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Hand Gesture Recognition System for Deaf and Dumb

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ABSTRACT: An in-depth literature review has been carried out to look at the present state of data relating to Hand gesture recognition systems that explicitly focused on the vision-based technique for sign language detection. The problem existing at the moment is that most of the people are not able to comprehend hand gestures or convert them to the spoken language quickly enough for the listener to understand. In addition to this communication with sign language is not a very easy task. This problem demands a better solution which can assist speech impaired population converse without any difficulties. The authors propose a non-vision based extended idea[1][12]that will assist in removing or at least reducing this gap between the speech impaired and the able-bodied people. The communication of speech-impaired people with others is only by using the motion of their hands and expressions. According to dumb people, every gesture is associated with a specific meaning and this is stored in a database. By frequently updating the database the dumb will communicate like a normal person using the artificial mouth [6].

KEYWORDS: artificial mouth, non- vision- based technique, sign language detection, speech impaired people, vision-based technique.

I. INTRODUCTION

Vision-based and Non-vision-based are the two techniques that are used today for sign language recognition. We have gone with the glove based i.e., non-vision technique as it is progressively useful in gesture recognition which includes the utilization of extraordinarily structured sensor glove which creates a sign relating to the hand sign. As the efficiency of the smart glove isn't influenced by light, electric, or attractive fields or some other factors, the information that is produced is very precise.The proposed system uses the American Sign Language for communication.[4] In this paper,the authors develop an artificial mouth to ease the communication process of speech-impaired people. We design one glove which is fitted with the flex sensor in our hand then the flex sensor senses the signal and this signal given to the microcontroller whereas all the data kept in the database, then microcontroller matches the motion of hand with the database and produces the speech signal and text [5] i.e. we will get the output through the speaker and OLED display. Here the Raspberry pi 3B is used as a single board computer and an Arduino nano is used as an A/D converter.

II. METHODOLOGY AND WORKING

Existing system: Currently, there are two gesture recognition techniques categorized as vision-based and non-vision-based techniques. The vision-based techniques [2][3]utilize a web camera and markers for sign detection. For gesture recognition, where in the signers or user's gestures need to be detected and localized in picture frames. Here the detection requires adequate lighting for the gesture to be captured accurately. However, the non-vision-based technique uses sensors mainly and other electronic hardware[1] [10] [4].

Proposed system: The proposed system aims at reducing the communication barrier between the speech impaired and normal people thus assisting them for effective communication and easing their difficulties. Our prototype involves Raspberry pi, Arduino nano as an A/D converter which are interfaced with flex sensors and accelerometer for reading the hand gestures, speaker module, OLED, hand glove and a power supply of 5v. When a specific sign is made, the flex sensors gets bended and unique values are generated. These values are stored in the database and when the sign is made the microcontroller matches the values with the stored values and the output is made available in the form of text on the OLED and a audio from the speaker which are connected to the raspberry pi.

Hardware components

Accelerometer: Accelerometers are devices that measure acceleration, which is the rate of change of the velocity of an object. It measures the acceleration of a gesture in three axes and the gives the output to the Arduino nano.

Flex sensors: Flex sensor is basically a variable resistor whose terminal resistance increases when the sensor is bent. These sensors are incorporated on the fingers and whenever a sign is made the fingers get bent and a specific value is then sent along with the accelerometer values to the Arduino nano.

Arduino Nano: It is a Microcontroller board developed by Arduino.cc and based on Atmega328p / Atmega168. In our project it is programmed to work as a Analog to Digital(A/D) converter. The output from accelerometer and flex sensors is in voltage variation i.e., analog and it must be converted to digital values for the Raspberry pi to process.

Raspberry pi 3B: The raspberry pi is an extremely sleek and tiny computer board. It is about the size of a normal credit card, and runs on a Linux based operating system called the Raspbian. It is the heart of our project which processes the input data and gives the output in text and speech using the OLED and speaker module respectively.

OLED: An Organic Light Emitting Diode(OLED) is a display device which has self- light-emitting technology. It is connected to the Raspberry Pi and it displays the sign detected in the form of text.

Speaker: The speaker module used here consists of a 3.5mm jack which is connected to the raspberry pi and a USB cable for power supply. It uses a text to speech conversion (TTS) block for audio output.

Block Diagram:

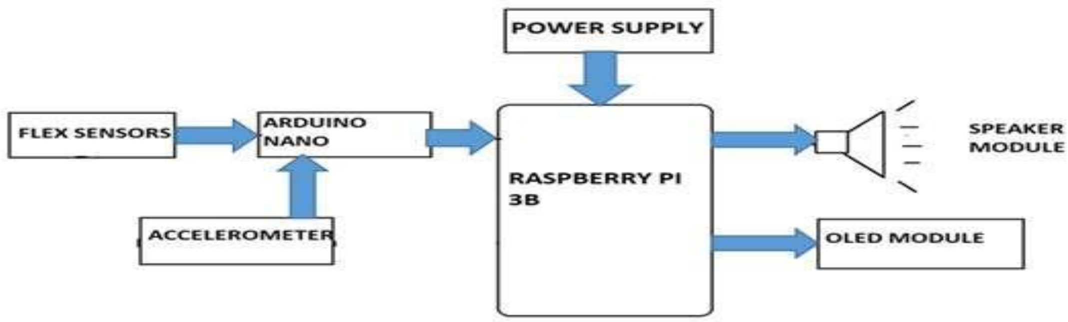

Figure 1. Block diagram of proposed system

The final prototype is developed using the above block diagram and it consists of flex sensors integrated on the glove. The unique value generated whenever a sign is made is given with the combination of acceleration values of axes from the accelerometer to the A/D converter since the former values are analog in nature and needs to be converted to digital for the Raspberry Pi to process and give the output in the form of text on the OLED module and in the form of Speech from the audio output of speaker connected to the raspberry pi 3B using the 3.5mm jack present on it. Here a text to speech converter is used and the basic block diagram representation of a TTS is given below

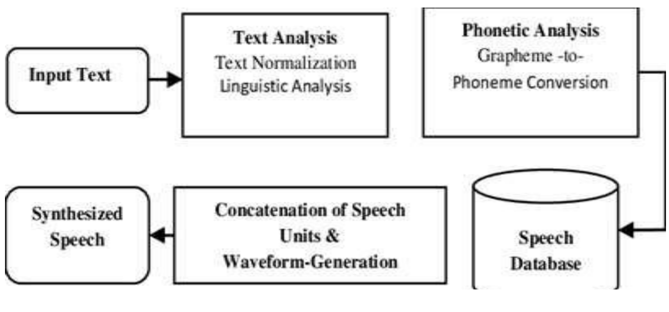

Figure 2. TTS block diagram [42]

2.5 Signs to be implemented

Figure 3.ASL hand gestures to be implemented

III. RESULTS AND ANALYSIS

Results and Discussions

The snapshot of the final prototype is given below.

Figure4. Final prototype of the project

Every hand gesture made has specific values that convey a message. That message is kept in a database. In real-time, the template database is stored in the Raspberry pi and the motion sensors are fixed in their hand. For every action, the motion sensors get accelerated and gives the signal to the Pi. The Pi matches the signal received with the database and produces the speech signal. The output of the system is using the speaker. Here different signs are given and the output is noted. Whenever a sign is made from the above given signs the microprocessor matches the sign with the stored message in the database and gives the meaning of the sign in the output in the form of text and speech. The following are some of the snapshots of different signs made and their results.

Table 1:- Tabulated results of six hand gestures with text output.

S.no	Hand Gesture made	Output on the OLED
1	Good Job	
2	I am watching you/stare	
3	I am sorry	
4	I am Deaf	

5	Wow! Perfect	
6	I Want to play	

The above table represents the five Hand gesture results on the OLED module. However, many signs have been implemented. Here the output is both on the OLED and the speaker module[10],[13].

IV. 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 sensor in combination with the Accelerometer, A/D converter, and Raspberry pi 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. It can be concluded that theexisting methods [1],[10] assisted in the development of our prototype but the inclusion of new technology will surely lay a major impact in this field.

Future Scope: In the near future, more sensors can be embedded to recognize full sign language with more perfection and accuracy and most of the units can be embedded together on a single board resulting in a compact model. The system can also be designed such that it can translate words from one language to another. In the future, the accuracy can be improved and more gestures can be added to implement more functions[13].

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