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An IoT Based Model to Defend Covid-19 Outbreak

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Abstract*: Covid-19 is a pandemic that has swept the globe since the end of 2019. Scientists are working around the clock to create a vaccine to combat the Coronavirus. People are now monitored using smart-phone and web-based software. The Internet of Things (IoT) refers to items that have sensors embedded in them. To check the spread of Covid-19, the IoT can be used. Social Distancing breaks the chain of spreading. It has an effect not only on healthcare spending but also on the speed at which infected patients recover. IoT can be used efficiently for maintaining social distance. As a result, the current research aims to define, analyze and highlight the inclusive applications of the IoT philosophy by providing a perspective roadmap to combat the COVID-19 pandemic by maintaining social distancing. Reviewing the literature, a real-time detecting and alerting method for the COVID-19 condition monitoring is proposed.

***Keywords*: Internet of Things, Monitoring, Alerting, COVID-19 outbreak, Social Distancing**

I. INTRODUCTION

The Internet of Things (IoT) is a very well system of interconnected computational methods, virtual and mechanical tools that can move data across a given network without a need for human interaction at any phase. IoT is now a well-established and proven technology that connects a plethora of tactics, rapid research, machine learning theory, and sensory products, among other things. In addition, IoT is described as the functionality of products or equipment that support real-life human needs in a variety of ways, such as home security, smart classrooms, smart healthcare systems, and many others that can be easily controlled by our daily use of laptops, smartphones, and other devices. In the current pandemic crisis, most nations, including India, are battling COVID-19 and are also searching for a realistic and cost-effective technology to tackle the issues that have arisen in a variety of ways. Unfortunately, no effective treatment or vaccination has been successfully applied yet. Some vaccinations has been come such as COVAXIN (India), SPUTNIK (Russia) etc. but the vaccination process will take time to cover overall population. The production of an effective drug is supposed to take over more time, especially as the existence of the new strain of virus has not yet been fully identified (Mônica Vitalino de Almeida et al., 2020). Researchers and scientists are working to solve these issues by coming up with new ways to clarify new study problems, create user-centred explanations, and construct ourselves and the civilian population in general. Today, the only way to slow the spread of Corona disease is to use precautions such as social distancing, hand washing, and face masks (i.e. "flattening the curve"). Many tools, on the other hand, are being used to combat the symptoms of the COVID-19 pandemic. AI, Block chain, IoT, and next-generation cellular networks such as 5G are some of the most common emerging technologies that will play a key role in pandemic 2021 (Ting et al., 2020). According to the WHO and the CDC, modern technology can contribute significantly in improving health services in response to the COVID-19 pandemic (World Health Organization, 2020). The use of IoT potential applications has increased in today's world. Early identification (or prediction) and monitoring of new COVID -19 cases using IoT technology can also help to limit its spread (Kelly, 2016). (Hlaing et al., 2018). Some current systems, such as the Aarogya Setu App, are being used to alert people to the presence of a COVID-19 suspected patient. However, it is not uncommon for a large number of people to be symptom-free.

As a result, they do not update their information on the App. As a result, people come into contact with an infected individual in the public domain without their knowledge. As a result, the disease begins to spread from one infected individual to another.

As a result, the current COVID-19 patient communication system often fails due to a lack of knowledge. This paper proposes a COVID-19 alerting digital belt system using the Arduino UNO board and an Ultrasonic sensor. The remainder of the paper is laid out as follows. The second section contains a thorough analysis of the literature. The proposed IoT model, as well as its components and functionality, are discussed in section 3. Finally, section 4 brings the job to a conclusion.

II. LITERATURE REVIW

Kevin Ashton, Executive Manager of the Auto-ID Centre, coined the term "Internet of Things." It became well-known in 2003 as a result of the Auto-ID Centre, as well as related market studies and publications. Various business organizations concentrated on the development of IoT and attempted to comprehend its significance, beginning to realize its role and potential aspects,

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and then these organizations began investing in the IoT sector at regular intervals in various times (Luigi A., Antonio I., 2010). Wu et al. created a hybrid Internet of Things (IoT) protection and health monitoring system. The model's primary goal was to ensure outdoor safety in COVID -19 scenarios. Environmental safety measures and consumer health signs have been obtained using wearable devices (Wu et al., 2019). Rath and Pattanayak used IoT technology to create a literary-inspired smart healthcare hospital in urban areas. For patients in the VANET region, issues such as hygiene, protection, and prompt treatment were addressed. NS2 and NetSim simulators were used to test the proposed system (Rath & Pattanayak, 2019). Din and Paul created a smart health monitoring system as well as a management mechanism for it. This architecture is based on the Internet of Things (IoT). It has three layers: the first will collect data using medical sensors and processing, the second will use Hadoop processing, and the third will use application layers. Due to battery power limitations, a piezoelectric device was connected to the human body (Din & Paul, 2019). Hamidi concentrated on the protection and privacy of health-related data in the Internet of Things. A biometric-based authentication technology was proposed by the author (Hamidi, 2019). Darwish et al. proposed a Cloud-based IoT-Health model in the health sector, which incorporates cloud computing and IoT. The challenges of integration as well as the most recent innovations in the IoT-Health cloud were discussed in this paper. Infrastructure, accessibility, and networking are the three layers of these issues (Darwish et al., 2019). Usak et al. looked at the use of IoT in healthcare programs, as well as the drawbacks of using IoT to provide healthcare services (Usak et al., 2020). Rao and Vazquez proposed a machine learning system for tracking potential COVID-19 events. The research was conducted using a smartphone-based online survey that gathered data from the consumer (Srinivasa Rao & Vazquez, 2020). Allam and Jones discussed the need for smart cities to establish proper protocols for exchanging information during pandemics caused by COVID-19 outbreaks. For example, AI procedures can be used to classify possible COVID-19 cases in thermographic camera data gathered in smart cities (Allam & Jones, 2020). Zhong and Li also looked at how to monitor college students when they were exercising. The focus of the article was on the Physical Activity Identification and Monitoring paradigm, which included data preprocessing (Zhong & Li, 2020). Otoom et al. suggested an IoT-based prototype model (ARIMA and Markov) for real-time blood glucose regulation (Otoom et al., 2015). Alshraideh et al. created an IoT-based method for detecting cardiovascular disease. For CVD detection, machine learning algorithms were used(Alshraideh et al., 2015). Nguyen demonstrated some of the Artificial Intelligence (AI) methods used in COVID-19 research. These methods, as well as the use of IoT, have been divided into several parts in this study (T.T. Nguyen, 2020). Maghdid provided smartphones with sensors to collect patient health data such as temperature (Maghdid et al., 2020). Fatima et al. proposed using the Internet of Things to monitor COVID -19 events. A fuzzy inference framework was used to develop this method (Fatima et al., 2020). Mohammed suggested a smart, thermal-mounted helmet imaging system for detecting sick people in crowds (Mohammed et al., 2020). It also has a facial recognition system installed. Scanning the crowd with an infrared camera, and if any person with an extreme temperatures is detected, the face is captured with a digital camera.

III. METHODS

A. *COVID-19 Outbreak*

An unprecedented outbreak of unknown etiology occurred in Wuhan of Hubei, China in December 2019. The WHO reported that the outbreak of novel coronavirus as causative agent with limited evidence of COVID-19. SARS-CoV-2 embodies ssRNA genome containing 29891 nucleotides encoding 9860 amino acids and shows various types of mutations such as D614G. The epidemic of this virus was officially declared an emergency of International Concern by the WHO in January 2020. In India, nearly six months after the peak of the first wave in September 2020, COVID cases once again rising from first week of March, 2021 signaling the arrival of second wave of the pandemic. The number of cases of laboratory-confirmed coronavirus has risen at an unprecedented pace worldwide, with more than 157,591,742 confirmed cases including 3,284,031 deaths as on May 08th 2021. The third phase is also inevitable and we should prepare for the new wave. The COVID-19 or "Coronavirus Disease-2019" is one of the novel respiratory ailments caused by SARS-CoV-2. SARS-CoV-2 is an encompassed infectious virus of order: Nidovirales, family: Coronaviridae of ss(+)RNA viruses and group: Beta corona virus. Coronavirus has spherical to pleomorphic enveloped particles. The shape of RNA is either helical or rounded in this virus. Human coronaviruses grouped into either OC43 or 229E serotypes. It may be L or S type with little contrasts at two spots. It is explained for that L type was more common in an early episode. Its non-segmented genome is comprised of 26.4-33.5kb to encode four structural (Nucleocapsid or N, membrane or M of ~25-30kDa, spike or S of ~150kDa and envelope or E of ~8.12kDa) proteins and few non-structural proteins. It has G + C contents of 32 to 42%. Its genes for major proteins present in 5’ – 3’ order as S (spike), E (envelope), M (membrane) and N (nucleocapsid) along with at least six ORFs. The glycoproteinous club-like tip in the envelope gives the crown-like appearance of this virus. The protein groupings of the spike of ~80virus has been adjusted and taken a gander at phylogenetically. The exact source of the virus, however, is unclear, and its gene sources are usually derived from bats and rodents(Cascella et al., 2020). It is reported that the spike of SARS-CoV-2 is stated to be 10-20 times bound to bind angiotensin-converting enzyme 2 (ACE2) on cells of human. ACE2 is produced by the gene SLC6A20 present on the 3rd chromosome of man. As indicated by one report, coronaviruses may be divided into four subgroups as α, β, γ and δ. Six zoonotic corona viruses, HCoV 229E (α), NL63 (α), OC43 (β), HKU1 (β), SARS-CoV (β), and MERS-CoV (β) are competent to cause either mild or severe and acute respiratory diseases. SARS-CoV-2 is also renowned for its D(Asp)614G(Gly) mutation in spike. Therefore, the underlying D614 is now the G614 variant. Results indicated that patients tainted with G614 variants have a more viral load in comparison to D614.

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In the first week of April 2021, a new variant of coronavirus named as N-440 or AP has been reported in Chandigarh, India. Recently, B-1.1.7; B-1.135 (South Africa); B-315, B-351, B-1.617; B-1.618, P.1 (Brazil) variants, as compared to world prototype of A2A, have also been reported. But S-G614 difficultly binds ACE2 than S-D614. These findings derive more stability of S-G614 contrasted with S-D614. An average of 15 days is required for its mutation. SARS-CoV-2 multiplies with the help of its copy machine, sometimes known as corona virus polymerase. B-1.617 (double mutant variant from India) showed E484Q and L452R mutations in the spikes. One of the clusters of B-1.617 did show E484Q but had T19R and D950N mutations. The virus was initially found to influence human existence in Wuhan of Hubei, China in Dec. 2019. From that point forward, it has spread more stunning all through the remainder of the world, signifying its essence in 213 countries and autonomous regions. As per the WHO, the current overall tally of COVID-19 cases remains at 157,551,742 while the loss of 3,284,031 lives as on May 08th 2021(Coronavirus Disease (COVID-19), n.d.). The snappy in the amount of these virus scenes on global scale has actuated the necessity for sure-fire countermeasures to check the cataclysmic effects of the virus flare-up. Covids are large, often round ss(+) RNA infections ranging in diameter from 600-1400nm, with proteins have been identified as spikes expanding from the surface, giving them a crown-like appearance under the electron microscope (EM). The SARS-CoV-2 outbreak began in China's Guangdong province and extended to 37 countries around the world, resulting in over 8000 illnesses and 774 deaths (Singhal, 2020). The bulk of the MERS-CoV outbreak was discovered in Saudi Arabia, which sparked a massive outbreak across the Middle East, resulting in 871 deaths (Brencic et al., 2017). The COVID-19 scene became uncovered in December 2019 when 27 instances of pneumonia of dark etiology were represented by WHO in Wuhan City of Hubei Province in China(Nasajpour et al., 2020). The focal point of the scene was connected to Wuhan's discount market for fish and other outlandish creatures, including snakes, bats and marmots(Bleibtreu et al., 2020). Another strain of a significantly contagious coronavirus, SARS-CoV-2, has been viewed as a subject for the quick flare-up of this virus. The infection's distinguishing characteristics include its incredibly contagious nature and a relatively long hatching period of 1-14 days. During this time, a person may be infected with the infection without showing any symptoms. While the vast majority of patients of this virus built up a gentle to direct sickness, a couple of patients were determined to have an extreme (13.8%) and a basic (6.1%) type of the same(Chamola et al., n.d.). Patients with serious or basic illnesses frequently create somewhat blue lips and are slanted to an assortment of confusions, including ARDS, intense cardiac damage, and auxiliary contamination. As indicated by the US-CDCP, the people at the most noteworthy danger for serious ailment from this virus joined individuals (age >60 years) and individuals with existing ailments, for example, diabetes I and II, hypertension, asthma and CVD(Lee, n.d.).

B. Proposed IoT Model

In this time of COVID-19 crisis, it has become mandatory to maintain social distancing at public places, crowd etc. For handling real-time problems, IoT is application-specific, low-energy, dependable, and simple to use. Sensors provide information about the real world that's been transmitted through the network, and actuators allow objects to response to the input they have received. Significant sensors used in IoT systems include the Ultrasonic sensor, thermometer, infrared, optical camera, smart watch, and IP camera. Figure 1 depicts a proposed IoT scheme for preventing the spread of COVID-19. A digital belt with an Ultrasonic sensor is connected to the Arduino UNO board in the proposed model. This model must be crafted in the form of a belt so that it can be worn as a waist-belt. Whenever we are in the public domain area, we have to switch on this model circuit, which is battery operated and has a switch to on and off the belt.

C. Working Principle

Whenever a person wearing this belt goes in the public domain, the Ultrasonic sensor in the belt will sense the any person coming closer than 6 feet and the buzzer attached with this belt will produce a beep sound that will put the attention of that person that he/she can come in contact with another person or has touched any anonymous object which can be virus infected(Haque et al., 2020). The block diagram of this model can be shown through Figure 1. This connectivity of this Arduino board and Ultrasonic sensor with Buzzer can be shown through Figure 2. Now the person will be alert of touching the face, nose and eyes(Ajit Kumar, 2020). Once the person will wash the hand, and then only the buzzer sound will stop buzzing by resetting it.

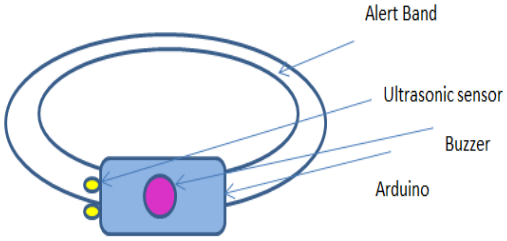

Figure 1: COVID – Belt

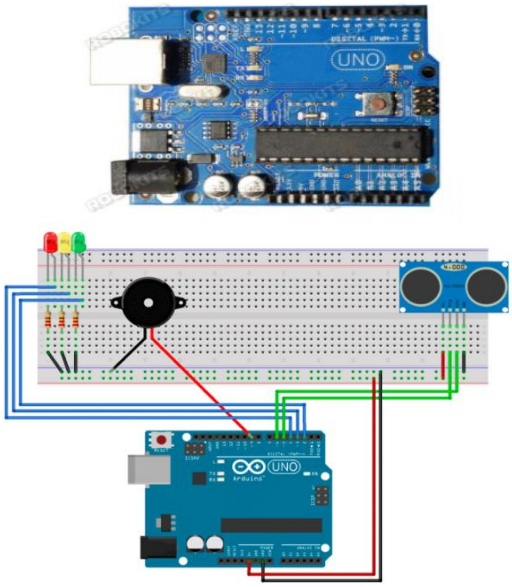

Figure 2: Arduino UNO Board and Connectivity of UNO Board, Ultrasonic sensor & Buzzer

D. Algorithm for Proposed Model

Though the vaccination has arrived, but still we have to maintain social distancing. “Social distancing” is one of the most effective way to fight against Corona Virus.

This model is designed keeping that in mind. Algorithm for the proposed model is:

Algorithm

Start

Arduino UNO gets input from the Ultrasonic sensor when we move closer to any other person.

If (IR will sense the object at d>6 ft and d<8 ft)

Arduino will activate the output pin AND at the output pin, the buzzer will start producing “Careful warning” alert sound.

Else If (IR will sense the object at d<6 ft)

Arduino will activate the output pin AND at the output pin, the buzzer will start producing “Critical warning” alert sound.

Else

Person is maintaining “**Social distancing”.**

End

E. Coding for the proposed model

Given Arduino code can be used for developing this proposed model. Arduino Blink Software will be used to code this model (Haque et al., 2021). Following is the screen of Arduino Blink:

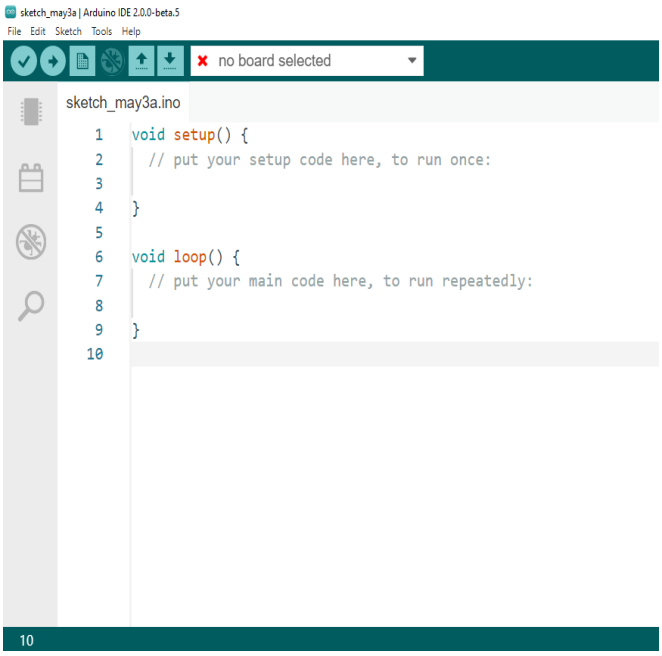

Figure 3: Arduino Blink Software

Arduino Blink Software is shown in Figure 3. Now, the Coding for Proposed Model is shown in Figure 4. This coding when uploaded on the Arduino will work according to its logic.

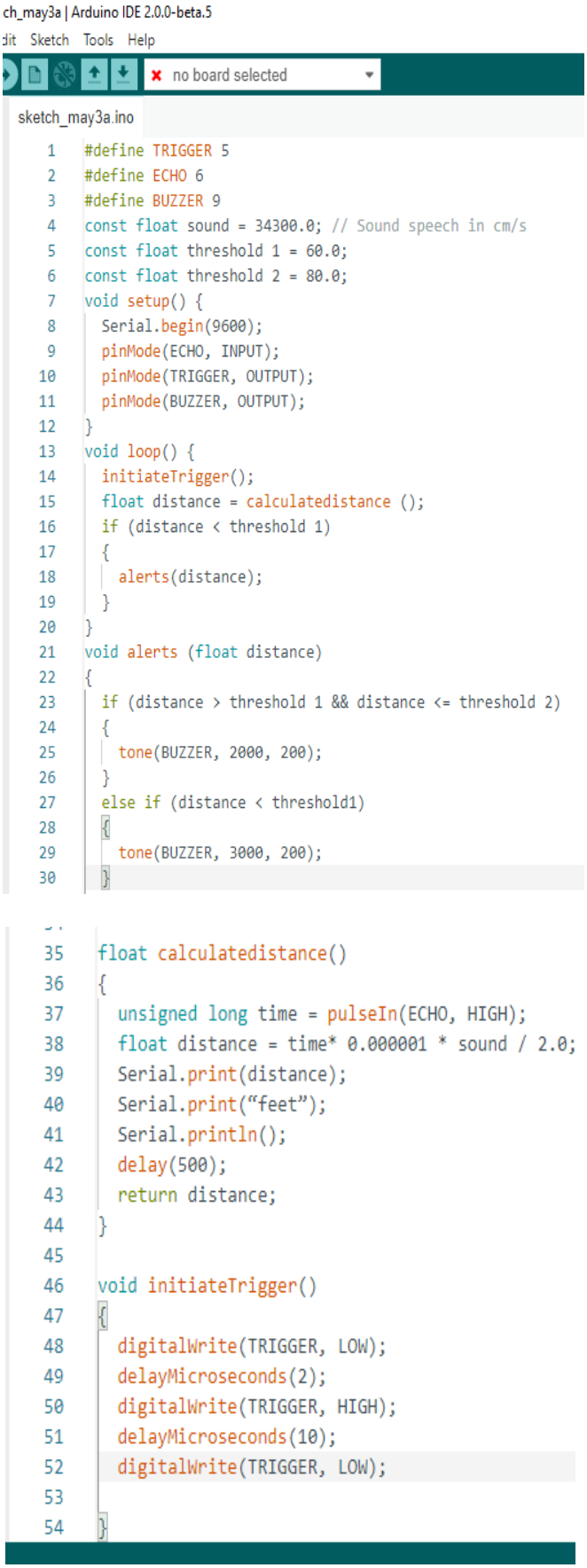

Figure 4: Coding for Proposed Model

The code given in Figure 4 will be uploaded and Run in the Arduino UNO Board and then the device will start sensing the coming object. According to their distances, the alert sound will be produced from buzzer. When the code was uploaded to the Arduino and get executed, it started producing warning alarm when any person comes in its range.

IV. EQUATIONS

The speed of sound is around 340 meters per second. This is equivalent to 29.412 microseconds per centimeter. We use the formula to calculate the distance traveled by sound:

Distance = (Time x SpeedOfSound) / 2

Since the sound must move back and forth, the "2" is included in the formula. The sound first moves away from the sensor, then bounces off a surface and returns to the sensor.

The formula for reading the distance in centimeters is as follows:

Centimeters = ((Microseconds / 2) / 29)

For example, if it takes 100µs (microseconds) for the ultrasonic sound to bounce back, then the distance is ((100 / 2) / 29) centimetres or about 1.7 centimetres. And we need to convert this centimetre into feet. As we know:

1 feet = 30.48 cm
And, 1 cm= 1/30.48 feet≅0.0328084 feet
Hence, we can convert centimetres into feet.

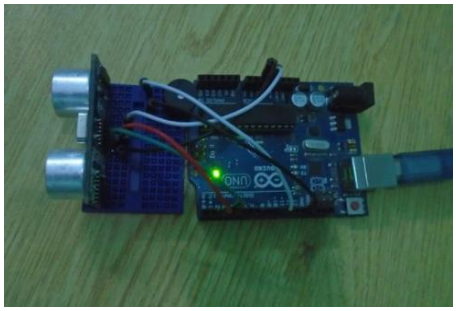

Figure 5: Working of the code with Buzzer

So, social distancing can be maintained with the application of model as waist belt. Figure 5 depicts the working of given code with ultrasonic sensor and buzzer.

V. RESULT AND DISCUSSION

As a result of the coding applied to the model, model will start working and will sense any person coming closer. “Careful alert sound” will be buzzer when the person is at a distance between 6 feet to 8 feet. It will produce a light sound buzzer. But when the coming person will be closer than 6 feet, it will produce “critical alert sound”. So that person can become alert of violation of “Social Distancing”. During this pandemic, along with mask and sanitizer, social distancing is one of the key factors in breaking COVID chain. We have to break the chain to save others. Therefore, social distancing and isolation is one of the important solutions during this pandemic.

VI. CONCLUSIONS

It's difficult to spot an infected individual. The only way to prevent the virus from spreading is to keep a social distance from the crowd. The use of IoT with smart sensors can assist in alerting the person and directing their attention away from crowded areas or touching their face, nose, or eyes. This model would also aid in the establishment of social estrangement. Many developed countries are experiencing economic hardship as a result of the lockout, and have begun the unlocking process. But in our country, a second wave of COVID-19 spread has been started. So we have to be clearer as we are in stage of Community spread i.e. third stage. As a result, the risks of viruses spreading in the population have increased. The proposed model would aid in protecting a person from COVID-19 by repeatedly alerting them and reducing the effect of group transmission.

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