ROLE OF IOT IN COVID-19

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ABSTRACT

The global pandemic known as covid-19 has spread. To create a vaccine, expand testing facilities, and improve monitoring systems, scientists and engineers are working day and night. Applications for smartphones and the web have already been created to track people's health using surveys. The spread of covid-19 can be stopped via the Internet of Things (IoT). The Internet and physical devices are connected through the "Internet of Things." Devices can monitor and respond in addition to detect and record information. In this article, we evaluated the covid-19 literature that is currently accessible, discussed monitoring approaches, and proposed an IoT based architecture that can be used to reduce the spread of covid-19. Modern healthcare systems are being transformed by the IoT revolution by embracing technological, economic, and social prospects. Health care systems are changing from traditional to more individualised ones so that patients can be diagnosed, treated, and monitored more simply. IoT technology is one of the pioneers in this field. Since the epidemic began, there has been a rapid push in various research communities to use a wide array of technologies to tackle this global menace.

Keywords - Covid-19, Internet of Things, Healthcare, Covid-19 screening, BioMeTs, Arduino

1. Introduction

The world is significantly impacted by a rise in the usage of mobile technology and smart devices in the healthcare industry. Health professionals are utilising these technologies, which could lead to the development of brand-new, highly effective tools for tracking people's health in clinical settings and beyond. IoT enables the integration of physical devices with Internet connectivity and gives clinicians access to patients real-time health information. Chronic conditions like diabetes, heart disease and blood pressure are notable contributors to global economic and societal concerns. Additionally, it can offer a platform so that public health organisations can access the data needed to track the COVID-19 epidemic. The number of new cases is rising more quickly in the USA than in other nations. Since China has successfully managed the COVID-19, the pace of growth in new cases there is the lowest. In a wide range of academic and industrial disciplines, particularly in the field of medicine, the Internet of Things (IoT) has recently received strong study traction as a new research area. Modern healthcare systems are changing as a result of the IoT revolution, which takes into account social, economic, and technological developments. As a result, patients can be diagnosed, treated, and monitored more simply than in the past thanks to the evolution of healthcare systems from traditional to more individualised ones.IoT is gradually becoming a crucial technology in healthcare systems as it can bring down costs, improve service quality, and provide cutting-edge user experiences.Despite the fact that this illness has a higher potential for rapid spread than other illnesses of the same coronavirus family, there are numerous current attempts and extensive research to slow the spread of this virus. In this situation, IoT technology has proven to be a secure and effective method of combating the COVID-19 outbreak.

2. Covid-19

A sizable family of viruses that can infect both humans and animals is the coronaviruses. Human coronaviruses are mostly responsible for respiratory infections, which can range from the common

cold to more serious illnesses. The initial human infection case was discovered in 1960. Charge or mutations in the produce new coronavirus infections.New diseases can be brought on by viruses. There are eight different types of coronaviruses, and they fall into two categories:

• **Less Serious**

○ 229E

○ NL63

○ OC43

○ MKU1

• **More Serious**

The SRAS-COV

The MERS-COV

○ COVID-19

New COVID-19 iteration

A novel coronavirus of the more dangerous types (SARS-COV, MERSCOV) surfaced in Wuhan City in December 2019. The World Health Organization termed this coronavirus COVID-19 (Coronavirus Disease 2019). It is a newly developing virus that spreads swiftly from person to person by respiratory droplets and direct touch.

COVID-19 pose a significant threat to the safety of public health and have drawn attention on a global scale. There are several characteristics of this illness, including epidemiological, clinical, biological, and radiological. It causes a range of symptoms, including mild to severe respiratory infections, fever, coughing, and breathing difficulties, and it poses a significant risk of consequences for the elderly and people with chronic conditions. Unlike other viruses, COVID-19's incubation period refers to the interval between infection and the onset of disease symptoms, and it may last up to 14 days.

If someone inhales these droplets from an infected person, they may get COVID-19. These droplets may stick to nearby objects or surfaces, including handrails, doorknobs and tables. Depending on the surface's substance, the corona virus can survive there for a long time. When people come into contact with Covid-19 patients, surfaces or things, they become infected.

Recently, different vaccines against these viruses have been developed, and numerous nations have begun immunising their citizens, but they have not yet achieved a global immunisation. A number of precautions must be taken in order to prevent the spread of the coronavirus, lower the risk of infection, and safeguard the population's most vulnerable and fragile groups, including:

• Steer clear of sick people.
• Put on a mask.

· Often wash your hands

• Don't touch your lips, nose, or eyes.
• Complete seclusion

3. Role of IoT in Healthcare

IoT-enabled technologies freed the potential for safe and healthy patient maintenance, made remote surveillance in the health sector practical, and gave clinicians the tools they needed to deliver great care. Patient engagement and satisfaction with the ease and effectiveness of interactions with providers were also increased.Remote health monitoring also shortens hospital stays and decreases the need for readmission. Improved therapeutic benefits and cost reduction in healthcare are both greatly impacted by IoT. Without a doubt, IoT alters the healthcare industry by expanding the range of devices and changing how people interact with solutions. IoT offers medical applications that are advantageous to patients, families, physicians, hospitals, and insurance companies.

3.1 IoT Application in Patient

Patients can access wearables like a fitness belt and other wirelessly connected equipment like glucometers, blood pressure monitors and cardiac monitors. These gadgets can be used to keep track of appointments, blood pressure fluctuations, calorie intake and other information. IoT has revolutionised people's life, especially the lives of older people, by continuously monitoring their health. People and families have been significantly impacted by this.

3.2 IoT Application for Physician

By using wearables and other home-monitoring devices included in IoT, the doctor can track patients' health more effectively. Anyone may keep an eye on how patients are following their treatment plans or any urgent medical needs. IoT enables healthcare professionals to pay closer attention to and actively engage with patients. Doctors may find the best treatment option for a patient and get the desired results with the help of data collected by IoT devices.

3.3 IoT Application for Health Insurance Companies

IoT-related intelligent gadgets offer a number of opportunities for health insurance. Insurance companies may use data obtained from health monitoring systems for its underwriting procedures and claims management procedures. These information aids them in both identifying potential subscribers and identifying claims of fraud. IoT devices offer clarity among insurers and customers during the underwriting, pricing, claims management and risk appraisal processes. Consumers will be able to understand the rational behind every decision and process outcome across all operating processes in light of IoT-captured judgments based on data. The use and sharing of IoT medical data may be encouraged by insurers with their clients.

4. Existing system for Monitoring Healthcare

A technique for making early predictions to identify different diseases is now available. The incorrect choice of machine learning models, however, has prevented them from achieving the accuracy level. The Dataset used were extremely constrained. Even if the models had been built, they were not user-friendly and were not accessible through a user interface. Accessing it was challenging for the average individual. Some of the systems currently in use can simply display the signs and symptoms of illnesses; they lack the tools necessary to evaluate data and produce reports on a person's specific health problems . Only a small number of health problems are taken into account, which prevents correct knowledge from spreading among the populace. The electronic health system is less useful because health-related tests are available but relatively pricey.

4.1 Telehealth Consultations

Doctors use video chat to determine whether or not a patient has been exposed to the virus without having been met due to the illness's contagious nature. The enormous influx of acute viral versions seen in hospitals and nursing homes is a great alternative to communication that uses technology and indoor limiting.

4.2   Digital Diagnostics

Many different IoT devices are used to monitor health data after digital diagnosis. The introduction of intelligent thermometers by Kinsa can collect crucial data to share with health experts and observe trends to improve community protection as compared to conventional thermometers.

4.3   Tracking

Using fever spikes from their devices, smart IoT-powered tracking thermometers may keep an eye on the spread of disease. With the use of this compiled data, it is possible to keep track on potential outbreak locations among local residents. It would be even better if there was a way to create individual user profiles for the home-made collection and sharing of anonymous, clean data.

4.4   Vaccine cold chain Monitoring

The supply chain for vaccinations can be optimised using mobile and IoT technology. Through IoT sensors installed on the vaccine, cold chain data loggers provide accurate data from condition records to the cloud using mobile data networks. The UNDP and the Indian government's development of the IoT-enabled mobile device called eVIN, which offers real-time logistical management throughout the cold chain, is one example. The programme, in conjunction with IoT sensors attached to vaccines, keeps track of the location, temperature, and vaccine stock to ensure a reliable and safe distribution.

5. Current Covid-19 Detection Techniques

A coronavirus is a wide group of viruses that have spikes of protein on their envelopes and genetic material that are collectively referred to as a "crown". Corona virus comes in a variety of forms, including as respiratory, gastrointestinal, etc.The most prevalent form of respiratory disease, which can range from the common cold to pneumonia, affects people mildly. The SARS-COV coronavirus is one of them. SARSC-COV, a coronavirus, was initially discovered in China in 2003. 2012 saw the discovery of the Mers-COV coronavirus in Saudi Arabia. The n-COV virus was originally discovered in China in 2019; spillover refers to the virus's ability to spread from animal to human.Mild to severe symptoms include coughing, shortness of breath, and fever. A test known as PCR can be used to diagnose the illness (Polymerase Chain Reaction). By using the genetic fingerprint, this test was identified. There are currently no particular medications, treatments, or immunizations available. Only stopping the virus from spreading is something we can do. People should keep their distance from those who are ill and wash their hands with alcohol-based hand sanitizer. Humans should avoid unnecessary animal contact. Before eating, make sure that animal items have been prepared properly.

5.1   Covid-19 detection using wearable Technology

The concept of using sensors for COVID-19 screening or detection is not new, but many of the currently available solutions propose proprietary devices, and the main emphasis has been on developing ventilators and personal protective equipment (PPE), 3D-printed medical equipment, and solutions that take advantage of nanotechnology . Numerous smartphones and wearables are available with sensors that can track various bodily functions, including heart rate, breathing rate, sleep quality, etc. Some of these devices also have APIs that allow third-party programmes to access the data they collect. However, given the privacy concerns with such devices and the lack of flexibility and extension in the proprietary systems, we decided to build our solution utilising open-source components. As a result, there have been various attempts to combine sensors for the treatment of coronavirus thanks to the idea of employing Free and Open Source scientific and medical Hardware (FOSH).

5.2   Additional proposed alternatives for covid-19 Detection

Recent research endeavours linked to COVID-19 and new developments in the application of IoT in smart healthcare procedures were covered by the authors of. The BioMeTs (Biometric Monitoring Technologies) available for taking vital signs (blood pressure, heart rate, temperature, respiratory rate, and oxygen saturation) were listed by the authors. They also discussed the advantages and disadvantages of continuous monitoring procedures in the coronavirus era.Then, we make an effort to discuss a few of the fresh, literature-proposed methods that employ sensors to find COVID-19.

- **Utilization of electrochemical sensors:** Historically, a variety of techniques, including staining, direct fluorescent antibodies, etc., have been used to identify respiratory infections. Such methods call for expensive chemicals and equipment, labor-intensive sample preparation, and qualified personnel. Methods including surface plasmon resonance, interferometry, and field effect transistor were used for virus detection to overcome these drawbacks. These techniques all rely on specialised equipment.

- **Use of Smartphone Sensors:** A novel method of COVID-19 detection via smartphone sensors has been proposed. Given that the majority of radiologists already have smartphones at their disposal for a variety of daily tasks, the suggestion provides a more affordable alternative. In addition, regular people can use the system to scan their phones for viruses.

- **Utilization of Smart Thermometers:** The authors evaluated the effectiveness of monitoring regional influenza and "influenza-like illness" (ILI) using data from smart thermometers and mobile devices. Similar to this, a team of researchers suggested a method to spot unusually high ILI levels in real-time, at the level of US counties.They discovered anomalies by making accurate, county-specific projections of seasonal ILI from a point before a potential epidemic using data from a geospatial network of thermometers including more than one million users across the US. Anomalies are highly connected with COVID-19 case counts and may serve as an early warning system for identifying the epicentres of potential outbreaks in the future.

- **Wearable Medical Sensors:** EasyBand, a WMS-based solution, has recently been suggested as a way to control the rise of new positive instances by monitoring auto-contact and promoting crucial social distance. The authors of another recent paper developed a method dubbed CovidDeep that employs commercial WMSs to detect the COVID-19 virus. Similar to this, the scientists created an application that collects information from smartwatches and activity trackers as well as self-reported symptoms in order to distinguish between COVID-19 positive and negative cases in symptomatic individuals.

- **Use of Cough Recognition Techniques:** Cough is a symptom of several respiratory illnesses, ranging from the most recent coronavirus infection to a typical cold. Coughing has been discovered to occur in many species in addition to humans. The authors described a novel method for cough detection that makes use of "K-band continuous-wave Doppler radar." Similar to this, a team of researchers has created an AI model that can recognise the COVID-19 virus from a forced cough.

- **Use of Arduino and IoT:** Arduino was used to sense temperature using an infrared sensor or a thermal camera, while computer vision techniques were used to recognise masks and assess social distance. The remedy could only aid in COVID-19 prevention; it could not assist in COVID-19 diagnosis.

6. Remote covid-19 screening using IoT Framework

Not all patients can be monitored using conventional diagnosis procedures in the absence of any medical tests. When patients should avoid intimate contact with caretakers, family members, or doctors due to the coronavirus, this poses a problem. In order to make this process easier, it is crucial to incorporate new technology. The most effective technology for remotely controlling COVID-19

outbreak victims is the Internet of Things, particularly the Internet of Connected Medical Things (IoMT).

The data providers, resource providers, and support providers all contribute to the framework's realisation. Main secure communication channels are used by the IoT infrastructure to connect with the three different types of providers. Sensing devices that collect real-time data from people and transmit it for processing and analysis are known as data providers. The infrastructure-connected computing and communication devices that enable data analysis and data visualisation and support decision-making are referred to as resource providers.

The network of healthcare providers and institutions in charge of patients' care and security completes the list of support services. Once a person is told they have COVID-19, it is their support system that keeps in touch. The consumers of the framework are the support providers; they do not actively participate in the framework.

6.1 Covid-19 Screening Device

Our screening tool enables doctors or other patient-supervising experts to remotely assess their patients' physiological data, continuously monitor their health, and identify the critical medical characteristics without ever having to come into physical contact with them. The equipment comes with a smartphone app to remotely monitor the patient's health and determine whether they have the flu or the coronavirus using information from the sensors. We use several widgets and various colours to display the sensor findings as well as the diagnosis, which is based on data from the sensors, using patterns from visualisation ideas. Along with specific sensor readings for explanation and evaluation, the programme employs an algorithm to determine whether the patient is symptom-free or whether they are experiencing mild, moderate, or severe symptoms.

For data processing and transfer to the cloud, the device integrates medical sensors with a processor and a Wi-Fi module. The device consists of two interconnected components that are put around the arm and attached to the frontal region closer to the neck to measure the frequency and severity of coughing. Its goal is to determine the severity of the patient's cough while also evaluating the patient's temperature, blood oxygen level, heart rate, and breathing rate. The data is combined by the on-board mechanism, which is Arduino-programmed, and is then sent via the Wi-Fi module to a cloud storage system.

6.2 Analysis and visualization in Real-Time Screening

A individual needs to be screened because they may have COVID-19. The person is given instructions to get a device from a certain location and wear it while following instructions transmitted across a distance by a health worker or other professional. The device is triggered by a mobile interface and begins reading through all the sensors as soon as a person feels comfortable wearing it. Each sensor's reading is finished, and the data is immediately sent to the IoT platform via the Arduino's Wi-Fi module.

Data is transmitted in streams. The patient must wear the gadget for at least two minutes for the data to stream, be stored in the cloud, and then be visualised on the dashboard in order to detect the cough. A signal is delivered to the mobile device telling the health professional to stop taking measurements as soon as all the sensors have finished gathering their data. As the mobile device receives information from the IoT platform, a final snapshot is also displayed on the screen. The patient is told to take the item out and put it back in its proper location. The gadget might be completely discarded in the event that the patient's screening results are positive.

7. Discussion and Future Work

Both a global health emergency and an international economic danger are associated with COVID-19. The COVID-19 pandemic-related restrictions have had a disastrous impact on numerous

businesses, markets, economies, society, and our daily lives. While it will take some time to fully recognise and quantify the full health, social, and economic effects of this pandemic and its limitations, there are numerous ongoing efforts in the research and industrial communities to use various technologies to detect, treat, and trace the virus to lessen its effects.

Although early identification, quarantine, and recovery from COVID-19 have all benefited from Internet of Things (IoT) technology, as we learn more about the virus and its behaviour, we need modify and improve our strategies at various stages. For instance, it would be intriguing to combine artificial intelligence (AI) with internet of things (IoT) technology to employ AI power to reduce contacts between medical staff and patients at all stages.

Another illustration is the use of touchless technology in conjunction with other inputs (such as gesture and speech) to effectively slow the spread of the disease and put an early stop to the pandemic.It will take more investigation to determine how to persuade confirmed COVID-19 cases to remain in isolation in order to stop the virus's spread. Additionally, how can IoT technology effectively assist solitary patients in their day-to-day activities. How may IoT devices be implemented into enterprises to cover both safety and efficiency after lockdown, while businesses and marketplaces are emerging progressively.

The privacy worry when patients are asked to disclose their information is one of the key issues with employing IoT devices at different stages of this epidemic. Determining secure pathways for communications or using various encryption techniques before sharing private information would be possible research fields because this is undoubtedly a major worry for every patient.Collaboration between hospitals, cities, and other organisations can be very beneficial in battling the present epidemic and any future ones thanks to IoT-enabled smart cities.By implementing intelligent transportation systems like crowd monitoring, smart parking, and traffic rerouting, smart city infrastructure can assist individuals in maintaining social distance.Smart house IoT-based solutions can help to improve smart city life by lowering the rate of COVID-19 infection. To restrict users from touching surfaces, for instance, smart home doorbells and security systems can be installed. This will prevent the spread of the virus from touching those surfaces.

8. Conclusion

While the COVID-19 pandemic is still causing havoc around the planet, numerous technological solutions have been put in place to combat it. The Internet of Things (IoT), one of these technologies, has been extensively utilised in the healthcare sector.This method has produced very encouraging results in treating the COVID-19 epidemic.IoT technology can be very effective in combating this pandemic, but it's also crucial to take data privacy into account. More patients can use IoT devices to engage in their treatment with peace of mind if IoT technology is implemented appropriately and securely.

The COVID-19 virus has been around for about a year, and the scientific community, researchers, and medical professionals are doing their best to find a solution for the illness. At the same time, people all over the world are having trouble identifying whether a person is healthy or infected by the virus. To execute a COVID-19 diagnosis using state-of-the-art solutions, a patient must go to a hospital or other healthcare facility. It is better to be able to undertake the illness detection utilising wearable devices due to the multiple challenges and related risks in doing so.Using standards-based practises found in the literature, this study provided a framework for remotely screening for the virus. The framework employs sensors that are incorporated into a wearable gadget that may be worn by anyone to determine in a matter of seconds if that person is healthy or uncertain of having a sickness.The framework has to be tested on a large population, but the information gathered during testing can also be used for advanced analytics, including epidemic prediction and prevention, population segmentation, and assisting the government and decision-makers in taking the proper action.

Unmanned Aerial Vehicle (UAV) or drone-based real-time early coronavirus detection and monitoring system with integrated thermal camera has been developed. From a distance above the ground, the suggested system can measure ground surface temperatures. The measured data might also be sent by the drone to a server to bepresented on a mobile application.The spread of the coronavirus has garnered a lot of attention and awareness among people as the most recent global crisis. One effective method to stop the spread of the coronavirus is early diagnosis of the symptoms. A real-time monitoring system of the screening process that automatically displays the thermal image of a person's temperature is required since a high body temperature is one of the symptoms that individuals experience most frequently.Therefore, the diagnosis and screening procedures will take less time and involve fewer human encounters that could hasten the transmission of the coronavirus. Conclusion: The technology of remote sensing and detection, which offers a variety of methods for coronavirus identification, screening, and monitoring, has an outstanding guarantee and ability tomeet the needs of the healthcare system.

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