An Efficient Patient Monitoring System for Healthcare Application Using Internet of Things

Parameshwari V[1], Nithya A[2], Preetha R[2], Ranjani B[2], Sumithra S[2]

[1]*Assistant Professor, Department of Electronics and Communication Engineering, Nandha Engineering college, Erode, Tamilnadu, India.*

[2]*Student, Department of Electronics and Communication Engineering, Nandha Engineering college, Erode, Tamilnadu, India.*

Corresponding Author: erparam@gmail.com

Abstract: - Science and expertise based on wireless-sensing node technologies have developed in today's health-care environment. Patients are in danger of dying unexpectedly owing to a specific health problem, which is caused by a lack of good medical care provided to patients at the appropriate time. This suggested system uses sensor technologies and the Internet of Things (IoT) to monitor patient health issues and rapidly communicate patient status to clinicians. Temperature sensor, Pulse sensor, Pulse Oximeter, Pressure sensor, ECG, Gyroscope, and Vibration sensor all play essential roles in this suggested system for tracking patient health parameters. All of the sensors are connected to the Arduino Nano, which is used to track the patient's health. The data is delivered immediately to the IoT cloud and stored on an SD card for offline storage utilizing Wi-Fi technology. The Thingspeak software can be used to view the graphical depiction.

Key Words: — ***Arduino Nano, Thingspeak, Cloud Computing.***

I. INTRODUCTION

IoT innovation is now being accepted for a wide range of regulating applications, like Farming, Military, Industries, Smart Vehicles, Smart cities, and countless others. It was seen as a new and revolutionary makeover. The Internet of Things (IoT), also known as the Modern Internet, has been described as a global basis for the digital society, enabling advanced benefits by networking (physical and virtual) things without relying on existing and emerging compatible data and communication improvements. As a result, a healthcare framework has been established with the use of IoT innovation for monitoring the patient's health state. From remote monitoring to smart sensors to medical device integration, IoT technology has a wide range of applications in healthcare. It keeps the patient safe and healthy while also improving physician-patient care. Various technologies, such as wireless communication, sensors and wearable technology, portal technology, and so on, can be used to monitor healthcare. However, these technologies have few advantages and disadvantages.

Manuscript revised April 20, 2022; accepted April 21, 2022.
Date of publication April 22, 2022.

This paper available online at www.ijprse.com

ISSN (Online): 2582-7898; SJIF: 5.59

II. LITERATURE SURVEY

Guangyu Xu [1] suggested a secure data transfer IoT Assisted ECG monitoring system for health care applications. The ECG-SSA methodology is presented in this work for automated ECG analysis. ECG Signals in the context of patient and physical activity are evaluated.

An IoT-based system for automated health monitoring and surveillance in post-pandemic life has been proposed by Seyed Shahim vedaei [2]. An IoT architecture is described in this system to monitor participants' health state and to alert them to maintain physical distance to reduce the danger of Corona virus infection.

The Internet of Things (IoT)-based LoRa Wireless Network System was proposed by Mohammad Shahidul Islam and Norbahiah Misran [3]. To generate vital signs and data for medical patients or applications, the My Signals platform has successfully interfaced with ECG, temperature, pulse rate, and oxygen saturation sensors.

Real-Time Signal Quality-Aware ECG was proposed by Barathram Ramkumar, M.Sabarimalai Manikandan [4].IoT-Based Health Care Monitoring Telemetry System ECG sensors, Bluetooth, a cloud server, and an Android phone can all be used to monitor your heart 24 hours a day, seven days a week.

D.Azariadi and D.Soudris [5] presented an alternative. On the Internet of Things, wearable medical devices can analyse

ECG signals and detect arrhythmia. This system is a proposal for a wearable ECG diagnosis equipment that can be used to monitor a patient 24 hours a day, seven days a week.

III. PROPOSED SYSTEM

The pulse sensor, which measures heartbeat in minutes or BPM, is used by Arduino to collect real-time health data (beats per minute). The Arduino is connected to the temperature sensor, pulse oximeter, ECG, and pressure sensors, which measure the patient's body temperature, oxygen level, pressure, and glucose level. The patient's movement is monitored using a gyroscope attached to the Arduino, and if the patient moves, an alert is generated. Arduino is connected to a generic ESP8266 IoT module. It connects the equipment to the internet and sends health data to a cloud-based IoT server (Thingspeak) for storage and monitoring. This circuit can not only transfer patient health data to a server, but it can also display real-time data on a 16x4 LCD display.

To offer the prescription, the gathered data will be instantaneously sent to the associated patients' and doctors' mobile phones. This is useful for a health care provider who is on the job and is actively monitoring a patient.

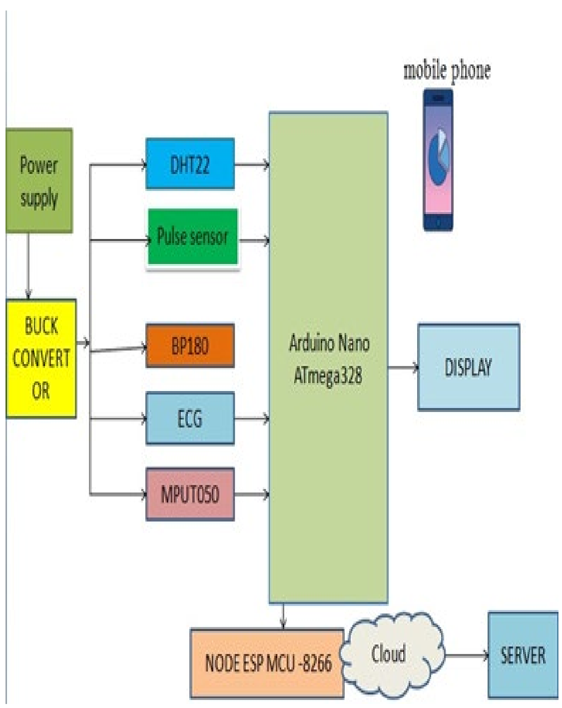


Fig.1. Block Diagram of proposed system

IV. HARDWARE DESCRIPTION

5.1. Arduino Nano

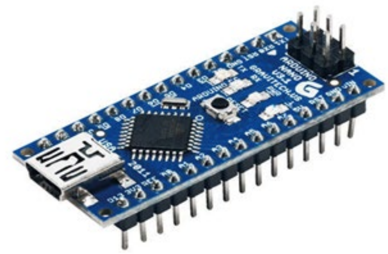


Fig.2. Arduino Nano

Based on the ATmega328, the Arduino Nano is a compact, comprehensive, and breadboard-friendly board (Arduino Nano 3.x). It offers a lot of the same features as the Arduino Duemilanove, but it comes in a different packaging. It just has a DC power jack and uses a Mini-B USB cable rather than a conventional one.

5.2 Node MCU ESP-8266

The Node MCU (node microcontroller unit) is an open-source programming and equipment development environment centred on the ESP8266, a small system-on-a-chip.

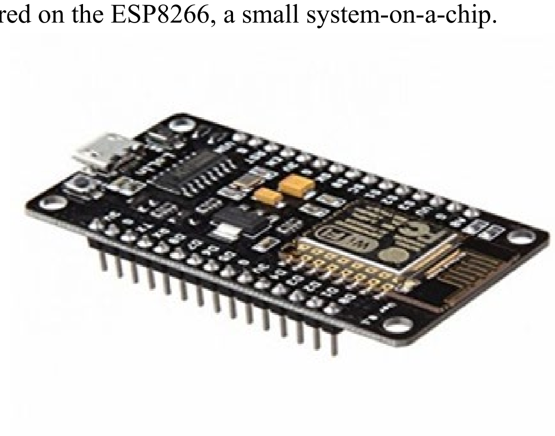


Fig.3. Node MCU ESP-8266

The Espressif Systems-designed and manufactured ESP8266 comprises all of the essential components of a computer: CPU, RAM, networking (WiFi), and even a sophisticated working framework and SDK. That makes it an incredible decision for Internet of Things (IoT) Ventures, if all other factors are equal.

5.3. Temperature Sensor-DHT22

Fig.4. Temperature Sensor-DHT22

The cheapest digital temperature and humidity sensor is the Temperature sensor. It uses a capacitive humidity sensor and a thermistor to monitor the ambient air and output a digital signal on the data pin. It has a temperature range of -400C to +1250C. It is used in weather stations to determine the temperature and moisture ratio in the air.

Table.1. Reference range of temperature

Age Span	Body Temperature
New born babies	99.5^{0}F(37.5^{0}C)
Children	97.5^{0}F(36.4^{0}C)
Adult	98.6^{0}F(37^{0}C)
Pregnancy women	96^{0}F-99.5^{0}F(35.6^{0}C-37.5^{0}C)

5.4. Pulse Sensor

The pulse sensor is also known as heartbeat sensor or heart rate sensor. This can be done by connecting it to the fingertip or human ear. The sensor attaches to a fingertip or earlobe and connects to Arduino via jumper cables.

Fig.5. Pulse Sensor

Table.2. reference range of heart rate

Age Span	Heart rate (bpm)
Less than 1 month	120-160
1-12 months	80-140
12 months - 2 years	80-130
2-6 years	75-120
6-12 years	75-110
More than 12 years	60-100

5.5. Pulse oximeter

Fig.6. Pulse oximeter

MAX30100 is a versatile sensor that may be utilized in a variety of applications. It combines a heart rate monitor and a pulse oximeter into one device. To detect heart rate and perform pulse oximeter, the sensor includes two Light Emitting Diodes, a photodetector, and a series of low noise signal processing circuits.

- Input Current - 20mA
- Integrated Ambient Light Cancellation.
- High Sample Rate Capability.
- Fast Data Output Capability.
- Operating Voltage - 1.8V to 3.3V

Table.3. Reference ranges of glucose level

Age span	Fasting	Before meal	1-2 hours after eating	Bed Time
Younger than 6 years old	80-180mg/dL	100-180mg/dL	~180mg/dL	110-200mg/dL
6-12 years	80-180mg/dL	90-180mg/dL	Upto 140mg/dL	100-180mg/dL

13-19 years	70-150mg/dL	90-130mg/dL	Upto 140mg/dL	90-150mg/dL
20+ years of age	Less than 100mg/dL	70-130mg/dL	Less than 180mg/dL	100-140mg/dL

5.6. ECG-AD8232

Electrocardiography, or ECG, is a method of collecting electrical impulses generated by the human heart. This is a tiny chip, and the electrical activity of it can be recorded in the same way that an ECG can (Electrocardiogram). The AD8232 ECG sensor is a commercially available board that calculates the electrical activity of the human heart. The ECG sensor's functioning mechanism is similar to that of an operational amplifier, which aids in obtaining a clear signal from the intervals.

5.7. Pressure Sensor-BMP180

Fig.7. Pressure sensor

A pressure sensor is a type of transducer or device that converts mechanical pressure in gases or liquids into an electric output signal. It is used to determine surface pressure or barometric pressure. It's a consumer-oriented sensor with a high level of precision. It is based on the concept of air weight.

Table.4. Reference range of pressure

Age	Systolic Range	Diastolic Range
New Born to 6 months	45-90	30-65
6 months to 2 years	80-100	40-70
Children (2-13 years)	80-120	40-80
Adolescent (14-18 years)	90-120	50-80
Adult (19-40 years)	95-135	60-80
Adult (41-60 years)	110-145	70-90
Older Adult (61 years &above)	95-145	70-90

5.8. Gyroscope Sensor-MPU6050

Fig.8. Gyroscope Sensor-MPU6050

The patient's movement is detected using a gyroscope sensor. It's utilized to keep the reference direction steady or to give balance in navigation. It detects rotational velocity along the x, y, and z axes.

5.9. Vibration Sensor:

A piezoelectric sensor is another name for a vibration sensor. This sensor is used to detect changes in pressure and temperature by converting them to an electrical signal. These sensors can operate at temperatures ranging from -500 to +850 degrees Celsius.

5.10.LCD Display:

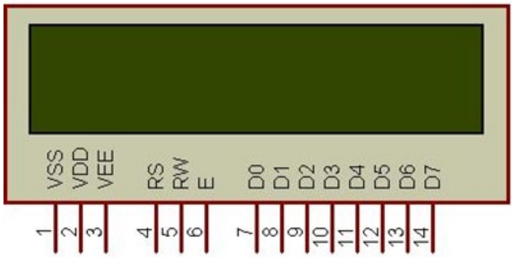
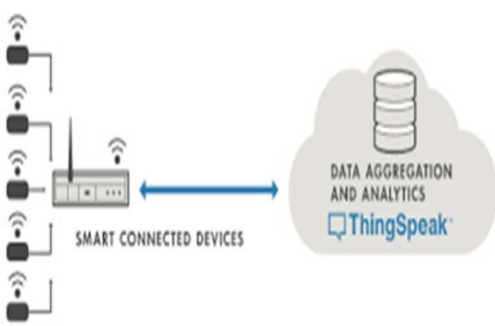


Fig.9. LCD Display

LCD (Liquid Crystal Display) is a sort of level board display that use fluid jewels as its primary mode of operation. LEDs are commonly found in cell phones, televisions, computer screens, and instrument boards, and they offer a diverse variety of applications for customers and businesses. LCDs were a significant advancement over the technology they replaced, which included light-emitting diode (LED) and gas-plasma displays. LCD technology allowed for thinner displays than cathode beam tube (CRT) technology.

LCDs use substantially less energy than LED and gas-display screens because they work on the principle of obstructing light rather than transferring it. Where an LED emits light, the fluid jewels in an LCD produce an image with background illumination.

5.11 THINGSPEAK:



ThingSpeak is an IoT investigation platform that allows us to visualise and break down real-time data streams in the cloud. ThingSpeak provides real-time representations of data sent by client devices. It can run MATLAB code in ThingSpeak, and it's ready to conduct an online investigation and cycle of real data. ThingSpeak is frequently used in IoT frameworks for model demonstration. The Internet of Things (IoT) is a new trend in which a large number of installed gadgets (things) are connected to the Internet. These connected devices communicate with people and things, and they may occasionally provide detecting information to distributed storage and distributed computing assets, depending on where the data is handled and examined to obtain critical bits of knowledge. This pattern is aided by a little amount of distributed computing power and a larger gadget network. Natural perception and the board, wellness observing, automobile armada checking, home computerization, and modern mechanization are some of the applications for which IoT arrangements have been built and control. The sensible gadgets (the "things" in IoT) that dwell at the organization's edge are on the left. Wearable devices, remote temperature sensors, heart rate screens, water-powered pressing factor sensors, and plant-floor equipment are among the devices that collect true field data. In the middle, we have the cloud, which is where data from various sources is gathered and broken down in real time, usually by a predetermined IoT research step. The computation progress associated with the IoT application is depicted in the right side of the chart. By doing a documented examination on the data, a specialist or researcher seeks to acknowledge knowledge into the obtained data. In this case, real-time data is fed from the IoT stage into a desktop programming environment, allowing the architect or researcher to demonstrate the calculations that will eventually run in the cloud or on the physical device. Every one of these elements is included in an IoT framework. ThingSpeak is a cloud-based platform that allows users to quickly acquire and analyze data from web-connected sensors.

V. Result And Discussion

7.1 Output of the Proposed Model:

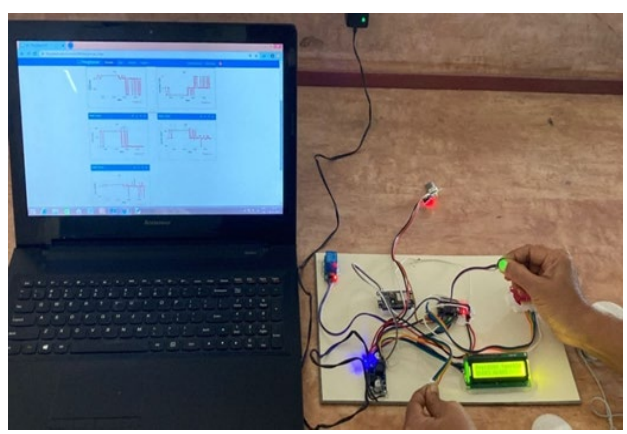


Fig.10. Output of the Proposed Model

7.2 Output of Patient-1:

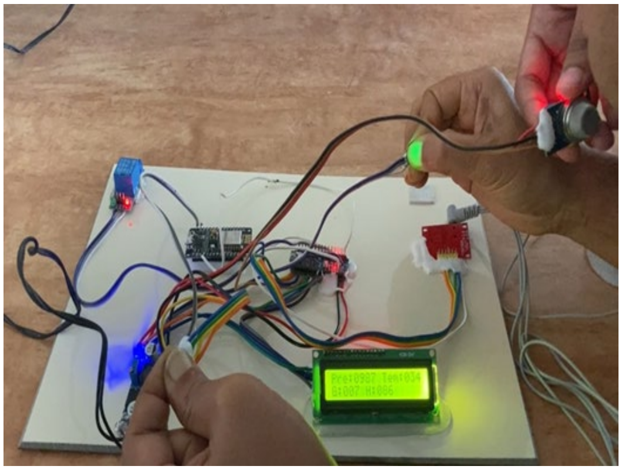


Fig.11. Output of the Patient-1

7.3 Output of Patient- 2:

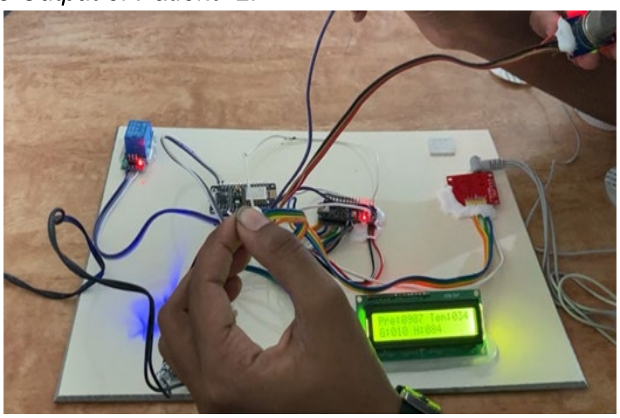


Fig.12. Output of the Patient-2

7.4 Output of Patient- 3:

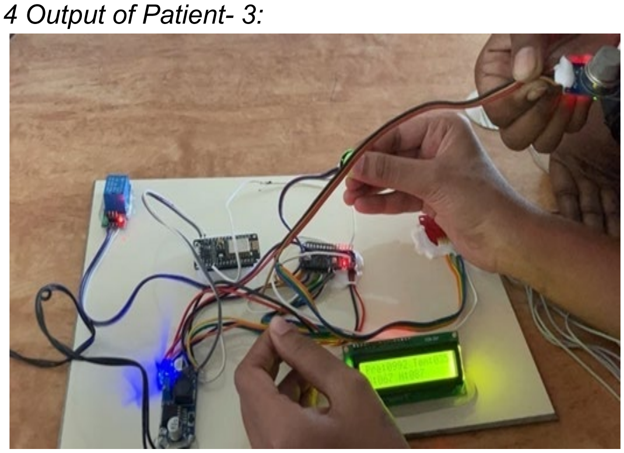


Fig.13. Output of the Patient-3

7.5 Output of Patient- 4:

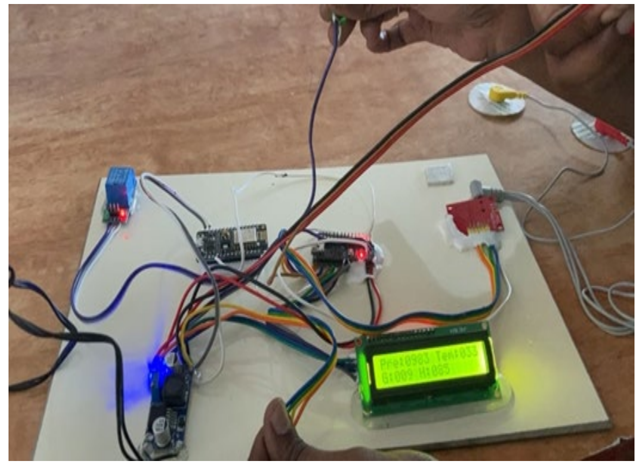


Fig.14. Output of the Patient-4

7.6 Output of Patient- 5:

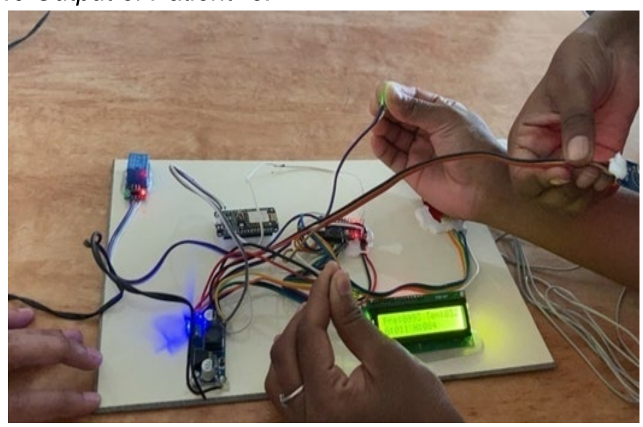


Fig.15. Output of the Patient-5

7.7 Output of Patient- 6:

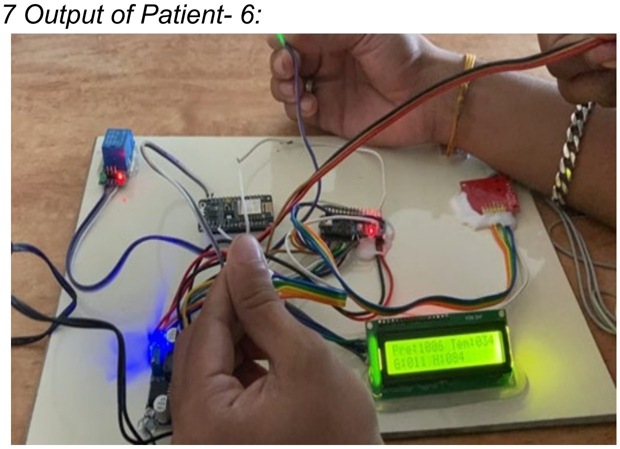


Fig.16. Output of the Patient-6

7.8 Thingspeak Output:

7.8.1 Output of Temperature

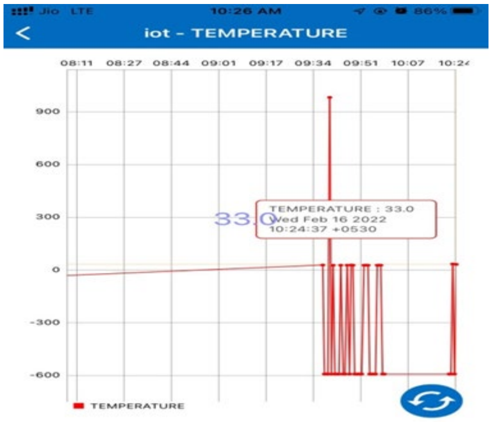


Fig.17. Output of temperature

7.8.2 Output of Oxygen level

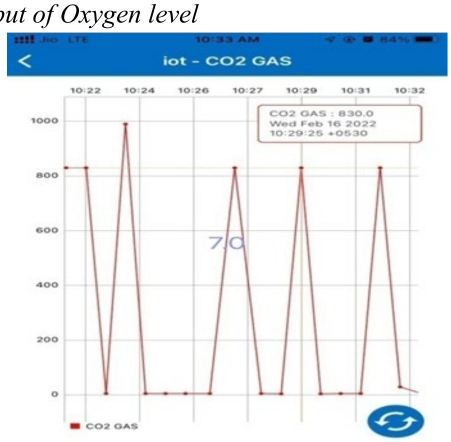


Fig.18. Output of Oxygen level

7.8.3 Output of Heart Beat

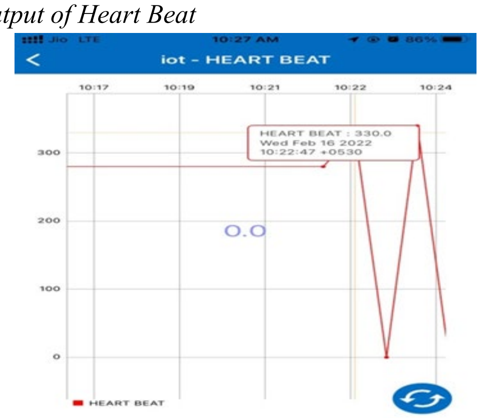


Fig.19. Output of Heart beat

7.8.4 Output of ECG Signal

Fig.20. Output of ECG Signal

7.8.5 Output of Pressure

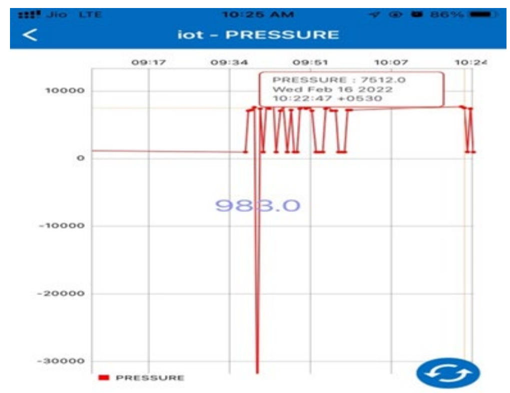


Fig.21. Output of Pressure

7.9 Output of Gyroscope:

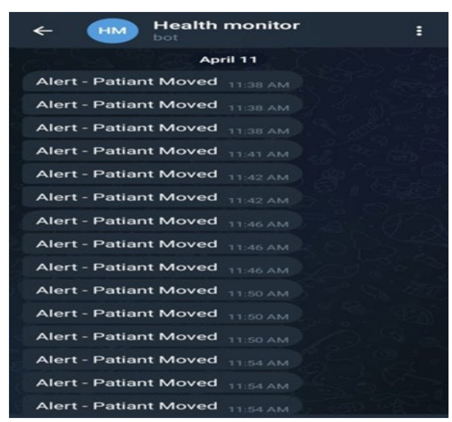


Fig.22. Output of gyroscope

7.10 Sample Real time data observed by patients:

Table.5. Sample Real time data observed by patients

Patients	Temperature (°C)	Pressure	Heart Beat (BPM)	Oxygen level
1	34	98.7	86	7
2	34	98.7	84	10
3	35	99.2	87	12
4	33	98.3	85	9
5	32	99.3	84	11
6	34	100.6	84	11

VI. CONCLUSION

The use of biomedical sensors in this process of measuring the patient's real-time body temperature, heart rate, and other physiological information is becoming more common. The temperature sensor and pulse sensor modules are used to collect medical data from the outside and convert it to digital signals. As a result, the project's goal is to track and detect the patient's real-time body temperature and heart rate data, as well as transmit them to the appropriate doctor. Patient comfort and convenience are improved, resulting in higher patient satisfaction and faster recovery periods. Gyroscope sensors can track a patient's movements and alert caregivers if something is amiss. Data on a patient's health parameters is saved in the cloud. As a result, it is more advantageous than keeping records on printed paper in files. Alternatively, the digital recordings that are stored on a computer, laptop, or memory device such as a pen drive. Because there's a potential these devices can become corrupted, and data will be lost. ThingSpeak cloud storage of real time observed patient’s data is more reliable and accurate in the case of IoT and has a lower risk of data loss. The health conditions of the patient can be monitored, diagnosing of the diseases can be done by any doctor at any time and immediately the prescriptions can be given to the patients.

REFERENCES

[1]. Guangyu Xu “IoT-Assisted ECG monitoring frame work with secured data transmission for health care applications”,2020

[2]. V.Parameshwari, P. Premkumar, M.Srinivasan, V.Logeswar “An Intelligent Bonic Person for Bomb Detection and Diffusion using Internet of Things (IoT) in Military Application.”,2021.

[3]. V.Parameshwari. “IoT Enabled Smart Energy Meter for Efficiency Energy Utilization in House hold and Industry Application.”,2020

[4]. V.Parameshwari, V.S.Sathishkumar, P.Premkumar, M.Srinivasan “IoT Enabled Irrigation System for Agriculture Fields.”,2019.

[5]. Wang Yun Toh, Yen Kheng Tan, Wee Song Koh and Liter Siek, “Autonomous Wearable Sensor Nodes with Flexible Energy Harvesting”,2014.

[6]. Vladimir Leonov., “Thermoelectric energy harvesting of human body heat for wearable sensors”, 2013.

[7]. Yanqing Zhang, Fanzhang, Benton H. Calhoun, “A Battery less 19 W MICS/ISM-Band Energy Harvesting Body Sensor Node SoC for ExG Applications”, 2013.

[8]. Sang-Joong Jung, Risto Myllyla, Wan-Young Chung, “Wireless Machine-to-Machine Healthcare Solution Using Android Mobile Devices in Global Networks”, 2013.

[9]. Qadeer A Khan, Sarvesh J Bang. “Energy Harvesting for Self-Powered Wearable Health Monitoring System”, 2013.

[10]. O.Lopez-Lapena and M.T.Penella. “Low-power FOCV MPPT controller with automatic adjustment of the sample & hold.”, 2012.

[11]. Vladimir Leonov “Energy Harvesting for Self-Powered Wearable Devices”, 2011.

[12]. Sujesha Sudevalayam and Purushottam Kulkarni. “Energy Harvesting Sensor Nodes: Survey and Implications”, 2011.

[13]. Sergio Gonzalez-Valenzuela, Min Chen and Victor C.M. Leung, “Mobility Support for Health Monitoring at Home Using Wearable Sensors”, 2011.

[14]. H. Pflug, J. Santana, H. Visser “Human++: wireless autonomous sensor technology for body area networks”, 2011.