

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 12, December 2018

Smart Classroom – Application of Gesture Recognition

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ABSTRACT: This paper outlines the strategy adopted for establishing smart classroom formed by two kinds of people: one is robot which acts as a teacher and others are people which act as student. Our aim is to setup a classroom which is useful for blind, deaf and dumb. This is very beneficial for such kind of people who will not face problem in learning due to their disabilities. The principle task of this project is that it transforms hand gestures and hand movements into voice message and displays the same message on screen, which will be helpful for all three deaf, dumb or blind. Thus the contribution of this project is remarkable in field of studies.

KEYWORDS: Gesture Recognition, Data Glove, Sensors, ATMEGA328

I. INTRODUCTION

Communication is the only way to express your views, ideas and thoughts to another person. The Life without communication is like TV without audio where you barely understand anything. When a person can't speak and hear, it becomes difficult for them to convey their message to the society. Sign Language is technique which solves this problem. Normal people cannot communicate with the dumb and deaf people. They need to learn sign language. For normal people, it is difficult to understand sign language [1].



Fig. 1: Classroom of Physically Disabled Students

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To change the life style of deaf and dumb people, the “Smart Classroom” project is developed. In this project, there is a robot which acts as teacher. The hand gestures of robot are converted into text and text is converted into speech. To detect different gestures, we will display the direction of movement of the robot in a 16 x 2 alphanumeric LCD placed in front of robot. Thus with the help of this project, the problem faced by these people in communicating with the society can be reduced to a great extent.

II. DESCRIPTION OF EXISTING SYSTEM

There are various approaches that have been used for converting sign language images into text or speech. This idea has struck the mind of many students in India. Sign language has different approaches:
Kinect sensor: Microsoft’s Kinect and a team of Chinese Researchers have invented a method of decoding the sign language by using Kinect sensor. It senses the gesture and the trajectory of the hand and converts it to text and speech [2].

- 2.1. **Image processing:** In the system using Image processing, the Image is captured through the webcam. Then the captured Colored image is converted into the gray scale image which is internally converted to the binary form. Coordinates of captured image are calculated with respect to X and Y coordinates and these are then stored into the database in the form of template. The templates of newly created coordinates are compared with the existing one. If comparison leads to success then the same will be converted into audio and textual form [3].
- 2.2. **Data Glove:** Four female students from the Holy Grace Academy of Engineering, Mala, Kerala, had developed a device (hand glove) that simplified communicating with the speech- and hearing-impaired people by converting sign language into voice and text. The device was based on body positioning technique (mainly hand gestures) [4].



Fig. 2: Data Glove as an existing system

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2.3. Leap motion: The Leap Motion Controller is a new device developed for gesture interaction by Leap Motion. The device has a small dimension of 0.5x1.2x3 inches. To use the Leap Motion Controller, the user needs to connect it to a computer by USB. Then the users put hands on top of the Leap Motion Controller. The Leap Motion Controller could detect palm and fingers movements on top of it. The tracking data which contains the palm and fingers' position, direction, velocity could be accessed using its SDK.

III. DESCRIPTION OF PROPOSED SYSTEM

In this system, at the transmitter end we use accelerometer sensor mounted on fingers of robot. The accelerometer sensor gives their output in the form of change in resistance according to the bend angle. The output from the accelerometer is given to the ADC channels of the microcontroller.

The processed ADC values from the microcontroller are compared with the threshold values for the recognition of a particular gesture. The particular gesture is recognized & is given to the microcontroller which transmits them through the RF module in a serial manner.

For each value received at RF receiver, the microcontroller gives corresponding commands to the LCD and the Voice Module (Voicy). Thus we get the voice output for each gesture and display of each gesture in form of text on the LCD display.

3.1. Working

This paper describes the technology which converts hand gestures into text and audio. To detect hand gesture, we will use the ADX335 accelerometer sensor. The sensor will be attached to our hand of robot. Three output signals of accelerometer sensor are analog in nature. So, we will use ADC. Once the hand gesture is known, the ATMEGA328 microcontroller will send the required signal to the signal to the DC motor driver (L293D) of robot to drive the robot in desired direction [5].

IV. ELECTRONICS REQUIRED

4.1. ATMEGA328: The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family. The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, and five software selectable power saving modes. [6]

The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

4.2. Accelerometer Sensor: The ADXL335 is a small, thin and low power device capable of measuring complete 3-axis acceleration. The ADXL335 can measure acceleration with a minimum full scale range of $\pm 3g$. It requires less power and gives output. Signals in terms of analog voltages that are proportional to acceleration. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock or vibration. The three axes' sense directions are highly orthogonal and have little cross-axis sensitivity since it uses a single polysilicon surface micro-machine sensor structure for sensing X, Y and Z axes. The user selects the bandwidth of the accelerometer using the Cx, Cy, and Cz capacitors at the Xout, Yout, and Zout pins [7]. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm \times 4 mm \times 1.45 mm, 16-lead, plastic lead frame chip.

4.3. LCD Display: LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.

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These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters, animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data [8].

The Command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

4.4. VOICE OTP IC (aP8942A): aP8942A high performance Voice OTP is fabricated with Standard CMOS process with embedded 1M bits EPROM. It can store up to 42 sec voice message with 4-bit ADPCM compression at 6 KHz sampling rate. Two trigger modes facilitate different user interface. User selectable triggering and output signal options provide maximum flexibility to various applications. Built-in resistor controlled, 8-bit current mode D/A output and PWM direct speaker driving output minimize the number of external components. Using PC controlled programmer and developing software, we can program this IC as per our needs [9].

V. RESULT

In this system, the sensor on finger of robot detects the particular gesture. Every gesture consists of movement and bending of fingers of hand in a particular order with specific angle correspondingly. The accelerometers are fed to the ADC channel of the microcontroller. These sensors produce different analog values based on positions of these sensors. For each gesture value that is received, the microcontroller outputs gesture specific commands to LCD module and to the Voice IC simultaneously for producing the voice signal and text. This goal is achieved successfully.

VI. CONCLUSION

As mentioned above, this system was proposed to reduce the difficulty of deaf and dumb people. By adding new gestures this project can be made compatible with every sign language in the world and thus make communication easier and more efficient. Thus, even hearing and speech impaired people can lead a normal life just as every other person.

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