Data Gloves for Sign Language Recognition System

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ABSTRACT
Communication between deaf-dumb and a normal person have always been a challenging task .About 9 billion people in the world come into this category which is quite large number to be ignored. As deaf-dumb people use sign language for their communication which is difficult to understand by the normal people. This paper aims at eradicating the communication barrier between them by developing an embedded system which will translate the hand gestures into synthesized textual and vocal format without any requirement of special sign language interpreter. This system consists of a glove that will be worn by a dumb person to facilitate the communication with the normal person. it translates the hand gestures to corresponding words using flex sensors and 3-axis accelerometer. The signals are converted to digital data using comparator circuits and ADC of microcontroller ARM LPC 2138.the microcontroller matches the binary combinations with the data given in the look up table of the databases and produces the speech signal. The output of the system is displayed using the speaker and LCD.

Keywords
Sign language, flex sensor, 3-axis accelerometer, ARM7 microcontroller (LPC2138).

1. INTRODUCTION
Humans communicate with each other by conveying their ideas, thoughts, and experiences to the people around them. There are numerous ways to achieve this and the best one among all is the gift of “Speech”. The only means of communication for deaf and dumb people is the “Sign Language” [1]. It will be injustice if we ignore those who are deprived of this invaluable gift. Deaf- Dumb people need to communicate with normal people for their daily routine. There are some difficulties when they come across in certain areas like banking, hospital.

India constitutes 2.4 million of Deaf and Dumb population. These people lack the amenities which a normal person should own. Fig. 1 shows a survey analysis. This decreasing ratio of Literate and Employed Deaf and Dumb population is a result of the physical disability of hearing for deaf people and disability of speaking for dumb people so it yields to lack of communication between normal person and Deaf and Dumb Person. It actually becomes the same problem of two persons which knows two different language, no one of them knows any common language so its becomes a problem to talk with each other and so they requires a translator physically which may not be always convenient to arrange and this same kind of problem occurs in between the Normal Person and the Deaf person or the Normal Person and the Dumb person. To overcome this problem, we introduce a unique application. Our application Model is a desirable Interpreter which translates sign language to synthesized text and voice.

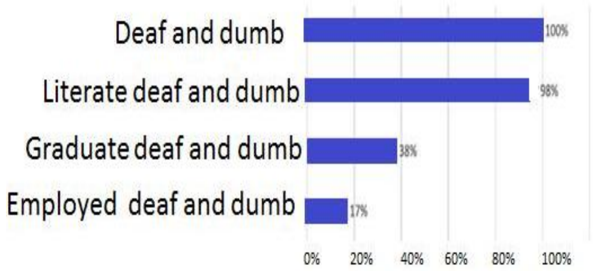

Fig 1: Employment analysis of deaf and dumb population of India

2. SIGN LANGUAGE
Wherever communities of deaf-dumb people exist, sign languages have been developed. A sign language is a language which uses hand gestures and body movement to convey meaning, as opposed to acoustically conveyed sound patterns. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expression to fluidly express a speaker's thoughts. A common misconception is that all sign languages are the same worldwide or that sign language is international. As sign language is well structured code gesture, each gesture has a meaning assigned to it [2]. Sign languages generally do not have any linguistic relation to the spoken languages of the lands in which they arise. The correlation between sign and spoken languages is complex and varies depending on the country more than the spoken language. For example, the US, Canada, UK, Australia and New Zealand all have English as their dominant language, but American Sign Language (ASL) [4], used in the US and most parts of Canada, is derived from French Sign Language whereas the other three countries sign dialects of British, Australian and New Zealand Sign Language Variations also arise within a 'national' sign language which don't necessarily correspond to dialect differences in the national spoken language; rather, they can usually be correlated to the geographic location of residential schools for the deaf. ASL got standardization recently, and very little research work has happened in ISL recognition [3].

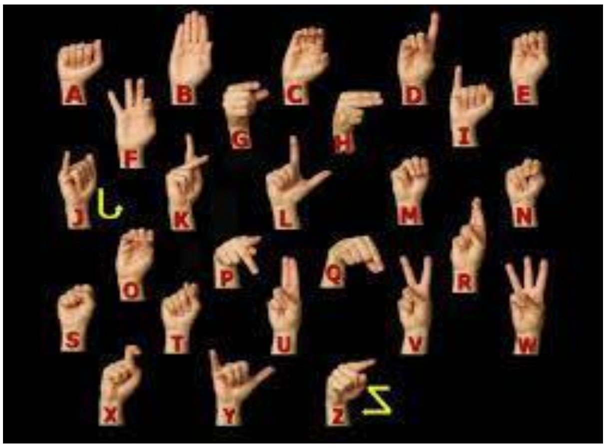

Fig 2: Sign language

3. EXISTING SYSTEM

Research in the sign language system has two well-known approaches are image processing and data Glove. The image processing technique [5] [6] using the camera to capture the image/video. Analysis the data with static images and recognize the image using algorithms and produce sentences in the display, vision based sign language recognition system mainly follows the algorithms are Hidden Markov Mode (HMM) [7], Artificial Neural Networks (ANN) and Sum of Absolute Difference (SAD) Algorithm use to extract the image and eliminate the unwanted background noise. Human-machine interactions are through keyboard, mouse and remote infrared control [9]. Advances in surgical technology, assessment tool based on the Body Sensor Network (BSN). it provides an accurate wireless gesture sensing. New technique is proposed which begins by detecting the hand and determining its canter, tracking the hands trajectory and analyzing the variations in the hand locations, and finally recognizing the gesture. System performs automatic gesture recognition without using data gloves or colored gloves.

The main drawback of vision based sign language recognition system image acquisition process has many environmental apprehensions such as the place of the camera, background condition and lightning sensitivity. User always need camera forever and cannot implement in public place.

Another research approach is a sign language recognition system using a data glove [8]. In this approach, detection of hand is eliminated by the sensor glove consists of flex sensor an accelerometer. The main advantage of this approach is less computational time and fast response in real time applications. It is a portable device and cost is also low.

4. SYSTEM OVERVIEW

Our system consists of 5 Flex sensors and accelerometer to recognize the hand and palm movements at the input. The accelerometer detects the rotation of palm which selects the language of the communication forming the 1st bit of binary number to be compared in the lookup table. The flex sensor has a Resistive strip which can be folded. The resistance varies as the flex strip is folded to indicate either logical 1 or logical 0 by giving the variable analog resistive Input to inbuilt ADC of ARM7 microcontroller. In this way, 6 bit binary digit will be formed for each gesture. In totality 32 such gestures are possible due to 5 flex sensors. These digits are stored in the external memory of ARM7. The microcontroller will then compare these readings to the look up table stored in the internal program memory. Whichever reading is closest to the lookup table ARM7 will then select that word. After this the ARM7 will search the external memory for the audio file for corresponding binary number i.e. the gesture.

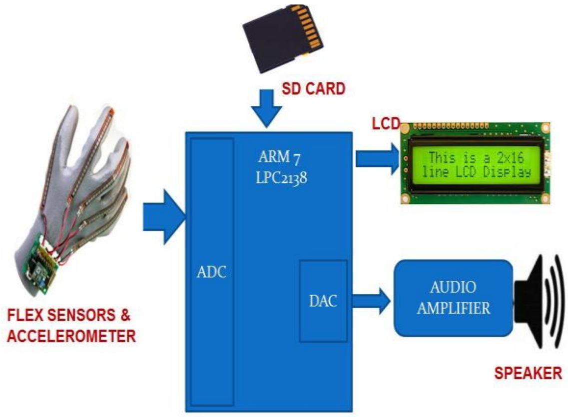

Fig.3. Proposed System

If the user hand is showing the following gesture, then according to the flex sensors reading, the ARM7 will search the binary digit for the word. After this the ARM7 will search the audio file with the name good. If the file exists in the external memory, then µC will play the corresponding audio file with the word pronunciation. Here we are using two keys i.e. English and Hindi/Marathi, if user wants to play English/ Hindi /Marathi words then select those keys.

Fig 4: Example of gesture recognition

4.1 Flex Sensor

The sign language translator starts with the Glove, the heart of the project. The black glove contains nine flex sensors, four contact sensors, one two dimensional x-y axis accelerometer and one dimensional z axis accelerometer.

The flex sensors are the most critical sensors because most letters can be distinguished based on fingers' flexes. All the fingers except the thumb have two flex sensors, one over the knuckle and the other over the lower joint. This provides two degrees of flexes for these fingers. For the thumb there is one flex sensors over the lower joint. Flex sensors are resistive carbon parts. When bent, the device develops a resistance output correlative to the bend radius. The variation in resistance is just about 10kΩ to 30kΩ. A global organization flexed device has 10kΩ resistance and once bent the resistance will increase to 30kΩ at 90o. The potential divider is employed to line the output voltage across two resistors connected non-parallel as shown in Figure 5.

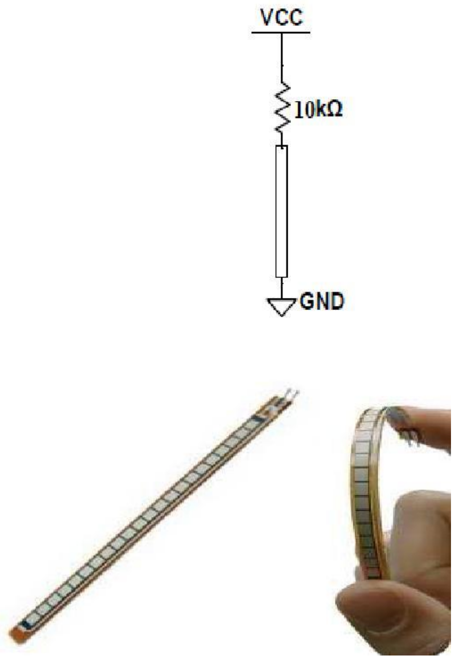

Fig 5: Flex Sensor

4.2 3-Axis Accelerometer

Accelerometers have multiple applications in industry and science. Accelerometer within the Gesture Vocalized system is employed as a tilt sensing element, which checks the tilting of the hand.

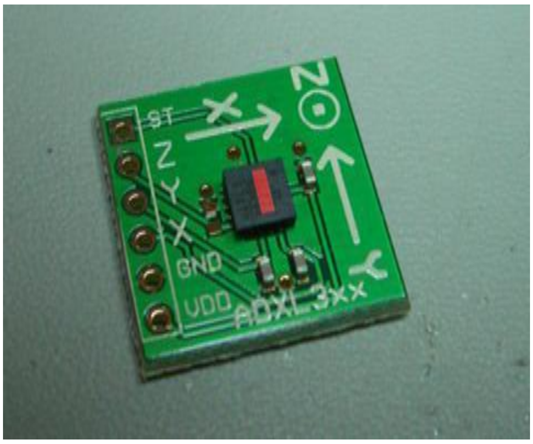

Fig 6: accelerometer

5. SYSTEM FLOW

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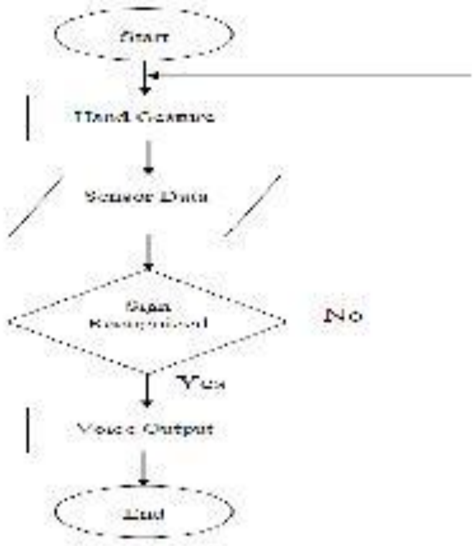

Fig .7.System flow

6. RESULTS

This prototype version, the user forms a sign and holds it for two seconds to ensure recognition. The system is capable of recognizing signs more quickly than this arbitrary two seconds limit. Hence it is a low time consuming approach Furthermore real time recognition ratio of nearly 99% can be easily achieved.

6.1 Advantages

1. Efficient way for mute communication.
2. Less time delays for the coverstion
3. Quick response time that is 2.44µsec. per channel.
4. Fully automated and robust system.
5. .low power requirement.
6. Person who is communicating need not be in the line of sight.

6.2 Applications

Works as a translating device for mute people also for biomedical applications that is for speech impaired and paralyzed patients, intelligent home and industrial applications and military applications.

7. CONCLUSION

Sign language being the only communication means for deaf-dumb community hampers their interaction with the normal people who lack the knowledge of sign language. This paper has the potential of minimizing this communication barrier by working as an automated translator and converting sign language directly into vocal and textual format for the understanding of normal people using various flex sensor, accelerometer and ARM7(LPC 2138). The input data glove detects the hand gesture done by the deaf-dumb person wearing it and provides the analog input to the microcontroller for further interpretation according to the database and the final output is observed on the LCD display and the speaker. Thus, hand gesture can be automatically converted with the help of this system into understandable form for the normal person.

Further this prototype can be designed to make wireless system for increasing the range of communication and area of application. In the future we have plan to recognize dynamic hand gesture recognition in video sequence for virtual reality, for example replacing the conventional input devices like joysticks and videogames with data gloves. Also designing of whole jacket which would be capable vocalizing the gestures and movements which can be worn by paralyzed patients. This system can be extended as a robot controlled system to regulate machine as well as human activities at remote sensitive areas.

8. ACKNOWLEGDEMENT

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9. REFERENCES

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