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Smart Monitoring and Controlling of COVID 19 using IOT, Big Data, Machine Learning

Sonia Verma[1], Manoj Kumar Phadwas[2]
[1]Assistant Professor, CSE, KNMIET, Ghaziabad, Uttar Pradesh, India
[2]Junior Telecom officer, ALTTC, BSNL, Ghaziabad, Meerut, Uttar Pradesh, India

ABSTRACT

Our goal is to develop an environment to monitor and controlling a corona virus of 2019 (COVID-19) with I²OT i. e. Intelligent Internet of Things. Analytics have changed the way disease outbreaks are tracked and managed, hence saving lives. Using technology smart sensor, facial recognition and location, existing surveillance cameras to identify, trace, and monitor people that may have contracted the coronavirus. The Internet of Things, a network of interconnected systems and advances in data analytics, artificial intelligence and ubiquitous connectivity can help by providing an early warning system to curb the spread of infectious diseases.

Keywords : Coronavirus, Internet of Things, Sensors, Security, Big Data analytics, Mobile computing, Cloud computing, Artificial Intelligence

I. INTRODUCTION

The coronavirus (COVID-19) originates from a virus family associated with Severe Acute Respiratory Syndrome (SARS) and common cold. Researchers say that the coronavirus originates from animals and spreads to humans after which people infect each other. Animals such as bats and snakes consist of viruses that are deadly to human health with researchers claiming that other animals contain different virus strains but are yet to spread to humans. The Middle East Respiratory Syndrome is another infection with similar origins as the coronavirus and poses risks to human health as well.

How is this coronavirus spread?

The coronavirus is most likely to spread from person-to-person through:

- ✓ direct close contact with a person while they are infectious
- ✓ close contact with a person with a confirmed infection who coughs or sneezes, or
- ✓ touching objects or surfaces (such as door handles or tables) contaminated from a cough or sneeze from a person with a confirmed infection, and then touching your mouth or face.

Most infections are only transmitted by people when they have symptoms. These can include fever, a cough, sore throat, tiredness and shortness of breath.

A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

Internet of Things (IoT) refers to a system of connected physical objects via the internet. The 'thing' in IoT can refer to a person or any device which is assigned through an IP address. A 'thing' collects and transfers data over the internet without any manual intervention with the help of embedded technology. It helps them to interact with the external environment or internal states to take the decisions. Internet of Things (IoT)-enabled devices have made remote monitoring in the healthcare sector possible, unleashing the potential to keep patients safe and healthy, and empowering physicians to deliver superlative care. It has also increased patient engagement and satisfaction as interactions with doctors have become easier and more efficient. Furthermore, remote monitoring of patient's health helps in reducing the length of hospital stay and prevents re-admissions. IoT also has a major impact on reducing healthcare costs significantly and improving treatment outcomes.

IoT is undoubtedly transforming the healthcare industry by redefining the space of devices and people interaction in delivering healthcare solutions. IoT has applications in healthcare that benefit patients, families, physicians, hospitals and insurance companies.

Table 1. Describing benefits of IOT in healthcare environment

Parameter	Description
Remote Medical Assistance	IoT devices automatically take readings and observe behavioral patterns, they can alert the responsible medical units and personnel in case of any discrepancy in the patterns
Tracking Staff, Patients and Inventory	Strive to increase efficiency and reduce operating costs
Operations Augmentation	Numerous IoT sensors can collect, analyze and transmit data to prevent postsurgical complications.
Data Insights	An effective data-driven approach to healthcare equals the optimized organizational performance, better customer engagement and enhanced decision making for medical units.

Big data means a large set (petabytes or gigabytes) of structured, unstructured or semi-structured data and analyzing those data to get the insights of the business trend.

Role of Big Data in IoT

When organizations are grabbing hold of the data for analysis purpose, IoT is acting as a major source for that data, and this is the point where the role of big data in IoT comes into the picture. Big data analytics is emerging as a key to analyzing IoT generated data from "connected devices" which helps to take the initiative to improve decision making.

The role of big data in IoT is to process a large amount of data on a real-time basis and storing them using different storage technologies.

IoT big data processing follows 4 sequential steps:

1. A large amount of unstructured data is generated by IoT devices which are collected in the big data system. This IoT generated big data largely

depends on their 6 V's factors that are volume, variety, velocity, veracity, validity, and volatility.
2. In the big data system, which is basically a shared distributed database, the huge amount of data is stored in big data files.
3. Analyzing the stored IoT big data using analytic tools like Hadoop MapReduce or Spark
4. Generating the reports of analyzed data.

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. **Machine learning focuses on the development of computer programs** that can access data and use it learn for themselves.

The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

Role of Machine Learning on Big Data:

By using big data technology along with machine learning and artificial intelligence, healthcare companies can make accurate decisions, significantly improve operating efficiencies, and do away with unwanted costs. With their improved efficiencies, healthcare companies can now save more lives. Organizations will be able to determine which patient is at a higher risk of contracting a certain disease.

II. RELATED WORKS

Confirmed cases of coronavirus disease 2019 (COVID-19) exceed those of severe acute respiratory syndrome (SARS), and, at time of publication, now stand at over 73, 435 confirmed cases and over 2000 deaths globally, nearly all in China. By comparison, SARS killed 774 people in 2003, again mostly in China, the epicentre of both outbreaks. Both COVID-19 and SARS spread across continents, infect animals and humans, and use similar mechanics to enter and infect the cell. On the frontline, tactical response to COVID-19 is similar to that of SARS but one major difference exists: in the 17 years since SARS, a powerful new tool has emerged that could potentially be instrumental in keeping this virus within reasonable limits—namely, artificial intelligence (AI).

Few would argue that AI is causing a paradigm shift in health care and there might be value in the application of AI to the current COVID-19 outbreak, for example, in predicting the location of the next outbreak. This application is effectively what the Canadian company, Blue Dot, has attempted to do and as such was widely reported as the first organization to reveal news of the outbreak in late December. Various other applications of AI that have emerged in response to the latest epidemic include BenevolentAI and Imperial College London, which report that a drug approved for rheumatoid arthritis, baricitinib, might be effective against the virus, while Insilico Medicine based in Hong Kong recently announced that its AI algorithms had designed six new molecules that could halt viral replication.

2. 1 Tracking the Spread of Disease

With the emergence of IoT and big data analytics in healthcare, data can be collected now from places where previously it was either done manually or not done at all. For example, smart thermometers are feeding data in real-time to global medical systems; bench-top analyzers are analyzing patient samples instantly and sharing data in real-time with disease monitoring tools installed miles away. At the Virginia Tech Network Dynamics and Simulation Laboratory, disease monitoring tools such as HealthMap and

Since IoT is a network of interconnected systems, machines or objects with sensors can all be connected

to each other, without the need for the wider Internet, in remote areas to collect data. This data can eventually be connected to the wider network to integrate it with the global health data system to not only track diseases in real-time but also to apply predictive analytics to prevent their spread.

2. 2 Implementing effective infection prevention mechanisms

In infectious disease control, the lack of readily available and relevant data required to test a hypothesis has led to a lack of evidence-based approaches. With technology and the advent of IoT, health systems can easily overcome this challenge.

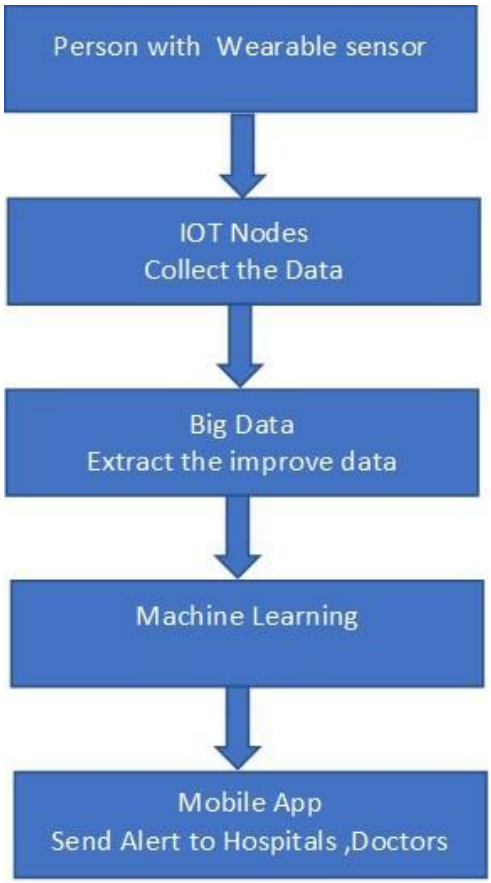
By collecting data from remote locations and feeding it into the global health system along with data from other sources, clinical researchers are better equipped to make an evidence-based analysis of an emerging outbreak. Based on this analysis they can suggest preventive measures using data from the IoT network or to further determine if the controlling measures suggested are being implemented properly. In the case of a flu outbreak in the U. S. , for example, washing hands and using sanitizers can be easily tracked using IoT-enabled devices, and their impact on the spread of flu can be tracked using the data collected, all in real-time.

The role of IoT in connected health and in preventing the spread of infectious diseases continues to grow, along with related new technologies. To be done effectively, however, requires proper planning and careful implementation using the appropriate technology platforms and tools. Thanks to IoT-enabled technologies, identifying and preventing the spread of infectious diseases more proactively than ever before is now a reality.

III. PROPOSED SYSTEM

In our proposed system we use the IoT devices and sensors acquired user health data information and relayed to the cloud with the help of a wireless communication network. The monitoredinformation is stored in the cloud repository, andthe big data are pre-processed to extract, analyse, and todetermine a diagnosis based on the knowledge base like fever, runny nose, cough, difficulty in breathing etc basically the symptoms of COVID-19 are predefined for diagnosis.

The flow of system is given in figure 1:



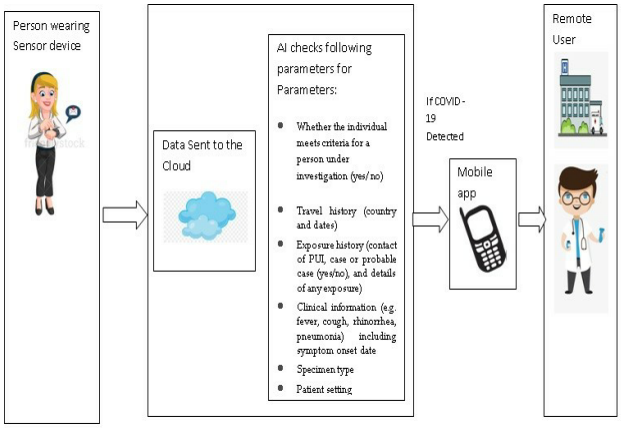
The value of machine learning algorithm comes into play by reducing the burden on clinicians in a scenario such as the current COVID-19 outbreak. Machine learning algorithms quickly process huge datasets and provide useful insights that allow superior healthcare

services. Although the industry was slow in adopting this technology, it is now rapidly catching up, to provide successful preventive and prescriptive for COVID-19.

Companies that deals with COVID-19 are now increasingly using computational power to analyse voluminous datasets and identify patterns that provide useful insights from the existing patient data to make accurate diagnosis and provide better patient care.

With their improved efficiencies, COVID-19 organization or companies can now save more lives. Organizations will be able to determine which patient is at a higher risk of contracting a COVID-19. Inaddition, post-discharge outcomes can also be kept under control and the number of re-admissions can be reduced substantially. Furthermore, diagnoses will no longer take time and patients will be able to know immediately what they are suffering from and what action they need to take next.

By applying AI with IoT we can identify and understand the patterns and doctor can analyze or detect COVID-19 in less time and take decision for further treatment.



Billions of users around the world have smartphones, with that number increasing every day. It also makes sense that mobile apps are the preferred channel for accessing IoT, due to the ease of developing them. Mobile has a more flexible platform for transmitting data as well. With a single device and app, IoT devices can be managed and monitored

The proposed system will have multi layer structure where sensor find the person data and infected person data will be on cloud after analyzing information of infected person then data will be to the hospital, doctor or data collector. The architecture of proposed system will be given below:

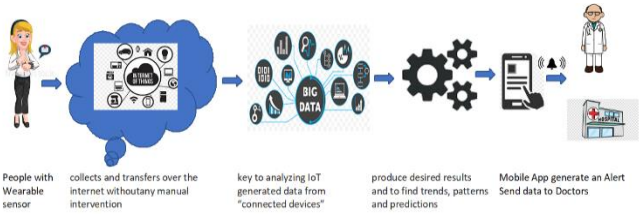


Table 1 (a) : Personal attributes

S. NO	Attributes	Narration
1	Ref no	Reference no of the user
2	Name	Name of the user
3	Age	Age of the user
4	Gender	Male/Female
5	Address	Address of the user
6	Mobile No	Mobile no of the user

Table 1(b) : Symptoms of COVID-19

S. NO	Attributes	Answer
1	Fever	Y/N
2	Running Nose	Y/N
3	Cough	Y/N
4	Sore throat	Y/N
5	Difficulty breathing	Y/N

After applying machine learning algorithm if Data contain symptoms of COVID-19 then mobile app will send an alert to doctors and hospitals.

MYSQL is a relational database to store structured data like user information and NoSQL is used to store sensor data. Based on these collected data, the users are monitored continuously. In this System user will wear sensor device that can quickly measure surface temperature without making any contact with a person's skin and is sensor detect the symptoms of COVID-19 it store and analyze the information from the cloud using IOT and then AI analyze data with some meaningful patterns and generate an alert using mobile app and call the doctor or send the information to the hospital.

In the cloud, the data are collected, stored, analyzed, processed to make a decision and notified wherein mobile app; the data are analyzed, notified, processed and finally stored in the cloud.

Through sensors, users are monitored in homes and hospitals. The data are analyzed, and the message is sent to doctors indeed for an emergency. However, the real-time smart homes and hospitals system yet to be deployed and its accuracy remains untested.

Enhancement of COVID-19 using Internet of Things

Clinical presentations that do not fit case definition, but are considered at risk of COVID-19 by the assessing clinician will also be accepted for testing. PHO is not currently recommending routine testing of asymptomatic persons for COVID-19.

Mandatory data accompanying testing requests:

In order to expedite testing, as of February 10, 2020 PHO Laboratory pre-approval for COVID-19 testing is no longer required, provided that the following mandatory information is included on the specific PHO COVID-19 Test Requisition:

1. Whether the individual meets criteria for a person under investigation (yes/ no)
2. Travel history (country and dates)
3. Exposure history (contact of PUI, case or probable case (yes/no), and details of any exposure)
4. Clinical information (e. g. fever, cough, rhinorrhea, pneumonia) including symptom onset date
5. Specimen type
6. Patient setting

By enhancing it more we can create sensor room at the airport, railway station or where public involvement is more when person cross through that room sensor monitor that person health is ok or not. If sensor having symptoms of COVID-19 then data then the information is directly sent to the cloud, starting with the previous stages of processing, cleaning, transformation, and normalization, as it has been seen in the works reviewed. However, most of this information can be preprocessed in the available resources on current mobile devices. Likewise, in the last stage of this scheme, analysis, and visualization, again the resources of the mobile devices could play an important role to use their processing capabilities in these tasks. Mobile app will generate an alert and call doctor or send information to the hospital. If we detecta disease before entering to our country, city etc then we can save more life. Using an Iot we can generate an advisory to the user how to save themselves from COVID-19

IV. CONCLUSION

Our system has developed with the advance of smart IoT devices and sensors, cloud computing, bigdata, Machine learning and smartphones. This application developed for patient-centric prediction, prevention, diagnosis, and treatment. The wireless communication technologies have been advanced rapidly and available everywhere to handle the healthcare complications remotely. COVID-19ecosystem is evolved as an innovationin role of machine learning Big Data era with efficient decision making andsupport for a new

lifestyle. Smartphone-based application can provide accurate and fast diagnosticprediction with controlling capability to address thechallenges like high cost, storage and demands of professionalsto attain directly. Wearable devices like smartwatches, smartphones, smart shirt, smart bracelets, smart clips, headbands, and smart clothing detect user'sheart rate, body temperature, blood pressure and otheractivities. This survey investigates the systematic overviewof the smart healthcare system and alert generationin the field of cloud computing, edge computing, BigData analytics, IoT , machine learning and mobile based applications withunique architectures. Exploring the pros and cons of eachpaper in the survey with different methodology and algorithmused.

The computing requirements for monitoring and advanced analysis of the data acquired by this environments can overcome the capabilities of the sensors and personal computers deployed by specialists. Additional specialized hardware is usually required to meet the application requirements. In this work, a distributed framework that combines sensing and processing at different levels of the network to share the computing load among the available devices has been proposed to address this challenge. The environments composed of wearable and other biosensors may benefit of it by allowing the processing of advanced applications with real-time constraints in a collaborative way.

The main advantages and novelties of the proposed system is the flexibility in the application execution by using resources from different available devices.

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