MINI PROJECT REPORT

ON

SMART WASTEBIN

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Index

Sl.No.	Chapter Name	Page No.
1.	Abstract	
2.	Introduction	
3.	Literature Review / Background Study	
4.	Problem Statement	
5.	System Requirements	
6.	System Design	
7.	Implementation	
8.	Results and Output	
9.	Discussion and Analysis	
10.	Applications and Future Scope	
11.	Conclusion	
12.	References	
13.	GitHub link of the project	

1. Abstract

This project demonstrates a Smart Dustbin system that fully automated and dispenses with any physical contact. When motion is sensed nearby using a PIR sensor, the dustbin opens its lid and further checks whether the dustbin is full with an ultrasonic sensor. The main controller for this system is Arduino UNO, then a servo motor and two LEDs represent the physical actuation and bin status showing when the bin is empty or not. The green LED glows when the bin is empty, and the red LED lights up when the bin is full. The entire circuit was simulated within Tinker cad. In general, this project encourages hygiene and convenience with a simple, low-cost automatic waste disposal option.

2. Introduction

Touching dustbins directly can be unhygienic, especially in public places. To make waste disposal contactless, this project uses **Arduino UNO** to control a servo-based dustbin that opens automatically when motion is detected. The **PIR sensor** detects nearby movement (like a hand or person), while the **ultrasonic sensor** measures how full the dustbin is. LEDs are used to visually indicate the dustbin's status.

This project shows how Arduino and basic sensors can work together to create simple automation systems that are useful in daily life.

3. Literature Review / Background Study

There are a range of smart dustbin projects available, each of which consists of ultrasonic or IR sensors that detect the presence of an object. In this smart dustbin, the combination of a PIR sensor (for motion) and an ultrasonic sensor (for fill level) makes it somewhat more advanced.

The ultrasonic sensor measures the distance from the top of the dustbin to the surface of the waste, while the PIR sensor allows detection based on motion.

In comparison to simpler systems, this provides more automation and the ability to reduce false triggering.

4. Problem Statement

Many people do not want to touch trash bins to avoid the risk of infection and to stay clean at home and other places. The issue is developing a system that opens the cover of the trash bin automatically when someone approaches it, as well as detects when the bin is full. The system should be simple and inexpensive for home as well as clean institutional use.

5. Apparatus Requirements

Hardware Components:

- Arduino UNO
- PIR Motion Sensor
- Ultrasonic Sensor (HC-SR04)
- Servo Motor (SG90)
- Green LED (indicates open/ready)
- Red LED (indicates full)
- Resistors (220Ω for LEDs)
- Connecting wires

Software Requirements:

- Arduino IDE
- Tinker cad (for simulation and circuit testing)
- Programming Language: Embedded C

6. System Design

The system has three main functions:

1. **Motion Detection:** The PIR sensor detects nearby movement (e.g., a person's hand).
2. **Lid Control:** When motion is detected, the Arduino signals the servo motor to rotate and open the lid.
3. **Fill-Level Detection:** The ultrasonic sensor measures the height inside the bin. If the distance is below a certain level (≤7 cm), it means the bin is full, and the red LED lights up.

Flow of Operation:

- Initially, the lid is closed, and the red LED is OFF.
- When motion is detected, the lid opens for a short time.
- If the bin's height reading from the ultrasonic sensor indicates fullness, the red LED turns ON.
- Otherwise, the green LED remains ON to show it's ready for use.

7. Implementation

The circuit was designed in **Tinker cad** using the Arduino UNO board. Connections were made as follows:

- **PIR sensor** connected to digital pin 4.
- **Servo motor** connected to digital pin 2.
- **Ultrasonic sensor:** Trigger → pin 13, Echo → A0.
- **Green LED** connected to pin 8.
- **Red LED** connected to pin 11.

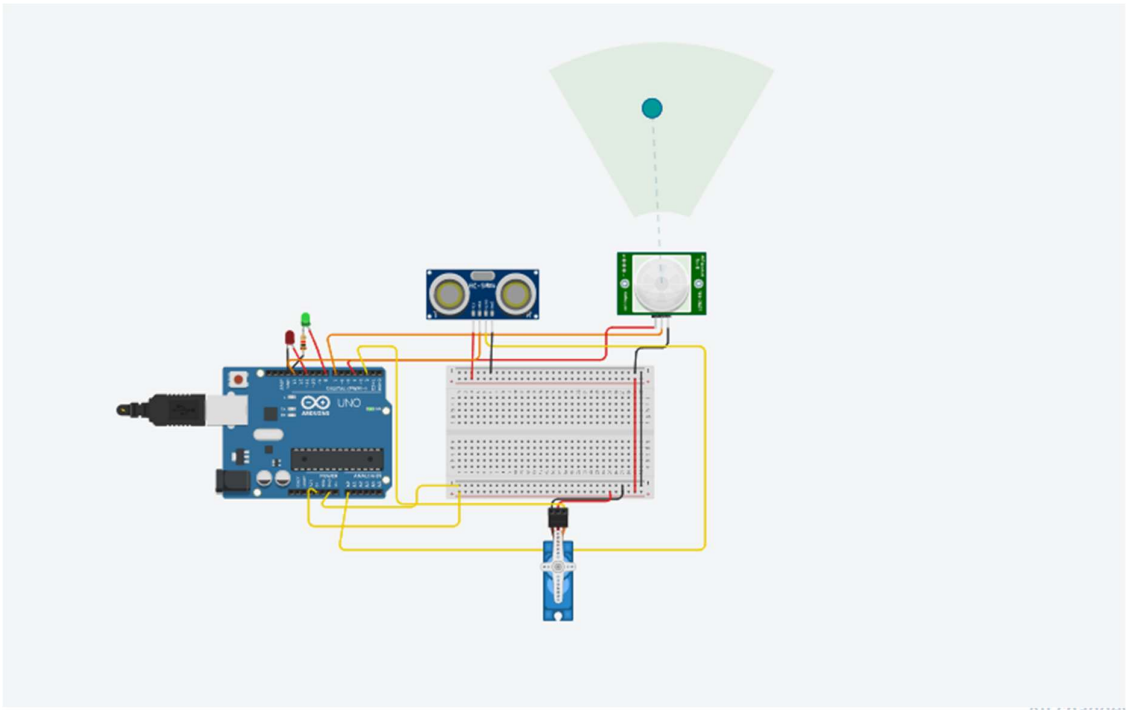
When powered on, the Arduino continuously reads data from the PIR and ultrasonic sensors. The servo motor operates based on motion, and LEDs indicate whether the bin is full or empty.

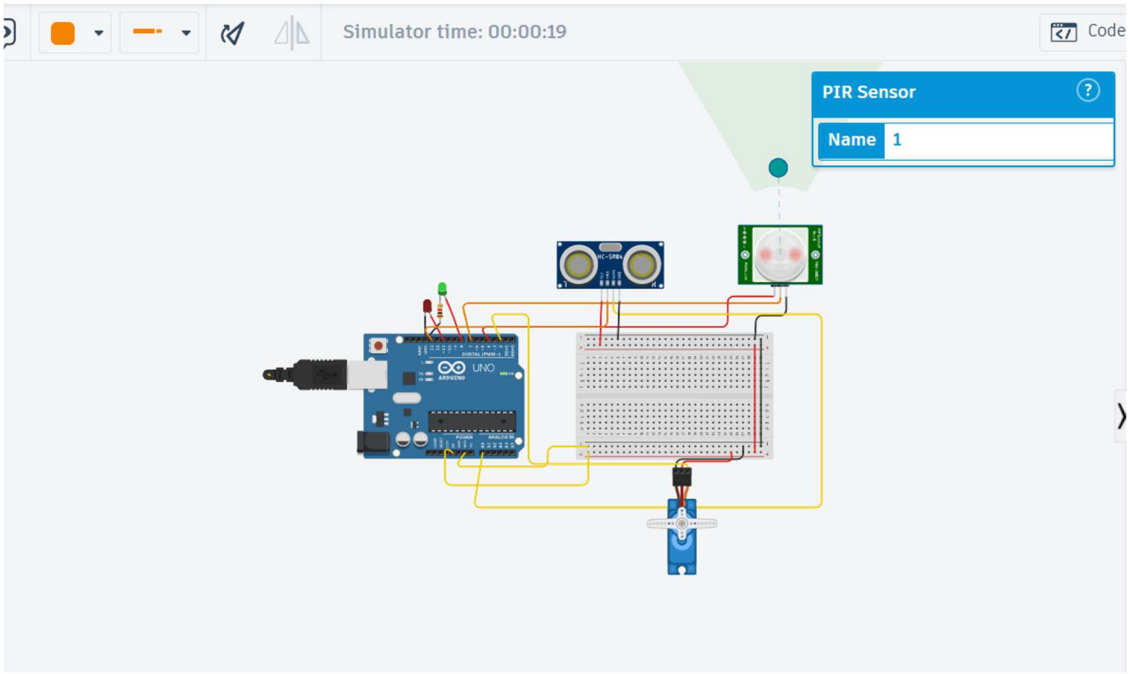
Arduino Code:

```
#include <Servo.h>

int movement = 0;

int height = 0;

int i = 0;

int j = 0;

Servo servo_2;

long readUltrasonicDistance(int triggerPin, int echoPin)
{
  pinMode(triggerPin, OUTPUT);
  digitalWrite(triggerPin, LOW);
  delayMicroseconds(2);

  digitalWrite(triggerPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(triggerPin, LOW);
  pinMode(echoPin, INPUT);

  return pulseIn(echoPin, HIGH);
}

void setup()
```

```
{
  pinMode(8, OUTPUT);
  pinMode(11, OUTPUT);
  servo_2.attach(2, 500, 2500);
  pinMode(13, OUTPUT);
  pinMode(7, OUTPUT);
  pinMode(4, INPUT);
}

void loop()
{
  digitalWrite(8, HIGH);
  digitalWrite(11, LOW);
  servo_2.write(0);
  digitalWrite(13, HIGH);
  height = 0.01723 * readUltrasonicDistance(13, A0);
  if (height > 7) {
    digitalWrite(8, HIGH);
    digitalWrite(11, LOW);
    digitalWrite(7, HIGH);
    movement = digitalRead(4);
    if (movement == HIGH) {
    digitalWrite(7, LOW);
    servo_2.write(90);
    }
    delay(1000);
    digitalWrite(7, HIGH);
    movement = digitalRead(4);
    if (movement == LOW) {
    servo_2.write(0);
    }
  } else {
    if (height <= 7) {
      digitalWrite(8, LOW);
      digitalWrite(11, HIGH);

    }
  }
}
```

8. Results and Output





When simulated in Tinker cad, the PIR sensor successfully detected motion and activated the servo motor to open the lid. The **green LED** indicated the bin was ready for use. When the ultrasonic sensor detected that the waste

level was high (distance ≤ 7 cm), the **red LED** turned ON, showing that the bin was full. The lid responded smoothly and automatically closed after a short delay.

Tinker cad link- https://www.tinkercad.com/things/kFPGMwFqV5T-ppc-project-sem-3

9. Discussion and Analysis

The combination of the two sensors was successful in the simulation. The PIR sensor was highly sensitive and precise with motion sensing capabilities. The ultrasonic sensor reliably measured the distance needed to determine fullness. A small delay was integrated to prevent rapid lid movements and openings. The presence of LEDs also distinguished status signal clear visibility. The only challenge was that fine-tuning the height threshold and delay times.

10. Applications and Future Scope

Applications:

- Smart waste bins for homes, schools, and hospitals
- Touchless bins for public areas to maintain hygiene
- Automatic lids for recycling systems

Future Scope:

- Add a buzzer or IoT module to alert when the bin is full
- Add solar power for outdoor use
- Implement GSM module for automatic waste collection alerts

11. Conclusion

The Automatic Smart Dustbin has been successfully designed and simulated using the Arduino UNO. It uses the PIR and ultrasonic sensors to open automatically, and detect when it is full. This project demonstrates how automation can be practically utilized to improve hygiene. During this project, I have learned sensor integration, motor (servo) control, and circuit simulation using Tinker cad.

12. References

1. Arduino Official Website – https://www.arduino.cc
2. Tinkercad Circuits – https://www.tinkercad.com
3. Arduino Project Hub Tutorials
4. YouTube: Smart Dustbin Arduino Projects

13. GitHub Link of the Project

https://github.com/abhipillow06/PPC-PROJECT-SEM3