Design and Development of an Assistive Device for Speech and Hearing Impaired

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Abstract—Communications between deaf-mute and a normal person have always been a challenging task. The paper describes a way to reduce this communication barrier by developing an assistive device for deaf-mute persons. The system consists of a sign language translator, speech recognition unit, traffic sensing module and GSM-GPS unit. Sign language translator module translates the gesture signs to text and further it is converted to voice. To convert acoustic speech to text form speech recognition system is used. Hence two way communication is possible. To provide assistance at times of danger and critical situation GSM and GPS technologies are used that transmit the gestures to the respective guardian of deaf-mute person along with location and time information. Traffic alert is provided to deaf person using sound sensor, obstacle sensor and vibrator. The main advantage of this project is, it can be used as an assistive device for deaf-mute person for both communication purpose and safety purpose.

Keywords—Sign language; speech recognition; flex sensors; glove; traffic alert; GSM; GPS;

I. INTRODUCTION

One of the important problems that our society faces is that people with disabilities are finding it hard to cope up with the fast growing technology. In the recent years, there has been a rapid increase in the number of hearing impaired and speech disabled victims due to birth defects, oral diseases and accidents. When a deaf-dumb person speaks to a normal person, the normal person seldom understands and asks the deaf-dumb person to show gestures for his/her needs. Dumb persons have their own language to communicate with us; the only thing is that we need to understand their language.

Generally dumb people use sign language for communication but they find difficulty in communicating with others who don’t understand sign language. Sign language is an expressive and natural way for communication between normal and dumb people (information majorly conveyed through the hand gesture). So, we need a translator to understand what they speak and communicate with us. The sign language translation system translates the normal sign language to speech and hence makes the communication between normal person and dumb people easier. But the question arises, how the deaf person understands the speech of a normal person and hence we need a system which converts the speech of normal person to text. So, the whole idea is to build a device that enables two way communications between deaf-mute person and a normal person along with a safety measure.

Deaf-Mute communication interpreter is a device that translates the hand gestures to auditory speech. Automated speech recognition system which aims to convert the speech signals into text form. Hence the two way communication is possible between deaf-mute person and normal person.

II. LITERATURE REVIEW

Attempts to automatically recognize sign language began to appear in the 1990’s. Research on hand gestures can be classified into two categories: First category relies on electromechanical devices that are used to measure the different gesture parameters such as hand’s position, angle, and the location of the fingertips. Systems that use such devices are called glove-based systems. The second category uses machine vision and image processing techniques to create visual based hand gesture recognition systems. The second technique is not flexible to users and is expensive.

tool for vision based hand gesture recognition in a camera projector system is described in reference [7]. A methodology using a neighborhood-search algorithm for tuning system parameters for gesture recognition is addressed in [8]. A novel method is introduced to recognize and estimate the scale of time-varying human gestures in [9].

In the past decade, much works have been done in the field of speech recognition and speech synthesis for communication. One promising study [10] at California State University at Northridge explored the performance of learning disabled college students using voice recognition technology to complete the university's written proficiency exam. With the use of this innovation, the learning disabled students achieved the same distribution of scores on the exam as their non disabled peers. Another exploratory study [11] focused on a single subject—a sixth grade student with learning disabilities. The authors [12] describe four methods for the persons who are blind or visually impaired use to access information: enhanced image, Braille, synthetic speech and optical character recognition. These devices can be used separately or in combination to access consumer products, personal computers and printed information.

Marshall H. Raskind, a learning disabilities researcher at the Frostig Center in Pasadena, Calif., found that voice recognition software could make a significant difference for many people with dyslexia. It is concluded that speech recognition not only allows dyslexics to communicate more efficiently, but may even help them overcome their condition [13].

The proposed system using the data glove technique [14]. Data glove especially made up of electronic glove worn by the user. It consists of flex sensors that used to detect finger gestures and transmit the information to a PIC microcontroller. Microcontroller processes the gesture of the user and plays the audio file corresponding gesture.

Embedded voice-box aid [EVB] for deaf and dumb persons that can translate their phenotype language to understandable language of a normal person and thereby enabling them to get better understanding of normally spoken words [15].

III. SIGN LANGUAGE TRANSLATOR

This paper describes the system with sign language translator as a main unit, which uses flex sensors and accelerometer to capture the hand gestures of a user. The data glove is fitted with flex sensors along the length of each finger and the thumb. The flex sensors output a stream of data that varies with degree of bend. The analog outputs from the sensors are then fed to the PIC microcontroller. It processes the signals and perform analog to digital signal conversion. The resulting digital signal is encoded and transmitted through RF system. RF receivers receive the signal and fed to the gesture recognition section through the decoder. In this section the gesture is recognized and the corresponding text information is identified. Text to speech conversion takes place in the voice section and play out through the speaker.

A. Flex sensors

There are two types of flex sensors. One is unidirectional which changes its resistance when it is bent in only one direction. Another one is bidirectional flex sensor which changes its resistance for both directions. In the proposed method bidirectional flex sensor is used. Fig. 1 shows the change of resistance as the degree of bending increases. This variable resistive property made flex sensors suitable for converting gestures to appropriate text.

![Figure 1. Change in resistance of flex sensor with bending](16)

Flex sensors are normally attached to the glove using needle and thread. The resistance of flex sensors varies with the degree of bend and the voltage output changing accordingly. An unflexed sensor has a resistance of about 10,000 ohms. As the flex sensor is bent, the resistance increases to 30-40 kilo ohms at 90 degrees.

IV. SPEECH RECOGNITION UNIT

Speech recognition (SR) is the translation of spoken words into text. It is also known as “automatic speech recognition”. Speech Recognition and Synthesis Tool was designed on Microsoft.NET 3.5 framework using C# language in Microsoft Visual Studio 2008 environment. Bing.com was used to post-edit the English speech. As for the ASR software, a custom proprietary application program based on Microsoft Speech Application Programming Interface (SAPI 5.0) engine was utilized to perform the speech recognition of English speech.
V. IMPLEMENTATION AND RESULTS

Fig.2 shows overview of the system. The processing unit gets input from sound sensor, flex sensor and speech recognition unit. The outputs are LCD display, speaker, vibrator and GPS-GSM unit. Sound sensor is used to detect the vehicle’s horn sound. If the sound level is above the threshold level then the processing unit will enable vibrator.

The gesture made by deaf-mute person is sensed by using flex sensors and is displayed on LCD display. The speech of a normal person is taken through microphone and converted to text form using speech recognition unit.

Single display is used for displaying converted text from both gesture form and speech form. Since single display is used we are assigning first priority to deaf-mute person, so that he gets priority over normal person when both are communicating simultaneously. The converted text from gesture form is also converted to sound using .net framework and comes out as speech through speaker.

GPS is used to provide time, date and location information. A hardware switch is provided in the system for safety purpose. When this button is pressed the information provided by GPS module is sent to the guardian of the person through GSM. When the deaf-mute person is in some dangerous situation he can press this button.

VI. CONCLUSION

This system is a useful communication device for deaf-mute person since it facilitates two way communications. In addition the device also provides assistance while the person is in traffic and at the time of danger. With small modifications this device can be made useful for physically challenged persons. It can be used for commercial purpose since it is a package of 4 applications.

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