Original Research Article

Design of IOT Based Health Monitoring System

Pandimadevi Ganesan[1*], Thushara Hameed[2], Maheswari Maruthakutti[3], Selvakumar Vairamuthu[4]

[1,2,3,4]Lecturer, Engineering Department, University of Technology and Applied Sciences, Nizwa, Sultanate of Oman.

*Corresponding author: Pandimadevi Ganesan
Lecturer, Engineering Department, University of Technology and Applied Sciences, Nizwa, Sultanate of Oman

Abstract

With advancement of technology at present health monitoring is one of the most emerging fields. Recently Internet of things is used in various applications like remote monitoring of parameters; control the process far away from the plant etc. In our work we used internet of things to design a health monitoring system using Arduino and several sensor network. This system will monitor the body temperature, environmental temperature, humidity, heart rate and fall detection of the patients. The measured value will be communicated to the thingspeak cloud platform. The thingspeak will read the values and send an alert message to the responsible person in the family and also to the respective doctors to do the immediate aid for the patients under abnormal conditions.
Keywords: Arduino, fall detection, health monitor, thingspeak.

INTRODUCTION

As we see in this time, almost a thousand people die every month because of neglect of their health due to heavy workload. Upon that, we decided to do our project as health care in an easy way. We have decided to use IOT (Internet of Things) in it. As we know, IOT makes our life easier, and by using it the project will provide to all people. Information about their health & they can check their historical health data. The best part of our project is that it can be used by everyone and make our health management easier than available systems. Also, the IOT based health care system is the cheapest health care device for patients & doctors. Also, we have decided to use the "THINGSPEAK" cloud service as one part of our project, used for storing all data in the cloud & it provides security & facility of accessing all the parameters at any time which is very useful for the doctors at the time of treatment. This project mainly depends on Arduino and some different sensors. First we have implemented the monitoring system as a simulation with help of Proteus and Arduino Software and then we developed a hardware model of health monitoring system. This paper discusses about the hardware model results.

The elderly health care system is an innovative idea that benefits the elderly in taking care of their health and following up on all matters such as electrocardiograms, temperature and heart rate. Various sensor modules are used in our work to monitor the different parameters. To communicate the data globally we have decided to use cloud platform like Thing speak. With help of this cloud we can get the values at any time from any places. Then we can consult the Doctor presents anywhere around the world.

The aim is to build the internet of things based medical services venture for people who give all of them the individual data about their wellbeing on their portable and they can check their all verifiable wellbeing information. In addition, we will use different sensors that sense different thing related to human. Our work will serve all age groups and is suitable for everyone. It designed to work in 3 steps. First step is to test the sensor units and other components Arduino IDE. In Second step we will combine the sensor units with Wi-Fi module and Arduino to test the working. Finally, we will connect all the components in single schematics and we will test for the result.

Development is happening in all areas. We did a literature survey to know about the works related to our project. Many researchers have done Projects using IOT. Some produced health monitoring system by using different sensors or by monitoring different parameters of human body or by using IOT or any other technologies for communicating the results with concerned patients or with hospitals or with doctors. We had given some of the related works regarding our project. In a project names GSM-based Cellular IOT

Home Automation, they developed a device to control the home electronic devices automatically. In some other IOT projects, they controlled the noise production in any area. In medical science, researchers used IOT to monitor the patients' health. The below section gives an outline of the work related to IOT in medical field.

The researcher Tamilselvi proposed a basic health monitoring device to monitor heart rate, oxygen level, body temperature, eye motion with help of IOT. In that they designed the device, but they didn't do any performance analysis [1]. Second researcher Acharya *et al.,* developed a healthcare monitoring system which run in IOT platform. They also monitored the heart rate, temperature and respiration. They used raspberry pi as the processing unit. The collected data were given to raspberry pi and then communicated to IOT network. They didn't provide any visual representation of the measured values [2].

Noninvasive technique based pulse rate detection was developed by Banerjee *et al.,* Plethysmography process is used and the measured value is displayed as digitally. It is better than the invasive method [3]. Smartphone-based heart rate monitoring system was introduced by Gregoski *et al.,* They measured the cardiac output based on the blood flow. Also they transmitted the measured pulse to a computer to hear the pulse. But it is a good design.

With this kit, we cannot monitor the heartbeat continuously [4]. Cardiovascular disease sensing system had developed by Oresko *et al.,* In their design they used a smartphone. But the prototype didn't detect the cardiac disease and not track the heart beat rhythm.

An Arduino based surveillance system was proposed by Trivedi *et al.,* in that research work, the sensor measured values are collected and given to Arduino board. The demerit is that it couldn't cover a large area [5]. A safety monitoring device using IOT was developed by Kumar *et al.,* The architecture of the device had three layers. Name or the layers are control, transmit and system layer. Human body temperature was measured by a Ds18b20 Sensor and a pulse measurement was done by the pulse sensor. The measured data were communicated form the Arduino to the cloud network with help of a WIFI module. Since they used Arduino Uno they couldn't use many sensors with that board [6]. A wireless sensor network was suggested by Desai *et al.,* It detected the smart home and the heartbeat. They used Spartan3 and FPGA. The results were displayed with help of a LCD module [7].

BLOCK DIAGRAM
The Block diagram consists of power supply, Arduino UNO, Meany sensors like (Heart Beat Sensor, Temperature Sensor, Humidity Sensor, and Acceleration Sensor) and ESP8266 wifi module (Fig 1).
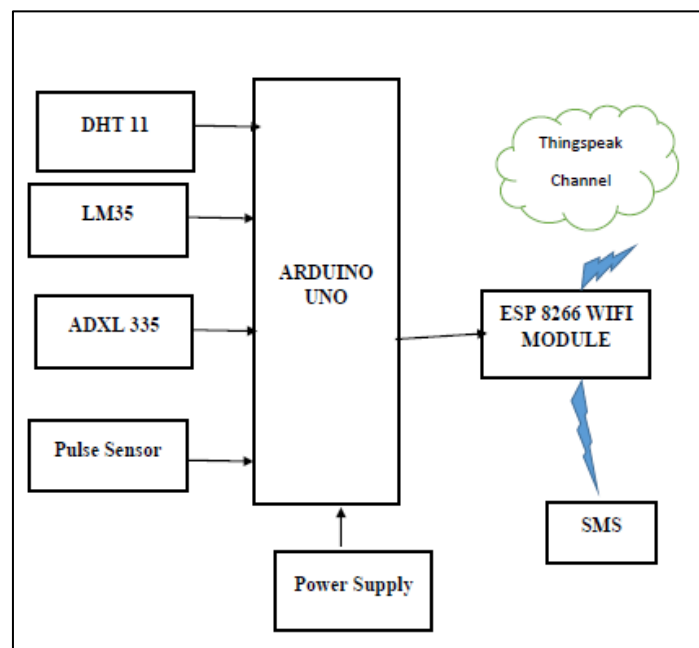

Figure 1: Block Diagram

We will fix sensors in the human body & the sensors will work like input devices to arduino process. The heart rate beat sensor used to measure the heart rate speed of heart beat. It measured in beats per minute. Also, the temperature sensor will measure the body temperature. The LM35 is the type of temperature sensor which we used in our project. The type of

humidity sensor which we used is DHT11 sensor; it is measure the surround temperature & humidity of that surround area & person. It will sense the amount of the temperature as well as humidity & will be given to the Arduino process. In addition, acceleration sensor is sense if there is any vibration, so it used to identify the fall detection. The data which we give from tis different

sensors will give to Arduino processor. In Arduino we have program, it will get all sensors data & compared with normal value. If the value or data of sensors is more or less than the normal value, the Arduino process will send signal to the thinkspeak with help of the Wi-Fi module to show the data or the information which

sensed by the sensors. Also if any abnormalities happened, Thinsgpeak will send sms to the concern doctor.

CIRCUIT DIAGRAM

Figure 2: Circuit Diagram

THINGSPEAK SERVER & IFTTT APP

Thingspeak is an IOT analytics platform service that allows to aggregate, visualize and analyze live data streams in the cloud. It provides instant visualizations of data posted by your devices to Thingspeak. With the ability to execute MATLAB code in Thingspeak you can perform online analysis and

processing of the data as it comes in. Thingspeak is often used for prototyping and proof of concept IOT systems that require analytics. IOT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation.

Figure 3: Thingspeak Channel

IFTTT is a free app which can help to connect all app or device together. In our work we used IFTTT app along with Thingspeak channel to send alert message to the concerned doctor. Four events were created for each of the parameters (Fig4). To trigger the event, Thingspeak HTTP & REACT app was created (Fig 5 &Fig 6).
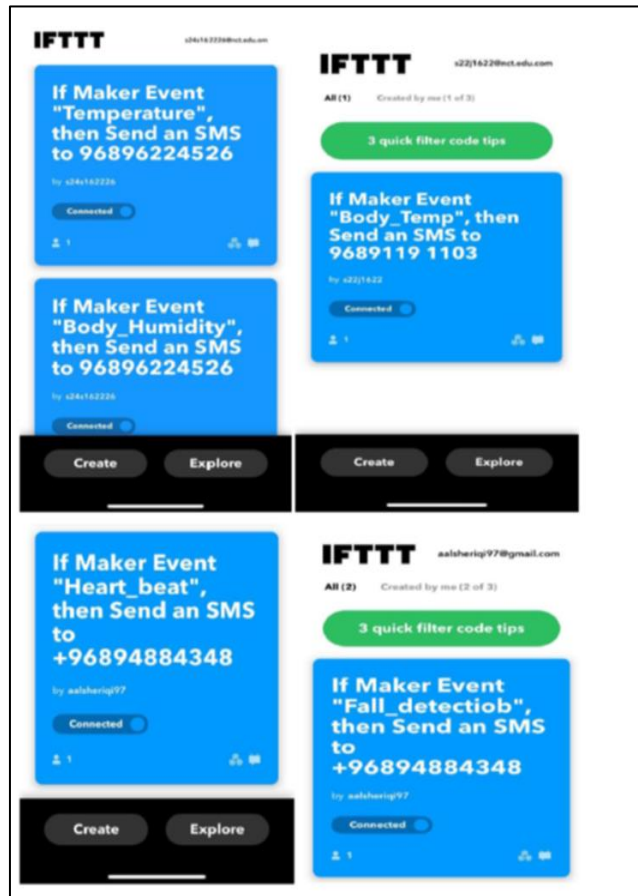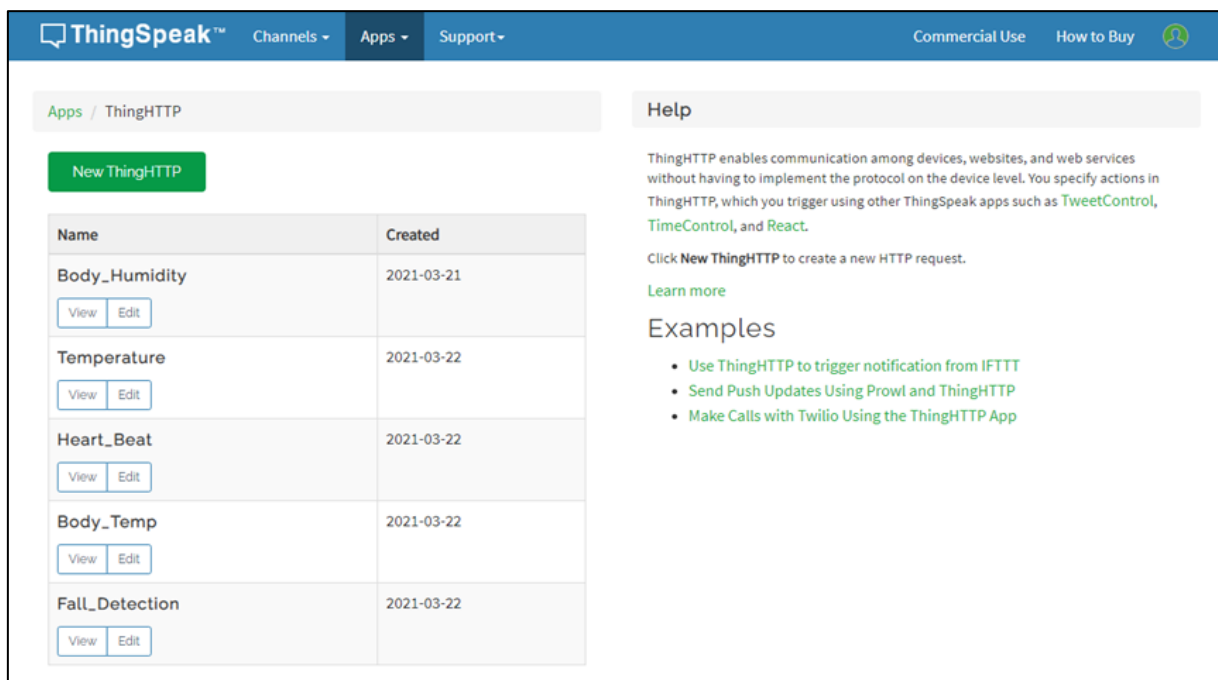

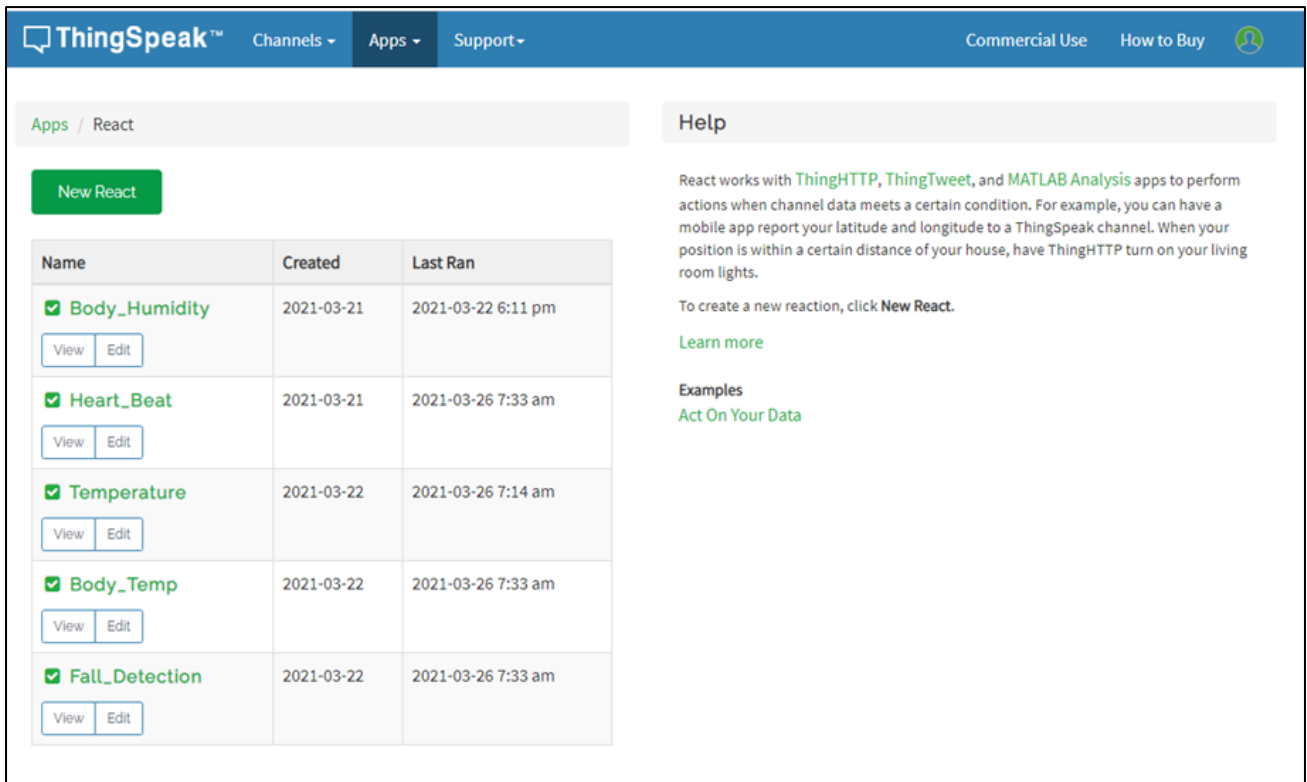**Figure 4: IFTTT Applet**

Figure 5: Thingspeak HTTP

Figure 6: Thingspeak React

RESULTS & DISCUSSION

The heartbeat sensor, DHT11 sensor, Body temperature sensor and ADXL sensors were calibrated and tested separately before assembling the health monitoring system. The code was uploaded and tested our system. The final connection testing and hardware model created is shown in figure 7 &8. The results are observed in the serial monitor and also in the Thingspeak channel. The results are shown in figure 9 and figure 10.
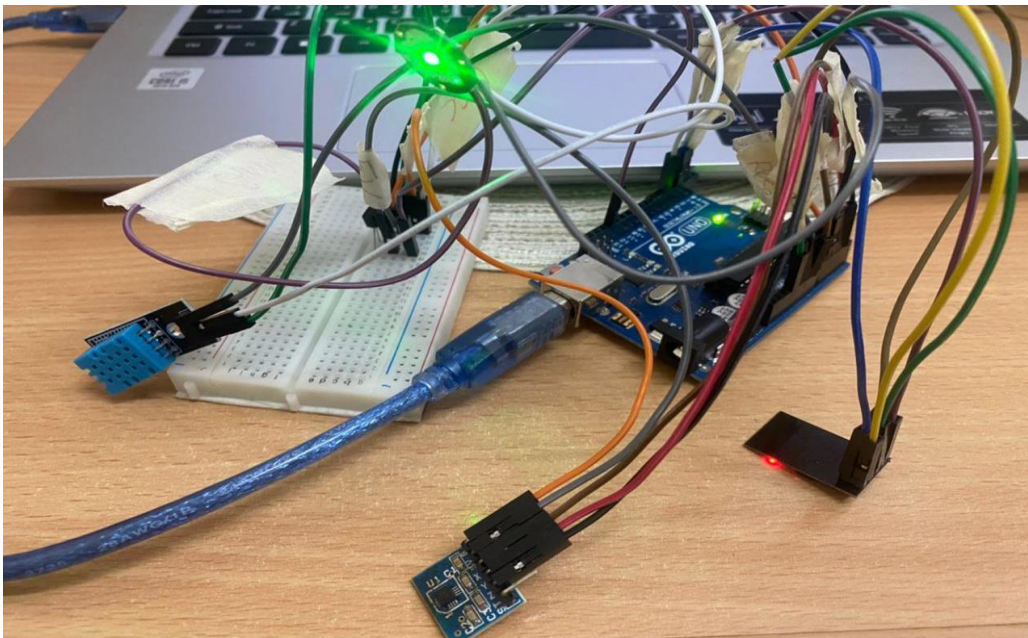

Figure 7: Final connection
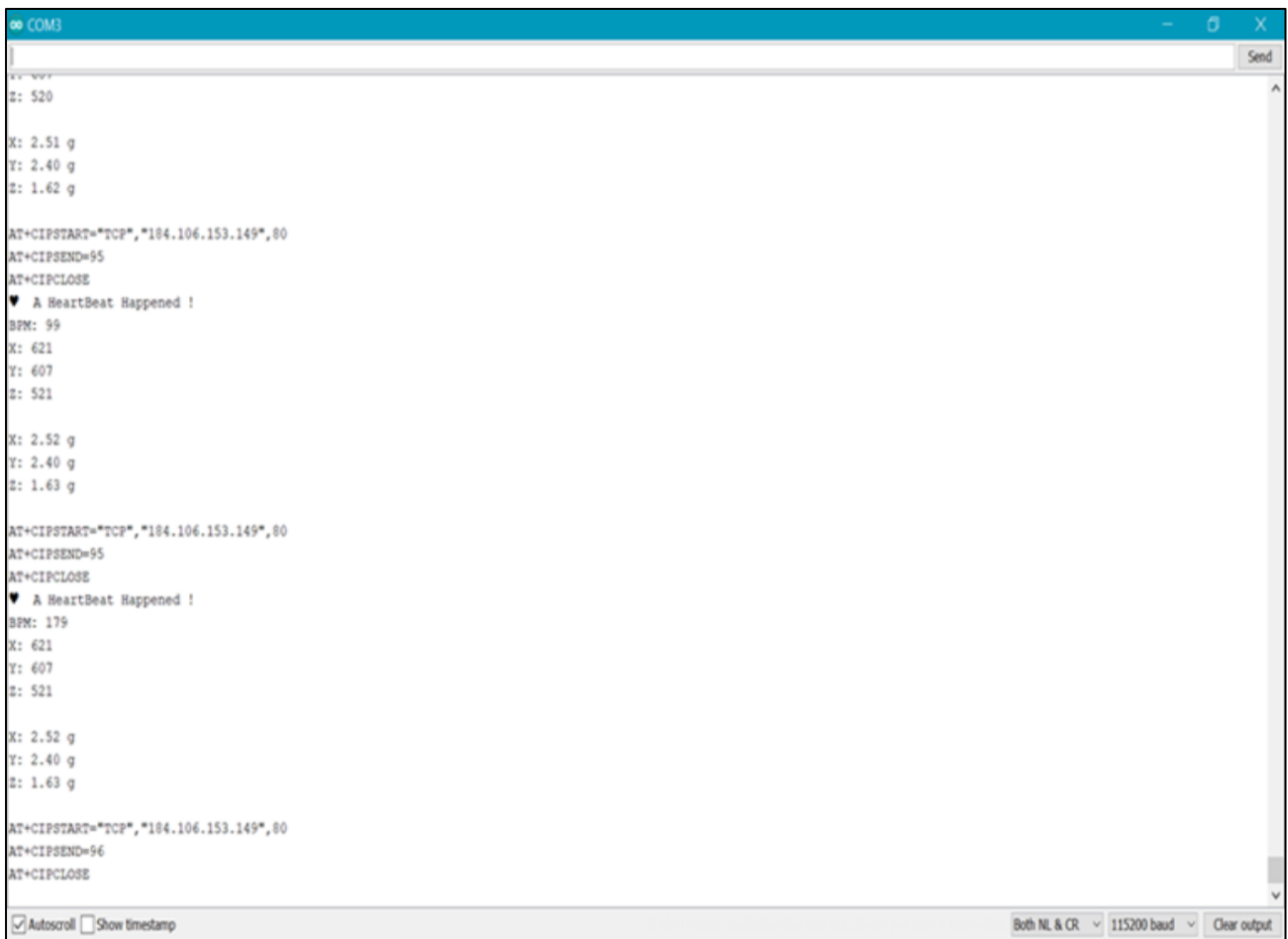
Figure 8: Final Hardware Model
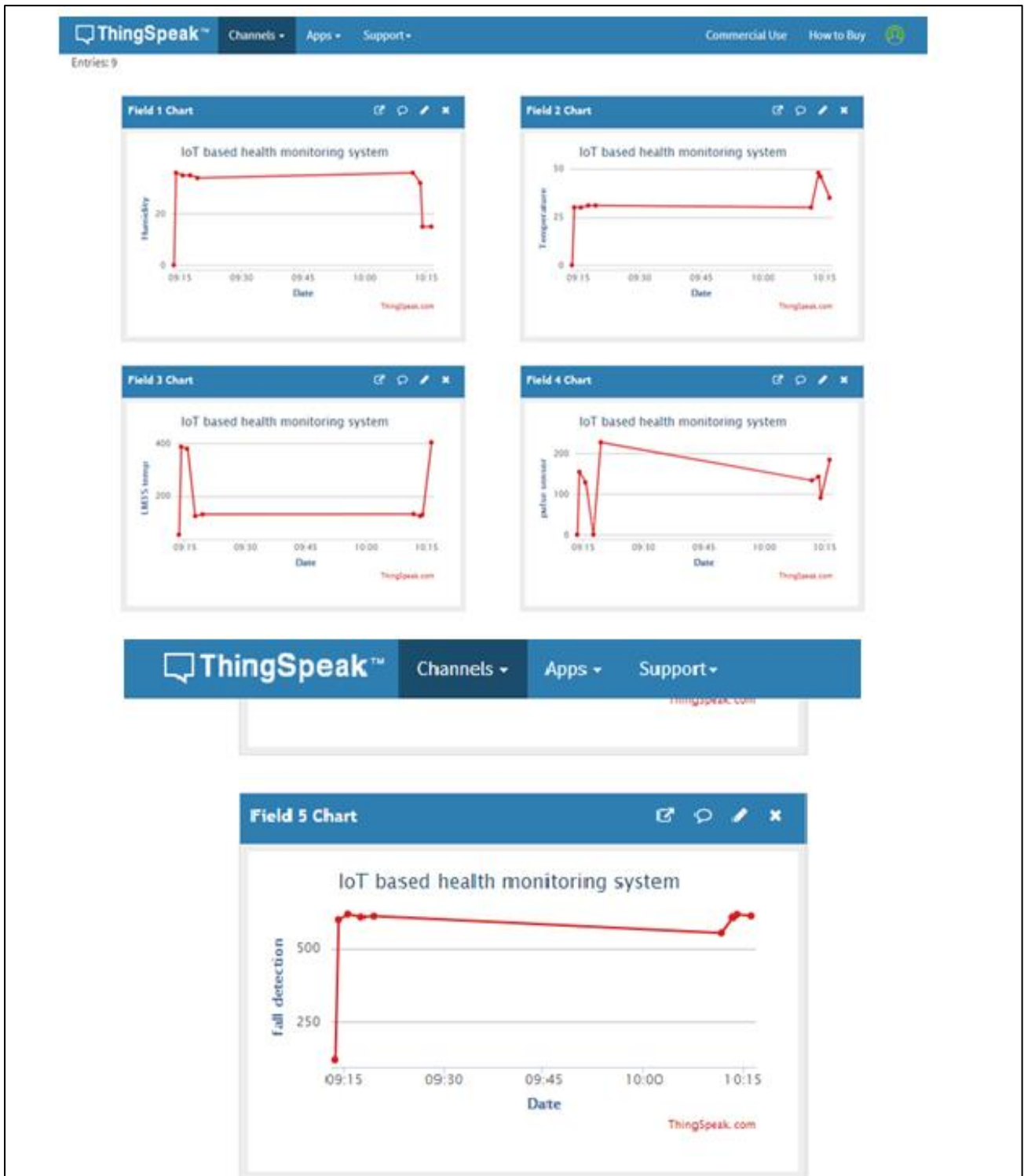

Figure 9: Serial Monitor

Figure 10: Thingspeak Channel Results

Whenever the parameter values exceeded the specific values, Thingspeak HTTP will trigger the react app to send sms with help of IFTTT. Some Sample of sms received is shown in figure 11.
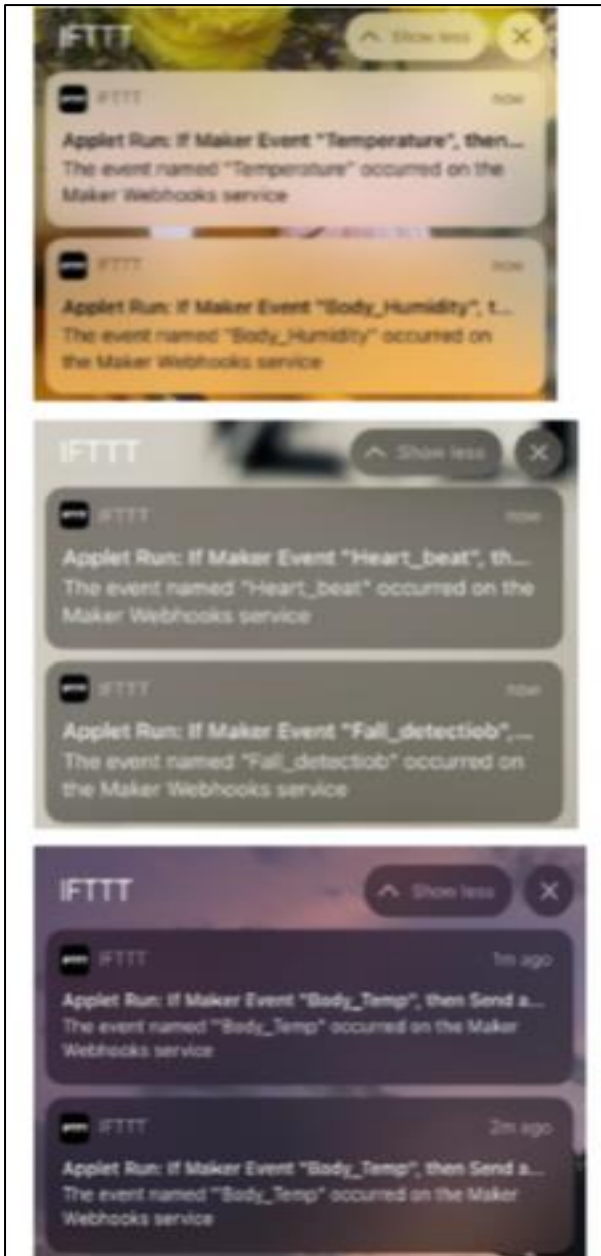
Figure 11: IFTTT Messages

CONCLUSION

Our main objective was to successfully monitor the basic four criteria's namely body temperature, pulse rate, Humidity &Temperature of surroundings and fall detection and react during emergency situation without any human interaction The IOT based health monitoring system was implemented and tested successfully with help of Arduino IDE and Thingspeak. We first checked the working of components by using Arduino Uno. Then we assembled all the components together and tested. The project is working fine and displays the values in the Thingspeak channel and also it is sending sms to the responsible persons in case of any abnormalities. This will be helpful for the people living in remote areas and doesn't have access to all the medical facilities.

ACKNOWLEDGEMENT

REFERENCES

1. Tamilselvi, V., Sribalaji, S., Vigneshwaran, P., Vinu, P., & GeethaRamani, J. (2020). IoT based health monitoring system. In: 2020 6th International conference on advanced computing and communication systems (ICACCS). *IEEE,* 386–9.
2. Acharya, A. D., & Patil, S. N. (2020). IoT based health care monitoring kit. In: 2020 Fourth international conference on computing methodologies and communication (ICCMC). *IEEE,* 363–8.
3. Banerjee, S., & Roy, S. (2016). Design of a photo plethysmography based pulse rate detector. *Int J Rec Trends Eng Res,* 2, 302–6.
4. Gregoski, M. J., Mueller, M., Vertegel, A., Shaporev, A., Jackson, B. B., Frenzel, R. M., Sprehn, S. M., & Treiber FA. (2012). Development and validation of a smartphone heart rate acquisition application for health promotion and wellness telehealth applications. *Int J Telemed Appl,* 2012, 1–7.
5. Oresko, J. J., Jin, Z., Cheng, J., Huang, S., Sun, Y., Duschl, H., & Cheng, A. C. (2010). A wearable smartphone-based platform for real-time cardiovascular disease detection via electrocardiogram processing. *IEEE Trans Inf Technol Biomed,* 14, 734–40.
6. Kumar, S. P., Samson, V. R. R., Sai, U. B., Rao, P. L. S. D. M., & Eswar, K. K. (2017). Smart health monitoring system of patient through IoT. In: 2017 International conference on I-SMAC (IoT in social, mobile, analytics and cloud) (I-SMAC). *IEEE,* 551–6.
7. Desai, M. R., & Toravi, S. (2017). A smart sensor interface for smart homes and heart beat monitoring using WSN in IoT environment. In: *International conference on current trends in computer, electrical, electronics and Communication (CTCEEC).*