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SMART GLOVE FOR SIGN TRANSLATION TO TEXT AND SPEECH AND TEXT TO BRAILLE CONVERSION

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ABSTRACT— *Sign-language is one of the means of conveyance for people with hearing or speaking disabilities amongst themselves as well as other people. It is considered to be a globally recognised language. Each country may have its own slangs and its own modifications to the language. Hence it becomes a difficult to keep up with such dynamic behaviour of the language. Our project aims at creating a low cost, Arduino based Smart Glove which will be able to translate the gestures made in sign language and give an output in text as well as speech format. This output will be displayed on a mobile phone application using a Bluetooth module. A system to convert text which can be entered on the application to braille using vibrating motors would also be implemented.*

Keywords— *Internet of Things, Braille, Natural Language Processing, Arduino.*

I. INTRODUCTION

There are approximately 450+ million people in the world are hearing impaired which is greater than 6% of the total population and these are expected to rise to 900 million by the year 2050 which is a huge part of the population. Apart from this, there are about 700000 deaf-mutes in the world. There may exist many people that lose their voices later in life due to some diseases or accidents. When we think about Sign Language, it is a globally considered standard way of communication for the speech and hearing impaired. Children with disabilities are taught in special schools using this language as a medium of communication. The most commonly used sign-language in the world is "American Sign Language (ASL)" which has been used across USA, Canada, Mexico and various parts of the world as well. In India we follow Indo-Pakistani Sign Language used by several thousand disabled people. We can see that Sign Language is dynamic and ever changing. Each country has its own terms and colloquialisms which may get difficult to keep up with. Also, disabled people may find it easy to communicate amongst them since they are well versed in the language but when it comes to communicating with normal people in the real world things start to get difficult. There have been many attempts over the years which help to bridge this communication gap.

Our project is based on the principles of:

A. Internet of Things

The "thing" can be any sort of device which has sensors which have the ability to collect or transmit data via network- Internet without interference from any external source. The technology embedded on the object aids in

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interaction with internal and external environments which fuels the decision making process. Basically IoT is the concept of communication between embedded objects over the internet or any network such that the giant network of devices can be controlled remotely and easily. This also gives rise to Smart Objects as they get connected online.

In our project, we use Flex Sensors and an accelerometer which are connected to an Arduino microcontroller. They transfer the data to a smart phone using Bluetooth module. The microcontroller is the IoT device and connects all the different components of the model to each other. In turn, it is also responsible for controlling them and passing commands to them when needed.

Also the vibrating motors act as IoT devices as they help to give an output of the data entered on the mobile app resembling Braille characters.

B. Natural Language Processing

It is subfield of linguistics integrated with computer technology and "artificial intelligence" that deals with communications between computers and natural (human) languages. Particularly deals with how computers can be programmed to analyze and process huge volume of natural language data.

In our project, the system is used to translate gestures made by human hands using the smart glove. These gestures are processed and analyzed by a microcontroller which gives output on a smartphone using Bluetooth.

II. STATE OF THE ART

[1] "Smart Speaking glove for Speech Impaired People. (June 2019) Authors: Meghana A, Niveditha M, Pratibha K, Raksha GR."

Smart Glove is incorporated with flex sensors whose resistance values change according to the gesture of the user. Information is processed by Arduino Mega 2560 microcontroller and corresponding to which output is given through a speaker. It also has a GSM module which has a GPS tracker which helps in case of emergencies.

The advantages of this model are the use of GPS for tracking the person which is extremely useful in case of any emergency.

[2] "Sign Language Interpreter using Smart Glove." Authors: Nikitha P, MS Megha, Naveen Karnath."

Proposed a new way of interpreting sign language using portable glove. Has LEDLDR duo on every finger to sense the gesture and couple the voltage to the microcontroller. The output is displayed on the screen and corresponding voice output is given.

A big advantage of this system is the ability to give the output as both text and speech.

[3] "Smart Glove with Gesture Recognition Ability for Hearing and Speech Impaired. Authors: T.Chouhan, A.Panse,A.K. Voona and S.M Sameer."

The interface allows use of "Human Computer Interaction (HCI)" without use of peripherals. HCI uses pattern recognition to classify and analyse gestures accurately and more efficiently.

Pattern interpretation increases the efficiency of the model.

[4] "Analytical Study and Overview of Glove based Indian Sign Language Interpretation Technique. Authors: P.Das, R.De, B .Neogi, S.Paul."

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The paper adds to the implementation methods of accelerometer, flex sensors and gyroscope towards the efficiency of smart gloves. It shows the development issue with proper data of current improvements on glove based sign-language interpreter. It gives and analytical study for the same.

The use of different sensors like the accelerometer is to increase the number of overall gestures that maybe possible and thus makes it a important addition to the model.

[5] "Smart Hand Gloves for Disabled People. Authors: Dhawal Patel, Harshal Tapase, Praful Landge, Parmeshwar P, Prof. A. P. Bagade."

The main objective of the smart hand glove is to develop a reliable, easy to use, portable system which minimises obstacles for disabled people. It also has a feature of Home Appliance Control which makes them more independent.

An unique addition for this model is the appliance control system. This is especially useful if the person is physically handicapped.

[6] "Smart Glove: Gesture Vocalizer for Deaf and Dumb People. Authors:K.V Fale,Akshay Falke,Pratik Chauhan."

This system has a "speech synthesizer" circuit that converts the hand gestures made by a person into real-time audio output and also display the output text.

The real time speech conversion is a method used to get the desired outputs faster.

[7] "Continuous Arabic Sign Language Recognition. Authors: K Assaleh, T Shanableh,F Amin, H Bajaj."

It focuses on spatial temporal feature extraction and translation of Arabic Sign Language based on Hidden Markov Model instead of only recognising finger movements. It proved to be more accurate then existing models for Arabic Sign Language and showed a success rate of 94%.

This provides a different perspective of translation to a regional language.

[8] "Deaf Mute Communication Interpreter. Authors: Anbarasi Rajamohan, Hemavathy R,Dhanalakshmi M."

It gives two broad classifications that is: a wearable device and an online learning system which define a glove based system, keypad method, handicom touch screen. All devices help to translate gestures to speech and text output.

[9] "Review on Feature Extraction for Indian and American Sign Language. Authors: Neelam Gilorkar, Manisha Ingle"

This system performs feature extraction and classification of patters using Neural Networks, HCI, Markov Models, Support Vector Machine. These combine to perform translation of gestures.

[10] "Reading Braille on Mobile Phones. Author: Zakaria Al-Qudah, Iyad Abu Doush, Faisal Alkhateeb, and Esalm Al Maghayreh"

The method aims to develop a Braille System for mobile phone with tactile feedback based on a fast method with low battery consumption. The scheme is optimised to reduce the average time for every character and also vibrating time for each character. It helps to provide a technology friendly system to assist blind people in a language they would be well versed in. The overall accuracy is 73%.

Table 1: Comparison

PAPER NO.	METHODOLOGY USED	ACCURACY
[1]	Arduino along with a GSM tracker for gesture input and voice output.	N/A
[4]	Using Gyroscope and Accelerometer for better results	89%
[9]	Data Glove based on Hidden Markov Models and discontinuity technique.	80.4%
[7]	Sentence Recognition of Arabic Sign Language.	73.3%
[10]	Vibrating motors that analyse the patterns of Braille characters on a mobile phone.	73%

III. PROPOSED WORK

The aim of the project is to be able to help deaf, dumb or visually challenged people communicate easily. The system consists of a wearable device fitted with flex sensors which along with the Arduino is designed to convert gestures to text and speech which would be displayed using a simple mobile application.

Along with that, a combination of vibrating motors is used to create a system to translate alphabets to braille.

IV. IMPLEMENTATION

In our system, flex sensors are placed on a glove. According to the gesture made by the user, the resistance values change and sensor produces voltage. There is also an accelerometer installed on the wrist to detect the orientation of the hand. This gives information of x,y,z axes as per the hand orientation. Output voltage, angles, and accelerometer values made by the gesture are transmitted to the "Arduino". The "Arduino" is a microcontroller. It has digital and analog I/O pins. It converts analog to digital. Each letter or word of the sign language is translated corresponding to its flex sensor and accelerometer values. Thus, based on the pre-defined values and inputs generated, the output is processed. Using a Bluetooth module, the output is transmitted to a smart phone which is used to display the letter/word corresponding to the gesture. It also gives a speech output.

The project makes it easier for disabled people to communicate with the world. They can simply make the gestures they need to communicate, which will be translated fast and easily and the output can be displayed or heard via a mobile phone. This can be read or heard by any normal person and interpreted easily.

Along with the above features, systems of vibrating motors are used to signal words broken into alphabets for visually challenged people. Braille is a system of raised dots that can be read with the fingers by people who are blind or who have low vision. Teachers, parents, and others who are not visually impaired ordinarily read braille with their eyes. In our project we have tried to add motors that generate vibrations that resemble braille.

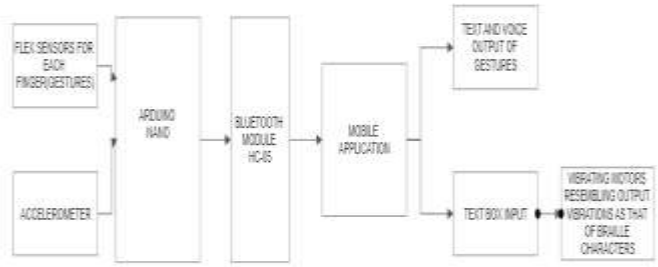

Figure 1: Architecture

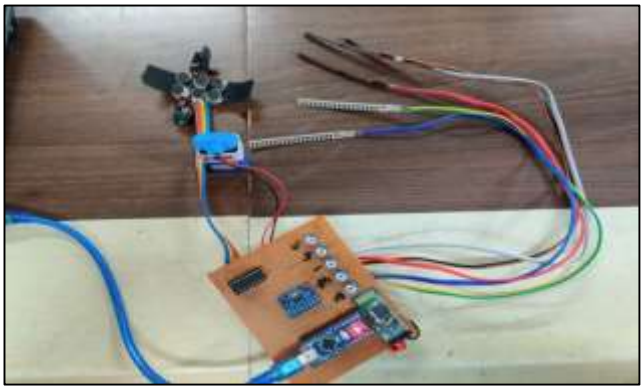

Figure 2: Sample Picture of Proposed System

V. RESULTS DISCUSSION

Most of the existing projects deal only with flex sensors, our project aims to provide a consolidated system which also includes a text-to-braille-vibration feature.

This is a useful feature for people with disabilities such as those who are blind as well as deaf or dumb.

Whenever a text is entered on the app, it vibrates as per the braille standards and the person is able to interpret the text. The feature can be developed further to advance the possibilities for the convenience of disabled people.

The system is a low cost and economical one and can be developed further to enhance the possibilities of communication between disabled people and normal people.

Flex sensors work on the principle of change in resistance. Using variable resistors, their resistance value is kept over 1000. Thus, when resistance drops below 1000, it indicates that flex sensor is bent.

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Table 2: that flex sensor is bent.

FLEX SENSOR	VALUE	COUNT INCREASE	OUTPUT
1	<1000	1	hi
2	<1000	2	how
3	<1000	3	are
4	<1000	4	you

Originally the count is taken as 0. The count is reset one the accelerometer is bending value is -5, the corresponding output to the count is given on the app and the count is reset.

On the mobile application, a text box is given in which text that has to converted to braille can be entered. The vibrating motors vibrate according to a set code of alphabets which can be easily interpreted by visually impaired individuals.

A sample screenshot of the code is provided which depicts how we can assign values to particular count values and hence we can increase the possible outputs as we are not dependent on the gestures alone but also the count

Figure 3: Code snippet of how the count is increased because of change in resistance of a particular flex sensor is shown below

Figure 4: Original configuration, i.e. all resistance value is above 1000(which is achieved using variable resistors whose resistance can be changed as per the need)

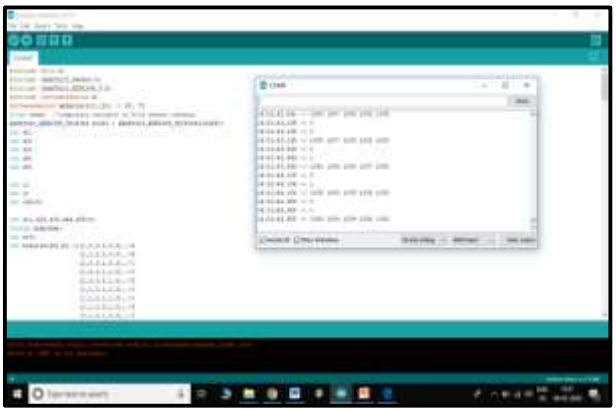

Figure 5: When flex sensor 2 is bent, its resistance value drops below 1000 and count increases by 2

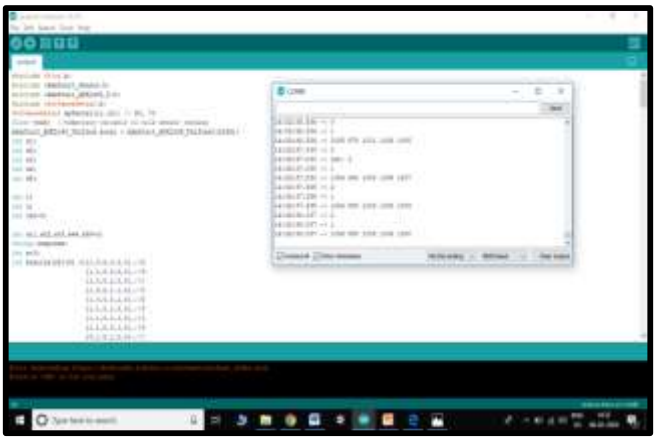

Figure 6: Flex sensor 1 is bent and count is further increased by 1 to achieve a total count of 3

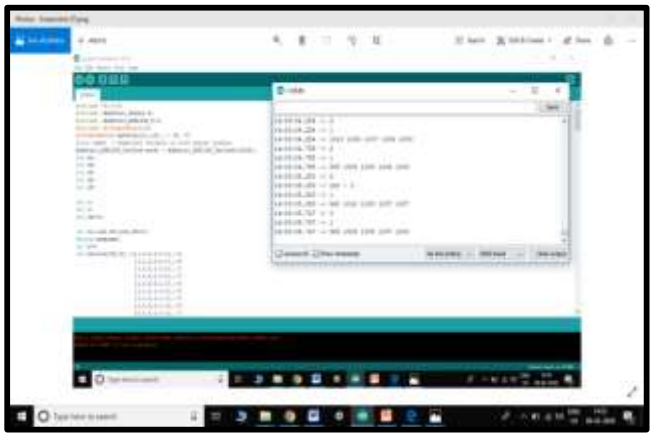

Figure 7: When accelerometer is bent at a value of -5, the output (i.e. are) corresponding to the count is displayed on the app as well as a voice output is given

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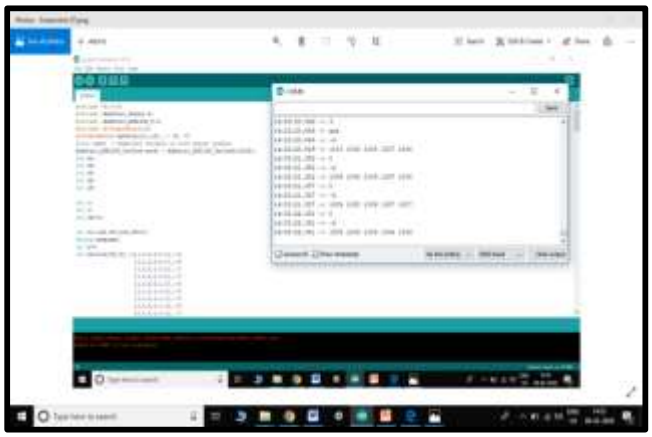

Figure 8: An online predefined method of vibrations of the single alphabets by the vibrating

An online predefined method of vibrations of the single alphabets by the vibrating motors for braille translation is taken. This is done so that the visually challenged people don't have to adapt to new method as it can be time consuming and difficult.

Figure 9: The braille code used for translation is as follows

VI. CONCLUSION

Using above papers as references, we have decided to make a basic, low cost, portable, reliable and easy to use smart glove. The glove will be fitted with flex sensors. Flex sensors are band sensors which measure deflection or bending based on change in resistance and voltage values. These will be fitted on the each finger along with an accelerometer which measures the orientation of the hand or wrist based on x,y,z axes. These will give an input to the Arduino. The microcontroller board will process this data and compare it against a predefined set of values for letters, words and sentences. The corresponding output is sent via Bluetooth module to a smart phone which displays the text and also gives out an audio output of the corresponding gesture. Also, any text entered on the mobile application will generate a vibrating sensation on the motors which can be interpreted as Braille characters. This model thus provides a unique novelty of translation of braille to text which is extremely useful.

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