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SMART GLOVES WITH HEALTH MONITORING AND SECURITY

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Abstract - *Smart Gloves aims to lower the communication barrier among disabled people. In this project, the disabled refers to those people who cannot speak and hear. Smart Glove is an electronic device that can translate sign language into text and speech. It contains IR sensors connected through pipes along the length of each finger which will be used to produce the gestures. These have pre-recorded gestures based on a language which when performed by the disabled person (i.e. a dumb person and deaf) would produce corresponding audio/text output in the mobile application, so that a person with or without disabilities can understand. For instance, if the other person is blind then the output will be audio signals generated through the mobile application. Our goal is to achieve communication among disabled people so that they can communicate among themselves and others.*

Key Words: **Communication, Smart Gloves, Health Monitoring, Security**

1. INTRODUCTION

This project is mainly focused on achieving real-time communication among the people suffering from speech and hearing impairment. Communication is the only way for expressing ideas, but some people aren't blessed like us. This should not become a limitation for them. So, it is very much important to design a model that is efficient and meets the requirements of the hearing and speech impaired people to communicate efficiently. So, we are using hand gestures as the primary resource for communication which is connected to a mobile application that produces the text and speech commands as output.

The limitations of the speech-impaired people are their verbal communication and for hearing impaired people is the inability to hear what people are saying. To improve the communication among them, we have designed a model in which gestures are given as input

which gives voice and display as output. The hearing-impaired person can't hear but can see and say as well, whereas the speech impaired person can explain through hand gestures and understand by hearing.

The technologies that we are using are a combination of hardware and software. The hardware will take the input from the user's gestures and processes in the microcontroller, giving voice and display as output.

This project is inspired by MIT projects and seeing the scope of this project, we will impart some extra features to it such as health monitoring system, security along with seamless communication, communication using an android application. In the future, we will be introducing more advanced features to it using Machine Learning and Artificial Intelligence.

2. BASIC CONCEPTS/ TECHNOLOGY USED

The basic components used are:

1. Microcontroller (Arduino NANO): It is a small, complete, and breadboard-friendly board based on ATmega328.It is the heart of the Smart Glove. It receives analog input from flex sensors and the value of x, y and z co-ordinate from accelerometer and processes to give text and speech.

   Arduino Nano used in our project is designed by Arduino company. Atmega328 is a microcontroller which is widely used in Arduino boards, Arduino Nano and Uno both have Atmega328, which provides numerous features. Nano is a widely acceptable microcontroller board because of its small size and flexibility.

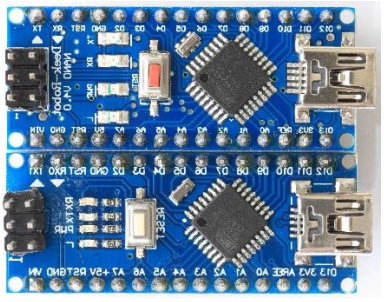

Figure -1: Arduino Nano

2. Gyroscope Sensor: Gyroscope sensor is a device that can measure and maintain the orientation and angular velocity of an object. These are more advanced than accelerometers. It measures the lateral and tilt orientation of the object whereas accelerometer measures the linear motion. Gyroscope sensors is also known as Angular Rate Sensor or Angular Velocity Sensors. The sensors are used to sense the orientation of the object is difficult to sense by humans.

Fig -2: Gyroscope Sensor

3. Force Sensor: It acts as a force sensing resistor in an electrical circuit. When no force is exerted on the force sensor, the resistance gets very high. When force is applied to the sensor, resistance decreases. The easiest way to measure a resistive sensor is to connect one end to the 5 V supply and the other end to a pull-down resistor connected to the ground. The analog input of a microcontroller is connected to the point between the fixed pull-down resistor and the variable FSR resistor.

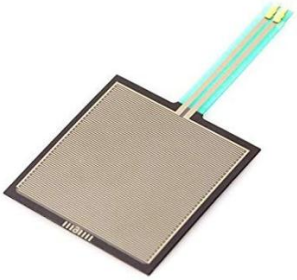

Fig-3: Force Sensor

4. Heart Rate Sensor: It is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. The principle involved in the working of the Heartbeat Sensor is Photoplethysmography. The changes in the density of blood in an organ are measured by the changes in the intensity of the light passing through that organ. Usually, the source of light in a heartbeat sensor is most probably an IR LED and the detector would be a Photo Diode, an LDR (Light Dependent Resistor), or a Photo Transistor.

Fig: 4- Heart Rate Sensor

5. IR Transmitter/Receiver: An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. This is achieved by emitting or detecting infrared radiation/heat in the surroundings.

Fig:5- IR Transmitter/Receiver

6. Thermistor: Thermistors are thermally sensitive resistors whose main function is to provide a large, predictable and precise change in electrical resistance when there is a considerable change in body temperature.

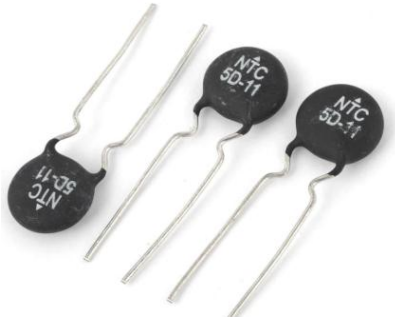

Fig:6- Thermistor

7. Bluetooth Module: This technology manages the communication channel of the wireless part. The modules can transmit and receives the data wirelessly by using two devices. The Bluetooth module can receive and transmit the data from a host system using the host controller interface (HCI).

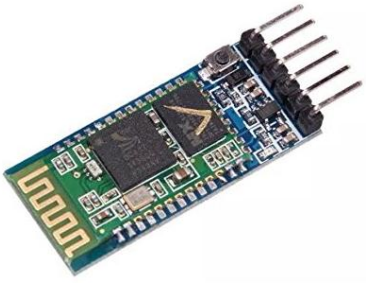

Fig:7- Bluetooth Module (HC-05)

8. Power Supply: It can be operated at 5V input Power supply from any suitable source. Sources can be power banks, Dc adapters.

3. STUDY OF SIMILAR PROJECTS OR TECHNOLOGY/LITERATURE REVIEW

Several studies and researches have been done in the field of smart communication for visually and hearing-impaired people. As per which, for effortless communication among normal people and these specially challenged people, sign language is the most effective medium, apart from writing and drawing, for a fluent communication. Numerous patents have been filed in this domain with the various methodology to overcome this issue.

An approach was made by DalalAbdullah [1] in his implementation of a sign to speech/text system for deaf and dumb people. In which he proposed the idea of making an electric device having two parts, one as a transmitter and the other part as a receiver. This system was designed to convert the Arabic sign language to speech or text. The idea was simple, to use flex sensors on each finger that are connected to the Arduino. This microcontroller collects the data from flex sensors and through the RF transmitter, the data is been transmitted. On the other hand, the Rf receiver takes the output from the transmitter and sends it to Arduino mega, which then after processing generates the output from LCD and Speakers. For mapping the data to the gestures made, they used the Arduino IDE. The drawback of using Arduino IDE is its space and speed limitations. Their system is restricted to the only limited amount of gestures. Another limitation is using flex sensors, as the value of resistance changes with the rigorous use of the system. Due to which, the probability of getting the correct output reduces by some percentage.

Another approach was made by AbhinandanDas [2] in his paper, using flex sensors and gyro sensors for finger and hand movement respectively. In this he used a flex sensor on each finger and a gyro sensor for hand movement. This increased the combinations of gestures thereby increasing the dataset of gestures. The transmission of data is done through Xbee transceivers for effortless data flow. They used Intel Galileo Gen 2 loT kit to analyze and classify the actions and hand movements into the sign. The need of using this powerful processor was to easily classify the gesture type. As per the system developed by them, the gestures made by a user can be an alphabet or a number for which proper classification is needed. With using this powerful intel processor, the data is been processed easily. Once the data is received, it was processed by a microprocessor and the output is shown according to the text mapping to the sign language. The text generated is displayed onto the Grove-LCD. Further, it is converted to speech via the Grove-buzzer sensor. The major drawback of this whole setup is, it can generate around 200 words only. Another downside to this system is the use of alphabets and numbers, which radically slows down communication.

Another astounding result was achieved by [3] Adarsh Ghimire, the system is based on a desktop application using a machine learning algorithm. The process flow is, data acquisition from the flex sensors embedded on each finger along with accelerometer and gyroscope from each hand followed by the processing of collected data in the Arduino mega processor. The data is then used as an input to the machine learning algorithm to predict the output of the gesture made by the user to an output screen and the speaker respectively. The accuracy of the machine learning model is 75 – 80 %, with a capacity of storing 350 datasets for each alphabet. The accuracy and precision of this system are far better than the other proposed ones. Although a drawback from the correlation plot was a confusion of the system to understand certain alphabets due to the almost similar finger bending making the results ambiguous sometimes.

A very interesting and easy to use system is proposed by [4], in which a handy mobile application was developed to project the output. The idea of being a smart glove uses Principle Component Analysis to classify the real-time input data for feature extraction. The smart glove uses a flex sensor on each finger, generates the output in the form of sound using an application. An interesting concept of interfacing an app with the smart glove is very fruitful. Although the project is having limitations of projecting limited gestures for an entire sentence thereby reducing the possibility of word change in a sentence.

5. PROPOSED MODEL/TOOL

Our project detects the movement of the hand and respective fingers and will generate the respective output. The glove is equipped with IR sensors. This system is beneficial for deaf and dumb people. Its working proceeds as follows:

1. Input is taken from using the gestures of the hand and fingers.
2. The microcontroller will process the information gathered by the sensors.
3. The android application connected to the microcontroller produces the desired visual and audio output.
4. Thermistor and Heart rate sensors can be attached to analyze the health of the disabled person.
5. The disabled person can always be tracked using the GPS feature.

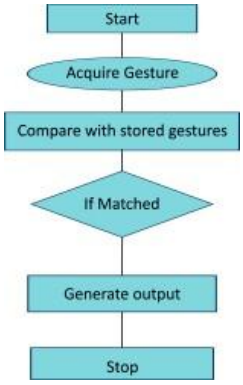

Chart:1- Flow Diagram

5. IMPLEMENTATION AND RESULTS

Our system is a combination of hardware and software modules comprising of various sensors. Starting from which, we have, the heart of our system, Arduino nano, which is the processing unit of our whole system. The system follows a sequence of flow, from the user-generated signal to the final output (i.e. Android Application).

The flow of data is from the gloves made by our team. The user generates some specific gestures from the glove. The data is then fetched and transmitted to the Arduino. The application software used in the system processes the data, and convert it into Visual and Audio signal. The system is designed in two parts hardware and software which is explained as follows:

A: Hardware

The hardware module is further divided into 3 sections, viz, Smart Communication, Health monitoring, and Security.

1. The smart Communication module is having a smart glove interfaced with the processing unit. Here, glove works as an input unit in the system, which includes a bend sensor, which works on the principle of transferring IR rays from the IR transmitter to the IR receiver. At the instance, when the user bends the finger, the signal is transmitted to the processing unit i.e. microcontroller which again sends it to the output Device i.e. mobile application.

2. Health Monitoring has Heart rate sensors and a temperature sensor that projects the basic health monitoring details. The data from the given sensors are calibrated to a meaningful result and sent to the output device as well.

3. Security, in the system, is being managed by the API included in the application. This part is mainly used, when the user is in objectionable circumstance. When force is exerted on the force sensor, it will pass a signal which triggers the output device to send the Message on the Emergency number.

B: Software

In this system, the software is providing the interface between all the hardware modules and the mobile application. All the input signals are processed using Arduino which is programmed in Arduino IDE. The output from the Arduino is sent to the mobile application via Bluetooth connection.

The mobile application is programmed in Android studio using JAVA language.

The mobile application provides speech and text output. The Glove includes the heart rate and temperature sensor whose calibrated output is also displayed in the mobile application. The application software is also responsible for sending the emergency message.

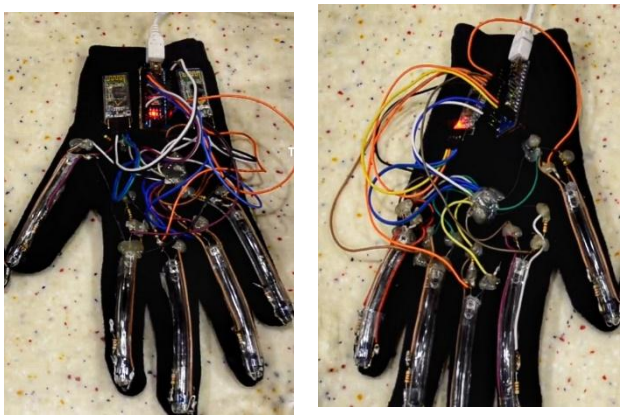

Fig:8- Smart Gloves

6. CONCLUSION

The focus of our project is on disabled people. This device can open up more job opportunities for disabled people. According to the 2016 Census Report, 2.21 % of people are disabled in India. The device can increase India's economy in the long run where disabled and normal people can shake hands together to brighten the future. A security feature is also implemented as any problem is faced; the exact location of the person can be tracked down so that his/her family member can approach the disabled person.

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