

# **Design of Health Monitoring Systems for Covid Patients**

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## **ABSTRACT**

*The modern healthcare system can observe multiple patient's data which are extracted from the devices like pulse rate, blood heat, pressure level, etc., and record, transmit and monitor if there's a speedy amendment in an exceedingly patient's life. After the COVID-19 pandemic, it's troublesome to spot potential covid patients and treatment cannot be standard. Hence, the new health observing system is demanded to spot potential covid patients and track the contact those that cause treating the patients safely ill from the virus and so contribute a major role in reducing the unfold of the virus. The proposed innovative system explains the planning and designing of cost-efficient low-power Internet of things (IoT) system and attainable contactless portable devices with social distance alert using Arduino Uno, MCU with biomedical parameters based sensors like the heart rate monitor, temperature sensing element, and ultrasonic remote sensing element. The ThingSpeak IoT platform used here helps diagnose online. Therefore, collected information is simply accessed from any place within the world through the internet. If any changes in the event, the information is going to be updated in the cloud and this notice helps to take necessary action at some place and point, which can facilitate with future patient health issues.*

**Keywords** – Covid-19, Health Monitoring, Internet of Things, Sensors, ThingSpeak.

## **1. INTRODUCTION**

A health monitoring system is established to monitor the patient's health limits and to send this data and location information to the physician on duty [1]. The health care system is a human need today. An inexpensive, lightweight, energy-efficient, and medium-sized electronic health registration system was developed. With this portable form, patients can keep records of health limits during the trip. At the same time, central data storage is used with the Internet of Things [2].

In March 2020, the World Health Organization (WHO) announced the spread of the COVID-19 virus as a pandemic, meaning that its spread had spread worldwide and that the number of patients with the virus was growing rapidly [3]. Numerous efforts have been made to identify potential COVID-19 patients by tracking the contact people that lead to the segregation of patients and thus contributing to reducing the spread of the virus. The Internet of Things (IoT) is a technology that can be used to help when people with viruses need to be isolated [4].

This study demonstrates a patient's health status monitoring system model with various parameters such as body temperature, heartbeat (in BPM), oxygen levels and blood pressure. These data can be tracked via ThingSpeak anywhere around the world [5]. The sensory devices, especially IoT-based devices, can be used for



longer and more home and work data monitoring compared to observations during laboratory visits. This large data collection when analyzed and presented with an easy-to-understand concept for health professionals has the potential to help improve the quality of health services and reduce costs [6]. The design of a remote health monitoring system consisting of data acquisition components, data transfer components, and servers that act as data storage, analysis, and detection is also used [7].

A number of portable medical devices can be used to observe the conditions needed to monitor patients. Patients can have a proper monitoring system to perform body measurements such as oxygen level, heart rate, respiratory rate, and so on [8]. IoT has strong market forces and one of the domains used is in the health sector. The use of IoT in the health sector includes a remote control, remote detection, remote monitoring and monitoring, and medical equipment tracking [9].

One study showed that the healthcare system was rapidly evolving, and a clever plan to monitor patient's current health status was proposed. The system can monitor patients and simplify patient health management. Thus, effective medical services can be provided on time. It was also concluded that the implementation of real-time local programs allows the hospital to achieve its goals, such as increasing efficiency, increasing patient satisfaction, reducing time and performing actions independently if necessary. Therefore, it is necessary to process and present good patient location data and sensor measurement results in a single dashboard [10].

The ThingSpeak IoT platform is a web application that is very effective in collecting large amounts of log data and other data from a variety of sources and is displayed on graphs and maps. This study aims to develop a system that can show the results of recording different patient situations and locations in real-time using the ThingSpeak platform for COVID-19 patient treatment needs [11].

This article proposes the design of a COVID-19 patient monitoring system that may collect real-time symptom data from the hooked-up wireless sensor technology. The potential coronavirus cases can be found quickly from the real-time data and so, this design suggests the employment of an open-source IoT web server. In this project, a variety of portable medical devices is connected to a server application that enables doctors and medical personnel to perform remote monitoring in real-time. Therefore, the introduction of this technology will improve the potency of medical staff by greatly reducing the complex load. This technology can assist in capturing real-time data and different information required in wide areas of the infected patient. With this app, doctors and medical staff will create diagnoses not solely within the patient's condition directly but from time to time as long as the medical device is employed.

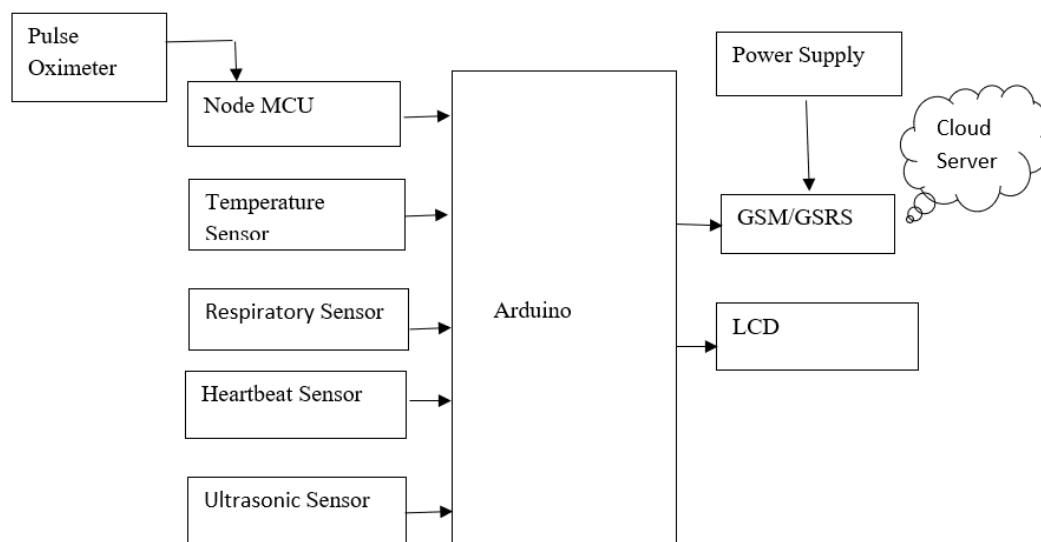
## 2. METHODOLOGY

### 2.1 Proposed Architecture

The monitoring system is developed using IoT infrastructure that may monitor the infected patients while they're on their own, in addition to treatment responses for patients convalescent from the virus. The IoT is the forthcoming technology that permits us to control hardware devices through the internet and use the

technology efficiently. Here, we have a tendency to use IoT to control the health vitals, so observing the patients online. The IoT is the inter-networking of physical devices, sensors and others peripherals that are embedded with electronics components, sensors, devices, software and network connectivity that permits these objects to collect and exchange data.

Fig. 1 shows the proposed structure that describes a remote monitoring module using IoT, collection of wireless sensors and Arduino Uno embedded with Node MCU that often sends data to the cloud server and real-time SMS alert to the caregiver or physician once it falls. These systems also can contribute to understanding the type of viruses and other people infected with the virus by collecting, analyzing, and storing relevant data. Significantly, so serving to physicians furthermore because the community in reducing corona illness spread.



**Figure 1: Block diagram of Proposed System**

## 2.2 Wireless Sensor Networks

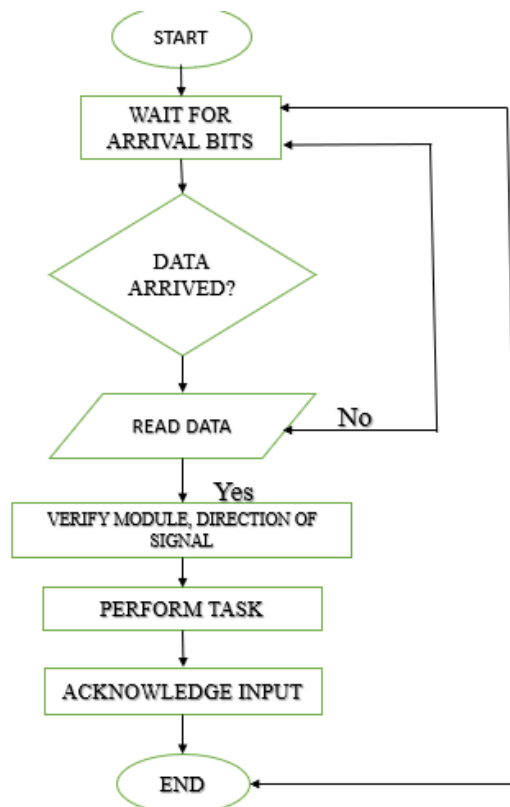
The measure of blood ‘O’ levels or SpO2 levels is one amongst the measurements to be created in customary patient analysis of COVID-19. The SpO2 measurement at home is used for early detection of “silent hypoxemia” in COVID-19 patients. Data from SpO2 measurement results in this study were obtained from precise measurements using the house pulse oximeter as a part of wireless body network (WBSN) networks. Ultrasonic oxygen sensors use sound speed to measure the amount of oxygen in a gas or liquid sample. Additionally, the sent location data is offered on a device with GPS and location API.

The temperature sensor (DS18B20) may be a one-wire digital temperature device used to measure a patient's temperature that is available with a waterproof version. The communication of temperature sensors for readings of temperature is done through a one-wire bus protocol that uses one data line to pass with an inner microprocessor. A Heartbeat device is a device that's used to measure the heart rate, i.e. speed of the heartbeat. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is acquiring or expanding during a minute. The sound sensor is employed because the respiratory device in this

module when detects the patient’s breathing. The sound sensor is one sort of module used to notice the sound. Generally, this module is employed to find the intensity of sound.

### 2.3 IoT Gateway

The data from the heartbeat measuring system, temperature sensing element, heartbeat sensing element, respiratory sensing element, etc., used in this design will transmit data via the Node MCU (ESP8266). A GSM/GPRS module utilizes a Subscriber Identity Module (SIM) and Radio Waves to interface with the GSM arrangement. The sensor device using Arduino and MCU will send the data as a series of bytes with a particular program in order that the amount of data can't be sent at the same time to different devices or applications that need that data. When the data is received from the sensor and collected, the GSM can send the data to the server along with patient vitals and time. The delivery method will turn up in real-time or be delayed per the availability of the internet connection. Fig.2 shows the flowchart for sending/receiving the data from the IoT gateway.



**Figure 2: Flowchart for sending / receiving the data from the IoT gateway**

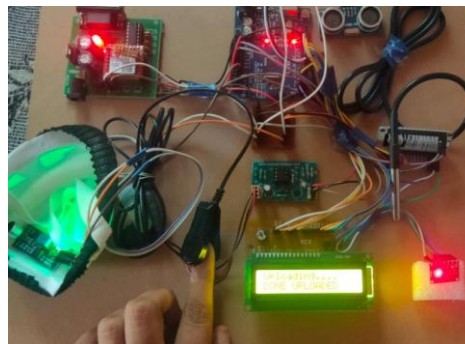
### 2.4 Implementation and ThingSpeak

The code should be uploaded to the Arduino UNO by assembling the grouping shown in Fig. 3. Open the serial monitor and it'll automatically connect with Wi-Fi and created everything. The ThingSpeak is an IoT analytics platform service that enables you to aggregate, visualize and analyze live data streams in the cloud. The ThingSpeak provides instant visualizations of data announced by your devices to ThingSpeak. With the chance to execute MATLAB code in ThingSpeak, you'll be able to perform online analysis and processing of the data

because it comes in. ThingSpeak is usually used for prototyping and proof of ideal IoT systems that need analytics.

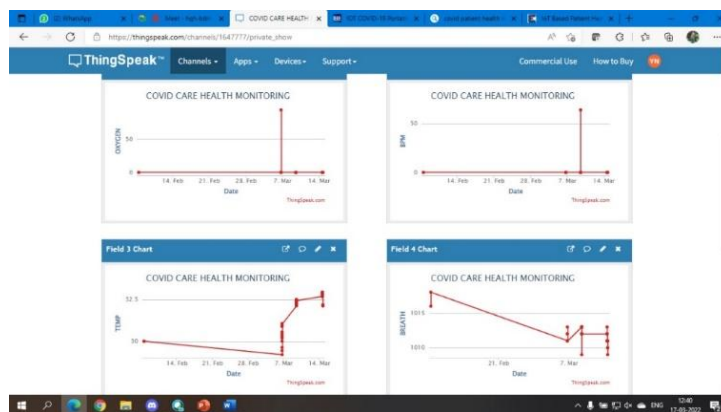
### 3. RESULTS AND DISCUSSION

The implementation and testing of the system are completed with all the values displayed on the liquid crystal display and therefore, the ThingSpeak IoT analytics platform service enables us to compile, visualize and analyze live data streams in the cloud wherever all inputs are uploaded and displayed frequently in the form of a graph and a date and time. Fig. 3 shows an example of the sensor data that has been successfully received and indexed on the liquid crystal display.



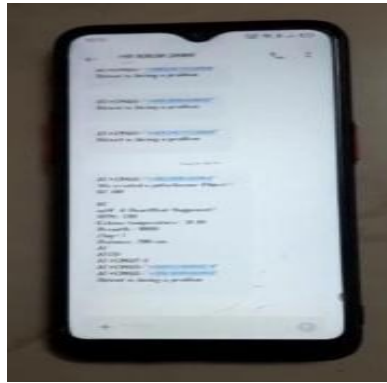
**Figure 3: Implementation Diagram with Results**

An SMS alert is also sent to the caregiver whenever the sensor reads data in excess of a given threshold value. Additionally, the data that has been indexed also can be explored by displaying it on the ThingSpeak IoT service as shown in Fig. 4. Users will customize the tables and also the map to suit their needs. They will select that sensor data should be displayed for better visibility in watching their patients.



**Figure 4: Example of IoT interface for monitoring patient physiological data and time**

The proposed system contains a smartphone alerting protocol whenever the sensor collects the user's physiological parameters. Also, the cloud service connects to the internet to send the data to the server once adding the patient's vitals and time coordinates. Fig. 5 shows an SMS alert that's sent to the doctor.



**Figure 5: Example of an SMS alert that prompted on mobile**

#### **4. CONCLUSION**

An IoT-based patient monitoring system has been developed to observe COVID-19 patients who are taking self-isolation at home. The proposed system is meant to observe a patient's physiological parameters like heart rate and blood oxygen saturation level. The system is capable to acquire data from a pulse oximeter, ultrasonic sensor and other kinds of sensors that transmit the data together with time information to a server to be monitored by medical workers. The system was designed using the open-source prototype for data storing and indexing. The program for COVID-19 isolation in the proposed system will facilitate medical workers to seek out the parameters required to observe a patient. It makes it easier for patients to report their condition while not going away from home; so, health care providers will at once offer services in-line with the patient's condition, for instance taking care of a patient once SpO<sub>2</sub> is low to forestall hypoxemia.

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