

AN IOT BASED SMART GLOVES FOR DEAF AND DUMB

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering Degree in Electronics and Communication Engineering

By

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC
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CHENNAI - 600119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of PAVITHRA T (39130344) and LOGESWARI (39130262) who carried out the project entitled "An IoT Based Smart Gloves For Deaf And Dumb" under my supervision from December 2022 to March 2023

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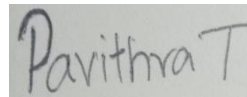
We, PAVITHRA T(39130344) and LOGESWARI (39130262) hereby declare that the Project Report entitled “AN IOT BASED SMART GLOVE FOR DEAF AND DUMB” done by us under the guidance of Dr.E. ANNA DEVI, M.E., Ph D, Associate professor, Dept. of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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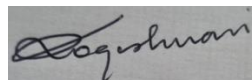
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SIGNATURE OF CANDIDATE

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2.

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ACKNOWLEDGEMENT

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ABSTRACT

This work describes a way to reduce barrier of communication by developing an assistive device for deaf-mute persons. There have been several researches done in order to find an easier way for non-vocal people to communicate with vocal people and express themselves to the hearing world. Everyday citizens face trouble in understanding the sign language. To defeat these continuous issues, this framework is created. The key goal of the proposed plan is to design a cost-effective device that can give voice to a voiceless individual with the help of Smart Gloves. Flex sensors were used to record the movement and variation of each letter. Then, through with microcontroller and text/voice presenting devices, likewise, the neural network was developed in Matlab software for the recognition of signals. The end product of this project is a combination of a mobile application that can translate the sign language into digital voice and IOT- enabled, light-weighted wearable glove, which capable of recognizing twenty-six English alphabet, digits, and words. Better user experience provides with voice-to-text feature in mobile application to reduce the communication gap within mute and non-mute communities. It is concluded that this prototype is capable of translating Sign Language with a high percentage of accuracy, also is viable and economical, so it is recommended to test the effectiveness of this prototype in multiple people with speech disabilities.

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LIST OF ABBREVIATIONS

S.NO	ABBREVIATION	FULL FORM
1	ISL	Indian sign language
2	IOT	Internet of things
3	HC-05	Bluetooth module
5	GY-61	Axis accelerometer module
6	NUI	Natural user interface
7	BBC	British Broadcasting Corporation
8	AYJNISHD	Ali Yavar Jung National Institute of Speech and Hearing Disabilities
9	ISLTA	Indian Sign Language Teacher's Association
10	ISLIA	Indian Sign language Interpreter's Association
11	ISLRTC	Indian Sign Language Research and Training Centre
12	IGNOU	Indira Gandhi National Open University
13	MSGE	Ministry of Social Justice and Empowerment's
14	GPRS	General packet radio services
15	1D-CNN	D Convolutional Neural Network
16	IMU	Inertial measurement unit
17	LCD	Liquid-crystal display
18	MATLAB	Matrix laboratory
19	FFNN	Feed Forward Neural Network
20	NN	Neural network

21	GSM	Global system for mobile communication
22	AI	Artificial Intelligence
23	WIFI	Wireless fidelity
24	IOS	iPhone Operating system
25	MPU6050	Triple-axis accelerometer and gyroscope module
26	MCP3008	Analog-digital converter
27	ADC	Analog - digital converter
28	TTS	Text to speech conversion
29	ESP8266	Wifi microchip
30	ESP32	Microcontroller with integrated wifi and Bluetooth
31	TSMC	Taiwan semiconductor manufacturing company limited
32	MCU	Multipoint control unit
33	SPI	Serial peripheral interface
34	SDIO	Secure digital input output
35	I2C	Inter-Integrated circuit
36	UART	Universal asynchronous receiver-transmitter
37	ROM	Read only memory
38	USB	Universal serial bus
39	BLE	Bluetooth low energy
40	GPIO	General purpose input output
41	SoC	System on a chip
42	SRAM	Static random access memory
43	MEMS	Micro-electro-mechanical systems
44	RDC	Remote data capture

45	ETSI	European Telecommunications Standards Institute
46	SMS	Short message service
47	SIM	Subscriber identity module
48	COM	Communication port
49	SCL	Serial clock pin
50	SDA	Serial data pin
51	EEPROM	Electrically erasable programmable read-only memory
52	DMP	Digital motion processor

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CHAPTER 1

1.1. INTRODUCTION

Sign language is movements of your hands and arms used to communicate. There are several official systems of sign language, used for example by hearing impaired people. Communication is the only medium by which we can share our thoughts or convey the message but for a person with disability (deaf and dumb) faces difficulty in communication with normal person. Because of this, a person who lacks in hearing and speaking ability is not able to stand in race with normal person. As a result of these obstacles, deaf and dumb people are discouraged to speak out about themselves or their situations in a public place or emergency cases or in a private conversation. Indian sign language is very scientific and has its own grammar, but lack of awareness has meant that many deaf people are not even aware of institutions where they can learn it and equip themselves for public communication.

British and American sign language dictionaries are an important reference point for the dictionary, but signs used by deaf people in India are very different because of their cultural, geographical and historical context. Deaf people in India use Indian Sign Language (ISL) as the main mode of communication among them. ISL is a natural sign language which has its own phonology, morphology, syntax, and grammar. The research on Indian Sign Language linguistics and phonological studies is limited because of lack of linguistically annotated and well documented data on Indian Sign Language.

Indian Sign Language is used in deaf communities which include deaf people, hearing children of deaf adults.. So, there is a need to build an automation system which can generate signs corresponding to the ISL words which are used while communicating with deaf people. The sensor based approach uses various sensors to collect the data, analyze, recognize and interpret. major advantage of this approach is the mobility. So in this paper, sign recognition system is proposed based on hand gesture which after detecting the gesture, based on trained classes, provides text display on developed Android app and also word/phrases are repeated vocally in a phone in real time.

1.2 INTERNET OF THINGS

The Internet of Things (IoT) refers to the process of connecting everyday physical objects to the internet—from common household objects like light bulbs; to healthcare assets like medical devices; to wearables, smart devices, and even smart cities.

IoT technology has brought transformation to the way we live life every day and will bring much more drastic changes in the automation world. From the consumer point of view, new IoT products like wearable devices and home automation devices are evolving and IoT technology is also giving lots of benefits even to disabled people. Sensors provide the basis to connect the things and enabling things to share information so that data can be stored, processed and presented in easy understandable form, in an IoT environment. IoT facilitates smart connectivity and context-aware computing via network resources. Earlier, wired gloves were invented to capture hand gestures and motions. The gloves used optical or resistance sensors or flex sensors to measure the bending of joints. Those gloves had “difficult to handle/use” setup, limiting the applications to research purposes. In the coming years, there is a need to create accurate and lightweight wired gloves. IoT platform also provides a suitable environment to connect the hardware devices through users and the cloud. Considering the huge potential of IoT Technology current and undergoing development, a novel IoT based wearable Gadget- Infinity Glove based on Arduino microcontroller integrated with Bluetooth module(HC-05) and GY-61 3-axis accelerometer sensors, is being proposed. The glove comprises largely of two main modules, one is for IoT automation and the other is to curb the communication barrier between the normal people and the specially challenged people.

In the age of automating everything, a touch-less, natural user interface (NUI) is critical for everyday users to engage with the intelligent devices and environments. Carefully designed interfaces and sensors that can recognize common user gestures will greatly enhance the user experience, productivity and safety in designing smart buildings.

When the signs are used to convey the message the bending of the flex sensor is measured using the voltage with the help of the connected resistors. Here for displaying the output through the smart phone (IoT) internet of things is used. Using this IOT an app is designed for displaying the output through the smartphone. This app displays the output in the form of text and audio.

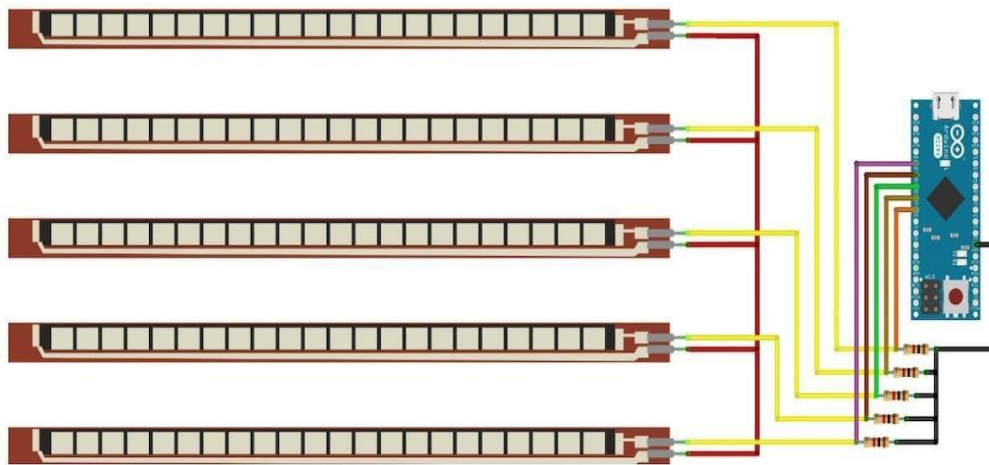


Fig 1.1: Flex Sensor Circuit Connections

1.3 INDIAN SIGN LANGUAGE (ISL)

Indian Sign Language is a well-structured and coded gesture. Every gesture has a fixed meaning to it. Sign Language is the only means of communication for deaf people. In the past years, there has been an increased interest among researchers in the field of sign language recognition. One of which is to introduce means of interaction from human to computer. Deaf and Dumb people rely on sign language interpreters for communication. Finding experienced and qualified interpreters for their daily communication throughout life is a very difficult task and also unaffordable. Hence, a human to computer interaction system will prove to be a reliable and consistent solution in the future for deaf and dumb people. Many types of research took place in this area that has been carried out for more than twenty years. Sign Language is the only fully

accessible language for deaf persons. Learning Indian sign language help a deaf person connect with other deaf person and the larger deaf community. For a hearing person, learning Sign Language is an entirely different experience. But it is still a great process that results in learning a new language. To be able to communicate with the deaf and hard of hearing people in one's community. Learning Indian Sign Language is a necessity for a deaf person. This helps him/her connect with other Deaf persons and the larger Deaf community. However, for a hearing person, learning Sign Language can be a useful tool:

1. To communicate with the Deaf Community and,
2. To bridge the gap between hearing and deaf people.

There is a need for sign language interpreters at various public places such as:

- Hospitals,
- Railway stations,
- Police stations, and
- The courts during proceedings that involve a deaf person.

There is an increasing number of corporate houses and companies that are recruiting deaf persons into their workforce. Deaf enabled foundation provides an orientation for the Human Resources personal of companies that are willing to employ deaf persons. This orientation helps them understand Sign Language.

HISTORY OF ISL

Indian Sign Language (ISL) has developed over the past century and taught since 2001. As per BBC, about 700 Indian schools teach sign language. ISL has its unique grammar and gestures, but there are some regional differences. It was Sibaji Panda, a deaf teacher, who created and introduced the first-ever formal training course in ISL at the Ali Yavar Jung National Institute of Speech and Hearing Disabilities (AYJNISHD), in 2001. Panda is the founding member of the Indian Sign Language Teacher's Association (ISLTA) and the Indian Sign language Interpreter's Association (ISLIA).

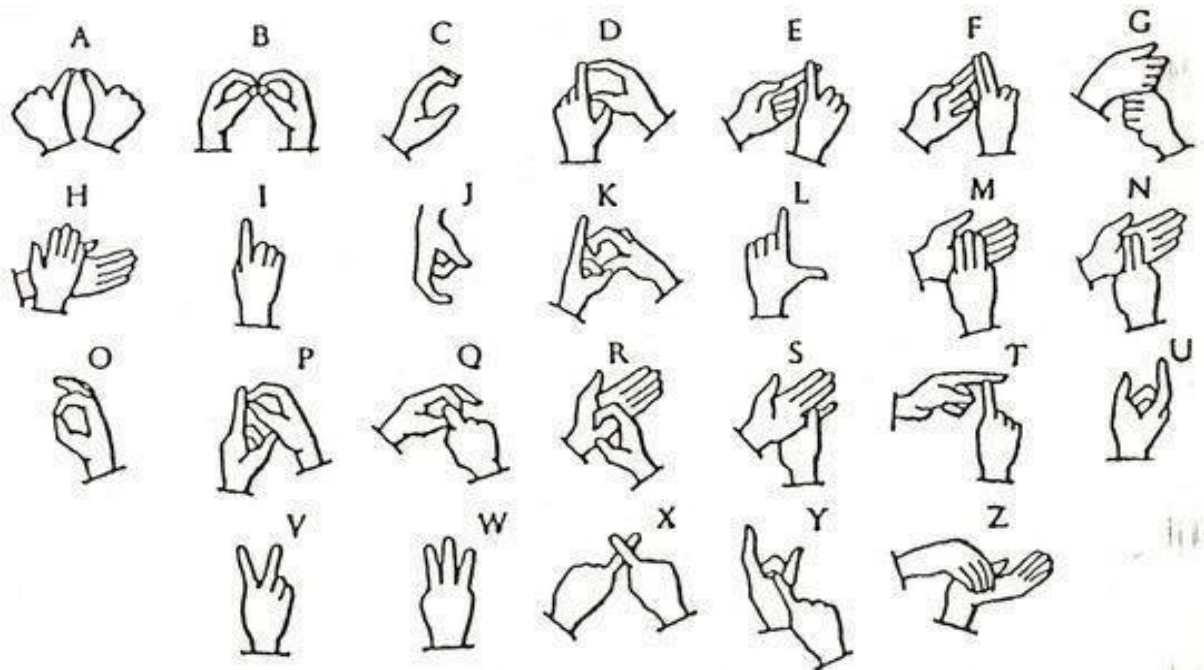


Fig 1.2: Sign Language for Alphabets

In 2011, the Indian Ministry of Social justice and Empowerment helped set up the Indian Sign Language Research and Training Centre (ISLRTC) at the Indira Gandhi National Open University (IGNOU). This center, however, was shut down and re-established in 2015 as a Society under the Ministry of Social Justice and Empowerment's (MSJE) Department of Empowerment of Persons with Disabilities.

1.4 Hand Gesture

A gesture is a movement that you make with a part of your body, especially your hands, to express emotion or information. There are three main types of gestures: adaptors, emblems, and illustrators (Andersen, 1999). Adaptors are touching behaviors and movements that indicate internal states typically related to arousal or anxiety. Adaptors can be targeted toward the self, objects, or others. In regular social situations, adaptors result from uneasiness, anxiety, or a general sense that we are not in control of our surroundings. Emblems are gestures that have a specific agreed-on meaning. These are still different from the signs used by hearing-impaired people. A hitchhiker's raised thumb, the "OK" sign with thumb and index finger connected in a circle with the

other three fingers sticking up, and the raised middle finger are all examples of emblems that have an agreed-on meaning or meanings with a culture. Emblems can be still or in motion; for example, circling the index finger around at the side of your head says "He or she is crazy," or rolling your hands over and over in front of you says "Move on."

Illustrators are the most common type of gesture and are used to illustrate the verbal message they accompany. For example, you might use hand gestures to indicate the size or shape of an object. Unlike emblems, illustrators do not typically have meaning on their own and are used more subconsciously than emblems. These largely involuntary and seemingly natural gestures flow from us as we speak but vary in terms of intensity and frequency based on context. Although we are never explicitly taught how to use illustrative gestures, we do it automatically. Think about how you still gesture when having an animated conversation on the phone even though the other person can't see you. Hand gestures are an important part of nonverbal communication and form an integral part of our interactions with the environment. Notably, sign language is a set of hand gestures that is valuable to millions of disabled people.

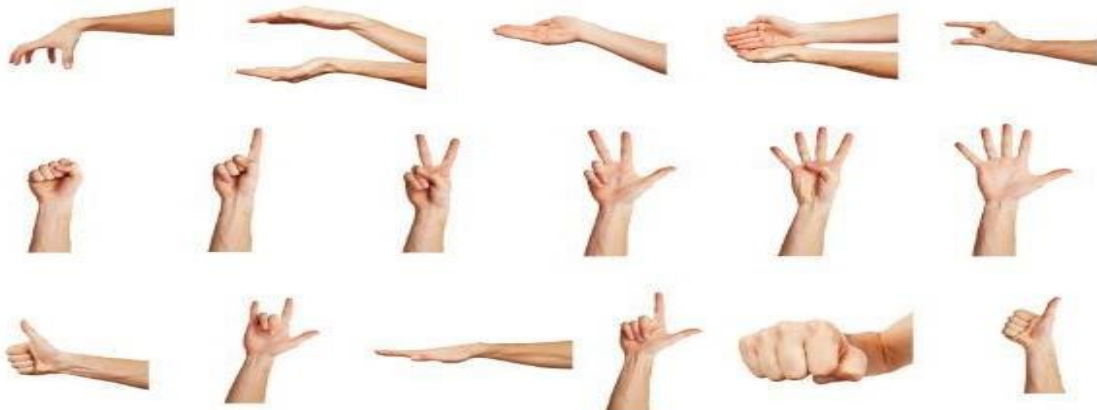


Fig 1.3: Hand Gestures

1.5 SMART GLOVES

A glove that helps people with hearing disabilities by identifying and translating the user's signs into spoken English. The proposed work Hand gestures are strong medium of communication for hearing impaired society. The deaf and dumb make

use of sign language to communicate which is difficult to interpret by the individuals who are not well-aware of it. Thus, there is a need of building up a device that can interpret the gestures into text and speech.

The main goal of this project is to create a smart glove system that can continuously recognize sign language gesture and translate that into spoken words.

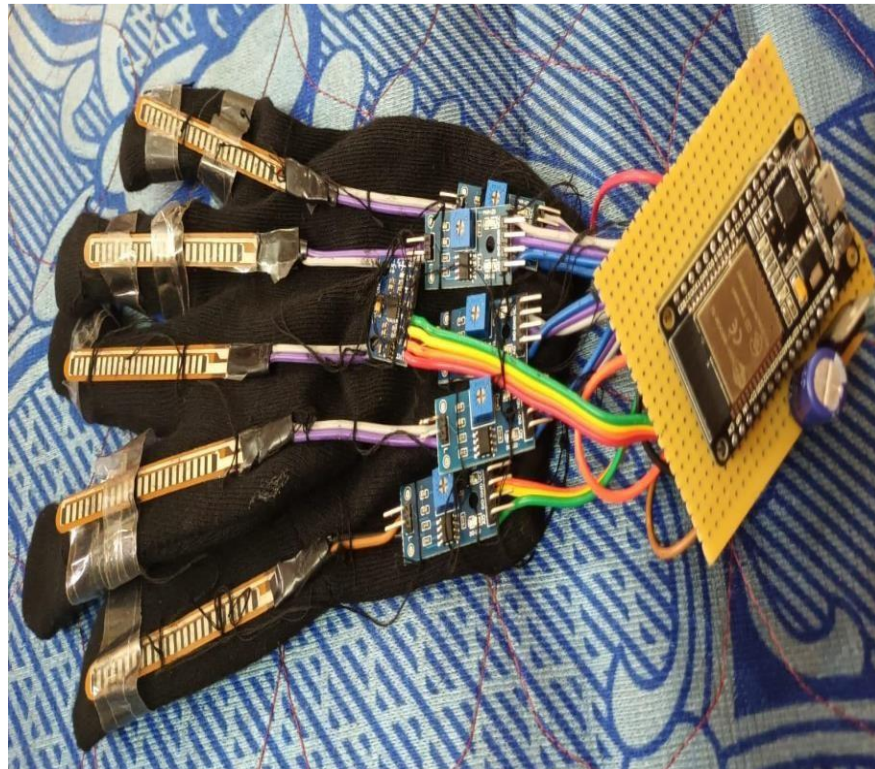


Fig 1.4: Glove

CHAPTER 2

LITERATURE SURVEY

2.1. Sign speaks – An IOT based smart gloves for dumb

Priiyadharshini et al, Communication is the only means by which we can express our feelings or articulate a message, but for a person with a disability (deaf and dumb) it is hard to connect with a normal individual. As a consequence, a person who loses the capacity to hear and speak is unable to stand with a normal person in a contest. Communication is visual, not auditory, for a person who can't hear and speak. Dumb people are likely to communicate using sign language, but they find it difficult to connect with others who do not understand it. There is also an obstacle to contact between these two communities. The main purpose of this smart gloves paper is to reduce this connection barrier. The key goal of the proposed plan is to design a cost-effective device that can give voice to a voiceless individual with the help of Smart Gloves. This ensures that the use of smart gloves would not drive a wedge for two separate communities. This system must a dream come true for dumb and deaf people to interact normally with people without seeking other's help. In this case, this system must be needed by the disabled people. With the aid of these gloves, people with disabilities will even get a chance to develop in their respective carrier and often helps the nation flourish.

This initiative supports deaf and dumb persons who can't speak to themselves or with common people. It is also helpful in establishing the moral responsibility in correspondence to cherish the translation of languages. A Smart Glove used in this paper distinguishes gestures made by hand. This application suggests a newly integrated full-duplex communication for voice impairments. This electronic mouth allows dumb people to communicate as normal. The flux sensor helps to collect the user's data. The meaning of each action would be distinct. The accessibility of the gestures is improved by the previously proposed system.

With the aid of smart gloves, this makes the user feel natural. Sign language is an instrument of communication used by a disabled person. Here we translate sign language through text and speech to remove the communication barrier between the various communities by smart gloves. The use of smart gloves would also enable disabled people to thrive and grow as millions of people with disabilities. By enhancing their future better, thus enhancing our country better

2.2 Arduino Based Smart Gloves for Blind, Deaf and Dumb Using Sign and Home Automation Mode

K Pujakumari et al, Clever Hand Mitten assist debilitated people to live with able people and make their existence comfort and efficient. As we all know that a dumb person are unable to speak then these intelligent hand mitten aid him/her to convert his finger indication into words and speaker voice. This also helps the able people to acknowledge what s/he is trying to say and reply accordingly. This Intelligent mitten has a provision of Home Automation control from which a physically challenged people become independent to live their life. The physical intent of the this IOT based project is to progress a comfort and efficient, easy to use, superficial smart hand gloves system which will minimize the obstacles for physically challenged people where they can stand with the race. An amalgamation of fingers will be used for demonstrating multiple gestures.

Fingers gestures will control our home appliances like Bulb, Fan etc. For dumb people we have used speaker through the finger gesture they will speak their basic needs. The platform used for the identification of the gesture is the Flex sensor. Once the first gesture is captured and processed, one appliance gets ON, then it is required to move to next appliance. Research is going on process to control home appliances by the gestures of fingers once the program is on run.

The future advancement will also be designed on the IOT basis and Android application in future will try to manage through application were the location of Disabled person location and his/her movement will be track through GPRS so we will come

know if any accident or loss may occurs and we will also try to control other home appliances around us by the help of internet of things.

2.3 Assistive Hand Gesture Glove for Hearing and Speech Impaired

Abhi Zanzarukiya Bhargav Jethwa et al, Hand based gestures are words of communication for people impaired of speech and hearing. This results in communication mismatch between such impaired people and a normal one. A deaf and dumb person many times finds difficulty in informing about basic phrases or words representing certain actions like "How are you?", "Yes", etc. to a normal human. To tackle this issue, one hand gesture recognition system is presented which uses a sensor and a microcontroller to capture a gesture movement in the form of a signal. This hand gesture recognition system uses 1D Convolutional Neural Network (1D-CNN) which can extract feature directly from the raw temporal signals captured.

The resulted word or phrase is communicated to a normal person through the Mobile phone of a disabled person in terms of audio voice and text-based notification. Furthermore, to reduce the latency in predicting output, the trained 1D-CNN model is deployed in Android phone itself rather than running the model on the server. The trained model achieves recognition accuracy of 97.96% on test data consisting of many samples of 10 different patterns.

The Assistive Hand Gesture recognition system has been successfully implemented. The resulting hand glove successfully captures pattern using the IMU sensor in form of accelerometer and gyroscope reading and classifies the pattern and accordingly displays the result on the mobile interface. Once the data reaches the phone via Bluetooth, the time taken to display the output is 0.56 sec. This instant response of the pattern recognition proves the real-time response-ability of this developed system.

2.4 Design and development of hand gesture recognition system for speech impaired people

Mrs. Neela Harish et al, The solution to this problem is determined in this paper, by the usage of the Indian sign language symbols which are generic to all deaf and dumb

people in India. The gestures illustrated by the Indian sign language symbols will be conquered with the support of the flex sensors and accelerometer. The movements included during gesture representation are rotation, angle tilt, and direction changes. The flex sensor and the accelerometer are incorporated over fingers and wrist respectively to acquire their dynamics, as these sensors are fitted over the data glove. These voltage signals will then be processed by microcontroller and sent to voice module, where the words voice outputs are stored and played back equivalent to each word values to produce the appropriate voice words with the help of the speaker.

In this paper, the usages of the hand gesture made by speech and hearing impaired people have been made successful to interpret their expression of words. Hence the gesture for each word was acquired with the help of the flex sensors and accelerometers. Their corresponding distinct voltages were fed serially to the setup. The data on processing by the microcontroller and voice module would generate the consonant words which can be heard by normal people with the help of the speaker. Thus, the communication gap between normal and speech and hearing impaired people is reduced.

The discussions of the Indian sign language have been made and the symbols of the eight commonly used words were captured and produced as voice output. Hence this research provides an elucidation for all the obstacles faced by all speech impaired people, as from this they will be satisfied, motivated and gain self confidence that their feelings will also be understood by other people.

2.4 Design and Implementation of A Sign-to Speech/Text System for Deaf and Dumb People

Dalal Abdulla et al, this paper presents an approach for designing and implementing a smart glove for deaf and dumb people. There have been several researches done in order to find an easier way for non-vocal people to communicate with vocal people and express themselves to the hearing world.

Developments have been made in sign language but mainly in American Sign Language.

This research aims to develop a sign to Arabic language translator based on smart glove interfaced wirelessly with microcontroller and text/voice presenting devices. An approach has been developed and programmed to display Arabic text. The whole system has been implemented, programmed, cased and tested with very good results.

This paper presents glove-based sign-to-text/voice translating system for deaf and dumb people. The glove represents the Arabic sign language letters as a text on LCD and outputs an audio through the speaker, which helps in limiting the communication barrier between deaf and dumb with vocal people. The important of the research is related to its aim to help this class of non-vocal people to communicate with others and improve their contributions to growth and build their nations. The system has been designed, programmed, implemented and tested with a very good result. The system could be extended to cover wider range of sign by using a combination of two gloves instead of one.

2.4 Design Of A Communication Aid For Physically Challenged

Suganya R et al, Communications between deaf-mute and a normal person have always been a challenging task. This paper describes a way to reduce barrier of communication by developing an assistive device for deaf-mute persons.

The advancement in embedded systems, provides a space to design and develop a sign language translator system to assist the dumb people, there exist a number of assistant tools. The main objective is to develop a real time embedded device for physically challenged to aid their communication in effective means. The proposed work in this paper is to implement a system without handheld gloves and sensors and by capturing the gestures continuously and converting them to voice and vice versa, thus making the communication simpler for deaf and dumb people by a handheld embedded device along with the hardware setup.

The effectiveness of the work is verified under MATLAB environment and further in future dedicated voice output will be produced corresponding to the text and the gesture images captured.

The work was initially started with MATLAB by capturing live images continuously (video- the hand gestures), then the gesture is segmented (Skin color based Segmentation) from the live image captured for both training the gestures using Feed Forward Neural Network (FFNN) and for Gesture recognition. The Gesture is recognized by pattern classification of NN and the corresponding text output is displayed. This research will greatly help in bridging the communication gap between a normal person and hard of hearing persons and vice versa. This system is proposed based on mobile devices that takes user video from the camera, perform image processing and gesture recognition based on that image to understand the gesture of the opposite person and then give a textual representation of that gesture and finally the future work is to produce a dedicated voice output and vice versa. Thus the implementation of the text output is done under MATLAB environment and further process of voice output will be done with a dedicated hardware setup.

2.7 Implementation of IoT Based Smart Assistance Gloves for Disabled People

R.Senthil Kumar et al, Communication between normal people and people with vocal and hearing troubles is a difficult task. The sign language used by these people is not understandable by the common people.

So it creates a communication barrier. People who are paralyzed also require assistance regularly. For such people we have proposed Implementation of IOT based Smart assistance gloves for disabled people. The gloves we designed is very simple yet effective when compared to the existing system. With the help of flex sensors, the finger gesture is detected and the corresponding instructions are displayed in the android app with audio output. The proposed system is implemented by Arduino uno and Raspberry pi, where the communication between these two modules is done by wireless serial port module due to its secured data transmission. An alert message will be sent through the GSM module during emergency situation

Thus, the proposed model has the advantage of assisting deaf and dumb as well as the paralyzed patients by displaying the output commands in android application vocal output in speaker. By using wireless serial port modules, data transmission is fast

and secured. In case of emergency, GSM will send alert messages to the respective person. Compared to the vision-based techniques, this data-based gloves will reduce noise disturbances and offer less complexity in algorithms. In future, we can enhance this proposed model with a maximum number of commands. Using AI, the data-based system can be further enhanced with speech recognition. For home automation, by using different gestures we can control various basic functions such as switching home appliances in an effective manner.

2.8 IoT Based Sign Language Recognition System

Punsara K.K.T et al, Sign language is the key communication medium, which deaf and mute people use in their day-to-day life. Talking to disabled people will cause a difficult situation since a nonmute person cannot understand their hand gestures and, in many instances, mute people are hearing impaired. Same as Sinhala, Tamil, English, or any other language, sign language also tend to have differences according to the region. This paper is an attempt to assist deaf and mute people to develop an effective communication mechanism with non-mute people. The end product of this project is a combination of a mobile application that can translate the sign language into digital voice and IoT-enabled, light-weighted wearable glove, which capable of recognizing twenty-six English alphabet, digits, and words. Better user experience provides with voice-to-text feature in mobile application to reduce the communication gap within mute and non-mute communities. Research findings and results from the current system visualize the output of the product can be optimized up to 25%-35% with an enhanced pattern recognition mechanism.

End product of this project is useful for handicapped mute community, which will develop a bridge between those who comprehend sign language and those who do not. Initial version of this sign language recognition system supports American sign language and consist of two main components i.e. wearable glove and mobile application. Hand glove is consisting of several sensors including flex sensors, gyroscope and battery monitoring sensors which can be used to obtain hand gestures. Raspberry Pi device establish a wireless communication between glove to obtain the gathered data for processing. Mobile application is capable of identifying the voices of

non-mute person, express the glove generated signal's electronic voice and training mode for new users. Mobile application and Raspberry pi is connected via WIFI and remaining battery percentage of the glove can also be monitored. Flutter has been used for develop the mobile application and it is compatible with iOS, Android and Web platforms.

2.9 Smart Audio Glove for Deaf and Dumb Impaired

A Snehaa et al, Deaf-Mute individuals all through the world using gesture-based communication to speak with others, which is feasible for the individuals who have experienced unique training. Everyday citizens face trouble in understanding the sign language. To defeat these continuous issues, this framework is created. The framework is employed to detect any gesture based communication, and plays recorded voice. This diminishes the issues among customary individuals and enables a free flow of interactions between public citizens. This work has three modules, they are detecting, handling and voice stockpiling unit. It can be done using a flex sensor and APR9600 voice recorder.

This model can be used by the people of all age groups and people can easily communicate between the normal individuals. By using this model, they can be normal as other individuals and lead the life by using their knowledge, earn and start a business too. The output from the device has high accuracy in identifying the sign languages executed, using the highly responsive flex sensors. The experimental simulations in image processing are implemented using MATLAB.

The proposed method is far more user-friendly, efficiency is high and can be developed in various higher grounds and processors. This gives a basic idea of the solution, with furthermore technologies and innovation, the basic model can be developed to a customized product. This system makes the communication through gestures easily and beats the ongoing challenge faced by deaf and dumb people in their normal life.

The smart glove is used to break the barrier between two communities, the flex sensors which help them to convert the sign to text and audio. We may also improve the

efficiency of this system. Since the flux sensors are used in this equipment, various ranges of the parameter are matched with the words and characters, likewise the same algorithm can be utilized to perform home automation using relays. The people who have speech, vision, hearing and movement disability can use this product to do their chores and requirements. The product can also be customized using Raspberry pi for their own needs and requirements.

2.10 Glove Based Deaf-Dumb Sign Language Interpreter

Santosh Kumar S et al, As deaf people they use sign language to communicate in a way that is difficult for ordinary people to understand. To overcome the communication gap with outside world a microprocessorbased Sign Language Interpreter is employed to handle data transfer operations. A Raspberry Pi based microprocessor is used as a compact microcomputer designed to govern the operation of six axis MPU6050, used for the detection of sign language. A triaxial accelerometer is used to detect the tilt of the hand.

The flex sensor module is interfaced with the microprocessor through MCP3008 which is an external analog to-digital converter. The decision making for sending message based on the data received from the MPU6050 and MPU3008. The proposed system is able to convert the different signs into the text and voice message. It is trained for the different symbols and works effectively

Sign language can be a useful method for reducing the communication between the deaf or dumb community and others. The proposed project aims to reduce the gap between the deaf and the people around them. This method translates sign language into text and speech. The proposed work overcomes the time constraints of mute people and improves their approach. The proposed system is implemented using Raspberry Pi, flexible sensor, Gyro sensor. Compared to the existing system the proposed system is compact and is more likely to be transported to any locations and better passes different signals.

CHAPTER 3

AIM AND SCOPE OF PRESENT INVESTIGATION

3.1 AIM:

➤ To reduce the Communication barrier between vocally impaired people and normal persons.

➤ To express their feelings with normal people.

➤ To convert hand gestures into voice. An electronic glove is designed for deaf-mute communication that allows the deaf and dumb to communicate with ease

3.2 SCOPE OF THE PROPOSED METHOD:

The aim of a smart glove for deaf and dumb project is to create a wearable device that can translate sign language into spoken or written language, and vice versa. The project's scope involves designing a glove that can recognize hand gestures and convert them into text or speech in real-time.

The smart glove for deaf and dumb project seeks to provide an alternative method of communication for individuals who are deaf or hard of hearing and who use sign language as their primary mode of communication. The glove would allow them to communicate more easily with people who do not know sign language, such as family members, friends, or strangers.

In addition to translation capabilities, the smart glove could also include features such as haptic feedback, which would provide tactile sensations to the wearer's hand to enhance communication. The glove could also be connected to a smartphone app or other device to provide additional functionality.

Overall, the aim and scope of the smart glove for deaf and dumb project are to create a wearable device that can improve communication and enhance the quality of life for individuals who are deaf or hard of hearing and who use sign language as their primary mode of communication.

3.3 PROPOSED METHODOLOGY

Communication is the only means by which we can express our feelings or articulate a message, but for a person with a disability (deaf and dumb) it is hard to connect with a normal individual. As a consequence, a person who loses the capacity to hear and speak is unable to stand with a normal person in a contest. Communication is visual, not auditory, for a person who can't hear and speak. Dumb people are likely to communicate using sign language, but they find it difficult to connect with others who do not understand it. There is also an obstacle to contact between these two communities. The main purpose of this smart gloves paper is to reduce this connection barrier. The key goal of the proposed plan is to design a cost-effective device that can give voice to a voiceless individual with the help of Smart Gloves. This ensures that the use of smart gloves would not drive a wedge for two separate communities. This system must a dream come true for dumb and deaf people to interact normally with people without seeking other's help. In this case, this system must be needed by the disabled people. With the aid of these gloves, people with disabilities will even get a chance to develop in their respective carrier and often helps the nation flourish. The smart glove is used in this project to record the hand signals and translate them into an expression of the user's sign language. The four sensors are mounted to the corresponding fingers of the glove. The information acquired as flexible nerve extracts changes in the degree of bending.

The four nerve sensors are fitted to each glove). The analog effects of the sensors are then integrated into the ADC (Analog-digital converter) step of Arduino (microcontroller). For further comparison and processing, the Arduino will continuously receive the ADC value. For each word, the ADC is checked and the characters are recognized.. Then the speech output is produced in the speaker of the Androidphone which is connected to the Arduino through the Bluetooth module HC-05 by TTS block (Text To Speech conversion). This message is sent to other users by text to translate voices to audio and LCD text information (using cell phone speakers) and will be continuously repeated using the same procedure. This project is accomplished almost 98- 99%, however, it is a large portion of lies upon the people's execution. The main

purpose is to incorporate the queries to translate acts or signals productive to each text and speech. A glove with the flexible sensors is used by the interpreter. As they are attached to the gloves it is easy for every individual to operate it by wearing the gloves in the hands and also there is great accuracy. The device can also be able to translate even larger gestures by only a single hand movement. The data is collected from parts of the physical body (usually the hand) through a flex sensor and processed to the speech of which the gesture is being performed.

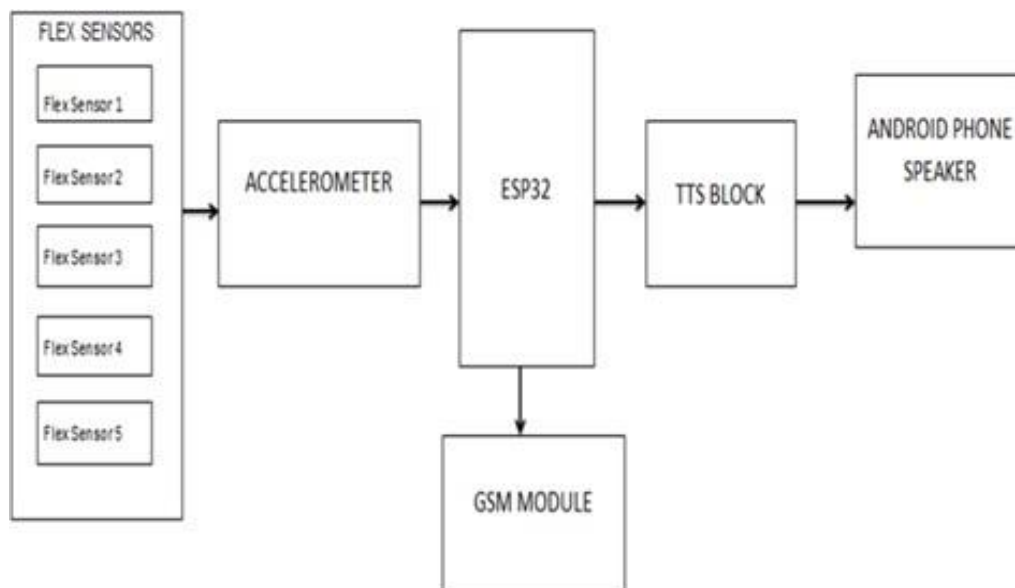


Fig 3.1: Block diagram

CHAPTER 4

MATERIALS AND METHODS

4.1 Flex Sensor

The Flex sensor also referred to as the bending sensor, is very flexible. On the basis of the bent, the resistance is modified. The length of the sensor that is used here is 2.2" In this project total of four flex sensors F1, F2, F3, and F4 are used (except the thumb finger. But can also include it) Flex sensors are attached to the glove fingers so it becomes very easy for the deaf and dumb person to use that. Resistance values are altered, and the values are then passed into the Arduino (microcontroller) type ADC (analog to digital conversion) They will change the output voltage of a flex sensor relating to various gestures.

Among different types of flex sensors, here Conductive ink-based flex sensor is used. The technology of Flex Proprietary is based on carbon-resistant compounds. The radius is less, increasing the strength value if the substrates are bent, and the flexor creates discharge resistance according to the radius bend. Depending on the degree of the sensor, the input and output sensor require 5 volts between 0 and 5V input and output. The flex sensor have the following features:

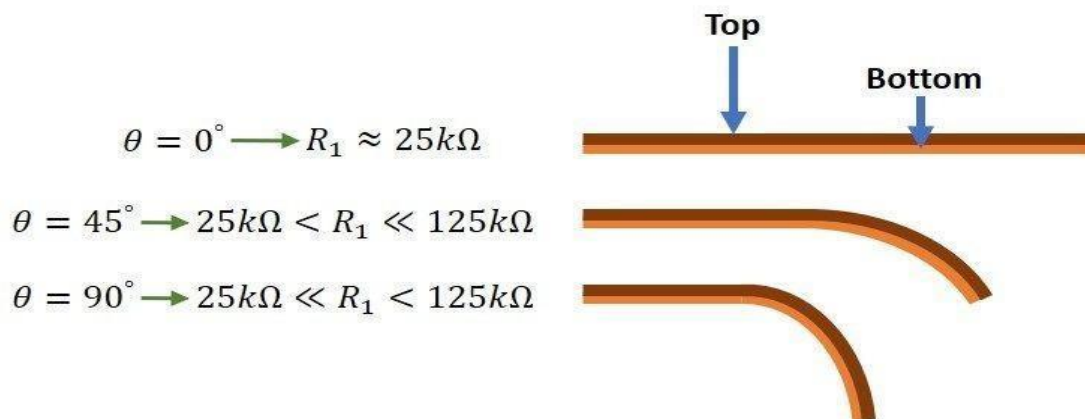


Fig 4.1: Resistance value against flex sensor bending angle

4.2. Flex characteristics

Basically, the flex sensor uses the voltage divider circuits and buffer. To the non-inverting mode op-amps, Flex sensor output is inputted to amplify the voltage. This increase in the bending degree decreases the output voltage. It is determined with a basic flex sensor circuit that uses the voltage divider principle and ranges between 1.35 V and 2.5 V. The voltage output is calculated by $V_{in} R_2 / (R_1 + R_2)$ equation, where R_1 is the other non-inverting terminal input resistor. The flexible sensor offers flexible resistance readability with another degree of flexible sensor flexion.

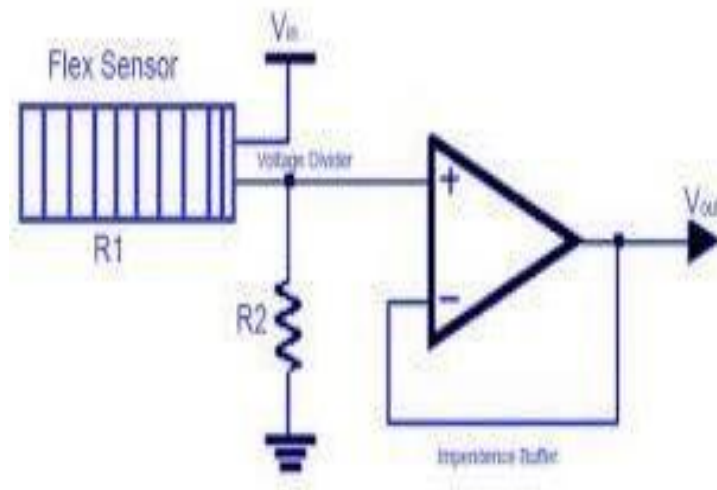


Fig 4.2: Flex sensor basic circuit

Pin Configuration

The pin configuration of the flex sensor is shown below. It is a two-terminal device, and the terminals are like p1 & p2. This sensor doesn't contain any polarized terminal such as diode otherwise capacitor, which means there is no positive & negative terminal. The required voltage of this sensor to activate the sensor ranges from 3.3V - 5V DC which can be gained from any type of interfacing.



Fig 4.3: Flex sensor pin configuration

- Pin P1: This pin is generally connected to the +ve terminal of the power source.
- Pin P2: This pin is generally connected to GND pin of the power source.

Specifications & Features

The specifications and features of this sensor include the following.

- Operating voltage of this sensor ranges from 0V to 5V
- It can function on low-voltages.
- Power rating is 1 Watt for peak & 0.5Watt for continuous.
- Operating temperature ranges from -45°C to +80°C
- Flat resistance is 25K Ω
- The tolerance of resistance will be $\pm 30\%$
- The range of bend resistance will range from 45K - 125K Ohms

4.3. ESP32

ESP32 is a low-cost, low-power Microcontroller with an integrated Wi-Fi and Bluetooth. It is the successor to the ESP8266 which is also a low-cost Wi-Fi microchip albeit with limited functionality. It is an integrated antenna and RF balun,

power amplifier, low-noise amplifiers, filters, and power management module. The entire solution takes up the least amount of printed circuit board area. This board is used with 2.4 GHz dual-mode Wi-Fi and Bluetooth chips by TSMC 40nm low power technology, power and RF properties best, which is safe, reliable, and scale-able to a variety of applications. Engineered for mobile devices, wearable electronics and IoT applications, ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software. ESP32 also includes state-of-the-art features, such as fine-grained clock gating, various power modes and dynamic power scaling.

Hybrid Wi-Fi & Bluetooth Chip

ESP32 can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces.

SPECIFICATIONS:

- ESP WROOM32, Dual-Core 32-bit LX6 microprocessor
- ROM: 448 KB, SRAM: 520 KB, Support up to: 16MB flash
- Built-in CP21XX USB-to-UART(serial) Bridge
- Wi-Fi: 802.11b/g/n/e/i
- Bluetooth: v4.2 BR/EDR and BLE
- 2 × 8-bit DACs
 - [D26][D25]
- 9 × touch sensors Note: Touch sensor 1 is [D0]. However, it's not available as a pin in this particular ESP32 development board (version with 30 GPIOs). GPIO 0 is available on the version with 36 pins.
 - [D13][D12][D14][D24][D33][32]
 - [D15][D2][D4]
- Internal Temperature Sensor

The ESP32 supports three types of I/O modes with each GPIO Pin. They are,

- Digital
- Analog
- Internal sensors

Analog: Used to send/receive analog data using the following functions:

examples based on Arduino IDE

analogRead();

analogWrite();

Digital: Used to send/receive digital data using the following functions:

examples based on Arduino IDE

digitalRead();

digitalWrite();

Internal Sensors: This mode allows us to fetch internal sensor data from the ESP32 itself. The three sensors available are as follows:

- Temperature Sensor
- Internal Hall Effect Sensor
- Touch Sensor

These sensors can be accessed by the following functions:

examples based on Arduino IDE

temperature_sens_read()

hallRead()

touchRead()

ESP32 is created by Espressif Systems with a series of SoC (System on a Chip) and modules which are low cost with low power consumption. This new ESP32 is the successor to the well-known ESP8266(became very popular with its inbuilt WiFi). ESP32 not only has Built in WiFi but also has Bluetooth and Bluetooth Low Energy. In other words we can define ESP32 as "ESP8266 on Steroids". ESP32 chip ESP32-D0WDQ6 is based on a Tensilica Xtensa LX6 dual core microprocessor with an operating frequency of up to 240 MHz.

The small ESP32 package has a high level of integrations such as:

- Antenna switches
- Balun to control RF
- Power amplifier
- Low noise reception amplifier
- Filters and power management modules

On top of all that, it achieves very low power consumption through power saving features including clock synchronization and multiple modes of operation. The ESP32 chip's quiescent current is less than 5 μA which makes it the ideal tool for your battery powered projects or IoT applications.



Fig 4.4: ESP32

Difference between ESP32 and ESP8266:

ESP32 is the successor of **ESP8266**, Lets learn what are the differences between ESP32 and ESP8266 with their features and specifications below.

- ESP32 has an additional core compared to ESP8266
- Faster Wi-Fi
- Increased number of GPIO (input/output) pins

Compatibility with Bluetooth 4.2 and Bluetooth low energy (*low energy*). Additionally, the ESP32 comes with touch-sensitive pins that can be used to wake up the ESP32 from *deep sleep* mode and a built-in Hall effect sensor.

Although both boards are extremely cheap, the ESP32 is slightly more expensive than ESP8266. ESP32 deserves it as it has more features than ESP8266.

ESP32 Internal memories and their functions:

- **ROM memory (448 KiB):** this memory is write-only, that is, you cannot reprogram it. This is where the codes that handle the Bluetooth stack, the Wi-Fi physical layer control, some general-purpose routines, and the bootloader to start the code from external memory are stored .
- **Internal SRAM memory (520 KiB):** this memory is used by the processor to store both data and instructions. Its advantage is that it is much easier for the processor to access than the external SRAM.
- **RTC SRAM (16 KiB):** this memory is used by the co-processor when the device operates in deep sleep mode .
- **Efuse (1 Kilobit):** 256 bits of this memory are used by the system itself and the remaining 768 bits are reserved for other applications.
- **Flash embedded (Embedded flash) :** This memory is where our application code is stored. The amount of memory varies depending on the chip used:
 - 0 MB (chips ESP32-D0WDQ6, ESP32-D0WD, ESP32-S0WD)
 - 2 MB (chip ESP32-D2WD)

- 4 MB (Chip ESP32-PICO-D4)

For ESP32s that do not have embedded memory or simply when memory is insufficient for your application, it is possible to add more memory externally:

- Up to 16 MB of external flash memory can be added. This way you can develop more complex applications.
- It also supports up to 8 MB of external SRAM memory.

4.4. ACCELEROMETER:

An accelerometer can be defined as a device that is used to measure acceleration forces, the forces which are defined by this can be static, like the continuous force of gravity or light we have seen in the case of mobile phones and it can also be said in the case of dynamics to sense movement or vibrations.

An accelerometer is a device that senses the different types of accelerations or vibrations. Acceleration is the change in velocity caused by the movements of a body. An accelerometer absorbs the vibrations created by the body and uses it to know the orientation of the body. A piezoelectric accelerometer has two types which are high impedance output accelerometer and low impedance output accelerometer. On the basis of the working mode, it is mainly of three types. The compression mode, the capacitive mode, and the shear mode. All of them work on sensing the vibrations.



Fig 4.5: Accelerometer

The same can be said for the stargazing apps where it somehow knows where in the sky we are looking and accordingly displays the constellations. Mobile technology in smartphones uses the mechanism to identify their orientation through the use of an accelerator which is a device made up of axis-based motion sensing. It is wonderful how this motion sensor can even be used to detect earthquakes and the advancement through research on the application can be used as bionic limbs and other artificial body parts, several other quantified self-movements, of the devices, also uses accelerometers.

Purpose of the Accelerometer

In previous days there were different apps in mobile devices and other things use excel in a meter so basically, its application extends to multiple disciplines both academic and consumer or commercially. Accelerometers in laptops can be used to protect hard drives from damage. In case if the laptop were to suddenly drop while using it, the accelerometer would detect the sudden fall and immediately turn off the hard drive to avoid hitting the reading heads into the hard drive platter. Now without this, the two-day strike because of which various scratches and damages to the platter would be caused for extensive file and reading damages.

Another usage may be a dynamic accelerometer which is used to measure gravitational pull to determine the angle at which a device is tilted of course with respect to the earth, now by sensing the amount of acceleration the users analyze the direction in which the device is moving or analyze how the devices working.

Now with the given properties, this allows the user to understand the surroundings of an item better and with this small device, we can determine any movement ranging from moving uphill to the tilting of an object or whether it is flying horizontally or at an angle and downward, the best example would be smartphones when rotated they display features between portrait and landscape mode depending on how we actually tilt our phone.

Different components are used to make up accelerometers which can also be used to purchase as a separate device, analog and digital displays at available but for

most of the technology devices these components are integrated into the main technology and then access is managed using the governing software or an operating system.

Now with the working also comes to the sensitivity of these devices which are quite high as they are intended and supposed to measure even the slightest minute shift and acceleration so the more sensitive the device is the more easily it can measure acceleration.

Specification of ADXL335

1. Supply Voltage: 2.8V to 3.6V
2. Current Consumption: 320uA
3. Sensitivity: 300mV/g
4. Bandwidth: 3Hz to 5kHz
5. Dynamic Range: $\pm 3g$
6. Operating Temperature: -40°C to $+85^{\circ}\text{C}$
7. Package Type: Surface Mount Plastic Package (LFCSP)
8. Pin Configuration: 5 Pin, 1.27mm Pitch
9. Output Type: Voltage Output
10. Interface: SPI/I2C
11. Output Range: 0V to Vcc
12. Storage Temperature: -65°C to $+150^{\circ}\text{C}$

Accelerometer Module Pin Description

VCC: Power supply pin i.e., connect 5V here.

X_OUT: X axis analog output.

Y_OUT: Y axis analog output.

Z_OUT: Z axis analog output.

GND: Ground pin i.e. connect ground here.

ADXL335 accelerometer provides analog voltage at the output X, Y, Z pins; which is proportional to the acceleration in respective directions i.e. X, Y, Z. We can calculate the angle of inclination or tilt by using X, Y, and Z values. Also, we can calculate Roll, Pitch, and Yaw angles with respect to X, Y, and Z axis. So first we need to convert 10-bit ADC values into g unit. As per ADXL335 datasheet maximum voltage level at 0g is 1.65V and sensitivity scale factor of 330mV/g.

Accelerometer Application

Some applications of the accelerometer are:

- The accelerometer has the capacity to sense the vibration from a micro-scale to a large scale. Even in most of the safety installations, the accelerometer is used.
- An accelerometer is also used in sports. The wearable devices athletes are using daily for practice and observations comprise accelerometers or gyroscopes.
- The physicians use it to check for gain in body mass and monitor body movements. It is also present in the devices used to check the heart rate.
- The piezoelectric accelerometers are used at the industrial level.
- The most frequent accelerometer used in aerospace is Micro-Electro-Mechanical-sensors (the MEMS technology) based. The reason for using MEMS sensor-based accelerometers is that they can sense the vibrations even on a micro-scale and can also provide value on a micro-scale.
- It is even used for satellites which are in space, as it can tolerate high pressure, heat, and vibration.
- For purposes like gearbox analysis, bearing analysis, rotor trim, and balance, an accelerometer plays an important role.
- The aircraft are navigated using the accelerometer. Aircraft flight testing is another thing that requires an accelerometer. To check the characteristics of flight and to confirm its design an accurate observation of data is expected. For that, an accelerometer named LCA-5080 is in use.

- An accelerometer is used for safety purposes in laptops for the hard discs. Because of accelerometer sensors, we have landscape and portrait modes on our phones. Mobile phones keep changing the screen mode in landscape or portrait mode due to accelerometer applications.

4.5. GESTURE RECOGNITION SYSTEM

Managing gestures is an important part of the system of recognition, It has data that suits incoming data. The system attempts to match incoming data to the existing posture. The finger bending values and the distance from the current data are determined for each posture definition.

The position/orientation data are further compared Gesture recognition is a research area that aims to incorporate gestural networks into human-computer interaction. Virtual reality, symbolic, RDC, and musical formation are some of the applications available on the framework. The more general pattern recognition method recognizes human gestures. The process translates raw numerical data into a decision-making type and then uses it to make decisions. The two major types are device-based and vision-based.

4.6. VOICE SECTION

The Data is processed to the voice section after the gesture recognition system. This conflates with the data fed If the information matches the data provided, the speaker and display system will be given the same. To make & easy for the opposite side ones, the speech output will be easy to recognize the signs than the displayed one on the Android mobile screen.

4.7. GSM MODULE:

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI).

It was created to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones and is now the default global standard for mobile communications – with over 90% market share, operating in over 219 countries and territories.

Cellular connections can be a quick and efficient way to get started with SMS notifications in network monitoring solutions because a special subscription to a separate service provider is not required. In most parts of the world, GSM modules are a cost-effective solution for sending and receiving alarm notifications since the utilization of existing networks instead of having to expand your infrastructure to include hardware that allows direct connections with your remote sites.

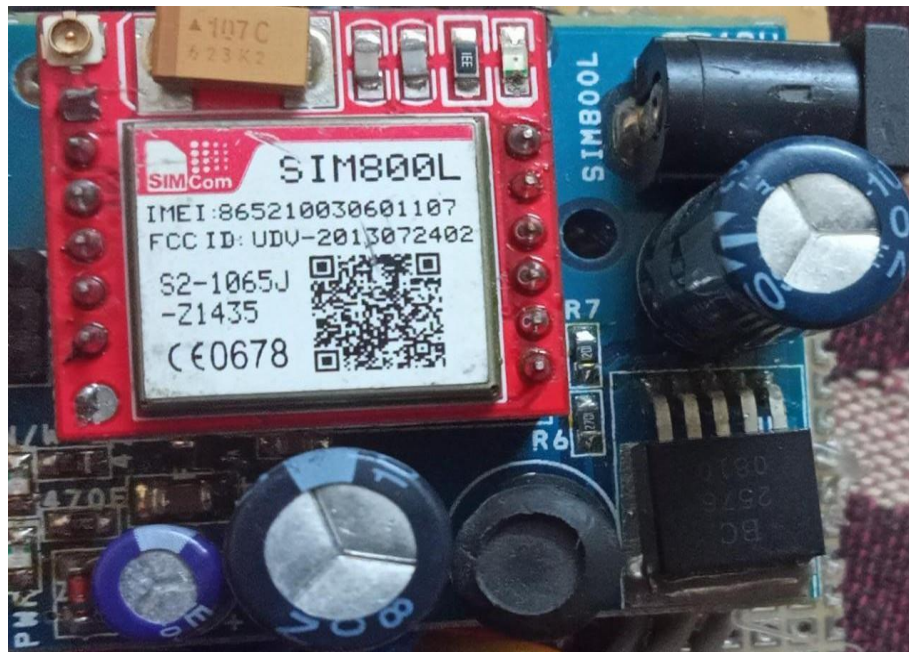


Fig 4.6: GSM Module

Difference between GSM/GPRS Modems, Modules, and Mobiles

- A GSM module or GPRS modules are similar to modems, but there's one difference: A GSM/GPRS Modem is external equipment, whereas the GSM/GPRS module is a module that can be integrated within the equipment. It is an embedded piece of hardware.

- A GSM mobile, on the other hand, is a complete system in itself with embedded processors that are dedicated to providing an interface between the user and the mobile network.

A mobile phone and Subscriber Identity Module (SIM) together form a mobile station. It is the user equipment that communicates with the mobile network. A mobile phone comprises Mobile Termination, Terminal Equipment, and Terminal Adapter.

Mobile Termination is interfaced with the GSM mobile network and is controlled by a baseband processor. It handles access to SIM, speech encoding and decoding, signaling, and other network-related tasks.

Terminal Equipment is an application processor that deals with handling operations related to keypads, screens, phone memory, and other hardware and software services embedded into the handset. The Terminal Adapter establishes communication between the Terminal Equipment and the Mobile Termination using AT commands. The communication with the network in a GSM/GPRS mobile is carried out by the baseband processor.

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.



Fig 4.7: GSM Module- Pin configuration

On the top surface of the GSM module, we can see a chip is mounted on the module board. This is a Quad-band SIM800L GSM/GPRS cellular chip from SimCom in SMT type. SIM800L supports Quad-band frequency its works on frequencies 850MHz, 900MHz, 1800MHz, and 1900MHz, it can transmit and receive voice, SMS, and data information with low power consumption. The operating voltage of this chip is from 3.4V to 4.4V which makes it ideal to operate by a LiPo battery supply. This chip supports a baud rate from 1200bps to 115200bps with Auto-Baud detection. It has a tiny size of 17.6*15.7*2.3mm which makes it a good choice for embedding into projects without a lot of space.

LED Status Indicators

On the topmost right corner side of the SIM800L Module, we can see an LED that indicates the status of your cellular network. After applying the power supply to the module the LED will blink at three different ratios, which shows three different statuses of your cellular network.

Blink every 1s:

When the LED Blinking with a delay of 1s, then it indicates that the GSM module is running but it hasn't made the connection to the cellular network yet.

Blink every 2s:

When the LED Blinking with a delay of 2s, then it indicates that The GPRS data connection you requested is active.

Blink every 3s:

When the LED Blinking with a delay of 2s, then it indicates that the module has made contact with the cellular network and it is ready to transmit/receive voice and SMS Antennas.

An antenna is a vital part of the module, it is used for voice or data communications as well as some SIM commands. SIM800L GSM/GPRS module provides two ways to connect Antennas. There are two types of antennas that can connect to the module one is a Helical GSM antenna and another one is PCB Antenna.

Helical GSM Antenna

The Helical GSM antenna is made of wire, which usually comes with the module. It can be soldered directly to the NET pin on PCB. This type of antenna is very useful in narrow space projects.

PCB Antenna

We can see a U.FL male connector present at the top-left corner of the module, which is used to connect the PCB antenna. This antenna has better performance and allows you to put your module inside a metal case – as long the antenna is outside.

Micro-SIM socket

On the backside of the module, a SIM socket is available, where we can insert an activated 2G micro-SIM card that would work perfectly. When we insert a SIM card into the socket we must ensure that the notch point will upwards. Normally the symbol of the SIM card is engraved on the surface of the SIM socket that helps us to identify the correct direction of SIM inserting.

Pinout/Pin Diagram of SIM800L GSM/GPRS Module

The SIM800L GSM module has 12 pins that are used to connect the module to any microcontroller. The Pinout configuration is explained below:

- **NET:** The NET pin is used to attach an external antenna. Where we can solder Helical Antenna which comes along with the module.
- **VCC:** The VCC pin is used to supply the positive (+) voltage to the module. Power supply 3.4V to 4.4V with min 2 Amp required to work the module finely. Remember, never connect it to a 5V power supply, which can destroy your module. Also, It doesn't work on a 3.3 V power supply.

- **RST**: This pin is a hard reset pin. Pulling this pin low for 100 ms to perform hard reset of the module.
- **RXD**: RX pin is used for Serial communication
- **TXD**: TX pin is used for Serial communication
- **GND**: This is the Ground Pin of the module that needs to be connected to the GND pin on the microcontroller.
- **SPK**: SPK + and SPK – is a differential speaker interface. The two pins of a speaker can be connected to these two pins. The positive pin of the speaker is connected to the SPK+ pin and the negative Pin to the SPK
- **MIC**: MIC+ and MIC- pins are differential microphone inputs. The two pins of the microphone can be connected to these pins. The positive pin of the microphone is connected to the MIC+ pin and the negative Pin to the MIC-.
- **DTR**: Pulling this pin HIGH to activate sleep mode. In sleep mode, the module disables serial communication. Pulling it LOW to deactivate sleep mode, means the module wakes up.
- **RING**: The RING pin acts as a Ring Indicator, which is used in detecting calls and SMS. Basically, this is the ‘_interrupt’ out pin from the module. It is by-default high, but when a call is received it gives a LOW pulse for 120ms. Also, it can be configured to pulse when an SMS is received.

Table 4.1: GSM module specifications

IC Chip	SIM800L GSM cellular chip
Operating Voltage range	3.4V ~ 4.4V
Recommended supply voltage	4V
Peak Current	2 A

Power consumption	▪ Sleep mode < 2.0mA ▪ Idle mode < 7.0mA ▪ GSM transmission (avg): 350 mA ▪ GSM transmission (peek): 2000mA
Supported frequencies	2G Quad Band (850 / 950 / 1800 /1900 MHz)
Transmit Power	▪ Class 4 (2W) for GSM850 ▪ Class 1 (1W) for DCS1800
Interface	UART (max. 2.8V) and AT commands
SIM card socket	Micro SIM card socket
Network Status Indicator	LED
Antenna connector	UFL connector and Header Pin
Working temperature range	-40 to + 85 ° C
Module size	25 x 23 mm

Features

- Receive and make calls using the external speaker and electret microphone
- Receive and send SMS/ Text messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- GPRS multi-slot class12 connectivity: max. 85.6kbps(download/upload)
- GPRS mobile station class B

- Controlled by AT Command (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands)
- Supports Real-Time Clock
- Supports A-GPS
- Low power consumption, 1mA in sleep mode

Power Supply for SIM800L GSM Module

One of the biggest issues with the SIM800L GSM module is the power supply to the module. If the power supply can't fulfill the required current well, then the module can't make the connection to the cellular network or it will shut down/reset in the middle of the action.

The operating voltage range of the module is 3.4- to 4.4-V. But another problem is the SIM800L module doesn't have an integrated voltage regulator. So, we need an external power supply between 3.4V to 4.4V (Ideal 4.1V). Also, remember that this module is a bit power-hungry and the current consumption can be up to 2 A in peaks. So, the power supply should be able to source 2A.

Interface a Mobile Phone with the Microsoft Windows Platform

Windows (XP and lower versions) comes with an application called HyperTerminal for data communication through the serial port of the computer. The interfacing of the GSM module or GPRS module with the serial port of the computer involves the following steps:

1. Connect the RS-232 port of the GSM module with the serial port of the computer. Insert a SIM card in the module.
2. Open HyperTerminal from Start -> All Programs -> Accessories -> Communications -> HyperTerminal.
3. Enter a name for the connection and press OK.
4. Now select the communication port (COM) at which the GSM module is connected.

5. Create a new connection set on HyperTerminal. Set parameters, like baud rate as 9600, handshaking mode as none, parity bit as none, stop bit as 1, and data bit as 8.

4.8. SOFTWARE USED:

- Arduino IDE

ARDUINO IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware 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 .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

The IDE environment is mainly distributed into three sections

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

The bar appearing on the top is called Menu Bar that comes with five different options as follow

- **File** - You can open a new window for writing the code or open an existing one. The following table shows the number of further subdivisions the file option is categorized into.
- As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.
- And at the end of the compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.
 - **Edit** - Used for copying and pasting the code with further modification for font
 - **Sketch** - For compiling and programming
 - **Tools** - Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
 - **Help** - In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

The **Six Buttons** appearing under the Menu tab are connected with the running program as follows.

- The checkmark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** - A separate pop-up window that acts as an independent terminal and plays a vital role in sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can

get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.

- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.
- The main screen below the Menu bard is known as a simple text editor used for writing the required code.
- The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors that occurred in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.
- More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

LIBRARIES USED:

I. `#include "I2Cdev.h"`

II. `#include "MPU6050.h"`

III. `#include "BluetoothSerial.h"`

I. `#include "I2Cdev.h"`

The I2C Device Library (i2cdevlib) is a collection of uniform and well-documented classes to provide simple and intuitive interfaces to I2C devices. The I2C protocol involves using two lines to send and receive data: a serial clock pin (SCL) that the Arduino Controller board pulses at a regular interval and a serial data pin (SDA) over which data is sent between the two devices.

I2C is used to connect devices like microcontrollers, EEPROMs, I/O interfaces, and other peripheral devices in an embedded system. A microcontroller is often used as the master device, and other peripheral devices are used as slave devices.

II. #include "MPU6050.h"

MPU6050 is the world's first integrated 6-axis Motion Tracking device that combines a 3-axis gyroscope, 3-axis accelerometer, and a Digital Motion Processor™ (DMP) all in a small 4x4x0. The MPU6050 is a Micro-Electro-Mechanical Systems (MEMS) that consists of a 3-axis Accelerometer and 3-axis Gyroscope inside it.

This helps us to measure acceleration, velocity, orientation, displacement and many other motion-related parameters of a system or object.

III. #include "BluetoothSerial.h"

To connect to the ESP32 for the first time, you need to pair a new device. Go to Devices. Click the settings icon, and select Pair new device. You should get a list with the available Bluetooth devices, including the ESP32test. ESP32 is compliant with Bluetooth v4. The default code is '0000' or '1234' but mostly '1234' works. Firstly download and install the app Then go to devices to find HC-05 Module.

WORDS USED:

Table 4.2: Words used

1	Hello
2	Good Morning

3	Please Come here
4	I need water
5	I need food
6	Need Medicine
7	I'm busy
8	How's it going
9	I'm fine
10	How's it going
11	I'm fine
12	Happy Birthday
13	What's your name?
14	Give me your number
15	Excuse me
16	It's beautiful
17	Give me the bill
18	This is not fair

19	Sorry
20	I will email you
21	I don't understand
22	Turn off the lights
23	Switch on the fan
24	Ok
25	Thank you

CHAPTER 5

5.1. RESULT AND DISCUSSION

The five sensors are mounted to the corresponding fingers of the glove. The information acquired as flexible nerve extracts changes in the degree of bending. The four nerve sensors are fitted to each glove). The analog effects of the sensors are then integrated into the ADC (Analog-digital converter) step of ESP32 (microcontroller). For further comparison and processing, the ESP32 will continuously receive the ADC value. For each word, the ADC is checked and the characters are recognized. The behavior is recognized at this point and the specifics of the text are seen on the LCD. Then the speech output is produced in the speaker of the Android phone which is connected to the ESP32 through the Bluetooth module HC-05 by TTS block (Text To Speech conversion). This message is sent to other users by text to translate voices to audio and LCD text information (using cell phone speakers) and will be continuously repeated using the same procedure .However, it is a large portion of lies upon the people's execution. As they are attached to the gloves it is easy for every individual to operate it by wearing the gloves in the hands and also there is great accuracy.

The device can also be able to translate even larger gestures by only a single hand movement. The data is collected from parts of the physical body (usually the hand) through a flex sensor and processed to the speech of which the gesture is being performed. After making all the connections and uploading the code in the microcontroller the output will be displayed in the android phone app when the gesture is performed. Fig 5.1 shows the overall image of the hardware designed embedded on a glove.

Fig 5.3 is a hand gesture which is made to denote the word "hello". The corresponding output is displayed on the screen of android phone app. The mobile device is connected via Bluetooth module in the esp32. The mobile application used to connect is Android Bluetooth text to speech. The text message is converted to speech and is read aloud in the phone speaker. Fig 5.4 is the output displayed for the corresponding gesture.



Fig 5.1 : Final image of the hardware

```

gloves | Arduino 1.8.19 (Windows Store 1.8.57.0)
File Edit Sketch Tools Help

gloves
#include "I2Cdev.h"
#include "MPU6050.h"

#if I2CDEV_IMPLEMENTATION == I2CDEV_ARDUINO_WIRE
#include "Wire.h"
#endif
MPU6050 accelgyro;

int16_t ax, ay, az;
int16_t gx, gy, gz;
#define OUTPUT_READABLE_ACCELYYRO
// #define LED_PIN 13
bool blinkState = false;

#include "BluetoothSerial.h"
int flux1=13;
int flux2=14;
int flux3=27;
int flux4=26;
int flux5=25;

#if !defined(CONFIG_BT_ENABLED) || !defined(CONFIG_BLUEDROID_ENABLED)
#error Bluetooth is not enabled! Please run 'make menuconfig' to and enable it
#endif

Error downloading https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json

```

Fig 5.2: Code compilation in Arduino IDE



Fig 5.3: Hand gesture for hello

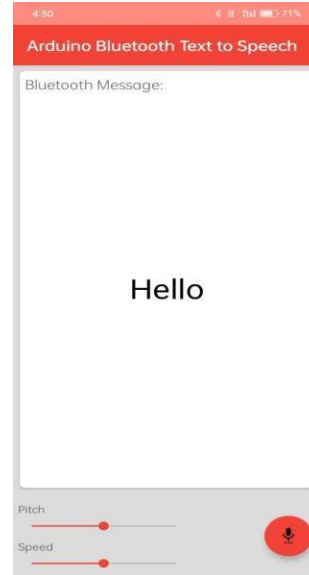


Fig 5.4: Output in android app

Fig 4.5 shows the position of the hand in which the accelerometer measures 90° facing upward. This hand gesture indicates that the deaf-mute person needs water. Fig 4.6 displays the word "I need water" on the screen.



Fig 5.5: Gesture for I need water



Fig 5.6: Output

Whenever the deaf-mute experience any kind of emergency situation he/she will make the gesture as in Fig.4.7 which will send an emergency alert message using the GSM module. This will notify the person's emergency contact. Fig 4.8 shows the screenshot of alert message sent via SMS.



Fig 5.7: Gesture for emergency alert

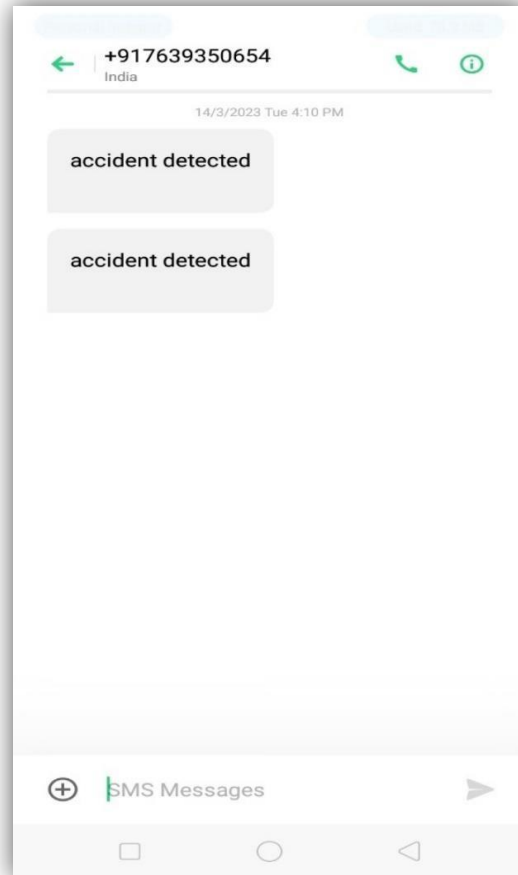


Fig 5.8: Alert message in phone

5.2. Advantages

- Low cost-Because it contains only fewer components.
- Small size: So that we can carry it easily in our hands.

- Light weight
- Flexible to users and portable so that they can carry it with them always. □ Easy to operate.
- Real-time translation
- Enables deaf people to communicate easier with others
- Opens more doors for new technological advancements in communication
- Intended to be 99% accurate

5.3. Limitations

- Ranges to 100 m only
- Facial expressions are not considered
- Prototype -90% accuracy
- Costly flux sensors-400 each

CHAPTER 6

CONCLUSION

The proposed method is far more user-friendly, highly efficient and can be developed in various higher grounds and processors. This system makes the communication easy through gestures and beats the ongoing challenge faced by deaf - mute people in their normal life. A Smart Glove used in this work distinguishes gestures made by hand and converts the sign language to speech. This application suggests a newly integrated full-duplex communication for voice impairments. This electronic mouth allows deafened people to communicate as normal. The flex sensor helps to collect the user's data. The meaning of each action would be distinct. With the aid of smart gloves, this makes the user feel natural.

Sign language is an instrument of communication used by a disabled person. Here the smart gloves translate sign language through text and speech to remove the communication barrier between the various communities by smart gloves. The use of smart gloves would also enable disabled people will be satisfied, motivated and gain self confidence that their feelings will also be understood by other people. By enhancing their future better, thus enhancing our country better.

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