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Communication and Obstacle Detection System for the Disabled using Arduino Lilypad

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***Abstract:** This paper proposes the design of a hand glove using Arduino Lilypad and Zigbee for the people with disability in hearing, speaking and vision. There are nearly 900,000 people who are deaf and dumb and 285 million people who are blind. This device would help for communication by the bending of flex sensors which are fixed on the glove and the obstacles are detected by Ultrasonic sensor. And the combination of input is processed by the microcontroller Arduino Lilypad. The processed value is transmitted through the Zigbee to Microcontroller-AT89S2051 and the sign language is recognized and the corresponding value is obtained through LCD and speaker. The obstacle is sensed by Ultrasonic sensor and the person is alerted through vibration. The proposed system is compact, wireless and easy to use.*

***Keywords:** Arduino Lilypad, Flex sensor, Hand glove, Microcontroller- AT89S2051, Ultrasonic sensor, Vibration motor, Voice module-WTV040, Zigbee-CC2500.*

I. INTRODUCTION

There are people who are born with disabilities of hearing speaking and vision. They use sign language which is a visual language or method of communication. It is composed of a system of conventional gestures, hand signs and finger spelling, plus the use of hand position to represent the letters of the alphabets. Signs can also represent complete ideas or phrases, not only individual words. But there exists a communication gap between the communication of deaf and dumb with normal people. To overcome this difficulty we have designed a compact device to aid in communication by using flex sensors placed on hand glove.[1],[2]. Five flex sensors are attached to every finger. The input from the flex sensors due to the bending movement of the fingers [3],[9] is given to the microcontroller Arduino Lilypad where the processing takes place [10].The processed output is transmitted to Microcontroller- AT89S2051 through Zigbee.

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This value will be verified with the already stored value and the output is obtained through LCD and speaker. Ultrasonic sensor is used to aid in navigation for the blind. It measures and detects the obstacles ahead [4],[6]. It senses the obstacles and passes this data to the microcontroller Arduino Lilypad which processes it. If the obstacle is not close then the system does nothing and if the obstacle is close the vibrator is activated by the microcontroller.

II. SYSTEM MODULE

The proposed system is wireless so it has transmitter and receiver.

A. Transmitter

The transmitter has two inputs: flex sensors and ultrasonic sensor. The flex sensor senses the sign language performed by the bending of the fingers[5],[8]. The resultant output is analog and the ADC is used to convert it into digital format then it is processed by the microcontroller Arduino Lilypad [10] where the preprogrammed word for each output of the sensor is matched . And the matched value is transmitted through the Zigbee to the receiver.

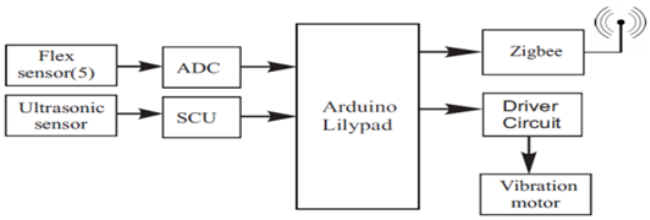

Fig. 1 Transmitter Side

The ultrasonic sensor aids in navigation by measuring the distance and detecting the obstacles ahead using ultrasonic waves [7]. On sensing obstacles the sensor passes this data to the microcontroller Arduino Lilypad which processes if the obstacle is close enough. If the obstacle is not that close the system does nothing and if the obstacle is close the microcontroller sends a signal to the vibrator to vibrate

B. Receiver

The receiver gets the processed data from microcontroller Arduino Lilypad through the Zigbee and is matched with the preprogrammed word in microcontroller - AT89S2051. There are two outputs: LCD display and audio through speaker.

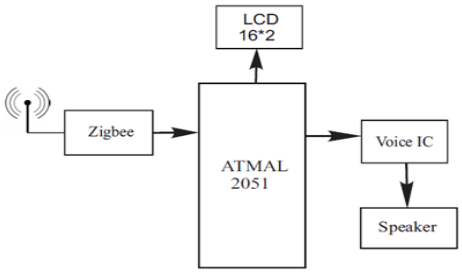

Fig. 2 Receiver Side

LCD display checks each signal and compares it with the already existing value. Based upon the comparison the microcontroller takes the decision about what message must be displayed on the LCD. The audio corresponding to each gesture is recorded in the voice module- WTV040 by using a MIC. The received data is compared with the predefined values and the function of this is to produce voice against the respective hand gestures.

III. HARDWARE USED FOR THE IMPLEMENTATION OF SYSTEM

The main component of this device includes a hand glove with flex sensors and ultrasonic sensors, microcontrollers- Arduino Lilypad and AT89S2051 for processing purpose, Zigbee for wireless network, voice module- WTV040 for recording of audio to each gesture, LCD, speaker and vibrator for obtaining the output.

A. Flex Sensor

The Flex sensor measures the amount of deflection or bending. Inside the flex sensor there are carbon resistive elements within a thin flexible substrate .It is a resistive sensor whose resistance varies according to its bending .Value of resistance is directly proportional to the flexing of sensor.

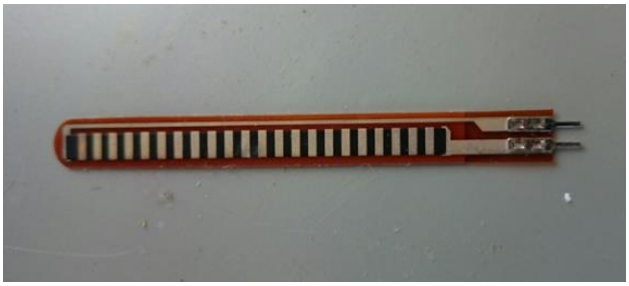

Fig. 3 Flex sensor

It contains two resistors which are used to measure the variations in the bend.

Vout = Vin * R1 / (R1 + R2)

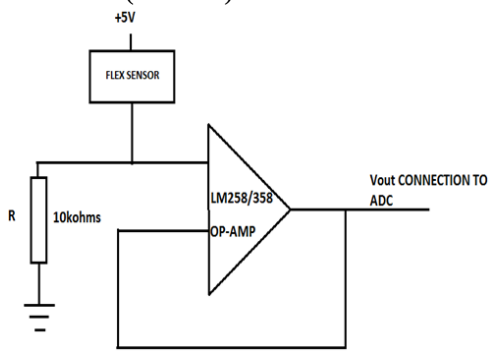

Fig. 4 Flex Sensor Circuit

If the R1 and R2 value is equal means the output is half of the Vcc supply. In this circuit output is a variable one. So the output is depending upon the R2 resistance value. Resistance will be varied depending upon the fluctuation level .Fluctuation level varied means the resistance value also varied .If the resistance value increased means output also increased. The resistance value and output is a directly proportional one.

B. Ultrasonic Sensor

An Ultrasonic sensor measures the distance of an object based on sound waves. The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After the sound waves are emitted, the sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the object distance from the sensor.

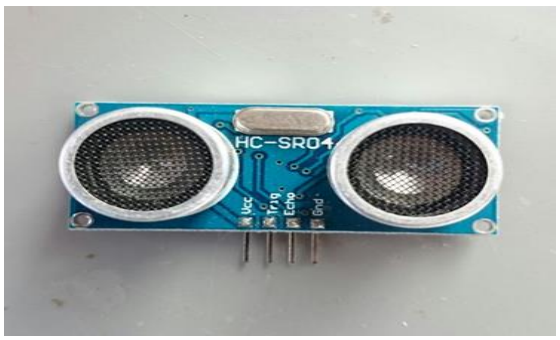

Fig. 5 Ultra Sonic Sensor

C. Arduino Lilypad

The Arduino LilyPad is an Arduino-programmed microcontroller designed to be easily integrated into e-textiles and wearable projects .It consists of an ATmega328 with the Arduino boot loader and a minimum number of external components to keep it as small as possible.

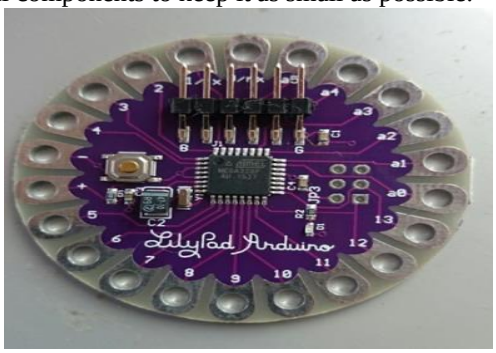

Fig. 6 Arduino Lilypad

D. Microcontroller- AT89S2051

Microcontroller- AT89S2051 is a low-power, high-performance CMOS 8-bit microcontroller with 2KB ISP flash memory. This device uses Microchip high-density nonvolatile memory technology and is compatible with the industry-standard.

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Fig. 7 Microcontroller- AT89S2051

E. Zigbee-CC2500

The Zigbee - CC2500 is a low-cost transceiver of 2.4 GHz. It is used for low-power wireless applications. The 64-byte transmit/receive FIFOs of data and other operations are controlled via an SPI interface.

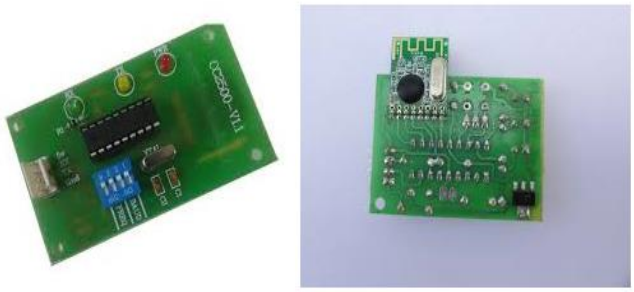

Fig. 8 Zigbee-CC2500

F. Voice module- WTV040

WTV-040 is a sound recorder and playback module which can play up to 32 different sounds using 5-bit address pins. This module works on 3.3V supply, but the adaptor makes it to operate in both 5V as well as 3.3 volt application using on-board regulator. The control pins include Play, Record and Erase pins.

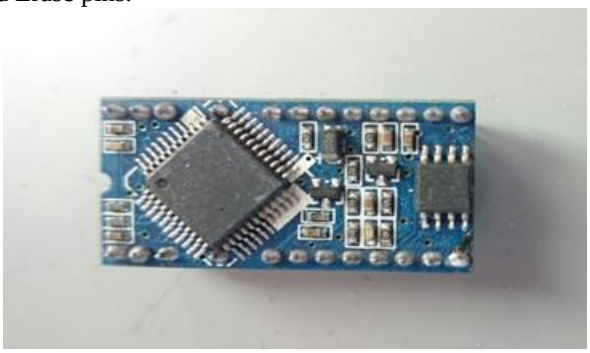

Fig. 9 Voice Module- WTV040

IV. SOFTWARE USED FOR THE IMPLEMENTATION OF SYSTEM

In this project two software tools are used for compilation.

A. Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

B. KEIL SOFTWARE

Keil Software, world's leading developer of Embedded Systems Software, makes ANSI C compilers, macro assemblers, real-time kernels, debuggers, linkers, library managers, simulators, integrated environments, and evaluation boards for the 8051, 251, ARM7, and C16x/ST10 microcontroller families. The compiler allows writing a microcontroller application in c that once, compile having the efficiency and speed of assembly language. We compile the program for LCD, speaker and zigbee interfacing with microcontroller -AT89S2051 using this software.

V. CONCLUSION

In this paper, we have proposed an electronic system which would be helpful for people who are born deaf and blind. This method replaces the common methods of communications using hand gestures and a normal stick to walk without getting hurt by obstacles. In this paper, we have used a hand glove which by the bending of flex sensor can communicate with others using voice chip and speaker. And an ultrasonic sensor to detect the obstacles and give the sensation through the vibrator. The accuracy of bending detection can be further improved by using capacitive sensors.

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