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Hand Gesture Recognition for Dumb People using Indian Sign Language

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Abstract— So many people in our country are not able to speak (dumb). A dumb people make the communication with other people using their motion of the hand and expressions. We proposed such a system which is called as hand gesture recognition for dumb people using Indian sign language. This system will help him to express their thoughts as a more convenient way. Sign language as a kind of gestures which helps the dumb people to make communication like as normal people. In this research, flex sensor and accelerometer sensors based hand glove is designed to recognize the Indian sign language. The glove is internally equipped with flex sensors and accelerometer. For each particular gesture, as the flex sensor bends some amount, its resistance gets varied and accelerometer measures the motion of hand. The flex sensor produces analog output values that are converted into digital values using an ADC converter. The processing of these hand gestures is in LPC2148. Microcontroller sends this digital signal to Cell phone via Bluetooth module. At other side cell phone is used to recognize hand gesture data which we have stored already in memory. The output of the system is presented with the help of the speaker. So every time updating the new words in the database the dumb will speak like a normal person.

Keywords— Dumb; Bluetooth; Gesture; Flex sensor; Accelerometer; Cell phone; Microcontroller;

I. INTRODUCTION

There are many people's in the world are dumb which is near about nine billion. The communication between a dumb person and hearing person is always challenging task as compared to communication between blind people and normal people. This creates an extremely little space for them with communication which is essential part of human life [1]. Sign language is one of the powerful tools for dumb people and hearing. It uses gestures instead of sound to elaborate their meaning. These people use the different parts of the body, such as palm, movement of finger and hand also its orientation, arms or body, facial expressions and lip-patterns for elaborating messages [2]. It is not universal, and just like spoken language, it has distinct forms of languages spoken in particular geographical areas. There are different languages in the world which are used for communication such as American Sign Language (ASL) [7] [8], British Sign Language (BSL), Indian Sign Language (ISL) [2] [9] etc. Gesture recognition is classified into two main categories i.e. vision based and data glove based. There are some disadvantages of vision based techniques includes such as noise interference while capturing the data, complex algorithms for data processing. There is one more challenge in image and video processing includes variation of lighting conditions, also background suppression. The data glove based technique achieves the higher accuracy, fast reaction speed also it offers greater mobility [3] [13].

This paper is to present a system that can efficiently translate Indian Sign Language gestures to both text and audible sound. In this system, we are using of a data glove based technique [11] which comparing the output of the flex sensor [4] [12], and accelerometer [13]. MEMS accelerometer is termed as Micro-Electromechanical system accelerometer. Accelerometers are used to detect and monitor vibration in the movements of an object. An accelerometer is a one kind of sensor which used to converts acceleration from motion to a voltage signal. We are using a flex sensor which produces an output voltage value directly proportional to the bending which is applied to the sensor itself.

II. METHODS

Hand gestures are one of the most powerful tools which provide the dumb people to express their thoughts as like a normal person. Actually in hand gesture there a different part plays a role to express their thoughts such as hand, finger, arms etc. The different approaches are present, which can be divided into: 1) Data-Glove Based; 2) Vision Based; 3) Colour glove based. The Gloves based method [20] uses various sensor devices which helps them to identify a hand gesture of analog signal which is digitized using an ADC converter. The data glove contains the flex sensor which used to measure the bend signal of hand. In second method, the Vision Based approaches [18[19]] require only a camera, which helps the human to make interaction with computer as easy as possible without the need of any extra circuitry. These systems are most likely to be biological vision by describing artificial vision systems that are implemented in software and/or hardware [10]. Third method is hand gesture recognizer based on a colour glove [17]. This method uses the three steps to recognize hand gestures. The first module, web cam is used to capture the hand movements. The

captured images are fed to the computer which is used to identify the images. The second module, different feature extractor vectors is used to extract the feature of images. The third module, various classifiers is used to identify the actual hand gestures which are performed by dumb people.

III. SYSTEM ARCHITECTURE

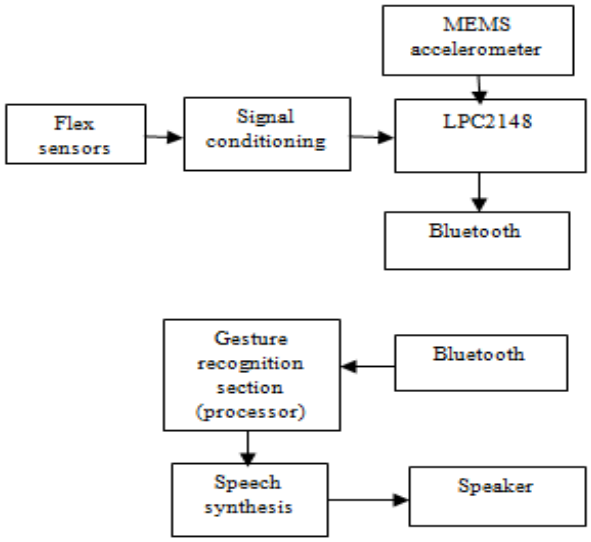

Fig 1 Block diagram of hand gesture recognition

IV. METHODOLOGY

Fig 1.Shows the block diagram of hand gesture recognition for dumb people using Indian sign language. In the above fig 1 flex sensors which are variable resistance sensor which are placed on each of the fingers of the dumb people. This sensor is used to determine the position/angle of the fingers [15]. Accelerometer is directly interfaced to the digital ports as it includes the signal conditioning circuit. Microcontroller processes the data for each particular gesture made. Microcontroller is used to read data from different sensors and then transmit these data to the other Cell phone via Bluetooth module. Cell phone is used as gesture recognition section which compares the predefined data with received data. If compared data get the matched then matched gesture sent with text to speech conversion module.

A. Flex sensor

Flex sensor also known as bend sensor or variable resistance sensor and it varies depending upon the bend. As more the sensor bends, more resistance generates. Flex sensors are normally attached to the glove using needle and thread. These sensor devices have three pin connectors (ground, live, and output). The resistance is between 10kΩ to 50kΩ and the input voltage ranges is between 3.5V to 12V. When the sensor is straight the output voltage from the signal condition circuit should be around 75% of V+ and when the sensor is bent it should be around 83% of V+. The R_M should be chosen in such a way that it is midway between the entire ranges of the Bend sensor [6] [4] [12].

Fig 2 Data glove with flex sensors.

Basic circuit: Flex sensor as voltage divider- output voltage increases with the bend. The impedence buffer in the circuit

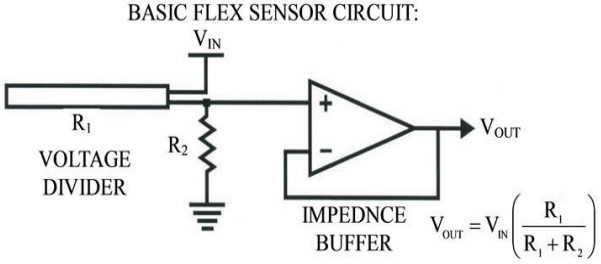

Fig 3. Basic flex circuit diagram

a single sided operational amplifier, used with this sensor because the opam are generally operates at low bias current so it reduces error due to source impedence of the flex sensor as voltage divider. Suggested opamps are LM324 or LM358.

B. MEMS Accelerometer

To measure the movements of hand in a single tri-axis MEMS Accelerometer (MMA7260QT) is used which is a low cost sensor. The operating voltage range is very low which ranges between 2.2V-3.6V. Input of MMA7260QT is acceleration and it has an inbuilt signal conditioning circuit and a low pass filter and hence produces a voltage signal. The sensitivity of this sensor is high. The sensor has ability to measure both positive (+) and negative (-) acceleration. For positive (+) acceleration the output of the sensor increases above Vdd/2 and for negative (-) acceleration it decreases by Vdd/2 finally for no acceleration the output of the sensor is at the mid supply [13][14].

C. The Sensory Gloves

The main critical parameters in designing the sensory glove are the glove instability and the misalignments of the sensors with respect to the related joints with usage. The sensor chosen may produce discrete data's or continuous data's. In our system the flex sensor and MEMS accelerometer chosen produces a continuous set of data's since sign language is encoded into different pattern that are classified. The issues of a deciding number of sensors and location for them are resolved using flex sensor because a single flex sensor determines the position/angle of a particular finger. Hence the performance of the glove is enhanced [20].The important issues while designing a glove is the calibration, the finger size, height and thickness varies from patient to patient and these inaccurate measurements of parameter leads to overlap of the sign.

D. LPC2148 Microcontroller

The output from the signal conditioning circuit of flex sensor and MEMS accelerometer are together fed into the LPC2148 microcontroller for further process. It operates at low power that ranges from 3.0V to 3.6V and has low frequency crystal oscillator of about 32 kHz. This microcontroller has inbuilt ADC which used to convert analog signal into digital one. This digital signal is send to the encoder to send it gesture recognition section via Bluetooth [14].

Specifications:

- (LPC2148) 8-channel 10-bit ADCs provide a total of up to 16 analog inputs.
- In system programming via on-chip boot-loader software.
- Low Supply-Voltage Range: 3.0 V to 3.6
- Measurement range of 0 V to 3.3 V.
- Each converter capable of performing more than 400000 10-bit samples per second.
- Burst conversion mode for single or multiple inputs.
- Optional conversion on transition on input pin or Timer Match signal.
- 16 B Receive and Transmit FIFOs.
- 8-frame FIFOs for both transmit and receive.

E. Bluetooth Module

The Bluetooth module we are using hc-05 industrial compatible module. The Bluetooth module is transmitting at an 11520 baud rate. We chose on a Bluetooth communication link because of the popularity of Bluetooth. Further, now a day mobile phones support Bluetooth and we plan to interface the device with the mobile eventually.

F. Gesture Recognition Section

The output from the microcontroller is transmitted to the cell phone via Bluetooth module. At the cell phone side predefined data gets stored in memory. When captured data match with predefined data recognizes that sign and output it as text to audio. Here Cell phone (processor) is used as gesture recognition section.

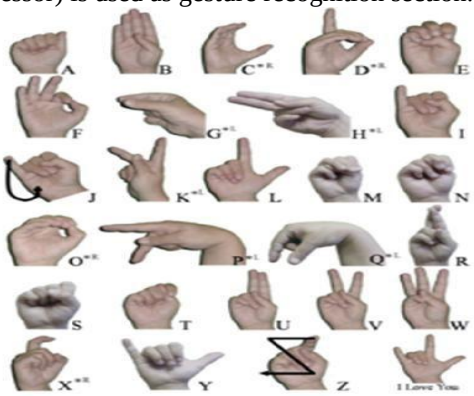

Fig 5. Different sign language symbols.

V. DISCUSSIONS

At the end of the research it is expected that we get higher accuracy (upto 90-95%) of hand gesture recognition by using sensory data gloves. So we have combined flex sensor and MEMS accelerometer sensors data together and then fading to the microcntroller. These both sensor inceases accuracy,reliability as well as comfort to the user.

VI. CONCLUSION

The more reliable, user independent and portable system which consumes less power because of the low ultra power LPC2148 microcontroller is designed and thus the limited communication between the dumb people and the rest of the world to overcome. The system designed here support only dumb people. The normal person can't understand the sign language performed by dumb people. So to overcome these difficulties we are designed hand gesture recognized module. Using flex sensor and accelerometer we can convert sign language into an audible sound via speaker.

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