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Role of IoT to avoid spreading of COVID-19

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ABSTRACT

Covid-19 has become pandemic, spreading all over the world. Scientists and engineers are working day and night to develop a vaccine, to evolve more testing facilities, and to enhance monitoring systems. Mobile and web-based applications, based on questionnaires, have already been developed to monitor the health of individuals. Internet of Things (IoT) can be used to avoid the spreading of Covid-19. Internet of Things is an interconnection of physical devices and the Internet. Devices are not only sensel and record, but can also monitor and respond. In this paper, we have reviewed the literature available on Covid-19, monitoring techniques, and suggested an IoT based architecture, which can be used to minimize the spreading of Covid-19.

1. Introduction

An increase in the use of mobile technology and smart devices in the healthcare sector results in a significant impact on the world. Potential development of new smart and powerful devices for monitoring of individuals' health, health experts are taking advantage of these technologies, thus a substantial improvement in healthcare in clinical settings and out of them. IoT allows integrating physical devices capable of connecting to the Internet and provides real-time health status of the patients to doctors. Chronic diseases such as diabetes, heart, blood pressor are remarkable in the world economic and social level problems. It can also provide a platform that allows public health agencies to access the data for monitoring COVID-19 pandemic. Fig. 1 shows the present trends of new cases of the top ten counties. New cases in the USA are increasing rapidly than in other countries. China has controlled the Covid-19, hence the rate of increase in new cases in China is the lowest.

2. Covid-19

Coronavirus is transmitted to humans, birds, camels, pigs, rats, bats, and cats. Bat origin coronavirus HKU2 was responsible for acute diarrhea syndrome in pigs in 2018. In November 2002, a novel beta coronavirus resulted in nearly 8000 human infections and 774 deaths in 37 countries. In 2012, Saudi Arabia identified the Middle East Respiratory Syndrome (MERS) coronavirus (MERS-CoV), which was the seventh member of the coronavirus family. COVID-2019 is closely connected to other bat-origin beta coronaviruses.

Zhu et al. [2] COVID-19's first case was identified, and a cluster of unknown patients with betacoronavirus pneumonia linked to the seafood wholesale market in Wuhan, China. A novel CoV (2019-nCoV) was detected in hospitalized patients in Wuhan, China, from December 2019 until January 2020. Evidence for this virus's discovery includes the identification of whole-, direct PCR, and bronchoalveolar fluid culture in three patients. Phylogenetic studies indicated that 2019-nCoV falls into the genus betacoronavirus, which provides for coronaviruses found in humans, bats, and other wildlife (SARS-, SARS- CoV bat, and others).

Guan et al. [3] analyzed the clinical characteristics of coronavirus and extracted data from 552 hospitals in 30 provinces, autonomous regions, and municipalities in China from 1099 laboratory-confirmed COVID-19 patients through January 29, 2020. The patients 'median age was 47 years; the patients were 41.9% female. The primary composite outcome occurred in 67 patients (6.1%), including 5.0% who were admitted to ICU, 2.3% who were subjected to intrusive mechanical ventilation, and 1.4% who died.

3. Role of IoT in healthcare

Joseph et al. [4] analyzed social media data based on three approaches: content, descriptive, and network analysis. Findings show that it can be used to extract the information of individuals likings and dislikings. Misra et al. [5] presented a review of IoT and depicted critical challenges in the same field. The article offers an outline of the IoT concept and its related technologies, application, and future scope of research of the area. Gil et al. [6] reviewed the current IoT technologies, approaches, and models.

Gómeza et al. [7] developed an architecture based on an ontology for monitoring the health and workout and provides recommendations to patients with chronic diseases. The model developed for the system proved to be efficient when making inferences related to the context. Li et al. [8] developed an IoT based system (nCapp) to diagnose COVID-19 earlier. According to existing data, questionnaires, and check results, the diagnosis is automatically generated as confirmed, suspected, or suspicious.

Zaheer et al. [9] highlighted the need for standardization of protocols for smart city communication. Noah et al. [10] utilized the Centers for Disease Control and Prevention (CDC, USA) website, and a comprehensive review of PubMed literature, and obtained information regarding clinical signs and symptoms, treatment and diagnosis, transmission methods, protection methods and risk factors for Middle East Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS) and COVID-19.

Mohammed et al. [11] explained the applications of IoT technologies

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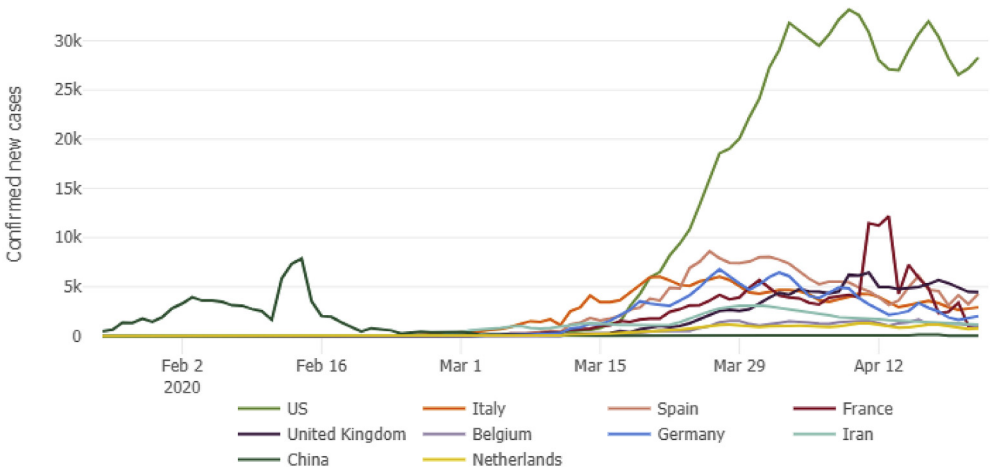

Fig. 1. Trends of new cases in the top ten countries [1].

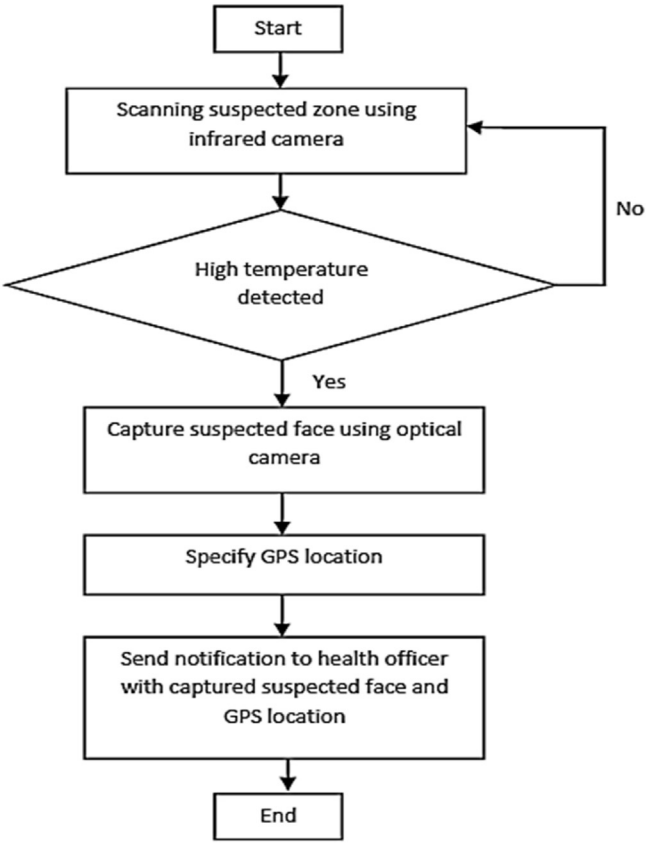

Fig. 2. Work flow of smart helmet [12].

in the medical and healthcare field and highlighted the potential. Mohammed et al. [12] developed a smart helmet-mounted with thermal imaging systems for identifying the infected among the crowd. It also equipped the facial recognition system. Fig. 2 shows the workflow of the smart helmet. Scanning of the crowd using infrared Camera and if the high temperature of any person detected, then it will capture the face using an optical Camera. It also provides the location of the infected person through GPS.

4. Existing COVID-19 detection methods

A coronavirus is a large group of a virus, they consist of genetic material and envelope with protein spikes, and these spikes are known as a crown (shown in Fig. 3). There are different types of corona virus-like respiratory, gastrointestinal, etc.

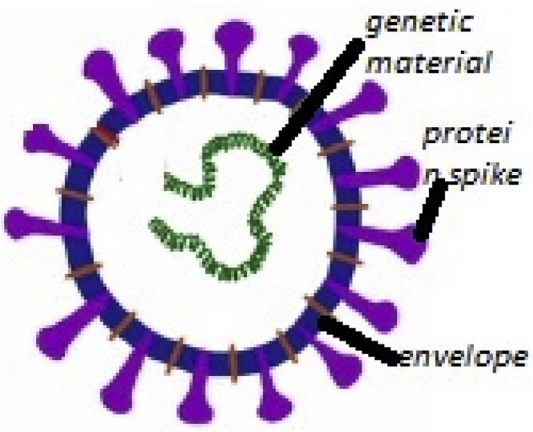

Fig. 3. Microscopic view of COVID-19.

The respiratory disease ranges from common cold and pneumonia, and most of the cases, people generally have mild disease. These include the SARS-COV coronavirus. However, coronavirus SARSC-COV was first identified in China in the year 2003. Mers-COV coronavirus was identified in Saudi Arabia in 2012. n-COV first identified in China in 2019; this type of virus comes from animals and sometimes transmitted from animal to human, called spillover. The number of symptoms ranges from mild to severe fever, cough, and shortness of breath. The infection can be a diagnosis by a test called PCR (Polymerase Chain Reaction). This test identified by the genetic fingerprint. At present, no specific medication, supportive care, and vaccines are available. We can only prevent the transmission of the virus. Humans should avoid close contact with those who are sick, use alcohol-based hand sanitizer. The human should avoid

Table 1
Sensors and their application areas.

S.No.	Sensor/devices	Applications
1	Infrared Thermometer	Thermal imaging/body temperature measurement
2	IR Sensor	Door and windows operation, Lift operation, Power switch operation, Water supply control in the toilet.
3	Smartwatch	Heart rate detection
4	Optical Camera	Face recognition of patient
5	IP Camera	For virtual conference/meeting/news broadcasting

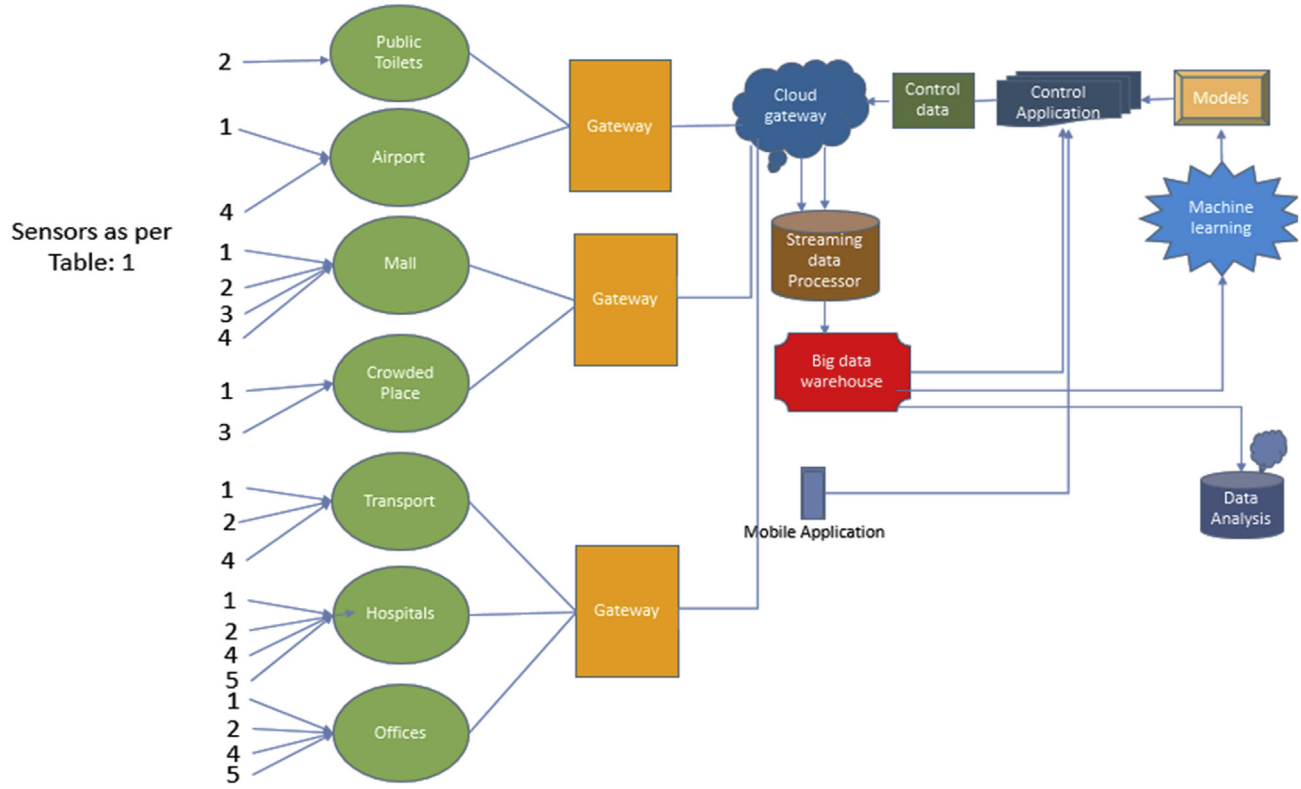

Fig. 4. Proposed IoT architecture to avoid COVID-19.

unnecessary contact with animals. Assure that animal products appropriately cooked before consuming.

5. Proposed IoT architecture

IoT is an application-specific, low power, effective, and easy to use a solution of any real-time problems. Sensors are the input providers from the physical world, which transferred over a network, and actuators allow things to act or react according to the input received from sensors. A list of IoT sensors and their application areas are shown in Table 1.

A proposed IoT architecture to avoid the spreading of COVID-19 is shown in Fig. 4.

Data communication is through a gateway device that will further transferred to the cloud gateway. In the big data warehouse, filtering of data, i.e., meaning full data, is extracted. A big data warehouse only contains structured data. Machine learning is used to create models of the system based on requirements and received data. Data analysis can be used for visualization of results, performance comparison. IR sensors can be used in public toilets for the automatic operation of doors and water supply. Infrared thermometers can be used to check the body temperature to identify the infected among crowd and face recognition by using optical Camera at the entry points of gates of airports, railway stations, bus stand, malls, etc. Similarly, sensors, as proposed in the architecture, can be installed to monitor the body temperature, automatic door operation, water supply control at public places and toilets, online conference to avoid direct contact with the physical world and humans interact. AI and deep learning can help to understand healthcare trends, model risk associations, and predict outcomes. For small applications or for individuals, the configuration of one temperature sensor, one NodeMCU, or Arduino board with sensors and the Internet can be used. A mobile app can be developed using App Inventor, which is an open-source platform provided by MIT. ThingSpeak, which is an open-source web service API of MATLAB to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network, can be used. Figs. 5 and 6 show the sequence of actuator activation and reading data from the sensor.

Fig. 5. Activating an actuator.

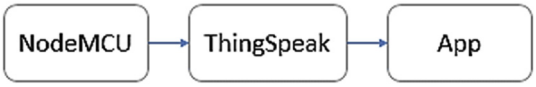

Fig. 6. Reading a sensor.

6. Conclusion

Identifying an infected person in-crowd is very difficult. Isolating people from the infected is the only solution to avoid the spreading of this virus. The use of IoT with smart sensors to measure and record the body temperature of individuals will help to identify the infected. It will also help to maintain social distance. IoT based health care systems connected through cloud computing and using data analysis to make an effective decision based on real-time data can be used.

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