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DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

KALANKI, KATHMANDU

A Minor Project Final Defense Report On

"IoT BASED HEALTH MONITORING SYSTEM"

[EX 654]

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A Minor Project Final report submitted to the Department of Electronics and Computer Engineering in the partial fulfillment of the requirements for degree of Bachelor of Engineering in Bachelor in Electronics, Communication and Information.

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ADVANCED COLLEGE OF ENGINEERING AND

MANAGEMENT

DEPARTMENT OF COMPUTER AND ELECTRONICS ENGINEERING

APPROVAL LETTER

The undersigned certify that they have read and recommended to the Institute of Engineering for acceptance, a project report entitled "IoT BASED HEALTH MONITORING SYSTEM"

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In partial fulfillment for the degree of Bachelor in Electronics, Communication and Information Engineering.

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Academic Project coordinator

Department of Computer and Electronics Engineering

Date: 2080-11-23

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ABSTRACT

The fundamental element of people’s needs is health. Humans face a haul of surprising death and plenty of diseases because of varied diseases that are a result of lack of treatment to the patients at the right time. The main objective of this project is to develop a reliable, sensible patient health monitoring system using IoT so that healthcare professionals can monitor their patients. The sensors are either worn or embedded into the body of the patients, continuously monitoring their health. The data collected in such a fashion is stored, analyzed, and well-mined to do the early prediction of diseases. A mobile device-based health monitoring system is being developed, providing real-time online data regarding physiological conditions of a patient primarily consisting of sensors, the data acquisition unit, Arduino, and programmed with code. The patient’s temperature, heartbeat rate, blood pressure, and ECG data are monitored, displayed, and stored by the system and sent to the doctor's and patient's mobile containing the application. The Smart Health Monitoring System monitors health status and saves it on the webpage. The system involves sensors such as temperature, heartbeat, and ECG, which are connected to an Arduino. Using the ESP8266 Wi-Fi module, the device sends this health data to the ThingSpeak Internet of Things platform. If there is a sudden change in the person's health, the system sends an SMS alert to both a family member and the attending doctor. This way, immediate action or necessary medical attention can be provided in case of an emergency or significant health change.

Keywords: *Arduino Uno, Sensors, GSM Module, Wi-Fi Module, I2C Module.*

Table of Contents

List of Figures

List of Abbreviations/Acronyms

ACEM - Advanced College of Engineering and Management

ECG - Electrocardiogram

GSM - Global System for Mobile Communication

IoT - Internet of Things

LCD - Liquid Crystal Display

SMS - Short Message Service

TU - Tribhuvan University

Wi-Fi - Wireless Fidelity

I2C - Inter-Integrated Circuit

List of Units and Conversions

BPM	Beats Per Minute
°C	degree Celsius
°F	degree Fahrenheit
PPM	Parts Per Million

CHAPTER 1
INTRODUCTION

The modern landscape is witnessing a surge in chronic diseases, driven by various risk factors such as unhealthy lifestyles and viral threats. The recent global impact of the coronavirus pandemic accentuates the critical role of healthcare. This introduction sets the stage for understanding the necessity of advanced health monitoring systems to address emerging challenges.

1.1 Background

In this context, a growing number of individuals are contending with chronic diseases, necessitating a closer examination of the factors contributing to this trend. Unhealthy dietary habits, sedentary lifestyles, and the impact of viral infections have become pervasive concerns. This background provides a contextual foundation for exploring the need for improved healthcare solutions.

1.2 Motivation

The motivation behind this research stems from the recognition of the inadequacies in existing health monitoring systems. The substantial impact of chronic diseases and recent global health crises, such as the coronavirus outbreak, underscores the urgency to enhance healthcare methodologies. The motivation is further fueled by the understanding that a more sophisticated approach, particularly one integrating Internet of Things (IoT) technologies, can significantly contribute to proactive and remote healthcare management.

1.3 Statement of the Problem

Despite the evident health risks and the pressing need for advanced monitoring systems, there exists a notable gap in comprehensive health monitoring infrastructure. Patients are exposed to serious health issues due to the limitations of current systems, particularly in areas affected by infectious outbreaks. The statement of the problem aims to articulate the challenges and deficiencies that this project seeks to address.

1.4 Project objective

To design and implement a smart patient health tracking system that can measure heartbeat, body temperature and heart rate tracking leveraging IoT technologies.

1.5 Significance of the study

The significance of this study lies in its potential to reshape the current healthcare landscape. The proposed IoT-based health monitoring system aims to fill existing gaps in patient care, offering a more accessible and cost-effective solution. By empowering healthcare professionals to remotely monitor patients' health conditions, the project aims to significantly improve the healthcare system, potentially saving numerous lives from avoidable health complications. The study's significance extends beyond individual health outcomes, contributing to the broader evolution of healthcare practices from traditional consulting methods to the more progressive realm of telemedicine.

CHAPTER 2

LITERATURE REVIEW

In the evolving landscape of healthcare technologies, Internet of Things (IoT) applications have emerged as a transformative force, offering innovative solutions to enhance patient care and monitoring. This literature review delves into a series of notable studies, each contributing to the broader understanding and development of IoT-based health monitoring systems.

In 2018, Krishnan, Gupta, and Choudhury proposed a notable IoT-based patient health monitoring system [1]. Their system, centered around Arduino-Uno, seamlessly integrates temperature and heartbeat sensors to facilitate wireless data transmission to an IoT platform. This architecture enables real-time monitoring of a patient's health parameters. A distinctive feature of their system is the capability to trigger alerts promptly in response to sudden changes in heart rate or body temperature, ensuring timely notifications to caregivers and healthcare providers.

Building upon this foundation, Valsalan, BarhamBaomar, and Baabood presented a comprehensive health monitoring system in 2020 [2]. Their system extends the monitoring scope by incorporating sensors for body temperature, pulse rate, and room humidity and temperature. The gathered data is transmitted wirelessly to a centralized server, establishing accessibility via a mobile smartphone with an integrated IoT platform. This innovative approach empowers medical professionals to remotely diagnose potential infections and comprehensively assess the overall health status of patients.

In 2016, Gómez, Oviedo, and Zhuma delved into patient monitoring within the IoT framework [3]. Their focus was on chronic diseases, presenting a case study involving diabetes and heart arrhythmia. The emphasis was on continuous health tracking and personalized guidance for patients, aligning with the broader IoT paradigm for healthcare monitoring and disease management.

A wireless health monitoring tool was introduced by Digarse and Pati in 2017 [4]. Leveraging Arduino UNO and GSM technology, their system measures heart rate, body temperature, and saline liquid levels. Real-time SMS alerts are dispatched to medical professionals, and the integration of GSM ensures prompt communication and alerts in cases of critical sensor readings.

Jayapradha and Vincent, in 2017, explored the applications of IoT in healthcare, underscoring challenges, particularly in ensuring security [5]. Their study employed a range of sensors, including ECG, BP, MEMS, and Eyeblink sensors, to comprehensively collect health data. The findings highlighted the paramount importance of addressing security concerns in the implementation of IoT in healthcare settings.

In summary, these IoT-based health monitoring systems exhibit diverse capabilities, from real-time monitoring and alerting to comprehensive data collection, showcasing the continuous evolution of IoT applications in healthcare. The studies emphasize the potential for remote diagnostics, personalized care, and the necessity of robust security measures in the implementation of these technologies.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 HARDWARE REQUIREMENTS

a. Arduino Uno

The Arduino Uno is a popular open-source microcontroller board that is a great introduction to electronics and coding. It is based on the ATmega328P microcontroller and has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. The Arduino Uno can be powered via a USB connection or with an AC-to-DC adapter or battery. It is relatively inexpensive and easy to use, making it a favorite for beginners and hobbyists alike.

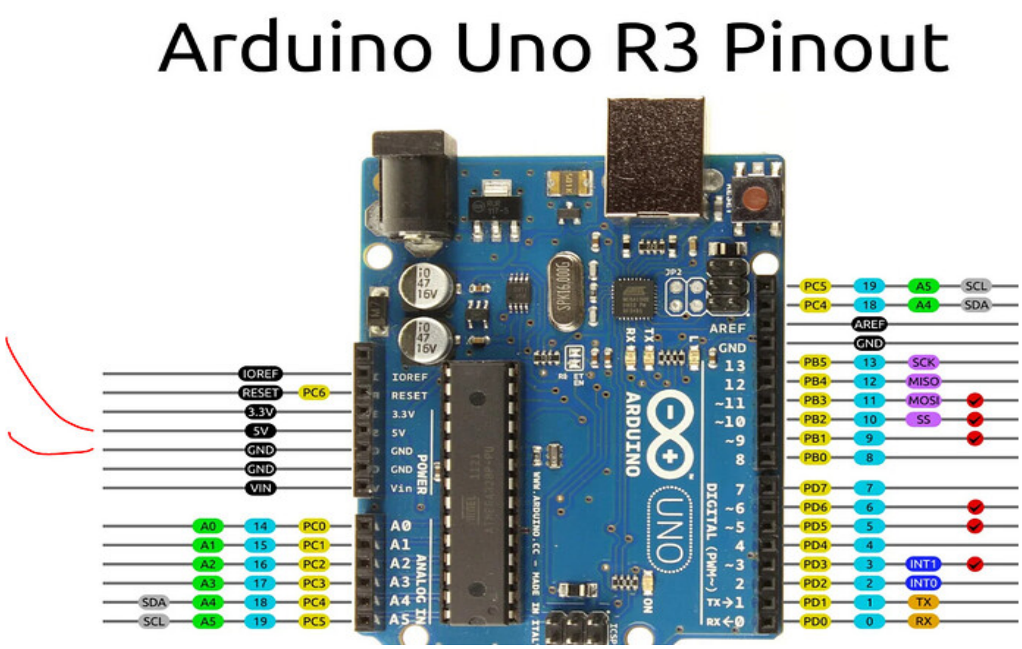


Figure 3.1: Arduino UNO

Source: https://forum.arduino.cc

b. **DS18B20 Temperature Sensor**

The DS18B20 is a 1-wire programmable Temperature sensor from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from *-55°C to +125°* with a decent accuracy of ±*5°C*. Each sensor has a unique address and requires only one pin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of your digital pins on the microcontroller.

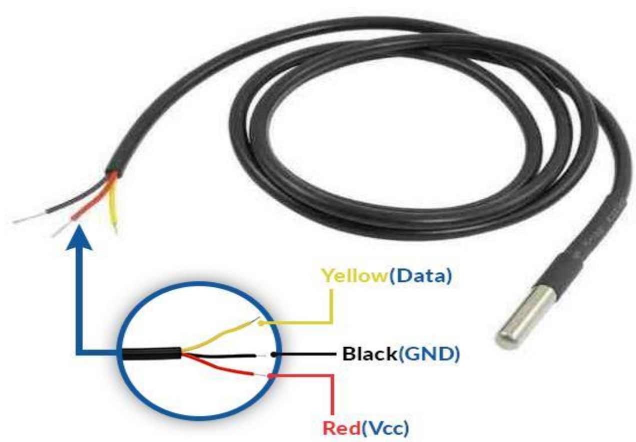


Figure 3.2: DS18B20 Sensor

Source: https://robocraze.com

c. **ESP8266 Wi-Fi Module**

The ESP8266 Wi-Fi Module is a self-contained SOC with in an integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Nodemcu has an inbuilt microprocessor and we can also use Arduino IDE to program nodemcu. It has 4 Mbytes storage Capacity. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers The ESP8266 module is an extremely cost-effective board with a huge, ever -growing, community.

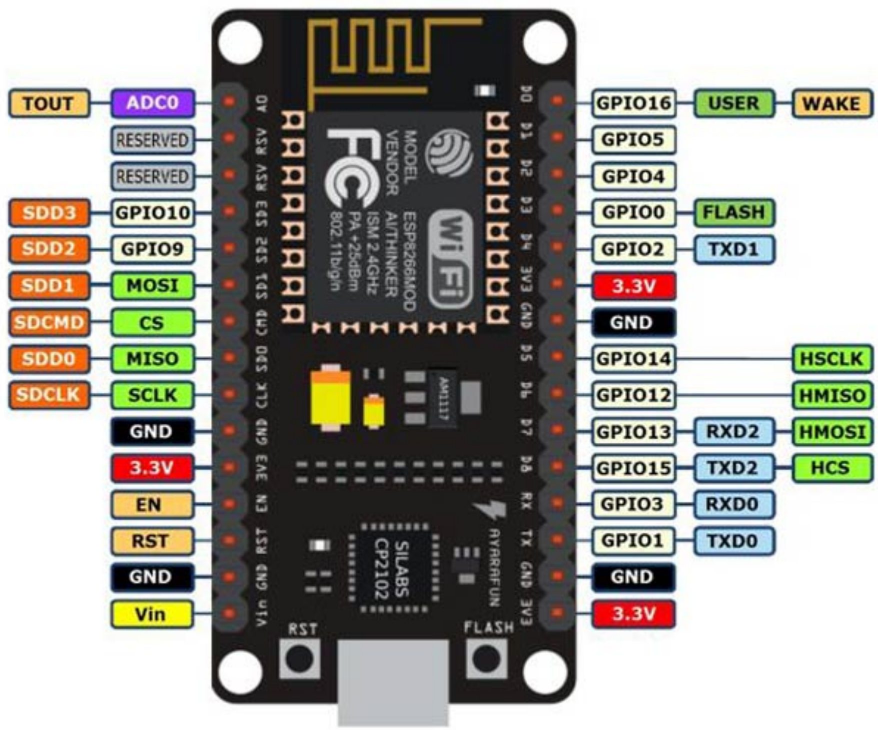


Figure 3.3: ESP8266 Wi-Fi Module

Source: https://components101.com

d. SIM800L GSM module

The SIM800L is a powerful and cost-effective GSM module that is widely used in a variety of applications. This quad-band GSM/GPRS module is designed to work on the four global GSM frequency bands (850/900/1800/1900MHz), making it compatible with most cellular networks around the world. The SIM800L module is a reliable and efficient solution for adding cellular connectivity to devices such as IoT devices, alarms, remote controls, and more. The SIM800L GSM module is a must-have for any project or device that requires wireless communication capabilities.

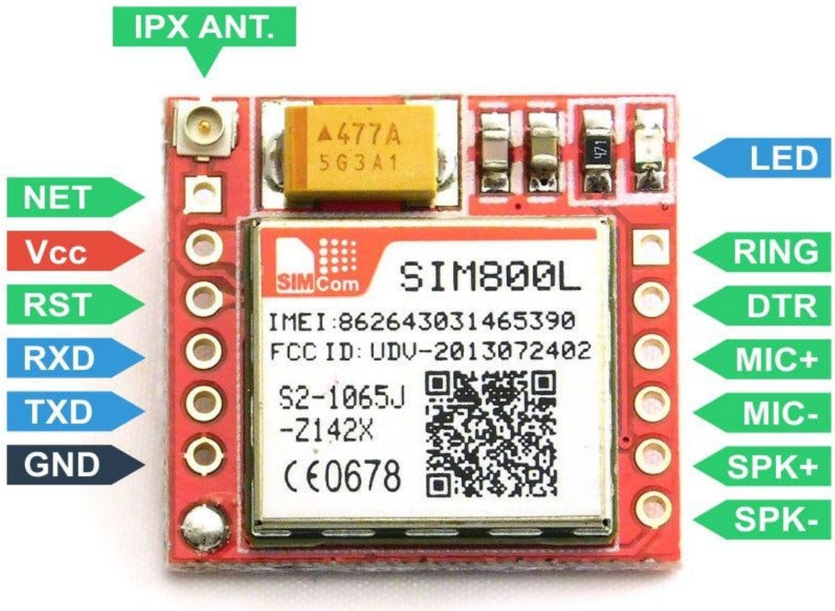


Figure 3.4: Sim800L GSM Module

Source: https://www.hackster.io

e. Jumper wires

A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

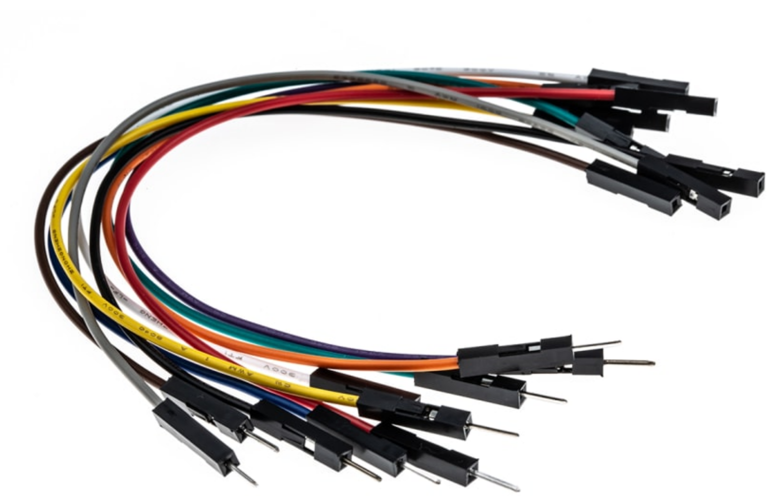


Figure 3.5: Jumper Wires

Source: https://robocraze.com

f. AD8232 ECG Module

The AD8232 ECG Module is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. Additionally, this board includes pins like the right arm (RA), left arm (LA) & right leg (RL) pins to connect custom sensors. An LED indicator in this board is used to indicate the heartbeat rhythm of humans.

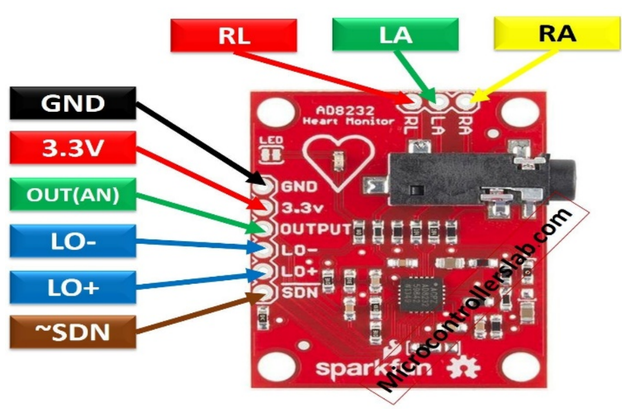


Figure 3.6: AD8232 ECG Module

Source: https://microcontrollerslab.com

g. **MAX30100 Pulse Oximeter sensor**

MAX30100 is a multipurpose sensor used for multiple applications. It is a heart rate monitoring sensor along with a pulse oximeter. The sensor comprises two Light Emitting Diodes, a photodetector, and a series of low noise signal processing devices to detect heart rate and to perform pulse oximetry. The sensor consists of a pair of Light-emitting diode which emits monochromatic red light at a wavelength of 660nm and infrared light at a wavelength of 940 nm.

Figure 3.7: MAX30100 Pulse Oximeter sensor

Source: https://components101.com

h. **LCD display (16x2)**

A Liquid Crystal Display commonly abbreviated as LCD is basically a display unit built using Liquid Crystal technology. When we build real life/real world electronics - based projects, we need a medium/device to display output values and messages. The most basic form of electronic display available is 7 Segment displays – which has its own limitations. The next best available option is Liquid Crystal Displays which comes in different size specifications. Out of all available LCD modules in market, the most commonly used one is 16×2 LCD Module which can display 32 ASCII characters in 2 lines.

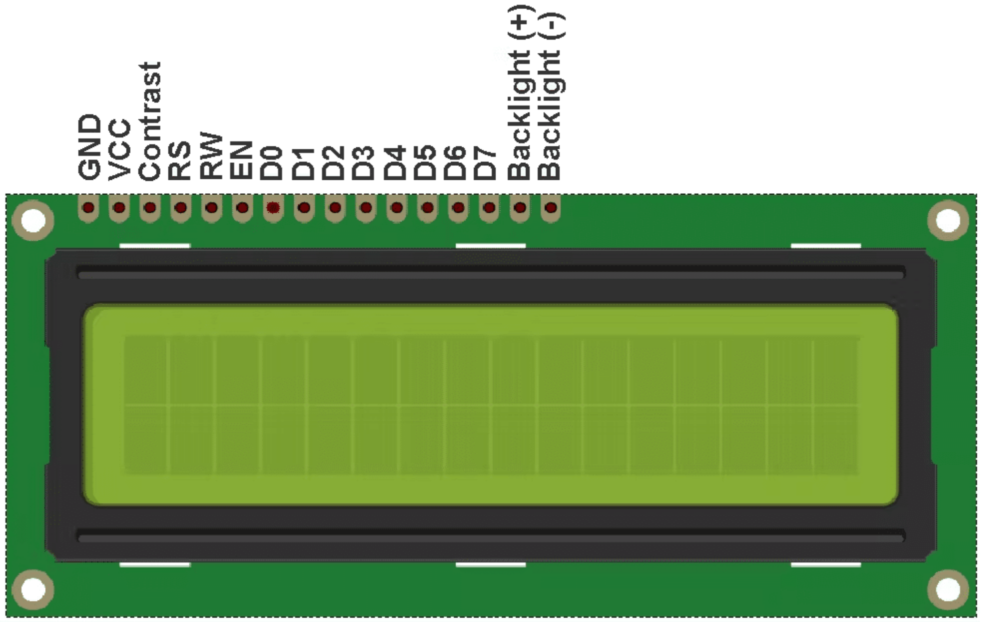


Figure 3.8: LCD display

Source: https://components101.com

i. MQ-135 Air Quality Sensor

The MQ-135 Gas sensors are used in air quality control equipment's and are suitable for detecting or measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2. The MQ-135 sensor module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. If you need to measure the gases in PPM, the analog pin need to be used. The analog pin is TTL driven and works on 5V and so can be used with most common microcontrollers.

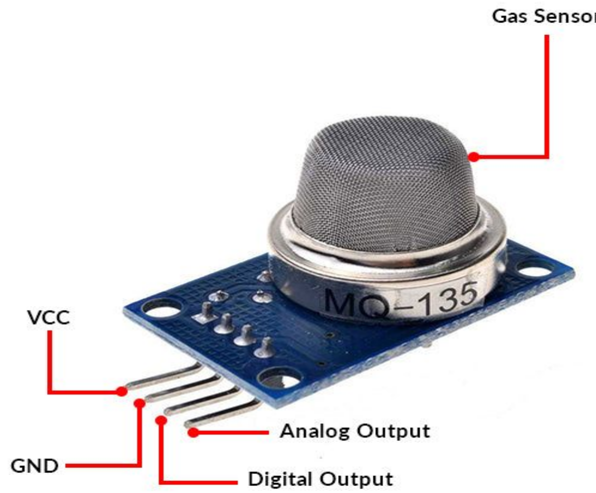


Figure 3.9: MQ-135 Sensor

Source: https://robocraze.com

j. I2C Module

I2C Module has an inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. The module has a contrast adjustment pot on the underside of the display. This may require adjusting for the screen to display text correctly. It has total of 20 male

pins. 16 pins are faced to rear side and 4 pins faced towards front side. The 16 pins for connect to 16x2 LCD and the 2 pins out of 4 pins are SDA and SCL. SDA is the serial data pin and SCL is the clock pin. The rest 2 pins for power supply (Vcc and ground).

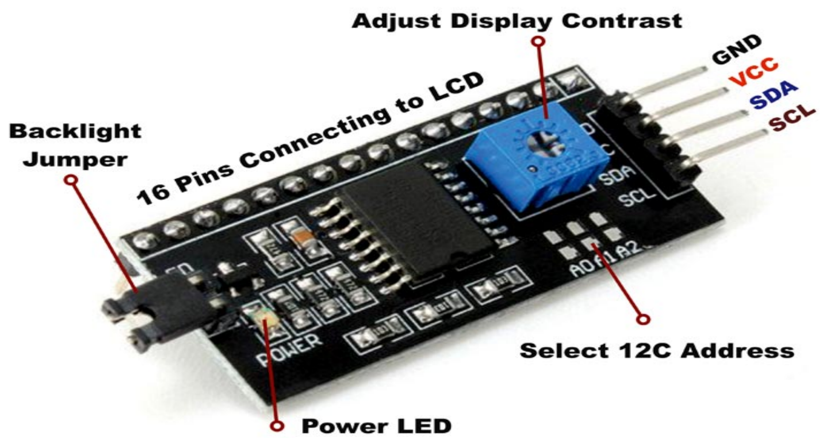


Figure 3.10: I2C Module

Source: https://components101.com

k. Bread-Board

A breadboard is used for building temporary circuits. It is useful to designers because it allows components to be removed and replaced easily. It is useful to the person who wants to build a circuit to demonstrate its action, then to reuse the components in another circuit. A breadboard consists of plastic block holding a matrix of electrical sockets of a size suitable for gripping thin connecting wire, component wires or the pins of transistors and integrated circuits (ICs).

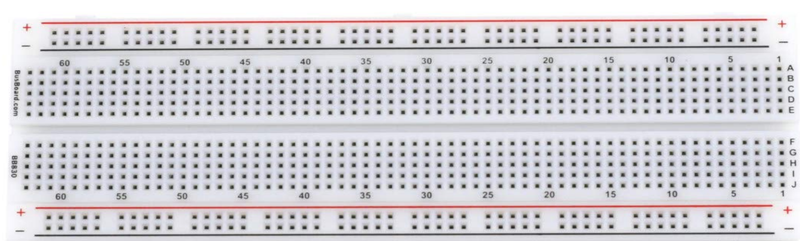


Figure 3.11: Breadboard

Source: https://components101.com

l. Matrix Board

A matrix board, also known as a prototype circuit board, is a reusable base used to temporarily build and test electronic circuits. They are typically made of a non-conductive material, such as plastic or FR4, with a regular grid of holes drilled through it. Electronic components are inserted into these holes and connected with jumper wires to create a circuit.

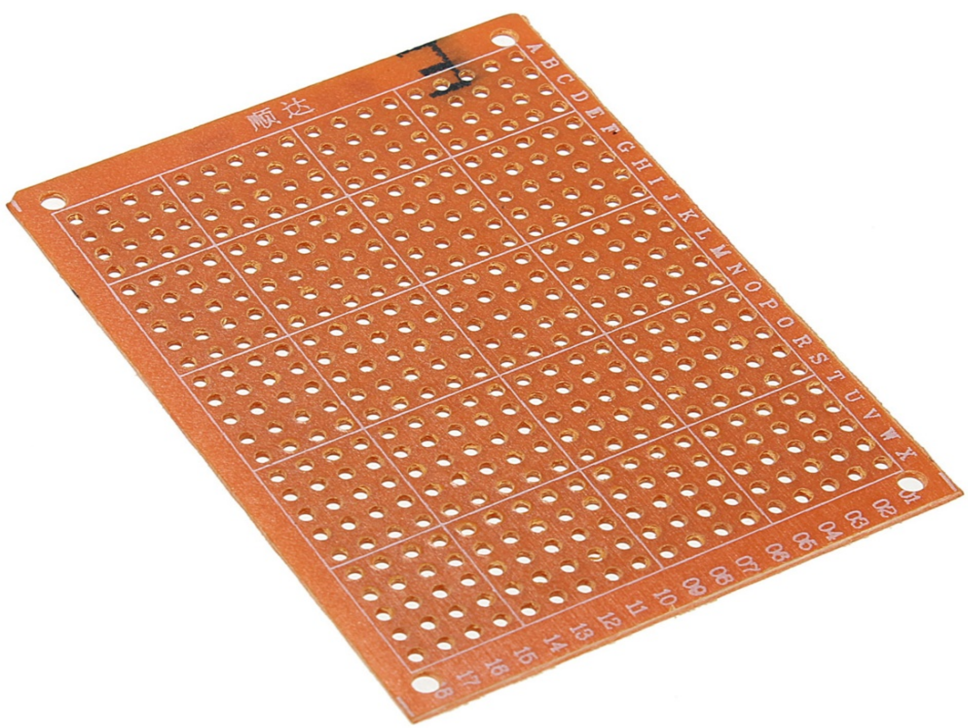


Figure 3.12: Matrix board

Source: daraz.com.np

m. Power Supply (LI-PO Battery)

A "Li-Po" battery, short for lithium polymer battery, is a type of rechargeable battery that uses a lithium-ion technology. The "5200 mAh" specification indicates the battery's capacity, specifically its charge storage capacity, measured in milliampere-hours (mAh).

Figure 3.13: Li-Po Battery

Source: https://w11stop.com/

3.2 SOFTWARE REQUIREMENTS

a. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. Userwritten code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main( ) into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program argued to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

b. ThingSpeak Cloud Server

ThingSpeak is an open-source Internet of Things (IoT) platform that allows users to collect, analyze, and visualize data from sensors or other devices in real-time. Developed by MathWorks, ThingSpeak provides APIs for devices to send data to its cloud servers and offers tools for data analysis and visualization, including charts, maps, and MATLAB integration. It is commonly used in various IoT applications such as environmental monitoring, home automation, and industrial control systems. ThingSpeak enables users to easily create IoT projects and share their data with others.

c. MIT App Inventor

MIT App Inventor is a user-friendly web platform that enables anyone to create Android mobile applications using a visual, drag-and-drop interface. It requires no prior programming experience and allows users to design app interfaces and add functionality by connecting blocks of code.

3.3 FUNCTIONAL REQUIREMENTS

Functional requirements for a health monitoring system using Arduino with ECG, pulse meter, and temperature sensor outline the specific capabilities and features the system must possess to meet its objectives. Here is a set of functional requirements for the project:

3.3.1 Data Acquisition:

The system shall read real-time data from the ECG sensor, providing accurate representations of the electrical activity of the heart.

It shall capture and interpret pulse rate information from the pulse meter sensor.
The system shall measure and record temperature data from the temperature sensor.

3.3.2 User Interface:

The system shall feature a user-friendly display presenting real-time ECG waveforms, heart rate, and temperature information.
Visual indicators shall distinguish normal and abnormal readings.
The user interface shall be clear, providing easy interpretation of health parameters.

3.3.3 Alert System:

An alert mechanism shall be implemented to notify users in case of abnormal health parameter readings.
Alerts shall be presented visually on the display and may include audible alarms or other noticeable indicators.

3.3.4 Calibration:

The system shall support calibration routines for the ECG, pulse meter, and temperature sensors to ensure accurate measurements.
Calibration procedures shall be user-friendly and accessible through the system interface.

3.3.5 Data Logging and Storage:

Optionally, the system may provide the ability to log and store historical health data.
Data storage mechanisms shall support efficient retrieval and analysis.

3.3.6 Deployment and Portability:

The system shall be deployable in various environments, and its components shall be compact and portable.
Deployment shall involve minimal setup procedures, ensuring ease of use for end-users.

3.4 NON-FUNCTIONAL REQUIREMENTS

3.4.1 Reliability:

Ensure the health monitoring system operates consistently and accurately, providing reliable data for analysis.

3.4.2 Performance:

The system should perform efficiently, handling real-time data without delays to support prompt health assessments.

3.4.3 Scalability:

Design the system to accommodate potential growth in users and data volume without compromising performance.

3.4.4 Usability:

Create an intuitive and user-friendly interface, considering diverse users, including healthcare professionals and patients.

3.4.5 Maintainability:

Design the system for easy maintenance, allowing updates, patches, and enhancements to be implemented efficiently.

3.4.6 Availability:

Ensure the system is consistently available, minimizing downtime and interruptions to health monitoring services.

3.5 FEASIBILITY STUDY

A feasibility study for the health monitoring system using Arduino with ECG, pulse meter, and temperature sensor involves a comprehensive analysis of the project's viability from technical, economic, operational, and scheduling perspectives.

3.5.1 Technical Feasibility:

1.Sensor Integration:

The chosen ECG, pulse meter, and temperature sensors are seamlessly integrated with the Arduino platform, ensuring compatibility and accurate data acquisition.

2.Signal Processing Algorithms:

The successful implementation of signal processing algorithms enhances the accuracy of ECG data through noise filtering and baseline correction, while heart rate calculations and temperature conversions are executed with precision.

3.Power Management:

Efficient power-saving features, including sleep modes during inactivity, are implemented, demonstrating technical feasibility for optimal energy consumption, crucial for extended battery life in portable configurations.

4.Calibration Mechanisms:

The system supports user-friendly calibration routines for ECG, pulse meter, and temperature sensors, ensuring accurate and reliable measurements.

3.5.2 Economic Feasibility:

1.Cost-Effective Components:

The overall project cost, inclusive of hardware components, development tools, and potential licensing fees, is kept within reasonable bounds, aligning with economic feasibility.

3.5.3 Operational Feasibility:

1.User Acceptance:

User feedback and involvement in the feasibility study phase indicate high levels of acceptance, affirming the operational feasibility of the system.

2.Ease of Use:

The clear and user-friendly interface, with visual indicators for normal and abnormal readings, ensures ease of use and interpretation of health parameters, contributing to operational feasibility.

3.5.4 Scheduling Feasibility:

1.Realistic Project Timeline:

The project timeline is well-structured, accounting for development, testing, and deployment phases, ensuring that milestones are achievable within the proposed time frame.

2.Resource Availability:

Necessary resources, including skilled personnel and hardware components, are readily available, ensuring the adherence to the proposed schedule.

CHAPTER 4

SYSTEM DESIGN AND ARCHITECTURE

4.1 Block Diagram

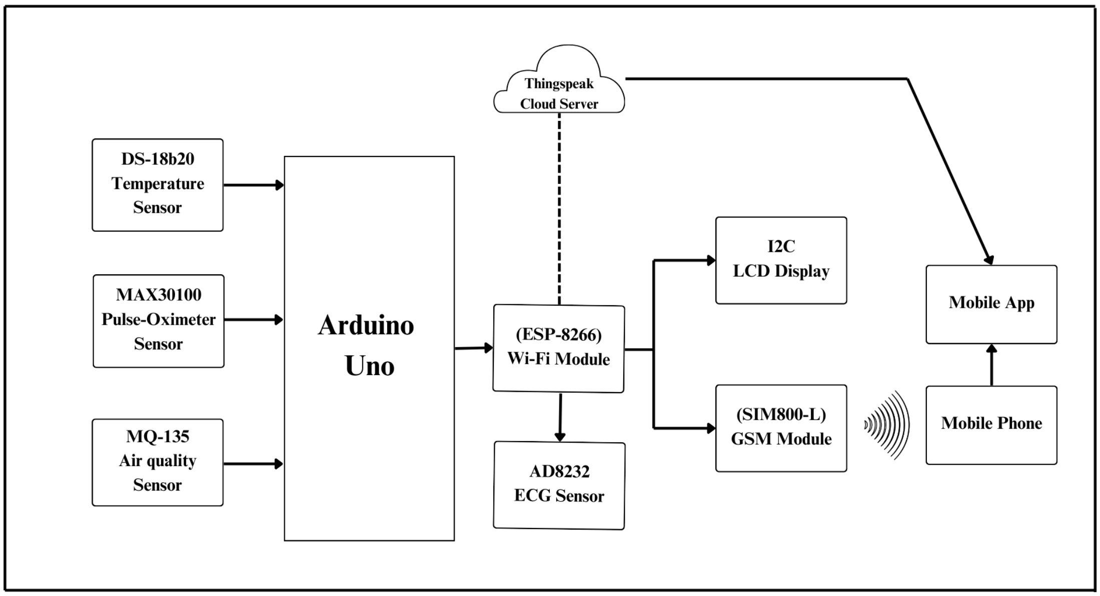


Figure 4.1: Block Diagram

The above block diagram shows sensors for measuring vital health parameters like heart rate, blood oxygen levels, air quality, and body temperature. These sensors interface with Arduino and Nodemcu which processes the data. The processed information is displayed on an LCD screen for immediate user feedback. Additionally, the Nodemcu connects to the internet, transmitting the data to a cloud platform for storage and analysis. Users can access their Real-time health data remotely via a mobile application, facilitating easy monitoring. Furthermore, a GSM module enables the system to send real-time alerts and updates to user's mobile phones via SMS, ensuring timely notifications even without internet access. This comprehensive solution offers users convenient and accessible health monitoring, empowering them to take proactive steps towards managing their well-being effectively.

CHAPTER 5

METHODOLOGY

This system includes a monitoring gadget that takes readings from the patient's various health markers. A *Pulse Oximeter Sensor, temperature sensor, ECG Sensor and Air Quality Sensor* are included in this system. This system also includes a blueprint for fabricating a patient's health monitoring system that uses sensors to measure health indicators. They gather the patient's data in the first stage that is further relayed to the microprocessor, which is linked to all of the detectors.

Here is our IOT-Based Health Monitoring Module's Connection Diagram:

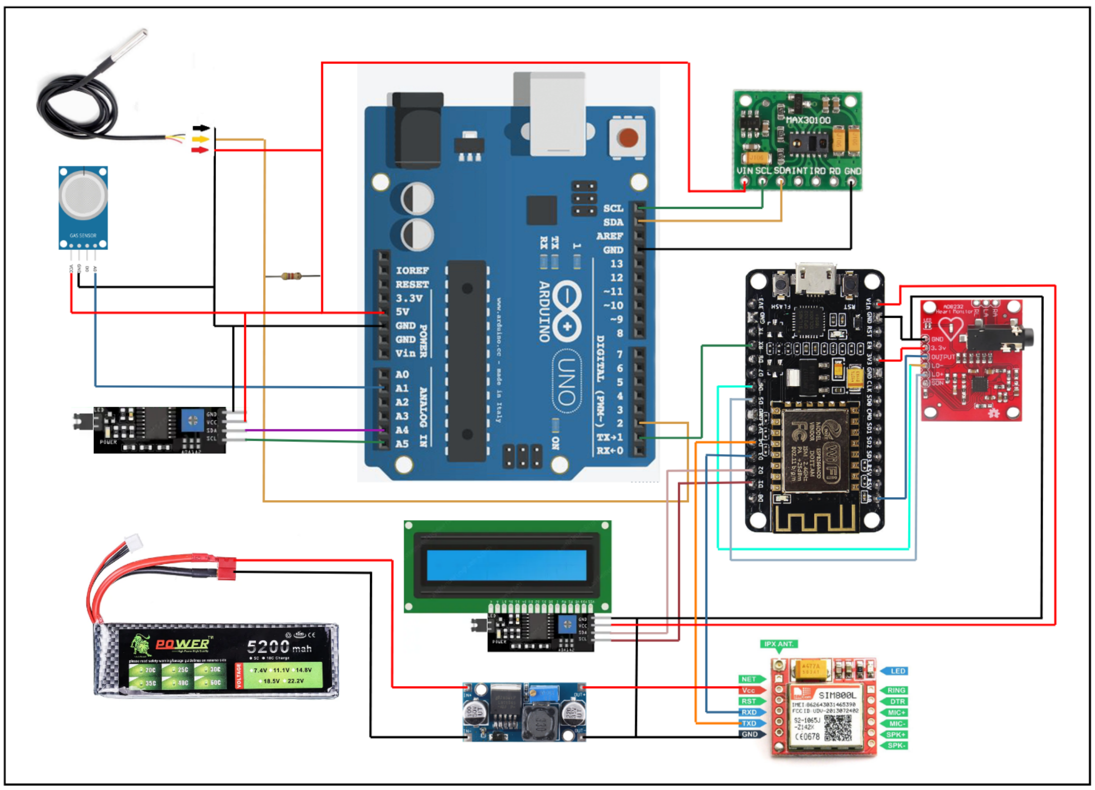


Figure 5.1: Connection Diagram

5.1 Algorithm of Our System: IoT-Based Health Monitoring System

Step 1: Initialize the System

1.1. Set up Arduino board with sensors (BPM sensor, Oxygen sensor, temperature sensor, air quality sensor).

1.2. Configure NodeMCU with Wi-Fi module to establish internet connectivity.

1.3. Initialize GSM module for sending alert messages.

1.4. Set up Thingspeak account for cloud data storage.

Step 2: Establish Connection between Arduino and NodeMCU

2.1. Connect Arduino and NodeMCU using serial communication.

2.2. Define Serial communication protocol for data exchange

Step 3: Read Sensor Data

3.1. Read BPM data from BPM sensor.

3.2. Read oxygen level data from oxygen sensor.

3.3. Read air quality data from air quality sensor.

3.4. Read body temperature data from temperature sensor.

Step 4: Send Data to NodeMCU

4.1. Package sensor data into a Serial format

4.2. Send the Serial formatted data from Arduino to NodeMCU using serial communication.

Step 5: NodeMCU Sends Data to Thingspeak Cloud

5.1. Establish Wi-Fi connection with the local network.

5.2. Connect to the Thingspeak server using API key and channel ID.

5.3. Send sensor data to the designated fields on the Thingspeak channel for storage and visualization.

Step 6: Check Alert Conditions

6.1. If BPM > 160 or Oxygen Level < 50% or Air Quality > 200 ppm or Body Temperature > 42°C:

6.1.1 Trigger alert message using GSM module.

6.1.2 Include relevant sensor data in the alert message.

6.1.3 Send the alert message to predefined recipient(s).

Step 7: User Input Feeding

7.1 Check for user input on the module.

7.2 If user input is detected:

7.2.1 Prompt user to input their vitals (BPM, oxygen level, temperature).

7.2.2 Send the Sensor data to NodeMCU.

7.2.3 Repeat steps 5 and 6 for user-inputted data.

Step 8: Update Thingspeak Cloud with User-Inputted Data

8.1 Send Sensor data to the designated fields on the Thingspeak channel.

8.2 Ensure synchronization with existing sensor data on the channel.

Step 9: Repeat Monitoring Cycle

9.1 Continue monitoring sensor data and user input.

9.2 Repeat steps 3 to 8 in a loop for continuous operation.

Step 10: End Algorithm

5.2 Flowchart:

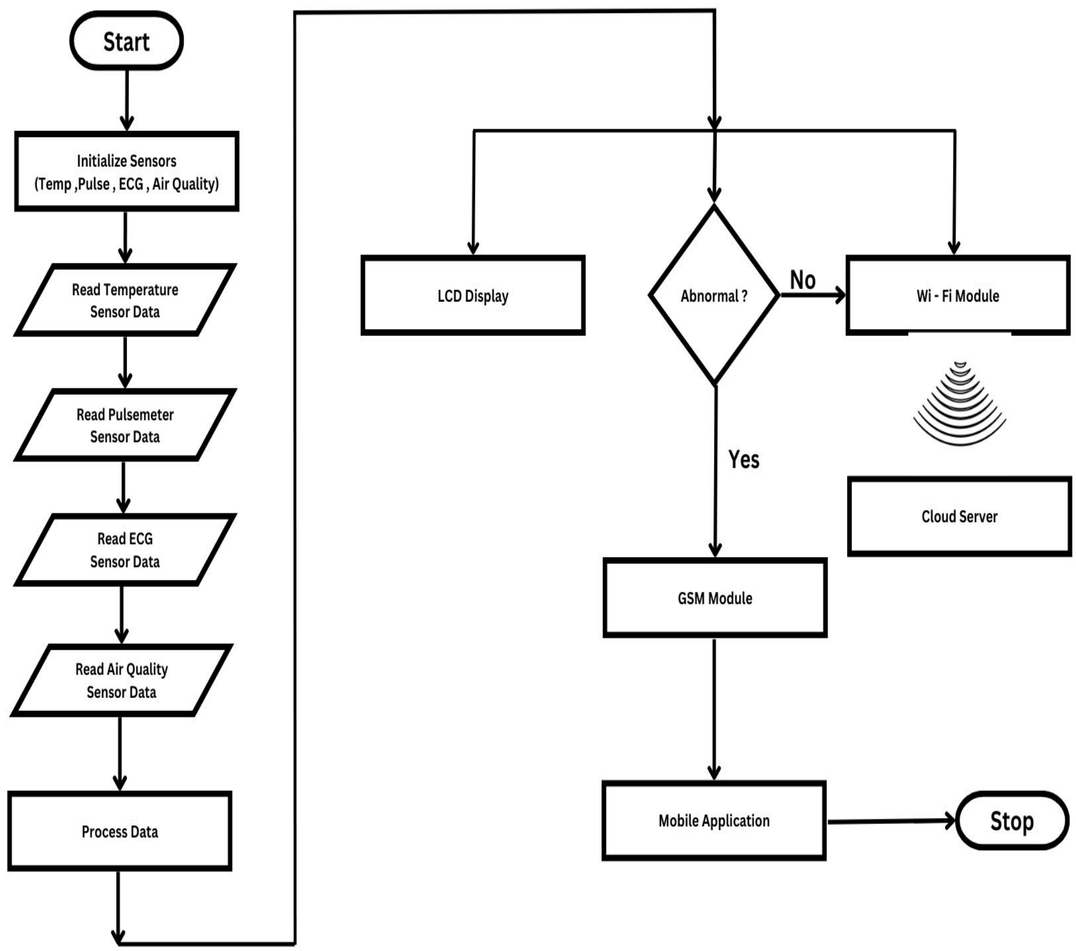


Figure 5.2: Flowchart

CHAPTER 6
RESULT AND ANALYSIS

The IoT-based health monitoring system successfully measures the following vital parameters:

i) BPM (Beats Per Minute): The system accurately measures the heart rate of the user in real-time.
ii) Oxygen Level: The system monitors the oxygen saturation level in the blood, providing crucial information about respiratory health.
iii) Air Quality: It measures the level of pollutants in the surrounding air, ensuring a safe environment for the user.
iv) Body Temperature: The system continuously tracks the body temperature, helping to detect fever.

Analysis of Alert Conditions:

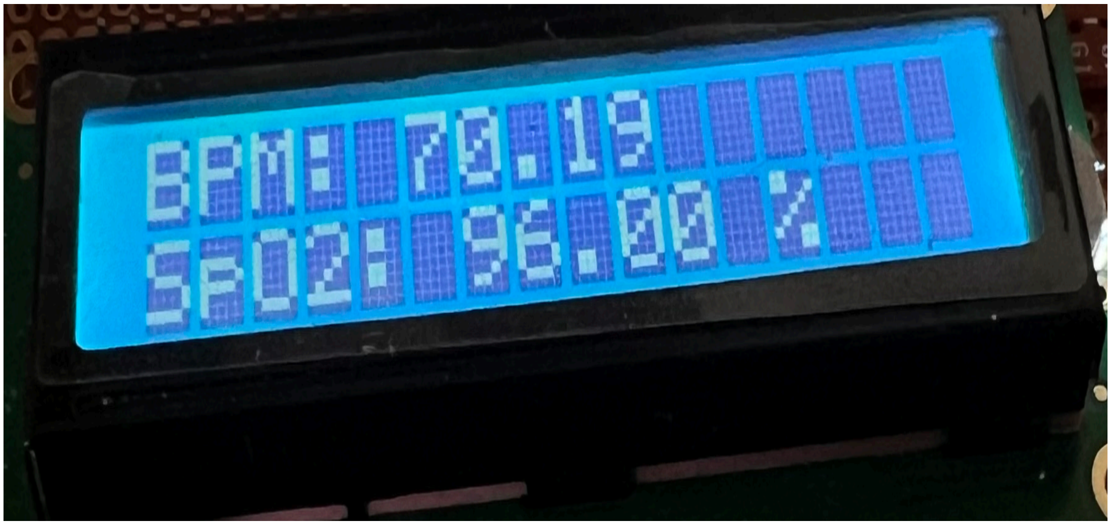
The system is programmed to trigger an alert message via the GSM module under the following conditions:

i) BPM > 160: A high heart rate could indicate cardiac stress or other health issues, warranting immediate attention.
ii) Oxygen Level < 50%: Low oxygen saturation indicates hypoxemia, which can lead to severe health complications.
iii) Air Quality > 200 ppm: High levels of pollutants pose respiratory risks, especially for individuals with pre-existing conditions.
iv) Body Temperature > 42°C: Abnormal body temperature can signify underlying health issues such as fever.

The alert mechanism ensures timely intervention and medical assistance in case of any potential health risks detected by the system.

Output in LCD :

Sequence 1:



Sequence 2:

Figure 6.1 : Data in LCD

Output in App:

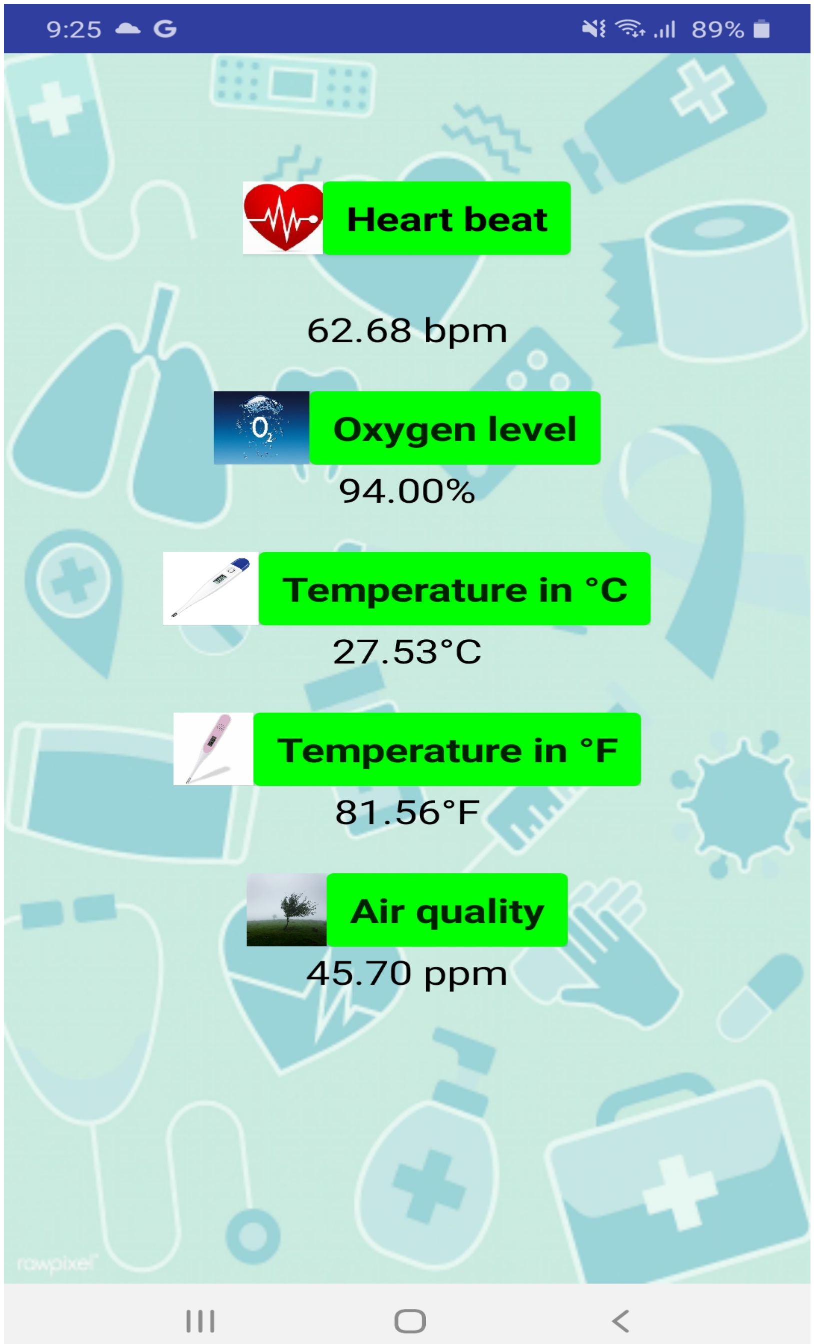


Figure 6.2: Output in App

Data and graphs from thingspeak:

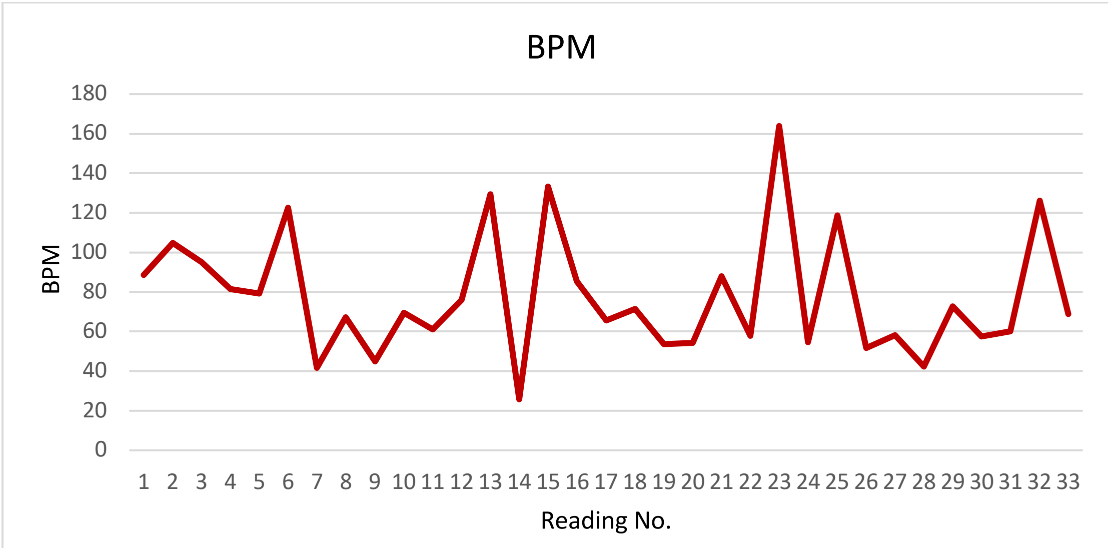


Figure 6.3 : BPM Data in Graph

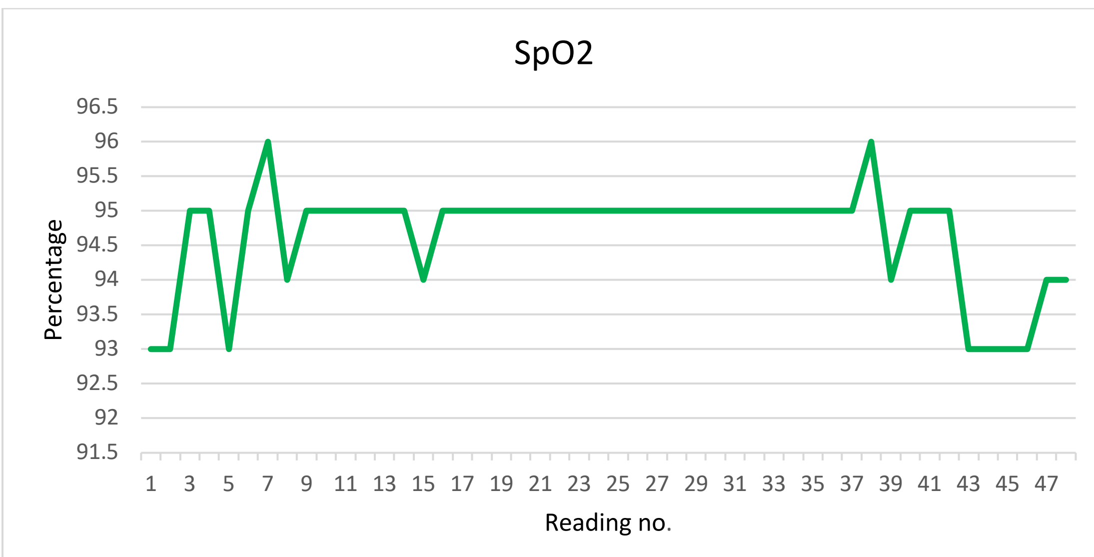


Figure 6.4 : Spo2 Data in Graph

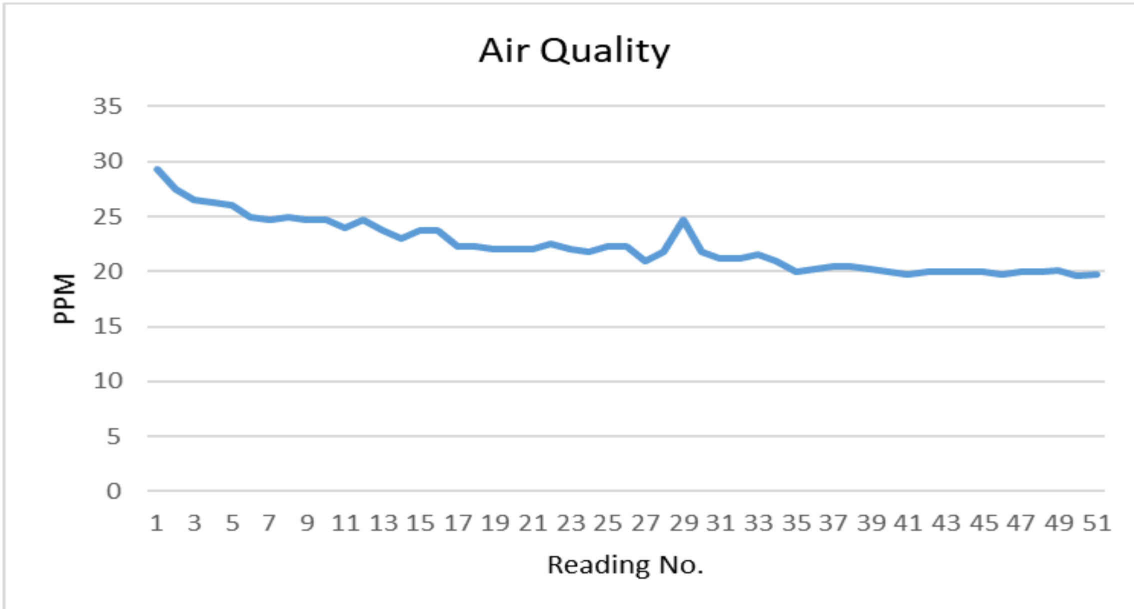


Figure 6.5 : Air Quality Data in Graph

Figure 6.6 : Ecg Graph

Alert Message from GSM

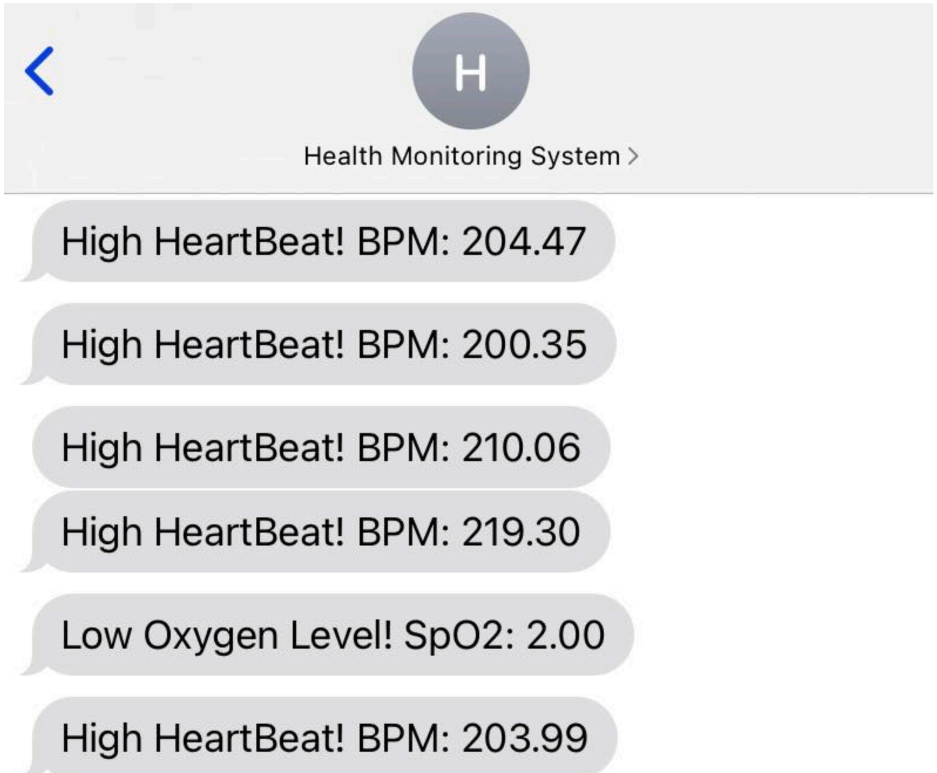


Figure 6.7 : Alert Message from GSM

Intentionally given data to check our GSM module reliability.

CHAPTER 7
CONCLUSION, LIMITATIONS AND FUTURE ENHANCEMENT

7.1 CONCLUSION

The "IoT-based health monitoring system" offers a transformative solution to the challenges faced in healthcare today. By integrating smart devices, sensors, and IOT, this system facilitates remote monitoring, real-time data collection and analysis, ultimately leading to improved patient outcomes and more efficient healthcare delivery. This project had two main parts: software and hardware development. We did a lot of research for the software part. We faced many problems, and errors kept popping up when we ran the program. But we managed to fix all the issues by finding and solving the errors. For hardware development, there were also challenges. Sometimes, the sensors didn't work properly because the wires weren't connected well. Also, performing calibration of sensors was difficult.

Despite these challenges, we built a health monitoring system that can show real-time health data using the Internet of Things. Also, the system can display current health conditions on a mobile app. It's a low-power system that can monitor body temperature, heartbeat, air quality and oxygen level. We tested it and made sure it updates data from sensors accurately. This system offers a low-cost and efficient solution for health monitoring, empowering individuals to take control of their well-being. Overall, the IoT-based health monitoring system represents a smart and effective approach to personalized healthcare management.

7.2 LIMITATION

- Need power to charge battery.
- Sensors used in system need to be changed routinely.
- Data security and privacy concerns.
- Calibration issues, inaccuracy of sensors.

7.3 FUTURE ENCHANCEMENT

Future enhancements for “IoT-based health monitoring systems” include integrating advanced and reliable sensors capable of monitoring additional health parameters and incorporating artificial intelligence and machine learning algorithms for more effective data analysis and personalized treatment recommendations. Devices could be improved with enhanced functionality, longer battery life, and more comfortable designs. Efficient security measures and privacy protocols would ensure the protection of sensitive information

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