International Journal of Research in Advent Technology (E-ISSN: 2321-9637) Special Issue
National Conference "NCSEEE-2016", 19 March 2016
Available online at www.ijrat.org

Gesture to Voice-Conversion for the Vocally-Impaired

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Abstract- In this paper, we have introduced our idea through which we can help the vocally disabled people to communicate by providing them Gesture Controlled Audio Gloves (GCAG) which will convert their hand gestures into audio signals. Accelerometer and flex sensors are used in this project.

Keywords— *GCAG, Flex Sensor, Accelerometer, Bluetooth, Android Application*

I. INTRODUCTION

Technological advancements in communication field has shrunk the world to a single global community. But there is still a part of the society which is impotent in expressing ideas verbally. With the fast-growing technology, these barriers have increased manifold as these people find it difficult to cope-up and grow with the new emerging trends. In the recent years, there has been a rapid increase in the number of deaf and mute due to birth defects, oral diseases and accidents. The people who are vocally disabled face problem in communicating with people who do not know or understand sign language. Hence they are at the losing end when it comes to communicating in public places, job interviews, etc. Every time a mute person is offered a job, the company needs to hire an interpreter. Also talking over the phone poses a big issue for these people.

The language they use for communication is called as Sign Language. Sign language uses hand gestures instead of sounds to convey meaning of letters or words. This language consists of hand shapes and orientation together to express.

This project aims to reduce the communication barrier faced by the mute by developing an assistive device for deaf-mute persons. The objective is to develop a hand-gesture based interface for facilitating communication among speech-and-hearing-impaired which is not only user-friendly but also less expensive.

Gesture Controlled Audio Gloves (GCAG) is a micro-controller based system for communication among the vocally-disabled people and the people who are not aware of the sign language.

This approach uses electromechanical devices to recognize finger bent and hand orientations. Data Gloves [4] which are instrumented gloves follow this method of implementation. It is used as an input device. It has two types of sensors- bent sensors (Flex Sensors) and tilt sensors (Accelerometers). Five flex sensors are fitted

along the length of each finger and accelerometer near the wrist. The output of these sensors is analog in nature and hence needs to be digitized. Finally, these digital values are converted into speech using the text-to-speech application of the android mobile phones.

II. LITERATURE SURVEY

Attempts to automatically recognize sign language began to appear in the 1990's. Various techniques have been employed in the recent past to achieve gesture recognition for the vocally-impaired. These include visual recognition approach using image and video processing, which however, come with their own limitations. These techniques are sensitive to lighting conditions, also motion cues limit the gesturer to a stationary background.

One of the approaches to acquire the hand gesture is from an instrumented data glove which consists of two sensors bend sensors and tilt sensors. The bend sensor is made up of IC555 in astable mode along with a photo-transistor [3].

Reference [2] offers a Wireless Data Glove in which Flex Sensors are fitted along the length of each finger along with RF transmitter and receiver.

Paper [4] describes a system with Sign Language Translator as a main unit which uses Flex Sensors and Accelerometer to capture hand gestures. It consists of a speech recognition unit which is defined in Microsoft Visual Studio 2008.

Yet another approach [5] uses computer vision to capture the hand gestures and neural network and artificial intelligence is used to analyze and detect the signs.

Reference [1] shows the capturing system which comprises of two main elements - an AcceleGlove and two-link arm skeleton. The sensors and wires of AcceleGlove are mounted on a leather glove so that it is able to detect hand shapes accurately for different hand sizes, also making the system portable. The classification of gestures is based on Hidden Markov Model (HMM) and neural networks.

Reference [6] defines a data glove fitted with tilt sensors used for gesture recognition and a speech synthesis unit. The tilt sensors are made of timer IC in astable mode along with photo transistor, whereas accelerometer ADXL103 is used as a tilt sensor, and the speech synthesis module consists of SP0256 (Speech Synthesizer IC).

Data is acquired from the sensors or cameras, analysed and finally recorded in a database. This data would be correlated with the actual data being generated while the user performs gestures. The recognized text word is then sent to the audio unit. This method of implementation is common to all the research papers.

III. WORKING

Block Diagram

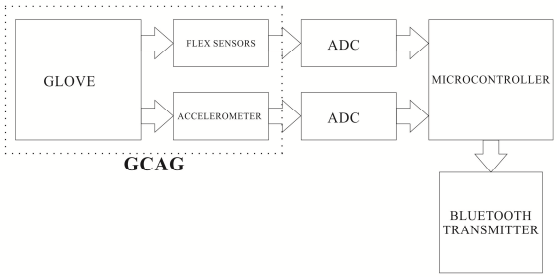

Figure 1. Transmitter Section

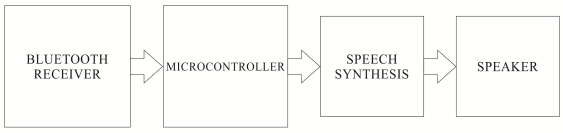

Figure 2. Receiver Section

The block diagram consists of the following parts:

- Glove
- Flex Sensors
- Accelerometer
- ADC
- Micro-controller

- Bluetooth Transmitter and Receiver
- Smart Phone

Initially, the values from sensors are acquired and digitized. These digital values are then compared with the already created database and if a match is found, the ASCII equivalent of that text is sent to the smart phone via Bluetooth. This smart phone has a text-to-speech conversion android application, which converts the received ASCII value into speech.

The glove being used in this system is made up of insulating and shock-proof material. Using a smart phone will not only make this system portable, but also user friendly and less expensive.

IV. SYSTEM DESCRIPTION

A. Hardware Implementation

1. Flex Sensors

Flex sensors are used as bend sensors in this system. These are attached along the length of each finger to detect bent in the fingers. The resistance of flex sensors changes with the degree of bent.

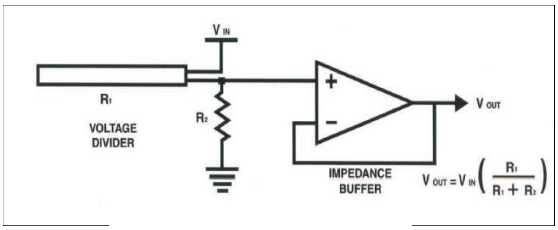

Figure 3. Flex Sensor Circuit

These sensors are connected in potential divider network so that change in resistance is converted into proportional change in voltage. The output of this potential divider is given to an impedance buffer. This impedance buffer is single power supply opamp LM311 used unity feedback configuration.

2. Accelerometer

Accelerometer ADXL335 is a small, thin, low power, complete 3-axis sensor which is used to sense the orientation of the hand in gesture recognition. It is fitted near the wrist in the glove. It uses the gravitational force as an input reference to determine the orientation of an object in space, and works on the principle of differential capacitance. It is most responsive to tilt when its reference axis is perpendicular to the gravitational force, which is, parallel to the earth's surface.

3. ADC (Analog to Digital Converter)

Analog to digital converter is required because the output of all the sensors is analog in nature. The on chip ADC of the micro-controller is used which is an 8-channel, 10-bit ADC.

4. Microcontroller

ATMEL MEGA 328P AU 1519 is used as the micro-controller.

Features:

- High performance, low power 8-bit micro-controller.
- Advanced RISC architecture.
- Single clock cycle execution of most of the instructions.
- 32*8 general purpose working registers.

8-channel, 10-bit ADC in TQFP and QFN (Quad Flat No-leads) /MLF (Micro Lead Frame) package.

5. Bluetooth

HC05 module is used for transmitting the ASCII value of text which would be converted to speech later. It uses Bluetooth SPP (Serial Port Protocol) module for wireless serial connection.

Features:

- Power supply: +3.3 V DC 50 mA
- Frequency: 2.4 GHz ISM band

Bluetooth protocol: Bluetooth Specification v2.0+EDR (Enhanced Data Rate) 3Mbps.

6. Receiver Section

A smart phone will be used as a receiver. It will receive data from the Bluetooth transmitter and convert the bit streams into speech. This will be done by an android application.

B. Software Implementation

We are using arduino IDE version 1.6.7 to program the arduino nano microcontroller to convert the 7 analog inputs from the sensors into digital signal and map it to the appropriate output.

We will use conditional statements for the controller to make appropriate choice of output letter whose ASCII

equivalent will be sent to the android application in the smartphone via the Bluetooth module.

The android application will be developed using Android studio version 1.0.4. Android studio is now the official IDE for developing android applications. The application will support a minimum API (Application Program Interface) of 19 for Android phones which is popularly known as the android version 4.4 Kitkat. Our application will run on approximately 49.5% of the android device active on the play store. The reason for selecting this API 19 is due to rapid advancement in the android technology and the percentage is expected to grow exponentially.

This android application will receive the ASCII value from the controller and will convert that value in speech which can be heard from the phones speaker. The application is able to speak in most of the languages across the globe and in their respective accent. It is programmed to signal the user of any error occurred due to improper usage of the glove or any gesture which is not a part of the database.

The application will itself act as a database through which any new user can learn and understand the sign language.

V. ALGORITHM

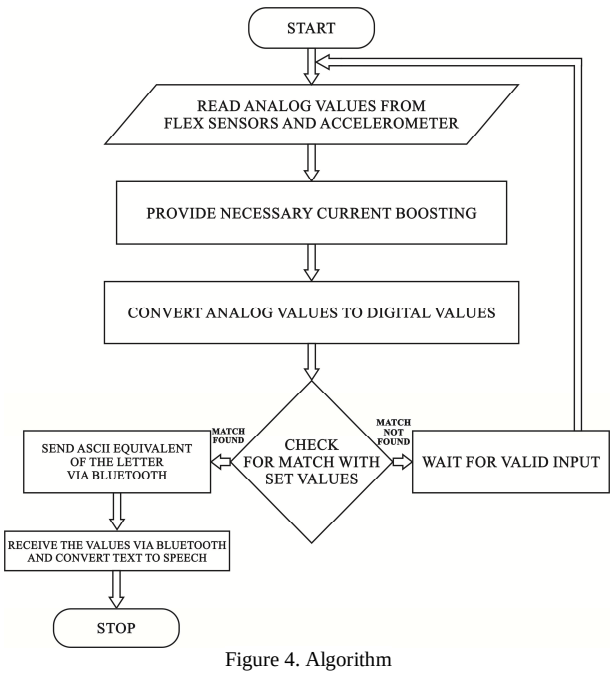

Figure 4. Algorithm

ACKNOWLEDGMENT

We are deeply honoured in expressing our sincere gratitude to prof. U.S. Rawandale for providing valuable insights. We are thankful to the HoD (E&T.C.), MIT College of Engineering, Pune, Prof. (Dr.) V.V. Shete, who has extended us a helping hand in all possible ways. We are also deeply indebted to all the teaching and non-teaching staff for the facility provided and their critical advice and guidance.

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