JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

IoT based system for Detecting Abnormal Heart Rate Using Machine Learning

S. Sowmya[1], Mr. S Sreehari[2]
[1]ECE Department, MVSR Engineering College/Osmania University, INDIA (2451-20-744-007)
[2]ECE Department, MVSR Engineering College/Osmania University, INDIA (Asst Professor)
namakarsudarshansowmya37@gmail.com[1], sreehari_ece@mvsrec.edu.in[2]

Abstract
Heart rate monitoring is a vital aspect of maintaining heart health. People from different age groups have different ranges for maximum and minimum values of heart rate, the monitoring system must be compatible enough to tackle this scenario. In this paper, an IoT based system has been implemented that can monitor the heartbeat from the output given by a hardware system consisting of a NodeMCU and pulse sensor. Further, an alert system is added which is executed if the heartbeat goes below or above the permissible level given in the devised algorithm. The alert message is received by the doctor through a mobile phone application. By using this prototype, the doctors can access the heartbeat data of the patient from any location. The nurses or the duty doctor available at the hospital can monitor the heart rate of the patient in the serial monitor through the real-time monitoring system. this platform is more secure to store the information and uses MQTT protocol which has lots of advantages over others... The heartbeat data and other personal details of the patient are stored in the cloud, this can be utilized for future studies on the health condition of the patient. The prototype is realized using NodeMCU, pulse sensor, ecg, and thing speak cloud.

Keywords: IoT, NodeMCU, Prototype, Heartbeat data.

I. INTRODUCTION
The Internet of Things is proposed as the platform for a heart rate monitoring and abnormality detection system in this paper. In today's world, treatment for the vast majority of heart-related diseases requires continuous monitoring over an extended period of time. The internet of things is very helpful in this regard because it can replace traditional monitoring systems with a system that is more effective. It does this by making vital information regarding the health of the patient available to the attending physician via the internet at any time and from any location that is remotely located. In addition, the nurses or the doctor on duty who is present at the medical facility are able to monitor the patient's heart rate in real time using the serial monitor that is connected to the real-time monitoring system. In addition, a warning system is incorporated into the device, and it sends an alert message to the attending physician via a mobile application if the patient's heartbeat falls below a certain value or rises above a particular value. The prototype is also capable of storing the data of the patient's heartbeat in addition to other information about the patient. This information can be used by the physician to evaluate the patient's heart condition as well as for other purposes in the future. Recognizing the disease in its earliest stages is absolutely necessary in order to forestall the development of further complications in the future.

II. LITERATURE SURVEY
[1] Heart rate is a very vital health parameter that is directly related to the human cardiovascular system. It is a physiological parameter that is measure of heart rate of an individual, indicating state of mind and physical condition. This will save time and money at a great extent and is very useful in emergency. The heart rate of a healthy adult at rest is around 72 beats per minute (bpm). We develop a project which will be an indication of how healthy our body is, by measuring and monitoring the heartbeat. The project presented here uses an infrared sensor and photodiode detector that monitors the heartbeat and LM358 is used for processing signal.

The processed signal is input to microcontroller which counts pulses and sends results to LCD connected to the microcontroller. In addition to that the result will be sent to the PC via Serial cable to display the result on interface developed using C#.

[2] The overall goal of this paper is to create a wireless body area network (WBAN). A range of different sensors including heart rate using electrocardiography (ECG), temperature, and accelerometer for fall detection were used. Each sensor was connected to a microcontroller with an RF module to transmit the data to a base station. The base station will be used to display sensor data locally. Medical and commercial sensors were used as benchmarking to validate and calibrate wearable sensors date. The Arduino Uno platform was employed to act as the processor unit for the deployed units, communicates with sensors and RF transceivers. All sensors' drivers were developed and tested individually before integrated in the area network. A LabVIEW graphical user interface (GUI) was constructed to display and assess the sensors signals locally. The sensor data and the RF modules will also be connected to the cloud either through a GSM modem or a Wi-Fi gateway. This provides remote access to sensor data and to the RF modules. Zigbee mesh network was created to connect the RF units wirelessly. They can therefore be remotely managed, configured and administered by qualified personnel. The final WBAN prototype was demonstrated using real persons at different moving postures to test overall system performance.

[3] Health monitoring is an important aspect of everyday life for many people. In this study, the design of a heart rate monitor with Bluetooth connectivity is discussed. The AD8232 Single Lead Heart Rate Monitor is the centrepiece of the design. The output of this monitor is an antilog output, so an antilog-to-digital converter is used on the Dragon12-Plus2 board. Data is wirelessly transferred to smartphone via Bluetooth. The data received from the monitor is analysed to determine a heart rate in beats per minute. MIT App Inventor 2 is used to design an app to display the heart rate on Smartphone.

[4] This paper presents the design of a wireless and battery less heart rate monitor. The measurement is done using a single-lead ECG raw signal. The design is based on a commercial ultra-low power microcontroller, an optimized full-custom RF Front-End, a ultra-low power Threshold Comparator and a Programmable Gain Amplifier implemented in commercial 90 nm CMOS. The communications are compliant with the ISO 11784/11785 HDX standard. The complete design consumes only 15 μW and the heart rate measurement is done in only 3.2 seconds. A comparison with the best literature approach demonstrate that presented design is a 45% more efficient in terms of energy.

III. METHODOLOGY

The information in this paper is organised as follows: in the beginning, a brief summary of the NodeMcu board and its specifications is presented. Next, the significance of installing Esp8266 with NodeMcu is discussed, and finally, a pulse sensor V1.1 is described in greater detail. Finally, show the results of the simulation to achieve the goal of learning how to set up the internet of things (IOT) and figuring out how to connect the system to the internet. When it comes to efficiency, the most effective way to connect to the internet is by making use of wireless network connections.

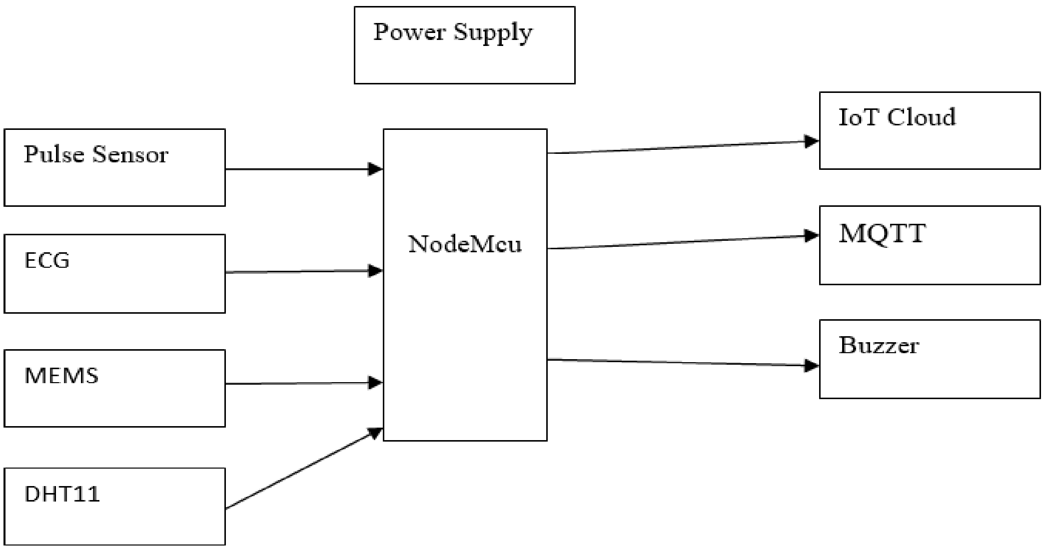


Figure 1: Block diagram of proposed system

➢ NodeMcu

NodeMCU is an Internet of Things platform that is open source and low cost. It initially consisted of both software and hardware, the former of which was based on the ESP-12 module and the latter of which ran on Espressif Systems' ESP8266 Wi-Fi System-on-Chip (SoC). Support for the ESP32 32-bit MCU was eventually added later on.

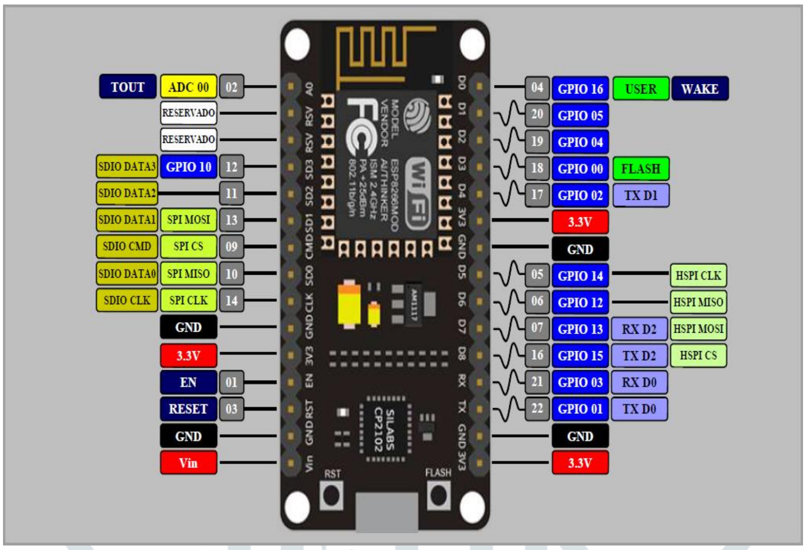


Figure 2: NodeMcu

Machine Learning

Machine learning is the learning brain. Machines learn like humans. Experimentation teaches. Knowledge makes prediction easier. By analogy, an unknown situation has a lower chance of success. Machines learn similarly. Example-based prediction helps the machine. Like humans, the machine struggles to predict if fed a new example.

Machine learning is about learning and inference. The machine discovers patterns first. Data reveals this. Data scientists must carefully select machine-readable data. Feature vectors are problem-solving attributes. Feature vectors are problem-solving data sets.

The machine simplifies reality and models this discovery using fancy algorithms.

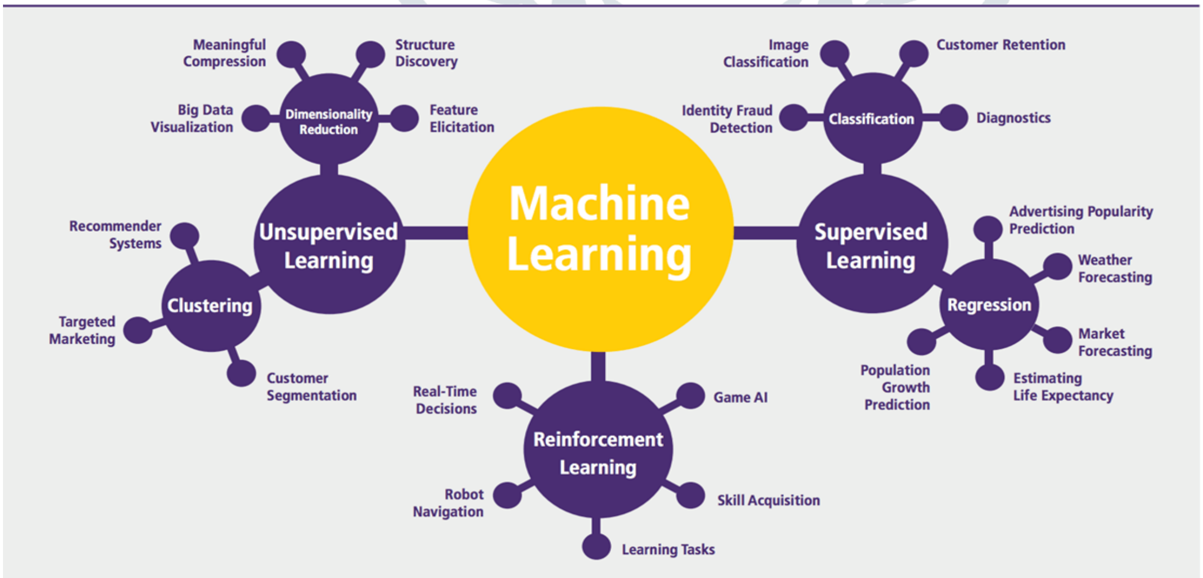


Figure 2: Machine Learning architecture

Thing Speak

Thing Speak is a cloud-based IoT analytics platform that aggregates, visualises, and analyses live data streams. . Thing Speak lets you analyse and process data live using MATLAB® code. Analytics-based IoT prototypes and proofs of concept use Thing Speak.

IoT?

Internet of Things (IoT) refers to the trend of connecting many embedded devices to the Internet. Connected devices send sensor data to cloud storage and computing resources for processing and analysis. .

Environmental, health, fleet, industrial, and home automation applications use IoT solutions.

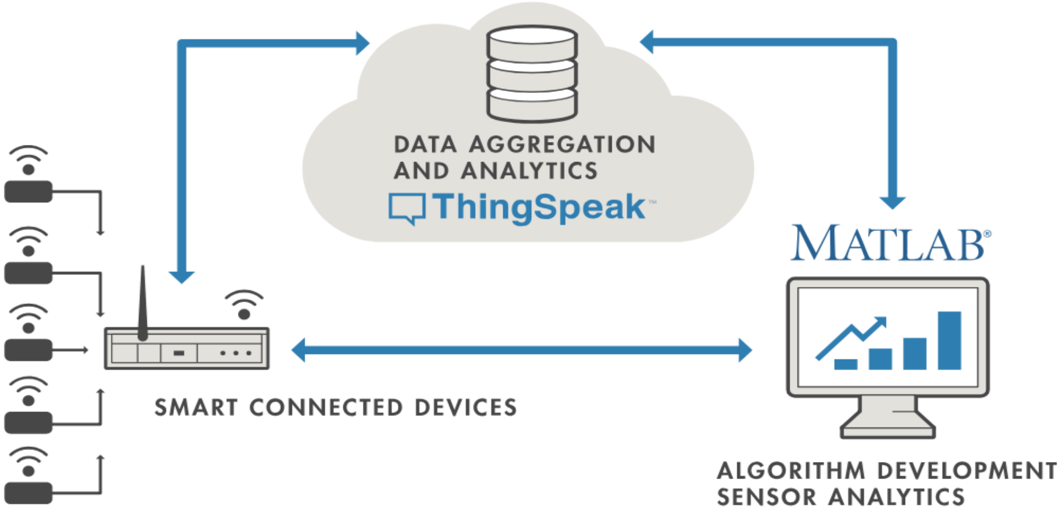


Figure 2: Thing Speak block diagram

MQTT (Message Queuing Telemetry Transport)

The MQTT protocol is based on the principle of publishing messages and subscribing to topics, or "pub/sub". Multiple clients connect to a broker and subscribe to topics that they are interested in. Clients also connect to the broker and publish messages to topics. Many clients may subscribe to the same topics and do with the information as they please. The broker and MQTT act as a simple, common interface for everything to connect to.

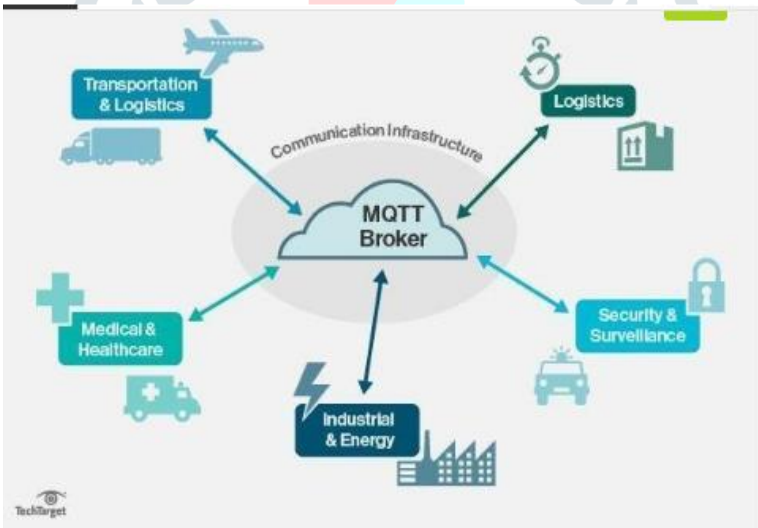


Figure 2: Message Queuing Telemetry Transport

MQTT in IoT

MQTT is one of the most used protocols concerning IoT. MQTT enables resource constrained IoT devices to send, or publish, information about a given topic to a server that functions as an MQTT message broker. The broker then pushes the information out to those clients that have previously subscribed to the topic. To a human, a topic looks like a hierarchical file path. Clients can subscribe to a specific level of a topic's hierarchy or use a wild-card character to subscribe to multiple levels.

ECG

An ECG is a paper or digital recording of the electrical signals in the heart. It is also called an electrocardiogram or an EKG. The ECG is used to determine heart rate, heart rhythm and other information regarding the heart’s condition. ECGs are used to help diagnose heart arrhythmias, heart attacks, pacemaker function and heart failure.

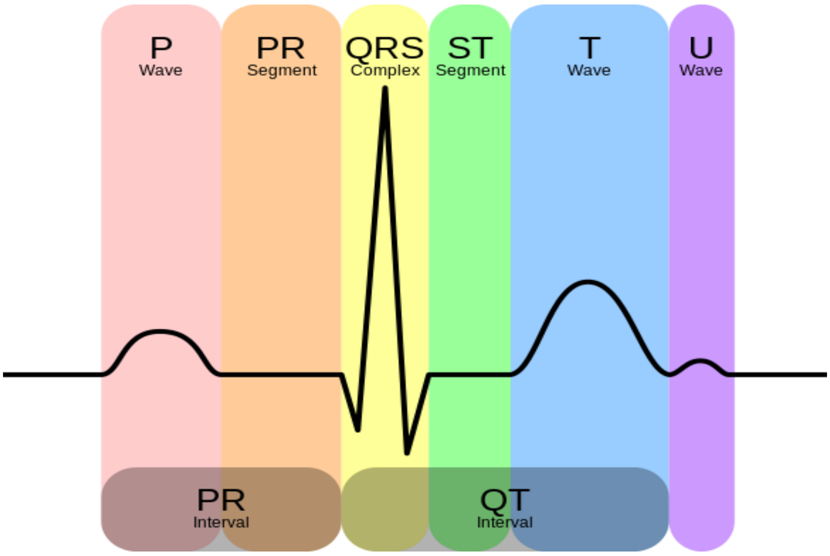


Figure 2: Understanding the ECG

MEMS

Micro-electro-mechanical Systems (MEMS) Technology is one of the most advanced technologies that have been applied in the making of most of the modern devices like video projectors, bi-analysis chips and also car crash airbag sensors. This concept was first explained by Professor R. Howe in the year 1989. Since then many prototypes have been released and revised and has thus become an integral part of the latest mechanical products available in the market today.

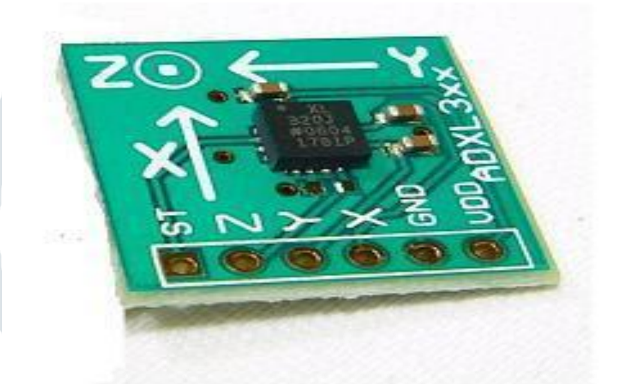


Figure 2: MEMS SENSOR

IV RESULTS & DISCUSSION

Heart health requires heart rate monitoring. . This paper implements an IoT system that monitors heartbeats using a NodeMCU and pulse sensor. An alert system activates if the heartbeat falls below or exceeds the algorithm's threshold. A mobile app alerts the doctor. . The hospital's nurses or duty doctor can monitor the patient's heart rate in the serial monitor using the real-time monitoring system. This platform stores data more securely and uses MQTT protocol, which has many advantages over others... The cloud stores the patient's heartbeat data and other personal information for future health studies. NodeMCU, pulse sensor, ecg, and Thing Speak Cloud create the prototype.

Proposed Prototype Kit

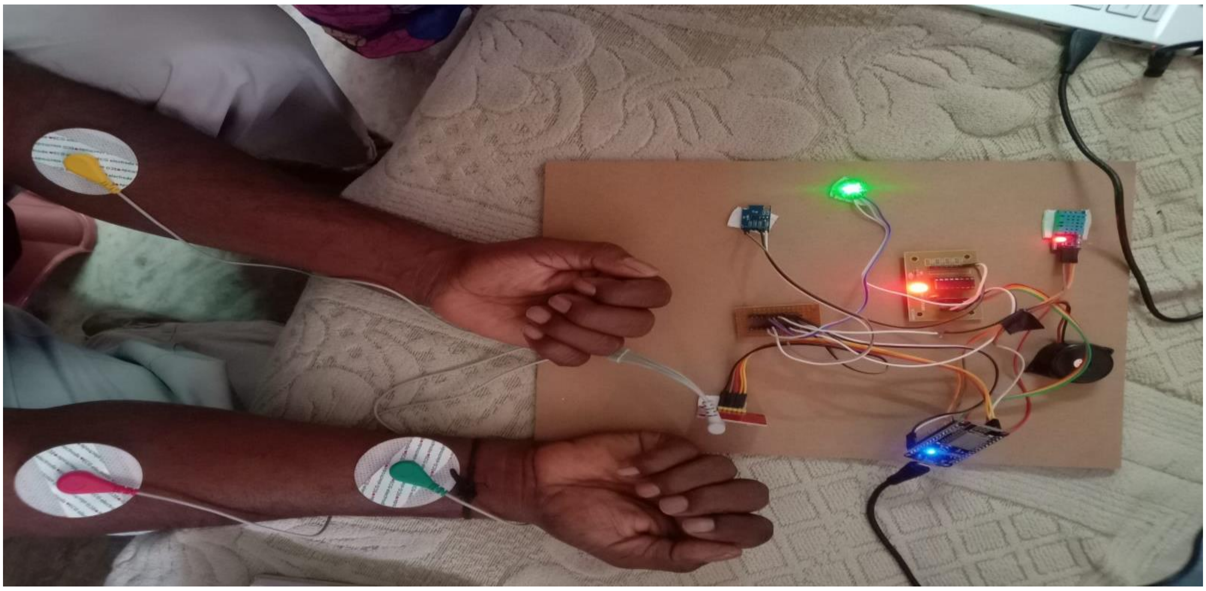
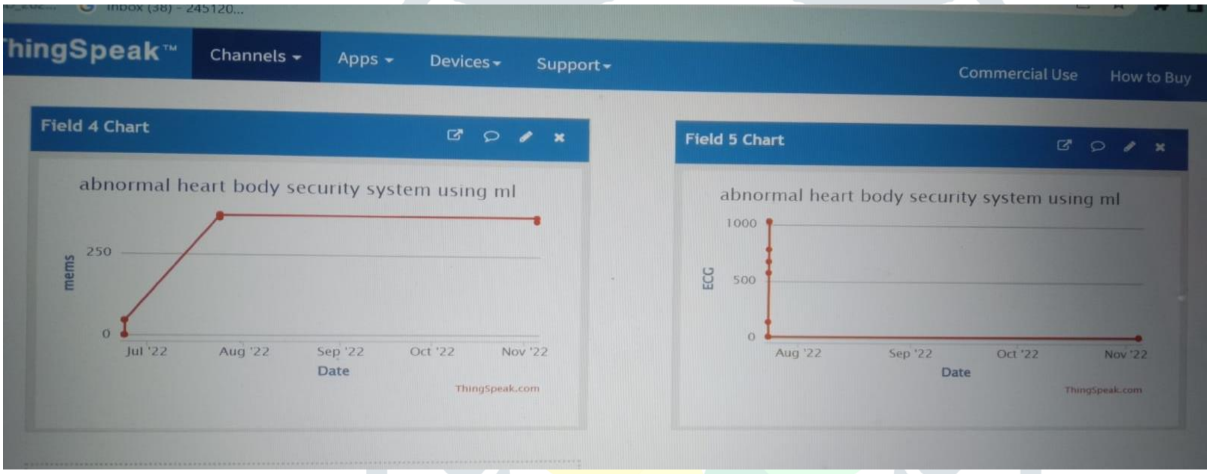
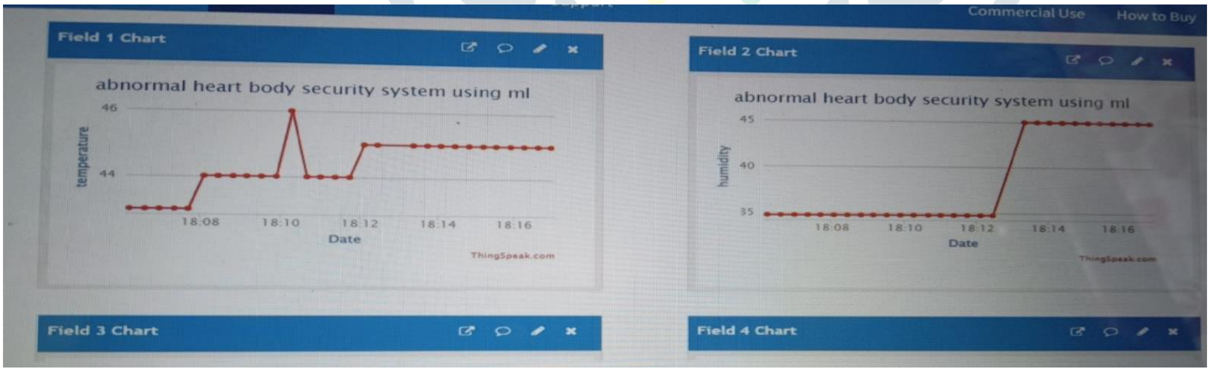


Figure 1: Live Prototype Kit Execution



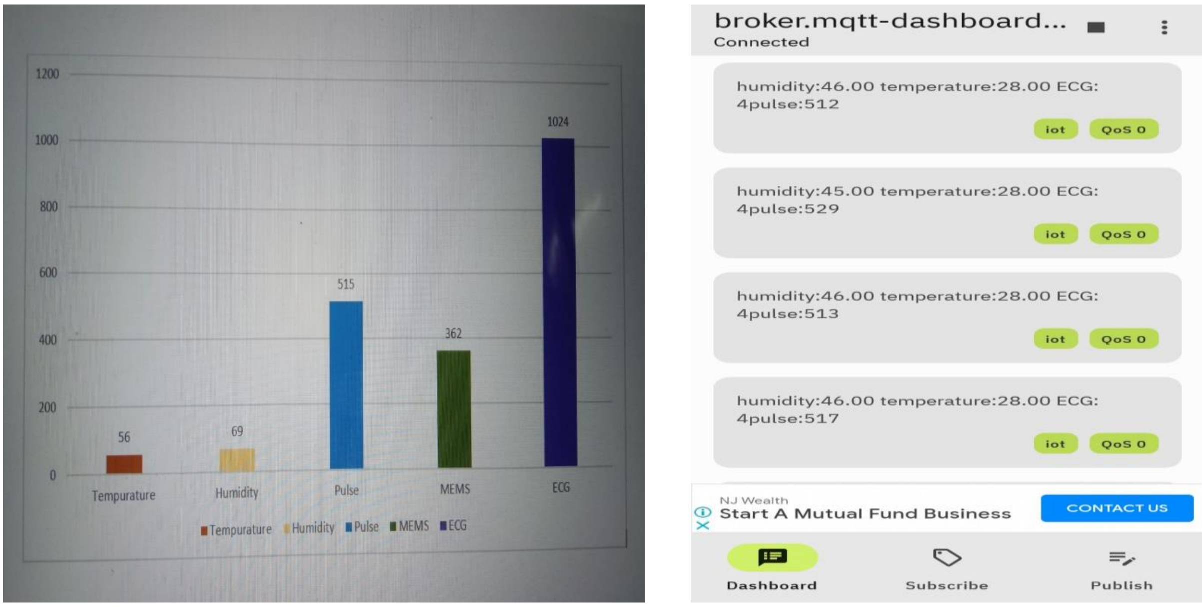
(a) (b)

Figure 1: Output response (a) MEMS Sensor; (b) ECG Sensor



(a) (b)

Figure 1: Output response (a) Temperature Sensor; (b) Humidity Sensor



(a) (b)

Figure 1: Output response, (a) Machine Learning Output; (b) MQTT Output

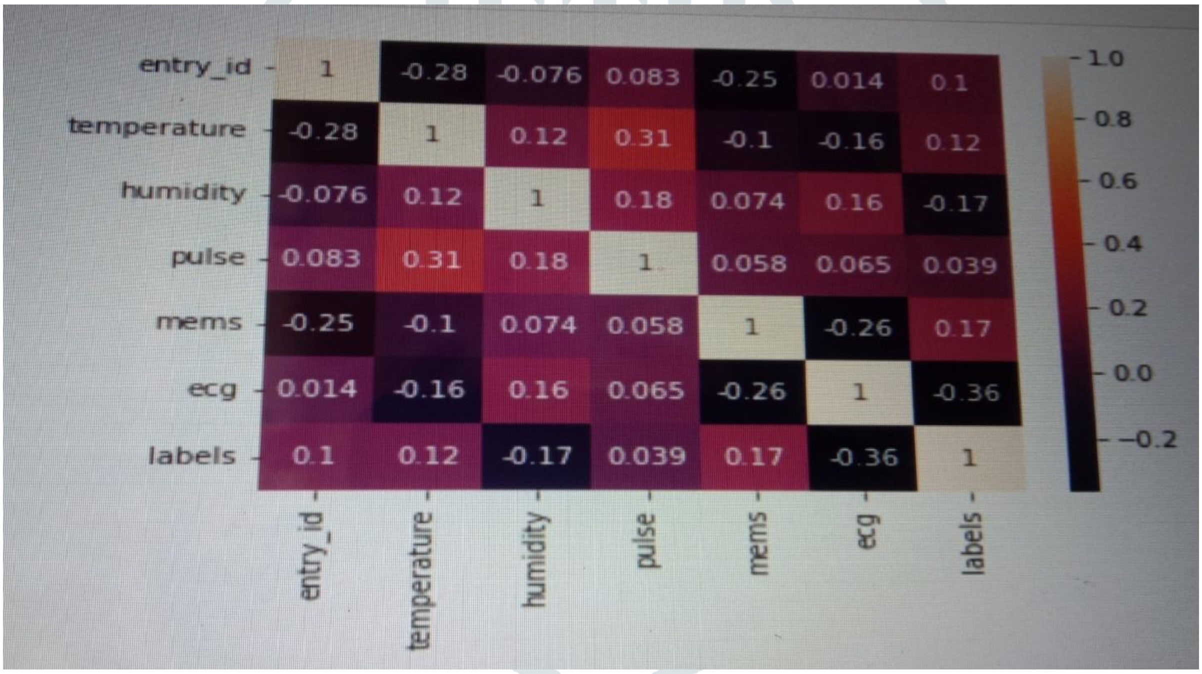


Figure 1: Heat map of correlated features

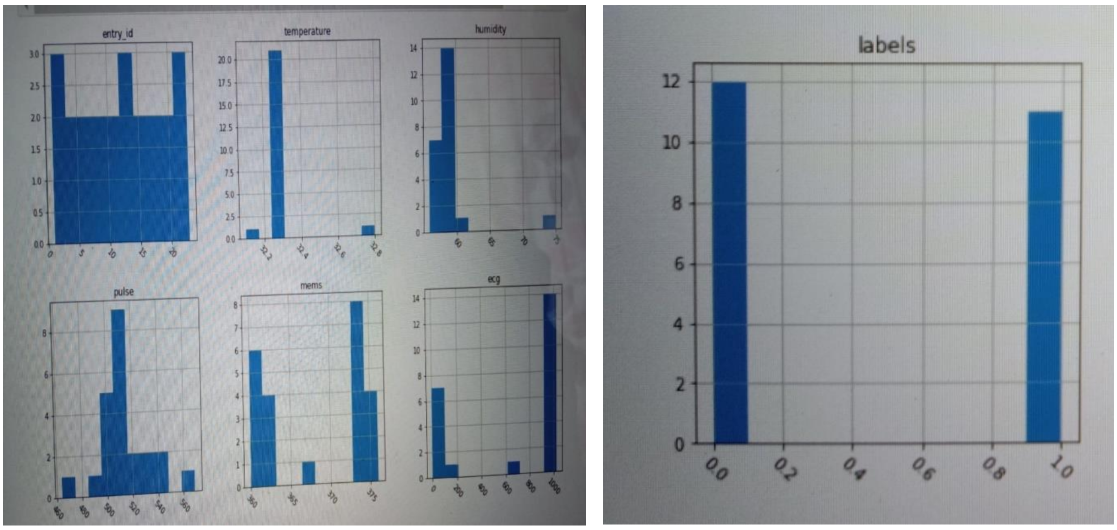


Figure 1: Output response for Visualization of Parameters of Sensors

V. CONCLUSION

After a process of designing, experimenting, testing, and data collecting, the author concludes that the heart rate detector works properly according to the experimental results on several patients compared to standard medical devices. The device's minimum system circuit works properly as it controls and displays the BPM measurement results. The finger sensor circuit shows satisfactory results in the detection of heart rate.

REFERENCE

[1] A. Biniyam, A. G. Tesema, A. A. Mohammed, N. S. Ramaiah, and A. E. Dilla, “Design and implementation of heart beat monitoring using PIC microcontroller,” in 2017 International Conference On Smart Technologies For Smart Nation (SmartTechCon), 2017, pp. 784–787.

[2] A. S. Mahmood, E. Jafer, S. Hussain, and X. Fernando, “Wireless body area network development for remote patient health observing,” in 2017 IEEE Canada International Humanitarian Technology Conference (IHTC), 2017, pp. 26–31.

[3] J. Turner, C. Zellner, T. Khan, and K. Yelamarthi, “Continuous heart rate monitoring using smartphone,” in 2017 IEEE International Conference on Electro Information Technology (EIT), 2017, pp. 324–326.

[4] J. Sosa and H. Solar, “Design of a wireless and batteryless heart rate monitor,” in 2017 IEEE 60th International Midwest Symposium on Circuits and Systems (MWSCAS), 2017, pp. 1292–1295.

[5] S. Tjiharjadi and A. Fajar, “Human Heart Rate Detection Application,” in 2017 International Conference on Soft Computing, Intelligent System and Information Technology (ICSIIT), 2017, pp. 167–172.

[6] P. A. Pawar, “Heart rate monitoring system using IR base sensor & Arduino Uno,” in 2014 Conference on IT in Business, Industry and Government (CSIBIG), 2014, pp. 1–3.

[7] L. Priya, R. Hariprasad, and R. Raghul, “Real time monitoring of vital signs using wireless technique,” in 2014 International Conference on Green Computing Communication and Electrical Engineering (ICGCCEE), 2014, pp. 1–7.

[8] Dr. A. Indira Priyadarsini, Kiran Kumar D Y, et, al “Internet of Things based Poaching prevention System in the Forest Using WSN,” in 2022, Application No: 202141061028, Published in https://ipindiaservices.gov.in/

[9] N. Saquib, M. T. I. Papon, I. Ahmad, and A. Rahman, “Measurement of heart rate using photoplethysmography,” in 2015 International Conference on Networking Systems and Security (NSysS), 2015, pp. 1–6.

[10] M. S. Ali and M. H. Bhuyan, “Design and implementation of a lowcost automated blood flow control device through smart phone for bio-medical application,” in 2017 6th International Conference on Informatics, Electronics and Vision & 2017 7th International Symposium in Computational Medical and Health Technology (ICIEV-ISCMHT), 2017, pp. 1–5.

[11] Kiran Kumar D Y, et, al, “IOT and Machine Learning-based Wavelet Domain for Electromagnetic Emission Based Malware Analysis by using Artificial Intelligence,” in 2022 Application No: 202241034932, https://ipindiaservices.gov.in/.