Hand Gesture Vocalizer for Deaf and Mute People

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***Abstract*: This paper presents the implementation of a Gesture Vocalizer for Mute and Deaf People that will provide the mute and deaf people to convey their message in sign language which is converted into audio and also displayed. After wearing the glove and turning on the system, once the user uses and sign language for convey the message this system will convert that message into audio signal and also get displayed. In this project we have used Arduino UNO controlled Hand Gesture Vocalizer. This project documentation includes all major design aspects.**

***Keywords*: Arduino Uno, Flex Sensor, Accelerometer, APR 9600, LCD Display, Speaker.**

1. INTRODUCTION

Digital vocalizer is a project for social purpose. We are trying to implement a system which makes a communication gap between deaf peoples and hearing people as less as possible. Deaf people make use of sign language or gestures to make understand what he/she trying to say but it is impossible to understand by hearing people. So, that we come on conclusion to make a simple prototype by taking some of those gesture and convert it into audio form so that they can understand by everyone.

For that we are making use of arduino UNO Chip as Atmega 328 Controller chip to interface all of the sensors and actuators. Some sensors are placed on the hand of deaf people which converts the parameter like finger bend hand position angle into electrical signal and provide it to Atmega 328 controller and controller take action according to the sign.

2. LITERATURE SURVEY

Deaf people have used sign languages throughout the history. One of the earliest written records of a sign language is from fifth century BC, in Plato's Cratylus. In 1620, Juan Pablo Bonet published "Reduction of letters and art for teaching mute people to speak" which is considered as the first modern treatise of sign language Phonetics. In order to overcome the gap of communication between dumb and normal person we have come up with this novel idea. Some papers present Sign Language Interpreter a recognition system for the vocally disabled.

In the recent years, there has been tremendous research on the hand sign recognition. The technology of gesture recognition is divided into two categories- Vision-based and Glove-based, in comparison with these two, vision based system faces many problem it is not convenient for user to use whereas glove based is convenient and simple method. One more study proposes that the system must be capable of recognizing the gestures continuously without any manual indication. The system must recognize the gestures accurately between 80 to 90 percent. There is a need of designing of wireless transceiver system for Microcontroller and Sensors Based Speech Converter. There is a need of monitoring health of speech impaired and paralyzed patients too so heartbeat sensor is mounted in a hand gloves which is convenient and reliable to use, which measure pulse rate.

The intension of the sign language translation system is to translate the normal sign language into speech and to make easy contact with the dumb and it is made portable. Proposed system avoids PC intervention for processing and all operations are controlled by microcontroller. Another study states that nowadays Embedded System emerging as an important trend in all applications. More recently developed embedded applications are changing our lifestyle in a smart way. The development of speech converter by using RF trans-receiver to send data to recorder leads to an effective use of a device.

3. METHODOLOGY

Block diagram of our project is shown above. There are 7 main blocks. The AT MEGA 328 is the heart of the project. The two inputs are flex sensor and the accelerometer. The output is given to the LCD and the APR 9600 kit.

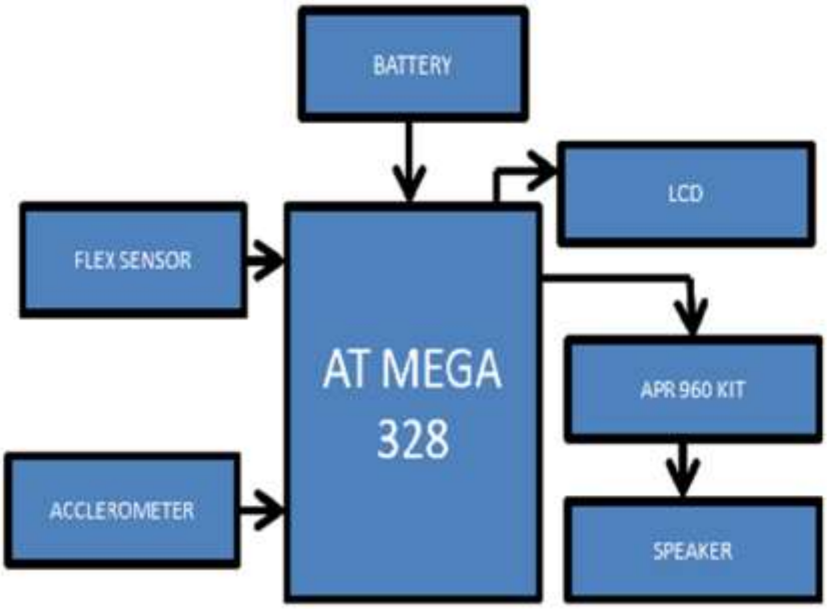


Fig.1. Block diagram

3.1 ARDUINO UNO

Fig. 2: Arduino uno

Arduino Uno is a microcontroller board based on the ATMEGA328P. It has 14 digital input/output pins(of which 6 can be used as PWM output), 6 analog input, a 16 MHZ quarts crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC to DC adapter or battery to get started. Arduino Uno can be powered via USB connection or with an external power supply. Arduino IDE supports Windows, Mac OS X or Linux

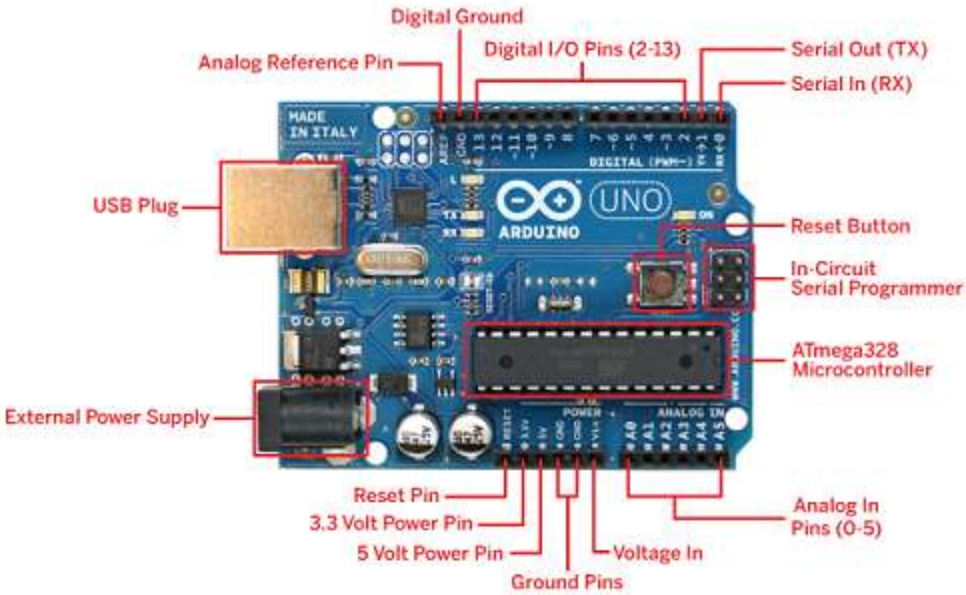


Fig. 3: Pin-out Diagram

Power USB

Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection (1).

Power (Barrel Jack)

Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack (2).

Voltage Regulator

The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.

Crystal Oscillator

The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz.

Arduino Reset

You can reset your Arduino board, i.e. start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, you can connect an external reset button to the Arduino pin labelled RESET (5).

Pins (3.3, 5, GND, Vin)

3.3V (6) − Supply 3.3 output volt

5V (7) − Supply 5 output volt

Most of the components used with Arduino board works fine with 3.3 volt and 5 volt.

GND (8)(Ground) − There are several GND pins on the Arduino, any of which can be used to ground your circuit.

Vin (9) − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.

Analog pins

The Arduino UNO board has five analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

Main microcontroller

Each Arduino board has its own microcontroller (11). You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.

ICSP pin

Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output.

Actually, you are slaving the output device to the master of the SPI bus.

Power LED indicator
This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

TX and RX LEDs
On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.

Digital I/O
The Arduino UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled "~" can be used to generate PWM.
AREF
AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

3.2 FLEX SENSOR

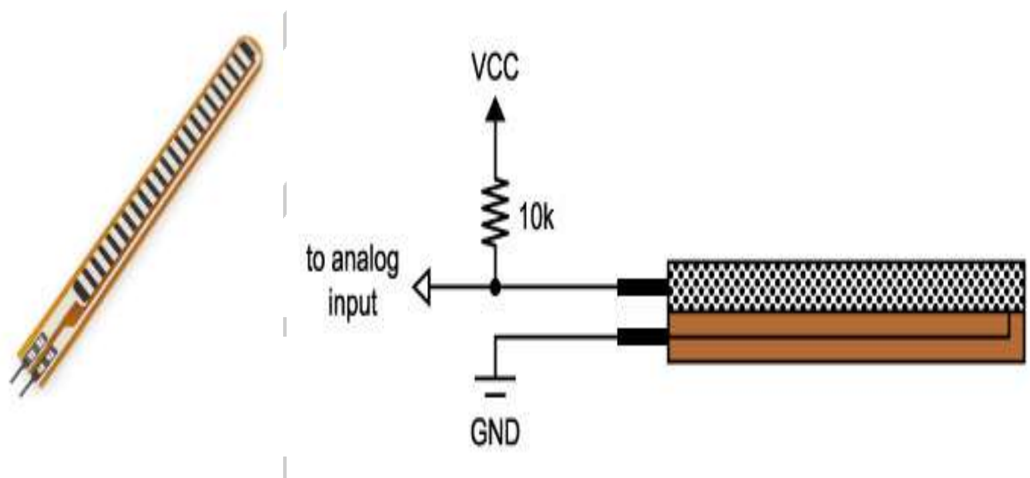


Fig. 4: Flex Sensor

A Flex and Force sensor. This is a flexible sensor which changes its output when it is bent or when force is applied on it. This sensor has two output wires. The resistance between these two wires varies when the sensor is bent or when subjected to a force. Hence, this sensor can be used as a flex or force sensor.

When the sensor is kept straight with no force acting on it, it has a resistance of around 10 K Ohms. When the sensor is bent in either way, or when force is applied on the sensor, the resistance between these two wires increases proportionally to the amount of bending. They convert the change in bend to electrical resistance - the more the bend, the more the resistance value. They are usually in the form of a thin strip from 1"-5" long that vary in resistance from approximately 10 to 50 K ohms.

Flex sensors are analog resistors. They work as variable analog voltage dividers. Inside the flex sensor are carbon resistive elements within a thin flexible substrate. When the substrate is bent the sensor produces a resistance output relative to the bend radius. With a typical flex sensor, a flex of 0 degrees will give 10K resistance will a flex of 90 will give 30-40 K ohms. The Bend Sensor lists resistance of 30-250 K ohms.

3.3 ACCELEROMETER

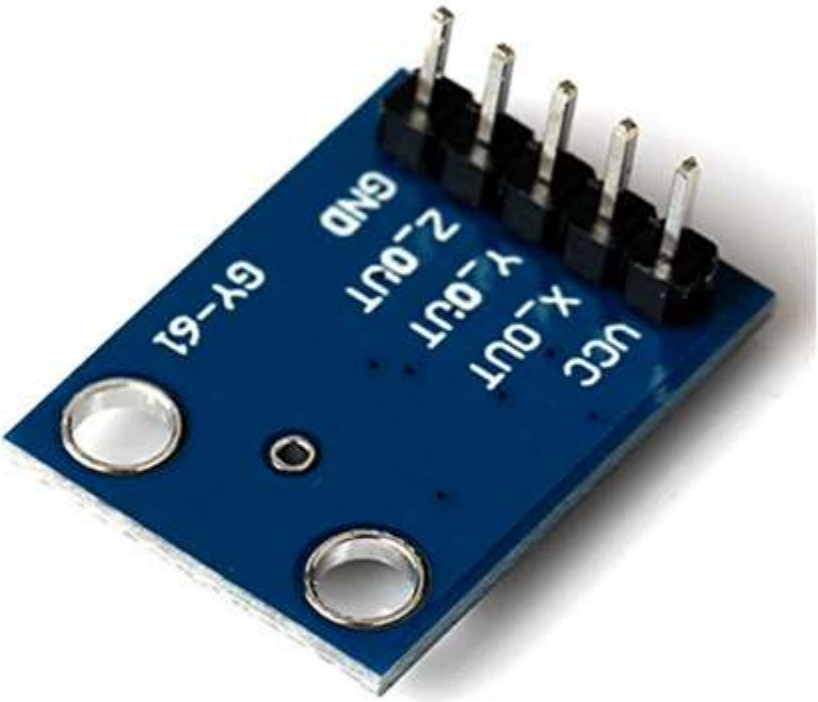


Fig. 5: Accelerometer

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. 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 × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package (LFCSP_LQ).

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 g minimum. It contains a polysilicon surface-micromachined sensor and signal conditioning circuitry to implement an open-loop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration. The sensor is a polysilicon surface-micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces. Deflection of the structure is measured using a differential capacitor that consists of independent fixed plates and plates attached to the moving mass. The fixed plates are driven by 180° out-of-phase square waves. Acceleration deflects the moving mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration.

The demodulator output is amplified and brought off-chip through a 32 k Ω resistor. The user then sets the signal bandwidth of the device by adding a capacitor. This filtering improves measurement resolution and helps prevent aliasing.

3.4 LIQUID CRYSTAL DISPLAY

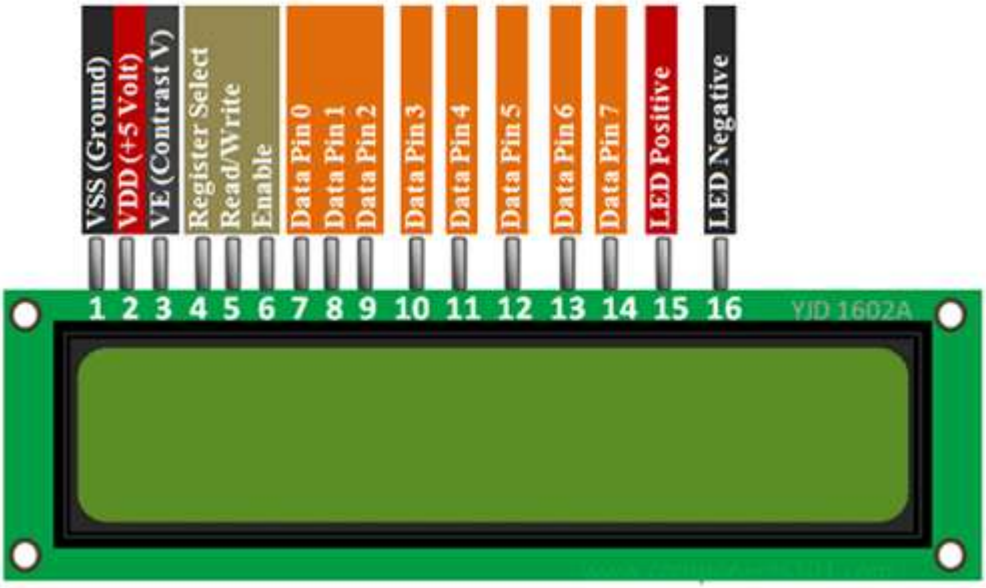


Fig. 6 LCD Display

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. 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 (unlike in seven segments), 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.

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. Click to learn more about internal structure of a LCD.

Pin Description:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	VEE
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

3.5 APR9600 KIT

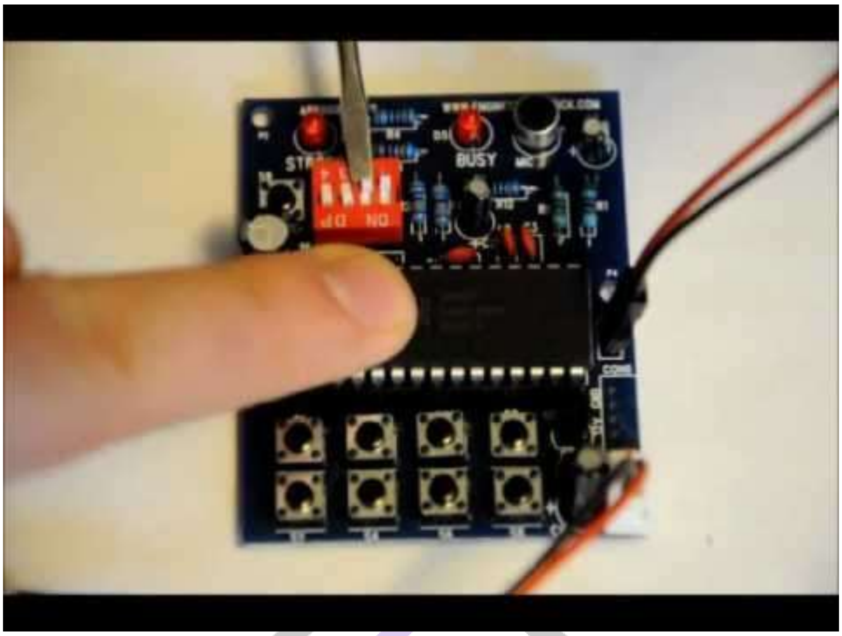


Fig. 7: APR9600 Kit

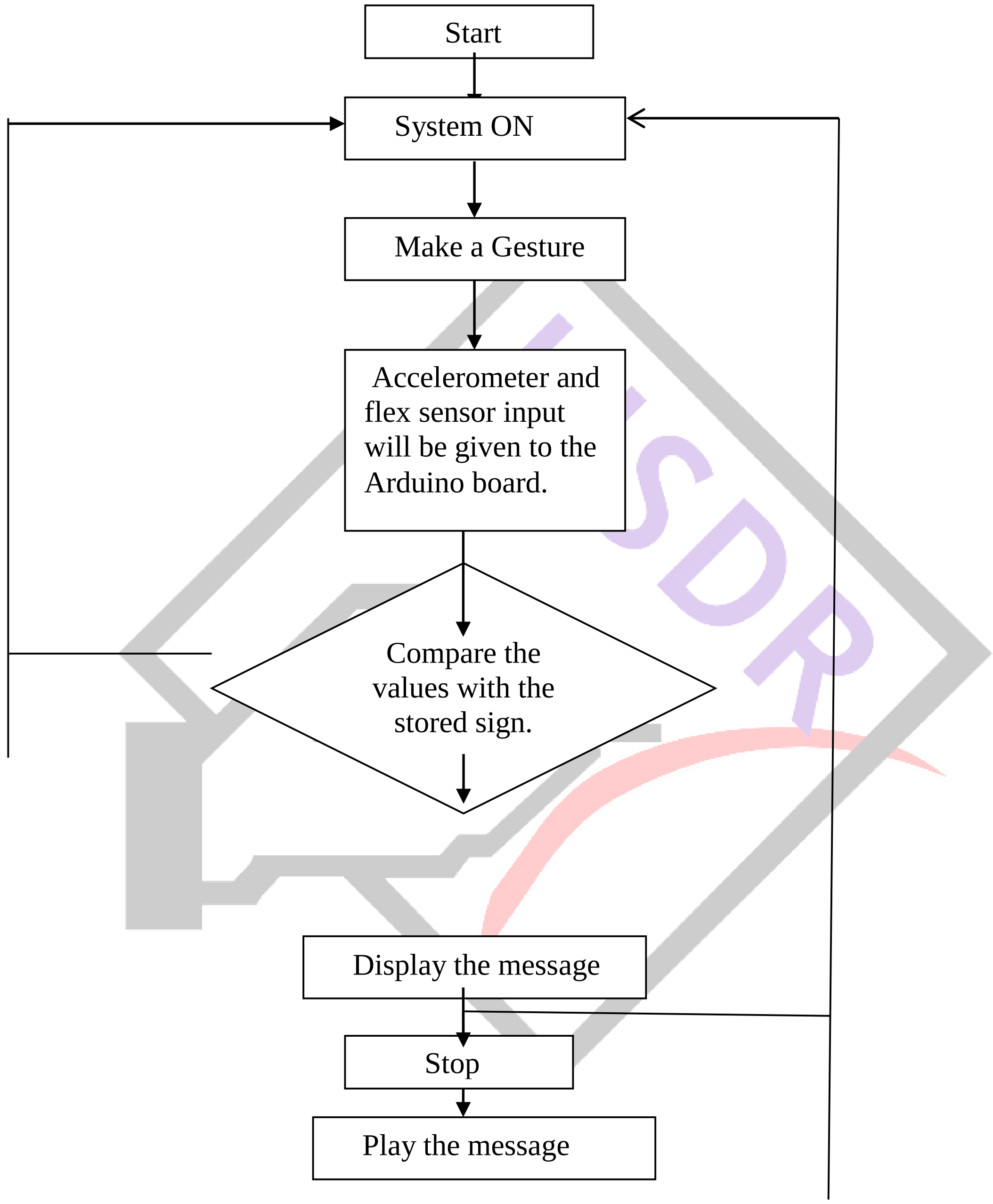
APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage technique. Recorded sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz. However, by changing an oscillation resistor, a sampling rate as high as 8.0 kHz can be achieved. This shortens the total length of sound recording to 32 seconds. Total sound recording time can be varied from 32 seconds to 60 seconds by changing the value of a single resistor. The IC can operate in one of two modes: serial mode and parallel mode. In serial access mode, sound can be recorded in 256 sections. In parallel access mode, sound can be recorded in 2, 4 or 8 sections. The IC can be controlled simply using push button keys. It is also possible to control the IC using external digital circuitry such as micro-controllers and computers. The APR9600 has a 28 pin DIP package. Supply voltage is between 4.5V to 6.5V. During recording and replaying, current consumption is 25 mA. In idle mode, the current drops to 1A.The APR9600 experimental board is an assembled PCB board consisting of an APR9600 IC, an electret microphone, support components and necessary switches to allow users to explore all functions of the APR9600 chip. The oscillation resistor is chosen so that the total recording period is 60 seconds with a sampling rate of 4.2 kHz. The board measures 80mm by 55mm.

3.6 SPEAKER

Fig. 8: Speaker

A loudspeaker (or loud-speaker or speaker) is a device which converts electrical signal into audio signal containing alternating current electrical audio signal is applied to its voice coil, a coil of wire suspended in a circular gap between the poles of a permanent magnet, the coil is forced to move rapidly back and forth due to Faraday's law of induction, which causes (usually conically shaped) attached to the coil to move back and forth, pushing on the air to create sound waves. Besides this most common method, there are several alternative technologies that can be used to convert an electrical signal into sound. The sound source (e.g., a sound recording or a microphone) must be amplified with an amplifier before the signal is sent to the speaker. Speaker or driver type (individual units only) – Full-range, woofer, tweeter, or mid-range.

4. FLOW CHART



5. CIRCUIT DIAGRAM

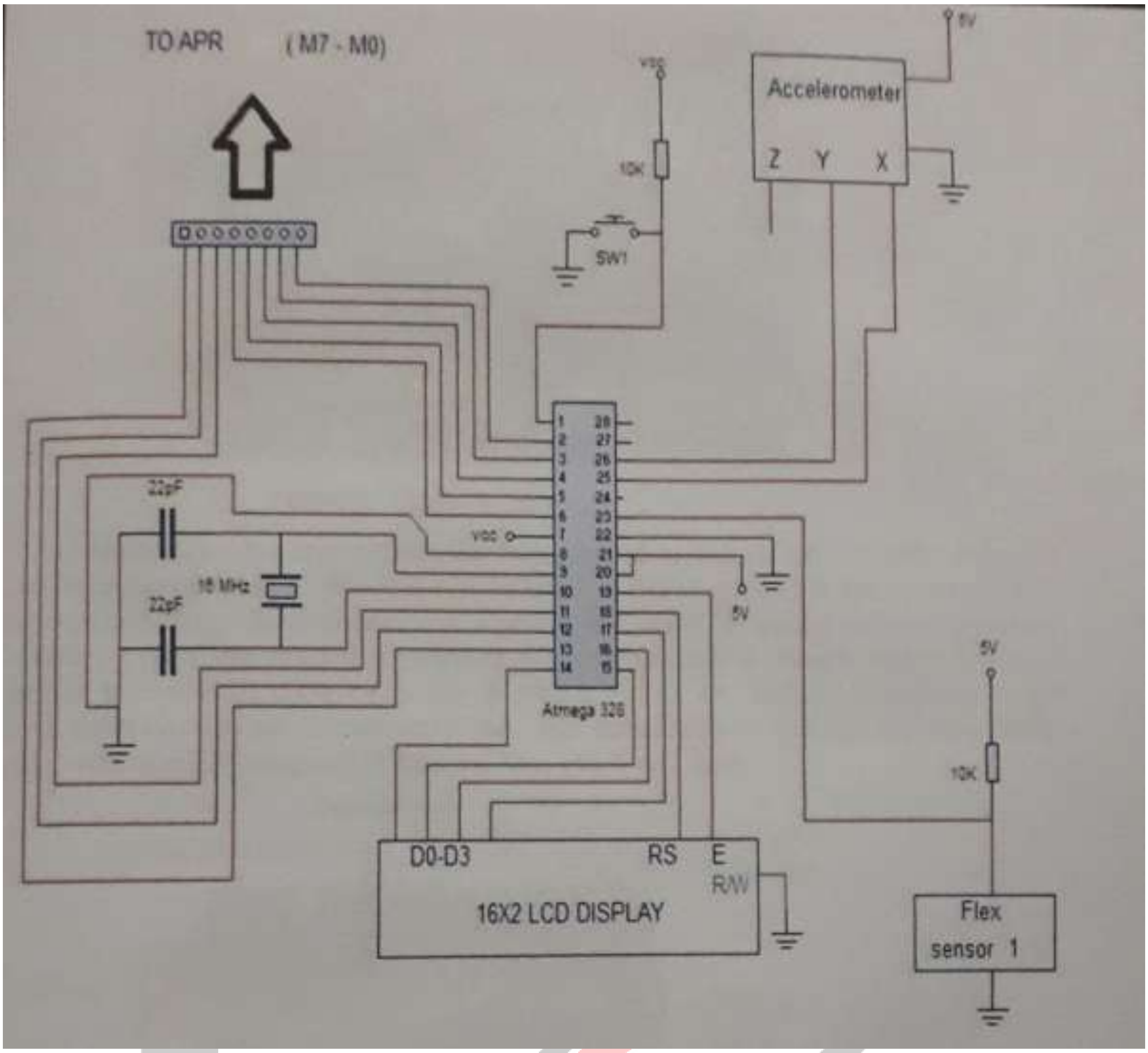


Fig. 10: Interfacing Diagram

The interfacing and connection diagram of different components like Flex sensor, Accelerometer, APR9600, microcontroller, LCD and speaker is shown in the Fig. 10 and Fig.11 shows the designed system.

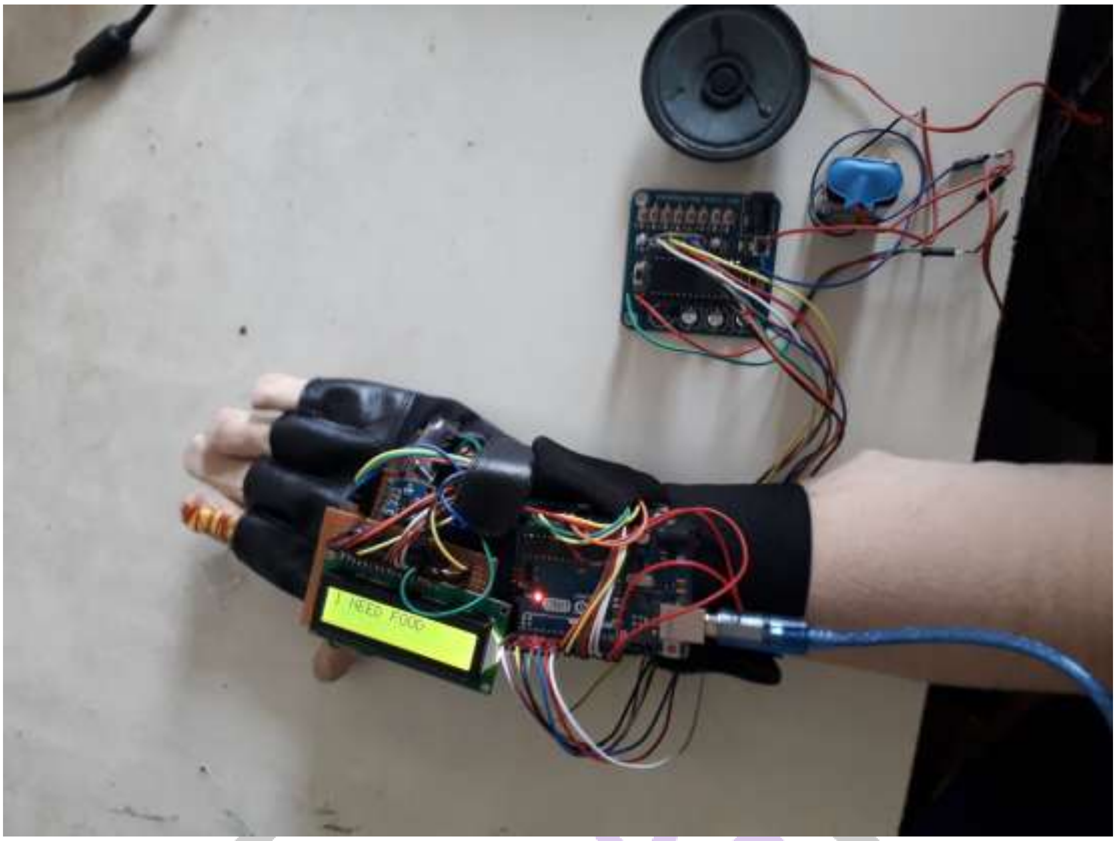


Fig. 11: Implementation

CONCLUSION

There can be a lot of future enhancements associated to this research work, which includes: Designing of wireless transceiver system for "Microcontroller and Sensors Based Gesture Vocalizer".
Perfection in monitoring and sensing of the dynamic movements involved in
"Microcontroller and Sensors Based Gesture Vocalizer".
Virtual reality application e.g., replacing the conventional input devices like joy sticks in
Video games with the data glove.
The Robot control system to regulate machine activity at remote sensitive sites.
Designing of a whole jacket, which would be capable of vocalizing the gestures.

This system is useful for deaf and mute people to communicate with one another and with the normal people. The dumb people use their standard sign language which is not easily understandable by common people and blind people cannot see their gestures. This system converts the sign language into voice which is easily understandable by blind and normal people. The sign language is translated into some text form, to facilitate the deaf people as well. This text is display on LCD.

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