We used LI-PO battery which is rechargeable. The HEPA filter for filtration can also be changed according to our necessity.

## Result and Implementation

### 1.5 Framework Implementation as Hardware

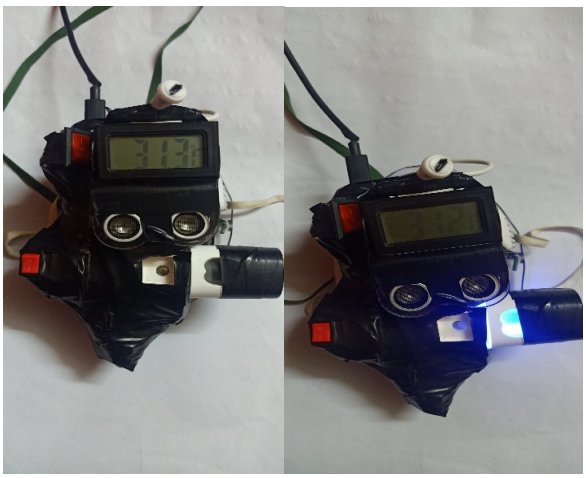

**Figure 4. Hardware Implementation of an Electronic Smart Mask**

The weight of the smart electronic mask is 100gm with the sensor on board. The face cover width of this mask is 12cm and the face cover height is 10cm. After the cleaning procedure, another significant factor that has been examined has been the facemask's comfort while being worn. The total manufacturing cost of our product is

Rs.1000 to Rs.1200 including the electronics. In our product digital technology has been used to measure temperature, an infrared thermometer without contact. The motor sprays because the sanitization procedure is simulated appropriately by a software-based device circuit. The motor sprays because the sanitization procedure is simulated appropriately by a software-based device circuit. For the sanitization process, a mist module is used.

## Conclusion

Face mask demand and cost have dramatically increased as a result of the COVID-19 pandemic's widespread presence in the world, especially in the early stages of the outbreak. For the world to continue to run smoothly and safely in the face of the deadly virus, the pandemic has put the survival of all life on Earth in danger [21]. Choosing the best face mask to protect the wearer from the transmission of the SARS-CoV-2 virus under all circumstances is a difficult task, even though there is a wide variety of commercial masks available on the market. This is especially true given the current commercial availability of face masks of the same type but with different shapes and filtering properties. This is because using face masks, hand sanitizer, and maintaining a social distance from others are the only lines of defense currently available to people, especially those who are immunocompromised. One of the best ways to stop the coronavirus from spreading would be to recognize the symptoms of the infection as soon as possible. One of the best methods for preventing the transmission of the virus is social safety distance, which lowers the potential exposure to infectious particles [22]. Different types of tests were conducted: some focused just on measuring temperature, others were created with sanitization in mind, and yet others were meant to look for face masks. Body temperature sensing, sanitization, and social distance maintenance are all components of this electronic smart face mask, which is an integration of all three. Our electronic smart mask provides a novel monitoring system for the real-time early detection of coronavirus. There are several situations when it is essential to directly measure or at the very least monitor high temperatures [23]. In a crowd, the intelligent mask can identify people with elevated body temperatures and display the information. A significant role has been performed by wireless sensors in several sectors for data collecting [24]. Implantable medical devices are affixed to people's bodies via surgery or other clinical procedures to carry out particular tasks [25]. This mask has no negative effects on either our bodies or others nearby. Industrial AC drive systems based on FOC (Field Oriented Control) are currently very close to becoming ideal [26]. In the modern period, any nation's economy is dependent on its use of energy [27]. A triple-layer protection mask with an automatic safety, sanitization, and temperature detection system. With the ability to detect our body temperature, this mask can be used for safety and sanitization purposes.

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