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An Automated Smart Healthcare System for COVID: Safe in Post Pandemic Life

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ABSTRACT
At the beginning of COVID-19 there is no cure or vaccine and it became more dangerous as the virus symptoms were kept concealed. The only way to get cure of this virus is self-isolation and maintain social distancing. Because of the COVID-19 rate of death and COVID-19 cases are increases day by day. The virus hadinfected over 168.9 million people worldwide. Becauseof the careless behaviour of people and complacency are leading to spike in COVID-19 cases. So in this work, the application of internet of things (IOT) in healthcare and social distance monitoring the patients in the pandemic situations from COVID-19 is proposed. this project consists of three parts: A lightweight and low cost IoT node for data analysis and give treatment to those who exceed the limit. The IoT node is used to track the healthparameter such as body temperature, blood oxygen level and pulse rate and update this to cloud and notify the user by message. Here is the two way to communicate between IoT node and smart phone is by Wi-Fi or Bluetooth and we use GPS tracker to track the patient. A smart health monitoring system maintains the contact between doctors and patient and it helps in daily monitoring the vital parameters and it is user friendly.

Keywords: *Blood oxygen level, Body temperature, COVID-19, Pulse rate, Smart phone, Smart health monitoring.*

1. INTRODUCTION

IoT has evolved over the year's and the term "Internet of Things" (IoT) was first brought about in a presentation about implementing radio-frequency identification (RFID) by Kevin Ashton for supply chain management in the Procter and Gamble company.

IoT in recent years has gained a lot of popularity. We can say that it is an advanced technology which links all smart objects in a connection within a network with no human interactions in simple words; any object or device that may be connected to the internet for monitoring purpose in the future or transferring files or data can be an IoT device [8].

The revolution of IoT is paving way for developments and advancements in the healthcare department, incorporating technological, economic, and social prospects. It is shaping and helping evolve healthcare systems from conventional to more personalized healthcare systems through which patients are diagnosed, treated, and monitored more easily [9-12].

One way to curb the spread of virus, until we have a vaccine or a reliable medication at hand, is by observing physical (or social) distancing. Here we try to implement better and convenient systems for surveillance, healthcare, and transportation, diseases which are contagious will have less chance of spreading. An IoT system, coupled or combined with Artificial Intelligence (AI) may offer [13].

The contributions listed below while considering a pandemic like Corona virus. 1) Improving public security using surveillance and image recognition systems, 2) utilizing drones to help in or to provide supply, delivery,or disinfection, 3) By contact tracing and by cutting the access to public places where people are usually found through apps and platforms empowered with AI. When it comes to healthcare, an IoT system is typically composed of many sensors connected to a server; it gives real-time monitoring of an environment or users.

In pandemic AI-assisted sensors are usually used to determine if people are infected by the virus or not, on the basis of certain sign's such as body temperature,

coughing patterns, and blood oxygen levels. The tracking of Geo Locations of people is also an advantage here. During the outbreak of a contagious disease, tracking the distance between people can provide valuable information. Using technologies, such as Bluetooth, we can get a reasonable estimate of how much distance people maintain when walking in public places.

Our goal in this study is to give a clear picture of the role IoT-based technologies has in COVID-19 tracking and control of the virus and also its applications, and industrial IoT-based solutions combating COVID-19 in three main phases, which includes early diagnosis, quarantine time, and after recovery.

2. RELATED WORK

As we can see from past few years IoT of things and its applications have been provided to update healthcare systems. Where IoT can be used in monitoring remote patients/senior citizen's health conditions such as by providing communicationbetween the doctors to the ones who are suffering from chronic diseases and medical resources. And wearable IoTapplications can also use as a personal health care device for example for a diabetic patient it is used to monitor their bloodglucose level and gives sufficient data to the patient.

In 2020 author Ding [1], David Clifton described about the wearable device and telehealth monitoring system. COVID-19 has appeared as a pandemic with serious demanding of medical support and causes deaths over worldwide. Where the frontline was assigned in testing the virus, to give medical support to the patients and also in developing vaccines. It is important to tackle the emerging disease and to control the spread and to provide solution for the prevention of disease. This system provides a wearable device which is capable of detecting the peoples who are atrisk or those who are in quarantine by evaluating their health status. Sensors systems which reads the mild condition of the patients to take further medical support before the situation becomes worse. And telehealth monitoring system to monitor remote patients and for the diagnosis of covid-19 virus and other related diseases.

In 2020 author Jiang and Hu [2] described about a potable health screening device to detect respiratory infections.On January 30, 2020 WHO marked COVID-19 as a public health emergency, the target was to stop the further spread of the epidemic, so many public places where equipped withthermal screening to detect the body temperature of the peoples. However, the novel corona virus has secreted symptoms: the first symptom may not be a fever it might lead to shortness of breath. So to prevent this epidemic many people start to were mask and avoid face to face interaction to maintain physical distance and to avoid physical contact. Therefore, this system works as a portable non-contact health screening device and provide data about their body temperature and respiration state. People start to were mask and avoid face to face interaction to maintain physical distance and to avoid physical contact. Therefore, this system works as a portable non-contact health screening device and provide data about their body temperature and respiration state.

In 2020 author Jaiswal and Agarwal [3] described about smart city technology to reduce the risk of COVID-19 with a smart solution. In early day of COVID-19 there was no vaccination for the virus, but its prevention can be possible by using some smart city technology. The smart cities are implemented to curb the spread of virus or COVID-19 risk. The system was proposed to maintain physical distance of 2m,so one can maintain face-to-face interaction and avoid physical contact. We have seen some of the position technology were used to trace the infected people. To help frontline workers wecan use robots and drones as medical staff to provide essential services to the patients. The advanced smart city technology can be very helpful in smart healthcare were it helps to monitor the infected patients and provide medical service.it is also been seen that it provides contact-free technologies by delivering essential items for the peoples in the pandemic which may include groceries, food and medicine by monitoring contact free delivery. These smart city technologies have been used to decrease the risk of COVID- 19.

In 2018 author Satya *et al.* [4] proposed a IoTsystem based health care monitoring system and also about the challenges. IoT have provided vast applications to this world but health care is one of the most important application where it can provide best medical support and services to the people. However, IoT is used to interconnect different system and build strong and effective communication between them. The advanced sensors are used to monitor the health status of the patients in the form of a wearable or embedded into the body of the patients. The system is made to monitor the health status of the patients by collecting data continuously based on their health parameter, and gives information about the risk in the preliminary stage. And the data are documented and sent to the concerned physician or the caretaker of the patients. In this proposed system they are also concerned about the challenges of implementing the health care monitor system in real life andto bring effective output for the social cause.

In 2020 author Valsalan *et al.* [5] derived a health care monitoring system which is based on IoT. Now a day's healthcare is given much importance in every country with advance technology to prevent the spread of COVID-19 virus. Our main motto is to provide a valuable solution for the epidemic using IoT based system. IoT have created a revolution especially in health care system. It helps in preventing the spread of

the disease and to provide proper medication to the patients by using a wearable sensors and using smart phones. The wearable IoT is used to measure the heartbeat rate, body temperature of the patient. If there is any risk is observed it will provide alert message to the concerned physician and helps to monitor the health parameters. It provides communication between the patient and doctors ifthey are far away from each other and help in providing medical support.

In 2020 Gang *et al.* [6] describe about IoT system used to track COVID-19 infected and other infectious diseases. To manage the spread of COVID-19 disease during epidemic they are using an effective method which is efficient in tracing disease using automated digital contact tracing system. Even though it is not used in other foreign countries which includes US, Europe and other countries due to strict rules and regulations, privacy regulations, and patient's rights. The proposed system is divided into three categories: contact tracing by names, mobile call details using mobile service provider application and a IoT based system to monitor and track the patient's current location and the places were the infected person was travelled, this gives a clear data in tracing the spreading of the virus.

In 2020 author Zheng *et al.* [7] proposeda system, the main source of this system is to provide a cheap remote health monitoring system under delay and reliability constraints. COVID-19 has shown the efficiency of remote health monitoring system which have provided the significant development of 5G low latency transmission resource. To provide accurate monitoring of the patients the IoT helps in collecting the physical data in real time and provide information of patient's health condition. To achieve high reliable communication and low delay transmission at the same time it is highly challenging. So it is important to provide a good communication and to provide a low cost system. The main motto is to reduce the cost of leasing BW bygiving access link and latency data queue, it is hard to solve the situation in a straight line as it is non-linear and non- convex. This system will provide an accurate performance, reliability, delay and other environmental conditions through alow cost [16-19].

3. METHODS

This current work consists of block diagram, flow chart design specifications of the project and the components used and so on. In the subsequent sections we are going to highlights the importance of each concept in more detail.

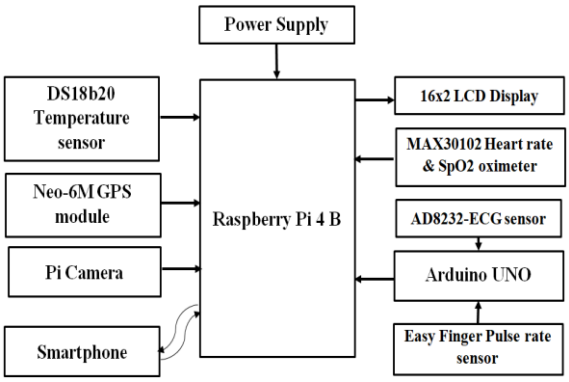


Figure 1. Block Diagram COVID-SAFE Frame work

The figure shows the block diagram of the proposed system, where it is consisting of temperature sensor, GPS module, Pi camera,16*2 LCD display, heart rate & SpO2 oximeter, Easy Finger Pulse rate sensor, Raspberry Pi 4 B+ board and a smartphone. Here we are using the latest model of Raspberry Pi board, and the above mentioned components are connected to it. This IoT system works in real time and it is used to measure temperature, heartbeat rate and blood oxygen level of the patients and updates the health parameters or data's continuously to their concerned physician or caretaker, if any threshold is being measured or observed it gives alert message. It can also be used as personal health monitoring device and it is very helpful for remote area people as it can create communication without smartphone [14-15].

3.1. Raspberry Pi 4 B

Raspberry Pi is one of the best device to work with, it is available in the size of a credit card. A Raspberry Pi board can work as a normal computer has it already contain processor, RAM, 4 USB ports to plug in a monitor, mouse, and keyboard.It consists of 2 HDMI port, one Ethernet port and GPIO portsof 40 pins. One of the main advantage of latest Raspberry it has the ability to connect to internet (Wi-Fi) and Bluetooth. It can work as a normal computer, such as browsing, editing documents, playing games and much more.

Figure 2. Raspberry Pi 4 B+

3.2. DS18b20 Temperature sensor

The DS18b20 temperature sensor is used to measure the temperature it gives the value in 9bit to 12bit.the sensor consist of three terminals Vcc, Ground and Data. The connection of this sensor can be made by using single wire. These sensors can be programmable and it acts as a digital sensor, it takes less power supply of 3V to 5V.

Figure 3 DS18b20 Temperature Sensor

3.3. Neo-6M GPS

Neo-6M GPS is used to track the location, it can be interface with any circuit or boards such as Arduino, Raspberry Pi. It can nearly track up to 22 satellites on 50 channels. And also works through DC input and takes 3.3 to 5V of power supply.

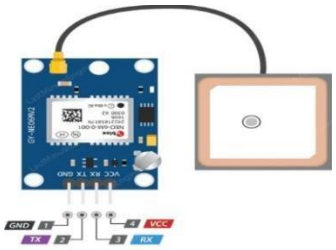


Figure 4 Neo-6M GPS

3.4. MAX30102 SpO2

MAX30102 spo2 it is an integrated pulse oximeter is a used to measure heartbeat rate. It is a biosensor where it reads the heartbeat rate of the person. it includes internal LEDs, Optical elements and photo detector. It operates on 1.8V to 3.3V power supply [20].

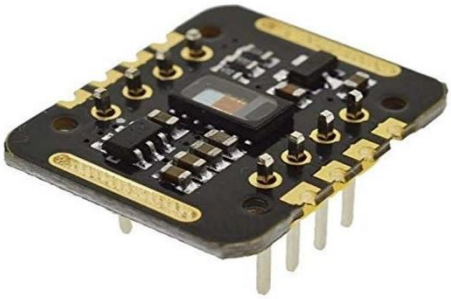


Figure 5 MAX30102 spo2

3.5. Pi Camera

The camera module compatible with all Raspberry Pi models. It provides high sensitivity, low crosstalk and low noise image capture in an ultra-small and lightweight design. it connects to the Raspberry Pi board via the CSI connector designed specifically for interfacing to cameras [23].

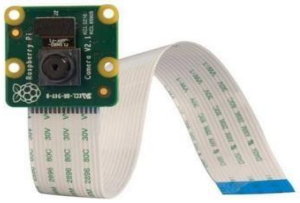


Figure 6 Pi Camera

3.6. 16*2 LCD Display

16*2 LCD Display is used to display or to convey the data from the circuit. It is basically display which is of 2 rows and each of it can display 16-character data. It requires 4.7V to 5.3Vpower supply [24].

Figure 7 16*2 LCD Display

3.7. Easy pulse rate sensor

The pulse rate sensor or heart beat rate sensor is used to measure heart beat rate by emitting red light or infrared light through the surface of the body where it can sense the flow of the blood during heartbeat. The transmission is measure through pulse wave. [21]

Figure 8 Easy pulse rate sensor

3.8. I2C Module

I2C Module is used to interface 16*2 LCD Display. Which isused to minimize the connection of pins in the circuit? It is basically in interfacing the display to the circuit board. The Raspberry Pi Camera it a light weight camera which supports Raspberry Pi board, which is portable. It is used in image processing, machine learning and for other surveillance projects. It creates communication with Pi using MIPI camera serial interface protocol [22].

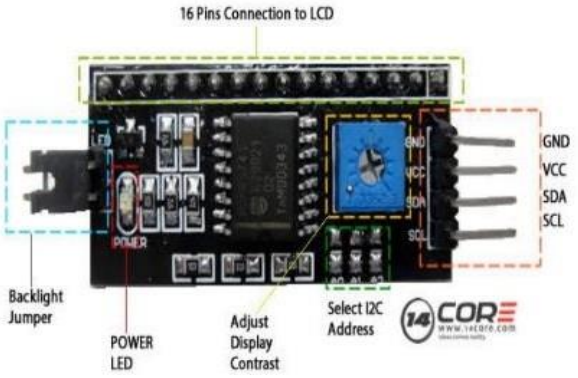


Figure 9 I2C Module

3.9. Flow Chart

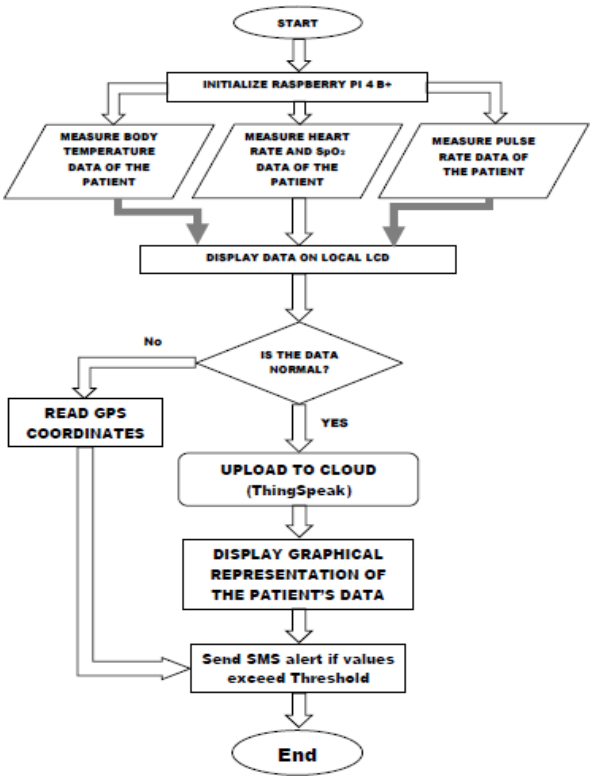


Figure 10 Flow diagram of proposed model

The figure 4 describes the flow diagram of entire project work. The components are connected to the Raspberry Pi board.Here we are using python 3.9.5 to program our Raspberry Pi 4 B+ board. This flow diagram explains an operation of the system. Firstly, it will initialize the system in Raspberry Pi 4 B+, and the health parameters or COVID-19 symptoms such as body temperature, heartbeat rate and pulse data of the patients are being measured and these are displayed in the local LCD display. If the measured data is normal, then it will be uploaded to cloud (ThingSpeak). And the health status is continuously monitored and sent to the patient's physician or caretaker. If the measured data is observed with threshold or when there is medical risk, then it will track the GPS location of the patient and the measured data will be uploaded to cloud and the data will be sent to their concerned physician or caretaker through an alert message via smartphone [25-29].

4. RESULTS AND DISCUSSIONS

The proposed work is used to measure body temperature, heartbeat rate, and pulse data rate and to track live location of the patient using GPS and Pi camera. This will help in detecting COVID-19 infection or other infectious diseases and provide information to the concerned physician or the care taker in the preliminary stage of the disease, this system will be a greatest system for remote peoples. The proposed system can also work as a personal device.

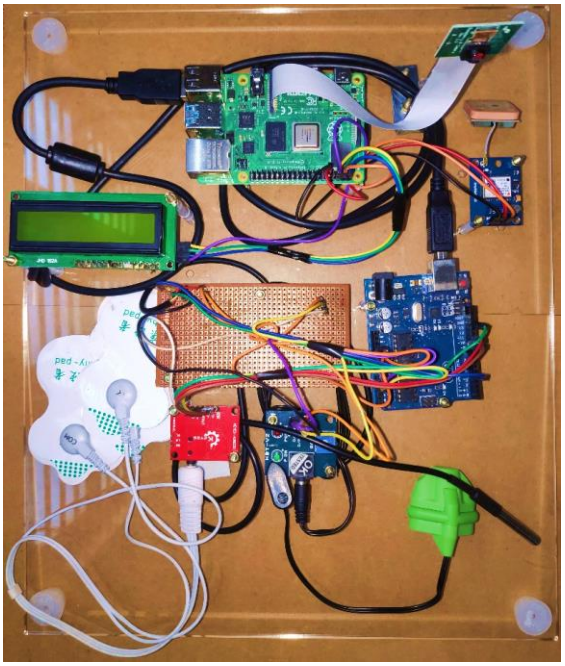
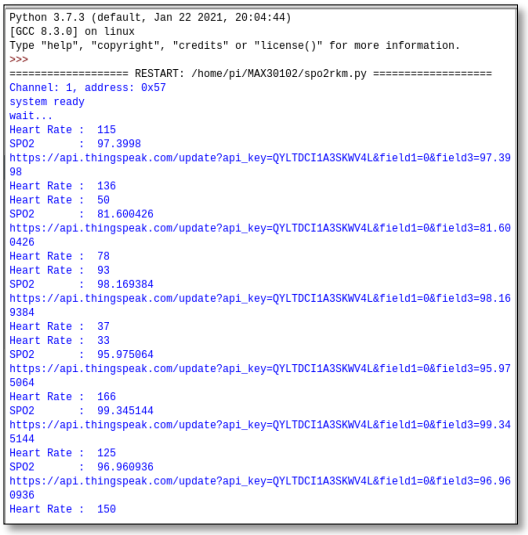


Figure 11 Hardware implementation of COVID-SAFE healthmonitoring system



```
Python 3.7.3 (default, Jan 22 2021, 20:04:44)
[GCC 8.3.0] on linux
Type "help", "copyright", "credits" or "license()" for more information.
>>>
=================== RESTART: /home/pi/MAX30102/spo2rkm.py ===================
Channel: 1, address: 0x57
system ready
wait...
Heart Rate :  115
SPO2       :  97.3998
https://api.thingspeak.com/update?api_key=QYLTDCI1A3SKWV4L&field1=0&field3=97.39
98
Heart Rate :  136
Heart Rate :  50
SPO2       :  81.600426
https://api.thingspeak.com/update?api_key=QYLTDCI1A3SKWV4L&field1=0&field3=81.60
0426
Heart Rate :  78
Heart Rate :  93
SPO2       :  98.169384
https://api.thingspeak.com/update?api_key=QYLTDCI1A3SKWV4L&field1=0&field3=98.16
9384
Heart Rate :  37
Heart Rate :  33
SPO2       :  95.975064
https://api.thingspeak.com/update?api_key=QYLTDCI1A3SKWV4L&field1=0&field3=95.97
5064
Heart Rate :  166
SPO2       :  99.345144
https://api.thingspeak.com/update?api_key=QYLTDCI1A3SKWV4L&field1=0&field3=99.34
5144
Heart Rate :  125
SPO2       :  96.960936
https://api.thingspeak.com/update?api_key=QYLTDCI1A3SKWV4L&field1=0&field3=96.96
0936
Heart Rate :  150
```

Figure 12 Heartrate and SpO2 monitoring results and the same will be uploaded to cloud (ThingSpeak)

Figure 13 Pulse rate and Body temperature detection results.

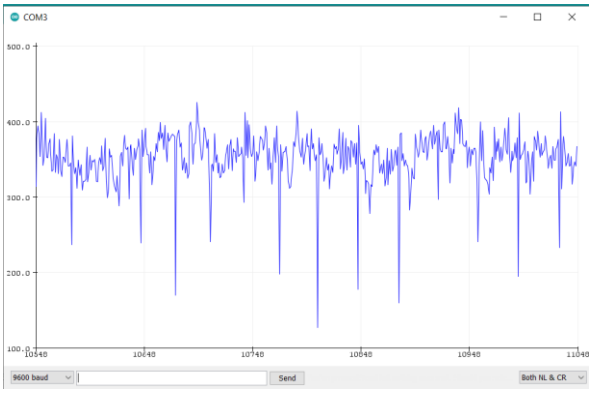


Figure 14 Electrocardiography output

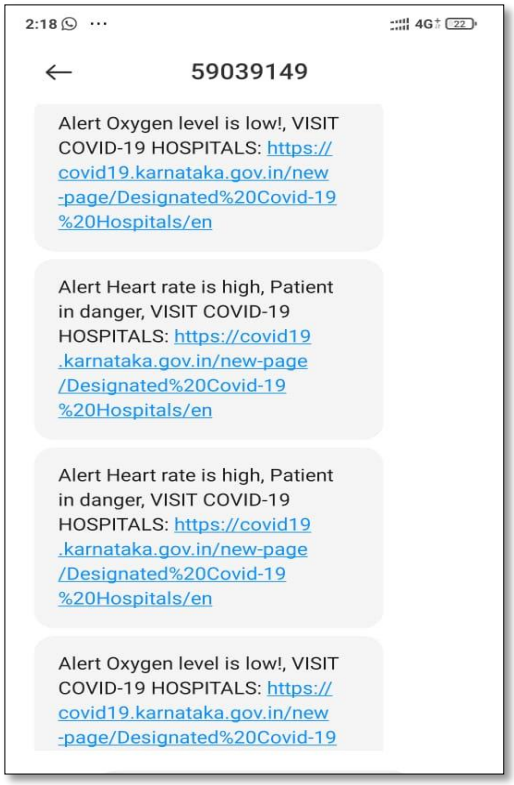
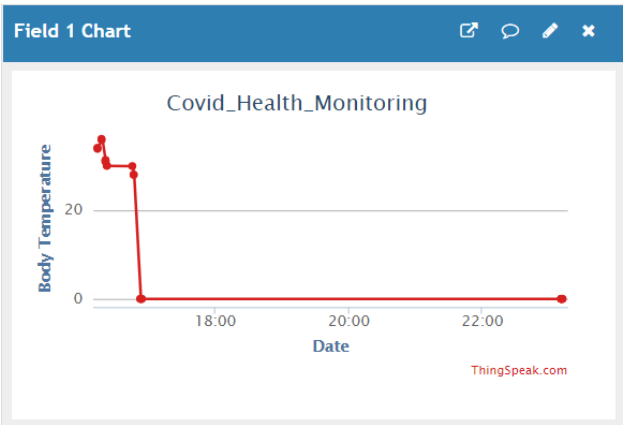
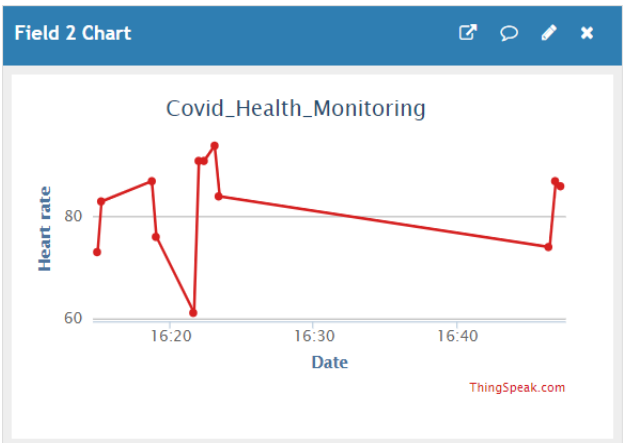


Figure 15 Alert SMS when threshold exceeds along with nearest Covid-19 Hospitals List.





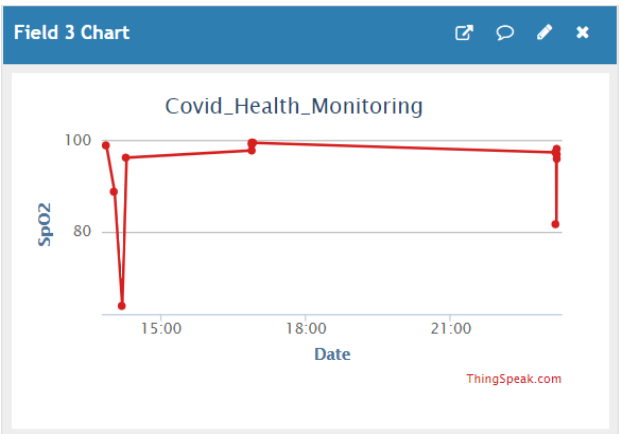


Figure 16 Health monitoring data uploaded to Thing Speak.

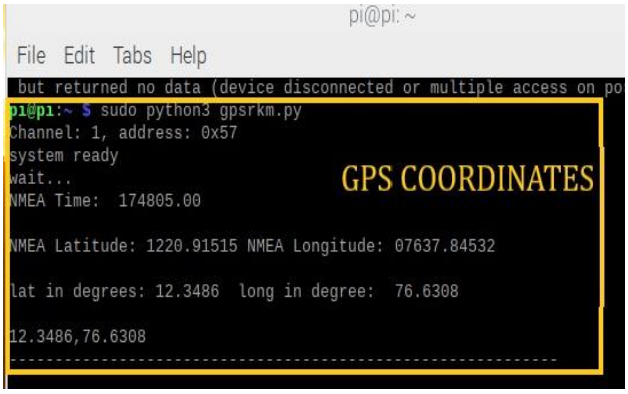


Figure 17 Results on GPS Coordinates

5. CONCLUSION

An IOT system is presented to monitor participants' health conditions and notify them when patient is in danger. A wearable IoT node with a smart phone application, by which the IoT sensor node can collect a user's health parameters, such as body temperature, heartbeat rate and pulse data rate. And the smart phone connects to the network to send the data to the server.

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