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Speaking System for Dumb & Deaf Using Hand Gestures

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Abstract— *Vocal communication is a means of communicating our feelings, messages, and records. However, due to physical limitations, some of us are not gifted with the ability to communicate our feelings verbally with others. Deaf and mute people have the most trouble interacting with others. Normally, deaf and mute people communicate using sign language, but this becomes problematic when others do not understand the sign language. This project proposes a sign-to-letter translator device that utilizes a hand glove. Any deaf or mute person may use the glove to communicate with people who do not understand sign language. The performed signals, with the gloved hand, can be heard over the speaker. This glove has the potential to be extremely useful, effective, and helpful in addressing communication problems that occur between people who are hard of hearing and those who are not. It is made up of flex resistors that detect changes in movements, as well as a microcontroller that collects, processes, and sends data to the speaker, which displays the resulting message. The Sign to Letter Translator is intended to make communication between the transmitter and receiver simpler so that the message's meaning is correctly transmitted and fully comprehended.*

Keywords— *Flex, Accelerometer, Arduino, Bluetooth, Android Mobile*

I. Introduction

Gesturing is a mode of expression that is used to express a particular message. According to the research done by WHO there are 466 million persons in the world with disabling hearing loss (6.1% of the world's population) ;432 million (93%) of these are adults (242 million males, 190 million females) ;34 million (7%) of these are children .On the other hand the 2011 Indian Census showed1.3 million people with hearing impairment. The India's National Association of the Deaf estimates that 18 million people or close to 1 per cent of the Indian population are deaf or suffer from hearing loss. 70% of deaf and dumb population is working in public as well as private sector. Sign Language is the only way of communication for them.

Many other countries in the South Asian region use this sign language as well. Just a small percentage of India's population is able to communicate in sign language, since they do not need to learn it. This creates a contact barrier between the Deaf Dumb and the rest of the population. As a result, hearing impaired individuals are removed from society's mainstream. A communication assistant is required to translate Sign Language to Auditory Speech in order to solve this issue.

As a result, the use of sensors to explain sign language is being investigated as an auxiliary method for deaf and mute people to integrate into society without barriers. There will be five flex sensors on this wearable system. The collected data is used to identify the alphabets. After that, the known alphabet is spoken aloud.

To fulfil this need, we use the Arduino microcontroller and Android Mobile in this paper. The proposed device is entirely portable and emphasises two-way communication. The system's primary objectives are to translate hand gestures into auditory speech for communication between mute and non-mute people, as well as to convert speech into readable text for communication between deaf and non-deaf people. The system is based on American Sign Language and includes all of the words that are required in everyday life.

II. Related Work

- *Signing Interpreter by Ryann Peterson*

The first Hand Talk glove was designed by Ryan Patterson within the year 2001. He began his assignment together with his signing. Signing Interpreter consists of two separate mechanisms, a glove that has some flexible sensors into it which monitor the position of the fingers by calculating the electric resistance shaped by the fingers as they bend. A little microcontroller on the rear of the hand converts the change within the electrical current into digital signals and conveys them wireless to a computer. The pc then reads the arithmetical values and converts them into the letters which appear on the screen. The most disadvantage with this model was that a computer or a laptop was always required for its functioning which made it less portable.

- *Sigh language to speech converter.*

This technique was developed in May 2014. This technique converts the gesture to audio with the assistance of MATLAB. But the main drawback about the system is that it always requires a computer for conversion and its non-portable.

- *Hand Glove for Gesture conversion to Voice*

This paper introduces a converter which recognizes the signed images made by the impaired person and converts them into text as well as speech without using other approaches like data gloves or other equipment. For this system implementation, videos of hand gesture are captured and recognized by the implementation of the same algorithm.

- *Hand Glove for Gesture conversion to Voice*

The aim is to propose a system for dumb people by using hand motion or gesture which can be detected and then it will be converted into human hearing voice signal.

- *Voice for the mute*

The work aims to bridge the barrier by building an application that can convert sign language to voice and provide them a medium to communicate. The system is being presented as a solution for the conversion of images into sound.

- *Embedded Based Hand Talk Assisting System for Deaf and Dumb*

This technique was developed in March 2014. This technique uses an easy method by storing and running audio using keypad. This technique features a drawback that it doesn't use signing.

- *The Hand Gesture Recognition and Voice conversion system*

It enabled the deaf/mute people to use the gloves to communicate using the sign language which is then converted into speech so that ordinary people can effortlessly comprehend. The foremost feature of this project is that the gesture recognizer is a standalone system, which is applicable in day to day life.

III. Proposed system

Basic aim of the project is to implement a device which can convert the hand gestures into speech audio. The device will consist of two parts i.e., transmitter and receiver section.

- *Transmitter Section*

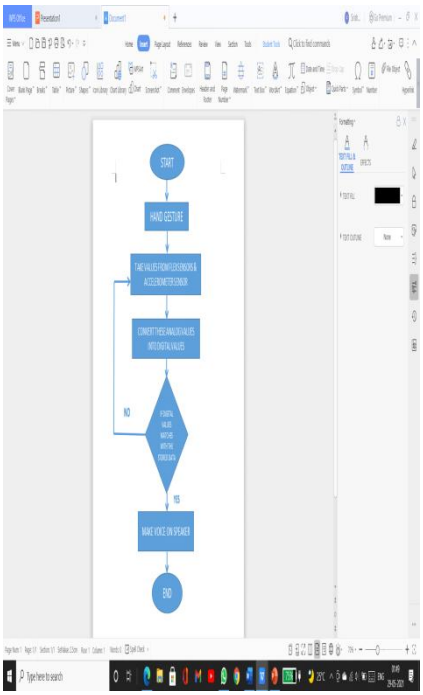
The transmitting part consist of Arduino Nano, Bluetooth Module, ADXL345 Accelerometer, Battery & Flex sensors.

- Arduino Nano- Arduino port for controlling entire transmitting section.
- Bluetooth Module- For transferring data from the microcontroller to Android Phone
- ADXL345 Accelerometer- To get the position of the hand.
- Battery- Transmitting Power Supply.
- Flex sensors- For identifying the movement/shape of the finger.

The entire transmitting section will be assembled on the glove setup. When the power is connected to the board the microcontroller keeps receiving the data from the flex sensors and accelerometer. The accelerometer works in all X-Y-Z direction. So, from the microcontroller the data from the flex sensor and accelerometer will be transmitted via., Bluetooth module wirelessly to the receiver section.

- *Receiver Section*

The receiver section will consist of an Android Phone. The phone will have an app installed in it which will receive the data from the transmitter section and will convert the respective message into an audio signal. So, when the transmitter section will transmit the message the app will receive the data and the output will be heard.



Working flow of the project.

System Design

- *Selection of sensors:*
- *Arduino Nano*

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P. The Arduino Nano is equipped with 30 male I/O headers, in a dip-30 like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline.

- Operating Voltage :5 V
- Input Voltage :7-12 V
- Digital I/O Pins :14 (6 PWM o/p)
- Analog Input Pins :8
- DC Current per I/O Pin :40 Ma
- Flash Memory :16 /32KB (ATmega168/328)
- SRAM :1/2 KB (ATmega168/328)
- EEPROM :512 bytes/1KB (ATmega168/328)
- Clock Speed :16 MHz
- Dimensions :0.73" x 1.70"

- *Flex Sensor*
- A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. These sensors are classified into two types based on its size namely 2.2-inch flex sensor & 4.5-inch flex sensor. We will use 2.2 inch flex sensor in our case. It is a two-terminal device, and the terminals are p1 & p2.

- 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 -45ºC to +80ºC
- Flat resistance is 25K Ω
- The tolerance of resistance will be ±30%
- The range of bend resistance will range from 45K -125K Ω.
-

- *ADXL345 Accelerometer*

Accelerometer sensors detect linear acceleration. The ADXL345 is a small, thin, low power, 3-axis accelerometer with high resolution. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic

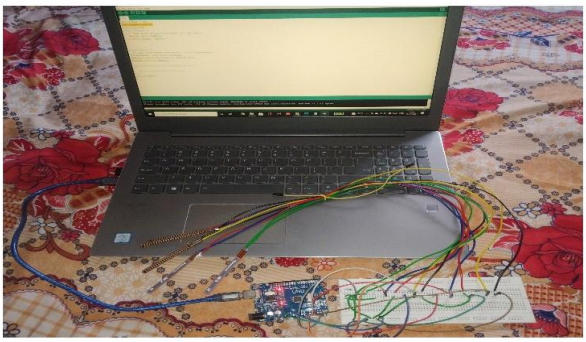
acceleration resulting from motion or shock. It's maximum bandwidth is of 3200Hz, and a maximum data transfer rate of 3200 times a second.

- Supply voltage range: 2.0 V to 3.6 V
- I/O voltage range: 1.7 V to VS
- Wide temperature range (−40°C to +85°C)
- SPI (3- and 4-wire) and I2C digital interfaces
-
- *Bluetooth HC-05*

Bluetooth is a technology for wireless communication. It is designed to replace cable connections. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART). It uses the 2.45GHz frequency band. The connection can be point-to-point or multi-point where the maximum range is 10 meters. The transfer rate of the data is 1Mbps.

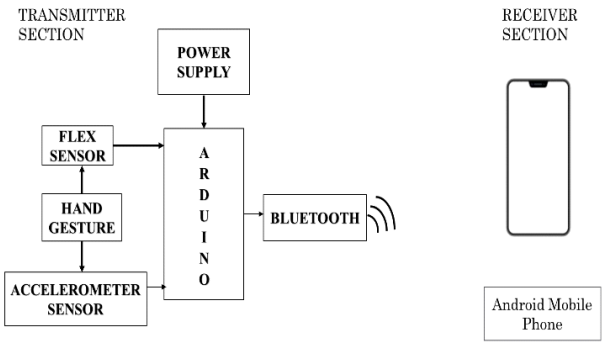
- Default Baud Rate: Data bits:8, Stop bit:1,Parity:No parity.
- Input/Output Voltage: 3.3 to 5 V.
- Transmit Power: Up to +4dBm RF
- Sensitivity: Typical -80dBm.
- *B. Experimental Setup:*

This is the experimental setup of the system. The purpose of this system is to introduce a speaking system device which will give output according to the hand gestures made.



Breadboard setup of the project

Block diagram

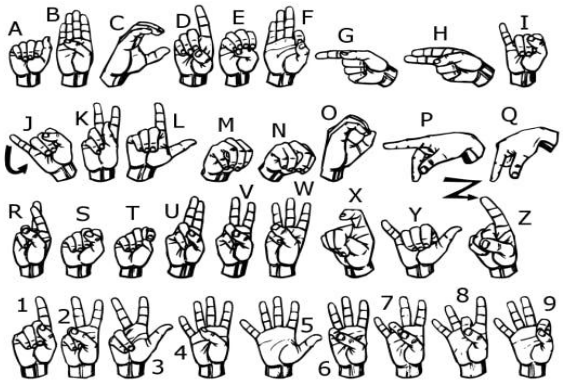


Block Diagram

IV. Results

- *Sign Language chart for alphabets:*

Using the given sign language for alphabets we have obtained the test results.



ASL Alphabets

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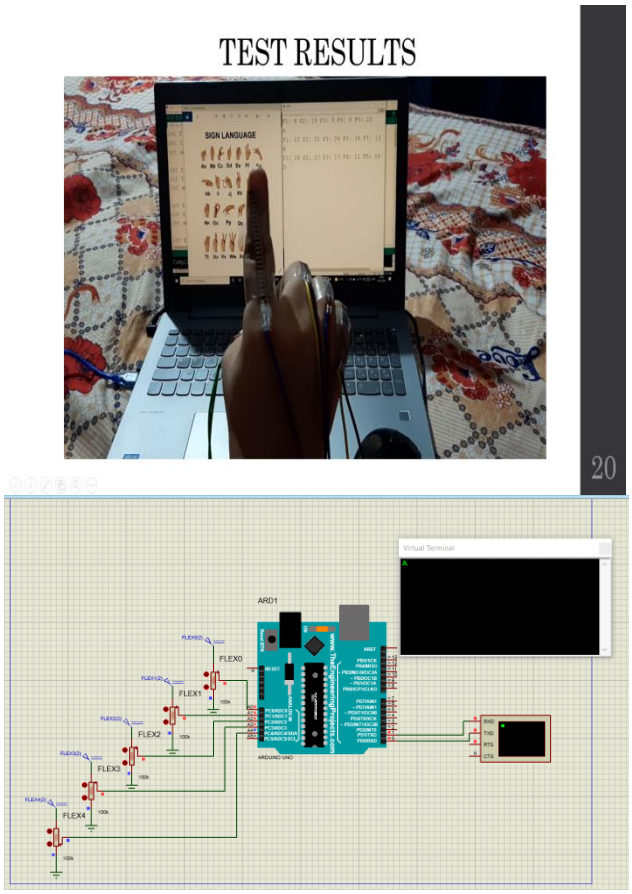
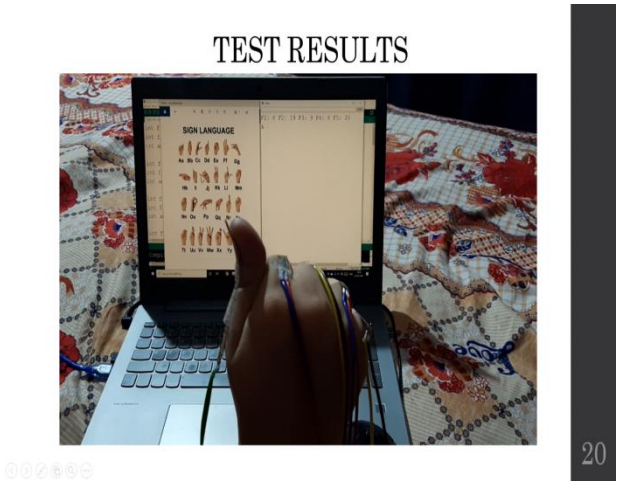
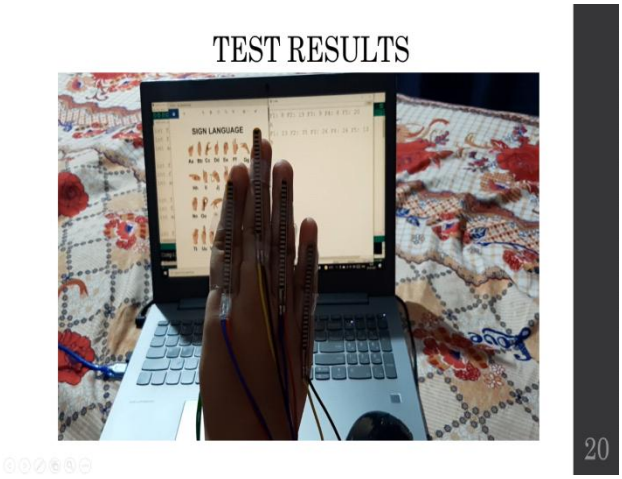


Simulation Results:

Simulation result for letter ‘A’ based on the ASL



Hardware Results:



Test result for letter 'A' based on the ASL
Test result for letter 'B' based on the ASL

Fig. 8. Test result for letter 'D' based on the ASL

Advantages

- This project is useful for dumb & deaf people those cannot communication with normal person, It is also useful for speech impaired or paralyzed patient those do not speak properly.
- It also provides communication between dumb and blind.
- It facilitates effective real time communication .
- It requires fewer components so, it's cost is low, it is economical.
- All apparatus carries less weight hence they are portable and flexible to use.

V. Conclusion

- We were able to develop an efficient gesture recognition system that did not utilize any markers and camera hence making it more user and cost-friendly. The flex sensors in combination with the Accelerometer and Arduino is successfully and accurately able to translate ASL to text and speech.
- By mounting these sensors on a glove, a very convenient to use wearable is made which is not only efficient but also comfortable to use in our daily lives. It provides an efficient method of alleviating the problems of the speech-impaired community. It empowers such people with the power of speech and allows them to express themselves better.

Future scope

- The glove is limited to single hand and since hand differ in size and freedom of motion, therefore work can be done on this glove so that the wearable hand glove mouse can be flexible for every hand size.

- This system can also be designed such that it can translate words from one language to another.
- In this system, some more sensors can be embedded to perceive full sign language with more perfection and accuracy.
- These glove cannot capture the facial expressions, so devise can be developed that can capture facial expressions also.

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