

# Designing An Iot Based Smart Monitoring and Emergency Alert System for Covid19 Patients

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**Abstract**— Covid-19 has become an issue in medical research since its inception with more than 45million positive patients in the World. IoT is beneficial in Health for effective Monitoring of Covid-19 cases through Networks. The purpose of this study is to suggest an IoT design for smart monitoring and emergency alert system for covid-19 patients which will monitor a patient who is in stage 1 of the disease using sensors like Temperature sensor, Blood Oxygen level and Heart rate sensor and Arduino Uno Controller which will gather information from the patient and send to the IoT server. The authors expect that the proposed system will be reliable and effective in reducing mortality and hospital admissions by saving lives in emergencies and alerting. Further, the system is made to generate message warnings to the nearest hospital compare to the location of the patient within he is under extreme conditions. It can be ended up that Smart monitoring and emergency alert System is important for monitoring covid-19 patients and can alert in case of an abnormal situation of the patient.

**Keywords**— *IoT, Covid19, alert system, monitoring*

## I. INTRODUCTION

COVID-19 disease has now become a hotbed of medical research. As of November 30, 2020, COVID-19 has increased to more than 45 million positive patients in many countries since its inception [1]. Three cases of bronchoalveolar lavage were collected from an analyzed case with abnormal pneumonia on December 30, 2019. Standard PCR tests (RT-PCR) on these cases were conclusive for coronavirus [2]. The Internet of Things (IoT) empowered Health is useful for the effective monitoring of COVID-19 patients, through the use of a connected network [3].

New appearing technologies could be the result of this universal dilemma. The Internet of Things and in particular the Internet of Medical Things can contribute an answer to the call into question of way, surveillance [4]. A wealth of today's technology in the Internet of Things (IoT) field increasing in terms of worldwide importance and its beginning towards availability to predict, prevent, and ascertainment of available for predicting, preventing, and monitoring visible viruses [5]. The world is currently striving to manage the initial epidemic of different types of viruses including many diseases and humans. Due to the lack of particular medicaments of Coronavirus, attempts to stop the expansion at this time have not progressed [6].

At the moment, the world has only one way to handle the Coronavirus is just to prevent its increase, (such as "fulfilling the change") by applying methods namely avoiding contacts

among people (social distance), washing hands, lockdown, and face covering. However, these practices may not use in 2020 for tackling the scale of Covid19. Nevertheless, this spread can be prevented by a means of technology by quickly identifying (or predicting) and observing and examining the updated chapters [7]. Those types of technology encompass large-scale data, together with cloud and cloud computing [8], the utilization of the data collected by distant observation like e-care, telecare, and schedule-patience check out circumstances [9].

This design aims to reduce death rates and admission in hospitals through advanced notification of cases already detected by searching a nearest hospital comparing to the location of the patient. Some IoT hardware devices will be worn by the patient. The fabric is used to produce patient data and then transferred through a Bluetooth to cell phone. The suggested design will generate an emergency alert based on what has been determined by comparing medical records.

## II. LITERATURE STUDY

The following section aims to facilitate the development of theories related to this study.

Many studies have been done in the Internet of Things while suggesting design in different field. A design has been done in the medical area to obtain patient temperature using sensor network for monitoring the temperature of the patient in real time [10], to monitor students during their physical exercises by checking temperature, heart rate, blood pressure of students during exercises [11]. Through Fog- computing, also design can be built in medical health sector to prevent health and assist lives in smart ambient [8].

Using wearables sensors and smartphone, a real-Time Health Monitoring System for Remote Cardiac Patients has been introduced [5] within the system communicated in two ways, patients and physicians. Another study, presented a framework of IoT for health monitoring System and telemedicine with the purpose of keeping all important information related with the patient in the system. The IoT health monitoring model includes three major functions: Identify and validate, sensing, gather information, Examining an object or patient [12]. This following study set up an information fusion that refers to the architecture of the body

sense things under healthy IoT environments [13] for the human body.

Currently, research continue to be done, especially in medical field within a study presented a design on ontology

which is able to monitor the health, daily training and supply guidelines for chronic disease patients. Then, patients will be tracked anytime through the application installed in their smartphone. The illustration designed for the framework demonstrated to be more effective when producing assumptions connected to the issue [14]. Ashwini has set up a program to control the well-being of adults utilizing IoT gadgets and stock the information amassed on the IoT host. The design process consists of three main blocks: one block contains raspberry example b within the Wi-Fi network of the package and omits require a Wi-Fi module from outside. The information is gathered in the direction and sent to the IoT host. IoT host of total body information cache. Those records are available on the side of the doctor so he may use patient data and appropriate prescriptions [15].

In this current world, Artificial intelligence has taken a huge place while using a design and a smartphone, it can help to identify COVID-19 very fast [16] by using different algorithms of Artificial Intelligence.

Even though there are designs for medical healthcare, but also in daily life, others researchers made IoT design for smart cities [17], smart agriculture [18], to monitor and control perishable food [18], to keep safe cloths in wardrobe [19].

Since many studies has been done in IoT design, a study to avoid the expansion of the pandemic Corona virus [20] by isolating people has been made. Then, also to identify and detect covid19 cases earlier and monitoring those covid19 patients [7].

Therefore, this study aims to reduce deaths rate and hospital admissions through advanced notification of cases already detected by searching a nearest hospital comparing to the location of the patient.

### III. PROPOSED SYSTEM

Recently, travel is not recommended, since it is a contagious disease that has spread in our society. Because of this, many patients find the courage to go to the hospital, after their symptoms are severe, which complicates the work of the medical staff. One way to quickly classify patients, without reducing the distance between the patient and the hospital, is to use devices that can be worn over the body, which will be visible has the status of the user's health and makes appropriate time in different areas of the user's health such as the physician.

stage 1 of the disease, which is having some symptoms such as fever, tiredness, dry cough, and many more. Once a person is infected with the coronavirus virus, it can take 2-14 days for symptoms to appear. The regular gestation period shows up to be about 5-6 days. When hospitalization lacks, it usually starts from 7 days.

But before being admitted to the hospital, medical exams should be done to make sure what kind of disease the patient has. After being tested positive, the patient must be quarantined either at his home(self-isolation) or at an isolation center. Data recorded from the patient will be saved in the monitor used by the physician.

Mostly, there are several numbers of people who are doing self-isolation instead of being in an isolation center. For some of them, their immune system defeats the virus, and they can become healthier as before. However, some

people infected with coronavirus, during self-isolation are found to be unhealthy and manifest some critical symptoms. But for reducing the death rate and to know how they are doing, such cases shall be using IoT sensors such as blood oxygen & heart rate, and temperature which will be worn by the patient to collect information. The fabric is used to produce patient data and then transferred through Bluetooth of his cell phone and will alert the physician in case of an abnormal situation.

#### A. The Architecture of Smart Monitoring System

According to different previous research within machine learning algorithms has been used to identify COVID-19 patients. K. Kumar, suggesting an IoT design structure to prevent the expansion of COVID-19. Through different studies, it shows that Internet of Things (IoT) empowered Health is useful for the effective monitoring of COVID-19 patients, through the use of a network website.

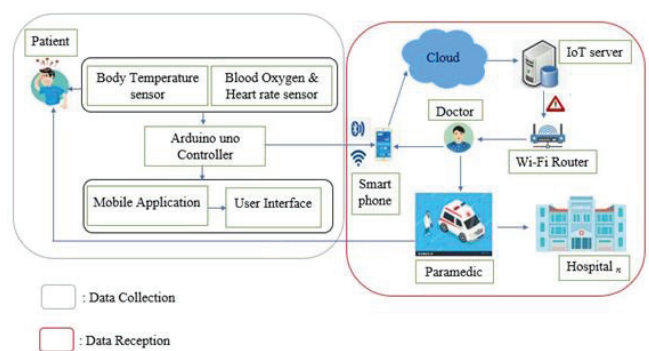


Fig. 1. Proposed Smart Monitoring System

The mobile devices used in data transmission are Wireless, Bluetooth, and the internet. All information obtained from the IoT devices (body temperature sensor and blood oxygen and Heart rate sensor) will be sent to the local device/ client (mobile phone) used by the patient through Bluetooth technology of Arduino Uno Controller. That mobile phone has an application to examine the quality status of the patient, and output will be sent to the IoT Server via the internet. The average body temperature for the human body is 37°Celsius [10] that will be calculated by a temperature sensor and its operations send to local machines/users via wireless communication. And blood pressure is between 90/60mmHg and 120/80mmHg [21]. When blood oxygen is high, oximetry is the IoT device used to monitor, and blood oxygen saturation can be controlled accurately, hoping for a filling rate saturation of 94-98% [22].

The IoT Server will be associated with the internet, and there will be a local device where information will be sent between the IoT server and the local device. This local machine or smartphone belong to the Doctor.

Hospital „ means the number of Hospitals that can receive Covid-19 patients for treatment.

In case of an abnormal situation of the patients, e.g.: blood oxygen saturation low, the Smartphone of the patient will get all information from blood oxygen and heart rate sensor which collected from the patient, and application used by the patient will search automatically the nearest hospital from the location of the patient. If the hospital is full of

patients, the application will search again another nearest hospital compared to the location the patient. After getting a hospital which is receiving patient, a notification alert will be given in that hospital, then the doctor will get the awareness of the illness and its syndromes over his monitor. The doctor will inform the emergency team, called Paramedic to go to pick the patient from the location and to get treatment near the physician.

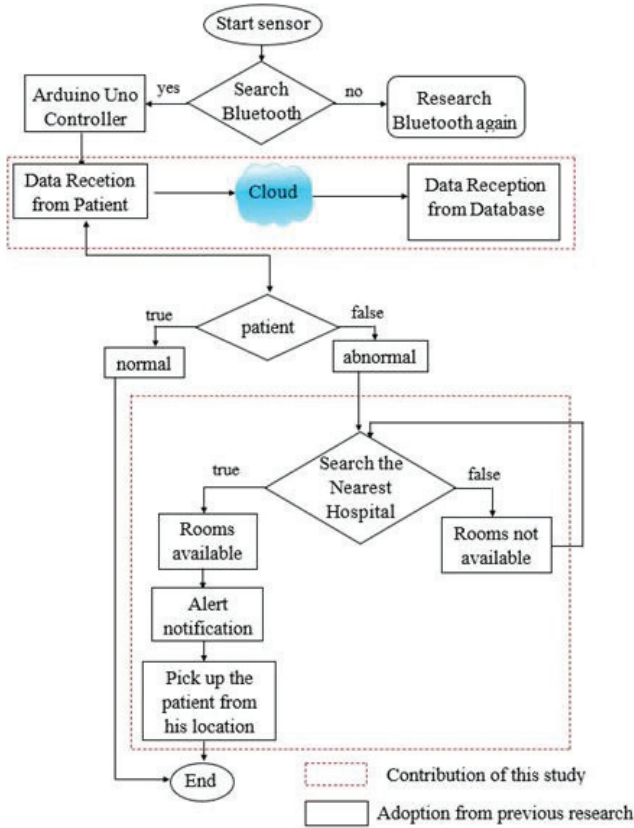


Fig. 2. Flowchart of the proposed Smart Monitoring

#### IV. STEP OF PROPOSED SYSTEM

In figure 3, there is an elaborate close view of the different sensors used by the patient mentioned in figure 1. All sensors that will be worn by the patient so that they will get information from his body to his smartphone and the hospital will get information from the IoT server.

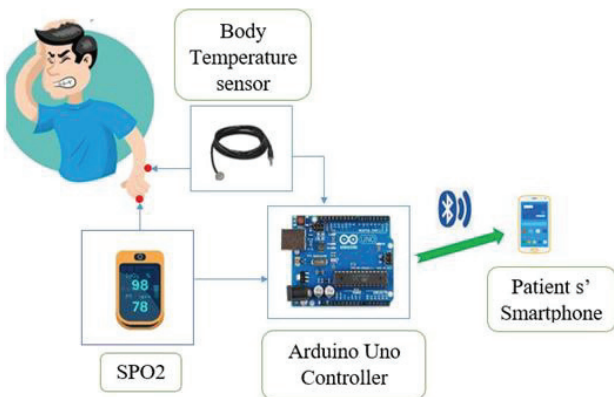


Fig. 3. Design and layouts of sensor placement on the patient

In this system, we implemented different sensors to control the evolution health of the patient while the patient is in an isolation center or at home. These sensors are adaptable to the Arduino Uno. The reason behind choosing an Arduino Uno because it is widely available, cheap, and easy to perform.

#### A. Arduino Uno Controller

This model of Arduino can read analog and numerical signals. It is used to read data from devices and then based on information the microcontroller will send a report, to the machine where devices are controlled and aware system. Arduino is the patient's heart monitor design; holds the main idea of the system [23]. Blood Oxygen and Heart rate and Body Temperature sensor will be controlled by Arduino.

#### B. Temperature sensor (Skin Temperature Probe)

Uniquely invented for endless temperature checking connected to the skin as an indicator of body temperature. It has a leading length of 2 meters and is created to work on a range of 0 - 50 ° C. All data acquired from the patient will be transmitted directly to a patient monitor through a wire from the body temperature sensor, then will be transmitted in an IoT server from Arduino Controller, and this information will be displayed on doctor's remote monitoring. The adequate body temperature for the human body is 37 ° Celsius.

#### C. Blood Oxygen and Heart rate sensor (SPO2)

SpO2 levels have been implemented in our system because they are a measure of the amount of oxygen carried by hemoglobin and the amount of hemoglobin in the blood. Standard SpO2 levels are 94 – 98% or up to 100%, usually measured by PO [22]. And blood pressure is between 90/60mmHg and 120/80mmHg. This sensor will be checking the blood oxygen saturation and pulse of the case. It will be positioned on the user's finger and information will be amassed from the patient and taken to the Arduino Uno Controller to which it connects, then displayed to the monitor.

#### D. Cloud

Cloud is a networking system which associate computer globally. In this system Cloud is needed to share information collected by sensors from the patient's body and display to his smartphone, and from the patient 'smartphone, through cloud, all information will automatically reach in the IoT server.

#### E. IoT Server

It gives authority of saving and displaying sensor data. IoT server is often under controller of a database manager, in order to control the entire system of the Hospital by running a network server application and managing server. It will be saving data from sensors, before information will be displayed to the monitor of the Doctor.

#### F. Paramedic (Emergency Team)

Paramedic is a health skillful team providing emergency medical assistances and they are most often found working in ambulances. In this system this team is in charge of going picking the patient from the location after receiving message from the doctor.

TABLE I. COMPARISON WITH OTHER STUDIES

References	Theory of the study	This study
[20]	prevent the expansion of COVID-19 by isolating people as a solution	The proposed system can monitor and alert in case of an emergency. It has been designed for reducing the death rate and admission in Hospital for avoiding distraction of healthcare staff medical
[7]	quickly identify potential coronaviruses cases from this real-time symptom data using eight machine learning algorithms and the framework would then document the treatment response for each patient who has contracted the virus	
[5]	develop a remote monitoring system for heart patients. the system can generate emergency alerts.	

## V. CONCLUSION AND FUTURE RESEARCH

Since COVID-19 disease has now become a hotbed of medical research. From November 30, 2020, COVID-19 has increased to more than 45 million positive patients in many countries since it started.

The proposed research is a system that monitors and alert for emergency for a covid-19 patient who is still in stage1 of the disease. After being tested positive, blood oxygen and heart rate sensor and body temperature sensor will be given to the patient, to monitor him from the isolation center. The author aimed to design to reduce the death rate in society and the admission of many patients in the Hospital. The system uses diverse devices guarded by an Arduino Uno Controller to gather information like temperature, blood oxygen saturation, and heart rate. The usage of Wireless, Bluetooth, and the internet will allow data to be transmitted from the patient until the patient will be monitored by the doctor while he is in an isolation place. Data will be gathered from his body to the IoT server through the cloud. The authors expect the proposed system to be reliable and effective in reducing mortality and hospitalizations by saving lives in emergencies and providing alerting.

Before this study, the Medical team intervenes while they receive call in case of an abnormal situation while for this one, medical will get alert notification of abnormal situations before receiving a call of emergency. From previous comments and studies, it can be ended that Smart monitoring and emergency alert systems is important for monitoring covid-19 patients and can alert in case of an abnormal situation of the patient.

During future research, we recommend making an IoT design and application for a covid-19 patient that can alert in the Hospital especially for people with chronic disease (e.g: heart disease). For such patients our system can alert in case of blood pressure is higher not caused by corona while this study focus for covid19 disease.

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## REFERENCES

- [1] "Global cases\_Coronavirus COVID-19 by CSSE at Johns Hopkins University." <https://coronavirus.jhu.edu/map.html> (accessed Oct. 30, 2020).
- [2] WHO and W. (PRC) Aylward, Bruce (WHO); Liang, "Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)," WHO-China Jt. Mission Coronavirus Dis. 2019, vol. 2019, no. February, pp. 16–24, 2020, [Online]. Available: <https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf>.
- [3] R. P. Singh, M. Javaid, A. Haleem, and R. Suman, "Internet of things (IoT) applications to fight against COVID-19 pandemic," *Diabetes Metab. Syndr. Clin. Res. Rev.*, vol. 14, no. 4, pp. 521–524, 2020, doi: 10.1016/j.dsx.2020.04.041.
- [4] S. Swayamsiddha and C. Mohanty, "Application of cognitive Internet of Medical Things for COVID-19 pandemic," *Diabetes Metab. Syndr. Clin. Res. Rev.*, vol. 14, no. 5, pp. 911–915, 2020, doi: 10.1016/j.dsx.2020.06.014.
- [5] P. Kakria, N. K. Tripathi, and P. Kitipawang, "A real-time health monitoring system for remote cardiac patients using smartphone and wearable sensors," *Int. J. Telemed. Appl.*, vol. 2015, 2015, doi: 10.1155/2015/373474.
- [6] N. Van Doremalen et al., "Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1," *N. Engl. J. Med.*, vol. 382, no. 16, pp. 1564–1567, 2020, doi: 10.1056/NEJMc2004973.
- [7] M. Otoom, N. Otoum, M. A. Alzubaidi, Y. Etoom, and R. Banihani, "An IoT-based framework for early identification and monitoring of COVID-19 cases," *Biomed. Signal Process. Control*, vol. 62, no. April, p. 102149, 2020, doi: 10.1016/j.bspc.2020.102149.
- [8] L. Cerina, S. Notargiacomo, M. G. Paccaniti, and M. D. Santambrogio, "A fog-computing architecture for preventive healthcare and assisted living in smart ambients," *RTSI 2017 - IEEE 3rd Int. Forum Res. Technol. Soc. Ind. Conf. Proc.*, 2017, doi: 10.1109/RTSI.2017.8065939.
- [9] B. Dinesen et al., "Personalized telehealth in the future: A global research agenda," *J. Med. Internet Res.*, vol. 18, no. 3, 2016, doi: 10.2196/jmir.5257.
- [10] H. Ding, "Application and design of patient temperature acquisition system based on wireless sensor network," *Int. J. Online Eng.*, vol. 13, no. 5, pp. 18–28, 2017, doi: 10.3991/iioe.v13i05.7046.
- [11] C. L. Zhong and Y. le Li, "Internet of things sensors assisted physical activity recognition and health monitoring of college students," *Meas. J. Int. Meas. Confed.*, vol. 159, p. 107774, 2020, doi: 10.1016/j.measurement.2020.107774.
- [12] S. T. Shirely and Abraham Abey, "IoT Based Health Monitoring System And Telemedicine," *Int. Res. J. Eng. Technol.*, vol. 07, no. 03, pp. 281–284, 2020, doi: 10.1109/ICACCS48705.2020.9074192.
- [13] A. He, J. Shen, Y. Wang, and L. Liu, "Research on the Fusion Model Reference Architecture of Sensed Information of Human Body for Medical and Healthcare IoT," *Proc. - 2018 17th Int. Symp. Distrib. Comput. Appl. Bus. Eng. Sci. DCABES 2018*, pp. 162–164, 2018, doi: 10.1109/DCABES.2018.00049.
- [14] J. Gómez, B. Oviedo, and E. Zhuma, "Patient Monitoring System Based on Internet of Things," *Procedia Comput. Sci.*, vol. 83, no. Ant, pp. 90–97, 2016, doi: 10.1016/j.procs.2016.04.103.
- [15] Ashwini Gutte and Ramkrishna Vadali, "IoT Based Health Monitoring System," *Conf. 2018 Fourth Int. Conf. Comput. Commun. Control Autom.*, 2018, doi: 10.1109/ICCUBEA.2018.8697681.
- [16] A. S. R. Srinivasa Rao and J. A. Vazquez, "Identification of COVID-19 can be quicker through artificial intelligence framework using a mobile phone-based survey when cities and towns are under quarantine," *Infect. Control Hosp. Epidemiol.*, vol. 41, no. 7, pp. 826–830, 2020, doi: 10.1017/ice.2020.61.
- [17] P. Vijai and P. B. Sivakumar, "Design of IoT Systems and Analytics in the Context of Smart City Initiatives in India," *Procedia Comput. Sci.*, vol. 92, pp. 583–588, 2016, doi: 10.1016/j.procs.2016.07.386.
- [18] S. Ratnaparkhi, S. Khan, C. Arya, S. Khapre, and P. Singh, "Materials Today : Proceedings Smart agriculture sensors in IOT: A review,"

Mater. Today Proc., no. xxxx, 2020, doi: 10.1016/j.matpr.2020.11.138.

- [19] F. B. P. Prakasa, J. Maiga, and Suyoto, "Iot-based smart and healthy wardrobe system," Proceeding - 2019 Int. Conf. Artif. Intell. Inf. Technol. ICAIIT 2019, pp. 119–123, 2019, doi: 10.1109/ICAIIIT.2019.8834592.
- [20] K. Kumar, N. Kumar, and R. Shah, "Role of IoT to avoid spreading of COVID-19," Int. J. Intell. Networks, vol. 1, no. April, pp. 32–35, 2020, doi: 10.1016/j.ijin.2020.05.002.
- [21] F. Ali et al., "A smart healthcare monitoring system for heart disease prediction based on ensemble deep learning and feature fusion," Inf. Fusion, vol. 63, pp. 208–222, 2020, doi: 10.1016/j.inffus.2020.06.008.
- [22] B. R. O'Driscoll et al., "BTS guideline for oxygen use in adults in healthcare and emergency settings," Thorax, vol. 72, no. 6, pp. i1-90, 2017, doi: 10.1136/thoraxjnl-2016-209729.
- [23] P. W. Digarse and S. L. Patil, "Arduino UNO and GSM based wireless health monitoring system for patients," Proc. 2017 Int. Conf. Intell. Comput. Control Syst. ICICCS 2017, vol. 2018-Janua, pp. 583–588, 2017, doi: 10.1109/ICCONS.2017.8250529.