Subject: Embedded System and RTOS	
Name of student:	
Class: BE (E&TC)	**Roll no.:**
Semester/Year: VII (2022-23)	**Exam no.:**
Date of performance:	**Date of submission:**
Examined by:	

Experiment No :

Design Door opener system using different sensors and actuators (Ultrasonic sensor and servo motor) with Arduino-Uno.

AIMWrite a program to Design Door opener system using different sensors and actuators (Ultrasonic sensor and servo motor) with Arduino-Uno.

OBJECTIVES:

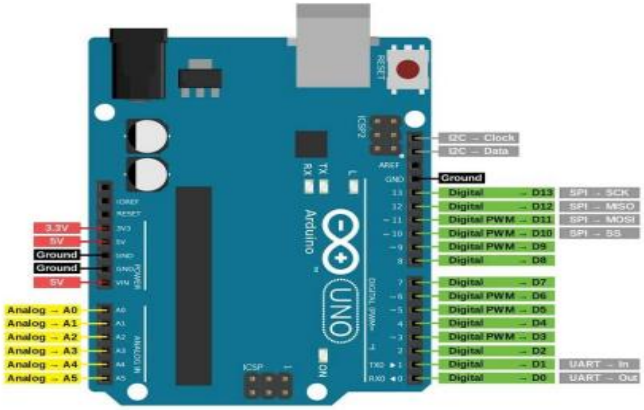
- To learn functioning of Arduino micro controller.
- To study working of Arduino with various sensors.
- To learn integration of different components with Arduino UNO.

APPARATUS:

Software – Arduino IDE,Hardware - Arduino Uno, Servo Motor, LCD Display, HC SR 04(Ultrasonic Sensor), Jumper Cables, Breadboard

THEORY:

1. Microcontroller development board (Arduino UNO): The microcontroller used was Arduino Uno. Arduino UNO is a microcontroller board based on the ATmega328P. The ATmega328 is a single chip microcontroller board based on the megaAVR family (later Microchip Technology). It has modified Havard architecture 8-bit RISC processor core. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16

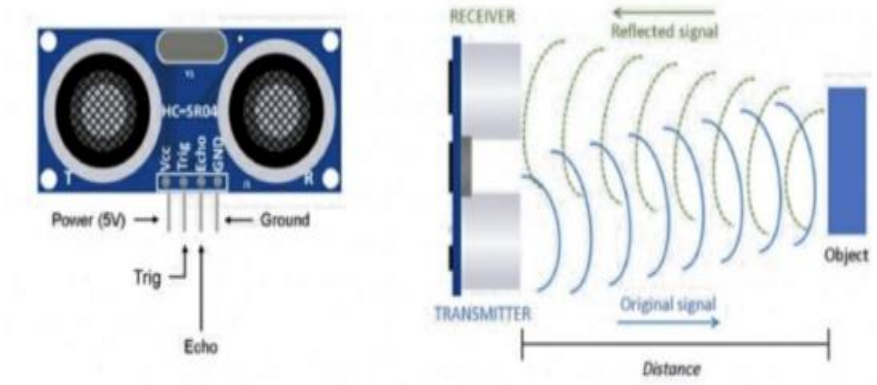


MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. The ultrasonic sensor needs two or one GPIO pins and the servo motor requires one GPIO pin that is capable of PWM output. It can be programmed using the Arduino IDE.

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read while-write capabilities, 1KB EEPROM, 2 KB SRAM, 32 general purpose working registers, 3 flexible timer/counter 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 5 software selectable power saving modes. The device operates between 1.8- 5.5 volts. The device achieves throughput approaching 1 Mhz.

2. Ultrasonic sensor:

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic



sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**

3. Servo sensor:

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Here reference input signal is compared to the reference output signal and the third signal is produced by the feedback system. And this third signal acts as an input signal to the control the device. This signal is present as long as the feedback signal is generated or there is a difference between the reference input signal and reference output signal. So the main task of servomechanism is to maintain the output of a system at the desired value at presence of noises.

3.1. Specification:

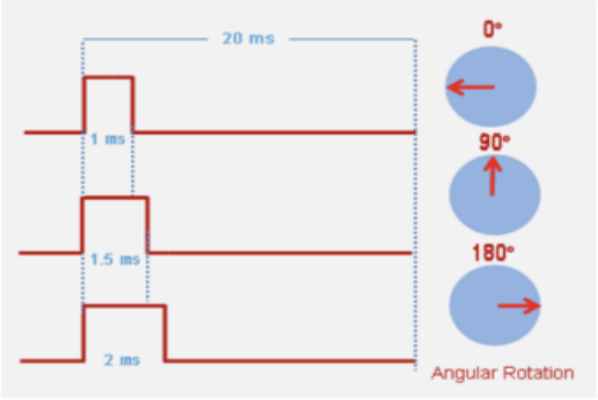
- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation: 0°-180°
- Weight of motor: 9gm
- Package includes gear horns and screws

3.2. Controlling the servo motor

All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degrees from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

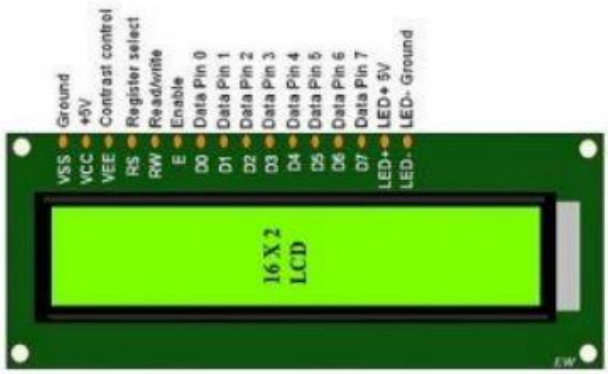
Servo motor works on PWM (Pulse width modulation) principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically, servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by Gears. We know that WORK= FORCE X DISTANCE, in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. The potentiometer is connected to the output shaft of the Servo, to calculate the angleand stop the DC motor on the required angle.



4. LCD Display-

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement.

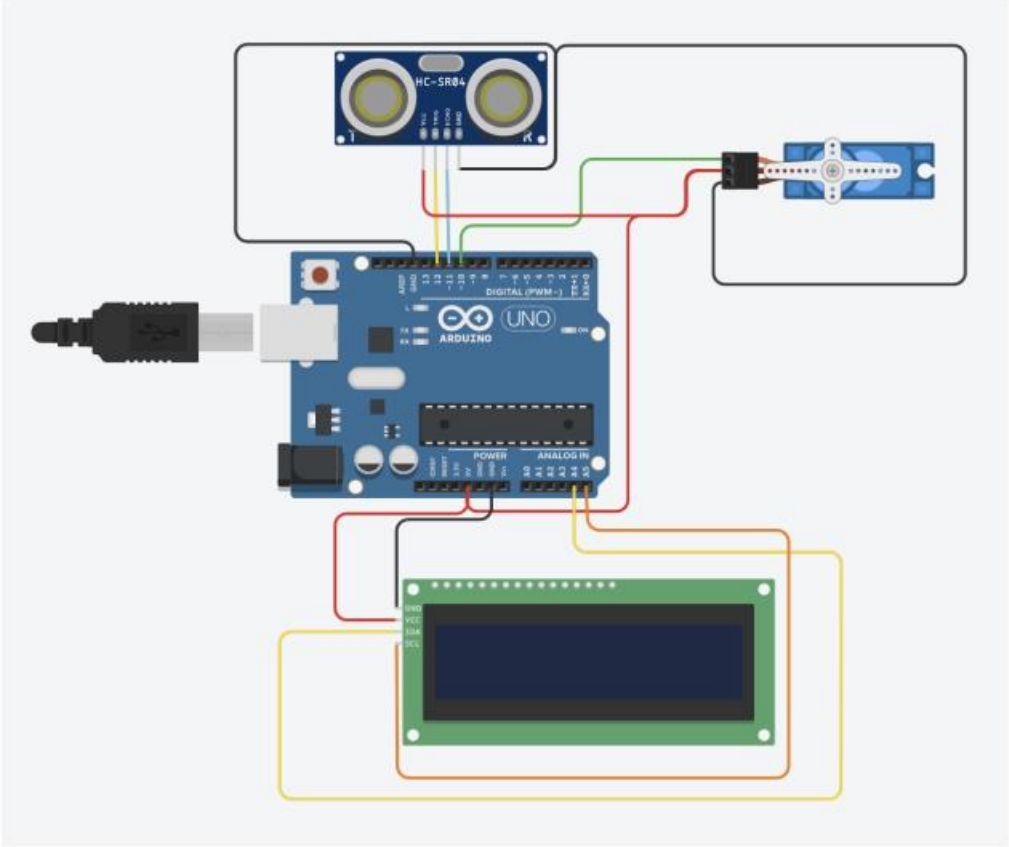
Working- LCD is connected to Arduino UNO using I2C module to reduce the connection complexity. Data from ultrasonic sensor is fed to LCD display via controller, LCD will display distance measured by ultrasonic sensor, also it will display if door is closed or open



What the code does:

When the ultrasonic sensor detects something in proximity, the device actuates the servo in such a way that the door opens. Threshold is set, if distance sensed by ultrasonic sensor is below threshold, then servo motor will run and door will open. Similarly, if door is opened and distance sensed by ultrasonic sensor is beyond threshold then servo motor will actuate and door will get closed.

5. Interfacing diagram:



PROCEDURE:-

1. Make necessary connections as per Interfacing diagram.
2. Write code in Arduino IDE.
3. Verify Output

CONCLUSION:

REFERENCES:

a) www.arduino.cc
b) LCD 16X2 DATASHEET
c) Servo motor Datasheet

SOURCE CODE:

```
#include <Servo.h>
#include <LiquidCrystal_I2C.h>
#include <HCSR04.h>
Servo myservo;
LiquidCrystal_I2C lcd(0x27, 16, 2);
int distance=0;
byte triggerPin = 12;
byte echoPin = 11;
int pos = 0;
void setup() {
 myservo.attach(10);
 Serial.begin(9600);
 lcd.init();
 lcd.begin(16, 2);
 lcd.backlight();
 lcd.setCursor(0, 0);
 lcd.print("start");
 pinMode(triggerPin, OUTPUT);
 pinMode(echoPin,INPUT);
 lcd.print("All set up");
}
void loop() {
 digitalWrite(triggerPin,LOW);
 delayMicroseconds(5);
 digitalWrite(triggerPin,HIGH);
 delayMicroseconds(10);
 digitalWrite(triggerPin,LOW);
 int duration = pulseIn(echoPin,HIGH);
 distance = (duration/2) / 29.1;
 Serial.println(distance);
 if(distance<=10){
 lcd.clear();
 lcd.setCursor(0, 0);
lcd.print("Door Open");
 lcd.setCursor(0, 1);
 lcd.print(distance);
 lcd.print("cm");
 myservo.write(90);

 }else{
 lcd.clear();
```

```
 lcd.setCursor(0, 0);
 lcd.print("Door Closed");
 lcd.setCursor(0, 1);
 lcd.print(distance);
 lcd.print("cm");
 myservo.write(0);
 }
 delay(250);
}
```

SOURCE CODE (without I2C Module)

```
#include <Servo.h>
#include <LiquidCrystal.h>
#include <HCSR04.h>
Servo myservo;
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int distance=0;
byte triggerPin = 13;
byte echoPin = 6;
int pos = 0;
void setup() {
 myservo.attach(9);
 Serial.begin(9600);
 lcd.begin(16, 2);
 pinMode(triggerPin, OUTPUT);
 pinMode(echoPin,INPUT);
 lcd.print("All set up");
}
void loop() {
digitalWrite(triggerPin,LOW);
 delayMicroseconds(5);
 digitalWrite(triggerPin,HIGH);
 delayMicroseconds(10);
 digitalWrite(triggerPin,LOW);
 int duration = pulseIn(echoPin,HIGH);
 distance = (duration/2) / 29.1;
 Serial.println(distance);
 if(distance<=10){
 lcd.clear();
 lcd.setCursor(0, 0);
```

```
 lcd.print("Door Open");
 lcd.setCursor(0, 1);
 lcd.print(distance);
 lcd.print("cm");
 myservo.write(90);

 }else{
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("Door Closed");
 lcd.setCursor(0, 1);
 lcd.print(distance);
 lcd.print("cm");
 myservo.write(0);
 }
 delay(250);
}
```