**ROBOTICS PROJECT**

# *SMART TRASH BIN*

## Project Report

**Submitted by:**


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***Youtube Link:*** ***Group-03_CSE461_Final Project_Smart Trash Bin***

# ***SMART TRASH BIN***

**Introduction:** In a world where efficiency, safety, and environmental sustainability are increasingly prioritized, innovative solutions are essential to address pressing challenges such as waste management. The smart trash bin project represents a step forward in this endeavor, integrating advanced technology to revolutionize traditional waste disposal methods. By combining sensors, actuators, and microcontrollers, this project aims to create a smarter, more efficient, and safer approach to waste management in both public spaces and households. With features such as automatic lid-opening, gas detection, and trash level monitoring, the smart trash bin offers unparalleled convenience, promotes hygiene, enhances safety, and contributes to resource conservation. This introduction sets the stage for an exploration of the project's components, functionality, and benefits in addressing contemporary waste management needs.

**The Hardware Used:**

- ➢ Arduino Uno
- ➢ Ultrasonic Sensor - HC-SR04 (Generic)
- ➢ Gas sensor
- ➢ IR sensor
- ➢ Red Led
- ➢ Buzzer
- ➢ Resistor 100 ohm
- ➢ Jumper wires
- ➢ Garbage container

**Gas sensor:** It operates on the principle of detecting changes in electrical conductivity when exposed to specific gas. Semiconductor gas sensors, for instance, use a semiconductor material like tin dioxide ($SnO_2$), heated to a high temperature. At this temperature, the semiconductor acts as a resistor. When target gasses are present, their molecules adsorb onto the surface of the semiconductor, altering its conductivity. This change in conductivity is measured, allowing the sensor to determine the presence and concentration of the target gas.

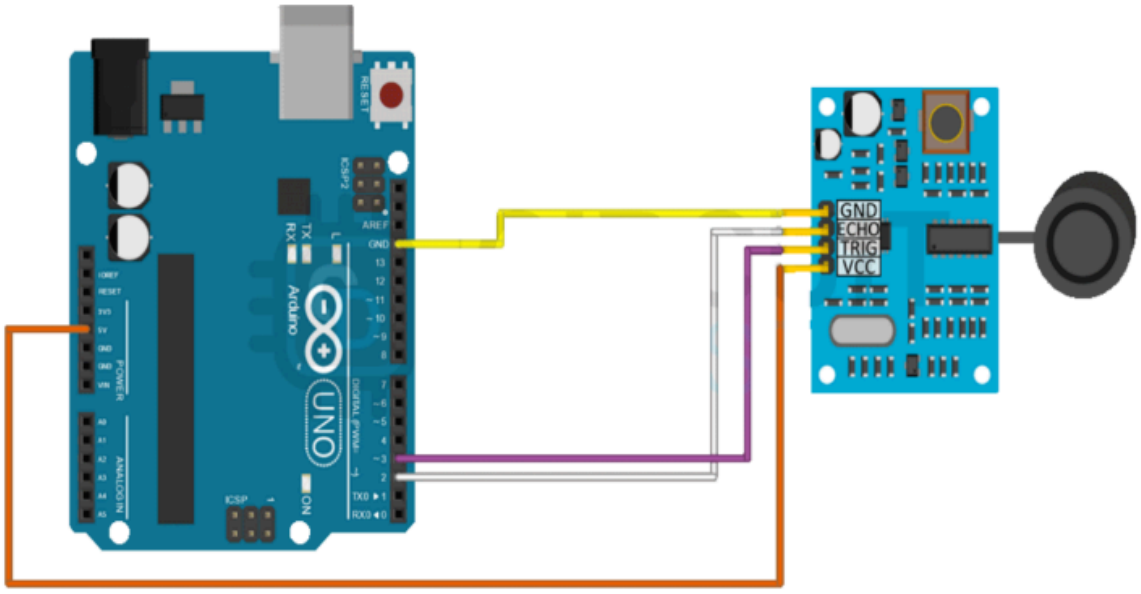
**Infrared (IR) sensor:** It functions by emitting and detecting infrared radiation, which is invisible to the human eye but can be detected by the sensor. These sensors typically consist of an IR emitter and an IR detector. The emitter emits infrared radiation, which interacts with objects in its path. Objects either reflect or absorb this radiation. The detector then receives the

reflected radiation. By analyzing the received signal, the sensor can determine the presence of objects and their distance based on the time it takes for the infrared signal to return.

**Ultrasonic sensor:** It works based on the principles of sound waves and echo detection. These sensors emit a burst of high-frequency sound waves (ultrasonic waves) into the environment. These waves travel through the air until they encounter an object in their path. When the waves strike an object, they are reflected back towards the sensor. The sensor then detects these echoes. By measuring the time it takes for the sound waves to travel to the object and back, the sensor can calculate the distance to the object using the known speed of sound in the medium. This enables the sensor to accurately determine the distance to nearby objects.

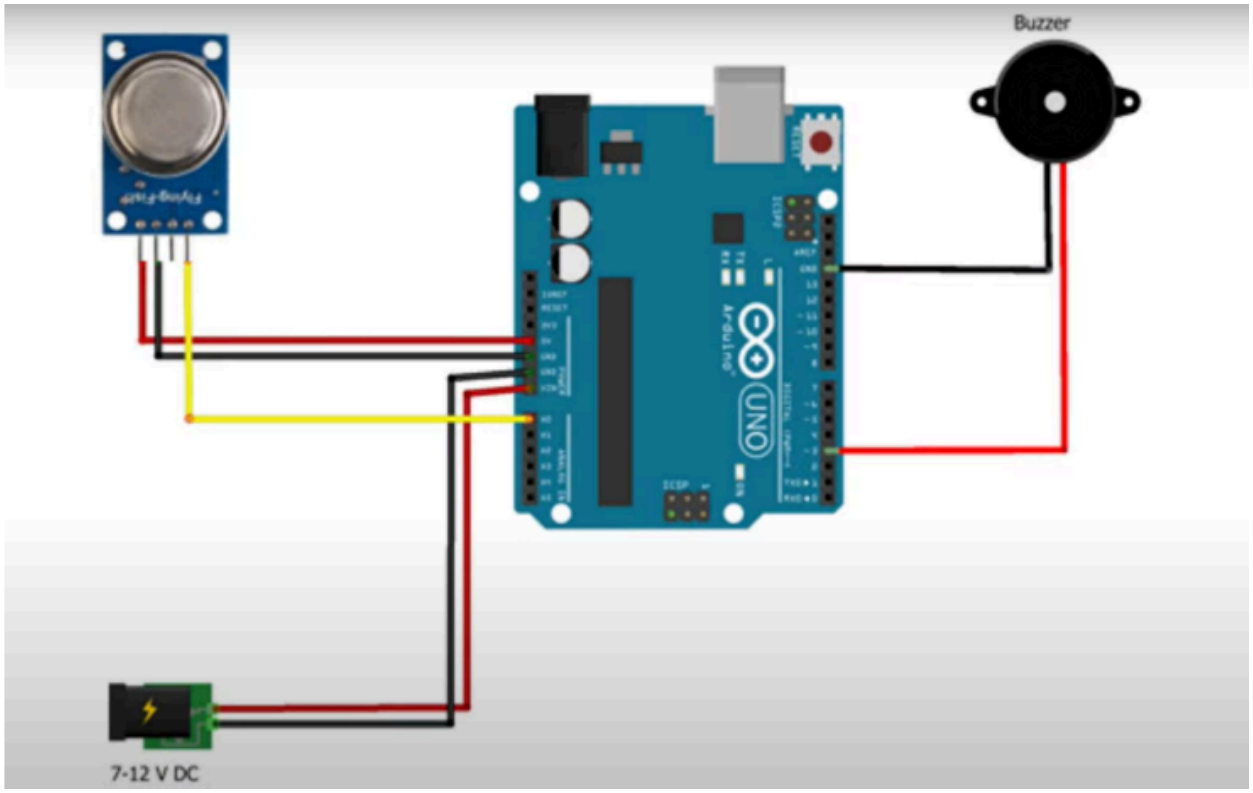
**Uses of Sensor:**

**Ultrasonic Sensor and Servo Motor:** The ultrasonic sensor operates by emitting high-frequency sound waves and measuring the time it takes for the waves to bounce back. This allows it to determine the distance to nearby objects. When someone approaches the trash bin, the ultrasonic sensor detects the change in distance and sends a signal to the Arduino Uno microcontroller. In response to this signal, the Arduino activates the servo motor, which is connected to the lid of the trash bin. The servo motor then rotates, opening the lid and allowing the person to conveniently dispose of their trash.

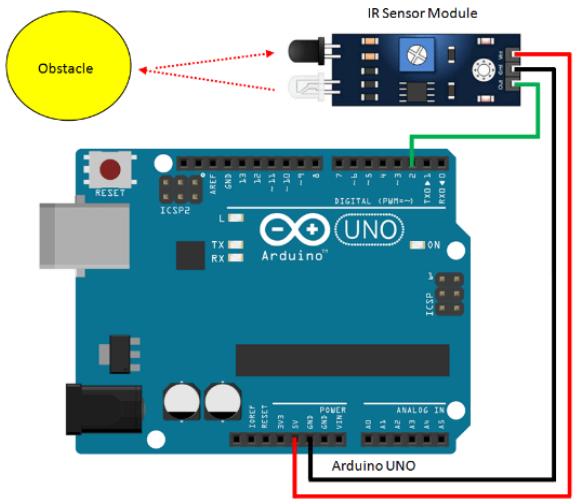



**Gas Sensor and Buzzer:** The gas sensor utilizes a semiconductor material that changes its conductivity when exposed to specific gas. It continuously samples the air and measures the

conductivity, enabling it to detect the presence of harmful gas like alcohol or other toxic substances. If the gas sensor detects the presence of these dangerous gasses, it sends a signal to the Arduino Uno microcontroller.In response, the Arduino activates the buzzer, emitting a loud sound to alert people nearby of the potential danger. This alarm serves as a safety measure to prompt immediate action or evacuation if necessary.




**IR Sensor and LED:** The IR sensor (Infrared sensor) works by emitting and detecting infrared radiation. It detects changes in infrared reflection caused by the presence or absence of objects. In the smart trash bin, the IR sensor is positioned to monitor the level of trash inside the bin. It continuously scans the interior and detects whether the bin is full or not. When the IR sensor detects that the bin is full, it sends a signal to the Arduino Uno microcontroller. In response, the Arduino activates the red LED, illuminating it to signal that the bin needs to be emptied. This visual indication makes it easy for users to see when the trash bin requires attention.




**Integration with Arduino Uno:** The Arduino Uno microcontroller serves as the central control unit for the smart trash bin. It receives input signals from the sensors (ultrasonic sensor, gas sensor, and IR sensor) and processes them to determine the appropriate actions. Based on the input received from the sensors, the Arduino activates the corresponding actuators (servo motor, buzzer, and LED) to perform the desired functions, such as opening the lid, sounding an alarm, or indicating when the bin is full. By integrating various sensors and actuators with the Arduino Uno, the smart trash bin becomes an intelligent and responsive device that enhances convenience, safety, and efficiency in waste management

The smart trash bin project combines innovative features to revolutionize waste management practices, offering unparalleled convenience, efficiency, safety, and resource conservation. With its automatic lid-opening mechanism, users can dispose of trash without touching the lid, enhancing hygiene and convenience, particularly in high-traffic areas. By leveraging sensors to detect object presence and trash levels, the system optimizes waste management efficiency, alerting users when the bin is full to prevent overflow and maintain cleanliness. Moreover, the integration of a gas sensor adds a crucial safety dimension by detecting harmful substances, triggering alerts to mitigate risks and ensure the safety of individuals nearby. Furthermore, by preventing overflow and signaling when the bin needs emptying, the project helps conserve resources and promotes a cleaner environment, leading to more efficient waste management operations. Overall, this project showcases the potential of technology to address real-world challenges and improve health, hygiene, efficiency, safety, and environmental sustainability in waste management.

**Conclusion:** In conclusion, the smart trash bin project represents a significant advancement in waste management practices, leveraging technology to address key challenges in efficiency, safety, and environmental sustainability. By eliminating the need for physical lid manipulation,

promoting timely waste disposal alerts, detecting harmful gas, and optimizing resource utilization, this project offers a comprehensive solution to modern waste management needs. From enhancing convenience and hygiene to ensuring safety and conserving resources, the smart trash bin exemplifies the potential of technology to create smarter, more efficient, and safer environments. As society continues to prioritize sustainability and innovation, projects like the smart trash bin serve as promising examples of how technology can be harnessed to create positive change for both individuals and the planet.

**Code:**

```
#include <Servo.h>   // Servo library

Servo servo;
int trigPin = 5;
int echoPin = 6;
int servoPin = 7;
int led = 10;
long duration, dist, average;
long aver[3];   // Array for average
#define BUZZER_PIN 3

void setup() {
   Serial.begin(9600);
   servo.attach(servoPin);
   pinMode(trigPin, OUTPUT);
   pinMode(echoPin, INPUT);
   pinMode(led, OUTPUT);  // Set LED pin as output
   pinMode(BUZZER_PIN, OUTPUT);  // Set BUZZER_PIN as output
   pinMode(13, OUTPUT);  // Set pin 13 as output
   pinMode(3, INPUT);    // Set pin 3 as input
   servo.write(0);         // Close cap on power on
   delay(100);
   servo.detach();
}

void measure() {
   digitalWrite(10, HIGH);
   digitalWrite(trigPin, LOW);
   delayMicroseconds(5);
   digitalWrite(trigPin, HIGH);
```

```
    delayMicroseconds(15);
    digitalWrite(trigPin, LOW);
    pinMode(echoPin, INPUT);
    duration = pulseIn(echoPin, HIGH);
    dist = (duration / 2) / 29.1;    // Obtain distance
}

void loop() {
    // Measure distance
    for (int i = 0; i <= 2; i++) {   // Average distance
        measure();
        aver[i] = dist;
        delay(10);              // Delay between measurements
    }
    dist = (aver[0] + aver[1] + aver[2]) / 3;

    // Control servo based on distance
    if (dist < 50) {
        // Change distance threshold as per your need
        servo.attach(servoPin);
        delay(1);
        servo.write(0);
        delay(3000);
        servo.write(150);
        delay(1000);
        servo.detach();
    }

    // Read analog sensor and activate buzzer
    int sensorValue = analogRead(A0);
    if (sensorValue > 800) {
        analogWrite(BUZZER_PIN, 50);
    } else {
        analogWrite(BUZZER_PIN, 0);
    }

    // Control LED based on digital input
    if (digitalRead(3) == LOW) {
        digitalWrite(13, HIGH);
    } else {
```

```
        digitalWrite(13, LOW);
    }
    delay(10);
}
```