Smart Communication Device For Dumb Patient

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Documentation submitted in partial fulfillment of the requirement for the degree of Bachelor of Science in Software Engineering.

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APPROVAL

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This thesis titled on "**Smart Communication Device For Dumb Patient**", submitted by **S.M. Raufuzzaman Ashik (ID: 181-35-2436)** to the Department of Software Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Software Engineering and approval as to its style and contents.

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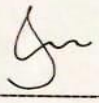

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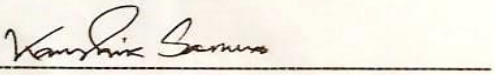

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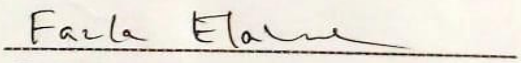

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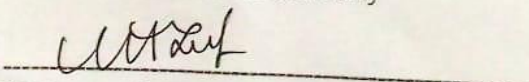

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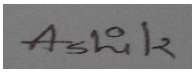
DECLARATION

I hereby declare that this project is my original work for the Bachelor of Software Engineering program, and that it was written by me under the supervision of Kaushik Sarker, Associate Professor & Associate Head, Department of Software Engineering, Daffodil International University. I also declare that this project or any part of this is unique and has not been submitted elsewhere for the award of to any degree.



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ABSTRACT

Nowadays lots of new diseases are increasing day by day and the number of patients is growing in every hospital. Some of them can not talk or say anything. So they need someone's help for doing several things like if they need food, medicine etc. Every time it's hard for nurses to check every patient, so if there is a smart device that can help them to inform doctors or nurses about their necessity it will be very helpful for the patients. For that work, this device can help the patient.This device is made with Arduino UNO and some sensors such as Flex sensor, BPM sensor, wifi sensor etc.With this device patient can send signal for food, medicine ; doctor or nurse can monitor patients heart beat rate; also patient can send emergency call to doctor or nurse.In that device we can use a temperature sensor which will calculate the current temperature of the patient.

Contents

CHAPTER 1

INTRODUCTION

1.1 Background overview

In this modern telecommunication technology, in the field of medical science people need smart devices to communicate more easily and faster over a long distance within a short time. There are lots of devices that help sick people recover fast. Our country Bangladesh is also trying to use those kinds of devices in the hospitals for patients but there are limited devices. In our country there are lots of patients who cannot talk and get admitted to the hospital but when they need something they cannot say it and they try sign language. They need someone to always help them and it is difficult to stay with patients always, hard to understand sign languages also. So sometimes they feel helpless and it creates a very difficult situation for them to communicate. They need something which helps them to communicate with a doctor or someone when they need something. There are many devices that help to communicate with other people but a bluetooth or wireless device is needed for those who cannot speak, so if there is such a device, it will be a relief for those patients who cannot speak.

We are going to make a system which can solve this problem. The system that we proposed mainly works based on hand-glove gestures. It will help doctors to keep an eye on dumb patients and they can monitor or visit them immediately when they need anything. The project is known as "Smart Communication Device for Dumb Patients'' for those patients who are unable to speak. The advancement in the field of medical science is extraordinary yet there are not so many contributions to help the dumb patients to recover from their illness. As this device is named as a communication system so there will be a wireless system for communication and sending emergency messages. Here we will use several sensors like flex sensor, pulse sensor etc and all the devices will be attached in a hand-glove. The hand-glove will be the device for the dumb patients. There will be calling and messaging features in this device and RF transmitter will be used for passing messages and communication, another RF will be used in receiver where the messages will be shown on 16*2 a display which was sent via RF transmitter.

1.2 Objectives

- This device will help to create an easier communication way between dumb patients and doctors.

- Dumb patients can contact with doctors or nurses any time when they want with this device.

- This device will help doctors to monitor dumb patients condition easily.

1.3 Motivation of the Device

Patients who can't speak and use sign language, this kind of device will play a vital role in their communication with doctors or others. There is always someone with those patients who can't talk but when no one is there, this type of device can be used for their emergency needs. These devices can be more than a communication device for dumb patients as there can add more components. These devices can help dumb patient to contact easily and faster in the time of emergency situation. These devices can be useful for doctors also because it can be hard for them also to understand immediately what those patients want and they can know what the patient needs. So, the main cause to build this device to make an easy communication system for dumb patients so that they can communicate easily with doctors or nurses and a monitoring system for doctors to monitor dumb patients conditions and what they want.

1.4 Features of the Device

We made a communication system based device for the dumb patients who cannot speak to make the communication metthod more flexible between those patients and doctors. The features of this device are,

- Messages will be shown on a LCD display monitor.
- Calculate heart beat rate of the patients and show it on the LCD display monitor.
- Can send phone calls and messages through this device when it is an emergency.
- Make an alarm when the message arrives to the doctors.

CHAPTER: 2

BACKGROUND STUDY

2.1 Software and Hardware Specifications

We made a smart communication device and used a hand-glove to build it for the patients who are unable to speak. By using this device those patients can easily communicate with doctors. To complete the device we use several other components such as Arduino UNO microcontroller, Flex sensor, NRF module, GSM module, Buck converter, Pulse sensor, LCD display, buzzer, resistors etc. For programming we used Arduino IDE software and uploaded the code to the microcontroller. A little description of the components is given below in this section.

2.1.1 Arduino UNO

Arduino UNO is a single board microcontroller used to make applications gradually open and used to build iot based projects. This board is an open source equipment board structured around a 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM microcontroller. Current models have a USB interface, 6 analog pins and 14 digital I/O pins that enable the client to join different kinds of spreadsheets.

The Arduino Uno board is a microcontroller basically based on the ATmega328 microcontroller. It has 14 digital pins in which 6 pins can be used as PWM pins also, a 16 MHz ceramic resonator, an ICSP header, a USB connection port, 6 analog data pins, a power jack and a reset button. This contains all the needed things that are required for a microcontroller. So to begin to work with it, they just need to be connected with a PC with a USB cable-wire or connect with an AC-to-DC connector or battery. Arduino Uno Board is slightly different from all other single boards and they won't use the FTDI USB-to sequential driver. Here is a picture of the microcontroller is given below:

Figure 2.1: Arduino UNO microcontroller

2.1.1.1 Pin Configuration

The pin configuration for the microcontroller is given below in the picture:

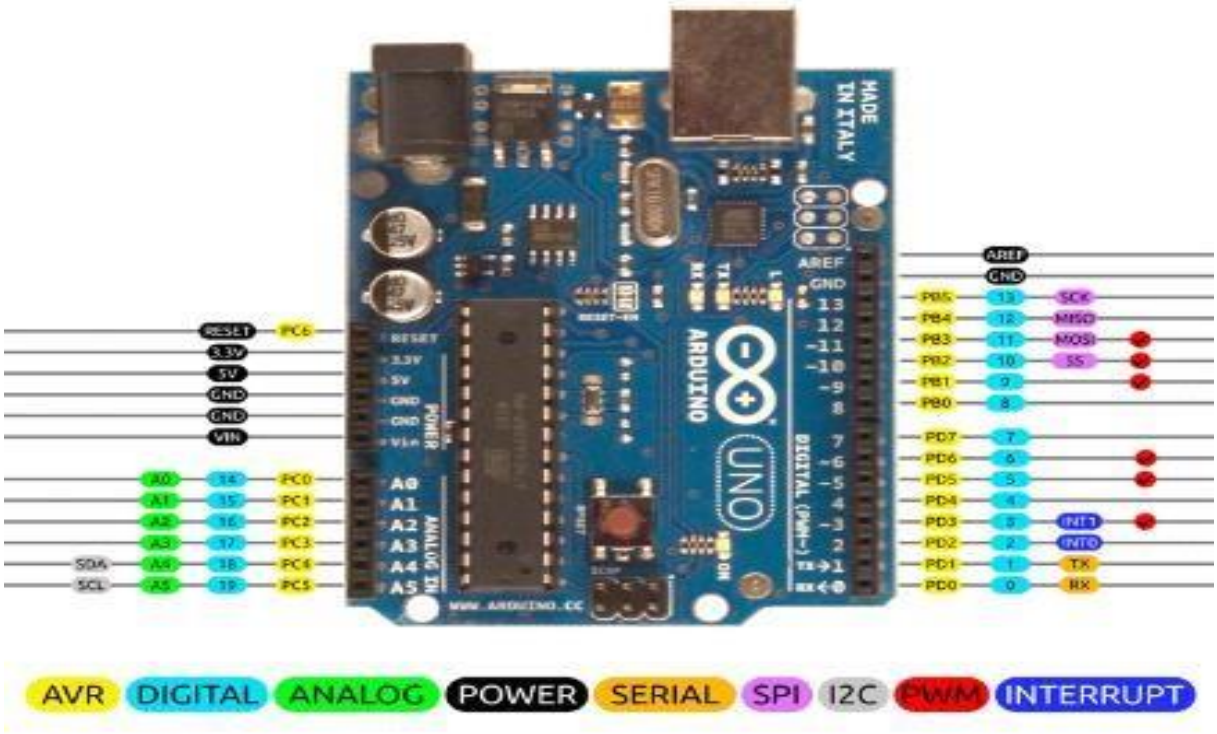

Figure 2.2: Pin configuration of the microcontroller

2.1.1.2 Pin functions

- LED: There is a working LED driven by digital pin number 13 and when the pin is HIGH it blinks and when the pin is LOW it gets off.
- VIN: You can supply voltage through this pin, or, if you want to supply voltage through power jack, access it through this pin (when the necessary voltage for the Arduino board is needed and it is using an outside power source rather than 5 volts from the USB cable or any other regulated power source.)
- 5V: This pin gives a direct 5V power from the microcontroller on the board when the microcontroller is on.
- 3.3V: This pin gives a direct 3.3V power from the microcontroller on the board when the microcontroller is on.

- GND: It is a ground pin and all the ground has to be connected with this pin. Always try to remove the wire which is in the 5v/3.3v pin before removing the wire from the ground.
- Reset: There is a reset button in the microcontroller and you can reset the microcontroller by pushing that button anytime.
- Serial: pin number 0 is Rx and 1 is Tx. They are used to receive (RX) and transmit (TX) the information.
- External Interrupts: pins 2 and 3 are used external pins in the microcontroller.
- PWM: Here are 6 digital pins which are known as PWM(3, 5, 6, 9, 10, and 11) and they can provide 8-bit .

2.1.2 NRF24l01

This NRF24l01 is a wireless remote module, which means this module can both send and receive information. This module is designed to work on 2.4GHz, which is represented by ISM band and it is also legal to use in practical applications in all countries for designing any applications. The module can cover almost 100m area when it works, which is considered as an incredible decision to use this module in all remote controlling ventures. This module basically works on 3.3v voltages so it is important to control the power supply otherwise it can be destroyed.

Figure2.3: NRF24l01

2.1.2.1 Specifications

- 2.4GHz RF transceiver Module
- Operating Voltage: 3.3V
- Nominal current: 50mA
- Range : 50 – 200 feet
- Operating current: 250mA (maximum)
- Communication Protocol: SPI ● Baud Rate: 250 kbps - 2 Mbps.
- Low cost wireless solution

2.1.2.2 Application/Uses

- Home automation systems.
- Automotive applications.
- Wireless data communication systems.
- Mesh network system.
- Wireless control system applications.

2.1.3 Flex Sensor

A flex sensor is basically used to measure the amount of the deflection or bending and a basic flex sensor is 2.2'' long. It is a protected innovation by Spectra Symbol. The value of the flex sensor changes when it is curved. It can be connected with breadboards which helps to work easily. As it changes value according to the curve so you have to be careful and bend the sensor smoothly to get the value that you want.

Figure2.4: Flex sensor

2.1.3.1 Features and specifications

- Simple Construction
- Low Profile
- Life Cycle: >1 million
- Temperature Range: -35°C to +80°C
- Height: 0.43mm (0.017")
- Flat Resistance: 25K Ohms
- Bend Resistance Range: 45K - 125K Ohms
- Resistance Tolerance: ±30%

2.1.3.2 Applications/Uses

- Car controlling system
- Medical products
- Mechanical automation
- Musical instruments
- Computer based virtual motion gaming

2.1.4 Pulse Sensor

This sensor is used to calculate the heart beat rate and this sensor can calculate the heart beat rate almost accurately. This sensor works on both 3.3v and 5v power supply and it needs only 4mA current. This sensor has three wires (positive,negative and source) and male header in the end so that it can connect to the breadboard.

Figure 2.5: Pulse sensor

2.1.4.1 Features and specifications

- Biometric Pulse Rate or Heart Rate detecting sensor
- Plug and Play type sensor
- Operating Voltage: +5V or +3.3V
- Current Consumption: 4mA
- Inbuilt Amplification and Noise cancellation circuit.
- Diameter: 0.625”
- Thickness: 0.125” Thick

2.1.5 GSM Module

The advancement of remote control innovation has been developed very quickly along with the other innovations these days. The innovation of the GSM module is also a huge innovation in the electronics field. There are different types of gsm modules invented and for our device we will use the SIM800l module with the microcontroller.

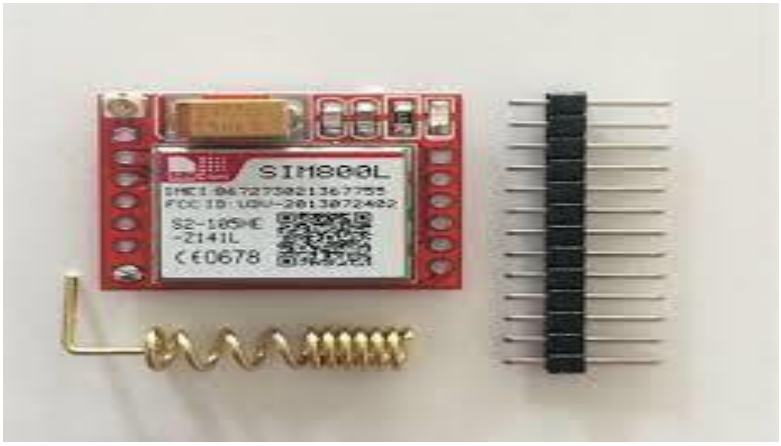

Figure 2.6: GSM module(SIM800l)

2.1.5.1 Features

- Make a call
- Send a message
- International roaming

2.1.6 Resistor

A resistor is anything that power can't go through effectively. Precisely when power is constrained through a resistor, frequently the centrality in the power is changed into another sort of centrality, for example, light or warmth. The clarification a light shines is that power is constrained through tungsten, which is a resistor. The vitality is delivered as light and warmth.An aide is the retrogressive of a resistor. Power experiences effectively and competently through a guide, with no other centrality delivered as it passes.

Figure 2.7: Resistor

2.1.7 LCD Display

The liquid crystal display which is known as LCD display basically utilizes the property of light checking of fluid gems and they don't give radiation of the light properly. This Liquid precious stone is a level board show or it is an electronic visual show. When the contents are uninformed the LCD' s are attained the fixed picture or the discretionary picture which are shown or viewed like present words or digits. The self-clicked pictures consist of large numbers of little pixels and the component has lots of bigger components than fixed pictures.

Figure 2.8: 16*2 LCD Display

2.1.8 10k Potentiometer

This 10k potentiometer is also known as a variable resistor. This potentiometer mainly is used for controlling the contrast and brightness of LCD display and this 10k potentiometer is outstanding for doing it.

Figure 2.9: 10k Potentiometer

2.1.8.1 Applications of Potentiometer

- Contrast controlling
- Brightness controlling
- Calibration and fine tuning
- User controlling inputs
- Audio controlling

2.1.9 Buzzer

There is a type of electronic buzzer with an integrated circuit structure, which works on the supply of DC power and is mainly used in computers,printers, photocopy machines, alarms, electronic

toys, automotive electronic devices, telephones, timers and other electronic products as alarming devices. There are different kinds of buzzers and they can be categorized as active and passive ones.

Figure 2.10: Buzzer

2.1.10 Buck Converter

The buck converter is a straightforward kind of DC to DC digital converter that can deliver fixed voltage that is needed for any device. This converter is so popular in light of the fact that the inductor depends on bucks and can act against the exact voltage that is needed. The accurate voltage of a buck converter is compared as equivalent to the result of the changing obligation cycle and the supply voltage.

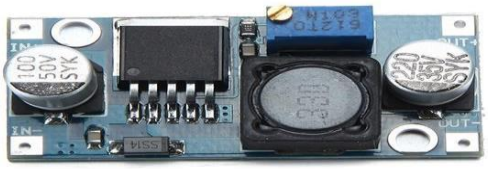

Figure 2.11: Buck converter

2.1.11 Breadboard

The breadboard has bits of metal connections which continue to run under the board, yellow square shapes and partner the social affairs of five holes on the board. The metal strips are organized. The top and baselines of openings are related on a level plane while the holes in the center regions are related upward.

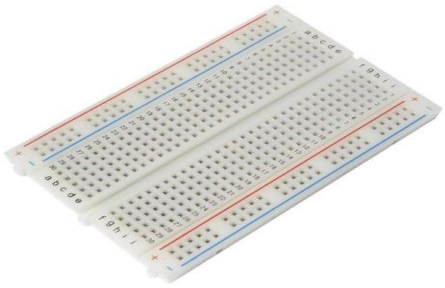

Figure 2.12: Breadboard

2.1.12 Jumper wires

Jumper wires are basically short wires used for creating electrical interfaces of at-least two positions in a connector. There are three types of jumper wires such as Male to Male, Male to Female and Female to Female.

Figure 2.13: Jumper wires

CHAPTER 3

DESIGNING and PLANNING

3.1 Design

We used many different types of components to build this communication system device and for that we have to design it properly so that it works as we wanted. As it is a hand-glove based device so we attached all the components with glue on the hand-glove. We attached flex sensors, pulse sensors, nrf module and the gsm module into the upper side of fingers of the hand-glove. We attached the microcontroller in the end of the glove, in the middle of the glove we attached the breadboard, battery and the other components. To connect all the components to the microcontroller and breadboard we used jumper wires. There is a picture given below of the design.

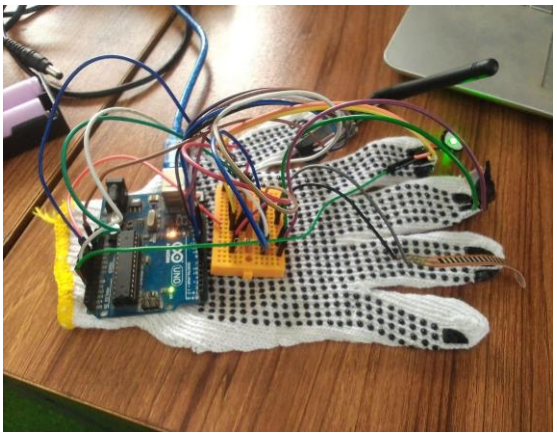

Figure 3.1: Sample Design of the device

3.2 Flow chart

Flowchart is one kind of diagram which represents an algorithm, workflow or process of any kind of project. In a flowchart there are some different kinds of shapes of boxes to determine the work and these boxes are connected with each other with arrows to show the relationship between them. A flowchart can illustrate the solving model of any kind of problem and shows the way how to finish the work step by step. To prepare a flowchart before doing any project is a good idea because

it helps to remember which work needs to finish first and which one is connected to another. We made a flowchart for our project.

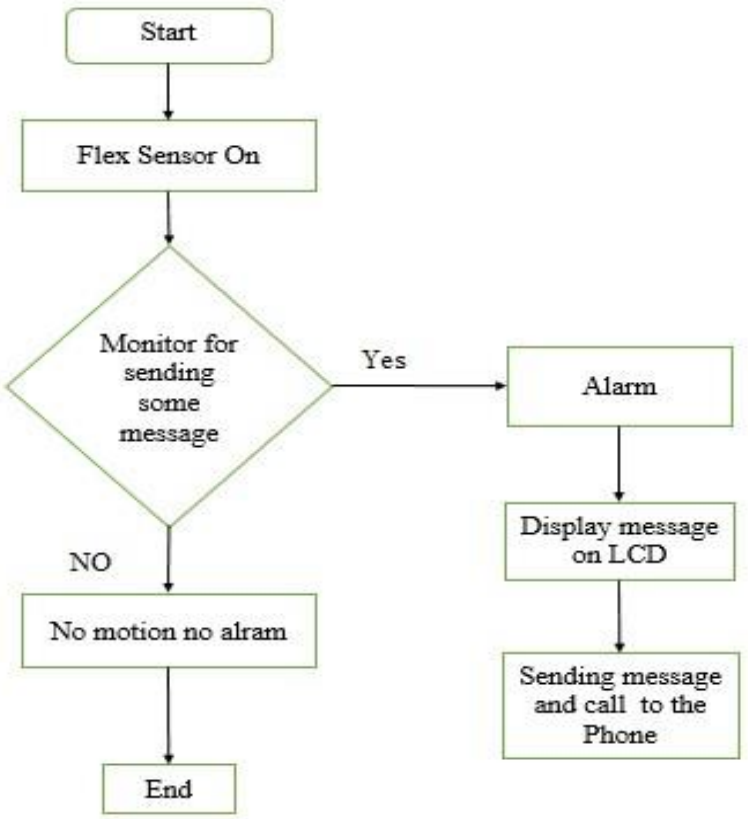

Figure 3.2: Flowchart of the device

3.3 Block Diagram

A block diagram tries to visually represent a system that uses simple, labeled blocks that represent single or multiple items, entities or concepts, connected by some lines to show the relationships between those boxes. As our device is a communication system so there should be a transmitter and receiver unit and we have block diagrams for both transmitter and receiver units.

3.3.1 Block diagram for Transmitter Unit

For the transmitter unit there are flex sensors, blood pulse sensor, NRF module and GSM module which are connected with the microcontroller. Flex sensor and GSM module works together to send a message or call and pass it through the NRF transmitter module.

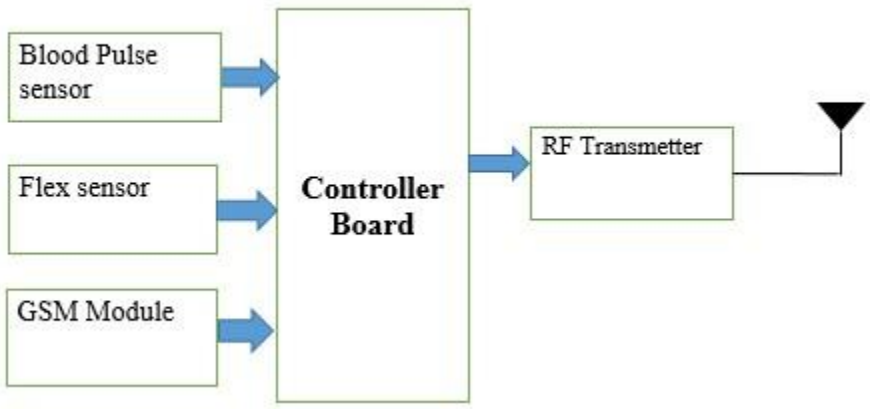

Figure 3.3: Block Diagram for Transmitter unit

In this project the work of a blood pulse sensor is to detect the heart beat rate and send it to the microcontroller to store the rate. Two flex sensors are used in this project. If 1st flex is bent then it will generate a message and send it to the receiver unit via NRF transmitter module .If 2nd flex is bent then it will make a signal for calling and text messaging and send the signal to the microcontroller. GSM sensors can detect the signal of the 2nd flex sensor and make a call to a given number using a SIM. After getting those signals, the microcontroller sends those text messages to the receiver unit using the RF transmitter.

3.3.2 Block diagram for Receiver Unit

In the receiver unit of this project we use another NRF module to get the signals from the transmitter unit , one display monitor, one buzzer and all are connected to the microcontroller.

For receiver unit block diagram looks like the picture shown below

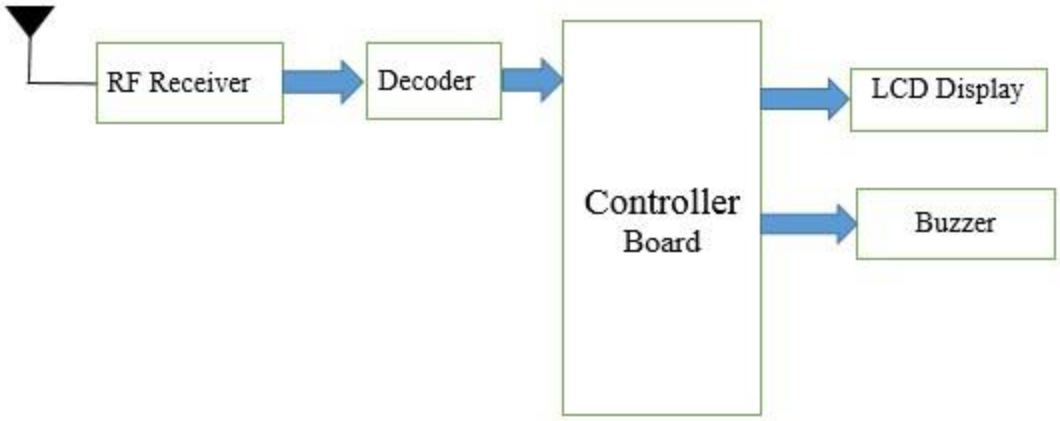

Figure 3.4: Block diagram of Receiver Unit

The NRF module of the receiver unit receives the signal from the transmitter unit and at first decodes those signals so that the microcontroller can store them in memory. After getting the decoded signals microcontroller sends them to the LCD display, buzzers and led lights.The LCD display shows the messages that are received from signals and when any message appears in the display buzzer starts to make alarm and led light starts to blink. In this way the receiver unit of the device works to create the communication system between patients and doctors.

CHAPTER 4

METHODOLOGY

4.1 Introduction

There are two types of methodology we used to build our device. They are 1. Hardware part and 2. Software part. In the hardware part we made our communication system device by using advanced IoT technology. We used two Arduino microcontrollers and many other electronic devices to complete our communication system. After completing all the hardware configuration we have to upload some codes to the microcontroller so that the device works. For coding those components we used a Software known as Arduino IDE. Now we have to write and upload code to the microcontroller. There are several ways of loading programs in a microcontroller. In our device we will use Arduino Uno as a programmer and there are some steps to use Arduino Uno as a programmer that we have to follow.

4.2 Software Installation and Customization

As we have two parts of our project, software is one of them and we need a software where we will write all the code and upload the code to the microcontroller. Without a code microcontroller will not be able to do anything and without software we cannot write any code. We are going to use Arduino as our microcontroller so we need a software where we can write the code for our Arduino microcontroller. For programming an Arduino microcontroller we need a software named Arduino IDE. We can download the software from arduino's official website and we have installed it on our computer. After successfully installing the software we can write codes and upload them to the microcontroller.

We have to customize the software. There are lots of boards of arduino and as we are using arduino uno, we have to select this board from the software before uploading any code. For selecting the board we have to go to Tools>select board> arduino uno. Also we have to select the port address before uploading code, for that we have to go to Tools>select port>port(number). Sometimes we will need different kinds of libraries for our code and there will not be any libraries found, we have to install them to our IDE, for that we have to go to sketch>include library>search library>install. After doing everything correctly we can upload the code to the microcontroller and run the program for checking.

4.3 Important Libraries

For programming we used several libraries to complete our project, without these libraries the program would not run and the microcontroller would not work. We used,

- SPI.h
- nRF24L01.h
- RF24.h
- PulseSensorPlayground.h
- LiquidCrystal.h
- SoftwareSerial.h

These are the libraries we need for our programming.Some of them can be installed but we have to install the remaining libraries before uploading them to the microcontroller.

4.4 Component Testing

The components we are going to use for building our communication system, we need to test them first individually. For testing individual components, we will connect them with a microcontroller individually and all the components need an individual program. After connecting the components we will write the program in our IDE and upload that to the microcontroller. Then we will run the program and see whether the components are working or not.

4.4.1 nRF24l01 Module Testing

nRF24l01 module mainly used for establishing wireless communication and for any communication system there should be one transfer side and one receiver side. So we need two nRF24l01 modules and we need to set them with the microcontroller with jumper wires. After setup is complete we have to write two programs for both transmitter and receiver sides. If everything is correct then there will be created a communication signal between both nRF24l01 modules and any kind of messages can be sent from transmitter to receiver side. We write a program for our transmitter where we use a message “Hello World” and try to send this message to our receiver. We write another program for our receiver side to identify the signal and receive the message. For creating the communication between transmitter and receiver we set the same address on both programs. When programming is complete we run the program and on the serial monitor we see, receiver side get the message. Here a screenshot of the output is shown below

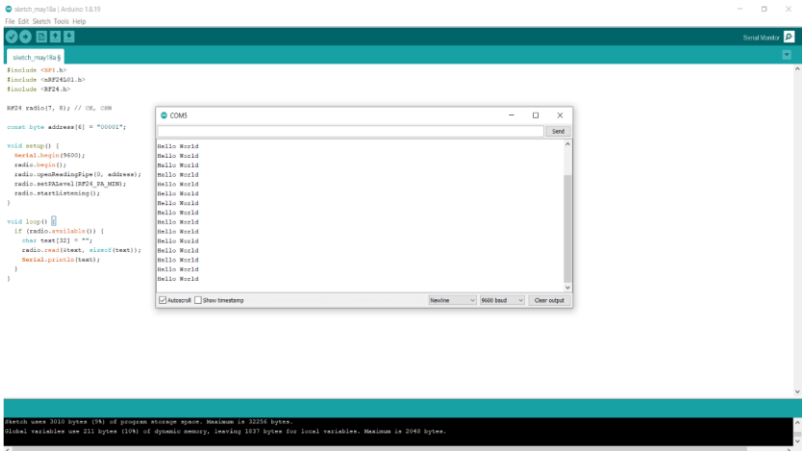

Figure 4.1: nRF24l01 testing output sample

4.4.2 Flex Sensor Testing

This flex sensor is the most important device that we use in our communication system, when this sensor is being bent it gives a value which works as a trigger for sending the signal from transmitter to receiver. To test this sensor we need to connect this with the microcontroller. We need a potentiometer to calculate the value of the flex sensor. To connect all of them we need a breadboard and after completing the set up we can write the program. We upload the code to the microcontroller and run it, we will see the resistance value and bend value like the screenshot given below

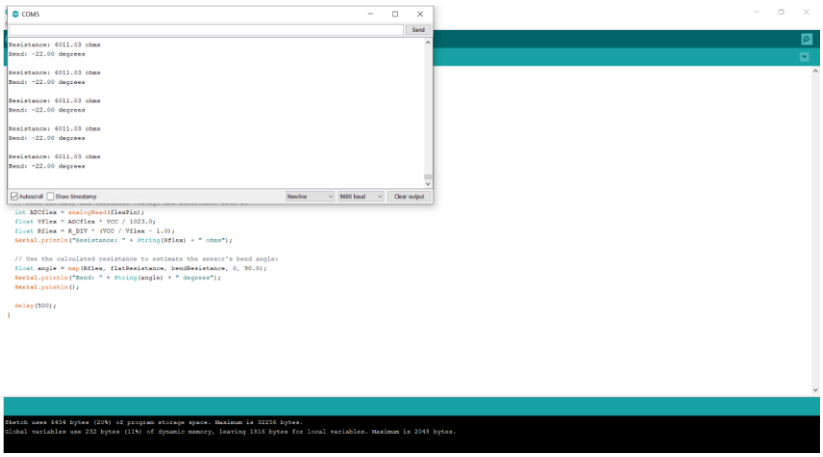

Figure 4.2: Flex Sensor Testing output sample

4.4.3 Pulse Sensor Testing

To test this sensor at first we connect it to our microcontroller. This sensor has three connectors, two are for getting the power and other one is for calculating the heart bit rate. Now the set up is done and we have to write the program to test it. We need a library for this program and we have to install it from arduino libraries. After that we can use the library in our code. After writing the program we upload it to the microcontroller and run it to see the output. The output will be like the screenshot below

Figure 4.3: Pulse sensor output sample

4.4.4 GSM Module Testing

The main purpose of using a GSM module in a system is, we can make a call or send a message with the module. We have a feature of sending messages and making calls on our device so we use a GSM module. There are many different types of GSM modules and we use the SIM800l module in our device. We connect this module to the microcontroller and write the program for it. Then we upload the program to the microcontroller and execute the program. This module is able to make calls and send messages to the selected mobile numbers. A sample screenshot is given below

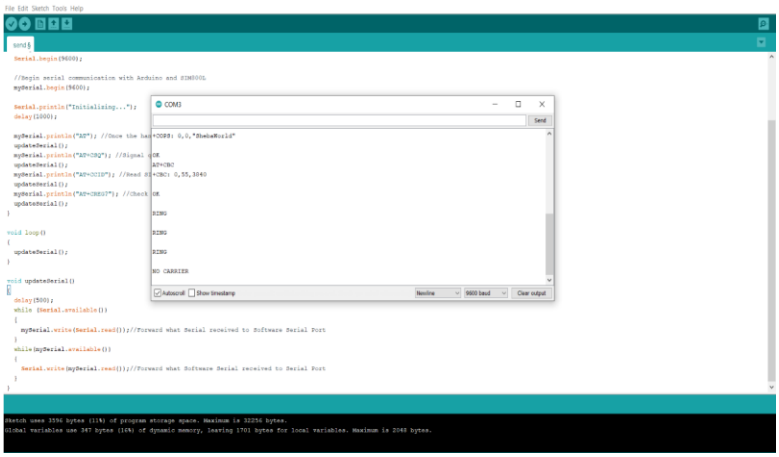

Figure 4.4: GSM module output sample

4.4.4 Other Components

There are some other components like LCD display, buzzer, potentiometer, resistor we use in our communication device. We have to test these components also because if any of them is faulty then our device will not work properly. In the time of testing all the components, if we find any component is not working then we should change it and test again a new one. So before connecting all the components together we have to test all the components individually. Testing all the components individually is mandatory before functioning the full connection. When all components are tested successfully we can start to connect them together as our design and planning.

CHAPTER 5

IMPLEMENTATION

5.1 Introduction

By completing all the necessary things such as designing, planning, background study etc we try to make a system and implement the system to make our communication device. The system that we implement has two different units, one is the transmitter unit and the other one is the receiver unit in our device. Our transmitter unit is basically a hand glove where we use two flex sensors, one bpm sensor, one gsm module, one nrf module and all are connected to a arduino microcontroller. On the other hand in our receiver unit we have a display module which will show the results and a buzzer to notify the receiver. Working procedures of our project are described briefly below.

5.2 Working Procedure

To make this project successful we developed the hand gloves where we connected the flex sensors and the ratings of the sensors changed simultaneously when the sensors bends in different angles. We use the flex sensors in the finger of the gloves, so when we bend the fingers the values of the sensors change and it works as it is assigned. We fixed a range for the flex sensors value, when the sensors achieve the fixed value then it works as it is programmed.

The microcontroller gets the values continuously from the sensors and analyzes them, when the fixed values are achieved it starts to work, and sends the signal through wireless nrf module to send the messages and calls. When the other wireless nrf module gets the signals, it sends them to the microcontroller for processing and shows them through LCD display and sends calls when the signal for calling.

5.3 Results

In our project we used an LCD display where we can see the results of our projects, and this can also send messages and call when there is an emergency for the patients. The possible results that we get from our system are shown below.

At first when we power up the display and run the program, it will show us an introduction of the system as “Hello Doctor!!” and after that the developers name also. Then the other function will start to work and show their result. Patients BPM will be visible in the display when the pulse sensor touches the patient's body. We fixed a range of values of the pulse per minute and when the microcontroller gets a value in range that will be visible in the display. The display will look like this picture shown below.

Figure 5.1: Introduction Message Shown on LCD Display

Figure 5.2: Showing BPM of the Patient

Other functions will show their results as the sensors start working. As we fix the flex sensors in the middle and index finger of the gloves, they will start to show the result as they programmed. When the patient bends the middle finger of the gloves it will create a signal in the transmitter unit

with the flex sensor and other components and transfer that via the NRF module. The NRF module of the receiver unit will receive the signal and convert the signal into the message that we fixed in our program “Food/Water Please”. This message will be visible in the display and also the buzzer will start to make an alarm signal. A picture of the display showing this message is given below.

Figure 5.3: First message shown on LCD Display

When the patient has an emergency and bends the index finger, there will be a signal created in the transmitter unit for sending emergency messages and making phone calls to the doctor. The GSM module that we use in our project will send the message and make the call when it gets the signal. A pop up message “Call/SMS sended” will be displayed on the LCD display when the message and call is sent.

Figure 5.4: Notification for call or sms

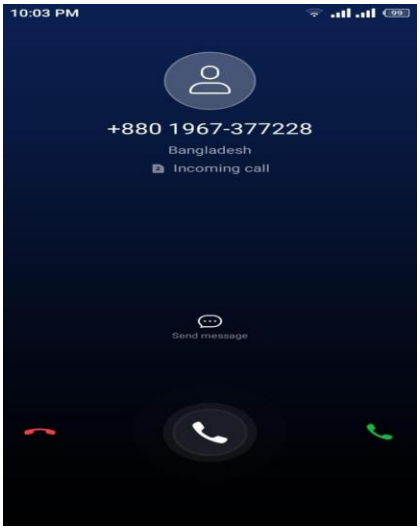

Figure 5.5: Emergency phone call sended

CHAPTER 6

CONCLUSION AND FUTURE WORKS

6.1 Conclusion

This idea for this project comes because there are lots of people who can not talk and they need a way to communicate with doctors. Even sometimes people get injured by accidents and can not talk for many days in the time of their treatment. So if there is a communication device like ours they can use it for communication easily. This device can be very helpful and useful for both the patients and the doctors.

6.2 Future Works

This project can be updated in many ways in future, there are lots of scope to increase features for this projects like,

- We can add more flex sensors to do some other things in our project.
- We can make this device bluetooth or wifi based.
- We can use this device in our education system for the people who are unable to speak.
- We can use more sensors like temperature sensors to calculate a patient's temperature.
- We can make a feature of medicine time reminder for patients.

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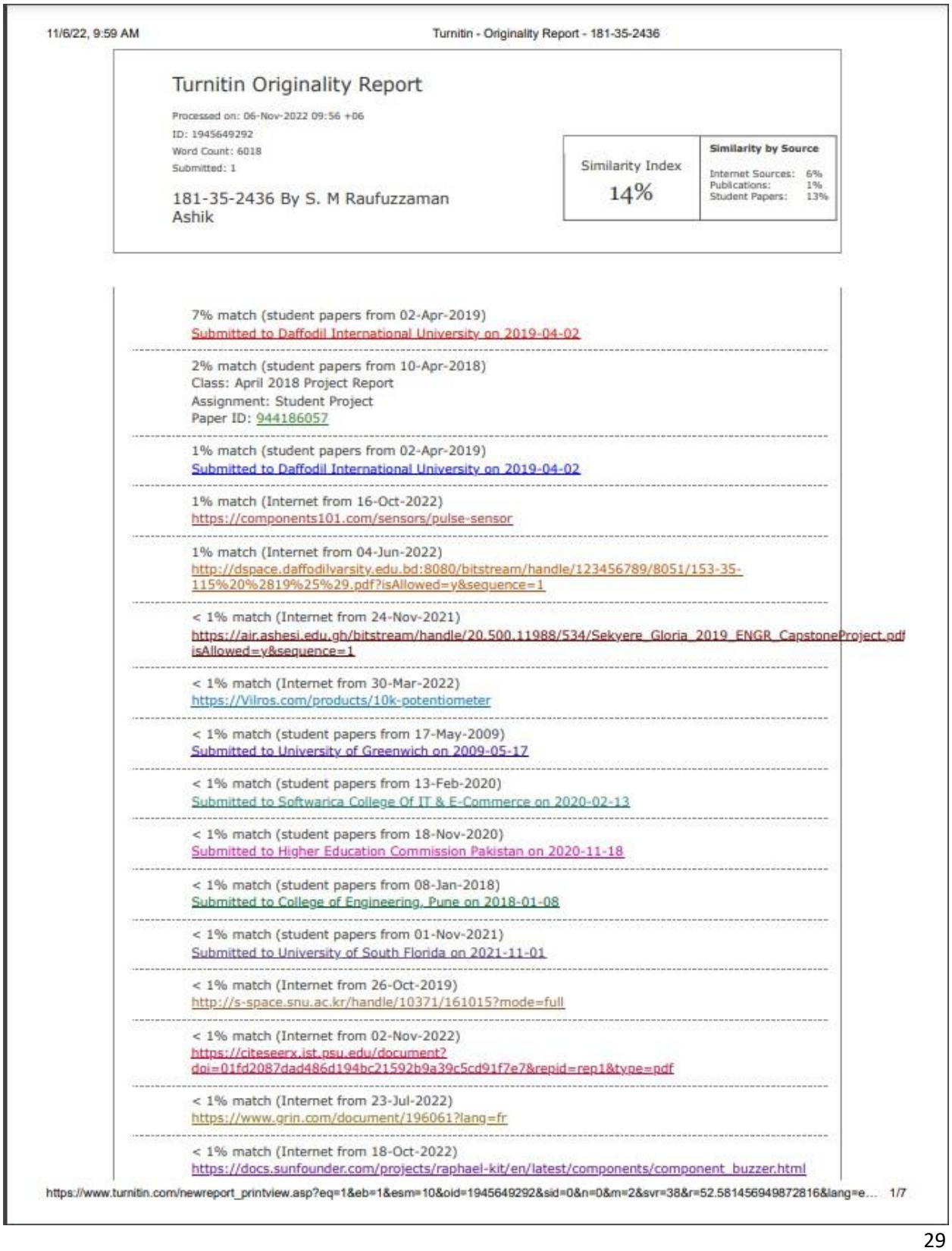

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