T.C.
FIRAT ÜNİVERSİTESİ
YAZILIM MÜHENDİSLİĞİ BÖLÜMÜ

YMÜ338 MİCROPROCESSORS AND PROGRAMMİNG
YMÜ338 MİKROİŞLEMCİLER VE PROGRAMLAMA

SMART HAND SANİTİZER MACHİNE PROJECT

Ömer AKRUM

TABLE OF CONTENTS

Page No

ABSTRACT

Smart Hand Sanitizer Machine Project

Ömer AKRUM

FIRAT ÜNİVERSİTESİ
Yazılım Mühendisliği Bölümü

Smart Hand Sanitizer Machine Project (Akıllı El Dezenfektan Makinesinin Projesi). It's Software Engineering College Project. YMÜ338 Microprocessors and Programming (YMÜ338 Mikroişlemciler ve Programlama) course project of the software engineering program at Firat University. The main objective of this project is to work on a smart hand sanitizer machine that this machine work without touching a liquid soap box, in order to reduce the spread of the covid-19 virus. The method used to achieve the objectives of this project is by using the Arduino. In addition to the way the smart hand sanitizer machine works by means of a sensor, I will also add to this project the possibility of working a this machine based on a password to learn how to work passwords with machines b using Arduino.

LIST OF FIGURES

Page No

LIST OF TABLES

Page No

1. INTRODUCTION

In covid-19 pandemic period which is a global outbreak, hand hygiene is the core preventive measure in the spread of the disease with COVID-19 transmission mainly spreading between people through direct, indirect (through contaminated objects or surfaces), or close contact with infected people via mouth and nose secretions, washing hands with soap and running water is of critical importance. In order to eliminate most of the germs on the hands, one needs to apply a good hand washing practice but this will make the hand sanitizer dispenser to be contaminated. For this reason, I decided to work on designing a smart hand sterilization machine in order for this machine to work without touching the bottle of liquid soap, in order to limit the spread of the Covid-19 virus. I have been using an Arduino to work on this project. I also chose to add another working method to the smart hand sanitizer machine by entering a password, as this project allows the machine to be used in two different ways at the same time.

2. PROPOSED SYSTEM

I used Arduino Uno for working on this project. The input to the Arduino is given using an ultrasonic sensor, which is used to sense the distance, it emits ultrasonic frequency from one side and the notes the time taken by sound wave to get reflected back. The ultrasonic sensor is used to detect hands with a distance of approximately 10 cm from the sensor. If a human hand has been detected, the sensor will send input to the Arduino Uno as a microcontroller.

The Arduino Uno microcontroller is the control main which has a program to access data from the input of the ultrasonic sensor. The Arduino gives a 100ms pulse from it's digital output pin. The pump cannot be used directly, hence a relay is used as a switch. The relay accepts the pulse from Arduino and makes the pump run which pumps out a few drops of hand sanitizer on to the hands, after pumping, the distance is sensed for every 1000ms(1s) for scanning purposes.

3. TOOLS & SPECIFICATIONS

3.1. 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 outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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.

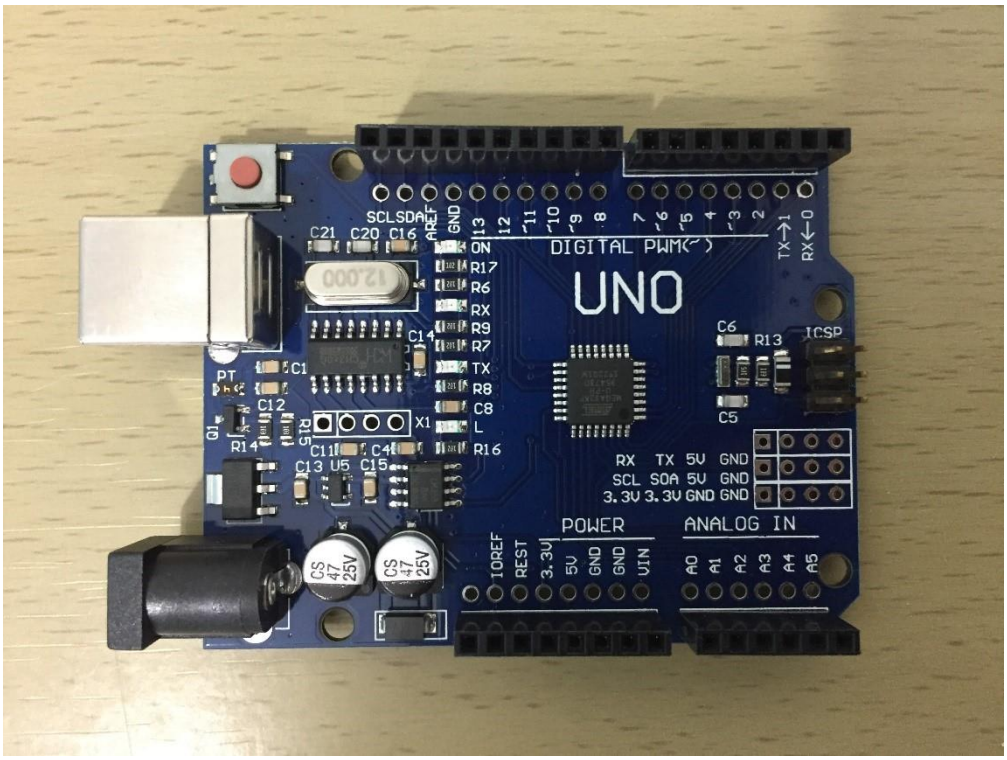

Figure 1. Arduino Uno

Arduino Uno Technical Specifications:

Microcontroller: ATmega328
Working Voltage: 5V
Input Voltage (recommended): 7-12V
Input Voltage (limit): 6-20V
Digital I/O Pins: 14 (6 of which are PWM outputs)
Analog Input Pins: 6
Current per I/O: 40 mA
Current for 3.3V Output: 50 mA
Flash Memory: 32 KB (ATmega328) 0.5 KB from bootloader
SRAM: 2 KB (ATmega328)
EEPROM: 1 KB (ATmega328)
Clock Speed: 16MHz
Length: 68.6mm
Width: 53.4mm
Weight: 25g

3.2. Distance sensor

Ultrasonic distance sensor is this type of ultrasonic sensor that can measure from 2cm to 400cm with 3mm precision. It is possible to use the HC SR04 ultrasonic distance sensor.

Figure 2. Distance sensor

HC-SR04 Technical Specifications:

Working Voltage: DC 5V
Current Drawn: 15 mA
Operating Frequency: 40 Hz
Maximum Seeing Range: 4m
Minimum Visual Range: 2cm
Viewing Angle: 15°
Trigger Leg Input Signal: 10 us TTL Pulse
Echo Output Signal: Input TTL signal and Distance Ratio
Dimensions: 45mm x 20mm x 15mm

3.3. Servo Motor

Tower Pro MG996R High Torque Servo Motor - 13KG 360 Degrees

Servo is defined as a drive system that accurately controls the angular-linear position, speed and acceleration of mechanisms. In other words, it is a motion-controlled mechanism. Although servo motors are the most used motor type in robot technologies, they are also used in RC (Radio Control) applications. RC Servo Motors were first used in remote controlled model vehicles. Servos are designed to take the desired position and not change its position unless a new command is received. Servo motors can be used for many different purposes.

Figure 3. Servo Motor

Tower Pro MG996R High Torque Servo Motor Technical Specifications:

Model: MG996R
Control System: +Pulse Width Control
(RX) Required Pulse: 3.0 ~ 5V Peak-to-Peak Square Wave
Working Voltage: 4.8 ~ 7.2V/DC
Carrying Capacity: 13KG
Rotation Angle: 360 Degrees
Gear Type: Metal Gear
Box Material: Sturdy Plastic
Programmable: NO
Connector Type: JR
Connector Cable Length: 32.0cm
Weight: 50gr

3.4. 4X4 Membrane Keypad

4x4 Keypad- 4x4 Keypad; The keypad with 16 keypads provides support for your microcontroller projects. You can mount it easily thanks to the adhesive surface on the back. It is used as a hardware tool to input your information in your projects. It works compatible with Arduino and other small processors. Since it has 16 keypads, there is a special membrane switch under each key. All these membrane switches are connected to each other by a conductive line under the pad forming a grid matrix.

Figure 4. 4X4 Membrane Keypad

4x4 Keypad Technical Specifications:

Maximum Efficiency:24V/DC

Operating Temperature:0/5°C

Interface:8-pin access to 4x4 matrix

Table 1. Component list on tinkercad web app

Name	Quantity	Component
U1	1	Arduino Uno R3
DIST1	1	Ultrasonic Distance Sensor
KEYPAD1	1	Keypad 4x4
SERVO1	1	Micro Servo
D1	1	Red LED
D2	1	Blue LED
PIEZO1	1	Piezo
R1 R2	2	1 kΩ Resistor

4. HARDWARE MODELLING

4.1. Circuit Diagram

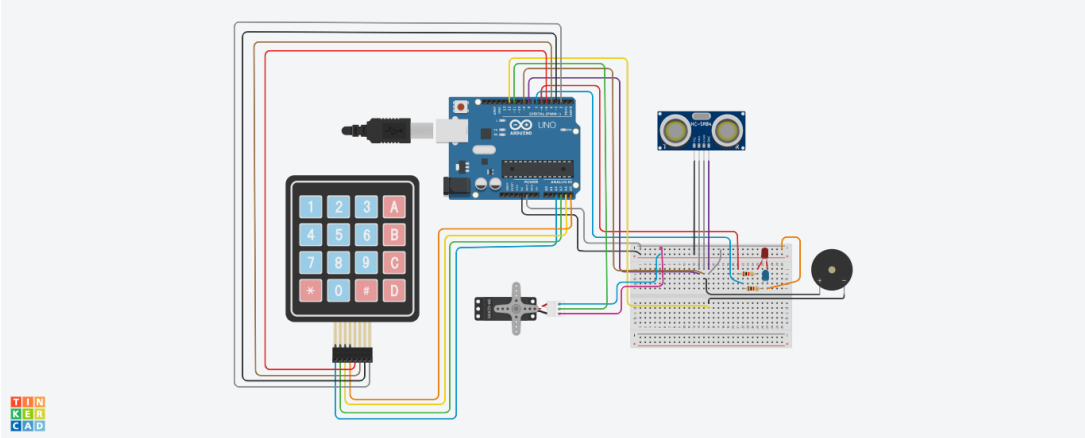

Figure 5. Circuit Diagram

4.2. Schematic Diagram

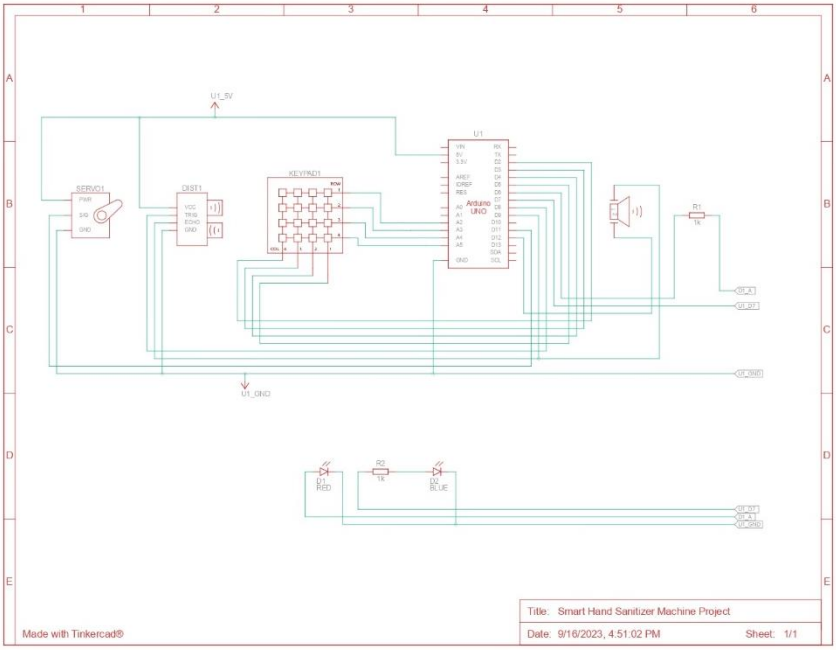

Figure 6. Schematic Diagram

5. WORKING PRINCIPLE

Whenever the user puts his/her hand at a distance less than 10 cm, the ultrasonic sensor detects it. The signal from the ultrasonic sensor is then processed and obtained in the Arduino Microcontroller. Then Arduino will send an output signal to the motor driver, LEDs and Buzzer. Also Servo Motor will make a motion to press the liquid soap bottle high part out to use it.

In addition to the way the smart hand sanitizer machine works by means of a sensor, I will also add to this project the possibility of working a this machine based on a password to learn how to work passwords with machines b using Arduino. When the correct password is entered, the Servo Motor will start and the blue LED will turn on. If the password is wrong, the red LED and the buzzer will turn on.

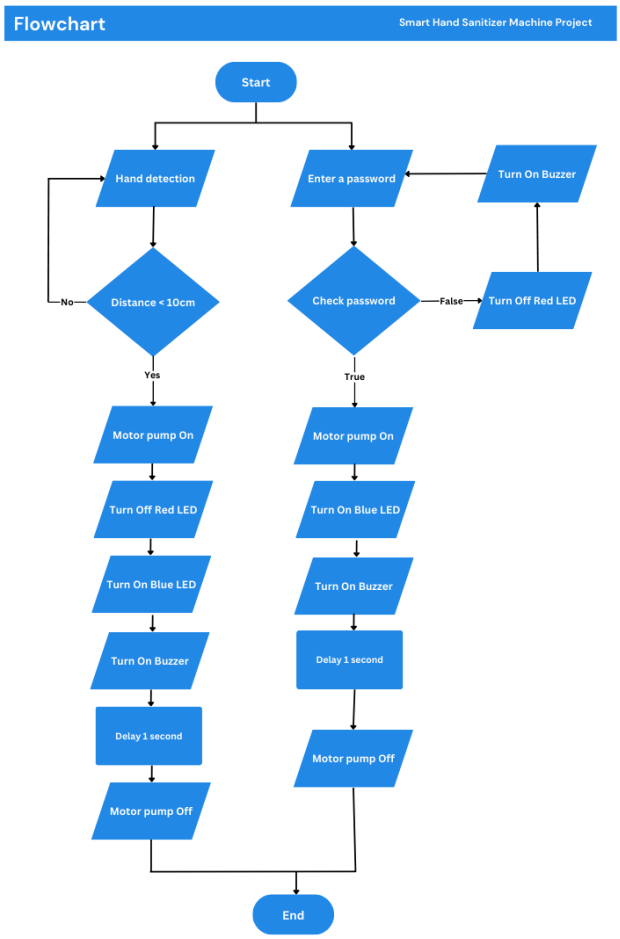

Figure 7. Flowchart

6. SOURCE CODE

```
#include <Keypad.h>
#include<Servo.h>
#define ledr 6
#define ledb 7
#define trig 8
#define echo 9
#define buzzer 12

int kere=0;
const byte ROWS = 4;
const byte COLS = 4;
char keys[ROWS][COLS] = {
  {'1','2','3','A'},
  {'4','5','6','B'},
  {'7','8','9','C'},
  {'*','0','#','D'}
};
byte rowPins[ROWS] = {A2, A3, A4, A5};
byte colPins[COLS] = {5, 4, 3, 2};

Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );
char pass[4];
char storepass[]="1234";
int i,count, pos = 0;
Servo myservo;

void setup(){
  pinMode(trig,OUTPUT);
  pinMode(echo,INPUT);
  pinMode(ledb,OUTPUT);
  pinMode(ledr,OUTPUT);
  pinMode(buzzer,OUTPUT);
  Serial.begin(9600);
```

```
myservo.attach(11);
}

void loop(){

 char key = keypad.getKey();
  if (key && key!='D'){
     Serial.print(key);

     pass[i]=key;
     i++;
    }else if(key=='D')
    {
      if(i==4){
        for(int j=0;j<4;j++){
          if(pass[j]==storepass[j]){
            count++;
          }
        }
        if(count==4){
           kere++;
          Serial.print("\nŞifre Doğru, Basım sayısı= ");
          Serial.print(kere);
          Serial.println(" kere");
          for (pos = 0; pos <= 540 ; pos += 1)
  {
    myservo.write(pos);
    digitalWrite(ledb,HIGH);

    delay(1);


  }
  delay(100);
  for (pos = 540; pos >= 0; pos -= 1)
  {
```

```
  myservo.write(pos);
  digitalWrite(ledb,LOW);

  delay(1);
}
       delay(1000);
       i=0;
       count=0;

     }else{
       Serial.println("\nŞifre Yanlış, lütfen tekrar deneyin ");
     digitalWrite(ledr,HIGH);
     digitalWrite(buzzer,HIGH);
     delay(1000);
     digitalWrite(ledr,LOW);
     digitalWrite(buzzer,LOW);
     i=0;
     count=0;
     }
   }else {
     Serial.println("\nŞifre Yanlış, lutfen tekrar deneyin ");
     digitalWrite(ledr,HIGH);
     digitalWrite(buzzer,HIGH);
     delay(1000);
     digitalWrite(ledr,LOW);
     digitalWrite(buzzer,LOW);
     i=0;
     count=0;

     }
  }
```

```
      if (calc_dis()<10)
{
 for (pos = 0; pos <= 540 ; pos += 1)
 {
  myservo.write(pos);
  digitalWrite(ledb,HIGH);
  digitalWrite(buzzer,HIGH);
  digitalWrite(ledr,LOW);
  delay(1);


 }
 delay(100);
 kere++;
 Serial.print("Basım sayısı= ");
 Serial.print(kere);
 Serial.println(" kere");
 for (pos = 540; pos >= 0; pos -= 1)
 {
  myservo.write(pos);
  digitalWrite(ledb,LOW);
  digitalWrite(buzzer,LOW);
  digitalWrite(ledr,HIGH);

  delay(1);
 }

 delay(100);
}

}
```

```
int calc_dis()
{
  int duration,distance;
  digitalWrite(trig,HIGH);
  delay(10);
  digitalWrite(trig,LOW);
  duration=pulseIn(echo,HIGH);
  distance = (duration/2) / 29.1;
  return distance;
}
```

7. RESULTS & DISCUSSIONS

Testing of the smart hand sanitizer machine project is in the form of testing the success rate of the project. Arduino was used as a microcontroller for calculating the distance between the sensor and the hand placed below it. If it is less than 10cm, then pump runs for 100ms through a relay and pumps out few mL of liquid soap based bottle and also senses the distance for every 1000ms. Components like pump, relay, Arduino microcontroller were tested. Testing is done by testing the ultrasonic sensor by placing your hands at a certain distance, namely 4 cm, 8 cm, and 10 cm.

Table 2. The success rate of project using distance sensor

Testing No	**The Distance**		
	4 cm	8 cm	10 cm
No 1	100%	100%	0%
No 2	100%	100%	0%
No 3	100%	100%	0%
No 4	100%	100%	0%
No 5	100%	100%	0%
No 6	100%	100%	0%
No 7	100%	100%	0%

8. CONCLUSIONS

The World Health Organization says that non contact dispensing is very important to prevent pathogen spreading and finally, hand hygiene is most important and must be part of our daily life. In this report, a new design for a smart hand sterilization machine was presented. The components needed for the machine fabrication were described in detail. The relevant diagrams and components of the machine were presented in sequential order for a better understanding. Arduino Uno was used to input the program into the microcontroller. The algorithm used in this device was described with a flowchart to depict the functionality of the machine. Based on the results of the testıng on the smart hand sanitizer machine the machine can work well when the hands are at a distance of 9 cm or using keypad.

9. REFERENCES

[1] WHO Guidelines on Hand Hygiene in Health Care. World Health Organization.

[2] To learn the basics of Arduino or electronics you can learn from the arduino.cc it's very useful.

[3] JavaTpoint provides Arduino Tutorial.

[4] Arduino Course for Beginners - Open-Source Electronics Platform.

[5] I created circuit diagram, schematic diagram of the project and I learned more about electronics with Tinkercad is a free web app for 3D design, electronics, and coding, trusted by over 50 million people around the World.

[6] I created a flowchart with Canva's free online flowchart maker.

[7] To see all the practical steps of the project, you can watch my video on YouTube.