IOT BASED ROBOTIC AGENT FOR HEART DISEASE DETECTION

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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DHAKA, BANGLADESH

SEPTEMBER 2021

APPROVAL

This Project titled "**IOT Based Robotic Agent for Heart Disease Detection** ", submitted by Rasidul Haque, ID No: 173-15-1640 and Md. Mazedur Rahman, ID No: 173-15-1690 and Md. Ridoy Hasan, ID No: 173-15-1695 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 19-09-2021.

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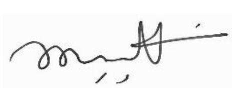

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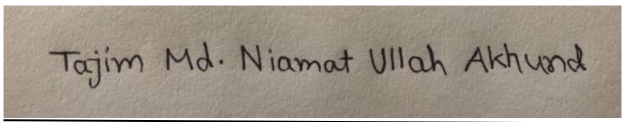

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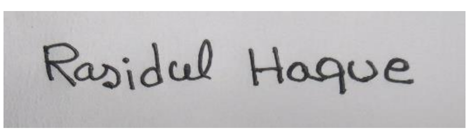

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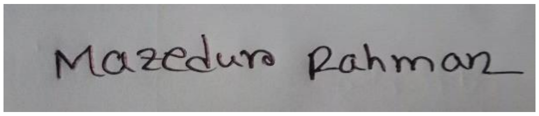

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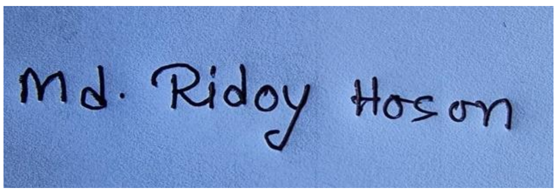

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ACKNOWLEDGEMENT

First, we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project successfully.

We really grateful and wish our profound our indebtedness to **Tajim Md. Niamat Ullah Akhund**, **Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Internet of Things, Machine Learning & Robotics*" to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to Tajim Md. Niamat Ullah Akhund, Md. Sabab Zulfiker, and Head**,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

The Internet of Things (IoT) plays a significant role in the medical field. New technologies have been implemented in the area of medical science and may aid in lowering medical costs. Heart attack is the most frequent condition that embraces the valuable life of the sufferer. Heart disease is a leading reason for the death of adult aged and older persons, and it may strike at any time without warning. If we monitor our health condition on a daily basis, we may identify a wide range of diseases earlier. For the purpose of overcoming and assisting our community in the fight against heart disease, we have suggested an IOT-based heart disease detection system with a robotic agent that will aid in the earlier identification of a heart attack.

Keyword: IOT (internet of things), GSM Module, Pulse Sensor, DHT11 temperature and humidity sensor, Blood pressure, NODE MCU, Arduino UNO, OLE

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CHAPTER 1

Introduction

1.1 Introduction

Heart disease, commonly known as CVD (cardiovascular disease), is a general concept that refers to a variety of various heart-related diseases. A heart attack occurs if something restricts the blood supply to the heart, depriving it of the oxygen it requires. The longer the period of time without therapy to reestablish blood circulation, the more harm to the heart tissue occurs. While each heart disease appears uniquely, but the general warning signals are chest discomfort, an increased pulse rate, and an increase in body temperature. Heart disease is the main cause of death across the world. Heart Diseases are responsible for many deaths globally, owing to the elderly population and increasing medical costs. In 2019, Approximately 17.9 million individuals died from Cardiovascular diseases, accounting for 32% over all deaths worldwide. Heart attacks and strokes accounted for 85% among these deaths. More heart disease deaths occur in poor and middle-income nations. Cardiovascular diseases were responsible for 38 percent of Seventeen million early premature deaths annually. It is essential to identify heart disease as soon as possible in order to the doctor will start treatment the patient that could be save his life.

Even though IOT is a pretty recent object of research, its prospective use in the field of healthcare is still in its early stages. The internet of things is being utilized in a variety of fields to enhance the connection of diverse objects on such a scale that previously unthinkable. IoT has emerged as a critical contributor to the healthcare industry due to its distinguishing features such as connectivity, sensing power, expression, security systems, and relationship with artificial intelligence Essentially, the Internet of Things (IoT) is defined as the connection of actual objects to the internet, that are permitted to interact with one another in order to exchange information. Beyond communicating with one another, they might be watched as well as directed from a distance.

A more recent idea is to check a person's health condition remotely. It has been much simpler to identify various characteristics about a person via the use of electronic sensor, such as heartbeat, temperatures, and so on, as a result of technological advancements in the area of medical sector. It represents a significant advancement in the medical field. Health experts have created a smart and affordable healthcare monitoring system that allows individuals suffering from different illnesses to live more comfortably by using technology such as Wi-Fi communications system, wearable remote patient monitoring devices. Several methods will be utilized to identify and forecast the different healthcare problems in order to put in place a system that will be adaptable to the detection and prediction of diverse illnesses.

We proposed an IOT based heart disease detection with a robotic agent. The main goal of our proposed device is speedily predicting heart disease from the data like as patient body temperature and pulse rate. First, we gather a person's body temperature and heart rate using the DHT11 and pulse sensor, which are both connected to the Arduino UNO via a wired connection. After that, we used a NODEMCU module to transmit the data collected into a cloud server, where it was analyzed using the Blynk app analytical platform. In the following step, we used a machine learning algorithm to predict a heart attack, and in the final step, we used a GSM module to send an alert SMS to the person who was at risk.

1.2 Motivation

In a rapid global society, health has emerged as a critical need for every person. However, when it comes to financial arrangements, the healthcare professionals are not always upfront with every patient. In Bangladesh, heart attack was top one in 2020, taking the lives of 180,408 individuals, or 21.1percent of a nation's population 8,54,253 fatalities this year. People who are afflicted with illnesses have moved significantly towards communicable to non-communicable, a trend that is also seen in Bangladesh. Heart disease is the most common non - communicable illness in our nation. Routine check is out of reach for many individuals in our country because of the expense. In rural and metropolitan regions, the number of older people is always increasing, thus monitoring their health frequently with such a right to live at house at cheap price is among the fundamental appeals. Heart disease a major effect on the people in our nation. According to the most recent studies on heart illnesses, hypertension affects approximately 20 to 25 percent among adults. It is a strong indicator that finding a method to avoid early heart illnesses would be extremely beneficial for the majority of the people in this nation. Furthermore, all of the existing therapies for cardiac illnesses are very expensive, which serves as another motivator for this initiative.

1.3 Objective

i. To improve the health-monitoring system for patients.
ii. To create a low cost and low power consumption heart attack prediction device.

1.4 Feature

i. It is a portable device.
ii. The patient's health status was constantly updated by this device.
iii. It has the capability of measuring body temperature.
iv. It has an OLED display for displaying real-time data.
v. It is equipped with a pulse sensor, which measures the person's heart rate.
vi. It includes a NODEMCU module for transmitting data to a cloud server.
vii. It contains a GSM module that sends a text message to the person.
viii. It may result in improved healthcare by taking use of data.
ix. It is an advanced health monitoring device with the ability to detect various factors in the body of a person.

1.5 Expected Outcome

i. Appropriate cardiac disease diagnosis is essential for successful patient therapy.
ii. The expense of rising healthcare has been reduced.
iii. Increased the overall experience of patients and medical staff
iv. The issue of real-time patient monitoring has been resolved.
v. Patients become conscious of their cardiac issues as soon as they occur and receive therapy at a hospital as soon as possible.

1.6 Problem Statement

The health problems of elderly individuals must be evaluated on a regular basis, which is a greater difficulty, both in medical research and in hospitals, as well as in the community. At medical institutions and hospitals, 12-lead systems are often employed to capture ECG signals from a patient's body, which are then processed. This equipment is too costly to use in a house or for private use, and it cannot be utilized as a movable device due to its size and weight. It consumes a lot of time on every visit to the hospital to have a regular evaluation, and manually record may potentially produce human mistakes. In this way, a low-cost portable technology is extremely necessary for continuing detection of cardiac disease. Mobile phones are used for secondary information processing in the majority of current heart disease detection systems. As a result of their limited processing capacity and computing efficacy, the widespread usage of smart phones for data transmission and processing has serious implications for everyday life. Although everyone thinks that all patients are unable to get perfect therapy, the most significant problem is that the expense of heart attack treatment continues to rise. Individuals may get therapy if they have substantial financial means, but our nation is not wealthy, for why those who are impoverished have a difficult time receiving care. This issue was solved by using an IoT-based cardiac disease diagnosis system in conjunction with a robotic agent system that measured the heart rate and body temperature. If the patient's pulse rate rises in tandem with their body temperature, the patient is alerted that they are in danger and should go to the hospital for treatment. It is also extremely portable.

1.7 Social Impact

The Internet of Things has transformed people's lives, particularly those of elderly patients, by allowing continuous monitoring of health problems. This has a significant effect on those who live only and their household members. If a person's regular heart activity is disturbed or changed, an alarm device transmits signals to families and healthcare professionals concerned. The proposed IoT-based heart disease detection system would enable family members and providers to be informed immediately of an occurrence. The technique that treat patients and perform surgical operations has been revolutionized by robotic technology. Avoid the risk of having a heart attack since you may check it at home to see why there has been a decrease in the number of heart attacks. This technology also aids in the monitoring of the hospital system. This technology allows physicians to do more accurate and less invasive heart fall procedures. Additionally, students may train extremely quickly to understand how to use this system by paying close attention to it. The patient may go to the hospital and get treatment as soon as he or she receives an alarm prior to learning of a heart issue, and society will carry out this task via the implementation of the Heart Detection Project. The fact that a large number of individuals in the society will be saved from heart attack will be evident in the future. A patient will be able to get the news about his heart much more immediately as a result of this, while it was previously just a question of time. This will save time, and work will be completed more quickly. Many people in the rural area are unconscious of this method; if they were, everyone in the community would know about it, and they would be able to get a fast treatment for heart illness. As can be seen, if this method is generally understood, it will have a beneficial effect on society by improving society and save many people from heart attacks.

1.8 Report Layout

Report layout: The project's visual presentation is comprised of a figure that clearly depicts the whole endeavor. The material, as well as additional information the material, and so much more. The project report is divided into 5 chapters. All chapters are explained in detail by a demographic depiction, which includes a short description.

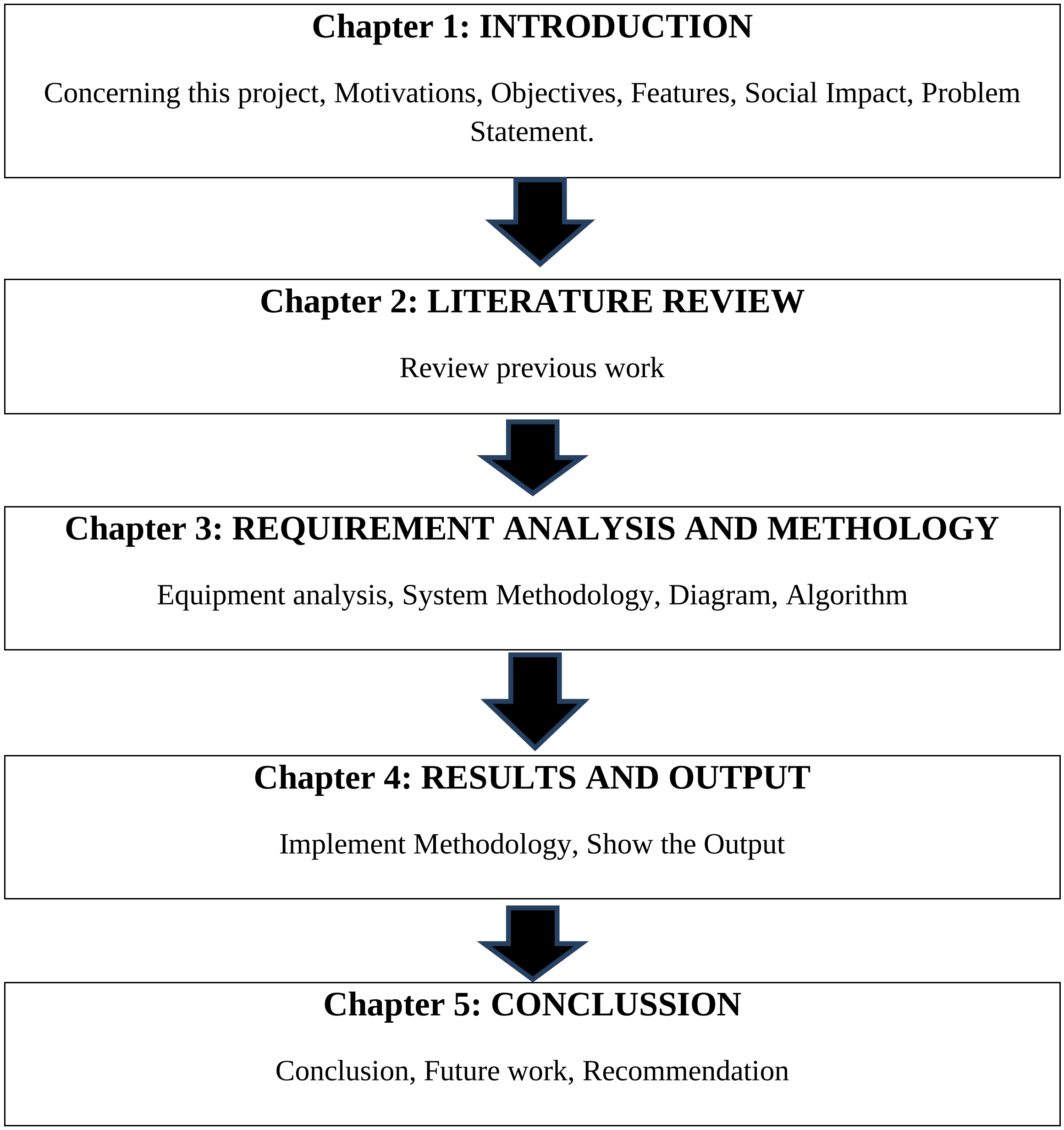


Figure 1.1 Report Layout

CHAPTER 2

Literature Review

Pranav etal. [1] used ECG Sensors AD8232 to create a healthcare monitoring system. Through remote patient monitoring, ECG sensors detect critical parameters. The authors have developed an Android application for continuous patient ECG monitoring. Data Collection, Data Prediction, and User Interface Module are the three modules that make up the system's operation. Various data extraction methods accurately forecast cardiac disease. The amplitude and RR interval of an ECG pulse produced by a sensor are calculated using data extraction methods. This method employs data mining to decrease the time and effort required for heart disease diagnosis. Patients who are pressed for time and need close monitoring may benefit from the application. The authors also utilized IoT technologies and data mining techniques to detect cardiac disease. The author is attempting to make the whole module as small as possible in order to turn it into a wearable gadget in the near future.

Early Heart attack prediction with Android application was implemented by Shweta Gajbhiye etal. [2]. The heart rate is monitored by pulse sensors, and the amount of oxygen in the patient's blood is checked using an oximeter. The data from the heart rate and oxygen level sensors acquired by the microcontroller will be shown on the LCD module and also sent to the Wi-Fi module controlled by the ESP 8266. This data will be sent to the internet by way of a microcontroller connected to a Wi-Fi network. It will be possible to monitor the heart rate and oxygen level using an Android application that will be connected to the internet.

Chao Li etal. [3] suggested an Internet of Things-based monitoring system for the healthcare of people with widespread heart disease. The system is comprised mostly of two components: the data collection component and the data transmission component. In this paper, the author focuses on monitoring the patient's blood pressure, ECG, SPO2 level, heart rate, pulse rate, body fat, and blood glucose levels, and this system offers four distinct data transmission modalities. The sensors that were utilized to monitor the parameter were not mentioned by the authors. The data collected by the sensor will be sent via Wi-Fi and retrieved by the distant user, allowing him or her to determine the heart status at any given moment. This system made use of an application on a mobile device that was developed in Java and was capable of collecting and storing monitored data from the different sensors via Bluetooth, as well as sending required data according to the various operating modes. The author created a web-based application that allows doctors to query the data that has been collected and monitored. The author intends to incorporate the Data Stream Management System (DSMS) technology into the system in the near future in order to enhance its capabilities.

AKM Jahangir etal. [4] developed a multi-sensory system that uses an intelligent IoT system that collects BAS (Body Area Sensor) data to give early warning of an impending heart attack. The goal of this system is the design and development of a complete smart Internet of Things system with a low-power connection that can collect heart rates and body temperatures silently using a smartphone while not interfering with the everyday activities and activities of daily living. In order to detect sudden heart arrests with high accuracy, the author presents the use of signal processing and machine-learning methods for sensor data analysis. To identify aberrant heart patterns, the author establishes a normal heart rate criterion, and quantitative assessment of heart rate consistency and pulse symmetry provides a set of characteristics such as heart rate, RR intervals, and ST segments. In addition, the system may find a variety of applications in the field of behavior detection for individuals with a variety of different impairments. In the future, the author could improve the system by adding more sensors to the IoT device, such as GSR (galvanic skin response) and an accelerometer.

Roopa etal. [5] developed a method for monitoring heart pulses that transmits data directly to the cloud through NODEMCU. The key advantage of the system is that data can be accessed at any time and from any location, and doctors may get alerts via text message if a patient's health is in poor condition. This proposal focuses primarily on the issue of health safety for individuals who have problems with blood pressure. Three elements were included in the author's suggested system. There are 1. Pulse sensors is used to determine the patient's heart rate. 2. The NODEMCU is used to send collected data to the cloud.3. Thinkspeak is a cloud platform that stores data.

Khushboo etal. [6] developed a system that analyzes data gathered from sensors worn by individuals who are at risk of heart disease in order to determine the emergency condition. Additional information considered by this system includes the user's age, maximum and lowest heart rates. On the basis of the analytical results obtained from the input data, the system sends a notification to emergency contacts like as family members of the patient as well as doctors, hospitals, and ambulance services in the area. The author's suggested method, in a combination with an improved navigation platform, will help medical personnel to determine the quickest path to provide primary care to the patient. A total of two modules were utilized in this system: one was a sensing module and the other was an alert module. This system utilized a sensor-enabled Arduino Board to collect data, and it used Bluetooth to communicate the gathered data to the Blynk App, which then sent the data to firebase, a cloud platform, for calculation, and depending on the outcome, firebase triggered an alarm. The limitations of this suggested method are being evaluated with a small number of individuals.

The Ravi Kumar Sah etal. [7] developed a device that has been used to monitor cardiovascular beat in the real time, which is helpful for heart disease patients. The system is linked to an ECG sensor, which is mounted to the patient's body and collects the patient's heartbeat readings. The Bluetooth device HC-05 is responsible for establishing connectivity and transmitting data over short distances between the two devices. The sensors are linked to a microcontroller, which collects the readings and sends the data to Bluetooth's mobile application for analysis and sends an alarm to the patient if the present values exceed or are below the threshold value and the treatment may be delivered on time. As a result, the patient's life can be saved. The system assists the doctor in providing treatment and precautions by evaluating the values gathered by the sensors. Because the system is linked to the mobile application, the current position of the patient is communicated to the users who are in need of assistance at the moment of need.

The authors of this paper [8] are developing a wireless display of heart rate and temperature using an ATmega328 microprocessor. The majority of monitoring systems being used nowadays operate in offline mode; however, this system has been built in such a manner that a patient may be watched remotely and in real time using this proposed system. The sensors in this system, which monitor the patient's heartbeat and temperature and are operated by a microprocessor. The heart rate and body temperature are shown on the LCD panel. The data that is sent is wireless and is routed via a microcontroller. The pulse sensor counts heartbeats in BPMs, while the temperature sensor detects temperature, and both data are transmitted to the microcontroller for transmission to the receiving side. This method might be made accessible with a tremendous impact on accuracy at a reasonable cost.

This study paper [9] shows that the cardiac rating may be determined by measuring the pulse rate with medical equipment like as an electrocardiogram, moveable handlebars or additional marketable cardiac surveillance devices. In spite of its precision, it is rather expensive, involves numerous clinical settings, and requires that the patient be constantly monitored by medical professionals. A patient who has previously been diagnosed with deadly heart disease must have their heart rate status checked on a continual basis. This paper proposed a warning system that is capable of monitoring the patient's heart beat rate condition and issuing alerts as necessary. The photoplethysmograph (PPG) method is used to detect the heart rate. In order to calculate the heart rate per minute, this signal is analyzed by the PIC16F87 microcontroller, and then an SMS alarm is sent in cell phones of health professionals, or close relatives of patient through text message.

Mohammad Wajih Alam etal. [10] have created an MCU-based cardiac beat and temperature monitor system where heartbeat measures with a fingertips and temperature sensor measures the temperature of the body. Optical technology is used to detect the flow of blood via the fingertip in this device, which has the benefit of being more portable than traditional recording devices. Numerous issues were identified, including effective data extraction and dynamic data tuning, to maintain quality of data transmission via a WI-FI based remote patient surveillance technologies. The device's accuracy in heartbeat monitoring has been shown in real-world testing, even while the user is engaged in strenuous exercise. By developing an architecture that enables a network both the patient and doctor to be established in beneficial to enable of observing the patient through evaluating patient data, this article discusses these difficulties and also potential solutions to these problems. A central unit controls this device, which comprises of sensors that monitor a patient's heartbeat and body temperature. In this proposed system the data which collect from the used sensors is processed further and transmitted to a peripheral location via GSM device where it is shown on a mobile phone. When compared to conventional systems, this device has been proven to be better.

CHAPTER 3

Requirement Analysis and Methodology

3.1 Requirement Analysis

3.1.1 Arduino Uno

The Arduino Uno is a microcontroller board created by Arduino.cc and released in 2010; that board is based on the Microchip ATmega328P microprocessor. It is free and open-source software. Arduino Uno boards are often used to develop projects in digital electronics, embedded systems, robotics, automation, the Internet of Things, and other related fields. The latest variety of Arduino Uno has a Universal Serial Bus port, 6 pins are used analog input (A0 to A5), and 14 Input/Output digital pins, which are used to interact with outer electrical circuits. When it comes to PWM output, six pins are available out of the 14 Input/Output pins. All of them may help the microcontroller by connecting it to the computer for further functioning. The Arduino Uno board may be powered via an alternating current (AC) to direct current (DC) converter or a USB connection; alternatively, a battery may be utilized.

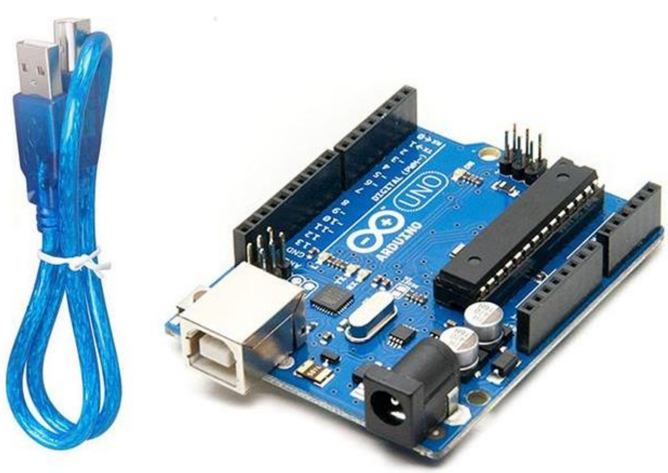


Figure 3.1: Arduino Uno R3 [11]

Technical specifications of Arduino Uno are given below:

- Microcontroller used: ATmega328P
- Required Voltage for Operation: 5 volts
- Voltage Recommendation for Input: 7V to 12V
- Range of Input Voltage: 6V-20V
- Pins for Analog Input: 6 (A0 to A6)
- Pins for digital input and output: 14 (6 Pin for PWM output)
- Required DC Current for input/output Pins: 20 milliampere
- Required Direct Current for 3.3V Pin: 50 mA
- Flash Memory size: 32 kilobytes
- The Arduino has a Static Random-Access Memory which size is 2 kilobytes. It also an electronically erasable programmable read-only memory size of 1 kilobyte.
- CLK /frequency: 16 MHz
- Built-in Light Emitting Diode: 13 number digital pin
- The Arduino length, width, and weight are respectively 68.6 mm, 53.4 mm, and 25 g.

3.1.2 Breadboard

The breadboard would be a quadrilateral plastic panel that has a slew of small holes drilled into it along its length. Breadboards are also used to develop prototypes of electrical circuits and may be applied for other applications in the future. The breadboard central half contains two columns, separately with 30 connection strips similar to the one on the breadboard that has been pushed out and to the side. These attach whatever that is strapped through from the forward-facing into single of the five holes to form a cohesive unit. Both borders of the breadboard have significantly longer portions of the clip that connect the columns of holes represented by red and blue lines on its exterior. Red lines are intended for 5V and Blue line are meant for ground (GND). The interior of a breadboard is constructed of small metal clips, it is possible that the leads will be accommodated by the board.

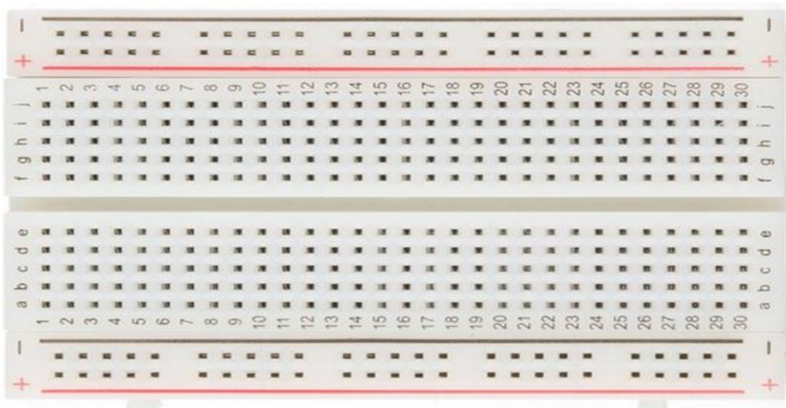


Figure 3.2: Breadboard [12]

3.1.3 OLED Display

OLED be contained in a tiny self-Light Emission technology, multifaceted structural film inserted among an anode and a cathode. Unlike LCD display, OLED requires no backlight. OLED has a widespread series of potential applications across practically completely sorts of displays as a display technology. It is broadly well-thought-out the perfect technology for the benefit of the future generation of flat-panel display. Microcontroller can easily manage this 0.96″ OLED panel, which has 128 x 64 pixels resolution an 4-pin I2C interface. Powerful brightness, self-emission, large contrast ratio, little outline, extended viewing angle, comprehensive temperature range are some of the properties of this display module. It also has a low power expenditure. There are four pins on the 0.96" I2C OLED 128x64 - Blue display. 1. GND-this pin is used to connect system ground. 2. VCC -VCC is the power source for the display and is activated by connecting the 5V. 3. SLC-SLC is a serial pin for configuration. 4. SDA-IT is a serial data pin.

Figure 3.3: 0.96 Cm OLED Display Module

Some characteristics of OLED Display are given below:

- Size of the diagonal screen is: 0.96"
- The I2C OLED 128x64 - Blue display has the following dimensions: 27.8 x 27.3 x 4.3 mm.
- Voltage Required for Operation: 3.3 to 5V direct current
- This product has an angle of view is more than 160 degrees.
- The driver integrated circuit that was used in this device is: SSD1306.
- Temperature range: -40 degrees Celsius to 70 degrees Celsius.

3.1.4 Pulse Sensor

In medical science, a pulse wave is defined as the variation in the quantity of a blood artery that happens as the heart pumps blood. A pulse sensor is an indicator that measures this volume change and is used to identify heartbeats. The ECG, photoelectric pulse wave, blood pressure measurement, and phonocardiography are the four primary methods for determining heart rate. The photoelectric technique is used by pulse sensors. A 24" flat strip cable with 3 ports is included with the pulse sensor. Those three pins are ground (GND), VCC, and signal.

The pulse/heartbeat sensor operates in a relatively straightforward manner.

There are two sides on the pulse sensor. On one side of the pulse sensor, there is an LED and an ambient light sensor, and on the other hand, there is circuitry.

The sensor front-side LED is positioned above a vein within our human body, allowing it to detect blood flow.; This vein may be found on our finger or ear tips. If We observe the bloodstream in the veins, we can also trace the heart's beats since the veins will only have bloodstream while the heart is beating.

Figure 3.4: Pulse Sensor

Technical specifications of Pulse Sensor are given below:

- 1.The pulse sensor is a simple plug-and-play device.
- 2.Operational voltage of the pulse sensor is either +3.3V or +5V.
- 3.The current usage of the pulse sensor is 4 milliamperes.
- 4.The pulse sensor's diameter is 0.625" and its thickness is 0.125"
- 5.Amplification and noise reduction circuit are integrated within the pulse sensor.

3.1.5 LCD Display

An LCD is a kind of electric display module that provides a viewable picture by using liquid crystal. It is a relatively simple module that is often used in homebrew initiatives and circuits. The 16*2 LCD is a two-line representation with 16 characters each line. On a 16*2 LCD panel, each letter is represented by a 5x7 pixel matrix. An SPI interface card connected to a 16x2 LCD module. The control of a standard 16*2 LCD requires more than six pins on the board. This SPI interface enables simple control of the display across the various bus protocols in use. Here we utilized the SPI LCD, which requires three lines (SPI) to show information. SPI 16*2 LCD module has two kinds of pins. The first is the power pin including two VCC, GND and the second is the digital pin with 4 pins, Data, Clock, Latch and BL. When the Back-Light switch is turned off, use the BL Pin to manage the LCD backlight.

Figure 3.5: LCD Display 16x2 Character

Some characteristics of LCD Display are given below:

- The supply of power voltage ranges from 4.5 to 5.5V.
- Color of the display: white characters illuminated by blue light.
- Dimensions of the module: 47x80x19 mm.

3.1.6 NodeMCU

NodeMCU is an open-source development board which based on Lua firmware that has been considered precisely for IoT based applications. In addition to software that operates on Espressif Systems' ESP8266 Wi-Fi SoC, it also incorporates hardware that is built on the ESP-12 module. The ESP8266 Wi-Fi is comprised of many components, including a Central processing unit, Random Access Memory, Wi-Fi, and even a current OS (operating system) and Software Development Kit. The board is comprised of a 32-bit MCU and a

Transceiver for Wi-Fi networks, as well as 11 GPIO pins and a corresponding analog input. It implies that we may program it the same way that we would any other Arduino or microcontroller. Additionally, we receive Wi-Fi communication, which allows us to attach to our Wi-Fi system, to connect our smartphone among other things. AT-Command firmware is included within this module that enables it to be utilized with any microcontroller through the COM port. CH340 family of chips is well-known for being a more economical replacement to the CP210x family of chips. The ESP8266 NodeMCU is equipped with 30 pins that allow it to communicate with the rest of the world.

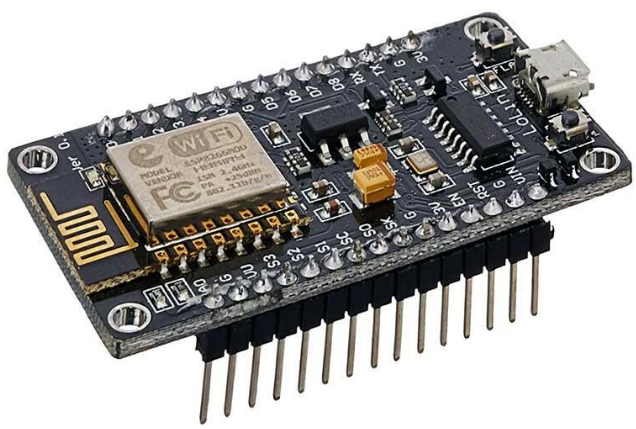


Figure 3.6: NodeMCU ESP8266 Wi-Fi

Technical specifications of NodeMCU are given below:

- The input voltage range is 7V to 12V
- NodeMCU ESP8266 Voltage Required for Operation: 3.3V
- Tensilica 32-bit RISC CPU Xtensa LX106 was used as a microcontroller.
- It has an instruction RAM which size is 64 KB, and also a data RAM of 96 KB.
- The Node MCU used the IEEE 802.11 b/g/n Wi-Fi Standard, and the temperature range was -40°C to +125°C
- 80 MHz is the clock frequency.
- Data transmission interfaces UART and GPIO are supported.

3.1.7 LiPo Battery

Lipo Battery is an acronym for lithium polymer battery, and it is also referred to as Li-po battery or, more precisely, lithium-ion polymer battery. Instead of a liquid, Lipo is a rechargeable lithium-ion technology battery that uses a polymer electrolyte. Lipo batteries have more incredible particular energy than other kinds of lithium-ion batteries, making them more efficient. It is a more recent form of battery currently found in a wide range of consumer electrical products. Compared to regular LiIon batteries, LiPo batteries have less temperature-free (0'C to 60'C), and draining LiPo cells to ultra-low voltages might be harmful. When a LiPo cell is charged to its trivial voltage of 3.7V, it is known as a lipo cell. A lipo cell = 1 cell = 1S = 3.7V. The battery of lithium polymer may be manufactured with an extremely thin design. The production cost of lithium polymer batteries has now been reduced, and weight is likewise low.

Figure 3.7: LiPo Battery

3.1.8 Jumper Wire

Jumper: A wire is a particular stick of metal that is generally cylindrical in shape and it is flexible. Mechanical weights or messages for electricity and telecommunication signal are all carried on wire. Jumper wires are basic cables that include connection pins on both ends, allowing them to link two locations without the requirement for soldering between them. Jumper wires are generally used in conjunction with breadboards and other equipment to create it simple to modify the configuration of a circuit as required. Although jumper wires are available in several colors, the colors themselves have no significance. Although jumper wires are available in several colors, the colors themselves have no significance. Jumper wires are commonly available in three different variants.

1. 1.Male to Male
2. 2.Male to Female
3. 3.Female to Female

Figure 3.8: Jumper Wire

A pin protrudes from the male end, allowing it to plug into objects, but female points do not, allowing them to plug into other objects.

3.1.9 DHT11 Temperature and Humidity Sensor

The DHT11 is a frequently used temperature and humidity detection sensor. Both the resistive humidity sensor and the thermistor are used in the construction of the DHT sensors. DHT11 circuit measures the humidity and temperature of the ambient air and then generates a digital signal that is sent to the data port of the microcontroller. Any MCU may be used to read the digital signal, and it is relatively simple to do so. It's pretty easy for using, but it needs precise timing to capture data. Between the two electrodes of the humidity detecting capacitor is a moisture-retaining substrate that acts as a dielectric. When the capacitance value changed, the humidity levels shifted as well. This sensor measures temperature with the use of a thermistor with a negative temperature coefficient, which reduces its resistance with the rise in temperature. The sensor is capable of measuring temperatures between 0°C - 50°C and humidity levels between 20% to 80% with the correctness of ±2°C and 5%, respectively. The DHT11 sensor module is supplied with three pins: one for ground (GND), one for power (VCC), and one for data (A Data pin).

Some characteristics of DHT11 Temperature and Humidity Sensor are given below:

- The operating voltage of the DHT11 is between 3.5V and 5.5V.
- The DHT11 operates at a current of 0.3mA for measurement and 60uA for standby, respectively.
- The DHT11 has a 16-bit resolution for temperature and relative humidity.
- The size of DHT11 is 15.5mm x 12mm x 5.5mm.
- DHT11 operates at a 1Hz sampling rate.

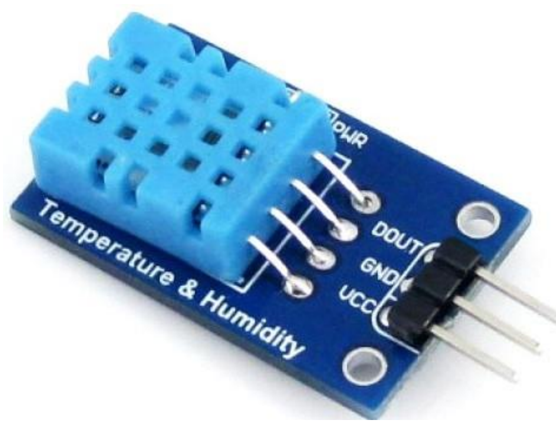


Figure 3.9: DHT11 Temperature and Humidity Sensor Module

3.1.10 MAX30100 Finger Oximeter Heart Rate Module

The MAX30100 is a sensor system that combines a pulse oximeter and a heart rate monitor into one device. Two wavelengths of light are emitted from two LEDs – the first one is a red LED, and another one is an infrared LED – which is then measured by an optical sensor to determine the absorbance of pulsating blood using a photodetector. This specific LED color combination is tailored to read the data via the fingertip. The basic purpose of the

MAX30100 is to distinguish between oxygenated and deoxygenated blood by measuring how much infrared light is absorbed and how much red light is passed by the blood. Blood that has been oxygenated consumes more increased infrared light and transmits more extended red light. In contrast, blood that has been deoxygenated consumes more further red light and transmits more infrared light. The software registers are entirely programmable, and digital output is kept within a 16-depth First in First Out device. Through the use of an I2C digital interface, the MAX30100 interfaces with a host microcontroller. The GY - MAX30100 Finger Oximeter Heart Rate Module includes 5 pins, which are as follows: 1.VIN 2.GND 3.SDA 4.SCL 5.INT.

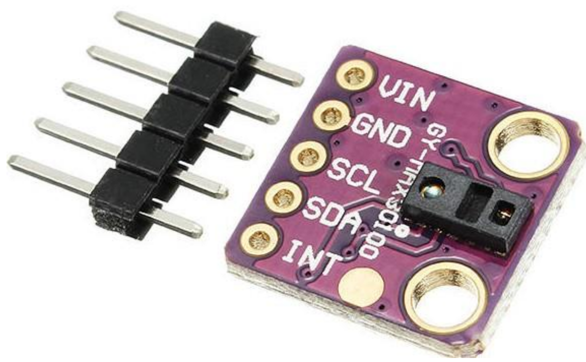


Figure 3.10: MAX30100 Finger Oximeter Heart Rate Module

Technical specifications of MAX30100 Finger Oximeter Heart Rate Module are given below:

- MAX30100 operating voltage range is 1.8-3.3V.
- The MAX30100 has the following dimensions: 8 x 4 x 10 cm and weighs 2 g.
- Increased battery life for portable devices because to the MAX30100's high-performance analog front and ultra-less-power process.

3.1.11 SIM900A GSM/GPRS Module

The worldwide standard for mobile communications is GSM, which stands for Global System for Mobile Communications. The term GPRS refers to the General Packet Radio Service. In cellular communication, General Packet Radio Service is a phone service that is available on both 2G and 3G frequencies. The SIM900A is a widely accessible GSM/GPRS module that is found in various mobile phones and personal digital assistants (PDAs). Making Arduino projects capable of connecting to the cellular network and sending and receiving text messages, making phone calls, and even connecting to the Internet via GPRS and GSM makes it simple to join the Internet of Things (IoT) world with the Shield GPRS/GSM SIM900 module. SIM900A GSM/GPRS is a dual-band module that runs on the EGSM 900MHz and DCS 1800MHz frequencies. It is compatible with both GSM and GPRS networks. The SIM900 is the primary chip in the Shield, and it is a minimal cost GSM/GPRS transmitter that is capable of supporting a broad variety of network protocols and devices. AT instructions are supported by the SIM900 through the Serial UART interface, and by using the instructions, it is possible to make phone calls text SMS, and connect to the Internet. The SIM900 module's 12 GPIO pins, 2 pulse width modulation (PWM) pins, and one analog to digital converter (ADC) pin are all present on the shield, as are the module's additional peripherals.

Figure 3.11: SIM900A GSM/GPRS Module

Some characteristics of SIM900A GSM/GPRS Module are given below:

- SIM900 is the primary processor.
- 5-12V DC power source is required for the SIM900 GSM/GPRS module.
- The I / O voltage of the SIM900 GSM/GPRS module is 5V TTL.

- The SIM900 features a 10/8 multi-slot configuration.
- It also has a mobile station that is classified as class B.
- SIM900 operates with little amount of current :1.5mA
- The working temperature of the GSM900 module is --30ºC to +80ºC.
- This module has support for a real-time clock, a programmable serial port, as well as connections for a loudspeaker and an earphone.
- An SMA connection is used to connect the GSM antenna to the device.

3.2 Methodology

3.2.1 System Architecture

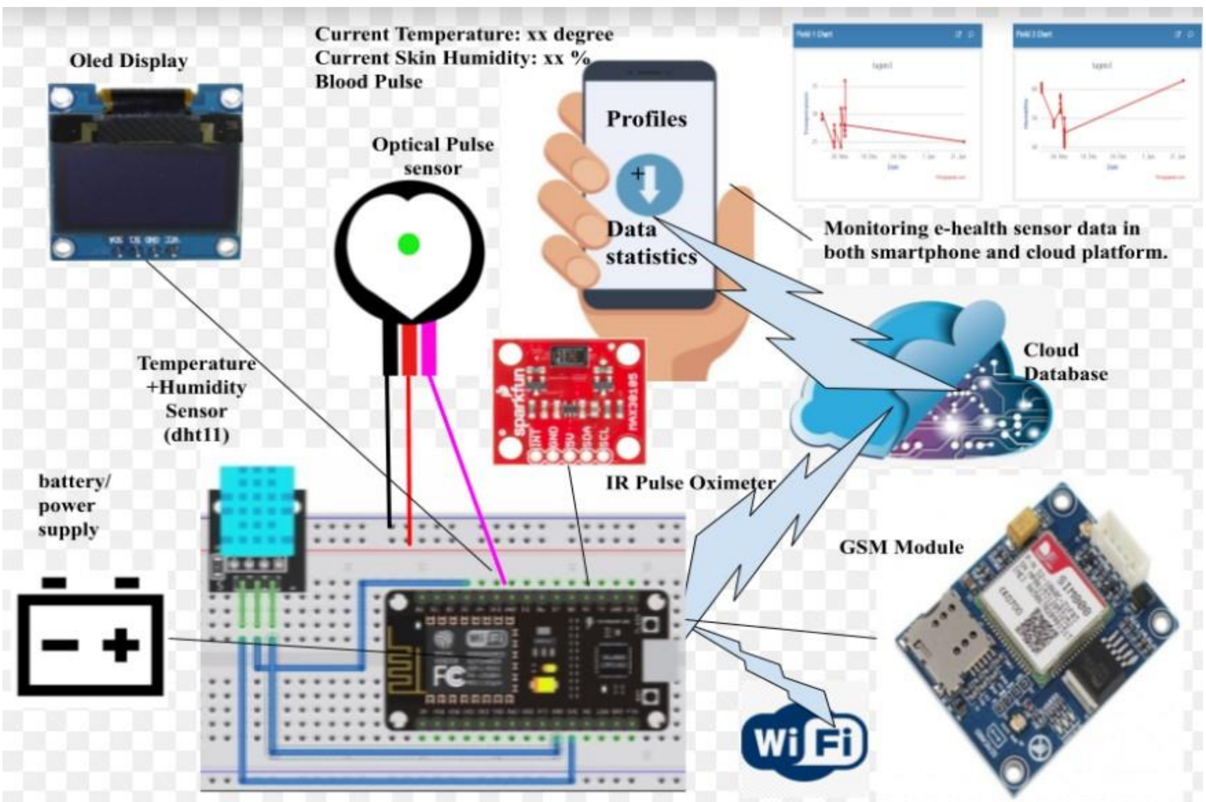
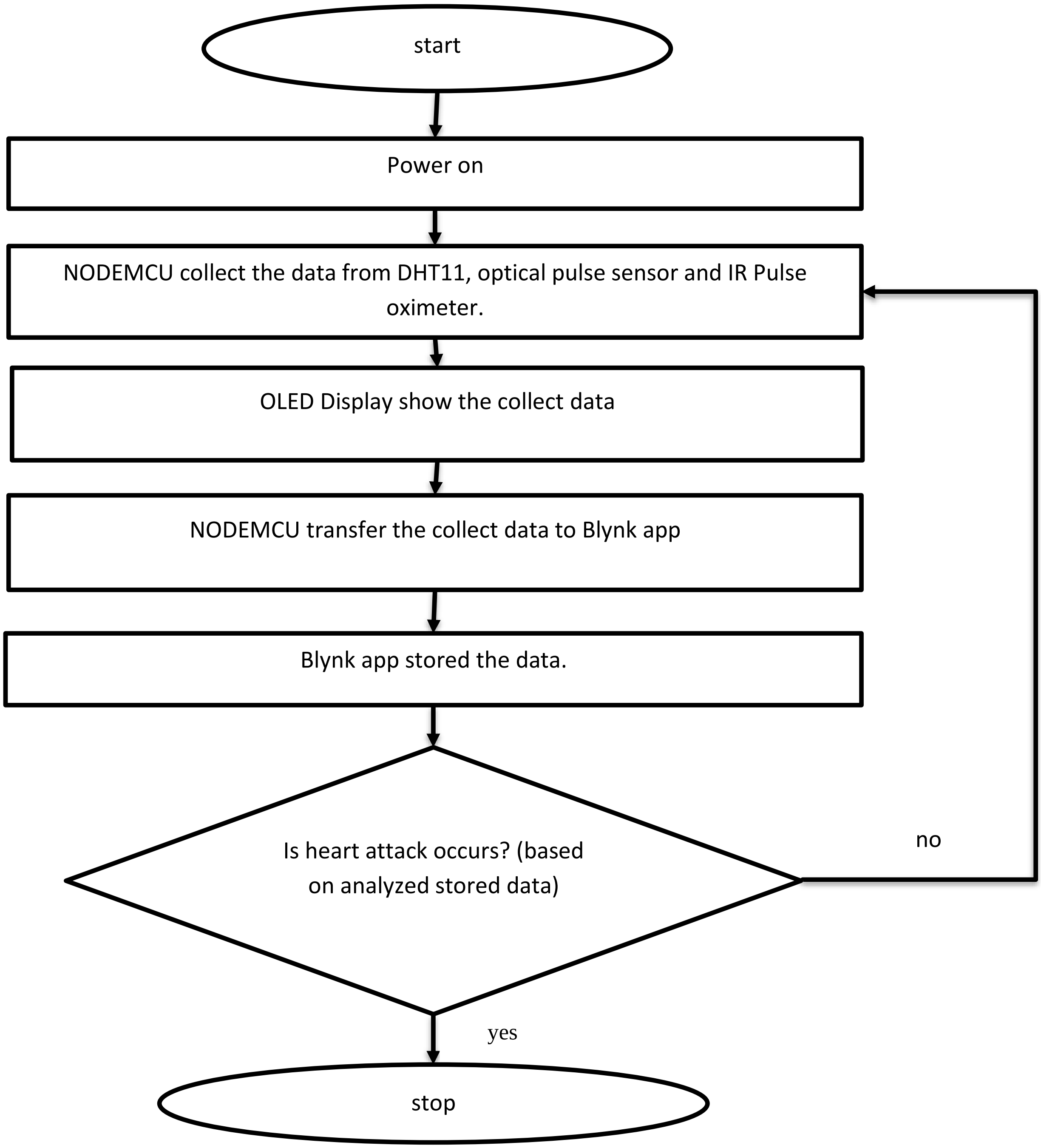


Figure 3.2.1: System Architecture

The system architecture of our proposed IoT-based heart disease detection with a robotic agent is shown in the above diagram. We utilized a variety of modules to complete our project. There is a battery in the above diagram, and when we turn on the battery, the system is powered up as well. Here, we used the NodeMCU module, which is an open source framework built on the ESP8266 that can link devices and allow data transmission via a Wi-Fi network. There are three sensors used to collect patient's real-time data: a DHT1 temperature sensor and humidity sensor, an optical pulse sensor, and an IR pulse oximeter. Those three sensors are connected to the NodeMCU module via wires. There is also an OLED display, which displays the data that has been collected. A GSM module is used to establish a cellular network with a distant network, using mobile phone technologies. If any of the parameters change, an alarm is sent to the patient's family members through a GSM module. NodeMCU also sends data to the Blynk app , which is an Internet of Things analytical platform that enables to gather, display, and evaluate real-time data from connected devices.

3.2.2 Flow Chart



3.2.3 Algorithm

Step 1: Start

Step 2: Power On

Step 3: NodeMCU collect the data from both of temperature, pulse and oximeter sensor.

Step 3.1.1: OLED show the collect data

Step 3.1.2: NodeMCU transfer the collected data to Blynk app.

Step 3.1.3 Blynk app stored data

if (Is Heart attack occurs based on analyzed stored data)

Then go step 4

else go to step 3

Step 4: Stop

3.3 Dataset

In the Dataset we use three different algorithm, There are artificial neural networks (ANN), Logistic regression, Support Vector Machine (SVM).

ANN

The phrase "artificial neural networks" comes from neuronal biological networks which form the human brain patterns. Artificial neural networks, like the human brain, contain neurons that are linked to each other at different levels of the system, similarly to how neurons in the brain are coupled to each other in the human mind. An Artificial Network is part of the area of artificial intelligence, where the system of neurons and brain activity is imitated such that computers can comprehend and make choices in a gentle way. Computers are programmed to act like linked brain cells in order to create an artificial neural network. Neural networks are a kind of parallel computing device that are essentially an effort to create the brain on a computer using data from many sources. The primary aim is to create a system to carry out different computer operations more quickly than conventional systems. This tuition is helpful for students who may have an interest in this topic, postgraduates and researchers, and those who have this topic in their curricula. Artificial Neural Networks (ANNs) may be thought of as optimal path graphs for which artificial neurons are vertices and directed edges with weights represent the connections between the neurons' outputs and their inputs, respectively.

Logistic regression:

Logistic regression is a classification system based on supervised learning that is used to forecast the chance of an objective variable. The type of the destination or variables is dichotomous, meaning that only two classifications are available. As a result, the result must have been a discrete or categorical number. Put another way, in binary data analysis, the response variable is binary in nature, and the data is coded as either 1 (which represents successful or yes), or another number 0 (which represents fail or no). The Logistic Regression is very related to the Linear Regression, with the exception of the way they are applied. Logistic regression has been used to solve classification difficulties, while linear regression has been used to solve regression problems. The variable dependent must really be inherently categorical. There should be no multi-linearity of the independent variable.

Support Vector Machine:

Support Vector Machine (SVM) is among the most widely used supervised learning algorithms, and it may be used to solve classification and regression issues, respectively. With the SVM algorithm, the purpose is to find the best quote or target variable that can be used to divide n-dimensional space into courses, so that additional data points may be readily placed into the appropriate category in the next. The optimal boundary for decisions is a hyperplane. The extreme points/vectors that assist create the hyperplane are chosen via SVM. In the SVM method, every data item is plotted as a point in n-dimensional space, with n being just the value of a specific coordinate, as the value of every single feature. It does categorization by locating the hyper-plane that best distinguishes the two classes. SVMs are utilized in a variety of applications, including handwriting recognition, intrusion detection, facial identification, email classification, gene classification, and web page generation. We employ SVMs because they are able to uncover intricate links among your data without you having to make many changes alone. SVMs are used in machine learning for this reason.

3.3.2 Dataset Analysis:

We are using it for our research. There are seven columns in the dataset. Like gender, age, temperature, heart rate, level of oxygen, and target CVD.

Gender: The gender column contains two different kinds of gender.

1 for male and 0 for female.

Age: In second column is the age column. Here the range of column is 29 years to 76 years.

Temperature: In third column is represent as temperature column.

Minimum temperature: 28 degrees.

Maximum temperature: 38 degrees.

Heartbeat: In the fourth column represent as heartbeat.

Minimum heartbeat: 48

Maximum heartbeat: 100

Oxygen level: In the fifth column represent as Oxygen level.

Minimum Oxygen level: 87

Maximum Oxygen level: 98

Target CVD: The last column represent as target people that have possible to occur heart attack or not.

0 for not occur

1 for occur.

3.3.3 Dataset graph

In our following dataset contain 4 graphs. First one is range of ages that fall heart attack. Then second one is range of temperature that which temperature will fall heart attack. Third one is range of heart rate and also which heart rate is dangerous and may fall heart attack is shown here. Lastly range of oxygen level, which oxygen level is better and which oxygen level will occur heart attack is shown the above graph.

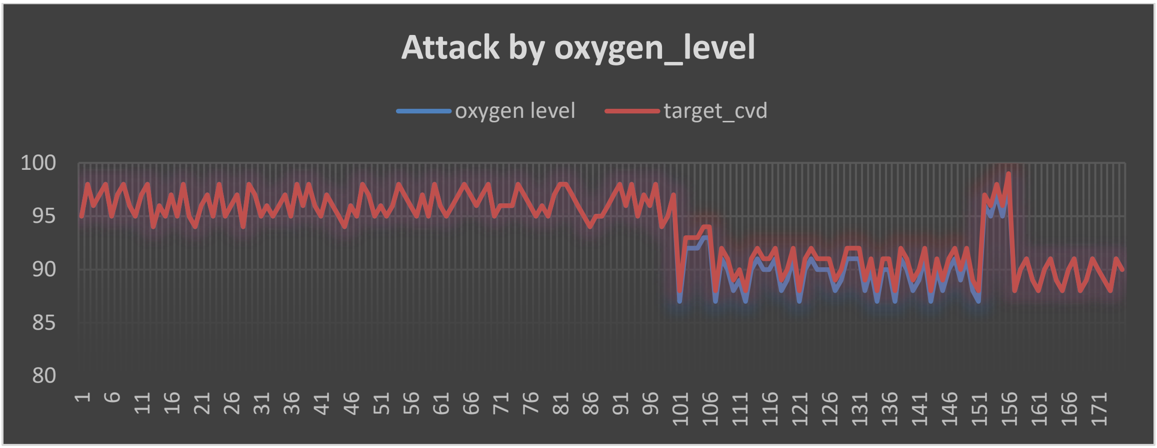


Figure 3.3.1: Heart attack by Oxygen_level

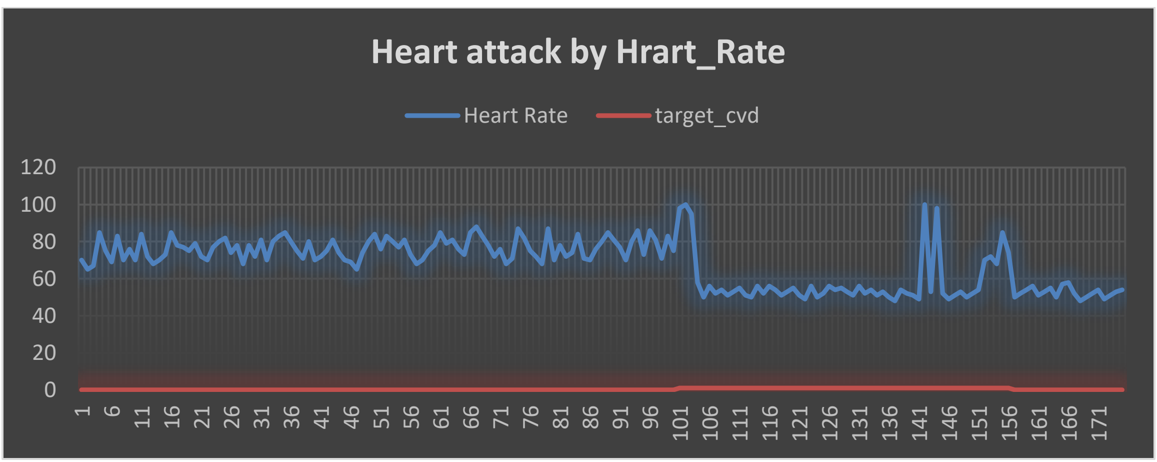


Figure 3.3.2: Heart attack by Heartrate

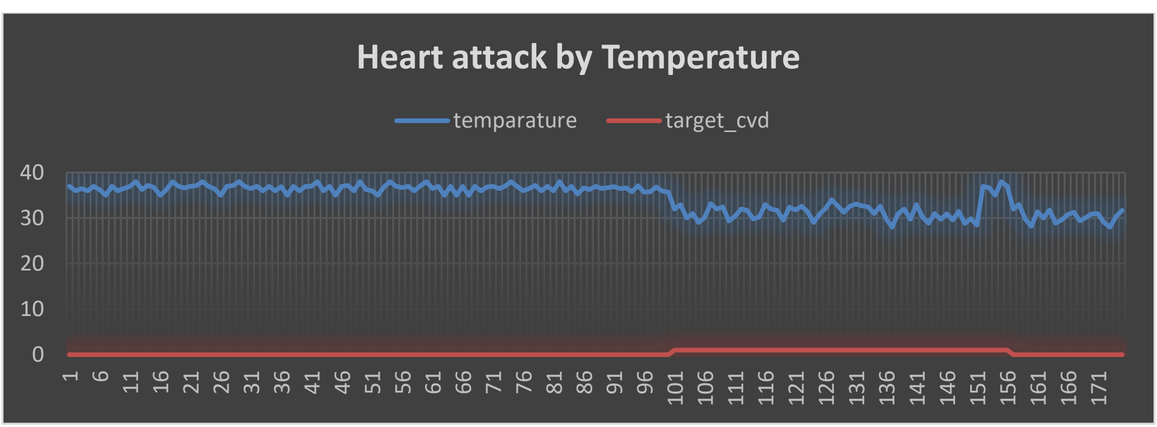


Figure 3.3.3: Heart attack by Temperature

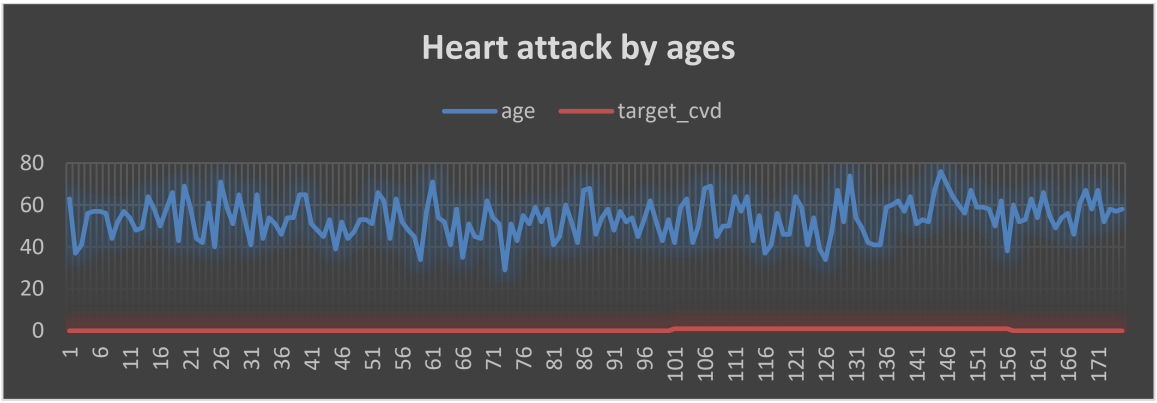


Figure 3.3.4 Heart attack by ages

CHAPTER 4

4.1 Project Implementation

Here the hardware implementation in our project. Here we use some of equipment there are breadboard, two NODEMCU, DHT11 temperature and humidity sensor and also max30100 pulse oximeter sensor. On the breadboard put two NODEMCU then pulse oximeter sensor connect with one NODEMCU and also connect DHT11 temperature and humidity sensor with another NODEMCU. Now OLED is connected with all of equipment in our project.

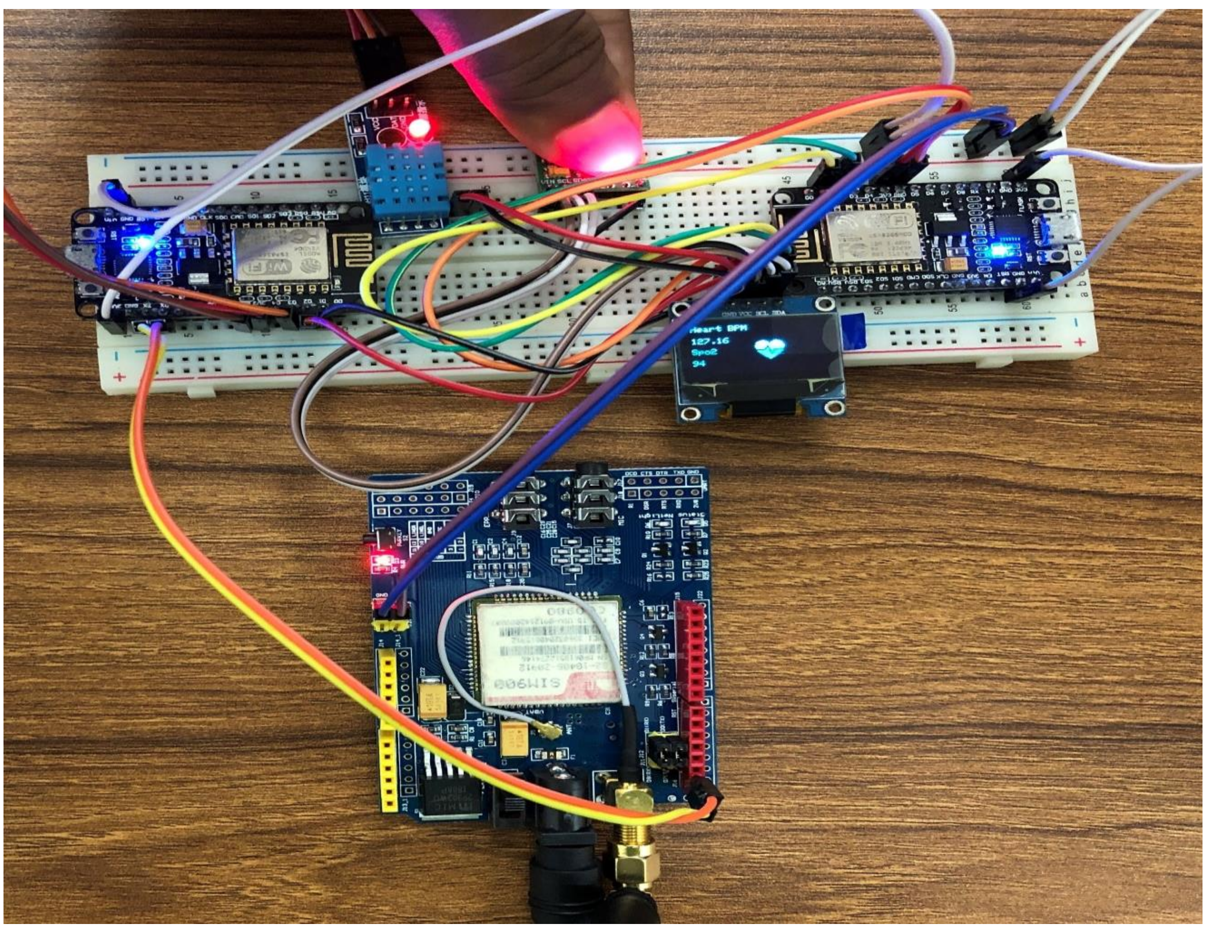


Fig: 4.1.1 Project Implementation

Here we can see live data in Blynk app that are shown our project and also download the CSV file from the BLYNK App.

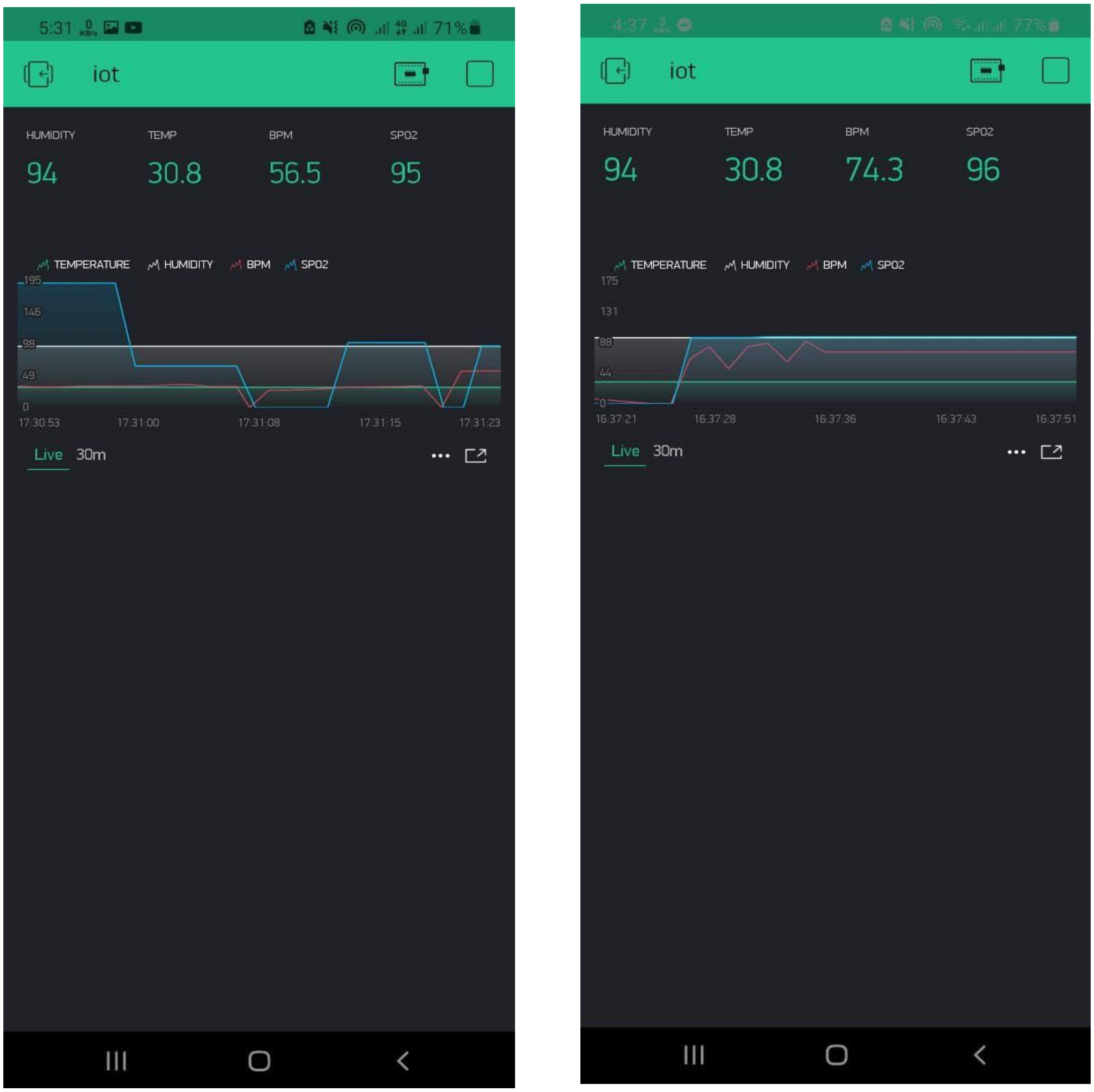


Fig:4.1.2 Live data in Blynk app

4.2 Accuracy of Measurement

The bar chart gives information about how much accurate prediction our sensor provides in real-time data. Summaries the information by selecting and reporting the main features. First and foremost, there is the issue of temperature. It can measure temperatures with an accuracy of around 98% rather than 100%. The humidity can then be measured with 95% accuracy rather than 100% precision. Furthermore, blood pressure can be measured with 92% accuracy. Finally, oxygen can be detected with 95% accuracy.

The efficiency of power in our project is 98% accurate. It also sends data to Think Speak, a cloud service that has a 94% accuracy rate. The cloud can then display the data with a graphic accuracy of around 98%.

Features	outcome
Temperature	98%
Humidity	95%
BP	92%
OS	95%
power_efficiency	98%
cloud data	94%
cloud graph	98%

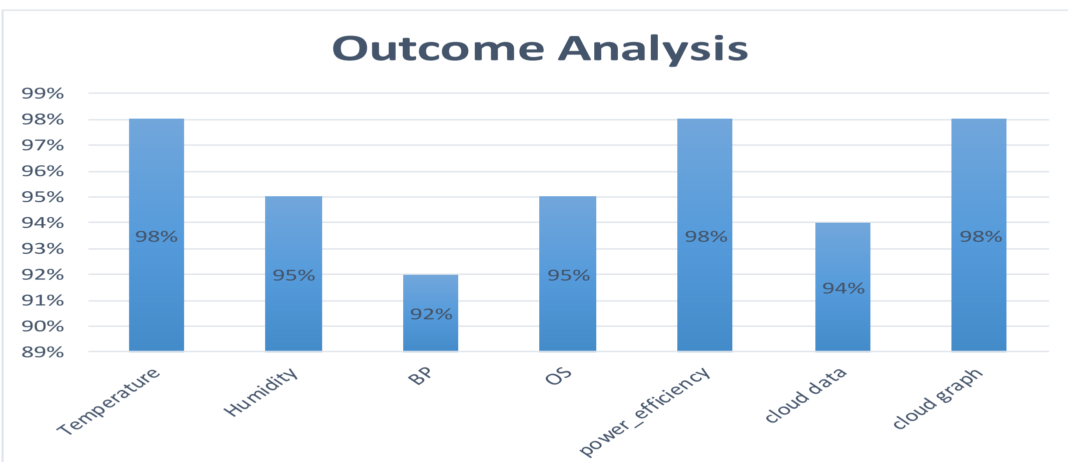


Figure 4.2.1: Accuracy of Measurement

4.3 Experimental Evaluation

We utilized various machine learning methods in this project, like the Artificial neural network (ANN), logistic regression, support vector machine (SVM) and compared them by measuring model accuracy.

A confusion matrix is produced and a confusion matrix created for assessing the accuracy of machine learning methods to indicate how many times each class has been allocated. An example of a confusion matrix is shown below that we use in our project.

First of all, we used the Artificial neural network (ANN) algorithm in our project. And by applying this algorithm we have got 85.71% accuracy.

Result Of ANN

```
ANN_score = round(accuracy_score(y_test, y_pred)*100,2)
print("The accuracy score achieved using ANN is: "+str(ANN_score)+" %")
```

```
The accuracy score achieved using ANN is: 85.71 %
```

Figure 4.3.1: Result of ANN

Then, we used the Logistic Regression algorithm in our project. And by applying this algorithm, we have got 82.86% accuracy. That means our project gives a prediction of 82.86%.

Result of Logistic Regression

```
score_lr = round(accuracy_score(Y_pred_lr,y_test)*100,2)

print("The accuracy score achieved using Logistic Regression is: "+str(score_lr)+" %")
```

```
The accuracy score achieved using Logistic Regression is: 82.86 %
```

Figure 4.3.2: Result of Logistic Regression

And lastly, we used the Support Vector Machine (SVM), algorithm in our project. And by applying this algorithm, we have got 85.71% accuracy that is highest. That means our project gives a prediction of 85.71%.

Result of SVM ¶

```
score_svm = round(accuracy_score(Y_pred_svm,y_test)*100,2)

print("The accuracy score achieved using Linear SVM is: "+str(score_svm)+" %")
```

```
The accuracy score achieved using Linear SVM is: 85.71 %
```

Figure 4.3.3 : Result of SVM

Here we can see our project prediction accuracy. The first one is given 85.71% accuracy by using the ANN algorithm. The second one is given 82.86% accuracy by using the Logistic Regression algorithm. And Lastly, we have got 85.71% accuracy by using the Support Vector Machine algorithm.

Output final score ¶

```
scores = [ANN_score,score_lr,score_svm]
algorithms = ["ANN","Logistic Regression","Support Vector Machine"]

for i in range(len(algorithms)):
    print("The accuracy score achieved using "+algorithms[i]+" is: "+str(scores[i])+" %")
```

```
The accuracy score achieved using ANN is: 85.71 %
The accuracy score achieved using Logistic Regression is: 82.86 %
The accuracy score achieved using Support Vector Machine is: 85.71 %
```

Figure 4.3.4 : Output of the algorithm.

Confusion Matrix in our project

Making the Confusion Matrix.

```
from sklearn.metrics import confusion_matrix, accuracy_score
cm = confusion_matrix(y_test, y_pred)
print(cm)
```

```
[[20  3]
 [ 2 10]]
```

===Confusion Matrix===

n = 175		Predicted		
		Positive	Negative	
Actual	Positive	20	3	23
	Negative	2	10	12
		22	13	

Table: 4.1 Confusion Matrix

Now the graphical representation of accuracy for each algorithm. In the bar chart X-axis represented the features of our project and Y-axis represented the accuracy level.

Figure 4.3.5: Graphical representation of accuracy for each algorithm.

4.4 LIMITATION

i. It is solely capable of predicting heart attacks.
ii. A cardiac blockage cannot be measured with this device.
iii. It is unable to recommend medicines after predicting heart disease illness.

CHAPTER 5

Future works and Conclusions

5.1 Future works

In our future work, we will create an Android platform that contains a location tracking framework to assist clinical staff in determining the shortest pathway to provide the earliest treatment process for the afflicted person. The above application will also communicate with the traffic police to assist in clearing the pathway while the emergency vehicle can reach the closest hospital as quickly as possible, we will gather additional data characteristics from numerous sensors that are presently absent in addition to achieve more sustainable results. We can enhance this project's Electrocardiogram monitoring program as well as the detection of several other illnesses such as diabetes. If modern technology progresses, our proposed device will be upgraded so that it can able to identify heart blockage.

5.2 Conclusions

Cardiovascular disease has been one of the leading causes of mortality, and early detection of heart attacks is critical for everyone. The heart attack is hard to recognize, therefore we are presenting to this method that will aid in the early detection of a cardiac arrest. This device detects a patient 's heart rate via pulse rate sensor even while the person would be at residence. Patient's health data such as temperature, pulse rate is recorded by sensors and saved in the cloud via NODEMCU. Additionally, this device also aids with the healthcare monitoring system, with all patients being observed by a person in the main server. Our proposed system, which aids in the measurement of an individual's temperature and pulse rate. This method has also been developed for animals in order to preserve their lives.

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