Development of Portable device for Gesture based Communication for mute person

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Abstract

since many years the physically disabled people who are deaf are using sign language for communication. That's is the principle resources for their communication. Sign language as a type of gestures which helps the dumb people to make communication like as normal people. Also Normal people in general around them face problem in communicating with these type of people. The propose system prototype is really helpful to this kind of people, that is capable of automatically recognizing the sign language for helping normal people to communicate more effectively with speech impaired people. In the country like India around 2.78% of people are not able to speak (dumb). In General the dumb people who know sign language for reaching others as communication language find exertion in communicating with majority of people who don't understand the sign language as medium of communication. One novel thought is to make dumb person interact with others via their hand movement not by all signs. The mentioned and describing system will be more helpful to express their thoughts to others in more convenient way. This article describes a system that will help them to express their thoughts and willingness in most convenient way. The prototype will help those people by providing them a medium of communication that is more convenient.

Keywords: deaf people, sign language, TTS, Raspberry Pi, hand gestures

1. Introduction

Around 9,000 million individuals in the world are not normal and physically challenged as not able to hear. Here the specific people are deaf. However every now and then we don't go to these individuals and their difficulties in speaking with the normal world. The correspondence is difficult for unable to hear compared to the ordinary individual who are not able to see. The issue is significant for deaf people for communicate with normal world compared to blind one. Sign language is a non-verbal format of intercommunication that is used by deaf people in all over the world.

The visually disabled iindividuals can talk uninhibitedly by methods for typical language though the deaf individuals have their own manual-visual language prevalently known as gesture based communication. Communication via gestures is a non-verbal type of intercommunication. Deaf - Mute correspondence translator is a gadget that makes an interpretation of the hand signals to hear-able voice. A motion of hand or movement of hand using fingers and different shapes are implemented as gestures. Expression of face and outer movement are taken in consideration as gesture here. Thus gesture on the other hand, is a static shape of the hand to show orientation towards sign.

2. Block diagram

In this block diagram consists of an accelerometer as vibration or acceleration force measuring device and Flex sensors that is attached to the gloves that are considered as input devices for application of signals generated by an individuals. A voltage divider is used for these two signal generated by accelerometer and flex sensors. The output of divider network is then applied to the processor Raspberry Pi which acts as the most important part of the proposed system.

The discussion on Flex sensors includes its required all details basically they are made up of resistive carbon that impairs characteristics of bending of sensor results in change in resistance this is incorporated by movement of fingers.
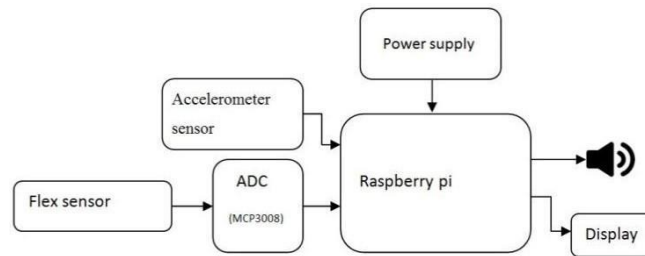
Figure 1. Block diagram of Portable device

One can mount five Flex sensors on each of five fingers of one's hand. Sensing of direction and concept of gravity is fulfilled by Accelerometer for this module. The output of the Flex sensor is the varying resistance that convert resistance in to a voltage signal using a simple network i.e. voltage divider biasing circuit. Continuous monitoring of received output is done. Processor is been interfaced to a memory device IC that acts as an input or an output device [1]. The Output text of Raspberry poi is converted to sound by TTS. The TTS software used for letters to sound rules. The in built stepwise Algorithm allows it for real time translation of different characters of English. It is used along with speaker that support text to speech conversion. TTS accepts serial Data in form of ASCII characters and translates to syllabic sounds. The voice output is through a speaker [2].

Hardware used

Table 1. List of Components

SR. No	Components
1.	Flex sensor
2.	Raspberry Pi
3.	ADC (MCP3008)
4.	Speaker
5.	Accelerometer sensor

● Flex sensor

The discussion includes Flex Sensors which are analog variable resistors, they work as variable analog voltage dividers network. The Flex Sensors are mounted on each thumb and fingers of the glove. Flex sensor is used as sensor's degree of bend and the voltage output changes accordingly [3]. The sensors connect to the device through three pin connectors.
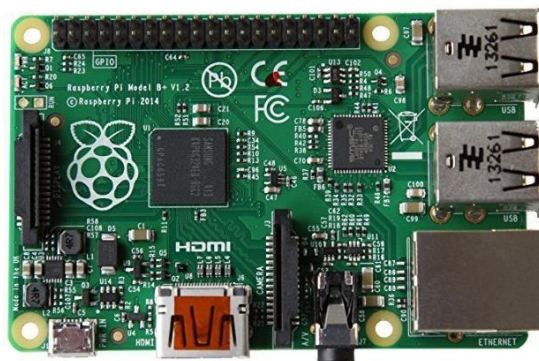

Figure 2. flex sensor

The sensor shown in picture is flex sensor. This sensor changes resistance when it gets bent. The sensor is capable to change resistance increase of 30- 40 Kilo ohms at each 90 degrees. This flex sensor is further connected to ADC IC MCP3008 [4].

● Raspberry Pi

Figure 3. Raspberry Pi

Raspberry Pi is a very low cost, credit card sized computer or PC that can be plugged into a computer monitor or Television kind of device it uses a standard mouse and keyboard [5]. This is a little device which is capable to explore computing, and to learn how to program in languages like Scratch and Python[6] for all ages of people. Device also provides a great supporting environment for learning stepwise programming and digital making. One can definitely connect hardware to the Pi's GPIO (general purpose input/output) pins and learn to program using electronics components.[7]. Raspberry Pi is used as a on types of data saver which does data comparison [8]. It can execute the various comparison of stored and input data

● ADC (MCP3008)

ADC MCP3008 is used for Analog to Digital conversion. This is a very low cost 8-channel and 10-bit analog to digital converter-ADC [10]. The ADC-MCP3008 will be connected to Raspberry Pi using a SPI serial connection. One can either hardware SPI serial bus or otherwise any 4 GPIO pins and software SPI which interacts to the ADC-MCP3008 [11]. SPI Software is quite more flexible as that can work other pins on the Raspberry Pi. Hardware SPI is slightly faster but it is less flexible as it only works with specific pins of the processor. One if not sure to use anything else then software SPI is an easier option for setup. It is necessary to make connections for ADC-MCP3008 to Raspberry Pi along with a software SPI connection. One need to have mentioned connections [12].

Table 2. Pin configuration for Raspberry Pi

| ADC-MCP3008	Raspberry Pi
VDD	3.3V
VREF	3.3V
AGND	GND
DGND	GND
CLK	Pin 18
DIN	Pin 24
DOUT	Pin 23
CS/SHDN	Pin 25

● Speaker

Figure 4. Raspberry Pi with speaker

A speaker is output device of the module it's TTS-Text-to-speech type of speech synthesis type of application which is used to convert any speech or spoken sound version of the text in to a computerized document, e.g. help file. Text-to-Speech-TTS is capable to enable the reading of computer displayed information for the visually challenged person. This may very simply be used to be augmented to reading of any textual message. Recent TTS- Text-to-Speech applications incorporate the feature of voice-inability. This is possible from the data and spoken speech in audio response system. So one can say that Text-to-Speech is in general more often used in coordination of voice recognition algorithms [13].

● Accelerometer sensor

Accelerometer-MPU6050 is a sensor that is an integrated 6 axis motion tracking instrument and is used as motion processing device. This has a Digital Motion Processor, 3-axis Gyroscope, 3-axis Accelerometer, and also a Temperature sensor. This all are available in a single package of device. This is capable of accepting input from other sensing elements like 3-axis magnetometer or pressure sensor with the help of the Auxiliary I2C bus. If an external 3-axis magnetometer is connected, then this device becomes capable of processing 9 axis algorithms.

Microcontroller is capable to communicate with this module using a serial communication protocol i.e. I2C. Gyroscope and accelerometer reading along the 3 cartesian axis X, Y and Z axes are available in 2's complement form. Gyroscope readings are in degrees per second i.e. dps whereas, accelerometer readings are mentioned in g unit.
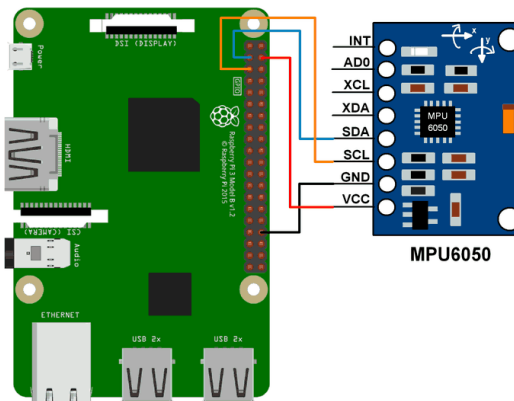
Figure 5. Accelerometer sensor connect with raspberry Pi

● Selection of Raspberry Pi

Main reasons for selection of Raspberry Pi are given below:

Raspberry Pi is a very low cost, compact computer that can work similar to a desktop when connected to monitor, keyboard and mouse. It is capable of edge and fog computing. Due to its compact size it is preferable to place Raspberry Pi at edge location and to carry out computing instead of placing a whole computer at the remote locations. It has inbuilt wi-fi and is capable of handling light internal or web traffic It is adaptable as it provides vast peripheral support. It is an open source platform which provides faster computation hence is one of the most popular development board.

Table 3. Comparison for Controllers

Controller	Raspberry Pi	Atmega328	Esp12e
Connect multiple sensor	✔	✔	✔
WIFI	✔		✔
Data comparison	✔	✔	
TTS	✔		

Hardware Implementation
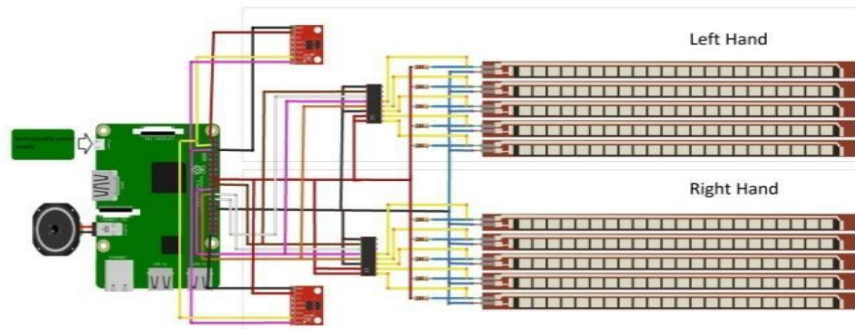
Figure 6. Hardware Implementation with raspberry Pi

You can show in figure I will use 10 flex sensors for 5 right hand and 5 left hands. And 2 Accelerometer sensors. A flex sensor is connected to ADC ICs. Because a flex sensor output is analog data so, I will use ADC ICs (MCP3008). And ADC ICs output is connected to Raspberry Pi SPI pins It's an SPI interface. And Accelerometer sensor is connected to Raspberry Pi I2c pins It's the I2c interface. And the output of data text to speech conversation via a speaker.

1st program is Enter data-name or data save the program from the flex sensor and Accelerometer sensor (HandGesture) in LibreOffice calc.

2nd program is the Compression Data program from the flex sensor and Accelerometer sensor (Hand Gesture). If both data are same so the output is text to speech converter.

1. **Features**

- Angle Displacement Measurement
- Bends and Flexes physically with motion device
- The prototype can be enhanced to produce full alphabet series & numbers
- Module on wrist makes it portable
- It is economical.
- Fast conversation

2. **Applications**

- Robotics
- Recognition of Gesture and other conversion
- As a translating device for deaf and dumb people
- Interpretation of sign language in many regional languages

Conclusion and Future enhancement

Wearable Technology like Smart Gloves can act as a between disabled person and normal person. Sign language is one of the mediums used by specially abled persons to express their thoughts with others but their

communication is hindered as the normal people lack in understanding their language. Hence the smart gloves fitted with flex sensors ensures the communication between two different communities. It is small in size, due to its compactness it can be easily placed on our hand. In future the following modifications can be carried out inorder to create it to its most adaptable version:

1.   Ability to translate in various languages (i.e. if gesture in English language "How are you." And it's converted to Spanish language and it's spoken "cómoestás").

Further reduction in size (Module on wrist makes it portable)

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