ES1113: Fundamentals of Automation Engineering II

Programme: BTECHCS

PROJECT 1

SECTION: **B**

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Report Format:

1.Title of Project

2.Problem Statement

3.Block Diagram and Circuit Diagram

4.Working

5.Result Analysis

6.References

Title Of Project: Automatic Hand Sanitizer Dispenser

SDG: Our project is based on SDG 3 – Good Health and Well-Being and SDG 6 – Clean Water and Sanitization.

Introduction:

Hygiene is an important aspect to remain healthy. Our hands are generally touched at various surfaces and can be exposed to direct contamination. Cleaning hands at regular interval is recommended by various health organizations including WHO. This is a modern and innovative solution to the problem of maintaining hygiene in public spaces without the fear of contacting germs and dirt. The project utilizes Arduino Nano, ultrasonic sensor, servo motor, switches, voltage regulator ICs (7805) and batteries to create a contactless and efficient dispenser that can be used in homes, schools, hospitals etc. It can be customized and scaled according to the user's requirements, making it a versatile and cost-effective solution for maintaining cleanliness and health.

Problem Statement:

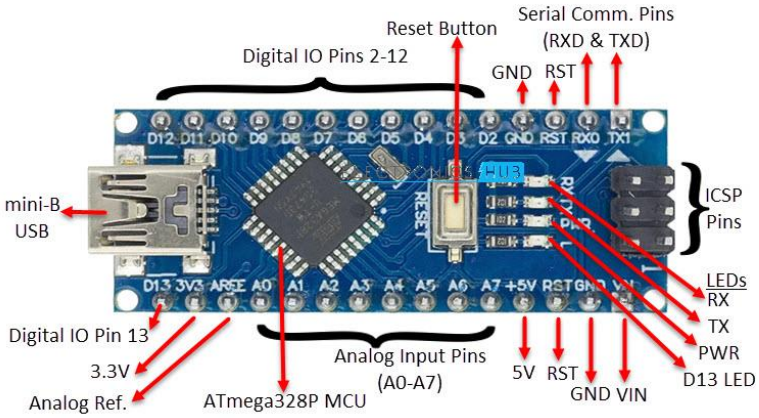
In many places in India, the traditional method of dispensing hand sanitizer often involves touching the dispenser which is not hygiene friendly and can lead to the transmission of germs and infectious agents, especially in public spaces and poses a significant health risk. Therefore, there is a need for a contactless and efficient hand sanitizer dispenser being cost-friendly that can be easily accessed in various settings, including homes, schools, hospitals etc. The solution to this problem is developing an innovative and practical automatic hand sanitizer dispenser to create a touchless and hygienic solution that reduces the spread of infectious diseases in public spaces.

Components Required:

1) Laptop/PC with Arduino IDE installed to upload code to Arduino

2) 1 x Arduino Nano with cable –

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.



3) Wires –

They are flexible pieces of metal that establish electrical conductivity between two devices on a electric circuit. They possess negligible resistance to the passage of current. They are covered by an insulated coating.

4) 4 x 3.7V Rechargeable cells with holder –

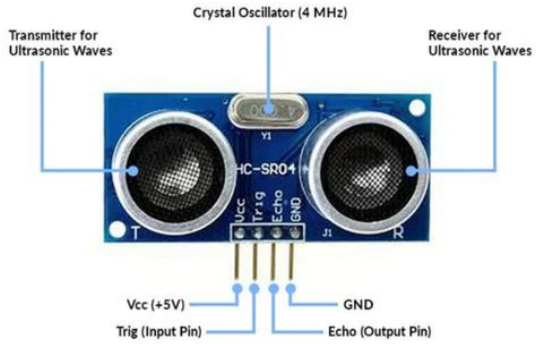
18650 Li-ion battery is a lithium-ion rechargeable battery and is used in high drain applications due to its superior capacity and discharge rate.

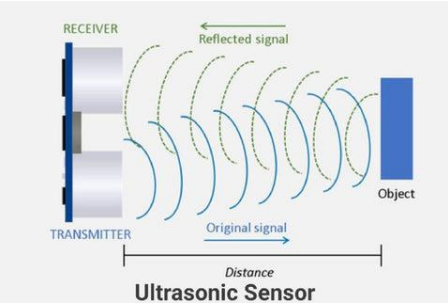
5) 1 x Servo Motor (Tower Pro MG995) –

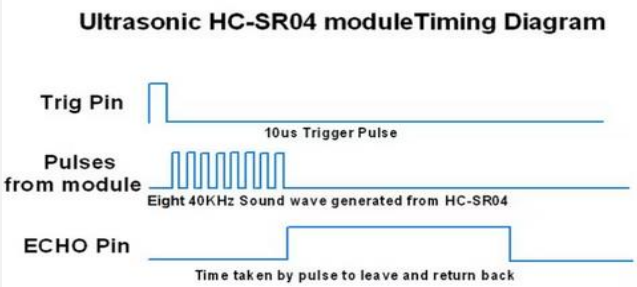
A motor whose position can be controlled by using a microcontroller like Arduino. This motor is metal geared, has high torque and provides precise rotation over 180^{o} while having a long life. Can take voltage 4.8 – 7.2 volts.

6) 1 x Ultrasonic sensor (HC – SR04) –

The ultrasonic sensor is an electric device used to measure distances. Ultrasonic sensors are used as proximity sensors. Compared to infrared (IR) sensors, ultrasonic sensors are less susceptible to interference from smoke, gases etc. and can work with more distance and is more accurate. Ultrasonic sensors will send sound waves in the direction of the target and calculate its distance by timing how long it's takes for the waves to bounce back to the sensor.

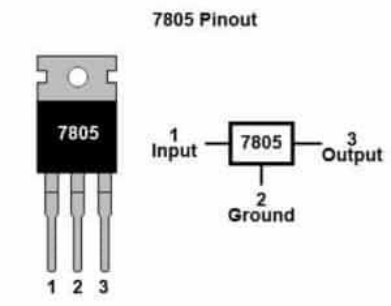






7) 2 x 5 Volt Regulator IC (7805) –

It is a three-terminal voltage regulator IC and is used to provide a fixed 5V output voltage for varied input voltage supply.



8) <u>2 x Switch</u> –

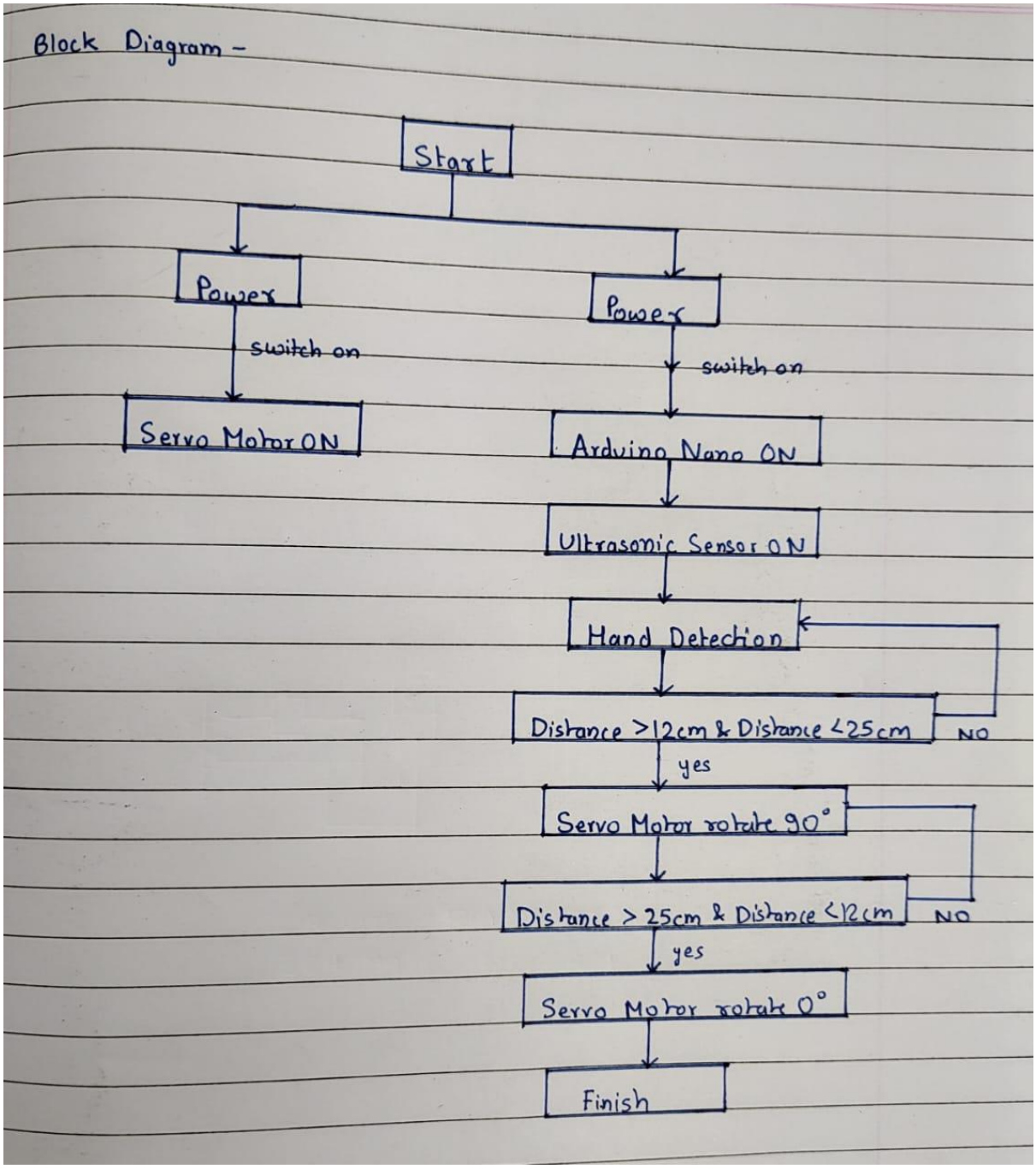
A switch with two positions open or closed. Which closes or opens the circuit when slid.

9) <u>1 x Hand Sanitizer</u> –

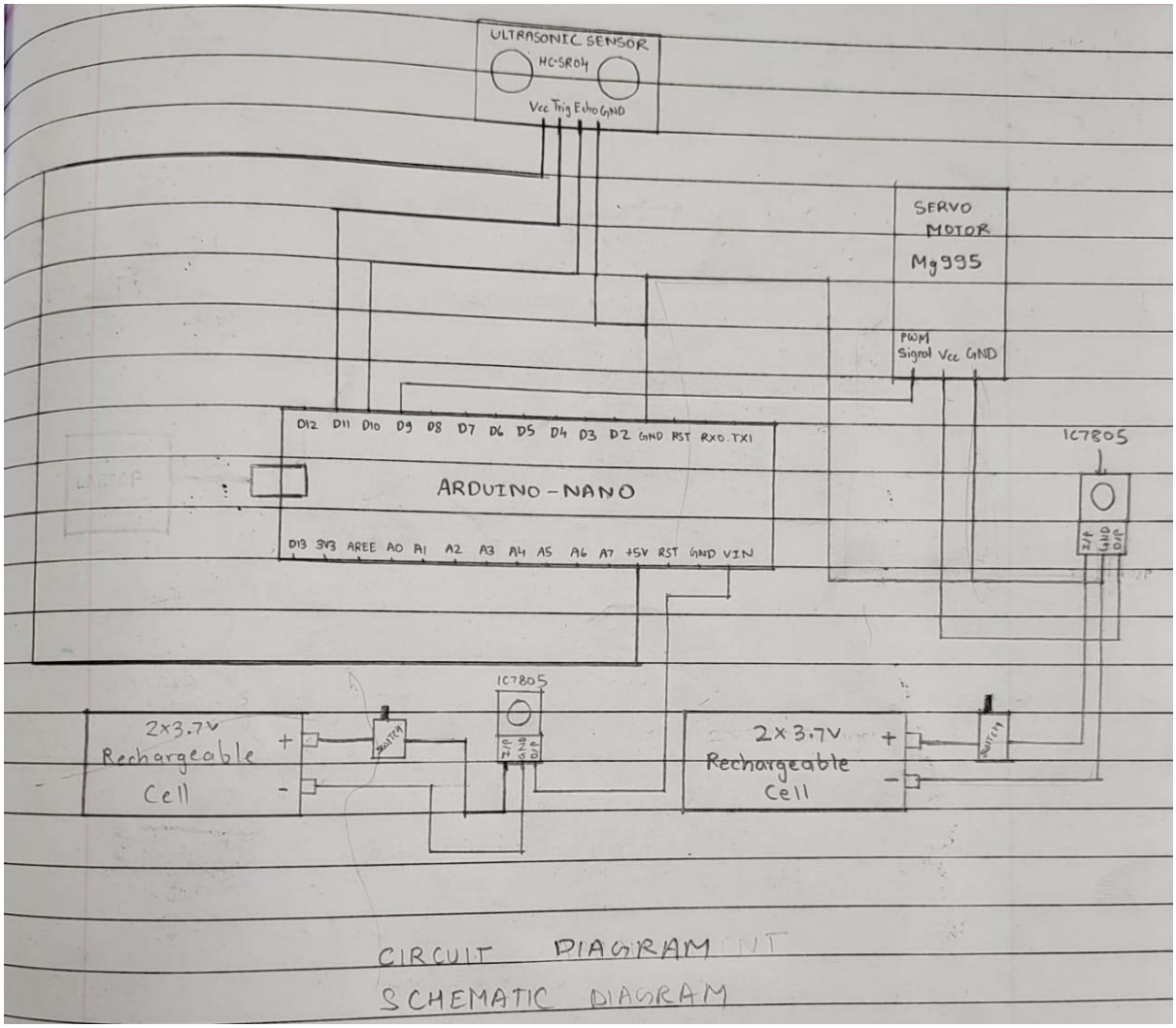
Soap and water work to remove all types of germs from hands while sanitizer acts by killing certain germs on the skin. Alcohol-based hand rubs are the best alternative to soap and water for washing hands and surfaces.

Block Diagram and Circuit Diagram:

Block Diagram:



Circuit Diagram:



This functions and works after uploading the following code to Arduino Nano chip via Arduino IDE

Code:

```
#include <Servo.h>

const int Echo  = 10;
const int Trig  = 11;
const int SERVO = 9;

Servo servo;

float duration, distance_cm;

void setup() {
  Serial.begin (9600);
  pinMode(Echo, INPUT);
  pinMode(Trig, OUTPUT);
  servo.attach(SERVO);
  servo.write(90);
}

void loop() {
  digitalWrite(Trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(Trig, LOW);

  duration = pulseIn(Echo, HIGH);
  distance_cm = 0.017 * duration;

  if(distance_cm > 12 && distance_cm < 25 )
    servo.write(0);
  else
    servo.write(90);

  Serial.print("Distance= ");
  Serial.print(distance_cm);
  Serial.println(" cm");

  delay(500);
}
```

Working:

After connecting the circuit and uploading the code as shown above

1. Power Supply – We are using two batteries. First battery is connected to Arduino via a switch and a voltage regulator IC (7805). Second battery is connected to servo motor via a switch and a voltage regulator IC (7805). We are using IC so that only 5V gets supplied to both Arduino and motor from input Voltage supply. We use a switch to avoid unnecessary battery drain.
2. Switch – After the switches are turned on, the power goes to Arduino nano, servo motor and ultrasonic sensor.
3. Ultrasonic Sensor Detection: The project starts by detecting the presence of a user's hand using the ultrasonic sensor. The sensor emits ultrasonic waves that bounce off the user's hand and return to the sensor. The time taken for the waves to return is measured, and the distance to the user's hand is calculated.
4. Distance Calculation: The distance to the user's hand is calculated based on the time taken for the ultrasonic waves to return to the sensor. The Arduino Nano compares this distance with a predefined threshold value to determine whether the user's hand is within range of the dispenser. Here we put condition for hand to be in range > 12cm and <25cm from ultrasonic sensor.
5. Servo Motor Activation: If the user's hand is within range, the Arduino Nano activates the servo motor. The servo motor rotates 90^{o} and pushes the top of the sanitizer bottle to dispense the sanitizer onto the user's hand.
6. Sanitizer Dispensing: The top of the sanitizer bottle is pushed by the servo motor, and the sanitizer is dispensed onto the user's hand. Once the hand is removed, the servo motor returns to its initial position by rotating back to 0^{o}, ready for the next user.

Result Analysis:

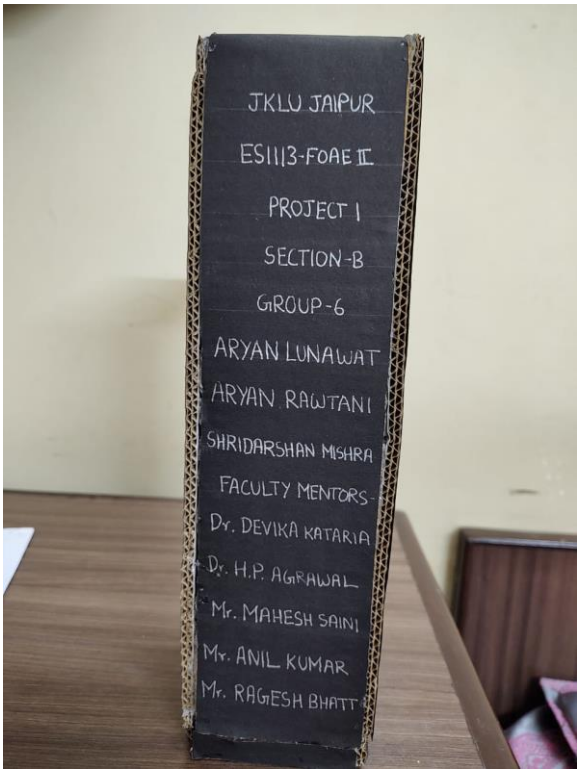
Result –

The project successfully accomplishes its intended purpose by automatically dispensing sanitizer when a user's hand is detected within the predefined range. The dispenser effectively detects the presence of a hand using the ultrasonic sensor and accurately calculates the distance to determine if it falls within the appropriate range. When a hand is within range, the servo motor is activated, causing the sanitizer bottle's top to be pushed and dispensing sanitizer onto the user's hand. The servo motor returns to its initial position once the hand is removed, preparing for the next user. The power supply system, with two batteries and switches, ensures efficient and controlled power distribution to the Arduino, servo motor, and ultrasonic sensor.

Analysis –

- Accuracy of ultrasonic sensor plays a critical role to determine the effectiveness of the dispenser and can detect hand inaccurately if damaged or uncalibrated leading to dispensing errors. Therefore, it’s accuracy must be tested and verified.
- Servo Motor’s performance needs to be calibrated correctly in order to successfully push the top. If not, it may not push the top with required angle due to calibration error.
- Battery life should be sufficient and adequate as it is powering many components. If it’s not, it won’t be able to operate continuously for an extended period of time.
- Distance Threshold should be set accurately and according to need otherwise the sanitizer could dispense anytime even when the hand is not present.
- We should handle solder machine carefully.

Images of our project –



Video Link –
https://drive.google.com/file/d/1va0TXkzwRK8Sw_NFgyQvVFKpZ7F_H6Zq/view?usp=share_link

Distinctive Features –

- The usage of battery makes the dispenser mobile and portable even in areas without power supply. It is also rechargeable so that user could charge whenever needed.
- Switch ensures battery conservation and avoids unnecessary battery drain when not in use with easy activation and deactivation of system.
- It is customizable and scalable as the user can change the distance threshold and angle of servo motor according to their needs.
- It has an opening for attaching cable if user wants to change the code.
- We placed the ultrasonic sensor above so that the sanitizer does not damage it.
- If we place our hand where the sanitizer is not present, the sanitizer will not dispense. It also has a feature that it will stay pressed as long as the user has hand below it and will go back to it's position when hand is removed.
- It is easy to build and construct.
- It is cost effective and affordable.
- We can use it anywhere and anytime.

Conclusion –

We successfully created and demonstrated a fully working and functional Automatic hand sanitizer dispenser. This project is an efficient and user-friendly way to help the users provide hygiene. It effectively detects the presence of a user's hand and dispenses sanitizer in a controlled manner. The system is designed to conserve power and offers a user-friendly experience. It provides a reliable and convenient solution for maintaining hand hygiene in various settings such as public places, offices, and hospitals.

Overall, the automatic hand sanitizer dispenser project demonstrates an effective implementation of automation and technology to promote hand hygiene. It combines user convenience, hygiene, power efficiency, and adaptability, making it a valuable solution for maintaining cleanliness and reducing the spread of germs and illnesses.

Learning Outcomes –

1)We have gained knowledge and experience in designing circuits, connecting components, and understanding the basics of electronics. This includes understanding how to wire and interface the Arduino Nano with the servo motor and battery.

2)We learned how to program the Arduino Nano using the Arduino IDE. This includes writing code to control the servo motor and respond to sensor inputs.

3)We learned about mechanical design considerations when building a dispenser. This includes selecting and integrating the servo motor into the system, designing a mechanism for dispensing the sanitizer, and ensuring the overall structural integrity of the dispenser.

4)As you work on the project, you may encounter challenges and issues that require problem-solving and troubleshooting skills. This could involve debugging code, resolving mechanical issues, or identifying and fixing circuitry problems. These skills are valuable in many other areas of engineering and technology.

5)By creating an automatic hand sanitizer dispenser, we can will raise awareness about the importance of proper hand hygiene. We will gain a deeper understanding of the need for such devices in public places and the potential impact on health and safety.

References –

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THANK YOU!