2nd Int'l Conf. on Electrical Engineering and Information & Communication Technology (ICEEICT) 2015
Jahangirnagar University, Dhaka-1342, Bangladesh, 21-23 May 2015

Electronic Speaking System for Speech Impaired People: Speak Up

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***Abstract*— Sign Language is the only way of communication for speech impaired people. But general people can't understand the sign language so it becomes difficult for a speech impaired person to communicate with them. In this project an electronic speaking system was developed to ease the communication process of speech impaired people. A glove was developed which consists of five flex sensors. When a gesture is made with the glove, the change in resistance of flex sensors fed into the Arduino Nano and specific prerecorded audio command for that gesture is played from SD card through speaker and the text command for that gesture is displayed on the LCD. There are four gestures that are designed for user input so that user can play his/her chosen audio commands using those gestures. This device not only helps a speech impaired person to communicate with a normal person via audio commands but also helps him/her to communicate with a hearing impaired person by displaying the text commands on the LCD.**

Keywords*— *Speech Impaired People, Glove, Arduino Nano, Flex sensor, SD Card.

I. INTRODUCTION

Speaking is the main way of communication for every normal human being. But think about a speech impaired person who can't able to communicate frequently with a normal person. Because speech impaired people use sign language for their communication. And most of the people don't understand sign language. So it puts the speech impaired person in a difficult situation. In recent years, researchers have been focusing on hand gestures detections and been popular for developing applications in the field of robotics and extended in the area of artificial or prosthetic hands that can mimic the behavior of a natural human hand. This project although utilizes a similar approach for the detection of the movement of fingers, however we have tried to extrapolate the idea in a slightly different perspective and have come up with a small yet significant application in the field of bioengineering. The main objective of this project is to design an electronic speaking system in the form of a glove to lessen this communication problem. This device benefits a speech impaired person to communicate with a normal person as well as with a hearing impaired person. The main component of this project is a glove with five flex sensors that are connected to Arduino Nano which is the main control unit of this project. This device has a feature of user input. So speech impaired person can easily use his/her own chosen commands for specific gestures.

II. RELATED WORK

Many researchers have found out a number of possible solutions. Ahmed et al [1] developed a hand glove which can convert specific hand gesture into audio command using AVR ATMEGA32L. Satpute et al [2] developed a data glove that can play recorded audio command for specific hand gesture using PIC18F4620. Wald [3] developed software for editing automatic speech recognition in real time for deaf and hard-hearing people. Itkarkar et al [4] developed a method to convert hand gesture into speech using MATLAB. Zhao et al [5] developed a five-fingered prosthetic hand system. Praveenkumar et el [6] developed a wireless glove that can translate sign language into speech.

III. ARCHITECTURE OF SYSTEM

This electronic speaking system has two way of communication. First one is audio through the speaker and another one text command displays on the LCD. Gesture is being made with glove consists of flex sensors. Prerecorded audio commands are saved in the SD card. For specific gesture there is particular audio and text command. To increase the audio sound an amplifier was also connected. In Fig.1 the model of this electronic speaking is given.

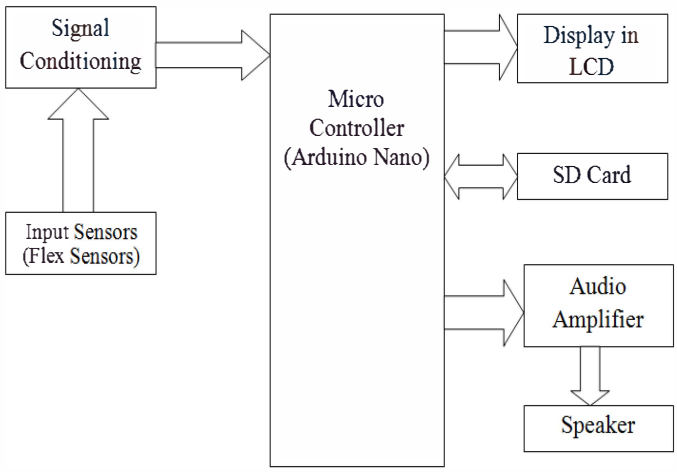


Fig. 1. Model of Electronic Speaking System.

A. *Flex Sensors and Glove*

Flex sensors are passive resistive devices that can be used to detect bending or flexing. The Flex Sensor patented technology is based on resistive carbon elements. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value [7]. Five flex sensors are connected in the glove. Glove is used to make gestures.

B. *Signal conditioning*

Signal conditioning is done with voltage divider rule.10k resistors are connected with flex sensors. As the flex sensors bend the resistance changes and for specific gesture there is a specific voltage output.

Formula for Voltage Divider:

$$Vout = \frac{R1}{R1+R2}\ Vin \qquad (1)$$

In the Proteus simulator potentiometers are used as flex sensors because potentiometers develop voltage divider as voltage source is connected. As in the Proteus simulator the value of potentiometer is shown in percentage so at first according to the gesture the percentage values were recorded and then using those values Arduino was programmed for each desirable command. In Fig.2 the potentiometers connection with the Arduino are shown.

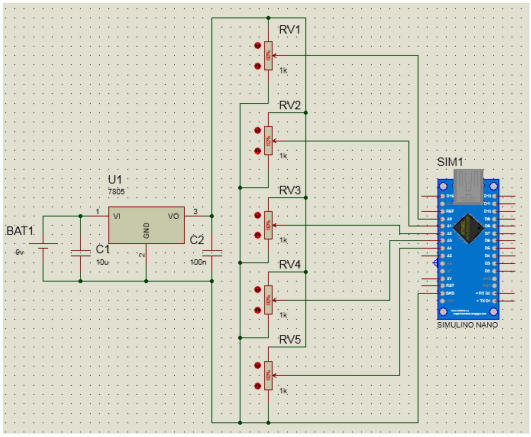


Fig. 2. Potentiometers as Flex sensors.

C. *Arduino Nano*

After making the gesture the signal is fed into the Arduino Nano. There are text commands saved in the Arduino for specific gesture. Analog to digital input pins of Arduino was used to connect the flex sensor. A LCD display and a memory card are also connected with Arduino.

D. *Text command on LCD display*

A 16x2 LCD display is connected with the Arduino Nano. When the gesture is being made Arduino recognize it and then saved text command for that gesture is displayed on LCD. In Fig.3 the connection of LCD with Arduino is shown.

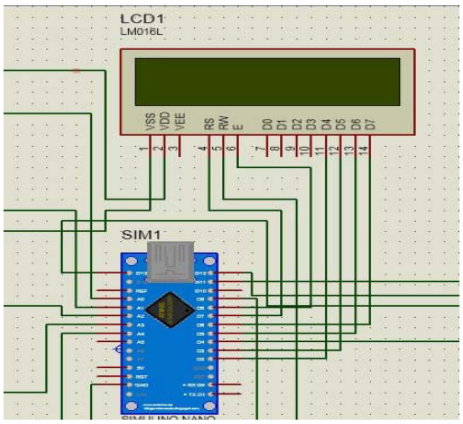


Fig. 3. LCD connection.

E. *Audio Command from SD card*

An SD card (Secure Digital Card) is connected with the Arduino via a memory card breakout board. Desirable audio commands with compatible format were saved in this SD card. As the gesture is being made the audio command saved in the SD card for that specific gesture is played through the speaker. Because of using SD card it is possible to save user chosen audio commands. Four gestures were designed for user input. User can play his/her own chosen audio commands for those gestures if user renamed and convert the audio file as instructed.

F. *Audio Amplification*

When the audio commands are played from the micro SD card the audio volume is relatively low. So to make it hearable an audio amplifier was used. In this project BC 548 an NPN transistor was used as audio amplifier. In Fig.4 the connections of SD card, speaker and audio amplifier with are shown.

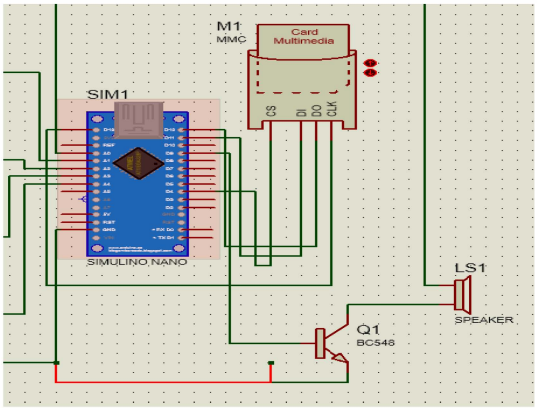
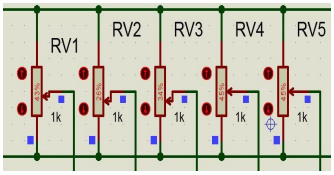
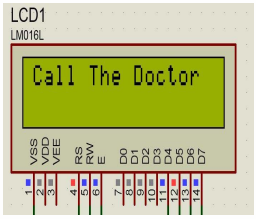
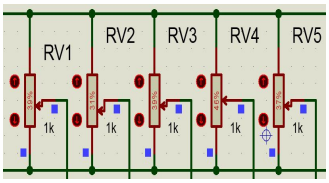
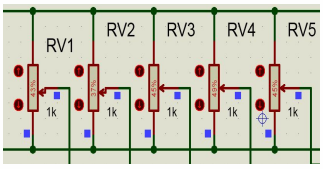
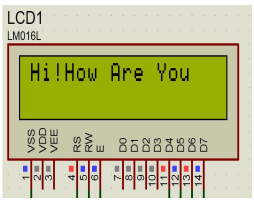


Fig. 4. SD card, speaker and audio amplifier connection.

IV. Simulation Result Analysis

For specific gesture there is specific value of flex sensor. In Proteus simulation potentiometer value was used as alternative to the hand gesture. So for different values of potentiometer there are different command. In Table I the simulation results are shown.

TABLE I. SIMULATION RESULT

Potentiometer Percentage	LCD display
 RV1=43%,RV2=26%,RV3=34%,RV4=45%, RV5=45%	
 RV1=39%,RV2=31%,RV3=39%,RV4=46%, RV5=37%	
 RV1=43%,RV2=37%,RV3=45%,RV4=49%, RV5=45%	

V. HARDWARE RESULT ANALYSIS

The main difference between simulation and hardware analysis is in hardware analysis instead of using potentiometer flex sensors are used. In hardware a glove was developed, with flex sensors, which is used to make the gestures. The complete hardware circuit is shown in Fig.5.

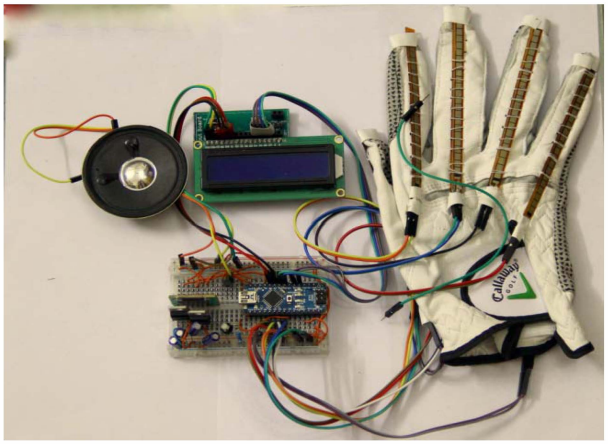
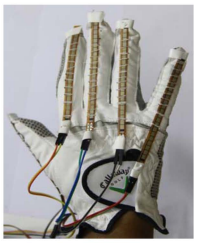


Fig. 5. Hardware Circuit.

In Table II three gestures and their text commands are shown. For these gestures audio commands are prerecoreded in the memory card. When the gesture is made, the audio for that gesture is played through the speaker. And the text commands for that gesture is displayed on LCD.

TABLE II. GESTURE AND COMMANDS ACCORDINGLY

Hand Gesture	Command on LCD Display
	
	
	

VI. USER INPUT

In this Table III four gestures are shown. These four gestures are designed for user input purpose. User can save his/her own chosen audio commands into the memory card and play them using these four gestures. Before saving the audio file user have to convert the audio file to .WAV format. User has to make sure that the following instructions are being followed while converting the audio file [8]:

- Samples Per second(Hz):16000
- Channel :Mono
- Bits Per Sample: 8

After converting the audio files user has to save them with a specific name. In Table IV the files names are shown.

TABLE III. USER INPUT GESTURE

Hand Gesture	LCD command
	
	
	
	

TABLE IV. FILE NAME

Command	File Name
Reserve for user input	"1.wav"
Reserve for user input	"2.wav"
Reserve for user input	"3.wav"
Reserve for user input	"4.wav"

VII. ADVANTAGES

Some of the advantages of this device are discussed below-

- The communication between a normal person and a speech impaired person become easier.
- As here LCD is used to show the user command so one speech impaired person can also communicate with a deaf person.
- There is an option for user input.
- This device is portable. So user can bring it anywhere he/she wants.
- It is cost effective. So everyone can afford it.

VIII. CONCLUSION

The main purpose of this project is to help the mute communities by developing an electronic speaking system. This electronic speaking system can help the speech impaired people to communicate with normal people in the real world. Arduino is main control unit for this project. A data gloves is finally developed for the speech impaired patients. Now they don't have to face any kind of problem with their communication. Arduino was programmed such way that configuration settings can readily change without changing the entire program code. Glove was prepared carefully so that everyone can use that glove. While developing this device the main problem was the lack of necessary equipment in our country. But alternative method was taken and make sure the electronic speaking system (Speak Up) is developed. All the simulation was done before implementing the hardware circuit to make sure all the component that were used worked correctly. After achieving desired output from the simulation, the hardware was implemented. After hardware implementation, final results were analyzed. Desired results were found. In this paper several recommendations were given so that this device can be developed more in the near future. This electronic speaking system (Speak Up) will make a revolutionary change in the communication process of speech impaired people.

ACKNOWLEDGMENT

Authors would like to express gratitude to Mr. Bishwajit Banik Pathik, Assistant Professor, Department of Electrical and Electronic Engineering, American International University-Bangladesh for his comments, corrections and support till the very end. Also Mr. Atul Rahman and Mr. Sadi Mahmud both is student of American International University- Bangladesh for their important suggestions regarding this project.

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[1] S. F. Ahmed, S. Muhammad, B. Ali, S. Saqib, and M. Qureshi, "Electronic Speaking Glove for Speechless Patients A Tongue to," no. November, pp. 56–60, 2010.

[2] A. Y. Satpute, A. D. Bhoi, and T. Engineering, "ELECTRONIC SPEAKING SYSTEM FOR DUMB," vol. 6, no. 3, pp. 1132–1139, 2013.

[3] M. Wald, "Captioning for Deaf and Hard of Hearing People by Editing Automatic Speech Recognition in Real Time", Proceedings of 10th International Conference on Computers Helping People with Special Needs ICCHP 2006, LNCS 4061, pp. 683-690.

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[5] Jingdong Zhao, Li Jiang, Shicai Shi, Hegao Cai, Hong Liu, G. Hirzinger, "A Five-fingered Underactuated Prosthetic Hand System",Proceedings of the 2006 IEEE International Conference on Mechatronics and Automation, June 2006, pp. 1453-1458.

[6] S. U. N. Praveenkumar S Havalagi, "THE AMAZING DIGITAL GLOVES THAT GIVE VOICE TO THE VOICELESS," vol. 6, no. 1, pp. 471–480, 2013.

[7] Cytron website. [Online]. Available: http://www.cytron.com.my/usr_attachment/SN-FLX-01 [Accessed: 20-Nov-2014].

[8] Husham Samir, "Playing Wave file using arduino." [Online]. Available: http://www.instructables.com/id/Playing-Wave-file-using-arduino/. [Accessed: 18-Nov-2014].

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