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IOT-BASED SMART GLOVE FOR SIGN LANGUAGE TRANSLATION

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ABSTRACT

This project presents a novel approach to bridge the communication gap between the deaf-mute community and the general public. It leverages the power of sign language - a vital mode of communication for the deaf and mute, and combines it with modern sensor technology. The core of this system is a flex sensor-based gesture recognition module, integrated into a glove. This module is capable of recognizing various hand gestures, which are integral parts of sign language. The recognized gestures, representing letters and certain words, are then converted into text. This text is subsequently transformed into speech using a Bluetooth Text to Speech app, making the communication understandable for the common people. The primary objective of this project is to facilitate seamless communication for people with speech impairments, thereby eliminating barriers and fostering inclusivity. There are many challenges that come with the usage of the sign language. Not everyone knows how to interpret the sign language. Hence, we use a sensor based glove to overcome this issue

1. INTRODUCTION

1.1 BACKG ROUND

Communication between the speech impaired community and the general public has always been an issue. The learning of sign language is a proposed solution that will require the awareness of every single individual. These efforts of creating awareness of sign language can be overcome with the help of technology. Technology plays an important role in every single aspect of our lives, and it can certainly help the deaf community as well. The sole purpose of this project is to bridge the gap between the communication of individuals and the Deaf- community by creating a glove that translates gestures to speech and text. This can also create a welcoming environment for them to be more communicative, confident, and interactive in the outside world.

1.2 MOTIVATION / PROBLEM STATEMENT

In the fast and developing world, the main challenge for the deaf community is to be able to communicate with everyone around them. The main intent of our project is to demonstrate the development of a Glove that can detect gestures

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that represent the alphabets of the sign language which is then converted to speech and text that any individual can understand. The project attempts to detect and convert signs in an easy, fast, and convenient way that provides a solution to the above-mentionedreal-world real-world problem.

1.3 SIGN LANGUAGE GESTURES

Sign language is basically a visual means of communication through gestures, body language, and hand movements.It is the most important form of communication for the Deaf and Hardof-Hearing community. People with disabilities such as Autism, Apraxia of speech, Cerebral Palsy, and Down Syndrome also can use sign language to communicate.

There are several sign languages currently in use all over the globe. Similar to spoken language, even sign languages have developed regionally in groups of people interacting with each other, explaining the number of sign languages present. There are around 138 -300 different sign languages currently in practice.

One can note that several countries share the same vocal language yet do not have the same sign language.

One such example is English has three varieties in Sign Language itself:

- American Sign Language (ASL)
- British Sign Language (BSL)
- Australian Sign Language (Auslan)

In general one may start learning sign language by learning sign form equivalent to each alphabet. The use of the hand signs to represent each letter of a word is called ‘fingerspelling’. Sign language may represent alphabets in one hand, for example, ASL and French Sign Language, or may use both hands for example in BSL or Auslan. There are several similarities between each of the alphabets but each sign language has its style.

American Sign Language (ASL)

ASL is one of the most popularly used sign languages and hence we have chosen it for our project. Our project can be programmed for any sign language with very minor changes since the structure, logic, software, and hardware remains the same. ASL has the same alphabet as English, ASL is not a subset of the English language. American Sign Language was created independently and it has its linguistic structure. (It is descended from Old French Sign Language.)

Signs are also not expressed in the same order as words are in English. This is due to the unique grammar and visual nature of sign language.

Fig 1.1 American Sign Language

We have used a combination of the hand gestures from the ASL

The IOT smart glove is capable of translating alphabets, numbers, directions and words listed below - into audible speech from signs

Table

ALPHABETS	NUMBERS	WORDS
A	1	NAME
B	2	TIME
C	3	SPEAK
D	4	OLD
E	5	HUNGRY
F	6	GOOD
G	7	GOOD MORNING
H	8	GOOD AFTERNOON
I	9	GOOD EVENING
J	10	AFTER
K	20	YOU
L	30	YOUR
M	40	IAM
N	50	WHAT
O	60	WHERE
P	70	WHEN
Q	80	IS
R	90	THE
S	100	HE
T	FORWARD	HELLO
U	BACKWARD	BYE
V	RIGHT	ARE
W	LEFT	FROM
X		DO
Y		DOES
Z		HOW

2. LITERATURE SURVEY

Paper [1]: *S. A. Mehdi and Y. N. Khan, "Sign language recognition using sensor gloves,"* *Proceedings of the 9th International Conference on Neural Information Processing, 2002. ICONIP '02., 2002, pp. 2204-2206 vol.5, doi: 10.1109/ICONIP.2002.1201884.*

This paper examines the opportunity of spotting sign language gestures with the use of sensor gloves. Previously sensor gloves had been utilized in video games or applications with custom gestures. This paper explores their use in Sign Language popularity. This is done with the aid of implementing a venture referred to as "Talking Hands", and reading the results. The challenge makes use of a sensor glove to seize the signs and symptoms of American Sign Language performed by a consumer and translates them into sentences of English language. Artificial neural networks are used to recognize the sensor values coming from the sensor glove. These values are then classified in 24 alphabets of the English language and two punctuation symbols delivered by way of the writer. So, mute people can write complete sentences the use of this utility. One problem that changed into confronted inside the challenge changed into that one of the alphabets concerned dynamic gestures

These may not be diagnosed using this glove. So these have been left out from the area of the assignment.

Paper[2]: *V. Y. Flamenco, P. M. Yanik, R. D. Adams, and M. L. Tanaka, "An Automated Method for Evaluating the Accuracy of ASL Static Gestures," 2014 International Conference on Computational Science and Computational Intelligence, 2014, pp. 173-177, doi: 10.1109/CSCI.2014.36.*

This paper has offered a brand new approach in correcting the location of static American Sign Language (ASL) gestures the usage of present algorithms and characteristic reputation strategies. In ASL the position of the fingers is very crucial thinking about a moderate misplacement conveys a totally one of a kind phrase, letter, or meaning

Paper [3]: A. Kannan, A. Ramesh, L. Srinivasan and V. Vijayaraghavan, "Low- cost static gesture recognition system using MEMS accelerometers," 2017 Global Internet of Things Summit (GIoTS), 2017, pp. 1-6, doi: 10.1109/GIOTS.2017.8016217

The number one objective of this paper is to assemble and check a low-cost, minimally supervised gesture popularity device that mentioned realtatic gestures efficaciously and as they should be. The proposed machine makes use of ADXL335 accelerometer sensors which detect the gestures and these sensors are interfaced with an Arduino ATMega 2560 microcontroller for data processing and gesture popularity. The overall performance of the system is classed the use of static gestures within the alphabets of the American Sign Language. (ASL)

Paper [4]: *O. Sidek and M. Abdul Hadi, "Wireless gesture recognition system using MEMS accelerometer," 2014 International Symposium on Technology Management and Emerging Technologies, 2014, pp. 444-447, doi: 10.1109/ISTMET.2014.69365.*

This paper provides the development of a wi-fi Bluetooth hand gesture reputation gadget the usage of six three-axis accelerometers embedded in a glove and a database gadget in a pc. This machine can recognize any sampled information saved inside the database at the same time as selling maximum portability and mobility to the person via wi-fi Bluetooth era. Analyses along with static statistics, dynamic records, and average recognition fees relationships are mentione in this paper.

3. TECHNOLOGY FOR CAPTURING GESTURE

Mechanics of the Sign Language

Gestures are a significant movement of the hand to convey some information. The recognition of these gestures involves the technology of tracking the hands by interpreting the various orientations and movements. We have proposed a design that is a microcontroller-based hybrid system to identifies hand gestures using flex sensors and an mpu6050. These sensors can be worn by an individual which can detect his gestures and finger movements. The system we have introduced will continuously read these signals and process t hem to produce a speech and text conversion which is done using a wireless connection over Bluetooth. The values detected by our hardware system are processed by the software where the values are compared with predetermined values to map the gestures to particular alphabets, numbers, words. Each flex sensor's output varies with each bend angle of every finger, hence we are able to map each angle combination to different alphabets. The

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mpu6050 we have used also helps us differentiate between different alphabets, numbers, words, direction of the sign language.

Fig 3.1 Mechanics of hand gestures

Communication between hearing and non-hearing

Gesturing is the main medium of communication between hearing and non- hearing humans to Sign Language Interpretation can be proven to be very useful as a tool for the deaf and mute people to be a part of the community with no obstacles. In this paper we thus introduce a smart system that provides a wearable hand glove that can detect gestures, transmit the signal and convert that to text and speech. Sensor data is collected and processed by the software and sent to identify each sign. It is further sent over Bluetooth to a mobile application that converts the processed alphabet, number, words, direction output to text and speech.

4. PROPOSED SYSTEM

4.1 User Requirements and Design Specifications

Easiness of Usage: There should be minimal problems faced by user while using the glove in their daily lives. Delay of the translation should also be taken care of as it is an important feature in usage. There should be minimal tasks given to the user while using the glove in order to process the sign alphabet

Cost Efficiency: For these devices to be accessible to the general public, cost is a very important consideration for the designers of the glove.

Lightweight, compact & convenient- The physical aspects of the glove also define how easy it is to use. The weight and dimension should be taken into consideration in order to provide maximum usability.

Accuracy- This is the most important factor. The accuracy of the device defines how many users will continue using such a device.

4.2 Design Outline

Our design outline specifies a simplification of our entire model to understand the basic working principle of our design. It consists of a smart glove with 5 flex sensors and one accelerometer connected to a microcontroller that can process the signals and is programmed using software. The flex angle values are then used to identify the letter, which is sent via a bluetooth signal to a smartphone. The bluetooth ensures minimal delay and hence we get an instant text and speech conversion that can be heard and read on our smartphone. market appeal, and accuracy.

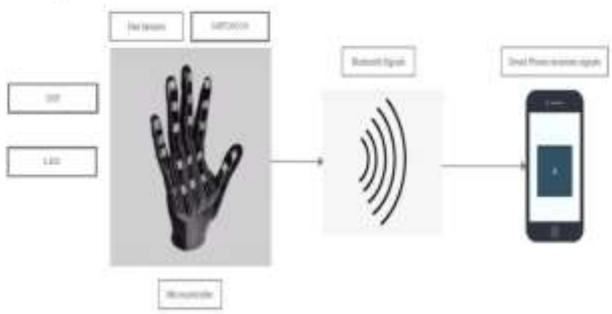

Figure 4.1 Flowchart of the Design outline

4.3 Block Diagram

The electrical quantity from the flex sensor, and accelerometer processed in for each standard sign gesture. It is then converted to text and then sent to arduino bluetooth text speech app and it is converted into speech.

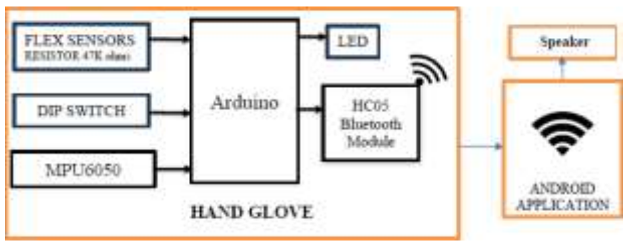

Fig 4.2 Block diagram of the smart glove

4.4 Working Principle

The working of the smart glove is as follows:
Initially, the five flex sensors are attached to five fingers, and an mpu6050 is connected to detect the tilt. The flex sensors are a part of the voltage divider circuit, so whenever there is a change in the position of the finger(bend), resistance of the

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corresponding flex sensors change. This results in change in the voltage drop across the corresponding flex sensors.

- These values along with the values measured by the mpu6050 and dip switch reading are sent to the Arduino nano microcontroller.
- The microcontroller detects that particular sign by analysing the values sent by the sensors.
- The sign detected is sent to the user's mobile phone via bluetooth.
- The phone receives the sign language sent by the microcontroller and the text-to- speech converter app on the phone reads out that particular sign through its speaker.

5. RESULTS

Fig 5.1 Gesture for "HELLO" and the corresponding text is displayed

Fig 5.2 Gesture for "A" and the corresponding text is displayed. gesture for "A" and "HELLO" are same but DIP switch 1 and 4 is in on state for HELLO for A 1 and 4 is in off state

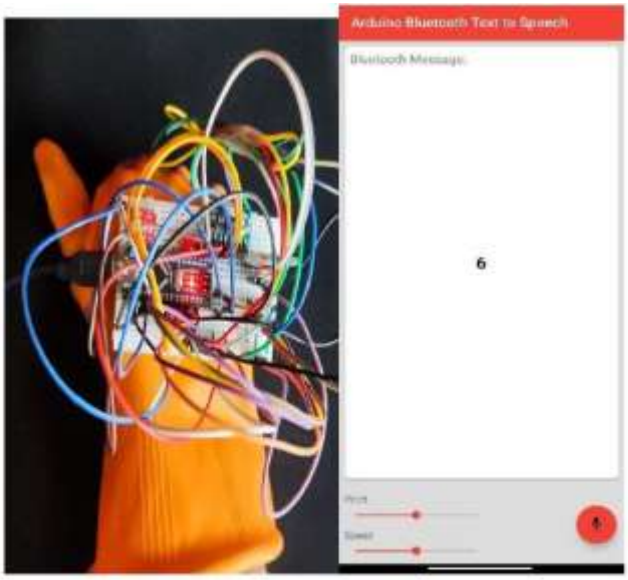

Fig 5.3 Gesture for "6" and the corresponding text is displayed

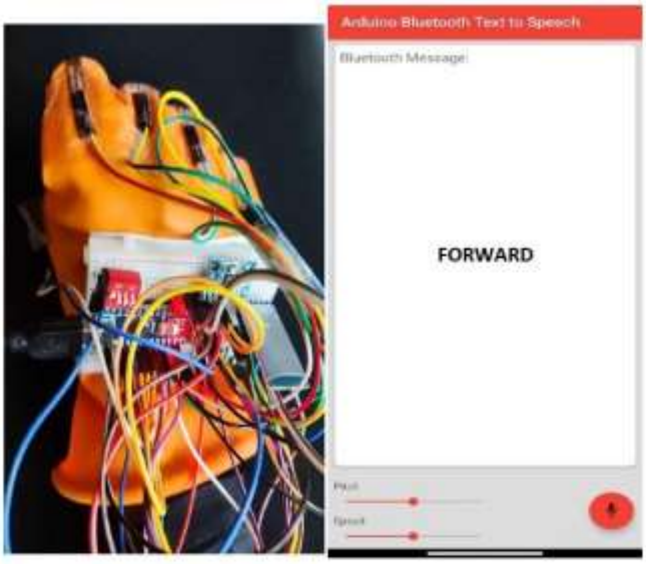

Fig 5.4 Gesture for "FORWWARD" and the corresponding text is displayed

6. CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

Most importantly we aim to create a working model that will be able to convert almost all the 26 English letters, numbers, nearly 26 words, 20 numbers . We have succeeded in building all of the necessary hardware for the project. However, more can be done to improve the device's accuracy, form, and other important specifications. We are excited about the progress made in the development of the glove prototype. Although it is not a finished product, it shows that using a glove outfitted with sensors, a microcontroller, and wireless communications can be used to translate signs. It satisfies all of the major requirements put forth by us, and it may lead to further developments in translation devices. With increased attention to the challenge of sign translation, the team hopes the communication gap between sign users and the hearing may soon be diminished.

6.2 FUTURE SCOPE

If this basic model is complete the future scope of this would be to control Bluetooth devices with smart glove and to convert more different signs for full words, common actions used in general daily life, and increase the dataset that the model is working on.

We can research and create a vaster dataset and implement it.

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