DESIGN OF EYE TO SPEECH INTERPRETER FOR THE WELLBEING OF A PERSON WITH SPEECH ISSUES

A THESIS SUBMITTED TO LAHORE COLLEGE FOR WOMEN UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF B.E. IN ELECTRICAL ENGINEERING

BY

DARAKHSHAN ASHRAF	**1925115015**
EMMAN HAFEEZ	**1925115018**
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DEPARTMENT OF ELECTRICAL ENGINEERING, LAHORE COLLEGE FOR WOMEN UNIVERSITY, LAHORE

2023

B.E. THESIS

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CERTIFICATE

This is to confirm that the project work present in this report, which was completed under direct supervision of Ms. Ismat Hira and submitted by Ms. Darakhshan Ashraf, Ms. Emman Hafeez , Ms. Mahak Waseem and Ms. Muqadas Fatima to the Department of Electrical Engineering at Lahore College for Women University. I have personally gone through the raw data; certify the correctness and authenticity of all results reported here in. I further certify that thesis data have not been used in part or full, in a manuscript already submitted or in the process of submission in partial fulfillment of the award of any other degree from any other institution or home or abroad. I also certify that the enclosed manuscript has been prepared under my supervision and we endorse its evaluation for the award of BS degree through the official procedureof University.

Name Supervisor: Ms. Ismat Hira
Date:

Verified By

Dr. Sadia Murawwat

Chairperson

Department of Electrical Engineering

Controller of Examination

Date:

DEDICATION

This project is wholeheartedly dedicated to our beloved parents, who have been our source of inspiration and gave us strength when we thought of giving up, who continually provide their moral, spiritual, emotional, and financial support.

To our brothers, sisters, relatives, mentor, friends, and classmates who shared their words of advice and encouragement to finish this study.

And lastly, we dedicated this book to Allah Almighty, thank you for the guidance, strength, power of mind, protection and skills and for giving us a healthy life. All of these, we offer to you

ACKNOWLEDGMENTS

The completion of this project would not have been possible without the support and encouragement of several people. Firstly, we would like to thank Allah almighty for giving us the ability to take on this project and complete it with passion and resilience. We would also like to show tremendous gratitude towards our respected Ms. Ismat Hira (our project supervisor) for inspiring us to do our best and guiding us with every step of the way. Her advice and leadership have been supremely valuable to us, both professionally and personally. Last but not the least; we also like to thank our respected Chairperson of Department Dr. Sadia Murawwat for consistently guiding us.

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Abstract

The "eye to speech module" is designed to help the patients with Motor neuron disorders such as Paralysis, Lock-in Syndrome, and Amyotrophic Lateral Sclerosis (ALS) in enabling them to communicate with other people using their eye movements. These patients can use only two senses sight and hearing out of five senses. Therefore, to express their needs, feelings and thoughts, a module is designed that converts eye movement signals to speech. Our eye to speech module provides a high accuracy, low cost and user friendly solution. In eye to speech module, a glasses with four sensors ring is used to detect the eye four movement i.e. up, down, right and left of patient. When an eye movement is detected, text to speech converter convert it into text and display the text on LCD as well as speaker. In this way, high accuracy of eye command is obtained on LCD and speaker and help the patients with motor neuron disorders to communicate with others.

CHAPTER NO. 1
INTRODUCTION

This report explains the details of eye to speech module to help those people who are unable to communicate using their voice. The orientation of this report describes into five chapters: The first chapter of project eye to speech interpreter explains the introduction of eye to speech module, second chapter gives literature review, third chapter is about materials and methods, and fourth chapter is about results, and last chapter explains discussion. This chapter explains the introduction of eye to speech module. Our eye to speech module is to assist those people who are unable to communicate using their voices. There are 30 Million people out of 8 Billion people in world who are unable to communicate using their voice. Those people suffer from diseases such as lock-in syndrome, stroke, and Amyotrophic Lateral Sclerosis (ALS) cause progressive damage to nerve cells. Locked-in syndrome is a rare disorder of the nervous system. People with locked-in syndrome are paralyzed except for the muscles that control eye movement. A stroke is a life-threatening disease that occurs when part of the brain does not receive enough blood flow due to blockage or bleeding. Amyotrophic Lateral Sclerosis (ALS), also known as Lou Gehrig's disease, is a rare neurological disease that affects motor neurons—those nerve cells in the brain and spinal cord that control voluntary muscle movement. The movements of people with these diseasesare restricted or they remain completely immobile, they cannot control any part of their body except eye movement and eye-blink. Due to the loss of control of all voluntary muscles, these people are unable to speak, write messages, and therefore unable to express their thoughts and feelings to the people around them. In this case, the most appropriate and perhaps the only way for communication seem to be using eye movements.

1.1: Scope of Project

The following table is the scope of project eye to speech module:

Table 1.1: Scope of Project

SDGs	SDGs Targets	CEP Attributes	CEA Attributes	EHS Factors
SDG 3: Good Health and Well-Being	Target 3.12 (3-C): Increase health financing and support health workforce in developing Countries.	Depth of Analysis	Range of resources	Health and well-being of user

SDG 3: Good Health and Well-Being	Target 3.13 (3-D): Improve early warning systems for global health risks	Breadth and depth of knowledge	Innovation and Familiarity	Availability of resources
SDG 10: Reduced Inequalities	Target 10.8: Special And Differential Treatment For Developing Countries	Familiarity of issue	Consequences to society and the environment	_

1.1.1: Sustainable Development Goals (SDGs)

The UN has defined 17 Sustainable Development Goals (SDGs) that all members of the UN have adopted in 2015.This project maps with SDG Goals 3(Good Health and Well-Being) & Goal 10 (Reduced Inequalities).

In 3.12 targets (3C) of goal 3, Increase health financing and support health workforce in developing countries: Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and Small Island developing States.

In the 3.13 target (3-D target) of goal 3, Improve early warning systems for global health risks: Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks, our Eye-to-Speech Module device minimizes the global health risks.

Our module embraces SDG 10(Reduced Inequalities) of target 10.8, Special And Differential Treatment For Developing Countries: Implement the principle of special and differential treatment fordeveloping countries, in particular least developed countries, in accordance with World Trade Organization agreements, aims to remove inequalities within and among countries, especially in poorer regions and it enhances the international support for new affordable, and reliable technologicaland innovative things for better future scope.

Within this SDG our solution can bring value to people with speech related disabilities by givingthem a way to communicate.

1.1.2: Complex Engineering Problem (CEP) Attributes

The Complex Engineering Problem (CEP) Attributes that are mapping with our aye to speech module are:

- **Breadth and depth of knowledge** in our project eye to speech is to design an affordable and customizable module for Locked-in syndrome paralysis patients by monitoring Eye's pupil movement through sensors on glasses. The alternative approach is to use the Machine learning algorithms for Locked-in syndrome paralysis patients to help them to communicate with other.
- **Familiarity of issue** in designing our project is to resolve the speech problem by introducing an affordable and easy to use module in society to serve mankind. The issues are short lifetime of eye to speech module and the inaccurate distance between eye and sensors. The solution of these issues is to use 3D printed sensors rings to rectify an inaccurate distance between eye and sensors and use 3D casing for long term use of module.
- **Depth of Analysis** in our eye to speech module is to use the glasses with sensors that sense eye's pupil movement to help a lock-in syndrome paralysis patient to communicate with people. After sensing direction, Text-to-Speech Module convert that certain command into text and then speaker read that command.

1.1.3: Complex Engineering Activities (CEA) Attributes

The Complex Engineering Activities (CEA) Attributes that are mapping with our eye to speech module are:

- **Range of resources** for eye to speech module includes research papers, books and articles related to techniques and products resolving speech issues to serve mankind.
- **Familiarity:** The eye to speech module is a device for those paralysis patients who are unable to move their body parts but the can only move their eye. So they cannot communicate with people. To assist those patients in communication, our eye to speech module monitors eye's pupil movement via sensors on glasses, a text to speech converter and a speaker.
- **Innovation:** The Components that are used in designing the eye to speech module includes 3D sensors and 3D hardware casing reduce the use of traditional, short life and expensive devices for a lock-in syndrome paralysis patient.
- **Consequences to society and the environment:** The eye to speech module is beneficial in multiple aspects as it can be used in homes, hospitals and also by army forces.

1.1.4: EHS (Environmental, Health, and Safety) Factor

The EHS (Environmental, Health, and Safety) Factors that are mapping with our eye to speech module Is **Health and well-being of user**: The eye to speech module ensures the safety of user's or wearer? The 3D sensors ring on glasses that is not be harmful to the user. For a long-term use of module, use 3D Casing on hardware.

CHAPTER NO: 2

LITERATURE REVIEW

Assistive technology is concerned with "devices or other solutions that assist people with deficits in physical, mental or emotional function" (LaPlante et al., 1992) [1]. By offering a wearable eye to speech solution that enables basic communication, the project's eye to speech module seeks to assist those with significant physical limitations who are able to communicate verbally. We are able to converse with persons who are disabled just by moving our eyes. The Rosalind Picard describes the value of emotions to the computing community (1997). Affective computing includes two components: the capacity to recognize emotions and the capacity to communicate feelings. An essential first step in creating an adaptable computer system is emotion recognition. A computer system that can adapt and learn is used to recognize an individual's emotional state. People that have complementary or similar personalities work together, according to a study (Dryer & Horowitz, 1997) [2].

Expression Glass is an application-based wearable device that offers an alternative to general- purpose machine vision face recognition systems. These facial expression glasses detect all facial muscle movements and, using pattern recognition, detect meaningful expressions like interest or confusion. These glasses have a prototype that has been constructed and tested. The employment of covert piezoelectric sensors in a visor extension to a pair of glasses is supplying the attributes of compactness, user control, and anonymity. For unskilled users, these glasses provide an accuracy of 94% when identifying an expression. Identify the expression of bewilderment or curiosity with 75% accuracy. Much improvement is being made with continued use and some input (Manisha Kumawat,2018) [3].

Although understanding of eye gazing's exact function or functions, as well as the methods used to illustrate this, have varied greatly, eye gaze plays a vital part in communication. This systematic review was conducted to provide an overview of the hypothesized purposes for eye contact during conversations between healthy individuals as well as the methodology used. The eligibility requirements were limited to a population of healthy adults and disqualified studies that used eye gaze manipulation. The main sources of variation were the number of participants, their level of familiarity and status, the topic of the conversation, the methods used to collect the data (video and eye tracking), and the definitions of eye gaze. The results demonstrate that eye gaze enables both purposeful and involuntary speech interruptions as well as turn yielding, speech monitoring, conversation breakdowns, and conversation repair. The results were less reliable when it came to turn initiation, necessitating further research.

Future studies might use this review as a springboard to decide on the best research techniques for analyzing eye gazing and choosing relevant study variables (Ziedune Degutyte and Arlene Astell,2021) [4]. The majority of the study's attention has been on desktop computers, and it was more interesting to employ eye-tracking as a dependent variable than as a predictor of behavior (Heiko Drewes,2019)[5]. Eye-based communication languages such as Blink-To-Speak play a key role in expressing the needs and emotions of patients with motor neuron disorders. Most invented eye-based tracking systems are complex and not affordable in low-income countries. Blink-To-Live is an eye-tracking system based on a modified Blink-To-Speak language and computer vision for patients with speech impairments (Ezzat,2023)[6]. The scope and representation of the diverse nature of the IS field are also strengths of the eye-tracking research. Yet, there is a lack of diversity and concentration in the analysis methodologies. It would be beneficial for the IS field to take inspiration from other disciplines like engineering and cognitive psychology.

Patients with severe mental and/or physical problems who are not only verbally mute but also unable to communicate through gestures and other ways are the major focus of this initiative. Patients with ALS, Apraxia, and other degenerative diseases that cause a gradual loss of control over bodily processes are included in this, as are those whose spines have been damaged, which prevents them from expressing themselves through body language and other means. Muteness can result from a variety of disorders, including birth anomalies, vocal cord damage, accidents that harm the appropriate organs, and many others (Maltehain,2021)[7]. Worldwide over 30 Million people are mute and therefore unable to communicate using their voice [8]. (cf. ASHA, 2018)

CHAPTER NO. 3

SYSTEM DESIGN AND BLOCK DIAGRAM

A: Software Design

3.1: Software development and Design

We employed one significant software implementation in this project. This software implementation calls for a distinct kind of programming expertise, talent, and methodology.

3.1.1: Types of software we used

Arduino IDE

3.1.2: Types of programming languages

C (for Arduino development)

3.2: Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - connects to the Arduino boards to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. In this, developer needs an Arduino board, shields to connect the board to other devices, a sensor,and other Arduino component modules.

The first step is downloading the Arduino IDE after gathering the essential devices, such as sensors, Arduino devices, and other modules. A developer cannot upload or load a program to the Arduino without the Arduino ide. Without the instruction put in the Arduino by the developer, connecting Arduino devices to sensors and other devices like relays or lamps will have less relevance.

There are several steps in order to do an Arduino project

Step 1- Downloading the ide from the official site Without the Arduino, ide doing a projectwith Arduino software is insanity (doing the same thing, again and again, expecting a different result). In this process the user should wisely choose the IDE that will be suitable for the operating system he/she are using, it might be mac, window or Linux.

Step 2- Installing the Arduino IDE the easiest part of all is installing the setup of Arduino because it needs nothing but following simple instructions settled by the setup providers

Step 3 – Creating a new project and start coding after successful installation of Arduino, the rest thing is done by the developers on their own, creating a new project in Arduino is very much is like opening a new file in Microsoft word. After creation of a new file in the Arduino, a user should right its code in C++ programming language because Arduino is built to process C ++ Language. In the Arduino documentation, there are many samples and example code provided by the IDE, the user is not expected to write code from the ground.

3.3: Software detail

Additionally, a microcontroller must be provided, into which program code must be fed for the device to function as the robot's brain. Additionally, a suitable power source and sensor must be provided for detecting the moment of eye.

3.3.1: Steps for Eye moment detection using Arduino

Writing C code in the Arduino ide

The Arduino IDE was designed in Java, but users can only compile program that are written in C, necessitating a working knowledge of C.

Downloading or importing useful libraries if they are not built in

In order to write a robust and useful code in the Arduino IDE, a user should have the necessary libraries and modules in the integrated development environment. In our project, we are using QRT-1A Reflectance sensor, cables and a speaker so we need to integrate libraries into our integrated development environment. One of the popular libraries is the “QTRSensors” library.

The “QTRSensors” library is quite advanced. It enables an easy communication between the Arduino and the infrared sensors. It´s necessary to read and setup the sensors. This library is not included in the Arduino IDE, so you will need to install it first.

To install the library, navigate to Sketch > Include Libraries > Manage Libraries… Wait for Library Manager to download the library index and update the list of installed libraries.

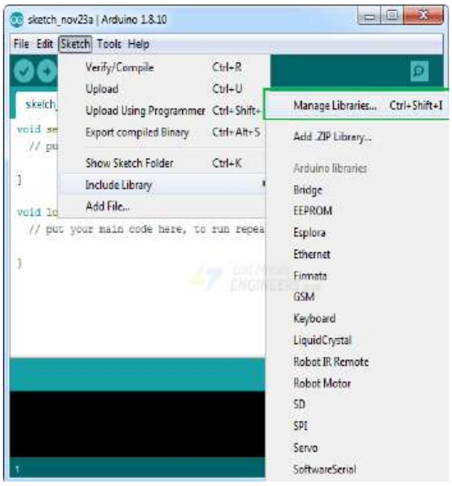

Figure 3.1: Installation of Library

Writing codes which include the library

We developed a program to retrieve the Eye moment through reflectance sensor. The complete code for our Arduino IDE is shown below.

Compiling and checking

After writing the program's code, the user must compile it using the Arduino device's IDEbefore importing or uploading it.

Cross checking if there is an error

Since it can be difficult and unclear for developers to write code, cross-checking is crucial and significant.

Uploading the code to the Arduino device

Importing the codes to the Arduino device is the last step in the Arduino coding process, which enables the gadget to perform real-world physical actions.

3.4: Sample Arduino code for sensor

Reflectance sensor has four pin connection. Arduino Code of Reflectance sensor is discussed in appendix A.

TCRT 5000 IR Sensor Module	Arduino UNO
VCC	5V
GND	GND
DO	Pin 8
AO	A0

Figure 3.2: Pin connection

3.5: Flow chart of Reflectance sensor working mode

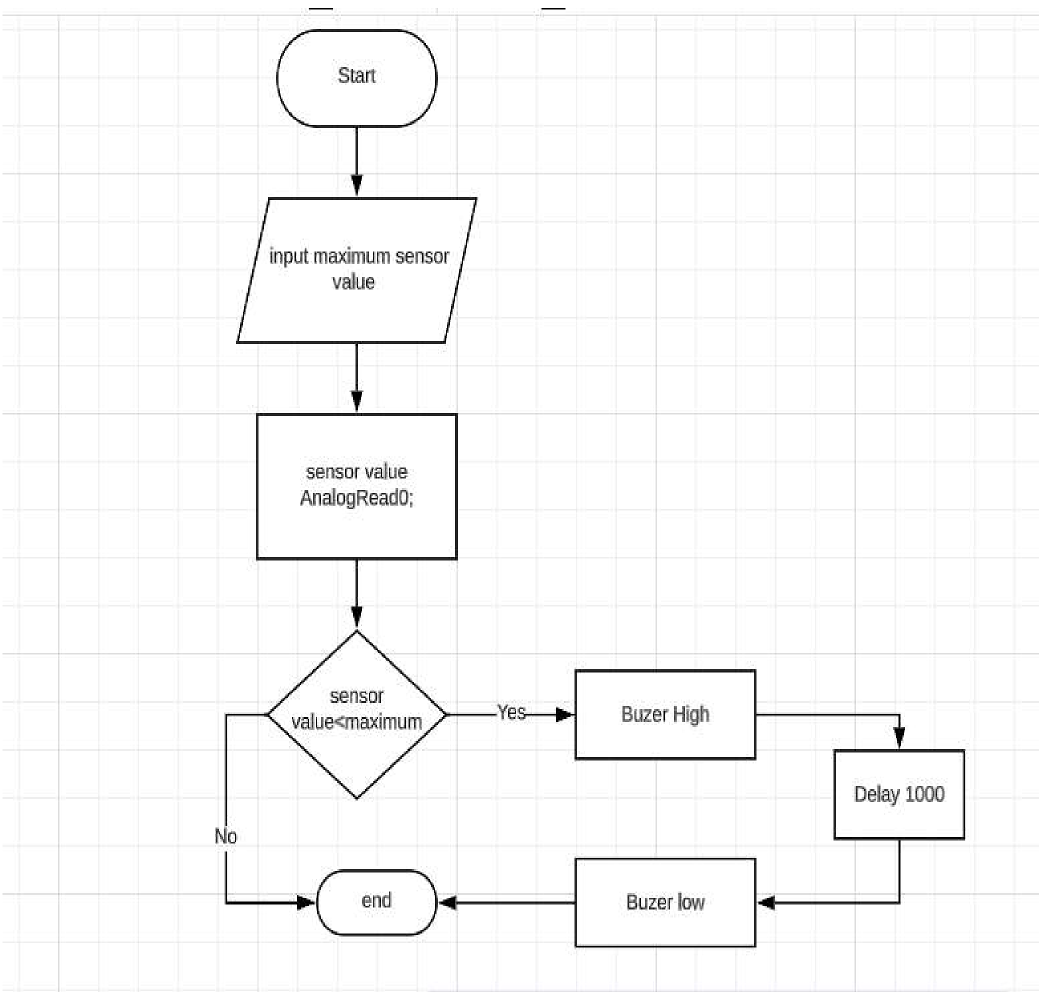

Figure 3.3: Reflectance sensor working mode

3.6: Source Code

Code of the project is discussed in Appendix B.

B: Hardware Design

3.7: System Design

Our system involves both hardware and software implementation, as was mentioned in the earlier sections. The hardware consists of a resistance sensor, a text-to-speech module, and Arduino, which serves as the system's primary brain.

3.8: Project's Components

In this chapter on hardware components, we will go through each individual component in detail. We'll go over the functions, traits, and roles of the components in our project. Consequently, the list of our parts is as follows:

Table no: 3.1 Project' Components

Sr.no	**Name**	**Quantity**
1.	QTR-1RC Reflectance Sensor	3
2.	DF Player Mini MP3 Player for Arduino	1
3.	3.5mm angle/straight jack cable (AUX, 1.5 mm)	1
4.	Insulated braided copper wire (3m)	1
5.	Arduino-compatible Nano board (ATmega328, mini-USB)	1
6.	USB 2.0 cable (EASY male A > male mini-B, 0,5m)	1
7.	Metal film resistor (20 Ohm, axial, 2W, 5%)	3
8.	NPN TO-92 transistor (40V, 0.6A, 0.625W)	1
9.	8 Ohms 2-watt speaker, 36mm _ Internal speaker	1
10.	USB 3.0 Type A Connector "G46"	1
11.	3,5mm Audio Jack Socket	1
12.	Status LED	2
13.	Voltmeter	1
14.	Soldering iron	1

3.8.1: Reflectance Sensor

The Pololu QTR-1A reflectance sensor carries a single infrared LED and phototransistor pair. The phototransistor is connected to a pull-up resistor to form a voltage divider that produces an analogue voltage output. The dimensions of Pololu QTR-1A reflectance sensor are Operating voltage: 5.0 V, supply current: 17 mA, Output format: analogue voltage and Output voltage range: 0 to supplied voltage. This sensor was designed to be used with the board parallel to the surface being sensed. Because of its small size, multiple units can easily be arranged to fit various applications such as line sensing and proximity/edge detection

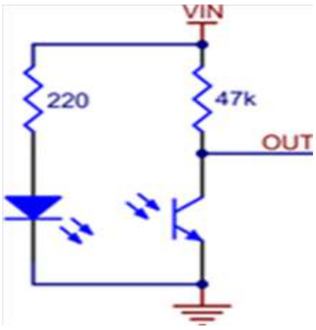

Figure 3.4: Reflectance Sensor

Sample code of Reflectance sensor discussed in Appendix A.

3.8.2: Arduino-compatible Nano board

Arduino Nano V3 is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3. X). Arduino Nano board has more or less the same functionality as the Arduino UNO but in a different package. Arduino Nano programming module lacks only a DC power jack and works with a Mini-B USB cable instead of a standard one.

In this project Arduino Nano Microcontroller driver module receives signals from eye tracker module via USB cable then uses the Text-to-Speech Module interfacing techniques in order to convert the selected phrases into audible speech. Since we are working with an operating voltage of 5 V with maximum amperage of around 400 mA, any common USB power bank is sufficient for our device.

Its specifications are it has a Microcontroller: Atmega328 (Arduino Nano), Operating Voltage (logic level): l5 v, Input Voltage (limits): 6-20 V, Digital I/O Pins: 14 (of which 6 provide PWM output), Analogue Input Pins: 8, FlashMemory: 16 KB (Atmega168) or 32 KB (Atmega328) of which 2 KB is used by the boot loader, Clock Speed: 16 MHz and dimensions are Length: 45 mm, Width: 18 mm and Weight: 5 g.

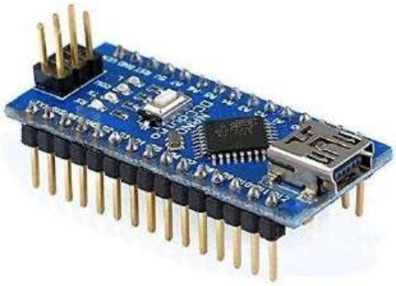

Figure 3.5: Arduino Nano

3.8.3: Insulated braided copper wire

Braided copper wires are extensively used for high quality electrical products such as high and low volt electrical appliances, mining explosion devices, proof switches, automobile industry and marine industry. It has specifications that it can be bare or tin-plated. Contact pads can be silver, tin or nickel plated. Current capacity to 3200 Amp. They provide protection from vibration, shock, temperature changes, climatic changes, movement and sometimes misalignment. They are known to deliver maximum power output even during peak performance. The biggest advantage to using a braided cable is that they have a long life span as well as Due to the presence of braids, the cable is more rigid, and durable and holds its shape for far longer.

Figure 3.6: Insulated Braided copper wire

3.8.4: USB cable (EASY male A > male Mini-B, 0,5m)

There are a number of different USB cables, each of which has different benefits and is suited to a different task. The cables and ports used by your smartphone and tablet will be either micro-USB or USB-C on one end, with a USB-A type on the other end. You can find out more about which type of USB your device uses. It is to connect Arduino Nano to Pc. The 3.5mm stereo audio cables are designed for use in computer audio applications. They are typically used to connect a PC sound card, mini stereo audio device, or a portable CD player to a multimedia speaker.

Figure 3.7: USB Cable 2.0 cable

3.8.5: Metal film resistor (20 Ohm, axial, 2W, 5%)

Metal film resistors are chosen for precision applications where initial accuracy, low temperature coefficient, and lower noise are required. Metal film resistors are generally composed of Nichrome , tin oxide or tantalum nitride, and are available in either a hermetically sealed or melded phenolic body.it has a specifications that metal film resistors are available with tolerances of 0.1, 0.25, 0.5, 1 and 2%. The temperature coefficient of resistance (TCR) is usually between 50 and 100 ppm/°C.it is used to check the resistance of the components.

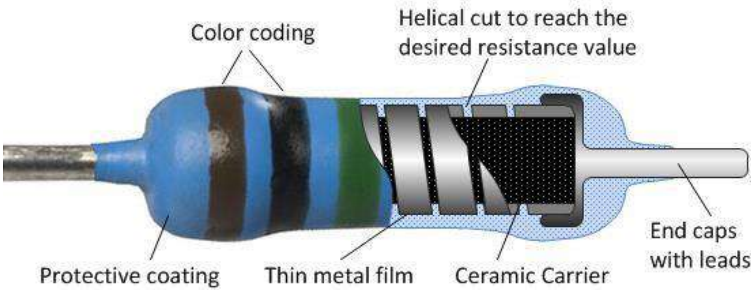

Figure 3.8: Metal film resistor

3.8.6: NPN TO-92 Transistor (40V, 0.6A, 0.625W)

The TO-92 is a widely used style of semiconductor package mainly used for transistors. The case is often made of epoxy or plastic, and offers compact size at a very low cost. The NPN transistor is designed to pass electrons from the emitter to the collector (so conventional current flows from collector to emitter). The emitter "emits" electrons into the base, which controls the number of electrons the emitter emits.

Figure 3.9 Transistor

3.8.7: Speaker Module

The internal speaker's basic and original role was to deliver audible "beep codes" during the startup process. This was a component of the POST process, which checks sure crucial hardware is available and operational in the startup process. There is no video display at this point in the boot process because the video driver, which depends on functional RAM, has not been activated. Therefore, oneof many tones is played by the internal speaker. Its specifications are 8 **Ohms 2-watt, 36mm and** speakers are used typically for home stereo systems, outdoor systems, and musical instrument amplifiers. Because home stereos have access to higher power supply voltages, a higher impedance speaker can be used to power speakers than say in a car. 4 ohm speakers are typically used for car stereo systems. A more complete, meaningful set of specifications for a single loudspeaker wouldlook like this: Anechoic frequency response ±6dB: 40Hz–25 kHz. Anechoic frequency response ±3dB: 45Hz–22 kHz. Anechoic linearity deviation between 100Hz and 10 kHz: ±1.5dB. The speakers are responsible for presenting good-quality audio sound. Modern speakers can play mp3, the speakersare capable of playing digital sound, stereo, and HD sound like Dolby. The speakers can easily be connected to personal computers.

Figure: 3.10: Internal speaker Module

3.8.8: Audio Jack Socket

The 3.5mm headphone jack is an industry standard audio plug. Most commonly used for connecting a pair of stereo headphones to your smartphone or 'piping' your audio from your phone to an external amp either in your home or your car. Dependent on the number of connector rings, headphones can also include a microphone. It has a specification that they are 3.5mm plugs are usually 14mm long but can, in some instances, be as long as 17mm and still be considered standard. 15mm and 17mm areused in video applications, though 17mm is quite rare. 3.5mm headphone jacks are typically designed to receive either 15mm or 17mm plugs. 3.5 mm jack used for Consumer electronics devices such as digital cameras, camcorders, and portable DVD players use 3.5 mm connectors for composite video and audio output. Typically, a TRS connection is used for mono unbalanced audio plus video, and a TRRS connection for stereo unbalanced audio plus video.

Figure: 3.11: Audio jack socket 3,5mm

3.8.9: Soldering Iron

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined and this bonds to the metal parts and forms a connection when the solder solidifies. Asoldering iron is composed of a heated metal tip (the bit) and an insulated handle. Heating is often achieved electrically, by passing an electric current (supplied through an electrical cord or battery cables) through a resistive heating element. It soldering iron is a hand tool used to heat solder, usually from an electrical supply at high temperatures above the melting point of the metal alloy. This allows for the solder to flow between the work pieces needing to be joined.it is used in Soldering Stained Glass and Mosaics, soldering in the Roofing Business, soldering for Plastic Circuit Boards, Soldering Metal Gutters, soldering for Electricians, soldering in Auto Repair, Soldering Tools for HomeProjects and Soldering in Jeweler.

Figure: 3.12: Soldering Iron

3.8.10: Solder wire

Solder wires are wires with a low melting point which can melt along with the soldering iron. Depending on the application and soldering temperature, many different types of soldering wires are available. Solder wires are generally two different types - lead alloy solder wire and lead-free solder. Its specifications are it is Ultimate Tensile Strength, Density, Ersin Multicore Solder and Electrical Conductivity. Solder is used to bond metal work pieces together and its applications are extensive. Solder is commonly used in, electronics, heating, air conditioning, mechanical, fire sprinkler and other similar systems as well as radiator manufacturing, repair and sheet metal work. It is also used in jeweler and stained glass work.

Figure: 3.13: Solder Wire

3.8.11: Status LED

A Light Emitting Diode (LED) is a semiconductor device, which can emit light when an electric current passes through it. To do this, holes from p-type semiconductors recombine with electronsfrom n-type semiconductors to produce light. The status LED is something you turn on when you want to see if the camera is picking you up as you adjust position and sensitivity. You walk into the field of vision and the LED goes on, so you can adjust to your liking. When you have it where you want it, that's it. he key LED light specifications are power rating, CRI, efficiency, LED color,voltage, power factor, LED light brightness, material type... Understanding LED light specification will help you choose a suitable LED lamp for any application. Remember, there are thousands of LED lighting systems today. The major uses of LED (Light Emitting Diodes) are to illuminate objects and even places. Its application is everywhere due to its compact size, low consumption of energy, extended lifetime, and flexibility in terms of use in various applications.

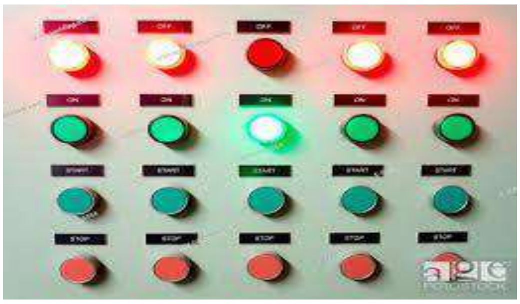

Figure: 3.14 LED

3.8.12: DF Player Mini MP3 Player for Arduino

The DF Player Mini MP3 Player for Arduino is a compact, reasonably priced MP3 module with a streamlined output that goes straight to the speaker. With a built-in battery, speaker, and push buttons the module can be used alone or in conjunction with other microcontrollers such the Arduino, ESP32, Raspberry Pi, and other microcontrollers having USRT (Universal Synchronous Asynchronous Receiver Transmitter).

3.8.13: Specification

- Sampling rates (kHz): 8/11.025/12/16/22.05/24/32/44.1/48
- 24 -bit DAC output, support for dynamic range 90dB, SNR support 85dB
- Fully supports FAT16, FAT32 file system, maximum support 32G of the TF card, support 32G of U disk, 64M bytes NORFLASH
- A variety of control modes, I/O control mode, serial mode, AD button control mode

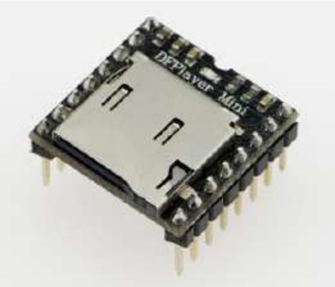

Figure: 3.15: DF Player

3.9: Blue Eye Technology

Every 100 milliseconds, the four sensors which we attached to the glasses, measure the brightness of particular parts of the eye. When measuring brightness, the time it takes for an infrared LED beam to reflect off a surface and return to the sensor is represented by a number ranging from 0 to 5000. The brighter the surface, the faster or lower the number, as brighter surfaces reflect more

Figure 3.16: Blue EyeTechnology

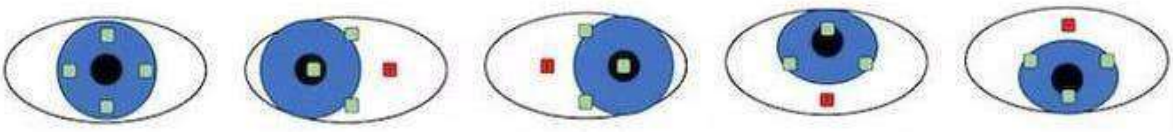

Figure 3.17: Eye moment detection

To establish whether the eye is looking left, right, up, or down, it is necessary to first assess the brightness of the four spots in a neutral eye position. The user must spend a few seconds staring straight ahead when turning on the device. These figures serve as the reference point for comparing the new measurements. A direction is recognized when the value on the opposing side briefly drops below the neutral value. This is due to the fact that the left side of the eye appears white when the eye is gazing to the right, for instance. For minor motions to be recognized as direction, the value must be greater than a specific threshold. In our testing, this tactic delivered the most reliable outcomes.

3.9.1: Flow chart Blue Eye Technology

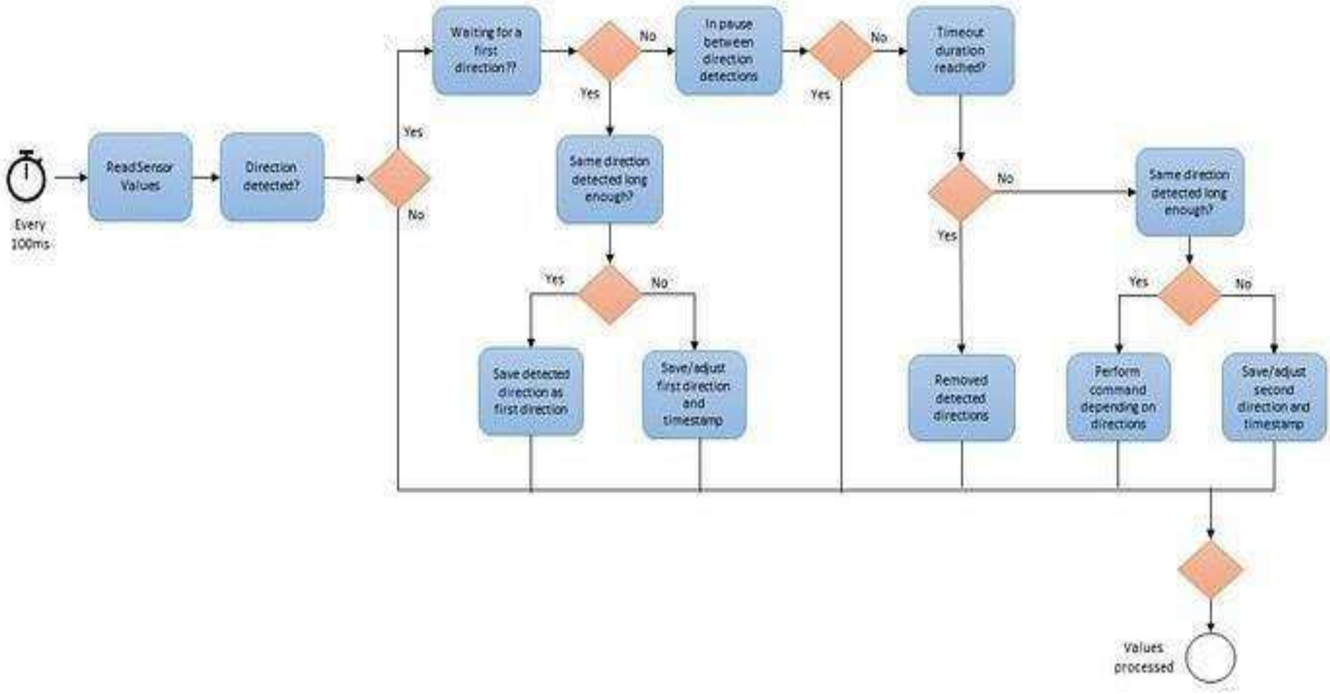

Figure 3.18: Blue Eye Technology

3.10: Working principle

The main device requires the usage of a microcontroller, which functions as the device's "brain," coordinating input, computations, and subsequent output while monitoring sequential tasks, etc. For this task, an Arduino Uno is employed. The team included a top-notch text-to-speech controller, Parallax Emic 2, as a relief for the Arduino to correctly isolate the audio output capabilities so that the Arduino is still usable for other inputs, like LED control, after delivering the output texts to the controller. After transmitting the output messages to the speaker, the team added a top-notch text-to-speech controller, Parallax Emic 2, to appropriately isolate the audio output capabilities so that the Arduino is still available for other inputs, such LED control.

3.11: Methodology

The goal of the BLUE EYES technology is to develop computational robots with sensory and perceptive abilities similar to those of humans. It makes advantage of the most advanced nonintrusive sensor techniques. Video cameras and microphones are used to track user behavior using their innate senses. The device is capable of comprehending a user's desires, the location of his gaze, and even his emotional and physical states. The details of our module and how we designed it are provided in this chapter.

3.12: Block Diagram

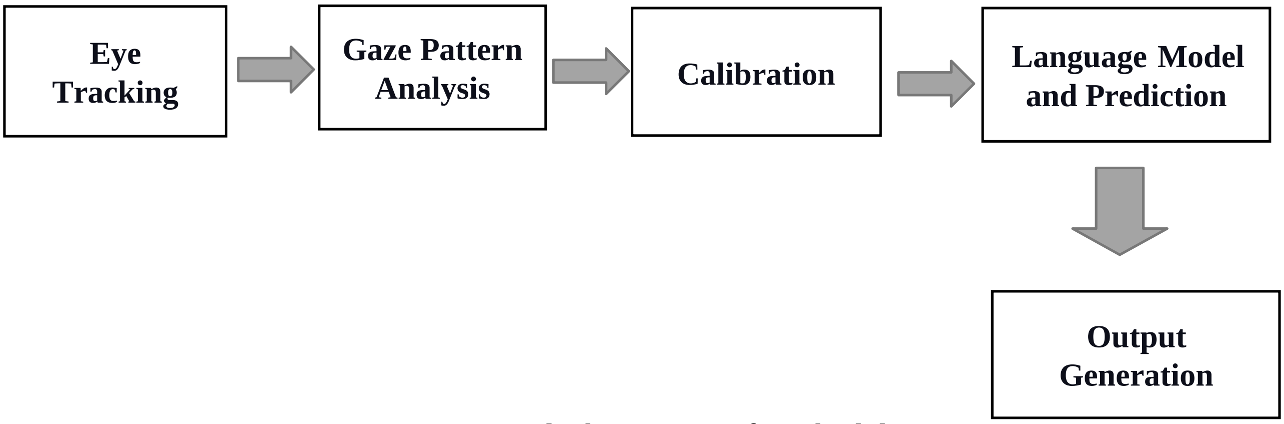

Figure 3.19: Block Diagram of Methodology

3.12.1: Eye Tracking

A person's presence can be detected by the sensor technology known as Eye Tracking, which can also track their gaze in real time. Eye motions are converted by this technology into a data stream that includes details like pupil position, gaze vectors for each eye, and gaze point. In essence, the technology decodes eye movements and converts them into insights that may be utilized as an additional input modalityor in a variety of applications.

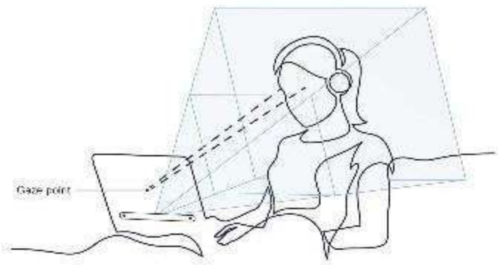

Figure 3.20: Eye Tracking

3.12.2: Gaze Pattern Analysis

Once the eye tracker has captured the gaze data, the system must interpret and analyze it. This entails analyzing raw eye-tracking data to derive useful information about the user's planned activities
Or communication cues.

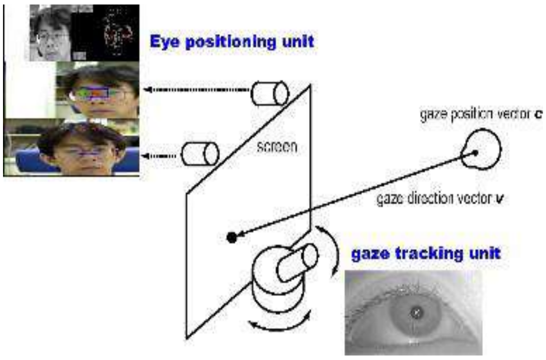

Figure 3.21: Gaze patternAnalysis

3.12.3: Calibration

A calibration phase is normally conducted before the eye-to-speech module can correctly understand the user's gaze. This method aids in the establishment of a mapping between the user's gaze patterns and certain system items or commands.

3.12.4: Language Model and Prediction

After analyzing and calibrating the gaze patterns, the eye-to-speech module uses a Language Model or a predictive algorithm to translate the user's eye movements into voice output. Machine learning, natural language processing (NLP), or voice synthesis techniques may be used by the language model to create meaningful words or answers based on the translated gaze patterns.

3.12.5: Output Generation

The final stage is to create the voice output using the information collected from the gaze patterns and language model predictions. Text-to-speech (TTS) synthesis methods can be used by the system to turn the produced text into audible speech. Speakers, headphones, or other assistive communication equipment can be used to produce the output.

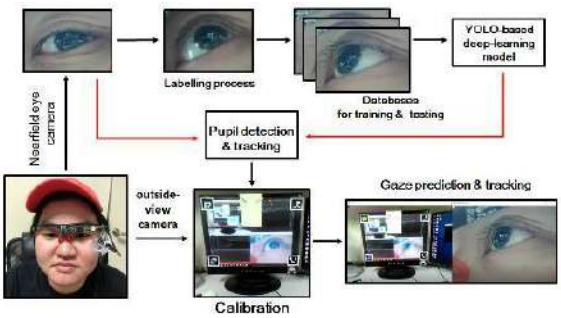

Figure 3.22: Eye Tracking System

It should be noted that precise implementation details and approaches may differ based on the eye- tracking hardware/software utilized, the complexity of the language model, and the general architecture of the eye-to-speech module. To improve communication for those with poor speech abilities, the system may additionally contain capabilities like word prediction, user customization, or interaction with other assistive technologies. Our project additionally contains capabilities like word/phrase prediction

Flow chart

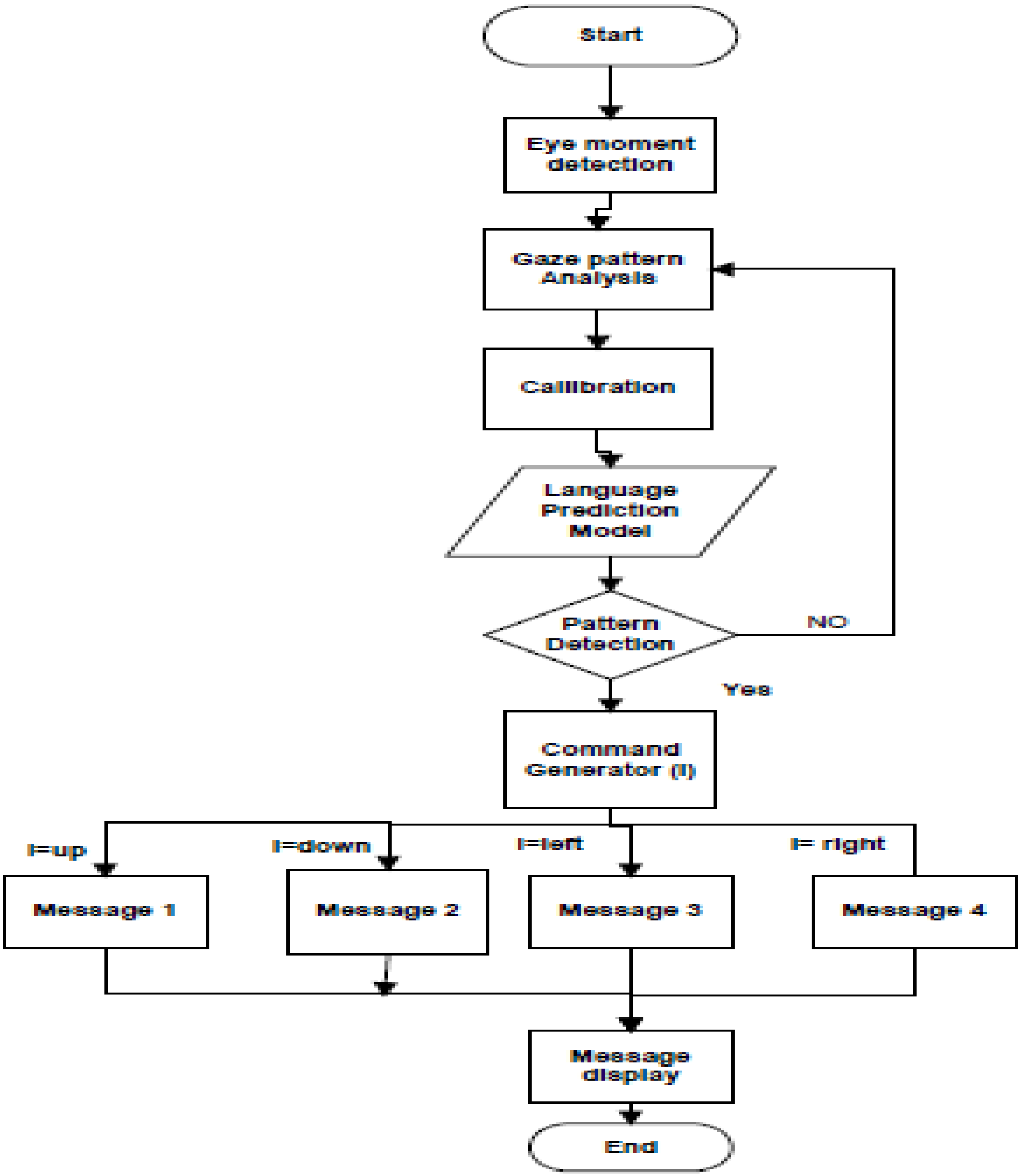

Figure 3.23: Flow chart of Methodology

3.14: Hardware design issues

I. The sensors were too far away from the eye, which caused them to report incorrect movement patterns.

II. To shorten the distance between the eyes and the sensors, directly attach a 3D-printed sensor ring to the spectacles.

III. Make sure our sensors wouldn't injure the wearer even over longer periods of time to confirm the viability of long-term health consequences.

IV. Build a 3D-printed enclosure with precise dimensions and the required cutouts to employ a specially built circuit board that best suits our needs in order to safeguard the circuit

CHAPTER NO. 4

RESULLTS

A: Simulation Results

4.1: Software Simulation

The software Arduino IDE code simulation is in Appendix of this report.

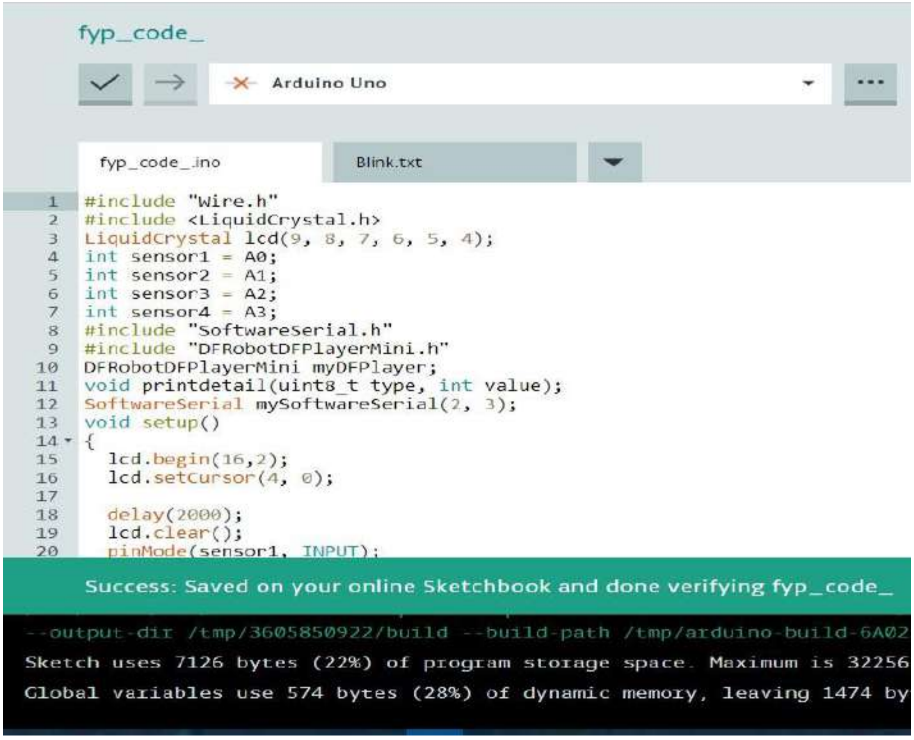

Figure 4.1: code Simulation

The Code of the project is discussed in Appendix B.

The Simulation of our project eye to speech Module on Proteus Software is given as

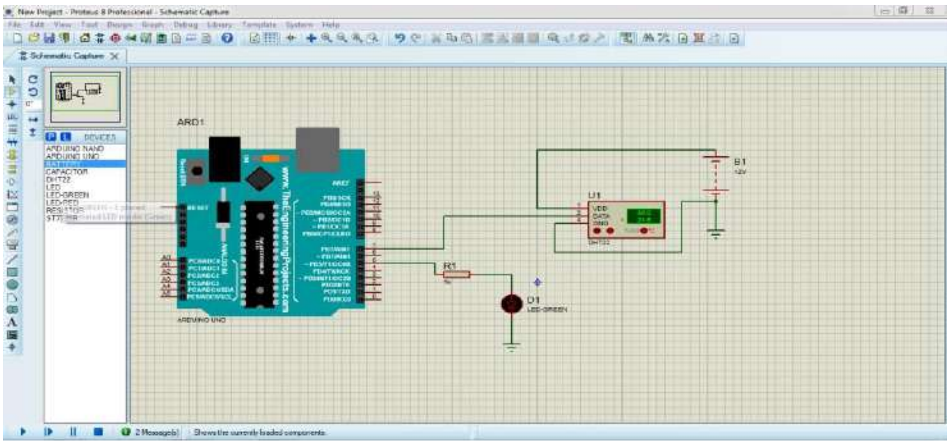

Figure 4.2: Proteus Simulation

B: Hardware Completion

4.2: PCB Designing

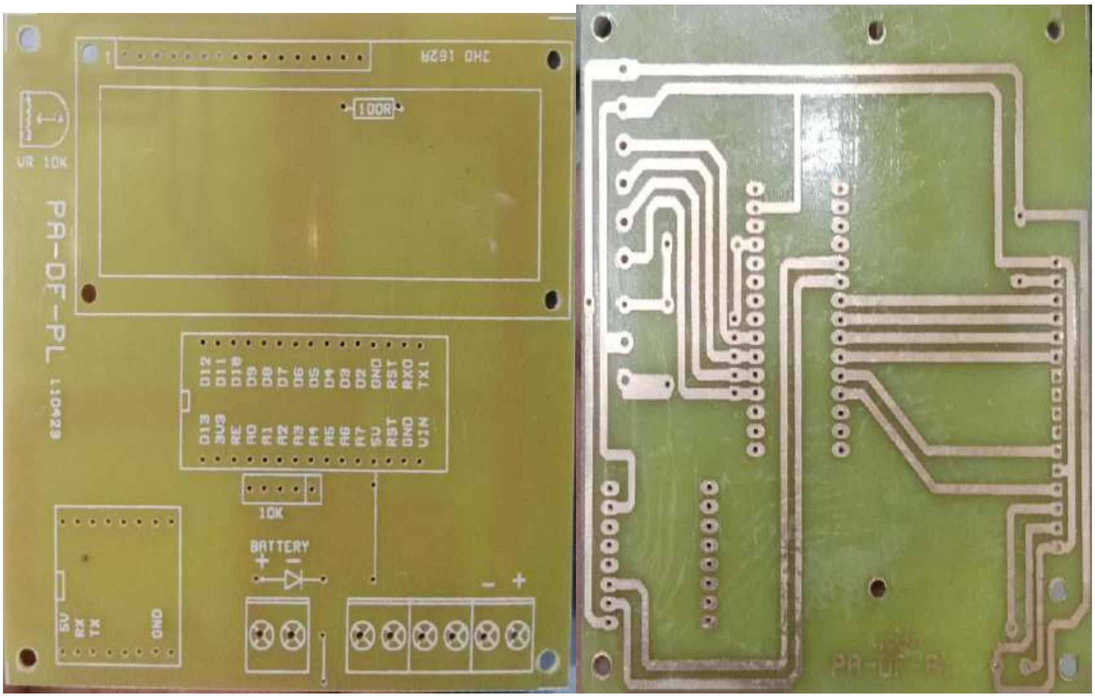

Figure 4.3: PCB Designing

The PCB (Printed Circuit Board) layout of Eye to Speech Module is given in the AppendixC of this Report.

4.3: Hardware Completion

The overall hardware of our project Eye to Speech module is given as follows:

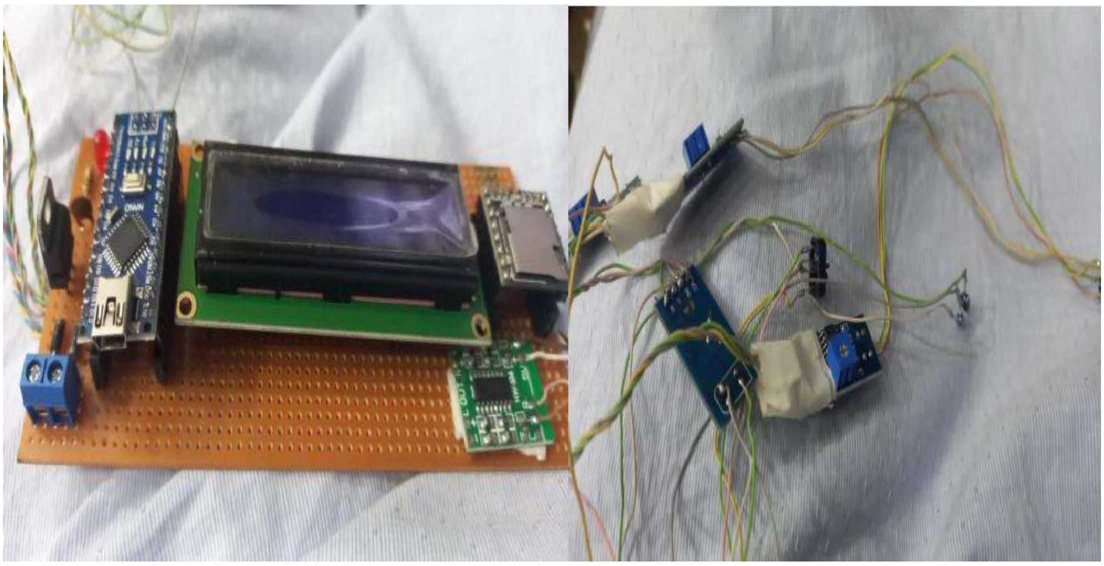

Figure 4.4: Hardware Completion

4.4: Training of Project

For the training of our project eye to speech module, we take total 39 patients which are categorized into 3 groups of patients on the basis of their disabilities. The details of Training groups are describing in following Table 4.1.

Table 4.1: No. of Training Groups

No. of Groups	**Names of Groups**	**Categories of Groups**	**No. of Patientsin groups**
1	Group A	Lock-in Syndrome Patients	14
2	Group B	Mute Patients	5
3	Group C	ALS(Amyotrophic lateral sclerosis) Patients	20

The training of Eye to Speech Module is done under the certain conditions:

- The distance between eye and sensor should be 7-10mm range.
- The operating voltage and operating current of our project eye to Speechmodule should be 5V

The operating current of Eye to speech module is 400mA

4.5: The Variables

The variables that on which our Project Eye to Speech Module depend are Dependent and Independent Variables. The Dependent variables including the average duration of fixations(the duration during which the eyes focus on a specific area, which might be a certainobject in the surroundings) and Distance between sensors and eyes while the independent variable of are Eye contact and time delay.

4.6: Training Hours

After 20 hours of training of Eye to Speech Module, the following bar graph is obtained.

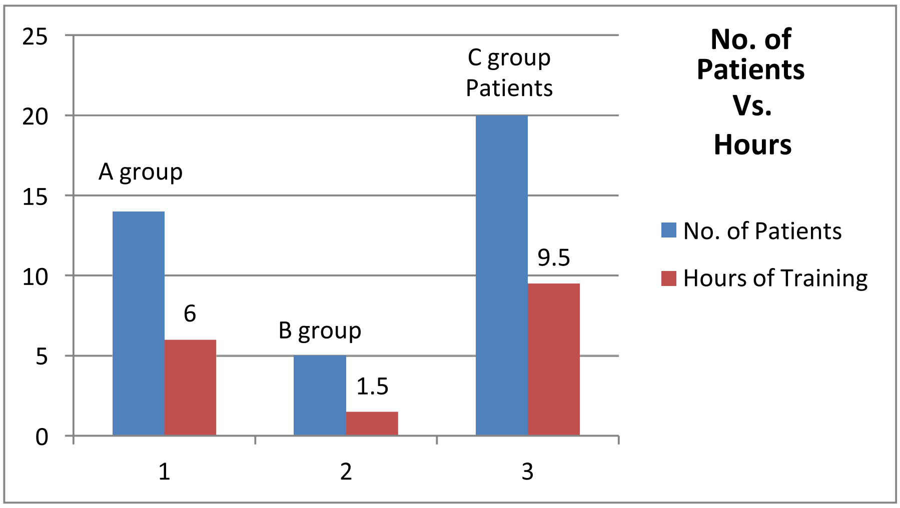

Figure 4.5: No. of Patients VS Training Hours

The A group (Lock-in Syndrome patients), B group (Mute Patients) and C group (ALS patients) take 6 hours, 1.5 hours and 9.5 hours of training on Eye to speech Module respectively.

4.7: Eye position and Time Delays

The eyeball position is used to control the Senor position. To determine the motion direction of eye movements, range of eye positions and their time delays are describing in Figure 4.4 and table 4.2.

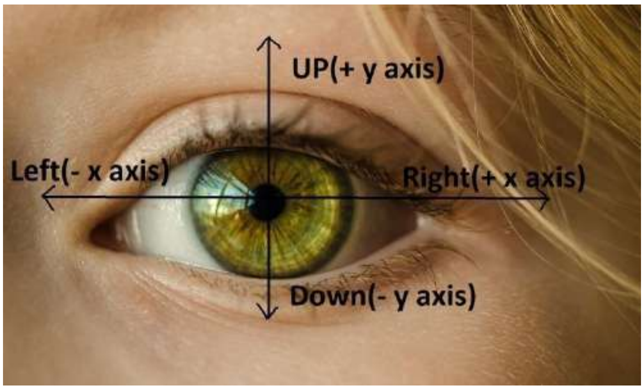

Figure 4.6: Eye movement Positions

When the eye's pupil moves to a certain position, the instruction on that position displayedon the LCD and on the speaker takes 2000ms and 1000ms, respectively

Table 4.2: Eye movement Positions and their Instructions

Eye Movements	**Distance Range of Eye Positions (cm)**	**Instructions on Movement**	**Speaker Time Delay(m s)**	**LCD Time Delay(m s)**
Up	$2 \leq y \leq 10$	Rest	1000	2000
Down	$-2 \leq y \leq -10$	Drink	1000	2000
Left	$-2 \leq x \leq -10$	Eat	1000	2000
Right	$2 \leq x \leq 10$	Reading	1000	2000

4.8: Graphs of Eye position and their precision

In order to check the accuracy of our project Eye to speech module, we take measurementof eye positions in all direction of all group categories. The Precision of Eye to Speech Module is within following range: **0 < Precision ≤ 1,** when x and y are within their limits.

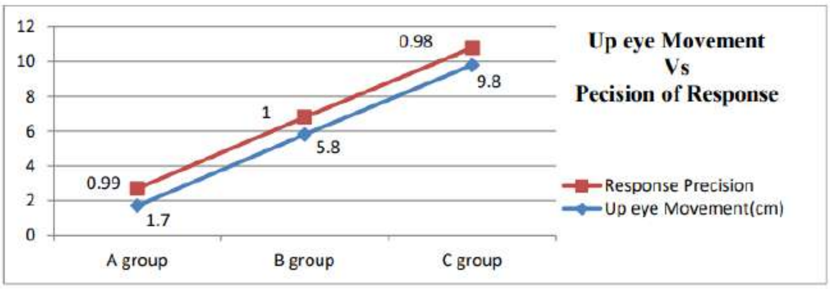

Figure 4.7: Up movement VS Precision

Figure 4.7 shows graph between the upward movement of eye taking distance on positive y-axis from center of eye and precision of upward movement command of all groups of patients. The group A (Lock-in Syndrome) patients use upward movement of eye with 1.7cm, group B patients (Mute patients) experience 5.8cm and group C (ALS patients) take 9.8cm distance from center of eye and have 0.9, 1 and 0.98 the precision of upward command respectively. The overall precision of upward command of eye is almost near to 1 that is our maximum precision of eye to speech module.

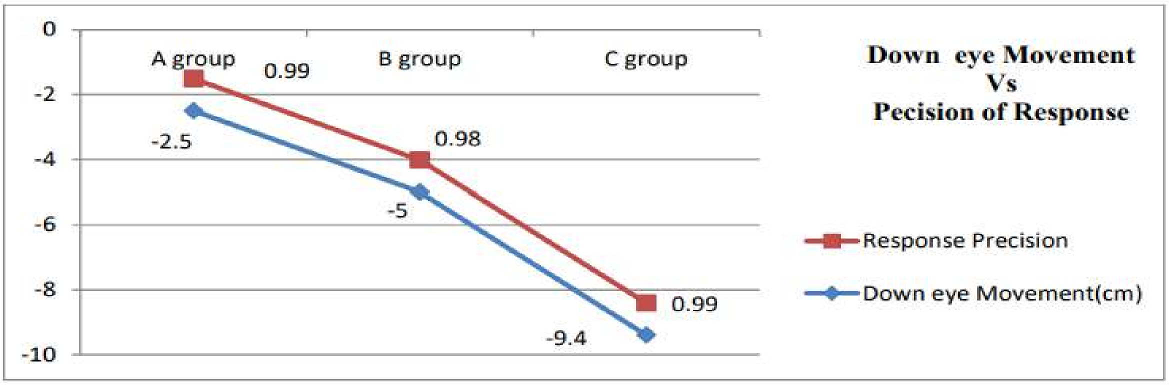

Figure 4.8: Down movement VS Precision

Figure 4.8 shows graph between the downward movement of eye taking distance on negative y-axis from center of eye and precision of downward movement command of all groups of patients. The group A (Lock-in Syndrome) patients use downward movement of eye with -2.5cm, group B patients (Mute patients) experience -5cm and group C (ALS patients) take -9.4cm distance from center of eye and have 0.9, 0.98 and 0.9 the precision of downward command respectively. The overall precision of downward command of eye is almost near to 1 that is our maximum precision of eye to speech module.

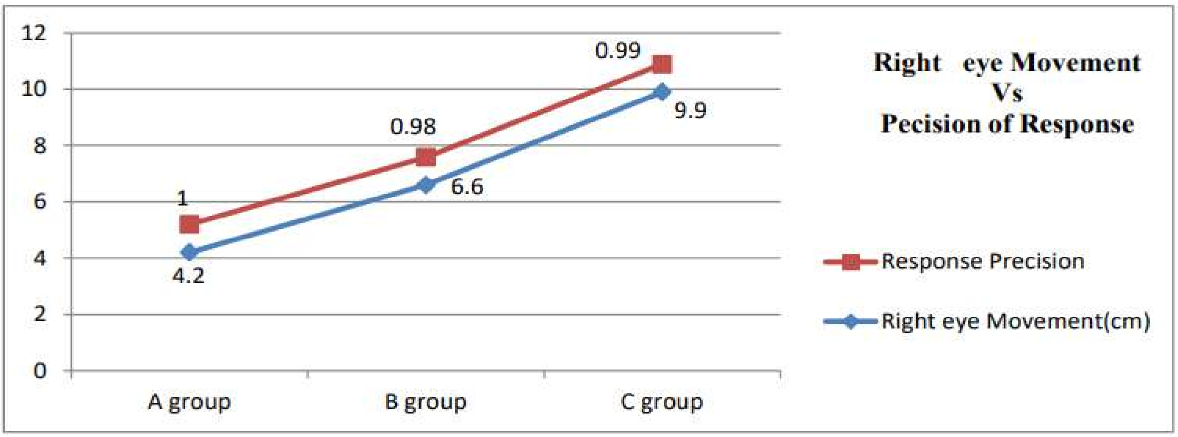

Figure 4.9: Right movement VS Precision

Figure 4.9 shows graph between the right movement of eye taking distance on positive x-axis from center of eye and precision of right movement command of all groups of patients. The group A (Lock-in Syndrome) patients use right movement of eye with 4.1cm, group B patients (Mute patients) experience 6.6cm and group C (ALS patients) take 9.9cm distance from center of eye and have 1, 0.98 and 0.9 the precision of right command respectively. The overall precision of right command of eye is almost near to 1 that is our maximum precision of eye to speech module.

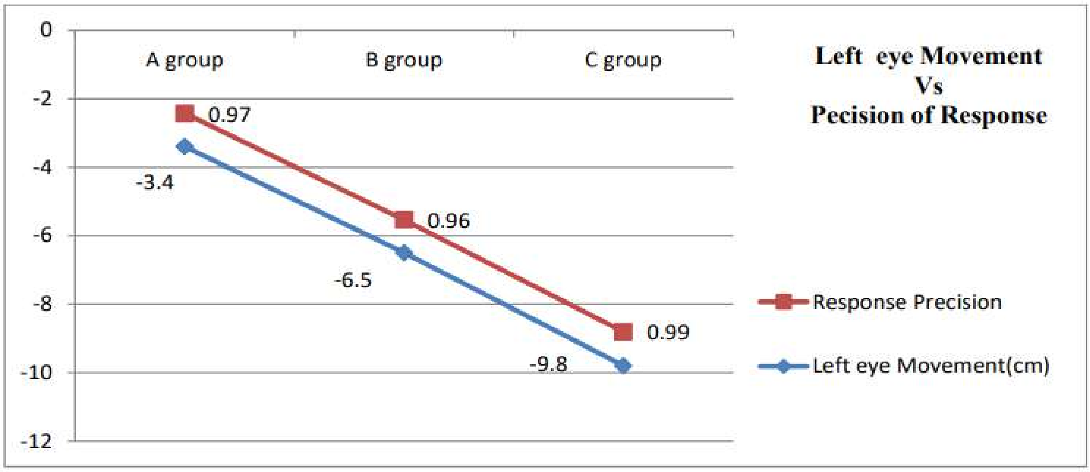

Figure 4.10: Left movement VS Precision

Figure 4.10 shows graph between the left movement of eye taking distance on negative x-axis from center of eye and precision of left movement command of all groups of patients. The group A (Lock-in Syndrome) patients use left movement of eye with -3.4cm, group B patients (Mute patients) experience -6.5cm and group C (ALS patients) take -9.8cm distance from center of eye and have 0.9, 0.9 and 0.99 the precision of left command respectively. The overall precision of left command of eye is almost near to 1 that is our maximum precision of eye to speech module.

4.9: Overall Result

The table 4.3 compares the all eye movements' positions according to group patients.

Table 4.3: Summary of all eye Movements

Groups	Up (cm)	Up Precision	Down (cm)	Down Precision	Right (cm)	Right Precision	Left (cm)	Left Precision
A	1.7	0.99	-2.5	0.99	4.2	1	-3.4	0.97
B	5.8	1	-5	0.98	6.6	0.98	-6.5	0.96
C	9.8	0.98	-9.4	0.99	9.9	0.99	-9.8	0.99

When the eye's pupil move in certain direction of four sensors that are mounted in all four directions i.e. Up, down, Left and Right, the instruction on that direction convert into text and then display on LCD and speaker in time delays as 2000ms and 1000ms respectively. After training of instructions on all four sensors, the precision is almost reaches to 1 that is maximum precision of our Eye to Speech Module as all the distance (cm) that eye's pupil cover is within the range of all eyes movements i.e. Up, Down, Right and Left.

CHAPTER NO.5

DISCUSSION AND FUTURE SCOPE

5.1: Conclusion:

Our Project Eye to speech module is a simple and cost-efficient application for speech- impairment patients who only have their eyes to initiate communication with their surrounding world. It relies on a glasses with four sensors mounted on it and a LCD and Text-To-Speak language to translate different eye gestures into a set of daily life commands used by the patients to express their emotions and needs. Our eye to speech module allows environmental barriers to be removed for people with a wide range of disabilities. The accuracy of instructions response in all four directions i.e. up, Down, Left and Right is 98.9% and precision is almost one that is maximum precision of ourEye to Speech Module.

5.2: Advantages of Eye to speech Module

o Eye movements are more natural, less tiring and reliable than other types of eye tracking. Other methods of eye tracking are less natural, exhausting, and dependable than eye movements. Human eyes can be manipulated as easily as a mouse pointer ona computer screen. This implies that users will find it easier to use than a traditional input device (such a keyboard or mouse), which requires physical power to use.

o Other forms of eye tracking technologies, such as head-mounted cameras or infrared light sensors connected to the user's head, are less precise. These alternatives have flaws since they are insufficiently accurate for users with restricted movement abilities

- They may need to move their heads several inches before reaching an object! However, eye tracking allows you to strike small targets even if your vision is affectedby cataracts or glaucoma (which affects over 8 million individuals in the United States alone).

5.3: Disadvantages of Eye to speech Module

o Eye movement based speech conversion system is not perfect.

o Eye movement based speech conversion system is not a cure for all speech disability cases.

o Eye movement based speech conversion system is not a substitute for a humanspeaker.

5.4: Limitations

o There are limitations to the use of wearable (such as Eye to Speech Module) because of their size. Due to their compact size, certain wearable is not appropriate forcommon tasks such as email correspondence or various types of research and they are limiting their usefulness and cost effectiveness.

o Wearable technology may pose security risks. Since wearable are always connectedto the internet, this makes them more vulnerable to attacks.

5.5: Future Scope

The future scope of eye-to-speech interpreters has enormous progress and improvement potential. Here are some probable future developments in this field:

5.5.1: Improved Accuracy

Improving the accuracy and reliability of gaze tracking and pattern analysis is a crucial part of eye-to-speech interpretation. Eye-tracking technology and algorithmic advancements can lead to more exact and robust interpretation of eye movements, allowing for more accurate communication.

5.5.2: Real-time Interaction

Future systems may priorities latency reduction and real-time interaction between the user and the eye-to-speech interpreter. This would improve the naturalness and flow of communication, allowing people to engage in more dynamic and responsive dialogues.

5.5.3: Calibration Techniques Improvements

Calibration is a critical step in setting up an eye-to-speech system. Future developments might look at automated or adaptive calibration systems that need less human work and enable more efficient and personalized calibration procedures.

5.5.4: Contextual Understanding

Advanced natural language processing and context-awareness approaches can help eye- to-speech translators. The system can better grasp the user's goals and provide more accurate and contextually appropriate voice output by taking the context of the discussioninto account.

5.5.5: Multimodal Integration

Eye-tracking technology may be integrated with other input modalities such as gesture recognition, voice commands, or brain-computer interfaces to provide multimodal integration. Integrating numerous input sources can improve overall communication experience and enable additional forms of connection for those who have complicated communication demands.

5.5.6: Customization and adaptability

Future systems may priorities giving user’s greater customization choices, allowing them to tailor the eye-to-speech interpreter to their unique requirements and preferences. Customizable user interfaces, personalized language models, and flexible algorithms can all help to make communication more personalized and successful.

5.5.7: Accessibility and portability

Improving eye-to-speech interpreter accessibility and portability can have a big impact. Miniaturization of eye-tracking gear and the creation of lightweight, portable systems have the potential to make this technology more widely available and accessible in a variety of scenarios.

5.5.8: Integration with Smart Devices

Eye-to-speech translators can be combined with smart devices and home automation systems, allowing users to manage their surroundings, access information, and execute numerous activities using their eye movements.

These are only a few of the possible areas of growth for eye-to-speech interpreters. As technology advances, there is considerable promise for innovation and advancements in this sector, enabling improved communication and improving the quality of life for those who have difficulty speaking.

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APPENDIX

Appendix A

Source code for Reflectance sensor

```
#include <QTRSensors.h>
// This example is designed for use with eight RC QTR sensors. These
// reflectance sensors should be connected to digital pins 3 to 10. The
// sensors' emitter control pin (CTRL or LEDON) can optionally be connected to
// digital pin 2, or you can leave it disconnected and remove the call to
// setEmitterPin().
// The setup phase of this example calibrates the sensors for ten seconds and
// turns on the Arduino's LED (usually on pin 13) while calibration is going
// on. During this phase, you should expose each reflectance sensor to the
// lightest and darkest readings they will encounter. For example, if you are
// making a line follower, you should slide the sensors across the line during
// the calibration phase so that each sensor can get a reading of how dark the
// line is and how light the ground is. Improper calibration will result in
// poor readings.
// The main loop of the example reads the calibrated sensor values and uses
// them to estimate the position of a line. You can test this by taping a piece
// of 3/4" black electrical tape to a piece of white paper and sliding the
// sensor across it. It prints the sensor values to the serial monitor as
// numbers from 0 (maximum reflectance) to 1000 (minimum reflectance) followed
// by the estimated location of the line as a number from 0 to 5000. 1000 means
// the line is directly under sensor 1, 2000 means directly under sensor 2,
// etc. 0 means the line is directly under sensor 0 or was last seen by sensor
// 0 before being lost. 5000 means the line is directly under sensor 5 or was
// last seen by sensor 5 before being lost.
QTRSensors qtr;
const   uint8_t   SensorCount   =   8;
uint16_t sensorValues[SensorCount];
void setup()
{
  // configure the sensors
  qtr.setTypeRC();
  qtr.setSensorPins((const uint8_t[]){3, 4, 5, 6, 7, 8, 9, 10}, SensorCount);
  qtr.setEmitterPin(2);
  delay(500); pinMode(LED_BUILTIN,
  OUTPUT);
  digitalWrite(LED_BUILTIN, HIGH); // turn on Arduino's LED to indicate we are in
calibration mode
  // 2.5 ms RC read timeout (default) * 10 reads per calibrate() call
  // = ~25 ms per calibrate() call.
  // Call calibrate() 400 times to make calibration take about 10 seconds.
  for (uint16_t i = 0; i < 400; i++)
  {
    qtr.calibrate();
  }
  digitalWrite(LED_BUILTIN, LOW); // turn off Arduino's LED to indicate we are
```

```
  // print the calibration minimum values measured when emitters were on
  Serial.begin(9600);
  for (uint8_t i = 0; i < SensorCount; i++)
  {
    Serial.print(qtr.calibrationOn.minimum[i]);
    Serial.print(' ');
  }
  Serial.println();

  // print the calibration maximum values measured when emitters were on
  for (uint8_t i = 0; i < SensorCount; i++)
  {
    Serial.print(qtr.calibrationOn.maximum[i]);
    Serial.print(' ');
  }
  Serial.println();
  Serial.println();
  delay(1000);
}
void loop()
{
  // read calibrated sensor values and obtain a measure of the line position
  // from 0 to 5000 (for a white line, use readLineWhite() instead)
  uint16_t position = qtr.readLineBlack(sensorValues);
  // print the sensor values as numbers from 0 to 1000, where 0 means maximum
  // reflectance and 1000 means minimum reflectance, followed by the line
  // position
  for (uint8_t i = 0; i < SensorCount; i++)
  {
    Serial.print(sensorValues[i]);
    Serial.print('\t');
  }
  Serial.println(position);

  delay(250);
}
```

Appendix B Source code of Eye to Speech Module

```
#include "Wire.h"
#include        <LiquidCrystal.h>
LiquidCrystal lcd(9, 8, 7, 6, 5, 4);
int sensor1 = A0;
int sensor2 = A1;
int sensor3 = A2;
int sensor4 = A3;
#include             "SoftwareSerial.h"
#include "DFRobotDFPlayerMini.h"
DFRobotDFPlayerMini    myDFPlayer;
void printdetail(uint8_t type, int value);
SoftwareSerial mySoftwareSerial(2, 3);
void setup()
{
  lcd.begin(16,2);
  lcd.setCursor(4, 0);
  delay(2000);
  lcd.clear();
  pinMode(sensor1,                  INPUT);
  pinMode(sensor2,                  INPUT);
  pinMode(sensor3,                  INPUT);
  pinMode(sensor4,                  INPUT);
  Serial.begin(9600);
  mySoftwareSerial.begin(9600);
  Serial.begin(115200);
   Serial.println(F("Initializing aFPlayer..."));  //Use softwareSerial to communicate
with MP3
  if (!myDFPlayer.begin(mySoftwareSerial))
 {
    Serial.println(F("Unable          to          begin:"));
    Serial.println(F("1.Please recheck the connection!"));
    Serial.println(F("2.Please insert the Sa cara!")); while
    (true);
  }
  Serial.println(F("dFPlayer Mini online."));
  myDFPlayer.volume(30);
}
void loop()
{
 int a = analogRead(sensor4);
 Serial.print("sensor1:       ");
 Serial.print(a);
  int b = analogRead(sensor2);
 Serial.print("sensor2:        ");
 Serial.print(b);
  int c = analogRead(sensor3);
```

```
 Serial.print("sensor3: ");
  Serial.print(c);
  int d = analogRead(sensor1);
 Serial.print("sensor4:         ");
 Serial.println(d);
if ((a < 230)&&(b < 45)&&(z < 120)&&(a < 850 ))
   {
    Serial.println("bye");
    lcd.clear();
    myDFPlayer.play(4);
    delay(1000);
  }
if ((b < 110)&&(a > 195)&&(z < 200)&&(a < 850 ))
   {
    Serial.println("assalam o alaikum");
    myDFPlayer.play(5);
    delay(1000);
  }
   if ((b < 860 )&& (c <870 ) && (d > 1005 ))
  {
    Serial.println(" hello");
    myDFPlayer.play(2);
    delay(1000);
  }
  if ( (b > 880 )&& (c > 905 ) && (d > 1005 ))
  {
    Serial.println("hi");
    lcd.clear();
    myDFPlayer.play(7);
    delay(1000);
  }
```

Appendix C

PCB Designing