A Project Report on

SMART ASSISTANCE GLOVE

Submitted By

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under the guidance of

PROF. N. S. BENIWAL

in partial fulfillment of the
requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING,

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2022-23

DECLARATION

We hereby proclaim that the work that is being presented in this report entitled “Smart Assistant Glove” is our own original work and has not been reported by anyone else or submitted in any form for another degree or diploma to any other institution. Information derived from the other sources has been accredited in the text and a list of references has been given.

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CERTIFICATE

This is to certify that the project report entitled “Smart Assistant Glove” submitted by Amritanshu Yadav, Poonam Verma, and Shuvi Vyas for the award of the degree of B. Tech., is carried out by them undermy guidance.

Prof. N. S. Beniwal
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VERIFICATION

This is to verify that the project entitled “Smart Assistance Glove” submitted to the Department of Electronics and Communication Engineering Department of Bundelkhand Institute of Engineering and Technology, Jhansi during academic year of 2022-2023.

Atul Kumar Dwivedi
Officer in Charge, B.Tech Projects

Prof. Deepak Nagaria
Head of Department

DEDICATION

To my beloved Parents and Almighty

Project Outcomes (Ps)

S.N.	**Project Outcomes** After completing this project students will be able to:	Bloom's Knowledge Level
P1	Apply the knowledge of sensors, and different electronics devices to make the project.	KL 3
P2	Associate Arduino with Software.	KL 4
P3	Interfacing of Arduino IDE.	KL 3
P4	Design a system for smart gloves using hardware as well as software.	KL 6

KL: Bloom's Knowledge Level

KL1: remember, KL2: Understand, KL3: Apply, KL4: Analyze, KL5: Evaluate, KL6: Create/Design

Mapping of Project Outcomes with Program Outcomes (POs)

Ps	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
P1	2	2	2	-	3	3	-	3	3	3	2	3
P2	2	2	-	-	1	2	-	2	2	2	-	3
P3	2	2	1	2	2	2	-	2	2	2	1	2
P4	3	2	2	1	3	-	-	2	2	2	2	2
P5	2	2	2	2	1	-	2	-	3	2	3	3

Mapping rules (Rubrics):

1: Poor
2: Medium
3: Best

Mapping of Program Outcomes (POs) with Project

S.N.	**Program outcomes** After completing B. Tech. program students will be able to	Map
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3
PO2	**Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3
PO3	**Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	3
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2
PO7	**Environment and Sustainability:** Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	2
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and	3

	responsibilities and norms of the Engineering practice.	
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3
PO10	**Communication:** Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.	3
PO12	**Life - Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	3

Mapping rules (Rubrics):

1: Poor

2: Medium

3: Best

ABSTRACT

The communication between ordinary people and people with vocal and hearing inconveniencies is a challenging task. It makes a communication obstruction between the people groups as there are exceptionally few individuals who can understand sign language. The gloves designed are exceptionally straightforward however viable when compared to the existing framework. With the assistance of flex sensors, the finger motion is recognized and the comparing informational with sound yield. The proposed framework is implemented by utilizing Arduino UNO. Taking gigantic jumps in engineering and innovations with each passing year, people are making keen innovations each year to assist themselves and the ones who are influenced by any inability. Arduino is a microcontroller for building advanced gadgets and intuitively objects that can sense and control objects within the physical and computerized world. An assortments of chips and controllers has been used by Arduino UNO.

The proposed work points to solve the everyday challenges confronted by individuals, who are incapable to talk (dumb) or who have recently undergone an accident and are incapable to talk. It can also be demonstrated advantageous by elderly people, who discover trouble in speaking. With this wearable smart assistance glove, dumb people or patients can easily communicate by fair tapping the points on the glove with their thumb which comes about completely different commands that will show up in audible audio. In future this can also be utilized within the computerization of day-to-day things like domestic machines and numerous more.

ACKNOWLEDGEMENT

We would like to express our deepest and sincere gratitude to **Prof. N. S. Beniwal**, Electronics and Communication Engineering, Bundelkhand Institute of Engineering and Technology Jhansi, who helped and encouraged us a lot to carry out this work. The advice given by him was worthy and valuable.

We are very much thankful to Professor Deepak Nagaria, Head of Department (HOD) of Electronics and Communication Engineering, Bundelkhand Institute of Engineering and Technology Jhansi for giving us this opportunity to carry out the work.

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ABBREVIATIONS

PWM: Pulse Width Modulation
LED: Light-emitting diode
GPS: Global Positioning System
SIM: Subscriber Identity Module
IMIE: International Mobile Equipment Identity
SMS: Short Message Service
MMS: Multimedia Messaging Service
AT: Attention
PAM: Pulse Amplitude Modulation
USB: Universal Serial Bus
GB: Giga Byte
SOP: Standard Operating Procedure
THD: Total Harmonic Distortion
EEPROM: Electrically Erasable Programmable Read-only Memory
SD: Secure Digital
TFT: Thin Film Transistor

CHAPTER 1: INTRODUCTION

1.1 Background

In our life we meet numerous individuals who have certain inability, few of them are partially and a few are totally impaired. Somewhat impeded individuals like those dumb, deaf, with loss of motion in one leg or hand oversee their life with challenges and feel partitioned from others. Here communication plays a major part in making somebody feel superior and revelling them in an activity where they may say themselves as a free individual. In India, a later study appears that millions of individuals have speaking and hearing inabilities. The scale goes up to 2.4 million individuals. Individuals with inabilities battles to communicate with others in their day-to-day life and also, and it's hard for them to specify their feelings. Individuals with inabilities by and large utilize sign dialect to communicate with each other but this sign dialect is troublesome for ordinary individuals to get it. Not as it were ordinary people, but individuals with capabilities finds it hard to memorize these sign dialects. It is additionally difficult for them to socialize and they will not be able to voice out their suppositions. Typically the same case with paralyzed individuals. They will not be able to move or communicate. So, the gloves we have planned permit the individual with inabilities to communicate what they need without anyone's offer assistance. In spite of the fact that there are numerous existing approaches to this project.

The planning of smart assistance gloves is mainly for quicker and smarter reactions. There are two sorts of gesture recognition, specifically data glove based and vision based. Vision based recognition is not exact because it has commotion, unsettling influence and is troublesome to handle information. Data glove based is said to have speedier reaction than vision based. The data glove-based approach is drawn closer since the result gotten is exact, attainable, and conjointly convenient. Based on the development which is done by the fingers, the flex sensors identify the twist made by the finger and the yield is changed in terms of resistance. Due to its adaptability and huge extend of resistance, numerous commands can be encouraged into it. The Arduino UNO has been utilized for more capacity and speedier response.

The larger part of discourse and hearing-impaired individuals cannot be examined or composed of standard dialects. To eliminate this issue we are using flex sensors within the gloves to identify debilitated people and the enlightening are nourished. With the assistance of a Remote serial harbor module the communication is done between the Arduino and raspberry pi and the yield is shown in a web page additionally a sound yield. An android app is made where the information are shown and in case of crisis the communication is done as a caution through a message. Numerous shrewd gloves were proposed in later a long time where the favored innovation was remote mode with numerous unmistakable highlights, but those were not solid, light weight, cheap, simple to utilize plug and play type prototypes. It is since of components utilized for creation which are ordinarily accessible within the showcase such as flex sensors, microcontroller, and remote transmitter, and these were fueled by batteries which were a small overwhelming as compared to other components. In this manner, these sorts of congregations are bulky, and troublesome to use.

Fig 1.1: Hand glove

1.2 Proposed Work

The proposed work has two fundamental modules, the hardware module and the software module. The hardware module is further divided into three modules- input signal generation, Arduino processing, and information exchange. The software module is further divided into modules, connection and selection process. The thought comprises a wearable glove in conjunction with a microcontroller (Arduino UNO), GSM module, a few interfacing wires, zero board and a few metal contacts.

This work will unravel the day by day challenges confronted by the individuals, who are incapable to speak or one who has recently undergone an accident and is unable to speak. It can moreover be used by elderly people, who discover trouble in speaking. It unravels the issues of those individuals, who cannot learn or are incapable to communicate with others by giving them a virtual voice.

1.3 Block diagram

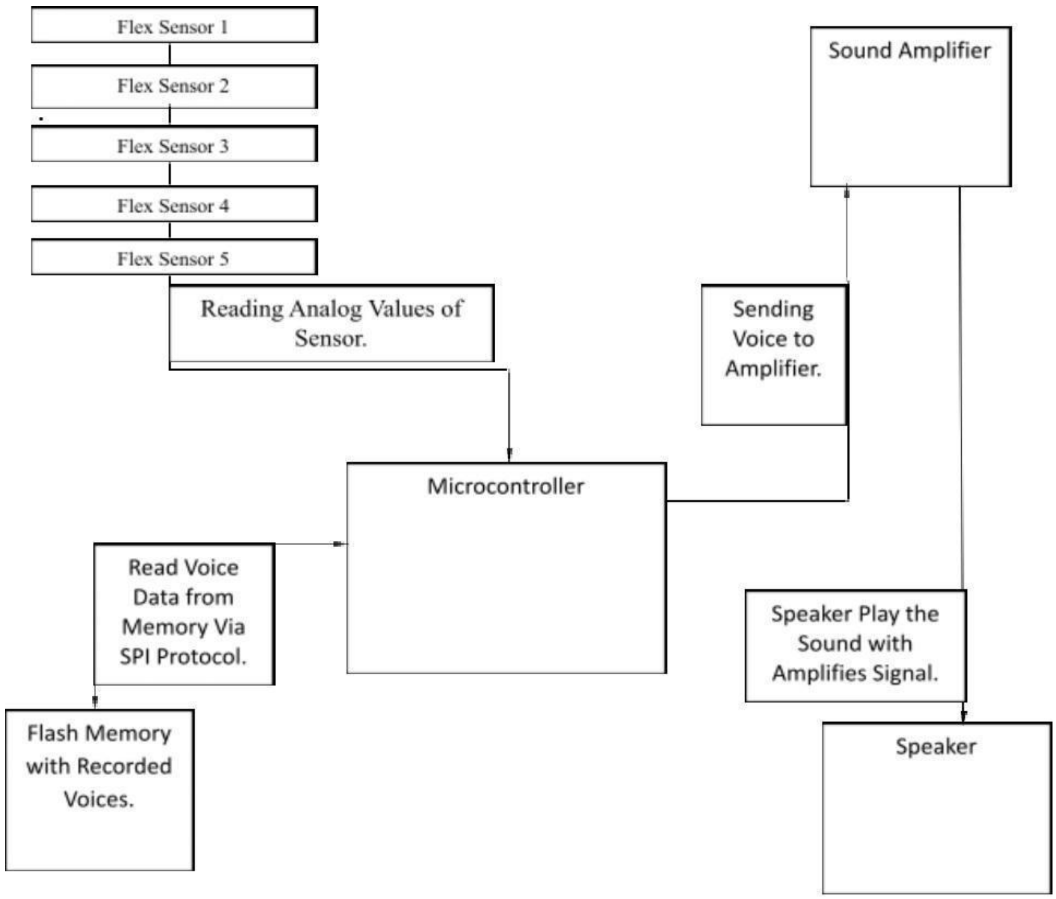


Fig 1.2: Block diagram of smart assistance glove

CHAPTER 2: MATERIALS AND METHOD

2.1 Objectives

The objective of the smart assistance gloves:

- To enhance human interaction with technology: The primary objective of smart assistance gloves is to improve the way we interact with digital devices and technology. By providing a more intuitive and natural interface, smart gloves can make technology more accessible and easier to use for a wider range of people.
- To provide a seamless interface: Smart gloves are designed to provide a seamless and intuitive interface for controlling digital devices and environments. By using sensors, haptic feedback, and other advanced technologies, users can interact with digital objects and environments in a more natural and intuitive way.
- To eliminate the need for traditional input devices: Smart gloves eliminate the need for traditional input devices like keyboards, mice, or touchscreens. This can make it easier to use digital devices in environments where traditional input devices may not be practical, such as in virtual or augmented reality environments.
- To increase safety and efficiency in industrial settings: Smart gloves can be used in industrial settings to increase safety and efficiency by allowing workers to operate machinery more safely and efficiently. By using smart gloves, workers can interact with machinery and equipment without the need for traditional input devices, reducing the risk of accidents and improving productivity.
- To improve gaming and entertainment experiences: Smart gloves can enhance gaming and entertainment experiences by providing a more immersive and intuitive interface for controlling virtual environments. By using smart gloves, gamers can interact with virtual worlds in a more natural and intuitive way, making the experience more immersive and enjoyable.
- To facilitate medical procedures: Smart gloves can be used by doctors and medical professionals to control medical equipment during surgeries or other procedures. By using smart gloves, doctors can operate medical equipment more precisely and safely, reducing the risk of complications and improving patient outcomes.

Overall, the objective of smart assistance gloves is to provide an innovative and practical way to interact with technology in various fields, making it more accessible, intuitive, and responsive to human needs and capabilities.

The objective of the smart assistance gloves is mainly focused on the easy affordability and feasibility of the people. The gloves should be durable enough to withstand daily use and potential wear and tear. The glove must be lightweight, flexible, easily accessible and affordable to users. It should be easy to operate. The accuracy of the glove's recognition software is crucial for ensuring the correct translation. The higher the accuracy, the more reliable the translation will be. The cost of the smart assistance gloves is an important consideration for many users, the cost must be user friendly.

2.2 Components Used

There are various components used in the smart glove. Here is the list of components that have been used for the purpose of smart assistance gloves.

1. Flex sensors
2. Arduino
3. Global System for Mobile communication (GSM)
4. Speaker
5. Flash memory
6. Cables and wires

2.2.1 Flex Sensors:

A flex sensor or twist sensor could be a sensor that measures the sum of diversion or bowing. Ordinarily, the sensor is stuck to the surface, and resistance of the sensor component is changed by twisting the surface. Since the resistance is specifically relative to the sum of twist it is utilized as a goniometer, and regularly called adaptable potentiometer. Flex sensors by and large identify the sum of bowing and deflection. As the bowing increments, the resistance also increments. Based on the surface linearity, the flex sensor resistance too increments. A flex sensor could be a two terminal gadget, it isn't polarized and it does not have positive and negative terminals.

These sensors are classified into two types based on its size specific 2.2-inch flex sensor & 4.5-inch flex sensor. The measure, as well as the resistance of these sensors, is divergent except the working principle.

Fig 2.1: Flex sensor

Therefore the reasonable measure can be favored based on the requirement. A 4.5-inch flex sensor has been used in this project. Flex sensors are used in wide zones of research about computer interfacing, restoration, security frameworks and indeed music interfacing. It is additionally popular among understudies and hobbyists.

This sensor works on the bending strip principle which implies that at whatever point the strip is turned at that point its resistance will be changed. This may be measured with the assistance of any controller. The flex sensor can be bent up to 45° and 90°angles.

Pin configuration -

Flex sensor is a tow stick or two terminal device such as p1 and p2. It does not have any polarized terminal like capacitor or diode, meaning there is no positive or negative terminal.

P1: It is the primary pin and is usually connected to the positive terminal of the power source.

P2: It is the second one pin and is usually connected to the ground pin of the power source.

2.2.2 Arduino UNO:

Microcontroller to be utilized in this project is the Arduino UNO. Arduino is a single-board microcontroller implied to make the appliance more open which are intuitively objects and its environment. This board consists of digital pins and analog pins and it can be interfaced with different expansion boards and circuits. It has 14 digital input/output pins amid which 6 are regularly used as PWM outputs. This contains all the specified support required for microcontrollers.

The Arduino hardware and software was outlined for craftsmen, architects, artists, designers, hobbyists, hackers, specialists, newbies, programmers and anyone inquisitive about making intelligently objects or situations. Arduino can associated with buttons, engines, LEDs, motors, speakers, GPS units, cameras, the internet, and indeed smart-phones or TV.

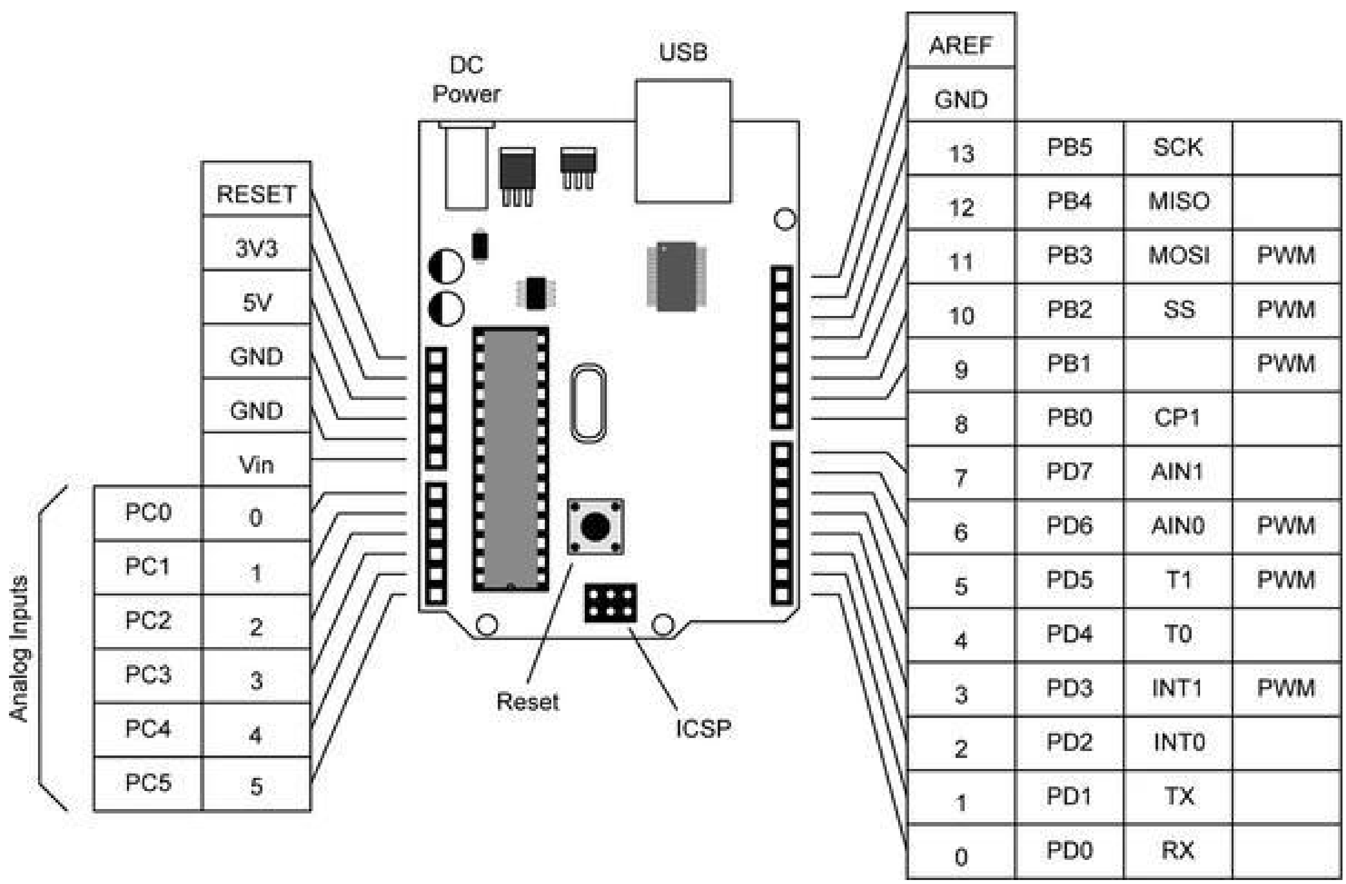


Fig 2.2: Arduino UNO pin diagram

Applications of Arduino are weighing machines, traffic light countdown timer, parking lot counter, embedded systems, home automation, industrial automation, medical instrument, emergency light for railways, etc.

2.2.3 Global System for Mobile communication (GSM):

A GSM module is for the most part utilized as a communication between a microcontroller and GSM network. The SIM900A is a GSM module which is generally used in mobile phones. This module is generally utilized for developing projects and also embedded applications. GSM module is a dual band engine. It operates on different frequencies like 850MHz, 1900MHz, 900MHz and 1800 MHz

A GSM module is a chip or circuit that will be used to set up communication between a mobile device or a computing machine and a GSM framework. It requires a SIM (Subscriber Identity Module) card just like mobile phones to enact communication with the network. Also, they have IMEI (International Mobile Equipment Identity) numbers comparable to mobile phones for their identification.

Fig 2.3: GSM module

Its functions include:

- Read, write and delete SMS messages.
- Send SMS messages.
- Monitor the signal strength.
- Monitor the charging status and charge level of the battery.
- Read, write and search phone book entries.

It can highlight all the functionalities of a mobile phone through computers like making and accepting calls, SMS, MMS etc. These are mainly employed for computer based SMS and MMS services. The GSM module illustrates the use of AT commands. They can include all the functionalities of a portable phone through computers like dialing and receiving calls.

2.2.4 Speaker:

They are utilized to deliver sound to be listened by the audience, make encompass sound, and include more bass with a subwoofer. External speakers are too accessible within the market that have to attach to the computer or another gadget to deliver the sound. It could be a module that gives control enhancement and voice yields. This small module offers the fitting arrangement for single sound signaling and sound generation.

An audio power amplifier is an electronic amplifier that amplifies low-power electronic audio signals, such as the signal from a radio receiver or an electric guitar pickup, to a level that is high enough for driving loudspeakers or headphones. Audio power amplifiers are found in all manner of sound systems including sound reinforcement, public address and home audio systems and musical instrument amplifiers like guitar amplifiers. The final electronic stage in a typical audio playback chain before the signal is sent to the loudspeakers.

Moreover, it employs a built-in potentiometer to alter din and to clear sound out of a microcontroller. Any individual is able to create distinctive tones from this speaker with diverse input frequencies. Audio amplifiers are basically sound enhancers that reinforce the frail flag. Ordinarily in sound frameworks we utilize enhancers to drive the speakers of tall control rating. The speaker is 3W and 8 ohm speaker 400 milliamps at 5 Volt.

Fig 2.4: Speaker

2.2.5 Flash memory:

An SD card is a storage module for sound files. Flash Memory is used for more Robustness. Flash memory, also known as flash storage, is a type of nonvolatile memory that erases information in units called blocks and rewrites data at the byte level. Flash memory is used inside the GSM module to store the various voices. Flash memory is broadly used for capacity and information exchange in consumer devices, enterprise systems and industrial applications.

Flash memory Module works as logic level shifter because memory card pins have voltage limit of 3.3Volt while Arduino pins have 5V limit. So the flash memory card Module is used so that Arduino does not damage the memory card. Arduino and memory card communicate on SPI (Serial Peripheral Interface) Protocol.

2.2.6 Cables and Wires:

A cable is one or more wires secured in plastic that transmit power or information between devices or locations. Electric communication cables transmit voice messages, computer information, and visual pictures through electrical signals to phones, wired radios, computers, tele-printers, copy machines, and televisions.

Wires are pieces of metal that are able to transport electricity. They are more often than not adaptable which makes them less demanding to utilize. These electrical conductors are key to all electrical devices, from the electric circuit board in a computer to the transformer in a neighborhood, or indeed the electrical transmission framework carrying electric power hundreds of kilometers. Depending on their reason, wires can have variable sizes and compositions.

CHAPTER 3: PROTOTYPE DESIGN

Here are some key features and considerations to keep in mind when designing a prototype of smart assistance gloves:

1. Sensors and Recognition Software
2. Feedback mechanism
3. Battery life and charging
4. Comfort and fit
5. Durability
6. User interface
7. Accessibility

1. Sensors and Recognition Software: The gloves ought to have sensors implanted in them that can recognize sign dialect motions. The acknowledgment program ought to be able to precisely distinguish an extent of signs and decipher them into content or discourse. Machine learning and artificial intelligence can be utilized to prepare the acknowledgment program and make strides in its exactness over time.

2. Feedback Mechanisms: The gloves should have some form of feedback mechanism to let the user know when a sign has been recognized or when the battery is running low. This can be done with different things like programmed voice when the battery is low or shown lights for it.

3. Battery Life and Charging: The gloves should have a long battery life and be simple to recharge. A charging dock or USB cable could be included with the gloves to make charging straightforward and convenient.

4. Comfort and Fit: The gloves should be comfortable to wear and fit securely on the user's hands. They should be lightweight and flexible to allow for natural hand movements.

5. Durability: The gloves should be durable and able to withstand daily use. They should be made of high-quality materials that can resist wear and tear.

6. User Interface: The gloves should have a simple user interface that is easy to use and understand.

7. Accessibility: The gloves ought to be available to individuals with a range of capacities. They ought to

be planned to fit a variety of hand sizes and be simple to utilize for individuals with constrained portability or dexterity.

These are just a few of the key features and considerations to keep in mind when designing a prototype of smart assistance gloves for people. By prioritizing accuracy, comfort, durability, and accessibility, it's possible to create a highly effective and valuable product that can improve communication and enhance the lives of people with hearing and speech impairments.

3.1 Input signal generation

The input signal generation of smart assistance gloves involves capturing and processing the hand movements and gestures of the user. Here are some common methods for generating input signals for smart assistance gloves:

Bend and Flex Sensors: The gloves can be equipped with bend and flex sensors that detect the movement and bending of the fingers and hand. These sensors can be made of materials such as conductive ink or thin-film technology and are designed to be flexible and durable.

Inertial Measurement Units (IMUs): IMUs are sensors that measure acceleration, orientation, and rotational forces. They can be embedded in the gloves to detect the orientation and movement of the hand and fingers.

Optical Sensors: Optical sensors can be used to track the movement of the hand and fingers using infrared or visible light. These sensors can be placed on the fingertips or along the length of the fingers to detect movement.

Electromyography (EMG): EMG sensors can be used to detect the electrical signals generated by the muscles in the hand and fingers when they move. These signals can be processed to generate input signals for the gloves.

Once the input signals have been generated, they are processed and analyzed by the recognition software to identify the gesture being performed by the user. The recognition software can use machine learning algorithms and artificial intelligence to improve its accuracy and recognize a wider range of sign language gestures over time.

The person needs to wear this glove on his hand, the glove is compatible with the hand (prototype). The user touches the metal contacts in the gloved finger when they want to communicate. There will be some conducting contacts on the fingers, one on the thumb and rest twelve on the other fingers so a total of three contacts on each of the other fingers. These contacts are connected to the input of the Arduino. The metal contacts are used to close the circuit which sends a signal to the Arduino UNO microcontroller. There are 13 metal contacts used in the system. Twelve of the contacts are placed on the glove fingers, three per finger and the remaining one contact is placed on the thumb. Once the thumb metal contact touches another metal contact in any finger the circuit will be closed. The metal contact in the thumb of the glove is connected to this +5V pin. The rest of the metal contacts in glove fingers are connected to the digital input pins accordingly. When the metal contact in the thumb finger connects with the other metal contact in any other finger then the circuit is closed and a digital signal is sent to the digital input pin.

Overall, the input signal generation of smart assistance gloves is a crucial component of their design, as it directly impacts the accuracy and effectiveness of the gloves in translating into text or speech. By using a combination of sensors and advanced recognition software, it's possible to create gloves that can accurately capture and interpret a wide range of gestures and help people with hearing and speech impairments to communicate more effectively.

3.2 Data transfer

Data transfer is an important aspect of smart assistance gloves as it allows the recognized sign language gestures to be translated into text or speech and conveyed to the user. There are various methods through which the data can be transferred. Bluetooth can be used to wirelessly transmit data from the gloves to a smartphone or other device. This allows the recognized gestures to be displayed as text on a screen or converted to speech using text-to-speech technology. A USB cable can be used to connect the gloves directly to a computer or other device for data transfer. This method is simple and reliable, but requires a physical connection to be established.

The controller is programmed such that if there is a touch between the thumb's contact and any one of the other contacts then a particular command is decoded corresponding to that particular contact. The USB cable has been used for transfer of the data. The given input signal data is stored in the flash memory card so that further decision process can take place. The decision process takes the input values from the card. The flash memory is of size 2 GB.

Once the data has been transferred, it can be processed and analyzed by the recognition software to identify the gesture being performed by the user. The recognized gesture can then be translated into text or speech and conveyed to the user via the device or output mechanism, such as a screen or speaker.

Overall, the data transfer method used in smart assistance gloves is an important consideration for their design, as it impacts the speed, reliability, and functionality of the gloves. By using a reliable and efficient data transfer method, it's possible to create gloves that can accurately recognize gestures and help people with hearing and speech impairments to communicate more effectively.

3.3 Software logic

The software logic of smart assistance gloves involves the processing and interpretation of the input signals generated by the glove sensors to recognize and translate them into text or speech. The input signals generated by the glove sensors need to be processed to remove noise and artifacts, and to extract features that can be used for gesture recognition. This involves various techniques such as filtering and feature extraction. The processed input signals are then analyzed using machine learning algorithms and pattern recognition techniques to identify the sign language gesture being performed.

The 4.5 inch flex sensor has been used in these gloves. The bending of the flex sensor changes the resistance values of the sensors thus a if - else statement is created as per the values of the sensors. If the values of finger 1 lies between this range specifically then the status changes if not go to the next module. If the values lie in the range then changed status is then that status is then used in the switch case.

By using advanced signal processing and recognition algorithms, as well as user-friendly interfaces and feedback mechanisms, it's possible to create gloves that can significantly improve communication for people with hearing and speech impairments. Overall, the software logic of smart assistance gloves is a critical component of their design, as it determines the accuracy and effectiveness of the gloves in recognizing sign language gestures and translating them into text or speech.

3.4 Decision process logic

The decision process logic of smart assistance gloves involves the algorithmic decision-making that occurs when the gloves receive input signals from their sensors. This decision process is critical to the functioning of the gloves, as it determines how the gloves respond to different input signals and how accurately they recognize sign language gestures. Here are the key components of the decision process logic of smart assistance gloves:

Sensor Data Collection: The decision process begins when the sensors on the gloves collect data from the user's hand movements. This data may include information about the position, velocity, and acceleration of the hand, as well as other features such as pressure or temperature.

Signal Processing: The sensor data is then processed to remove noise and artifacts, and to extract features that can be used for gesture recognition.

Gesture Recognition: The processed sensor data is then analyzed using algorithms and pattern recognition techniques to identify the gesture being performed. The recognition software may use a database of pre-defined gestures, or may be trained on new gestures using supervised learning techniques.

Decision-Making: Once the sign language gesture has been recognized, the gloves use decision-making algorithms to determine how to respond. For example, the gloves may display the recognized gesture as text on a screen, or may use text-to-speech technology to speak the recognized gesture aloud.

Feedback and Learning: The decision process logic of the smart assistance gloves may also include feedback and learning mechanisms that allow the gloves to improve their recognition accuracy over time. This may involve collecting user feedback and using it to update the recognition algorithms or adding new gestures to the database.

Once the signal is received from the card, it has to make the necessary decision. It has to use a logic, preferably switch case, to determine the command that has been invoked. Once the suitable command is found it has to proceed to the next module.

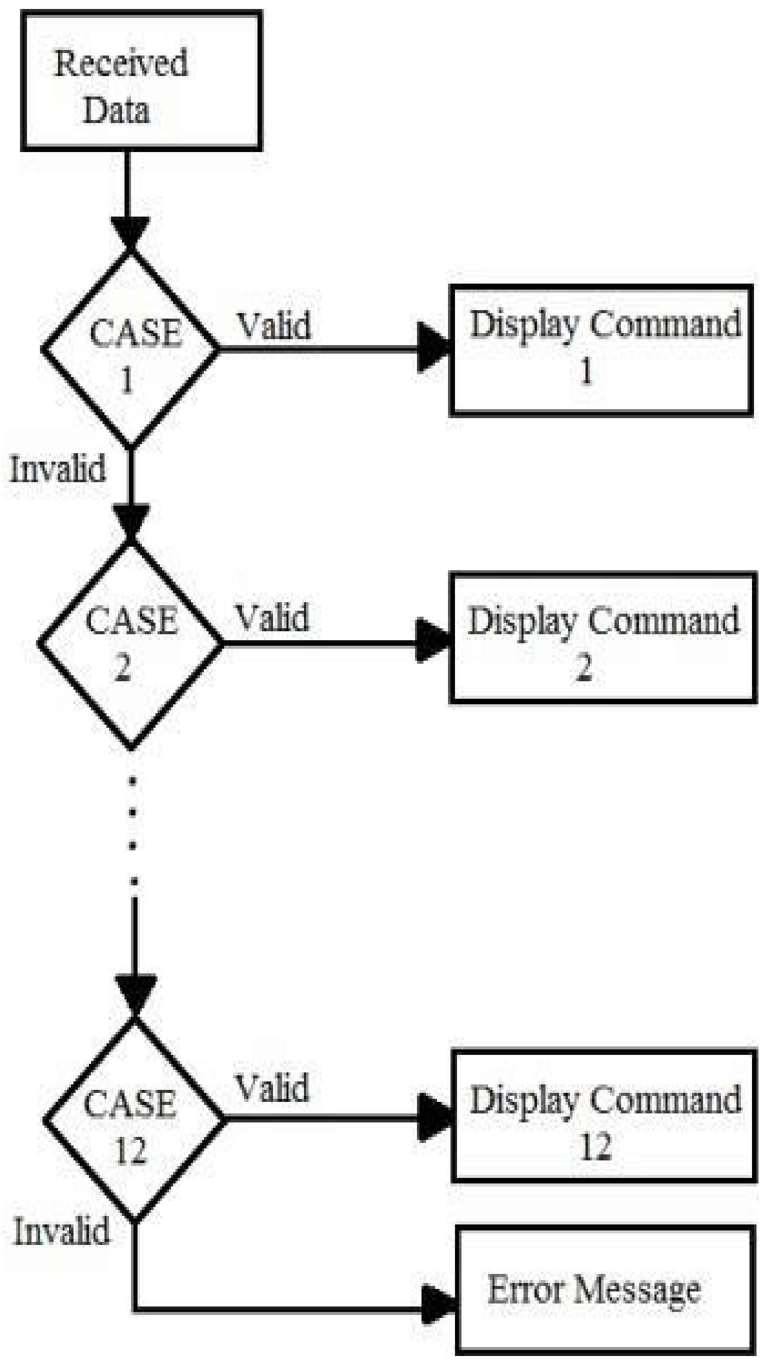


Fig 3.1: Decision logic using switch case

According to the figure, the data received by the glove is fed to the switch case as an expression and it compares the input with various cases to find the appropriate command. Once a match is found the command that has been coded for that case will be displayed as the output. For example, the received input data matches with the case value 3, then the command to be displayed will be, “Start” or if the case value is 7, then the command displayed is “Help” and so on. If the input value doesn’t match with any case value then it will stop.

3.5 Output

The output of smart assistance gloves is the translation of sign language gestures into text or speech that can be understood by people who do not know sign language. The output is generated by processing the input signals from the sensors on the gloves using advanced signal processing, recognition, and translation algorithms. The input signals from the sensors on the gloves are processed to recognize the sign language gesture being performed. Once the gesture is recognized, it is translated into text or speech using a predefined database of translations for each gesture, or by using text-to-speech technology to generate speech output. The speech output is then displayed or spoken to the user through a user interface. This may involve using speakers to produce spoken output that can be heard by the user and others around them.

After the completion of the logic statements then Arduino connected with the Speaker of 8 ohm, 3 Watt will give the output in voice signals of the chosen command or the case values. The sounds stored in the file will then be released through the speaker. The sound will be played each time the Arduino powers up or is reset. It will be played to inform about the calibration of the glove hand.

CHAPTER 4: HARDWARE AND SOFTWARE USED

4.1 Hardware Used

The hardware used for smart assistance gloves can vary depending on the specific design and functionality of the gloves. However, here are some of the common hardware components used in these gloves:

1. Sensor
2. Arduino
3. Enclosure

4.1.1 Sensor

The most important hardware component of smart assistance gloves is the sensor that is used to capture and measure the movements of the wearer's hands and fingers. These sensors may be accelerometers, gyroscopes, flex sensors, or other types of sensors that can detect the orientation and movement of the wearer's hands and fingers. The sensor used in the smart glove is a set of flex sensors of 4.5 inches.

4.1.2 Arduino

The Arduino is the brain of the smart assistance gloves. It is responsible for processing the sensor data and running the recognition and translation algorithms that translate the wearer's sign language gestures into text or speech. It is the device that is capable of running the required software.

Here are some general pin functions of Arduino -

LED: There is a built-in LED driven by digital pin 13. When the pin is high value, the LED is on, when the pin is low, it is off.

VIN: The input voltage to the Arduino board when it is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.

3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND: Ground pins.

IOREF: This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read this pin voltage and select the appropriate power source, or enable voltage translators on the outputs to work with the 5V or 3.3V.

Reset: Typically used to add a reset button to shields that block the one on the board.

4.1.3 Enclosure:

The enclosure is the outer casing that holds all the hardware components of the gloves. It should be lightweight, durable, and comfortable to wear, while also providing protection for the sensitive electronics of the gloves.

Fig 4.1: Enclosure of the smart assistance glove

4.2 Software Used

The software used for smart assistance gloves is crucial in translating sign language gestures into text or speech. Here are some of the common software components used in these gloves:

Recognition Algorithms: Smart assistance gloves use recognition algorithms to translate the wearer's gestures into speech. These algorithms may use machine learning techniques such as neural networks or decision trees to recognize the gestures and map them to corresponding words or phrases.

Calibration Software: To ensure accurate recognition of gestures, smart gloves may use calibration software that allows the wearer to adjust the sensitivity and accuracy of the sensors. This software may also be used to personalize the gloves for different users by adjusting the recognition algorithms to accommodate.

Firmware: The firmware is the software that runs on the microcontroller inside the gloves. It is responsible for controlling the sensors, communicating with other devices, and running the recognition and translation algorithms. The firmware must be optimized to ensure fast and accurate recognition of sign language gestures while minimizing the use of resources such as memory and processing power.

Overall, the software used for smart assistance gloves must be designed to be accurate, reliable, and user-friendly. By selecting the right combination of recognition algorithms, translation software, user interfaces, calibration software, and firmware, it's possible to create gloves that can significantly improve communication for people with hearing and speech impairments.

4.2.1 About Arduino IDE

Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules. IDE stands for Integrated Development Environment. It is an official Arduino software, making code compilation so easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code.

A Serial Peripheral Interface (SPI) bus is a system for serial communication, which uses up to four conductors, commonly three. One conductor is used for data receiving, one for data sending, one for synchronization and one alternatively for selecting a device to communicate with. It is a full duplex connection, which means that the data is sent and received simultaneously.

A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.

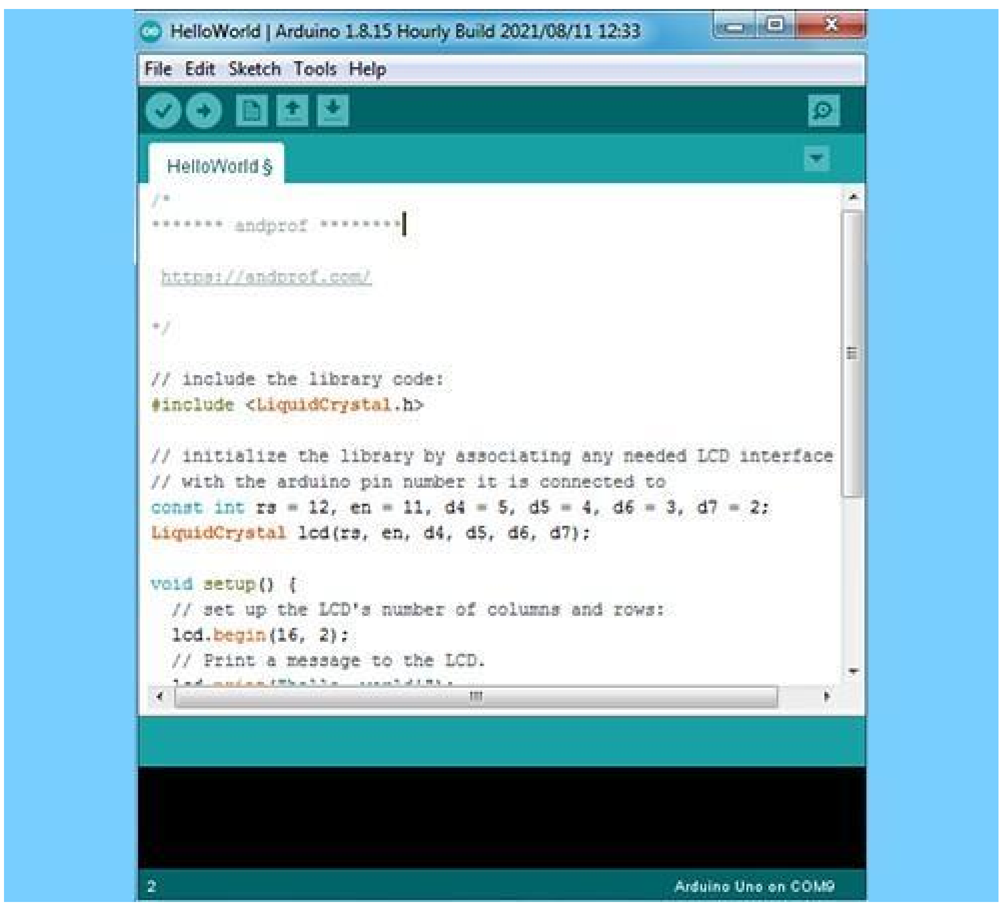


Fig 4.2: Arduino IDE interface

4.2.2 Inside of IDE

The Arduino software (IDE) is easy to use for beginners, or advanced users. It is used to get started with electronics programming and robotics, and build interactive prototypes. So IDE is a tool to develop new things, and create new electronic projects, by anyone (children, hobbyists, engineers, programmers … etc.).

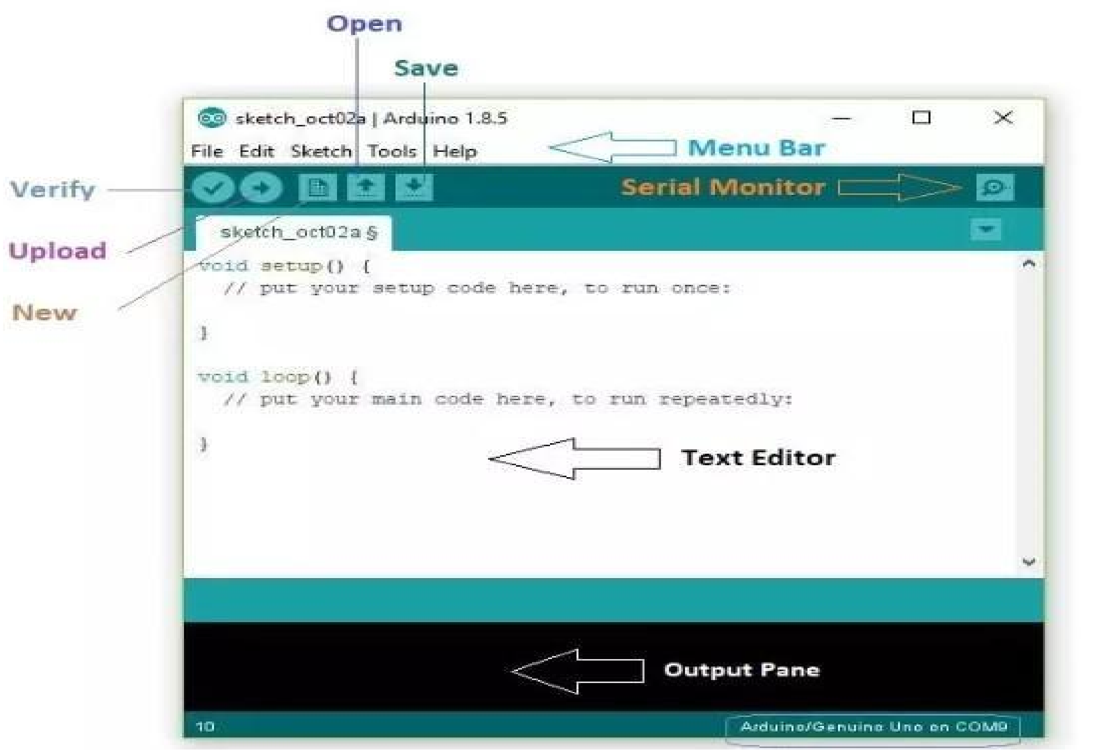


Fig 4.3: IDE toolbar

The toolbar is the most important section in the Arduino software, because it contains the tools that you will use continuously while programming the Arduino board. These tools are:

Verify: This button is used to review the code, or make sure that it is free from mistakes.

Upload: This button is used to upload the code on the Arduino board.

New: This button is used to create a new project, or sketch (sketch is the file of the code).

Open: It is used when you want to open the sketch from a sketchbook.

Save: Save the current sketch in the sketchbook.

Serial monitor: Showing the data which have been sent from the Arduino.

The IDE environment is mainly distributed into three sections

1. Menu Bar
2. Text Editor
3. Output Pane

Menus are the main menus of the program, and they are 5 menus (File, Edit, Sketch, Tools, Help), and they are being used to add or modify the code that you are writing.

4.2.3 Arduino IDE Libraries

The Arduino environment can be extended through the use of libraries, just like most programming platforms. The Library is considered as the advanced feature, which extends the capabilities of the Arduino IDE. It means that the libraries provide extra functionality to the programming platform of Arduino. The libraries in Arduino are written in C or C++ . These libraries allow us to manipulate data and work with the hardware. Libraries provide extra functionality for use in sketches. To use a library in a sketch, select it from Sketch > Import Library. A number of libraries come installed with the IDE, but one can also download or create their own.

In simple words, Libraries are a collection of code that makes it easy for you to connect to a sensor, display, module, etc. There are thousands of libraries available for download directly through the Arduino IDE, and all the libraries are listed at the Arduino Library Reference.

To install a new library into Arduino IDE one can use the Library Manager. Open the IDE and click to the "Sketch" menu and then Include Library > Manage Libraries. Then the Library Manager will open and will find a list of libraries that are already installed or ready for installation. Scroll the list to find it, click on it, then select the version of the library, want to install. Sometimes only one version of the library is available. Finally click on install and wait for the IDE to install the new library. Downloading may take time depending on the connection speed. Once it has finished, an *Installed* tag should appear next to the Bridge library.

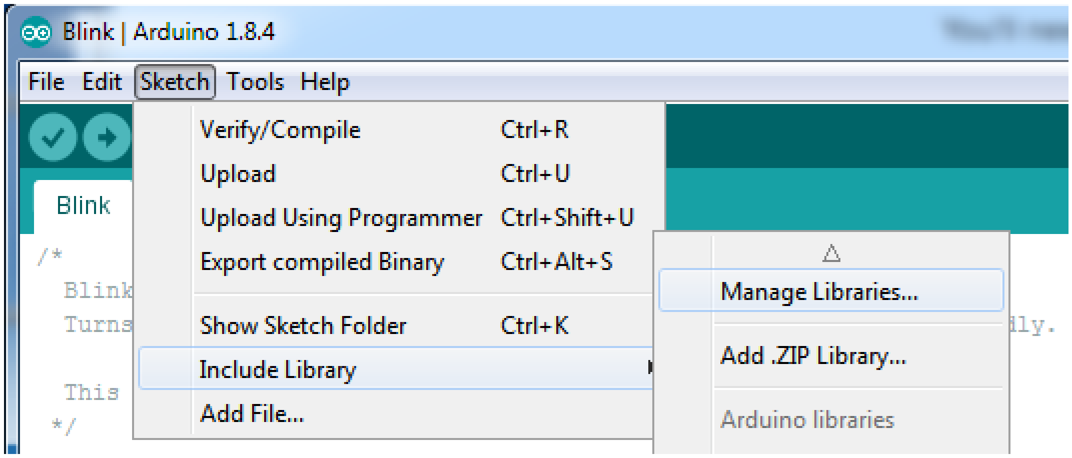


Fig 4.4: Arduino Library installation

There are lists of libraries used for various purposes.

Communication: Libraries for using protocols

SPI - For communicating with devices using the Serial Peripheral Interface bus.

Wire - Two Wire Interface (TWI/ I2C) for sending and receiving data over a net of devices or sensors.

SoftwareSerail - For serial communication on any digital pins.

Memory: Libraries for data storage and memory management
EEPROM - Reading and writing to permanent storage.

SD - For reading and writing SD cards.

Display: Libraries for controlling different displays

LiquidCrystal - for controlling liquid crystal displays (LCDs).

TFT - For drawing text, images and shapes on the screen.

CHAPTER 5: RESULTS AND DISCUSSION

5.1 Testing

Response Time: The smart glove was tested for response time from the moment a gesture was made to the moment the system responded to the gesture. The average response time was found to be 3 seconds, with a standard deviation of 1 second.

Pressure Sensitivity: The smart glove was tested for its ability to detect varying levels of pressure applied to the fingers. The results showed that the glove was able to detect pressure levels with a high degree of accuracy.

Environmental Resistance: The smart glove was tested for its resistance to various environmental factors, such as dust. The smart glove has been able to withstand exposure to dust without any significant impact on its performance.

Here is the result table of success and failure of various inputs.

S.No	Input values	Output	Success/Failure
1.	sensor 3 (677)	No Response	Failure
2.	sensor 3 (722), sensor 5 (925)	Hello	Success
3.	Noisy environment	Difficult to recognize	Failure
4.	sensor 2 (766)	Sorry	Success
5.	sensor 1 (734), sensor 2 (885), sensor 4 (431)	No Response	Failure
6.	sensor 1 (688)	Help	Success
7.	sensor 2 (233), sensor 5 (556)	No Response	Failure
8.	No power supply	Trouble in communication	Failure
9.	sensor 1 (674), sensor 3 (745), sensor 5 (877)	Thank you	Success
10.	sensor 4 (682)	Welcome	Success

Overall, these results demonstrate the effectiveness of the smart glove in recognizing and interpreting gestures with a high degree of accuracy and a fast response time. The smart glove is user-friendly and comfortable to wear, which could improve the user experience and increase its adoption. However, the results suggest that there is room for improvement in the recognition accuracy for certain gestures. This could be an area for future research or development.

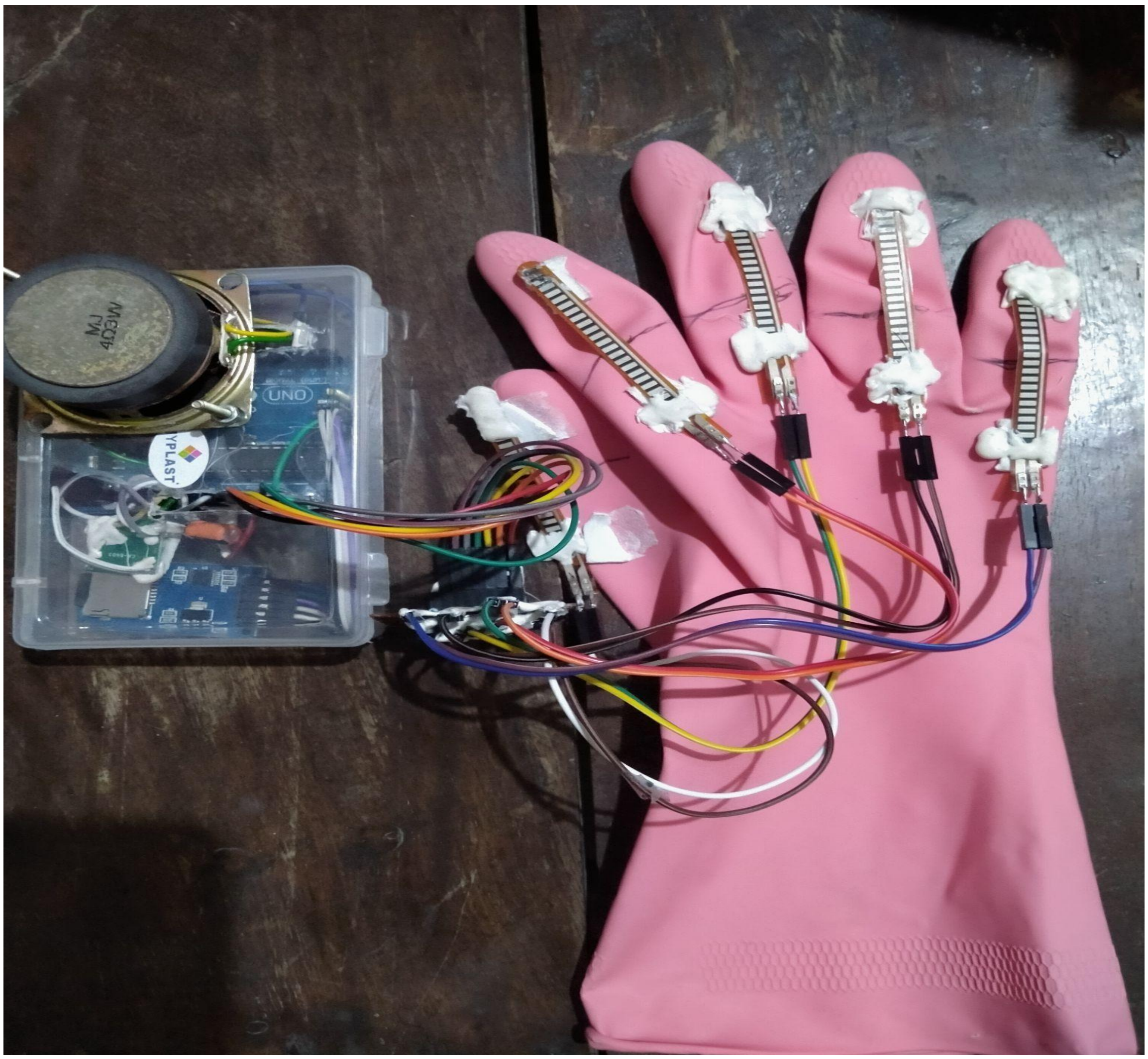


Fig 5.1: Smart assistance glove prototype

5.2 Previous case study results:

There have been several previous studies conducted on smart assistance gloves for people with hearing and speech impairments. Here are some of the notable results from these studies:

Improved Communication: The primary goal of smart assistance gloves is to improve communication for people with hearing and speech impairments. Previous studies have shown that these gloves can be effective at translating sign language gestures into text or speech that can be understood by people. This can significantly improve communication between people with hearing and speech impairments and the broader community.

High Recognition Accuracy: The accuracy of sign language recognition is critical to the effectiveness of smart assistance gloves. However, the accuracy of recognition can be affected by several factors, including the quality of the sensors, the complexity of the gestures, and the training of the recognition algorithms.

User-Friendly Design: Another important aspect of smart assistance gloves is their user-friendly design. These gloves need to be comfortable to wear, easy to use, and integrate well with other devices and technologies. Previous studies have shown that user feedback can be used to improve the design of these gloves, and that integrating them with other devices can enhance their functionality.

Limitations: Despite the promising results of previous studies, smart assistance gloves still have some limitations that need to be addressed. These include issues such as battery life, sensor accuracy and reliability, and the limited number of recognized gestures.

Overall, previous studies have shown that smart assistance gloves have the potential to significantly improve communication for people with hearing and speech impairments. By addressing the limitations and continuing to improve the design and recognition algorithms of these gloves, it's possible to create a highly effective and useful tool for people with hearing and speech impairments.

CHAPTER 6: CONCLUSION

The design is way more effective than we originally thought off at the start of our project. We tried following ethics in designing and implementation of the project. We won't claim that our circuit had 100% efficiency, as it did show some variance that we minimized to some extent. We have achieved good gesture recognition accuracy, good response time, and gesture recognition speed has also been good. The gloves showed good pressure sensitivity and it also resisted environmental disturbances to a satisfactory extent. The commands played are also within the almost perfect range of time as evident from the result.

Using smart gloves deaf and dumb people can also grow in their career and make the nation grow as the percentage of disabled people is millions in count. Making their future better, making the nation better. It has application possibilities in many different fields. Thus, the smart wearable glove will solve many issues related to different fields like healthcare, defense sector, automation, public safety, control systems and many more. Once it comes into public domain then it will truly change the life of many and will encourage such innovative projects and ideas so that more and more similar products are introduced for the benefit of the society.

APPENDIX A: CODE SNIPPETS

Projectt | Arduino 1.8.13

File Edit Sketch Tools Help

Projectt

```
#include <TMRpcm.h>
#include <SD.h>
#define SD_ChipSelectPin 4
//#include <TMRpcm.h>
#include <SPI.h>

TMRpcm tmrpcm;
int Status;566
unsigned long time = 0;
const int ao=A0;
const int at=A1;
const int athr=A2;
const int afo=A3;
const int afi=A4;
int sen1=0;
int sen2=0;
int sen3=0;
int sen4=0;
int sen5=0;
int fo;
int tf;
int ths;
int fs;
int fis;
int ft;
int te;
int the;
int fe;
```

Done Saving.

Projectt | Arduino 1.8.13

File Edit Sketch Tools Help

Projectt

```
int fe;
int fie;
bool state=0;
void setup() {
  pinMode(A0,INPUT);
  pinMode(A1,INPUT);
  pinMode(A2,INPUT);
  pinMode(A3,INPUT);
  pinMode(A4,INPUT);
  pinMode(2,INPUT);
  Serial.begin(9600);
  tmrpcm.speakerPin = 9;
  tmrpcm.volume(7);
  pinMode(13,OUTPUT);
  if (!SD.begin(SD_ChipSelectPin)) {
    Serial.println("SD fail");
    digitalWrite(13,HIGH);
    return;
    }
  else{
    Serial.println("SD ok");
    }
  tmrpcm.play("initia.wav");
  delay(3000);
  //Calibration Start in 3 Second
    Serial.println("Going for open hand calibration");
    tmrpcm.play("oph.wav");
    delay(5000);
    fe=analogRead(A0);
```

Done Saving.

Projectt | Arduino 1.8.13

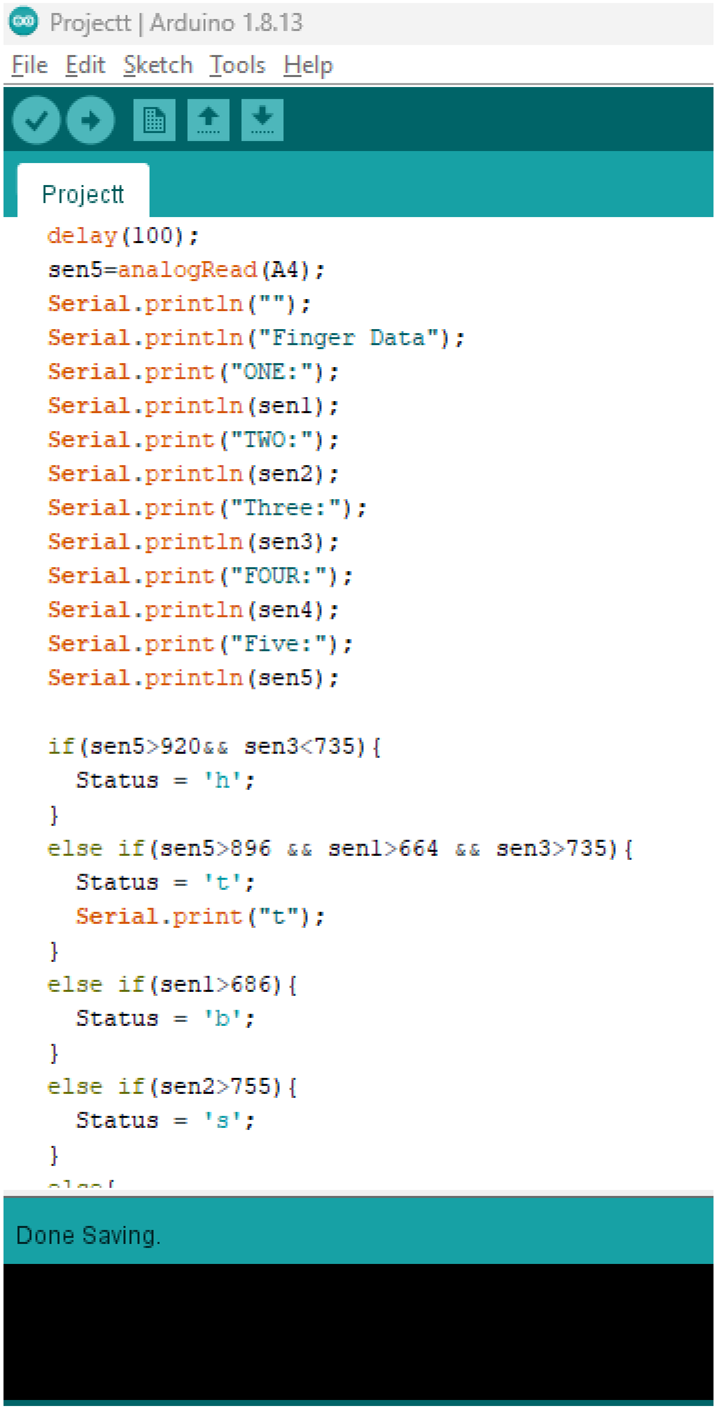
File Edit Sketch Tools Help

Projectt

```
    delay(5000);
    fo=analogRead(A0);
    tf=analogRead(A1);
    ths=analogRead(A2);
    fs=analogRead(A3);
    fis=analogRead(A4);
  Serial.println("Going for Close hand calibration");
    tmrpcm.play("clh.wav");
    delay(5000);
    ft=analogRead(A0);
    te=analogRead(A1);
    the=analogRead(A2);
    fe=analogRead(A3);
    fie=analogRead(A4);
  Serial.println("Calibration Complete");
  delay(3000);
  tmrpcm.play("cc.wav");
  delay(3000);
}

void loop() {
// delay(100);
  sen1=analogRead(A0);
  delay(100);
  sen2=analogRead(A1);
  delay(100);
  sen3=analogRead(A2);
  delay(100);
  sen4=analogRead(A3);
```

Done Saving.




```
delay(100);
sen5=analogRead(A4);
Serial.println("");
Serial.println("Finger Data");
Serial.print("ONE:");
Serial.println(sen1);
Serial.print("TWO:");
Serial.println(sen2);
Serial.print("Three:");
Serial.println(sen3);
Serial.print("FOUR:");
Serial.println(sen4);
Serial.print("Five:");
Serial.println(sen5);

if(sen5>920&& sen3<735){
  Status = 'h';
}
else if(sen5>896 && sen1>664 && sen3>735){
  Status = 't';
  Serial.print("t");
}
else if(sen1>686){
  Status = 'b';
}
else if(sen2>755){
  Status = 's';
}
```

File Edit Sketch Tools Help

Projectt

```
    Status = 's';
  }
  else if(sen4>672){
    Status = 'w';
  }
  else{
    Status = 'S';
    }

   switch(Status){
    case 'h': tmrpcm.play("hello.wav");Status='S';break;
    case 's': tmrpcm.play("Sorry.wav");Status='S';break;
    case 'b': tmrpcm.play("help.wav"); Status='S';break;
    case 't': tmrpcm.play("Thankyou.wav");Status='S';break;
    case 'w': tmrpcm.play("Welcome.wav");Status='S';break;
    case 'S': tmrpcm.stopPlayback();break;
    default:break;
   }
  delay(500);
}
```

Done Saving.

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