Designing of an Embedded Communication Aid for Speech Impaired People

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Abstract— In our country around 2.78% of people are not able to speak (dumb). Their communications with others are only using the motion of their hands and expressions. We proposed a new technique called artificial speaking system for dumb people. It will be very helpful to them for conveying their thoughts to others. Some people are easily able to get the information from their motions. The remaining is not able to understand their way of conveying the message. In order to overcome the complexity this system is introduced for the deaf and dumb people. This system is based on the motion sensor (Flex sensor). According to speech impaired people, for every motion they have a meaning. That message is kept in a database. Likewise all templates are kept in the database. In the real time the template database is fed into raspberry pi and the motion sensor is fixed in their hand with the help of glove. For every action the motion sensors get accelerated and give the signal to the raspberry pi processor. The processor matches the motion with the database and produces the speech signal. The output of the system is using the speaker. By properly updating the database the dumb will speak like a normal person using this system. The system can also convert the output into text.

Key words: Flex Sensor; Raspberry Pi; Gesture Recognition Module; Text-To-Speech Synthesis Module

I. INTRODUCTION

The speech impaired communicates with normal people in everyday life and they use sign language for communication, but they find difficulty in communicating with others who do not understand sign language. And often they need a support for effective communication. Aiming to extend the communication capabilities of those with hearing and speech disabilities after interacting with hearing and speech impaired athletes at their school, the quad Squad team set out to develop a way for those who know sign language to more easily communicate with those who don't. Their solution includes a hardware component – the gloves fitted with various sensors – and a software component – which translates the hand signals into speech in real time. Most of the existing systems are image based gesture recognition system and hence highly expensive, whereas this work has developed a low cost Glove based system. This project uses Raspberry pi to control all the processes and flex sensors will track the movement of fingers as well as entire palm. A CPU monitor will be used to display the user's gesture into text and a speaker to translate the gesture into audio signal. It is based on the need of developing an electronic device that can translate sign language into speech and text, in order to make the communication take place between the mute communities with the general public. The prototype is a complete portable communication aid for the speech impaired which includes converting the sign language into speech and text using flex sensor-based gesture recognition module to recognize English alphabets and few words. This work aimed to lower this barrier in communication.

II. LITERATURE SURVEY

1) HenrikBirk and Thomas BaltzerMoeslund, "Recognizing Gestures From the Hand Alphabet Using Principal Component Analysis", Master's Thesis, Laboratory of Image Analysis, Aalborg University, Denmark 2011 [4], presents simple as well as effective method of realizing hand gesture recognition using Covariance Method. First an image database is created which constitutes various static hand gesture images. These images are a subset of American Sign Language (ASL). Preprocessing of the image is done so as to reduce the amount of noise present in the image. Eigen values of the Eigen vectors are calculated. A pattern recognition system is used to transform an image into feature vector i.e. Eigen image, which will then be compared with the trained set of gestures. Thus method used was successful to retrieve the correct match.
2) Andrew Wilson and Aaron Bobick, "Learning visual behavior for gesture analysis," In Proceedings of the IEEE Symposium on Computer Vision, Coral Gables, Florida, pp. 19-21, November 2009 [13], proposed the development of an algorithm for recognition of hand gestures with reasonable accuracy. The segmentation of gray scale image of a hand gesture is performed using Otsu thresholding algorithm. Total image level is divided into two classes one is hand and other is background and image processing is done. Depending on optimal threshold value the output is generated.
3) Jennifer Schlenzig, Edward Hunter, and Ramesh Jain, "Recursive spatio-temporal analysis: Understanding Gestures", Technical report, Visual Computing Laboratory, University of San Diego, California, 2012 [12], presents a novel technique of recognizing hand gestures i.e. A-Z alphabets, 0-9 numbers and 6 additional control signals (for keyboard and mouse control) by extracting various features of hand ,creating a feature vector table and training a neural network. The proposed work has a recognition rate of 99%.
4) V.Ramya, B.Pallaniappan, "Designing An Embedded Communication Aid For Speech Impaired Using Xbee And Gsm" JTAIT 30th April 2014. Vol. 62 No.3 [14], This paper focuses on developing an aid for speech impaired and physically impaired, who can control the home appliance through hand gesture. The proposed system presents a design and working of a hand-gesture based interface for facilitating communication among speech impaired with the normal people using Handheld Device instead of PC. The system considers only single

handed gestures and converts the sign language into voice, which could be heard by the visually impaired and normal people.

5) Aarthi M, Vijayalakshmi P , "Sign Language To Speech Conversion" 2016 Fifth ICRTIC [7], defines a work in which a flex sensor-based gesture recognition module is developed to recognize English alphabets and few words and a Text-to-Speech synthesizer based on HMM is built to convert the corresponding text.

III. BLOCK DIAGRAM

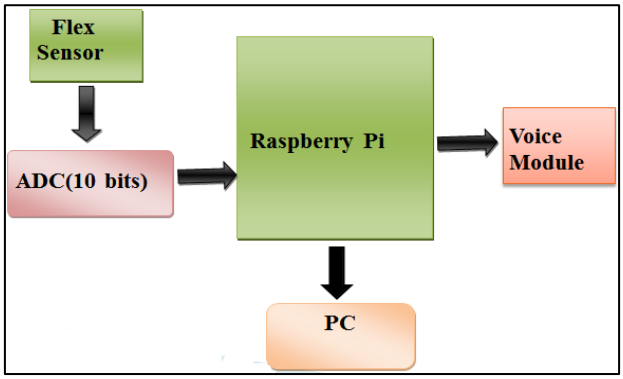

Fig. 1: Block Diagram

As per the block diagram, the flex sensors are used to generate the analog voltage by detecting the movement of the fingers. The analog voltage will be directly processed by the ACD for sending the digital signals to processor. The output of processor will be audio signals using the Voice Module. Thus status of the sensor values that is text will be displayed on the monitor Screen.

A. Methodology

Embedded computing systems often involves the design of hardware as well as software. Fig.1 shows a design methodology for a combined hardware/software project. Front-end activities such as specifications and architecture simultaneously consider hardware and software aspects. Similarly, back-end integration and testing consider the entire system. In the middle, however, development of hardware and software components can go on relatively independently. The proposed system is designed based on this methodology in which the requirement and specifications are first clearly specified and then the hardware and software design of the communication aid is designed.

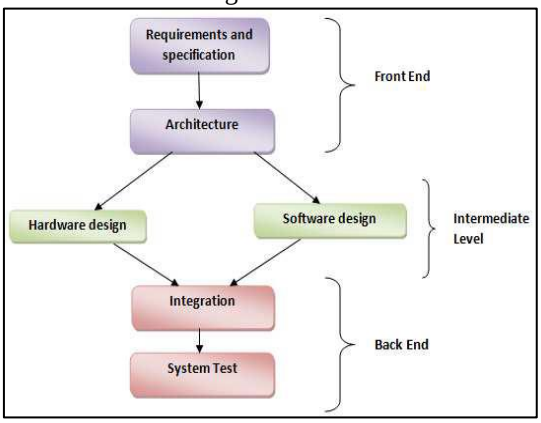

Fig. 2: A Simple Hardware/Software Co-Design Methodology

B. Description of the System

Generally dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign language. This project aims to lower this barrier in communication. In this electronic system we design one glove which is fitted with the flex sensor in our hand then the flex sensor sense the signal and this signal given to the raspberry pi whereas all the data kept in the database. Then processor matches the motion of hand with the database and produces the speech signal i.e. we will get the output through the speaker.

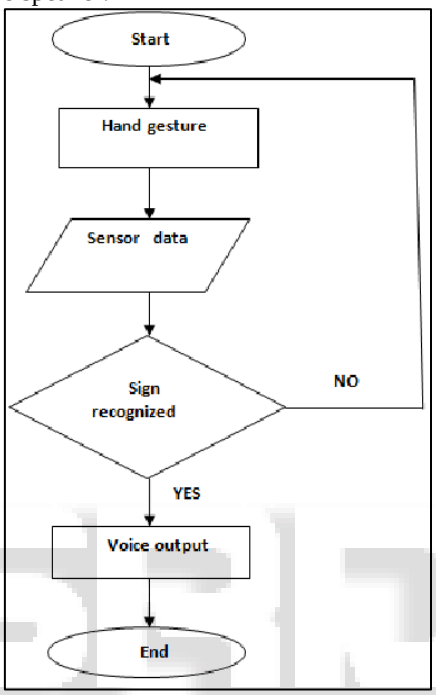

Fig. 3: Flow Chart of Working of System

C. Hardware Components

Sr.No.	Type of Component	Specification
1.	Glove	Hand Glove
2.	Flex sensors	Spectra Symbol 4.5"
3.	Speaker	8Ω
4.	Audio amplifier	LM 358
5.	Raspberry Pi	Model 3B

1) Glove

A simple hand glove is being used.

2) Flex sensor

Flex sensor is a unique component that changes resistance when bent. A flex sensor has a nominal resistance of 10k ohms. They convert the change in bend to electrical resistance the more the bend, more the resistance value. The sensors in the Data Glove are optical fibres that are scratched near the bending joint. The flex sensor value will be a changing one due to the hand movement and vibrations on displaying the hand sign. And hence in the received flex sensor value +/- 20 (optional) is considered to get the constant value for the given sign. In this work the size of the flex sensor used FLEX -01-L is1k to 20 k ohm (Flex sensor).

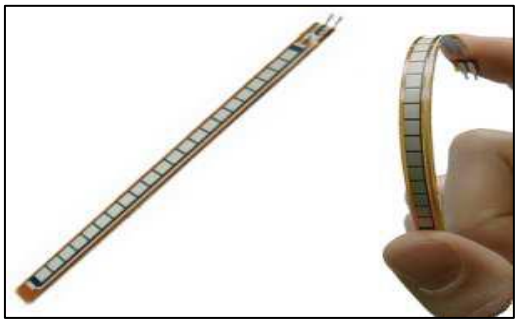

Fig. 4: Flex Sensor

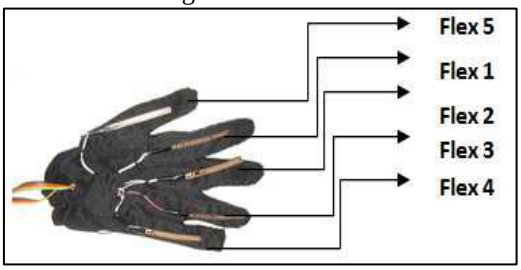

Fig. 5: Glove with flex sensor

3) Speaker

Generally used for all types of audio projects. The speaker with resistance of 8 ohm and power rating equals to 5W. Size: 4 inches

Usage/Applications

- General warning alarm for some projects
- Simple amplifier projects
- For TV & Music systems
- Will also fit in robots projects

Fig. 6: Speaker

4) Audio Amplifier

Utilizing the circuit designs perfected for quad op-amps, this dual op-amp features low power drain, a common mode input voltage range extending to ground/VEE, and single supply or split supply operation. The LM358 series is equivalent to one-half of an LM324. These amplifiers have several distinct advantages over standard operational amplifier types in single supply applications. They can operate at supply voltages as low as 3.0 V or as high as 32 V, with quiescent currents about one-fifth of those associated with the MC1741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

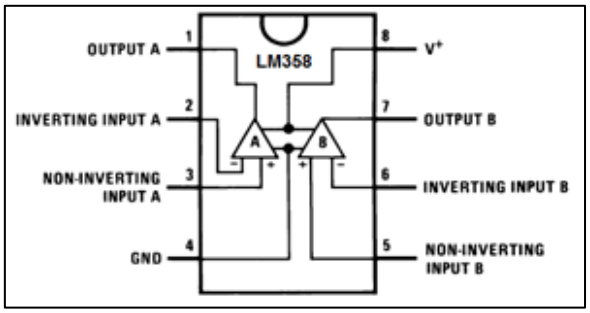

Fig. 7: LM358 IC

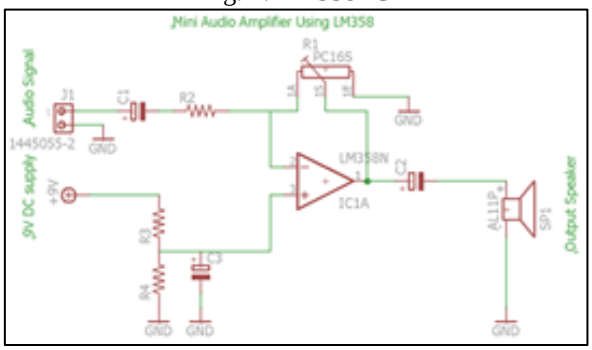

Fig. 8: Audio Amplifier using LM358

5) Raspberry PI

Raspberry Pi is an ARM based credit card sized SBC (Single Board Computer) created by Raspberry Pi Foundation. Raspberry Pi runs Debian based GNU/Linux operating system Raspbian and ports of many other OSes exist for this SBC. It has on-board WiFi / Bluetooth support and an 64bit improved Processor. It is has

- Broadcom BCM2837
- Quadcore ARM Cortex-A53, 64Bit
- 1.2GHz (Roughly 50% faster than Pi2)
- 1 GB
- 400 MHz VideoCore IV
- 1 x 10 / 100 Ethernet (RJ45 Port)
- 802.11n wireless LAN (WiFi) and Bluetooth 4.1
- 4 x USB 2.0
- 2 x 20 Pin Header
- 15-pin MIPI
- DSI 15 Pin / HDMI Out / Composite RCA
- 2.5A

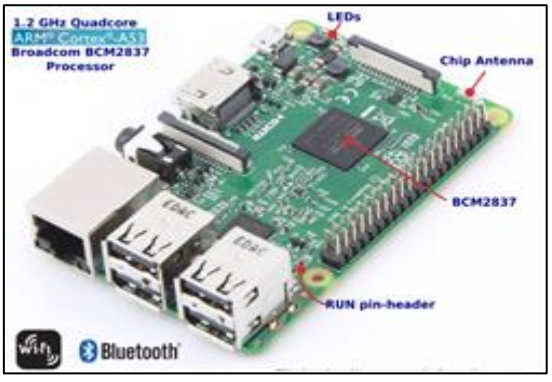

Fig. 9: Raspberry Pi processor

D. Software Components

1) Raspbian OS

Raspbian is a Debian-based computer operating system for Raspberry Pi. There are several versions of

Raspbian including Raspbian Stretch and Raspbian Jessie. Since 2015 it has been officially provided by the Raspberry Pi Foundation as the primary operating system for the family of Raspberry Pi single-board computers. Raspbian was created by Mike Thompson and Peter Green as an independent project. The initial build was completed in June 2012.The operating system is still under active development. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs.

2) VNC software

In computing, Virtual Network Computing (VNC) is a graphical desktop sharing system that uses the Remote Frame Buffer protocol (RFB) to remotely control another computer. It transmits the keyboard and mouse events from one computer to another, relaying the graphical screen updates back in the other direction, over a network. VNC is platform-independent – there are clients and servers for many GUI-based operating systems and for Java. Multiple clients may connect to a VNC server at the same time. Popular uses for this technology include remote technical support and accessing files on one's work computer from one's home computer, or vice versa. VNC was originally developed at the Olivetti & Oracle Research Lab in Cambridge, United Kingdom. The original VNC source code and many modern derivatives are open source under the GNU General Public License.

– Language to be used
– Python

IV. RESULT

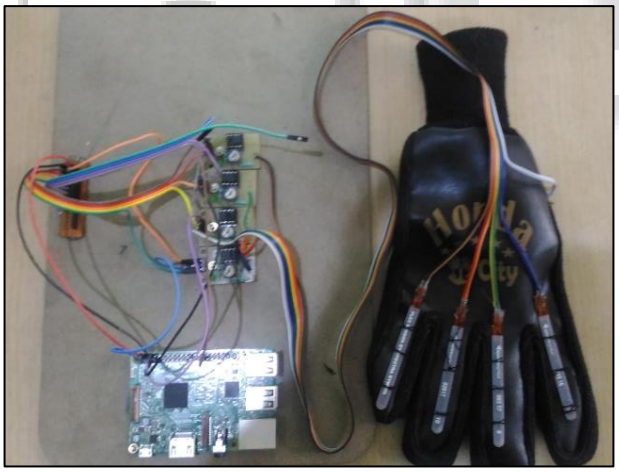

Fig. 10: Final Project

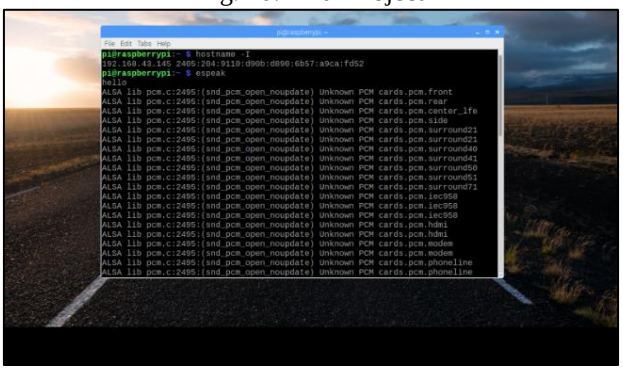

Fig. 11: Text Output of Gestures

V. CONCLUSION

In this project an electronic speaking system is to be developed to ease the communication process of speech impaired people. With this project, deaf or dumb people can use the gloves to form gestures according to sign language which will be converted into speech and text. Our system helps to mute people which to communicate with normal people.

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