HEALTH DIARY : AN IOT DEVICE FOR EXTREMELY SICK OR HALF PARALYZED PATIENTS

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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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APPROVAL

This Project/internship titled **"HEALTH DIARY : AN IOT DEVICE FOR EXTREMELY SICK OR HALF PARALYZED PATIENTS"**, submitted by **M. Al Fardin Ibne Shams**, ID No: **161-15-6838** 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 December 7,2019.
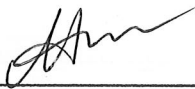
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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Ms Samia Nawshin, Lecturer, Department of CSE Daffodil International University**. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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

ABSTRACT

I have built an IOT device, which is for extremely sick or half paralyzed patients who can barely move their full body or strong enough to call someone through mobile phone. This device is a combination of two modules, a transmitter & a receiver module. Both modules are connected over Wi-Fi network. Now a days, there are smart bands/watches which can get live heart rate. But it can show the data on smartphone, only when it's connected with smartphone over Bluetooth, a short range network. But in my project, transmitter module will be attached with patient's body & it will get patient's live heart rate & upload it on google firebase. It will also generate messages with certain movement of patient's hand gesture, which will also be updated on live database. Patient's heart rate & messages can be watched from anywhere of the world, so that in case of emergency instant action can be taken. Also the receiver module will show the same data from the live database, once it's connected with Wi-Fi. So, the maid/nurse who takes care of the patient is somehow out of the patient's room for some reasons, will get the message instantly generated from patient's transmitter module. So, if patient want's something, instant action can be taken. I believe that, This IOT device is very user friendly & it will be a next revolutionary device in medical sector.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

The concept of IOT was developed with the wide range of use of Internet & thee increase of Internet speed. IOT creates relation with devices with internet. In modern days, almost every devices are connected with Internet. From Household to offices, from business sectors to medical sectors, everywhere IOT is implemented.

Using the concept of IOT, I have designed and implemented a device, which will help a serious patient to connect or to knock someone in case of emergency. Also, relative of the patient can get update of the patient's health condition from anywhere of the world through Internet.

1.2 Motivation

Serious patients or half paralyzed patients needs extra care as they are always at bed. But their relatives may not be always with them. Also, maids/nurses, who are assigned for their take-care, may not be always at their room. Now, if a patient needs something, like food, medicine or they need to go to the washroom, sometimes they feel extremely unwell. In this case, if there's no one in the patient's room, it's very hard for them to call someone with loud voice or over phone. My device is designed for them.

1.3 Objective

The main objectives of this project are:

- User (patient) can generate message with hand gesture.
- Upload Patients health condition (Pulse Rate) on live database, so relatives can observe patient's health condition.
- Patient's message generated from the device will be also be uploaded on live database. So that relatives can get the real time message and take action.
- The receiver module will also be connected with internet, which will show the data's from live database.

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1.4 Expected Outcome

This device will have two modules. 1. Transmitter 2. Receiver. Both of the modules will be connected to live database through Internet. The transmitter device will be attached with patient's body. It will continuous upload patient's pulse rate which will be live on live database & also in receiver module. It will also update the message generated from the module connected with patient's body. The messages will be live on both live database & receiver module. So, despite of having a smartphone, user can get live & continuous data from live database.

1.5 Report Layout

- Introduction
- Background Analysis
- Requirement Specification
- System Design & Implementation
- Testing & Discussion
- Conclusion & Future Scope
- Appendix
- References

CHAPTER 2
BACKGROUND ANALYSIS

2.1 Introduction

IOT creates connection between devices through Internet. Here two or multiple devices are inter-connected with each other. IOT is briefly used in home appliances, offices, business offices & industries.

This research is mainly focused on medical sector. A 3 way connection between sender, receiver and database. Though it is focused on medical sectors, but in can be implemented on home appliances too.

This project is designed for IOT based connection with two modules. The transmitter module gets the pulse rate of the patient and uploads it on google firebase. Also it can generate messages with the hand gesture of patient. Whenever it generates a message, it will upload it on google firebase. All the data will be live on google firebase's live database. The receiver module is also connected with internet. Whenever it gets powered up, it will get connected with google firebase's live database. The receiver will also show the data's from live database, and all the data's will be real time data.

2.2 Related Work

IOT is a huge sector. There are tons of applications of IOT in modern days. There are devices interconnected with each other over internet. Lots of devices are under research or under development. There is a device, which recognizes hand Gesture of dumb people[1]. But a customized device for specially patients, is currently complex and relatively highly costly comparing to Bangladesh's economy. This project has a great field to develop and work. There is a huge scope for future development of IOT based two way communication in medical sector, specially made for extremely sick or half paralyzed patients.

2.3 Comparative Studies

At first I had to gather knowledge about micro-controllers. So I had to learn about the basic and advance use of arduino concepts from youtube and different blogs. Then I had to study briefly about esp8266 nodemcu which is the main element of this project. Then I had to gather knowledge about google firebase and it's live database feature. Also I had to study about the I2c LCD display's feature and DC-DC step up power boosters to complete this project.

2.4 Scope

There are many scopes in this project. Now I am working on the project which is only works with the extremely sick or half paralyzed patients. But in future, It can be developed for fully paralyzed or physically disabled patients.

2.5 Challenges

There are so many challenges in this project. This project has been developed using multiple electronic components. The challenges I have faced doing this project are:

- This whole project has been done with a single person, me. Being the only member of the project group, it was difficult to implement the project.
- Esp8266 nodemcu is a very complex programmable board. I was facing many difficulties during programming on this board.
- Setting us a google firebase project, it was very difficult to connect the board with the firebase project's live database.
- I had problems with powering up receiver device. Because all the component used different power consumptions.
- The Pulse rate module gives analog data. It was difficult to convert it into a digital data

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CHAPTER 3
REQUIRMENT SPECIFICATION
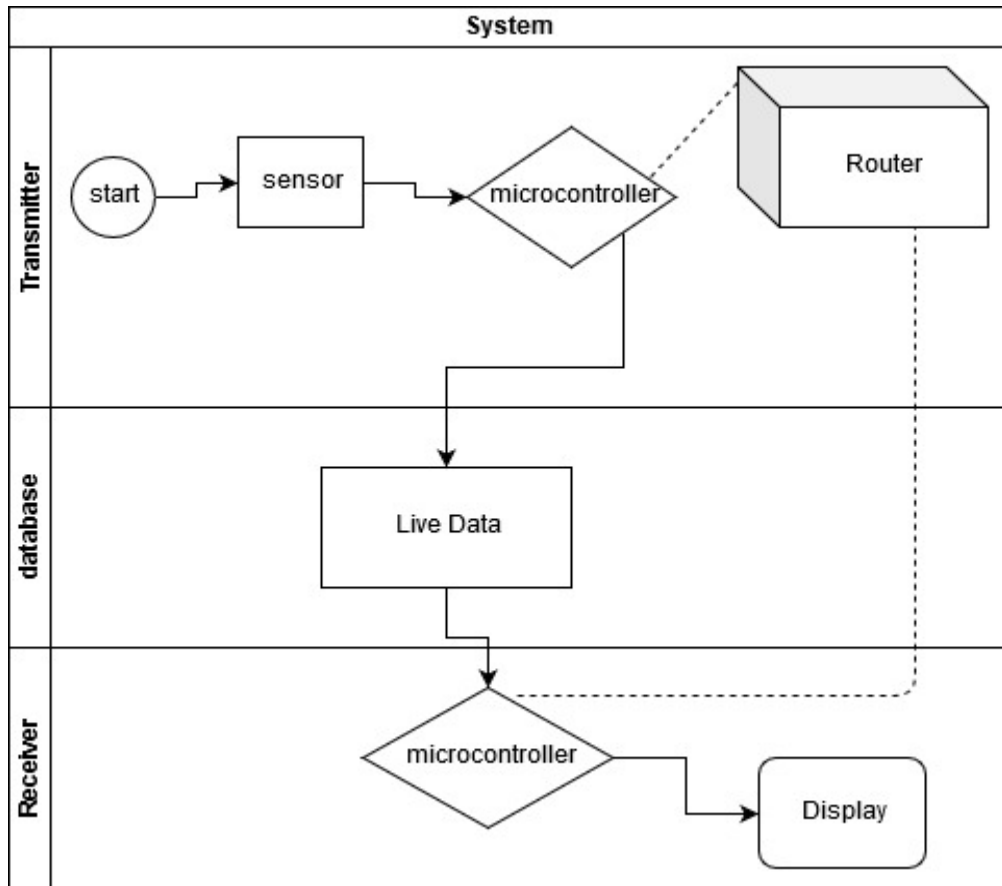
3.1 Business Process Model

Figure 3.1: Business Process Model

The transmitter will be connected with router, & will get live Pulse Rate & generate message from patient's hang gesture. Then it will continuous data google firebase's live database. The receiver module will also be connected with router. It will get data from database & show live data & messages from database (fig 3.1).

3.2 Use-case Modeling & description
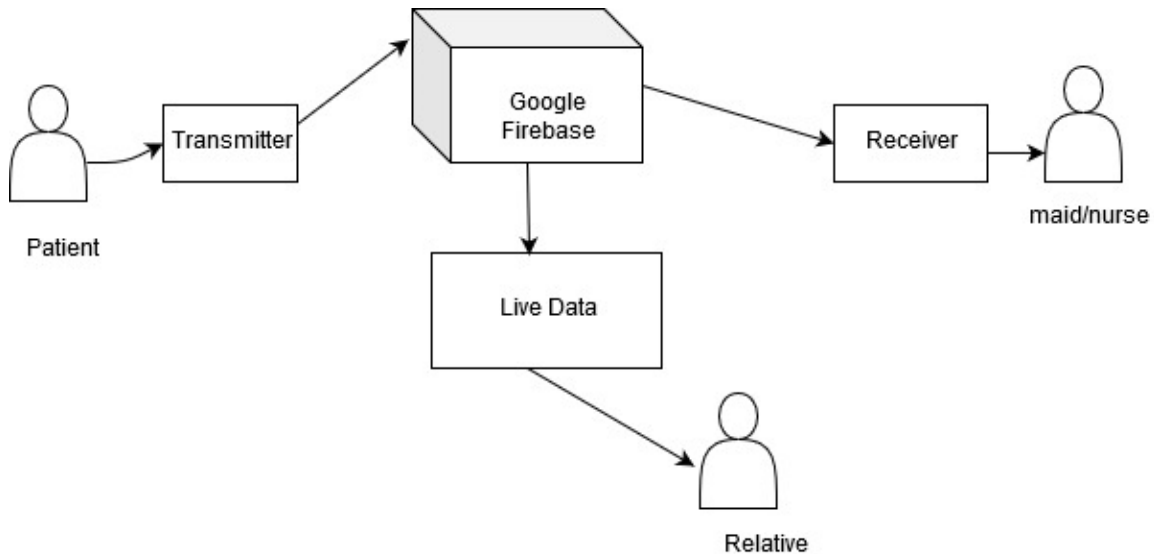
Figure 3.2 : Use-case Modeling

Here (fig 3.2) the transmitter module will be connected with patient's body. It will get the pulse rate & upload it on live database. Also it will generate messages from patient's hand gesture. All the data will be uploaded continuously on live database. It will be live on Google firebase's live database, so any of the relative can get the health condition & messages. The receiver module will continuous get the live data & show it on LCD display. So, the maid or nurse, doesn't need a smartphone to get the messages. If they are out of patient's room for some reasons, they can still monitor the patient & take instant action based on messages.

3.3 Requirement Collection & Analysis

I had to use multiple electrical components to build this project. List of requirments:

- esp8266 nodemcu
- Pulse Rate sensor
- Mpu6050 accelerometer

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- I2C LCD display

- DC power source

- DC-DC Boost converter

- Wi-Fi router

3.3.1 esp8266 nodemcu

Figure 3.3 : esp8266 nodemcu

esp8266 nodemcu is a programmable board which is mostly used for IOT based project. It is a micro-controller unit with built-in wifi module. I needed two esp8266 modules, one is used for building transmitter & another one is used for building receiver module. In the transmitter module, I have connected Pulse Rate sensor's data pin to esp8266's A0 analog pin. I have connected accelerometer's SCL & SDA pins with esp8266's D6 and D7 pins. Finally I have powered the module through powering the esp8266 nodemcu.

3.3.2 Pulse Rate Sensor

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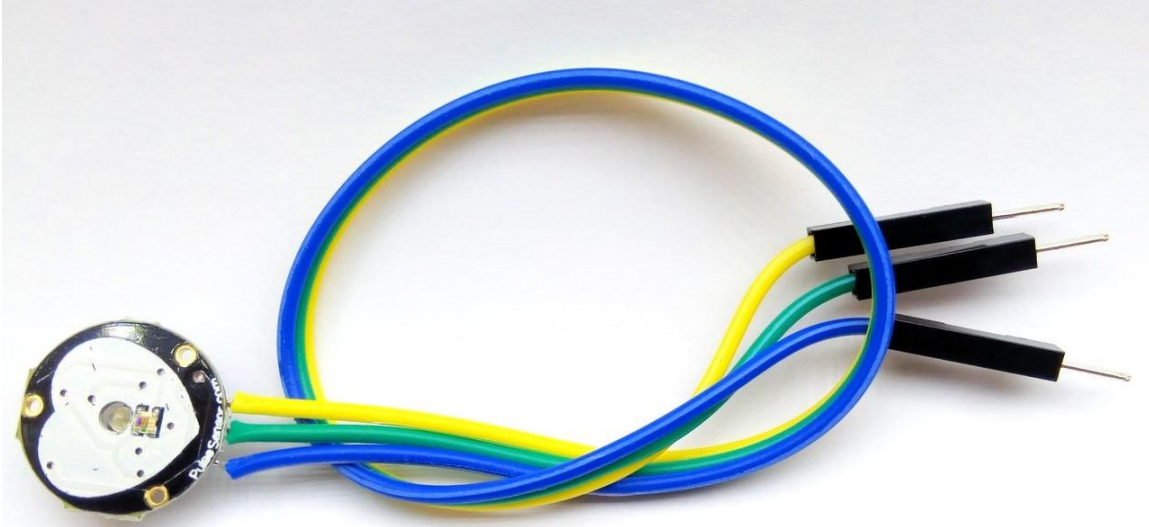
Figure 3.4: Pulse Rate Sensor

Pulse Rate Sensor is a sensor, which can be used with microcontroller units. It uses near IR technology to detect the pulse rate from human body. It has three pins. 1. Vcc+ pin. Which needs to be connected with a 3v power source. 2. GND pin. It needs to be connected with same power source's ground pin. 3. Data pin. It gives analog data based on it's use. I have connected it with esp8266 nodemcu's analog pin A0.

3.3.3 mpu6050 ACCELEROMETER
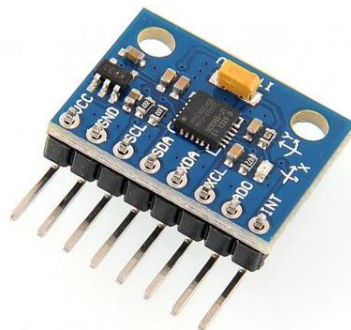
Figure 3.5: mpu6050 accelerometer

mpu6050 is a 6-axis accelerometer. In this project, I am only using 2-axis. X-axis & Y-axis. This sensor has 8 pins. In this project, I only need 4 pins. 1. Vcc+ pin. It needs to be connected with a 3v power source. 2. GND pin. It needs to be connected with same power source's ground pin. 3. SDA pin. I have connected it with, esp8266's D6 pin. 4. SCL pin. When it is connected with the microcontroller, it will give the module data's of axis's.

3.3.4 I2C LCD Display

Figure 3.6: I2C LCD Display

I2C LCD Displays are widely used in microcontroller projects. I have connected it with the receiver module's esp8266 board. It has 4 pins. 1. Vcc+ pin. It needs to be connected with a 5v power source. 2. GND pin. It needs to be connected with ground pin of the same power source. 3. SDA pin. I have connected it with the microcontroller's D1 pin. 4. SCL pin. I have connected it the microcontrollers D2 pin.

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3.3.5 DC power source

Figure 3.7: DC power Source

Rechargeable DC batteries are a very useful and handy source for microcontroller based projects. I have used 3.7V Lithium Ion rechargeable batteries. It has two sides. 1. Positive power side. 2. Negative power side. The positive side is used as Vcc+ or a 3.7V power supply and the Negative side is used as groung.

3.3.6 DC-DC Boost Converter

Figure 3.8: DC-DC Boost Converter

Here I have used DC-DC Boost converter. As I am using 3.7V power source to power up the project. But there are some components which needs 5V power supply. So, I had to use DC-DC Boost converter to convert 3.7V to 5V.

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3.3.7 Wi-Fi Router

Figure 3.9: Wi-Fi router

As my project is an IOT based project & it has two modules which are esp8266 nodemcu, wifi based microcontroller. So, I had to use Wi-Fi router to connect both of the modules with internet.

CHAPTER 4

SYSTEM DESIGN AND IMPLEMENTAION

4.1 Front-End design

Front-End Design Includes:

- Building Transmitter module
- Connecting it to Google Firebase
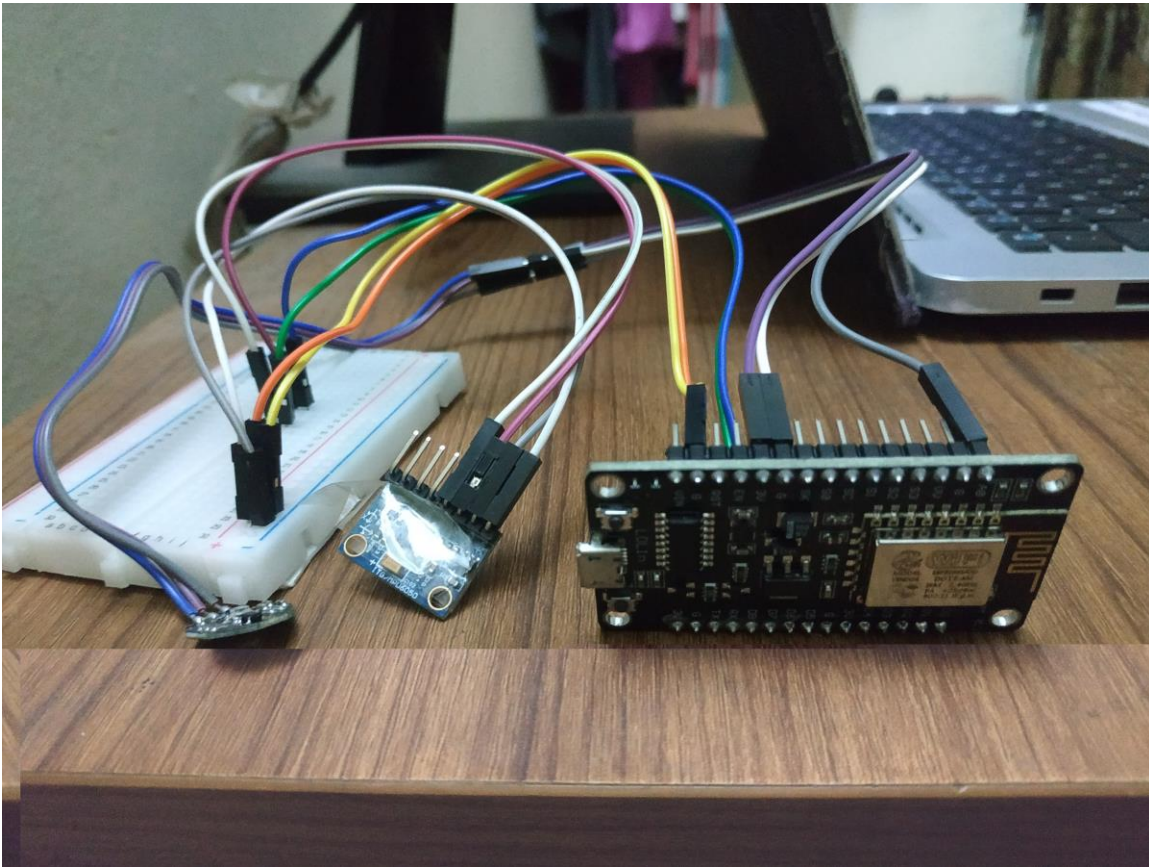- Building Receiver module

4.1.1 Building Transmitter

Figure 4.1: Building transmitter module

To build the transmitter, I have used a esp8266 nodemcu, a Pulse Rate sensor & a mpu6050 accelerometer[4]. In the transmitter module, I have connected Pulse Rate sensor's data pin

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to esp8266's A0 analog pin. I have connected accelerometer's SCL & SDA pins with esp8266's D6 and D7 pins. Finally I have powered the module through powering the esp8266 nodemcu.

4.1.2 Connecting it to Google Firebase

Figure 4.2: getting database secret

First I have opened "console.firebase.google.com". Then I have created a new project. After that, I have got my project url and database secret[5]. Then I have set the project url and database secret code to my arduino sketch. After the sketch is uploaded to the board, it's got connected with Google firebase[6].
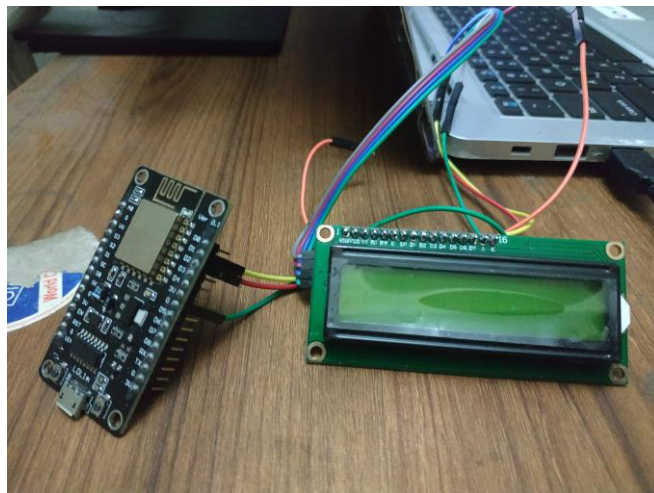
4.1.3 Building Receiver module

Figure 4.3: Building Receiver module

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To build the receiver module, I have used esp8266 nodemcu and a I2C display. The I2C display shows data's which the esp8266 nodemcu gets from google firebase's live database.

4.2 Back-End Design

Back-End Design includes:

4.2.1   Connecting Sensor with transmitter module

4.2.2   Connecting transmitter with Wi-Fi and Google Firebase

4.2.3   Sending data to google firebase

4.2.4   Connecting receiver with Wi-Fi and google Firebase

4.2.5   Getting and displaying Data from firebase

4.2.1 Connecting Sensor with transmitter module

```
int reading = 0;
#include <Wire.h>

// MPU6050 Slave Device Address
const uint8_t MPU6050SlaveAddress = 0x68;

// Select SDA and SCL pins for I2C communication
const uint8_t scl = D6;
const uint8_t sda = D7;

// sensitivity scale factor respective to full scale setting provided in datasheet
const uint16_t AccelScaleFactor = 16384;
const uint16_t GyroScaleFactor = 131;
```

Figure 4.4: Connecting Sensors with transmitter

I have connected Pulse Rate sensor's data pin to esp8266's A0 analog pin. I have connected accelerometer's SCL & SDA pins with esp8266's D6 and D7 pins. Finally I have powered the module through powering the esp8266 nodemcu.

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4.2.2 Connecting Transmitter with Wifi and Google Firebase

```
#include "ESP8266WiFi.h"
#define FIREBASE_JSONBUFFER_SIZE JSON_OBJECT_SIZE(32)
#include "FirebaseArduino.h"

#define FIREBASE_HOST "health-diary-e3b62.firebaseio.com"
#define FIREBASE_AUTH "12bui3YCRMplFh9RxniX6hoNvx0xL789C3XRdg3w"

#define WIFI_SSID "TP-LINK_04D4"
#define WIFI_PASSWORD "1234512345"
```

Figure 4.5: Connecting Transmitter with Wi-Fi and Google Firebase

To connect the transmitter esp8266 with google fire base, I had to define Firebase host & Firebase authenticator with project url & firebase secret. Then, to connect the transmitter to Wi-Fi, I had to define Wi-Fi SSID and Wi-Fi password[8].

4.2.3 Sending data to google firebase

```
reading = analogRead(A0);
int a = reading/5;
Serial.print("BPM: "); // Print phrase "BPM: "
Serial.println(a);
 Firebase.setFloat("BPM", a);
  // handle error
  if (Firebase.failed()) {
      Serial.print("setting /number failed:");
      Serial.println(Firebase.error());
      return;
  }
```

Figure 4.6: ending data to google firebase

I have used "Firebase.setFloat()" function to send data to google firebase.

4.2.4 Connecting Receiver with Wi-Fi

```
#include "ESP8266WiFi.h"
#define FIREBASE_JSONBUFFER_SIZE JSON_OBJECT_SIZE(32)
#include "FirebaseArduino.h"

#define FIREBASE_HOST "health-diary-e3b62.firebaseio.com"
#define FIREBASE_AUTH "12bui3YCRMplFh9RxniX6hoNvx0xL789C3XRdg3w"

#define WIFI_SSID "TP-LINK_04D4"
#define WIFI_PASSWORD "1234512345"
```

Figure 4.7: Connecting Receiver with Wi-Fi and google Firebase

To connect the receiver esp8266 with google fire base, I had to define Firebase host & Firebase authenticator with project url & firebase secret. Then, to connect the transmitter to Wi-Fi, I had to define Wi-Fi SSID and Wi-Fi password.

4.2.5 Getting and displaying Data from firebase

```
Serial.print(Firebase.getFloat("BPM")); Serial.print(" BPM");
float s = Firebase.getFloat("BPM");
Serial.println(" ");
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print(s);
 lcd.print(" BPM");
Serial.println(Firebase.getString("message"));
String m = Firebase.getString("message");
 lcd.setCursor(0, 1);

  lcd.print(m);

delay(1000);
lcd.clear();
```

Figure 4.8: Getting and displaying Data from firebase

To get data from Firebase, I have used "Firebase.getFloat()" function[7]. To display it on I2C LCD Display, I have used "lcd.print()" function[3].

4.3 Implementation Requirement

To implement the whole Back-End Design, I have used:

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- Arduino IDE
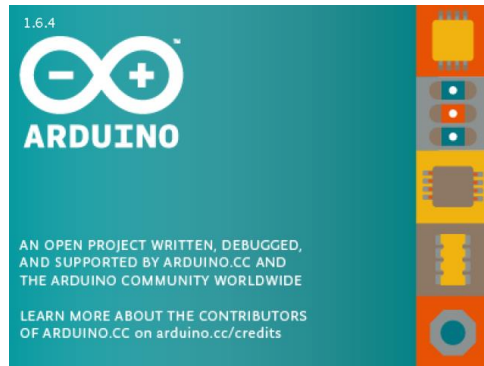- Google Firebase.

4.3.1 Arduino IDE

Figure 4.9: Arduino IDE

Arduino IDE is the compiler for Arduino based microcontrollers. To program an Arduino based microcontroller, we need Arduino IDE to compile the code & upload it on microcontroller.

4.3.2 Google Firebase

Figure 4.10: Getting and displaying Data from firebase

Google firebase is a open source Online database for IOT based projects from google. It provides storage, live data updates & visualizing the data's.

CHAPTER 5

TESTING AND DISCUSSION

5.1 Implementation of Front-End Design

Once The sensors are connected with esp8266 nodemcu, and the esp8266 is connected with Wi-Fi, It will start getting data from patients body and starts uploading the data and messages to google firebase's live database.

Again, once the Receiver module is connected with Database, it will display the live data from Google firbase's database via I2c LCD Display.
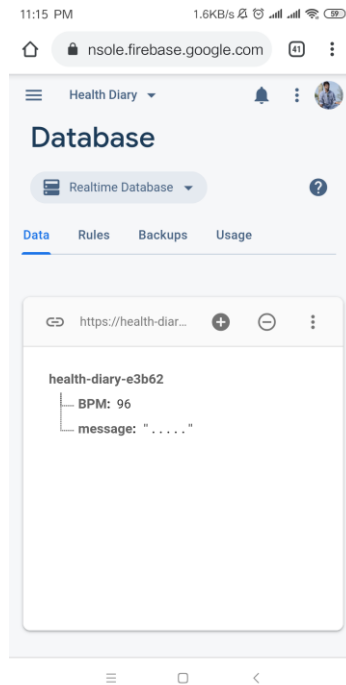
5.2 Implementation of Database

Figure 5.1: Implementation of Database

If the Transmitter device is connected with Database correctly, The database will start showing the live heart rate & messages generated from transmitter module.

5.3 Test Result & Reports

5.3.1 Test Results

Transmitter	Database	Receiver	Comment
Gets Pulse Rate and generates message	Shows nothing	Shows nothing	Transmitter module isn't connected with internet.
Gets Pulse Rate and generates message	Shows Live Pulse Rate & Message	Shows nothing	Receiver isn't connected with internet.
Gets Pulse Rate and generates message	Shows Live Pulse Rate & Message	Shows Live Pulse Rate & Message	Both modules are connected with internet & working properly.

Table 5.1: Test Result & Reports (Primary implement of sensors)

Hand Gesture	Generated Message (expected)	Generated Message (actual)	Database	Comment
Fist flat	"….."	"….."	"….."	Working Properly
Fist Right	"Medicine"	"….."	"….."	Not working properly
Fist Left	"Food"	"Food"	"Food"	Working properly
Fist Down	"Washroom"	"….."	"Washroom"	Not working properly
Fist Up	"Feeling Band"	"….."	"Washroom"	Not working properly

Table 5.2: Test Result & Report (1st implement of Data)

Hand Gesture	Generated Message (expected)	Generated Message (actual)	Comment
Fist flat	"….."	"….."	Working Properly
Fist Right	"Medicine"	"Medicine"	Working properly
Fist Left	"Food"	"Food"	Working properly
Fist Down	"Washroom"	"Washroom"	Working properly
Fist Up	"Feeling Band"	"Feeling Band"	Working properly

Table 5.3: Test Result & Report (final implement of Data)

5.3.2 Final Output

With the last implementation, the whole system is working properly. The transmitter module is getting pulse rate continuously and also generates messages with the hand gesture. It successfully uploads both Pulse rate & Messages to live database. The receiver module is also working properly. It gets the real time updates from the database and displays it on LCD display. So, we can say that, the IOT Project is successfully working.

CHAPTER 6
CONCLUSION AND FUTURE SCOPE

6.1 Discussion and conclusion

As per it's expectation, the device is working perfectly. The transmitter module is able to get Pulse Rate & Generate messages with hand gesture. It is also successful to upload the data's continuously. It has also got connected with google firebase properly & firebase shows real-time data's from live database. The receiver module is also working perfectly. It has got connected perfectly with google firebase's live database and it shows the Pulse Rate and messages real-time from live database.

6.2 Scope for Further Developments

As I have implemented this project, this device can get pulse rate & it can generate 4 messages from hand gesture. For future development, this devices activity can be expanded. For example: with heart rate, it may be able to show blood pressure, blood glucose, body temperature etc. And also, it may be able to generate more messages from hand gesture.

APPENDIX

APPENDIX-A

List of sensors & Basic uses of the sensors:

Mpu6050 is a 6-axis accelerometer, in this project I have used only 2 axis. X-axis & Y-axis. The Pulse Rate sensor uses NIR technology to observe the blood density & calculates Pulse Rate

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