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Health Monitoring System of Patient Using IoT

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ABSTRACT

Now a day's IoT brings gadgets together and assumes a fundamental part in different methodologies like smart home automation, brilliant industries, smart environment, agricultural fields and patient health monitoring system and so on. One of the approaches is to monitor the health state of the patient and screen it to doctors or paramedical staff through the IoT, as it is hard to screen the patient for 24 hours. So here the patient health condition or status i.e. Pulse rate, Body Temperature, ECG and so on can be measured by utilizing the protruding sensors. These sensors are associated with the node mcu and mcp 3008, it gathers the information i.e. biomedical data from the sensors and the detected biomedical information can be transmitted to the server. The "Thingspeak" named cloud is utilized here to place the detected information into the server. From this server, the information can be envisioned to the specialists and other paramedical staff either by Thingspeak website or Thingview android application. This system also notifies if there is any change in patient parameters. In this way, this Health monitoring system diminishes the toil of specialists and paramedical staff to screen the patient for 24 hours and further reduces time and cost for support.

Keywords : Internet of Things (IoT), node mcu and mcp3008, Thingspeak.

I. INTRODUCTION

In the recent years use of wireless technology is increasing for the need of upholding various sectors. In these recent years IoT groped the most of industrial area specially automation and control. Biomedical is one of recent trends to provide better health care. Not only in hospitals but also the personal health care facilities are opened by the IoT technology. So, having a smart system, various parameters are observed that consume power, cost and increase efficiency. In accordance with this smart system, this paper is reviewed

II. MOTIVATION

In India, there is one doctor for every 1,457 people as per the country's current population estimate of 1.35 billion, which is lower than the World Health Organisation norm of 1:1000, the government has informed Parliament. A little over 11.57 lakh doctors are registered with the state medical councils and the Medical Council of India as on January 31, and assuming 80 per cent availability, it is estimated that around 9.26 lakh doctors may be available for active service, Minister of State for Health Ashwini Choubey said on July 2.

As per Indian Nursing Council (INC) records, there are around 30.4 lakh nursing personnel registered in the country as on December 31, 2018, Choubey said in his reply. Assuming 60 per cent availability in the case of registered nurses and registered midwives and 80 per cent availability in the case of auxiliary nurse midwives or lady health visitors, it is estimated that around 20 lakh nursing personnel are available for active services, which gives a nurse-population ratio of about 1:675 against WHO norms 3:1000 (population taken as 135 crores), he said.

In this way, it is clear there is just a single doctor for 1457 patients and requires twofold sum paramedical staff for present existing staff. It is impractical to rise to the patient and specialist proportion and multiplying the paramedical staff. Health Monitoring System using IoT approach is used to decrease the endeavours of the doctors and paramedical staff. This strategy is likewise comfort for the patient since it lessens the enormous hardware, which is presently used as a part of ICU's.

III. RELATED WORK

Health monitoring system using IoT has drawn extensive considerations from the examination group and industry amid the most recent decade. Various and yearly expanding innovative work endeavours have been posted in the written works. We have constrained this push to incorporate just a portion of the extremely late related works. Continuous portable human services framework for observing the elderly patients from indoor or outside areas has been displayed in DONG Jun additionally depicts the design of a wearable ECG screen that is quiet area free and gives persistent checking. The signs from the sensors are transmitted utilizing Bluetooth to the PDA in its range, which can thus be sending to the goal through web.

IV. PROPOSED DESIGN AND OVERVIEW

A. OBJECTIVE

- To develop health monitoring system i.e. it measures body temperature and heart rate.
- To design a system to store the patient data over a period using database management.
- To do analysis of collected data of sensors and get alerts whenever there is change in parameters of patient.

B. BLOCK DIAGRAM

The general design of IoT applications can be categorized into three layers: the detecting layer, the transport layer and the application layer.

In the Detecting layer to measure the body temperature we use DS18B20 water resist body temperature sensor. The heart beat rate of the patient is measured by utilizing pulse sensor. It has its own visualizer to picture the heart beat waveform, BPM and IBI.

To recognize the Electrocardiogram and Electromyogram we utilized AD8232 Heart-Rate observing sensor. This Bio data from the sensors is checked persistently in Arduino software by utilizing the serial monitor.

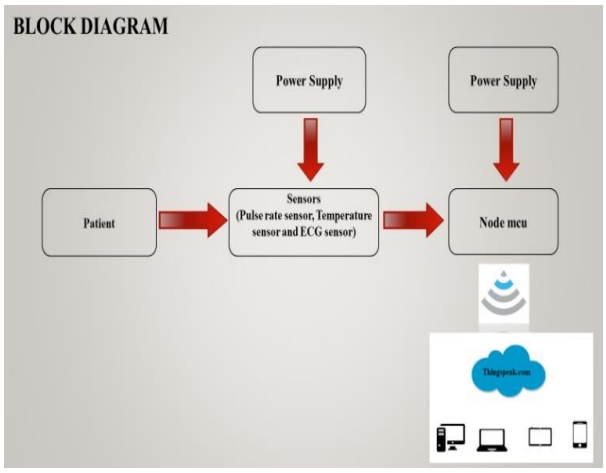


Fig 1 : Block Diagram

In the Transport layer, we send the information to the cloud by assistance of an Ethernet shield or Wi-Fi Module ESP8266. Here we utilize the open cloud server i.e. "Thingspeak" to make it accessible in cloud, with the end goal that the data can be seen at anyplace on the planet. Here in the Thingspeak server we create an own account and we make a different channel by the name of our project. So, in the process of creating the channel we get a unique id and an API key to compose the information to the cloud. This API key is utilized while programming in Arduino with the end goal that the information is put in the server and at the application layer we can recover the information by the utilization of an API key to such that the information can be obtained from the server.

C. COMPONENTS USED

1) Node MCU:

NodeMCU is an open source Lua based firmware for the ESP8266 Wi-Fi SOC from Espressif and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK.The firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module.

Fig 2 : NodeMCU 12E board

2) MCP3008 IC:

The **MCP3008** is an **8-Channel 10-bit ADC IC**, so it can measure 8 different analog voltage with a resolution of 10-bit. It measures the value of analog voltage from 0-1023 and sends the value to a microcontroller or microprocessor through **SPI communication**. It can operate on both 3.3V and 5V and hence it can be used with 5V microcontroller as well as with 3.3V systems like the Raspberry Pi. It uses the SAR method to convert the Analog voltage to digital value.

Fig 3 : MCP3008

The Features of MCP3008 are

- 8-Channel 10-bit ADC IC
- Communication protocol: Serial SPI interface
- Operating voltage 2.7V to 5V
- ADC method: Successive Approximation (SAR)

- Sampling Rate: 200ksps and 75ksps for 5V and 2.7V resp.
- Available in 16-pin PDIP, and SOIC packages.

3) Body Temperature Sensor:

The DS18B20 is the one of the best reasonable sensor for measuring the human body temperature (exact to±5° Centigrade over the extent of - 55°C to +125°C. We can put these sensors at different spots of the human body like on forehead, under arms and even under the tongue because its waterproof. The DS18B20 has three wires i.e. VCC, GND, DATA are mounted in a solitary wire. This temperature sensor is connected to the Nodemcu. Since each DS18B20 contains an ideal silicon serial number, more numerous DS18B20s can exist on the same Wire transport.We can use it in the thermostat controls system. It can be used in industries as a temperature measuring device. It can be used as a thermometer.

We can use it in thermally sensitive devices. It can also be used in HVAC systems.

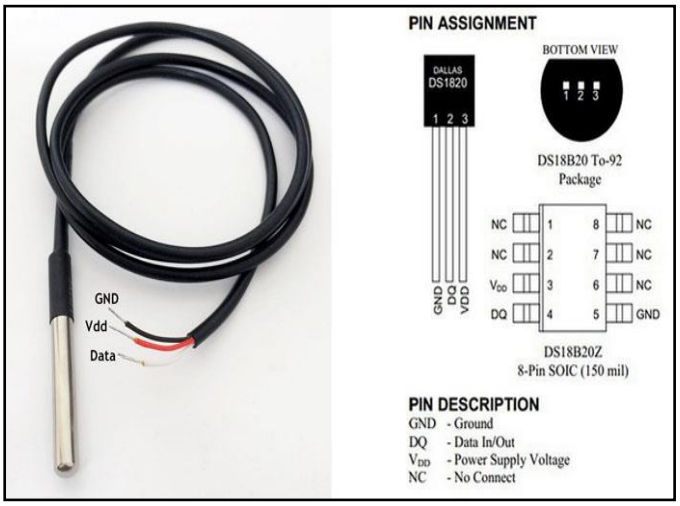


Fig 4 : DS18B20 Temperature Sensor

4) Pulse rate Sensor:

The working of the **Pulse/Heart beat sensor** is very simple. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Finger tip or you ear tips, but it should be placed directly on top of a vein.

Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflected by the

Power Supply Range:	3.0V to 5.5V
Operating Temperature Range:	-55°C to +125°C (-67F to +257F)
Storage Temperature Range	-55°C to +125°C (-67F to +257F
Accuracy over the range of -10C to +85C	±0.5°c
Size of Sheath	6*50mm
Connector:	RJ11/RJ12, 3P-2510, USB.
Pin Definition:	RED: VCC YELLOW: DATA BLACK: GND
Cable length:	1 meter, 2m, 3m, 4m are available

blood, this minor change in received light is analyzed over time to determine our heart beats.

The Pulse Sensor is an attachment and play heart- rate sensor for Nodemcu. It can be utilized by understudies, specialists, competitors, producers, and amusement and versatile engineers who need to effectively join live heart-rate information into their tasks. It basically consolidates a basic optical heart rate sensor with enhancement and noise cancelation hardware making it quick and simple to get solid heartbeat readings. The features of

- Diameter = 0.625"(~16mm)
- Overall thickness = 0.125"(~3mm)
- Cable length = 24" (~609mm)
- Voltage = 3V to5V
- Current consumption = ~4mA at5V

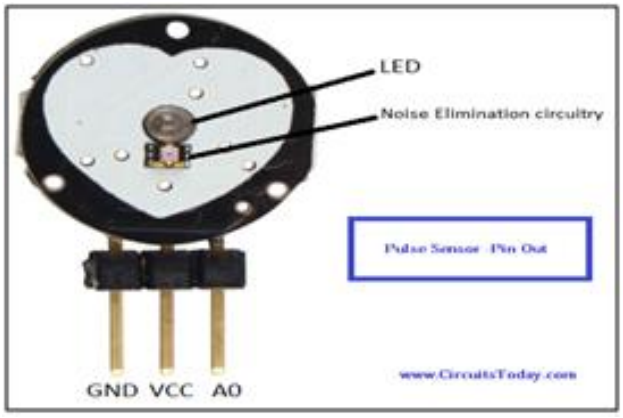


Fig 5 : Pulse Sensor

There are three primary links in the pulse sensor as shown in Figure. They are red wire, dark wire and purple wire. Each of them should be associated with the Arduino board to reach. The red wire need to interface with +3V to +5V stick dark wire to GND (Ground) stick and purple wire to the information stick. Pulse Sensor is utilized to identify the pulse through fingertip. Basically, Pulse Sensor is a Photo plethysmograph which typically measures blood- oxygen level (SpO2).

The maximum heart rate for each person from the age of 18 to 65+ is exhibited in the below table.

WOMEN'S RESTING HEART RATE CHART						
AGE	18 - 25	26 - 35	36 - 45	46 - 55	56 - 65	65+
ATHLETE	54-60	54-59	54-59	54-60	54-59	54-59
EXCELLENT	61-65	60-64	60-64	61-65	60-64	60-64
GOOD	66-69	65-68	65-69	66-69	65-68	65-68
ABOVE AV	70-73	69-72	70-73	70-73	69-73	69-72
AVERAGE	74-78	73-76	74-78	74-77	74-77	73-76
BELOW AV	79-84	77-82	79-84	78-83	78-83	77-84
POOR	85+	83+	85+	84+	84+	84+

MEN'S RESTING HEART RATE CHART						
AGE	18 - 25	26 - 35	36 - 45	46 - 55	56 - 65	65+
ATHLETE	49-55	49-54	50-56	50-57	51-56	50-55
EXCELLENT	56-61	55-61	57-62	58-63	57-61	56-61
GOOD	62-65	62-65	63-66	64-67	62-67	62-65
ABOVE AV	66-69	66-70	67-70	68-71	68-71	66-69
AVERAGE	70-73	71-74	71-75	72-76	72-75	70-73
BELOW AV	74-81	75-81	76-82	77-83	76-81	74-79
POOR	82+	82+	83+	84+	82+	80+

5) ECG Measuring Sensor:

ECG (electrocardiography) is a method of collecting electrical signals generated by the heart. This allows us to understand the level of physiological arousal that someone is experiencing, but it can also be used to better understand someone's psychological state.

The AD8232 Heart Rate Monitor module is used toanalyse the Electrocardiogram as well as Electromyogram. ECG sensor has three leads that can be placed at various positions on the human body like on chest, on hands etc.

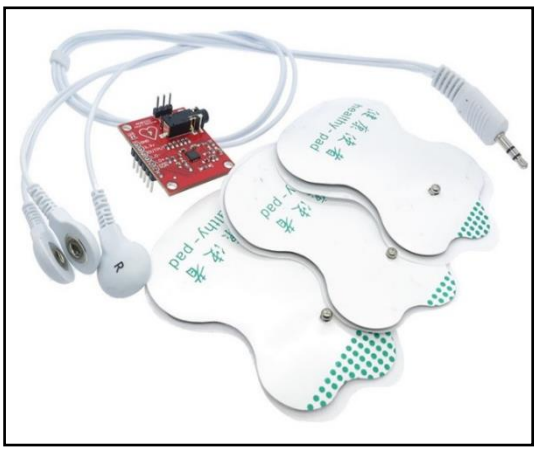


Fig 6 : AD8232 ECG Sensor

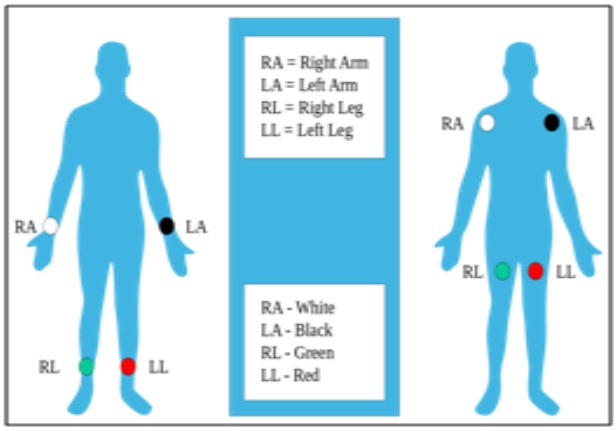
This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

The AD8232 module breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also, provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heartbeat.

The Electrical system of the heart controls the generation and propagation of Electrical signals through the heart muscle it periodically contrasts and relaxes to pump blood during each heartbeat. The healthy heart will have an orderly progression depolarization. Depolarization is a sudden electrical change with in the cell become positive for a brief time. Depolarization starts with pacemaker cells in the sinoatrial nerve spreads out through the atria ventricular node into the bundle of His fiber and into the purkinje fibers spreading down and to the left through the ventricles unlike all other nerves cells that requires stimulus to fire [8]. The sinoatrial nerve can be considered self-oscillating or self-firing it repeatedly gives Depolarization discharge and then repolarizes and fire again it can be compared to working of relaxation oscillator in Electronics. In fact, enforced artificial pacemakers the relaxation oscillator is used, which acts as the sinoatrial nerve.

The membranes of living cells act like charge capacitors one of the differences is that between capacitors and membrane is that the capacitors can be charged and discharged much faster than living cells. This is attributed to the slow mechanical nature of ionic nature in living cells. The Electrodes placed at patient body detect the small changes of Electro potential on the skin that arise from the heart muscle depolarizing during reach heart beat unlike in a conventional tripled ECG in which tend Electrodes placed on patient's limbs and chest.



Here for simplicity, we use only fire electrodes placed on limbs or just on chest. The magnitude range of the voltage is only 100 μV to about 5 mV.

For this project, we used AD8232 Single lead heart beat monitor kit connected to the

Nodemcu. This kit is convenient because it has all the necessary things. The body call, the electrode and wires.

The Nodemcu acts as a source providing 3.3V power supply to the ECD board and transfer information to personal computer. It is possible to use the power supply on the board from 2AA batteries and to connect on oscilloscope on which the same picture can be viewed. A laptop without connection with the AC power adapter is used for safety reasons.

The AD8232 is an integrated circuit developed by analog devices several years ago, it contains everything that is necessary to extract amplify and filter the small Bio potential signal in no easy conditions.

The Heart monitor kit is also used for EMG. EMG recording of the electrical activity produced by Skeleton muscles is used as a diagnostic technique. The features are

- Operating Voltage - 3.3V
- Analog Output
- Leads-Off Detection
- Shutdown Pin
- LED Indicator
- 3.5mm Jack for Biomedical Pad Connection or Use 3 pin header

6) IoT PLATFORM:

The "Thingspeak" named cloud is utilized here to place the detected information into the server. From this server, the information can be envisioned to the specialists and other paramedical staff either by Thingspeak website or Thingview android application. This system also notifies if there is any change in patient parameters through notification.

V. SYSTEM IMPLEMENTATION

Here we utilize the information that has been composed to the cloud to screen the patient's well-being condition. While making a channel in the Thingspeak server we make different channels for our utilization, for instance, we make a channel which incorporates the information of specific patient, and another channel for the other and so on. In every individual channel, we make sub fields for various well-being parameters including Temperature, pulse rate, Ecg. We can investigate the whole information of the patient in a graphical view. Indeed, even we can utilize this information for investigation in MATLAB for further more operations. As we utilize the Thingspeak open cloud server to screen the information, every esteem that has been obtained from the sensor placed at the patient's end is exchanged straightforwardly for every 15 seconds of regular intervals. The information that has been built into the Thingspeak server every information is acquired in a graphical frame containing an x-axis and y-axis speaking to the time and values respectively. With the end goal that any sudden changes in the patient's well-being condition can be observed rapidly and prompt can be made to the individual authorities. Indeed, even we can utilize this data for posting a tweet with the end goal that the patient prosperity status can be known to devotees. We can control the tweets that they can be sent when the patient well-being condition is unusual or even we can give a time to the open- cloud to tweet the patient well-being report. We have Thingspeak website and

Thingview android application for viewing the patient information independently in a protected way with the assistance of a unique API-key. This information can be stored for future usage and we can also get notified through twitter whenever there is a change in the patient parameters.

As showed in the below figure, we have made one unique channel and named it as Health monitoring. There are diverse sub-sections in every channel, for example, private, public. Where the private channel can be empowered to such an extent that the information can be viewed by the approved people who comprises of the exceptional API-Key and whereas out in the public anybody with the channel-ID can access to the information. Also, we can Import/Export the Data in excel sheet for nitty-gritty perception of the patient. While it comes to Thingview android app we can download it from google play store and enter the channel id and read API key. It displays the channel data in graph format as in Thingspeak website.

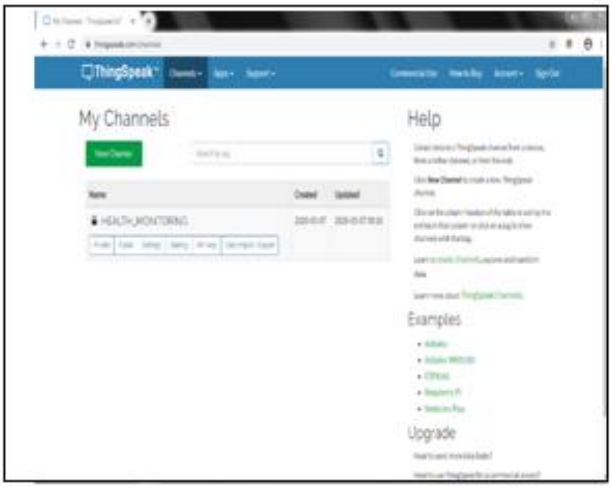


Fig 7 : Patient's Channel in Thingspeak cloud

VI. RESULTS

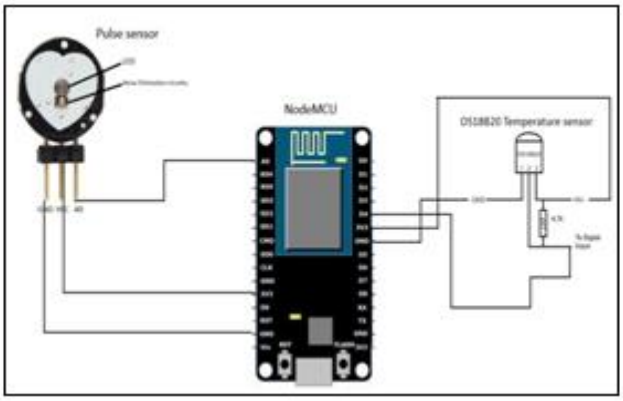


Fig 8 : Interfacing of Sensors with NodeMCU

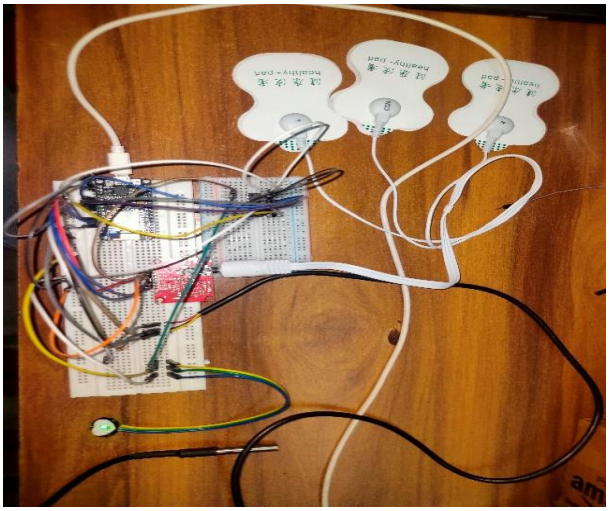


Fig 9 : Setup of System

The graphical representation of the information of the patient is demonstrated i.e. body temperature, Heartbeat, ECG are as shown in the below figure which is observed by signing into the Thingspeak server through a personal computer which has Time in x-axis and the parameter in y-axis. Though, fig demonstrates the information of the patient that is seen through the website, which gives more point by point data, as it demonstrates the most extreme and minimum values including the time stamps. It can also be viewed in Thingview android application.

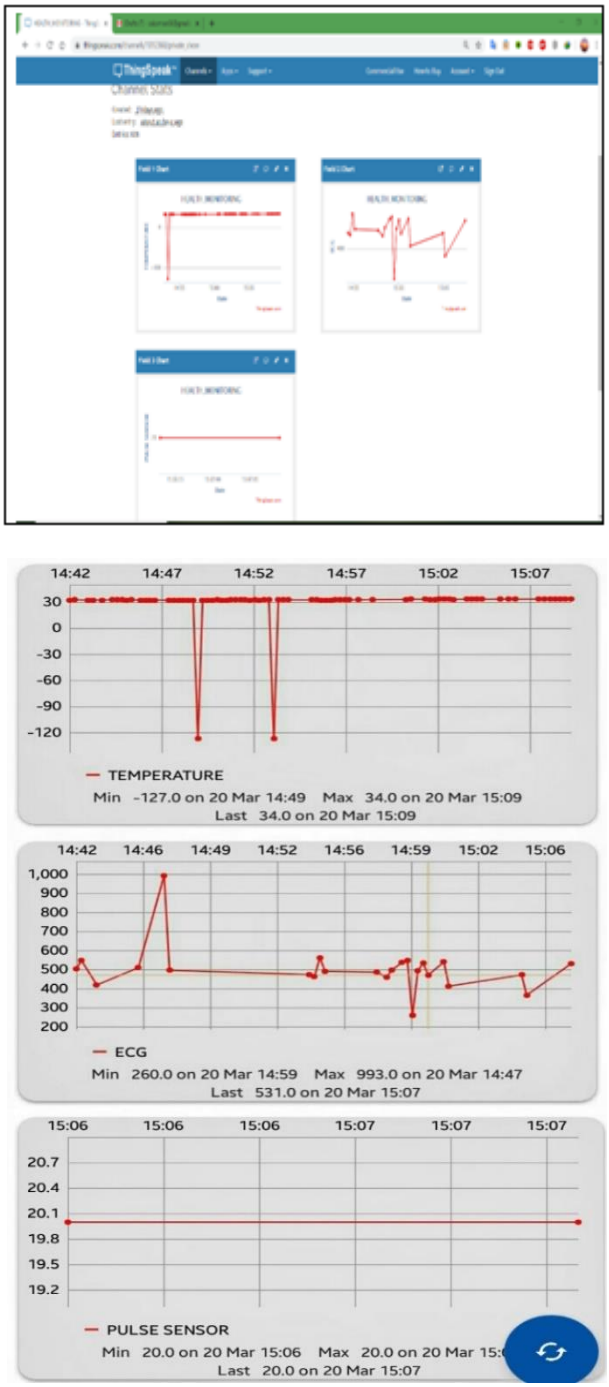


Fig 10 : Output of Sensors as graph format in Thingspeak website and in Thingview Android App

VII. CONCLUSION

Previously, the sensors that are utilized for observing the patient's status are not accurate. The sensors used here are essentially precise and appropriate for analysis purpose. So, as we are utilizing Thingspeak named cloud and Thingview android application. Doctor or medical staff can screen the patient's condition 24*7 and gets notified when there are any unusual changes in patient's parameters. As the information is accessible in the Thingspeak server, the patient's condition can be checked remotely from anyplace on the planet. Aside from simply seeing the previous information of a patient, we can utilize this information for analysing the patient's health thereby curing them.

VIII. FUTURE SCOPE

We can add a GPS module and many other bio-medical sensors in Health monitoring system of patient through IoT using Node MCU and Wi-Fi module project. This GPS module will find out the position or the location of the patient using the longitude and latitude received. Then it will send the location of the patient to the cloud using the Wi-Fi module. Then doctors can find out the position of the patient and they can take some necessary action.

IX. ACKNOWLEDGMENT

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X. REFERENCES

[1]. S. Pradeep Kumar, Venuri Richard Ranjan Samson, U Bharath Sai, PLSD Malleswara Rao,

K Kear Eswar “Smart health monitoring system of Patient through IoT, I-SMAC 2017”.

[2]. Dr.G. Joga Rao, B. Ravi, B. Alekhya, Priya, Sampath, Rakesh. “Wireless Health Monitoring System IJSRSET 2019”

[3]. Shivleela Patil,Dr.Sanjay Prakash, “Health Monitoring System using IoT”,IRJET, e-ISSN: 2395-0056 ,p-ISSN: 2395-0072, Volume: 05 Issue: 04 | Apr-2018

[4]. Andrea Zanella, Nicola Bui, Angelo Castellani, Lorenzo Vangelista,and Michele Zorzi, " Internet of Things for Smart Cities", IEEE Internet Of Things Journal, Vol. 1, No. 1, pp 22-32, February2014.

[5]. Bourouis, A., Feham, M., and Bouchachia, A.(2011), “ Ubiquitous Mobile Health Monitoring System for Elderly (UMHMSE)”, International Journal of Computer Science and Information Technology,Vol.2, No. 3, June, pp.74-82

[6]. Chien-Nan Lee, , Li-Lin Chen, Kai-Teng Jheng, Jheng-Guo Pan, and Yi- Syong Su. "An automatic window washer", CSQRWC 2012,2012.

[7]. Hirofumi Tanaka, K.D.M., Douglas R.Seals, Age-Predicted Maximal Heart Rate Revisited. Journal of the American College of Cardiology, 2001.37(No.1).

[8]. Höller, J. et al. 2014. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence. AcademicPress.

[9]. John A. Stankovic," Research Directions for the Internet of Things", IEEEInternetOfThingsJournal, Vol.1, No.1, pp3–9, February2014.

[10]. ‘Public hospitals in city have one nurse for 60 patients.’, DNA (Daily News & Analysis), May 25 2010 Issue

[11]. Subhas Chandra Mukhopadhyay," Wearable Sensors for Human Activity Monitoring: A Review", IEEE Sensors Journal, Vol. 15, No. 3, pp 1321-1330, March2015.

[12]. G. Joga Rao, G. Satish, "Temperature Controlled Fan using IOT", International Journal of Scientific Research in Science, Engineering and Technology(IJSRSET), Print ISSN : 2395-1990, Online ISSN : 2394-4099, Volume 4 Issue 4, pp.671-675, March-April 2018. DOI : 10.32628/IJSRSET1844255

[13]. Things peak, launched by ioBridge in 2016, available at https://en.wikipedia.org/wiki/ThingSpeak/ andhttps://thingspeak.com

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