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Flex Sensor Based Glove to Control Wheel Chair and Sign Language Translator for Speech Impaired People

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Abstract- The idea of this paper is proposed for rehabilitation of people who have mobility issues particularly for the paralytic Stroke Patients and mute person with difficulty to communicate in a society. To overcome these complications, this system is developed to control the wheelchair based on finger movement and it also provides the voice output. It consists of flex sensors to control the wheelchair and in another mode it uses flex sensor and voice module to provide audio output. Person can move the wheelchair in any direction by gesture. Gesture is a good medium to give command because it can be used in a noisy condition and so he/she can communicate in public places. The patients can control the wheelchair through hand gesture, so they can survey themselves for their basic needs and need not to depend on others to guide those patients. Thus, it is multipurpose hand gloves to control motion of wheelchair and also to convert hand gestures to speech.

Keywords- Hand gestures, wearable glove, flex sensor, Arduino, ASK RF Module.

1. INTRODUCTION

THERE are some set of people who face the problem of walking and it is difficult or impossible due to illness, injury or disability that requires the wheelchair to overcome this problem. There are different types of wheelchair available in the market the Manual wheelchairs are pushed using their handles, some are motor controlled they are controlled by joystick or the Voice-controlled wheelchairs. But in the case a person is unable to move the wheelchair even with joystick or voice command, an alternative option for them is gesture-controlled wheelchair. The wheelchair moves as per user's finger gestures.

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The user has to simply bend his fingers to move the wheelchair. This Automatic wheelchair solves the problem for navigation and safe movement in the desired direction.

To solve the problem of communication there is another mode called 'Gesture Vocalizer' through which person can communicate. Normally human beings can communicate by speaking to each other but patients with paralytic stroke and mute people use sign language for communication to convey their message simultaneously by combining hand shapes, orientations and movement of the hands, arms or body and facial expressions to express a speaker's thoughts. Sign language is a non-verbal form of intercourse which is found amongst deaf communities in the world. The languages do not have a common origin and hence difficult to interpret. Deaf-Mute communication require interpreter who will convert hand gestures into auditory speech. A gesture in a sign language is a particular movement of the hands with a specific shape made out of them. The movement of a hand conveying message to the other person. Therefore, gesture recognition is classified into two main categories, vision based and sensor based. The disadvantage of vision based techniques includes precise position of gesture and complex algorithms for data processing. Another challenge in image and video processing includes variant lighting conditions, backgrounds and fields of view constraints. The sensor based technique offers greater mobility compared to image processing. Thus using 'Smart Glove the gesture recognizer' a person does not have to carry twodifferent devices for two different purposes just changing the mode of working. The aim of this research work is to

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design a module using flex sensors which controls wheelchair directions and also gives voice output. The section II covers

related work. Section III includes hardware and software implementation. Section IV gives the output. Section V is on the future scope of the system and section VI gives the conclusions.

2. RELATED WORK

Previously the work has been done in which different forms of cameras, depth imaging, infrared and other imaging devices were used. In all of these works, the recognition demands a device in front of you. There is another very popular form of hand gesture recognition. With the rapid advancement in technology, major breakthroughs are made in the design and characterization of piezo-resistive sensors which are commonly referred as flex bend sensors since they measure the bending in the flexor tendons, such as fingers [1]. The sensors are implemented one for each finger which can be worn and taken off without harming the calibration of the sensors [2]. The output of the sensor is fed to an Arduino for further processing. With this interface it becomes very easy to acquire the human fingers movement in neurophysiological settings. These interfaces have several biomedical applications, such as hand prostheses and gesture vocalization [1].

3. METHODOLOGY

This section covers the implementation.

I. Block Diagram description:

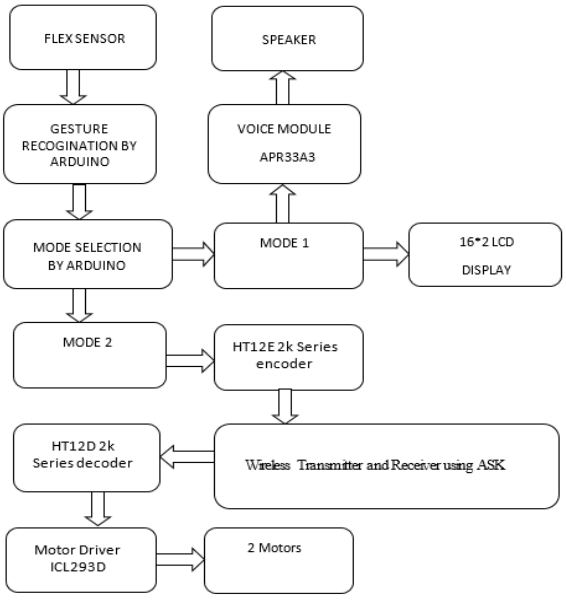

Fig 1. System Block Diagram

The Basic Block Diagram of the project is as shown in Figure.1. The flex sensor is mounted on the gloves so that it can be worn and taken off without harming the calibration of the sensor [1]. This sensor provides the analog signal to the Arduino for further recognizing the mode of operation. There are two mode of operation one is Gesture Vocalizer and another is Wheelchair Controller.

i. **Gesture Vocalizer**– In this mode of operation mainly deals with the gesture based vocalization for the deaf and dumb people who actually finds it difficult to communicate with the real world. The glove will work based on the American Sign language chart for static gesture. When the gestures are performed through the glove covered hand the sensor on that provides different voltages for different figure movement these values of the sensors are read and fed to an Arduino. The ADC ports on the Arduino convert these analog values to digital values. These digital values are further used in decision making process and accordingly voice will playback through a voice module in speaker and message will be displayed as text message on LCD display. The messages are prerecorded and saved in voice module as database. In order to switch the mode of operation, the person has to use pre-defined gestures. By using these gestures, we can switch from one mode to another.

ii. **Wheelchair controller** – This mode of operation deals with the gesture controlled wheelchair for paraplegia patient and handicap person who finds difficult in moving from one place to another. This mode of operation works in two-part transmitter and receiver. In this mode, four flex sensors are used at the transmitter side which provides the input to the device to navigate the Automatic wheelchair in different directions as required.

II. Components:

i. FLEX SENSORS:

Fig 2. Flex Sensor [9]

The change in bend is converted to electrical resistance, thus more the bend more the resistance value. They are usually in

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the form of a thin strip from 1"-5" long that vary in resistance. It also works as variable analog voltage dividers. Carbon resistive elements within a thin flexible substance is present inside the flex sensor. More amount of carbon, less the resistance as shown in Fig.3.
The sensor produces a resistance output relative to the bend radius when the substrate is bent.

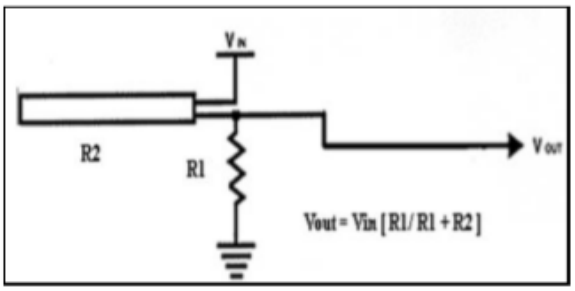

Fig 3. Working of a Flex Sensor [10]

ii. ARDUINO:

Arduino is an ATmega328P based Microcontroller. The operating voltage of the Arduino is 5V. Its recommended input voltage ranges from 7V to 12V and its normal input voltage is 6V to 20V.The digital input and output pins are 14 and those denoted with PWM are 6. It has got 6 analog input pins. Dc Current used for each I/O pin is 20mA and for 3.3V pin is 50mA as shown in Fig.4.

Fig 4. Circuit Board of an Arduino [8]

iii. HT12E ENCODER IC:

As shown in Fig.5, HT12E Encoder IC converts the 4-bit parallel data given to pins D0 – D3 to serial data and will be available at DOUT. This output serial data is given to ASK RF Transmitter. Address inputs A0 – A7can be used to provide data security and can be connected to GND (Logic ZERO) or left open (Logic ONE).1.1MΩ resistor provides the necessary external resistance for the operation of the internal oscillator of HT12E.

iv. HT12D DECODER:

HT12D decoder shown in Fig.5 converts the received serial data to 4-bit parallel data D0 – D3. The status of these address pins A0-A7 should match with status of transmitter for the transmission of data.51KΩ resistor provides the necessary resistance required for the internal oscillator of the HT12D.address pin in the HT12E at the

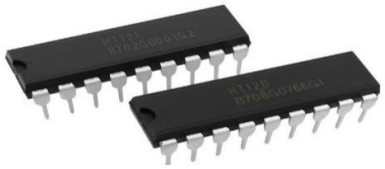

Fig 5. IC of HT12E and HT12 D [6]

v. L293D MOTOR DRIVER:

A motor driver as shown in Fig.6 is an integrated circuit chip which is used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. L293D has 16 pins.

Fig 6. Circuit Board of L293D Motor Driver

vi. DC MOTOR:

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. A DC motor can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings.

Specification:
Voltage:12VDC
RPM:1000RPM
Material:alloy
Color:silver
Size:25x70mm
Shaft diameter: 4mm

vii. ISD1760

Fig 7. ISD1760 Voice Module Board

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As shown in Fig 7, the voice module is an On board ISD1760 chip. The On board microphone can do direct recording. It can playback audio of 75 seconds. Recording, Erase, Play, FT (direct), Fast Forward, Reset, Volume buttons are the following configurations on the chip through which changes can be done in the respective audio. It can be easily interfaced with the microcontroller using the 2.54mm spaced male pin headers. The high quality natural voice reduction, can be used as a advertising machine. The working voltage is 5V. The status of the voice signal is accessed based on Led.

III. Experimental setup:

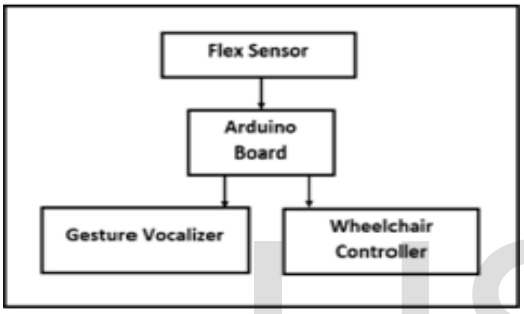

Fig 8. Experimental Setup

The Basic Experimental setup of the project as shown in Figure 8. When the gestures are performed the sensor provides different voltages for different gesture which are fed to the Arduino at ADC ports of the Arduino which convert these analog values to digital values. These digital values are further used in decision making process. The particular pre-defined gestures are allocated for each direction to move the wheelchair. If the gesture is recognized, then the digital output is transmitted to the receiver side by using ASK RF Module. At the receiver side same data is received by the ASK RF Module. The 12V DC Motors are interface with motor drive circuit which controls the direction of the wheelchair according to the pre-defined gesture preformed for left, right, forward, reverse direction.

IV. Algorithm for software description:

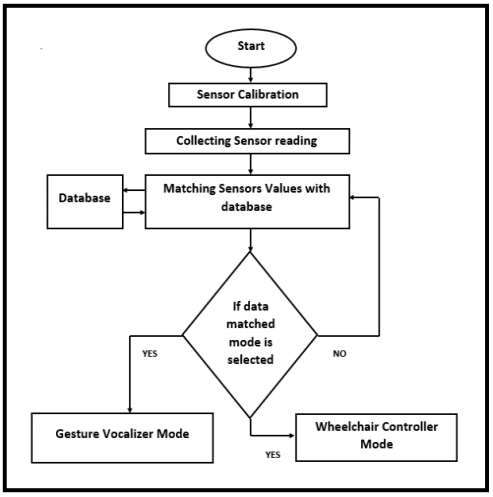

Fig 9. System Flow Chart

The figure 9 shows the algorithm of the system. At first, the hand gesture is detected and sensed by the flex sensors. The value of flex sensors is collected and matched with the database. If the data is matched, then there are two possibilities i.e. the vocalizer mode will function or the wheelchair will move. If the data is not matched, then it goes back to the initial stage.

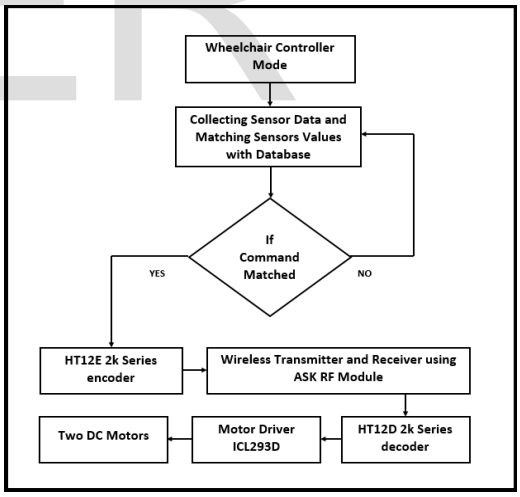

Fig 10. Wheelchair controller mode

The figure 10 shows the flow diagram for the wheelchair movement. The data is collected from the flex sensor and checked whether it is matched with respect to the wheelchair mode. If the command is matched, the data is passed on to HT12E encoder where the serial data enters the ASK module. The data is then passed to HT12D decoder, where the serial data is converted into parallel data and further passed to the motor driver. The driver helps to control and move the wheelchair. If the data is not matched, then the initial steps are repeated.

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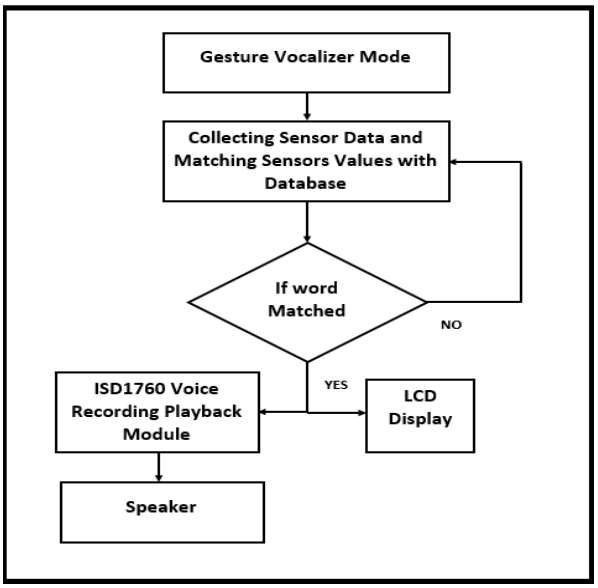


Fig11. Gesture Vocalize Mode

The figure 11 shows the flow diagram for the gesture vocalizer mode. The data is collected from the flex sensors and matched with respect to the vocalizer mode. If the word is matched with the database, then it is recorded by the voice recorder playback module and further passed to speaker for audible announcement. On the other side, the message is displayed on the LCD screen. If the word is not matched with the database, then it goes back to the initial stages.

4. RESULT

The hardware part shows the result in which the wheelchair is controlled by different hand gestures using Flex Sensors and also the voice output taken by using voice module and speakers. ASK Transmitter and Receiver module is used for transmission and reception of signal. ASK Modulation and Demodulation is used in ASK Module. Analog value of each flex sensor changes for each movement to control the direction of wheelchair such as Forward, Reverse, Initially, Stop. Analog values of All Flex Sensors for each Direction is as Shown in Table 1.

Table 1. Shows The Flex Analog Values for each

MOVEMENT	FLEX 1	FLEX 2	FLEX 3
INITIALLY	852	767	779
LEFT MOVE	822	900	892
RIGHT MOVE	952	778	930
FORWARD MOVE	849	765	927
BACKWARD MOVE	920	867	758
STOP	924	868	877

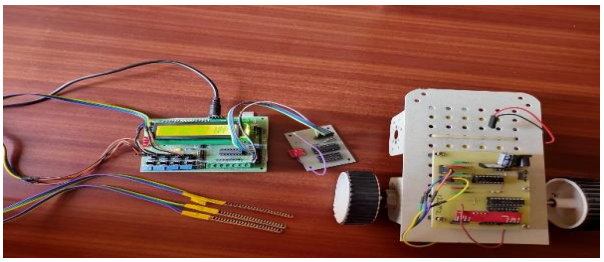
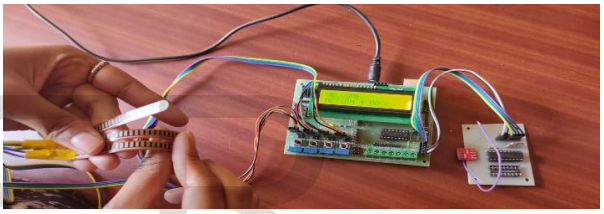


Fig 12. Entire Project Setup

Fig 13. Flex sensor movement for left Direction



14. Flex sensor movement for Forward Direction

Fig.12 shows the entire hardware setup. As, the index finger and middle finger experiences bend, resistances of the flex sensors decrease and as the required value of resistances is achieved, it is sensed by the Arduino and sent to HT12E encoder converts the parallel data to serial and then it is transmitted by wireless means to HT12D decoder which converts the serial data to parallel and passes it to l293D which enables the motor to move in left direction as shown in Fig 13. Similarly, for other directions Arduino sense the signal for flex sensors and give direction as shown in Fig 14.

5. FUTURE SCOPE

The implementations of this system can be made for a wider range of sign language recognition. It can be used for various applications related to paraplegia patient, handicap person and deaf-mute person. The system can be developed by using more number of flex sensors on a single finger to detect small gestures or even by attaching contact sensors on the fingers. Other methods such as a group of body sensors along with the gloves can also be designed for better communication.

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6. CONCLUSION

The focus of this paper was on the flexibility of the hand movement for easy communication between the hearing impaired and mute people with the normal people. And another motive of this paper is to design a handy and portable device for paraplegia patient and handicap person. The different types of hand gestures were detected and further displayed on the screen and the messages were made audible using speakers. The movement of wheelchair was controlled by the flex sensors attached to the hand gloves. Thus by use of the smart gloves minimizes the need of a translator for faster contact with the surrounding people and also smart glove help the handicap people move around without taking anyone's help.

7. ACKNOWLEDMENT

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8. REFERENCES

[1] Osama Nisar, Muhammad Anas Imtiaz, Shehwar Hussain, Omer Saleem,*"Performance Optimization of a Flex Sensor Based Glove for Hand Gestures Recognition and Translation"*, International journal of (ijert) engineering research & technology *Volume 03*, Issue 05 (May 2014)

[2] V. Pathak, S. Mongia, G. Chitranshi, *"A framework for hand gesture recognition based on fusion of flex contact and accelerometer sensor",Third International Conference on Image Information Processing (ICIIP)*, pp. 312-319, 2015.

[3] Y. Kuno, T. Murashima, N. Shimada, Y. Shirai, *"Interactive gesture interface for intelligent wheelchairs"*, *Proc. IEEE Int. Conf. Multimedia Expo.*, vol. 2, pp. 789-792, 2000

[4] A. K. Bhaskaran, A. G. Nair, D. K. Ram, K. Ananthanarayanan, H. R. N. Vardhan, *"Smart Gloves for Hand Gesture Recognition Sign Language to Speech Conversion System*", International Conference on Robotics and Automation for Humanitarian Applications (Raha), pp. 226-231, 2016.

[5] Laksh Narang, Garima Rao, Abhishek Solanki, Kapil Singh, Karamjit Kaur, Neeraj Gupta, *"Communication Interface for Mute and Hearing Impaired People", International journal of engineering research & technology (ijert) Volume 03*, Issue 05 (May 2014)

[6]https://www.google.com/search?q=ht12d&safe=active&rlz=1C1CHBF_enIN872IN873&sxsrf=ACYBGNSOqqMDnzm7OJFpNv89XfyaXCCsbQ:1580366479890&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjh1Jf126rnAhWeIbcAHbrECDoQ_AUoAXoECA0QAw&biw=1366&bih=657#imgrc=TxWkGlLZVKXscM 30/1/2020

[7]https://www.google.com/search?q=l293d+motor+driver&tbm=isch&ved=2ahUKEwjPjsP526rnAhV1XMBHV1vAmsQ2cCegQIABAA&oq=l2&gs_l=img.1.1.0i67j09.189046.191569..195432...1.0..3.185.824.0j6.....0....1..gwswizimg.....10..35i39j35i362i39.MkPqkwxcsN8&ei=mHoyXs_iO_6qz7sP3d6J2AY&bih=657&biw=1366&rlz=1C1CHBF_enIN872IN873&safe=active#imgrc=4Z3bnFCXkAD7lM 30/1/2020

[8] https://www.electronicscomp.com/arduino-uno-r3-compaible-best-price-india?gclid=CjwKCAiA98TxBRBtEiwAVRLquy09hKsDR5tq8SI6k6boJPRZWWezzg7UGu_tx_4wr1m0BLUMBwF7GRoCgiYQAvD_BwE 30/1/2020

[9]Khadijatul Kubra1, Dr. Baswaraj Gadgay, Veeresh Pujari, "*Speaking and Controlling System for Speech Impaired People*", International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: *2321-9653; IC Value: 45.98; SJ Impact Factor :6.887 Volume 5 Issue XII December 2017*

[10] GarimaRao,Laksh Narang ,Abhishek Solanki ,Kapil Singh, Mrs. Karamjit Kaur , Mr.Neeraj Gupta *"Communication Interface for Mute and Hearing Impaired People",* Amity University Haryana International Journal of Engineering Research & Technology (IJERT) *IJERT IJERT*
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