Touchless Smart Dustbin with Automatic Object Detection

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Abstract

In the pursuit of enhancing hygiene and promoting contactless solutions, this project presents a touchless smart dustbin that automatically opens its lid upon detecting an approaching object. Utilizing an ultrasonic sensor and a servo motor controlled by an Arduino Uno microcontroller, the system detects the proximity of an object (such as a hand) and actuates the dustbin lid accordingly. This mechanism minimizes physical contact, thereby reducing the risk of germ transmission, and offers a convenient waste disposal solution suitable for various environments.

Introduction

Traditional waste bins require manual operation, which can be unhygienic and inconvenient, especially in public spaces or during health crises. The integration of automation into waste management systems addresses these concerns by enabling contactless operation. This project focuses on developing a smart dustbin that leverages ultrasonic sensing and microcontroller programming to detect approaching objects and automatically open the lid, thereby enhancing user experience and promoting better hygiene practices.

Objective

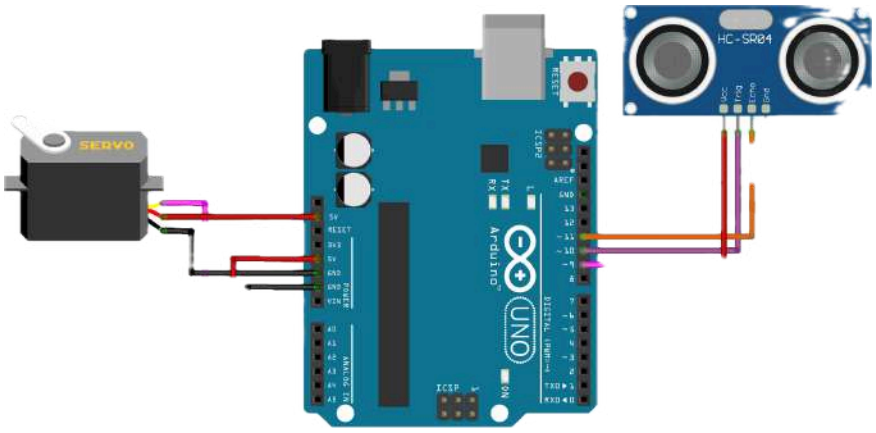
The primary objectives of this project are:

- To design and construct a touchless dustbin that automatically opens its lid upon detecting an approaching object.

- To implement object detection using an ultrasonic sensor interfaced with an Arduino Uno microcontroller.

- To enhance hygiene by minimizing physical contact during waste disposal.

- To develop a cost-effective and scalable solution suitable for various settings, including homes, offices, and public spaces.

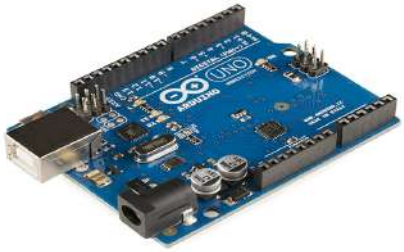


Components

The project comprises the following components:

1. Arduino Uno: A microcontroller board based on the ATmega328P, serving as the central control unit for processing sensor inputs and controlling the

servo motor.



2. Ultrasonic Sensor (HC-SR04): Measures the distance between the sensor and an object using ultrasonic waves, enabling object detection near the dustbin lid.

3. Servo Motor (SG90): A motor that rotates the dustbin lid open and closed based on signals from the Arduino.

4. Jumper Wires: Used for establishing electrical connections between the mArduino, sensor, and servo motor.

5. 9V Battery with Connector: Provides power to the Arduino and connected components.

6. Dustbin: A standard waste container modified to integrate the servo motor for lid movement.

Connections

The components are connected as follows:

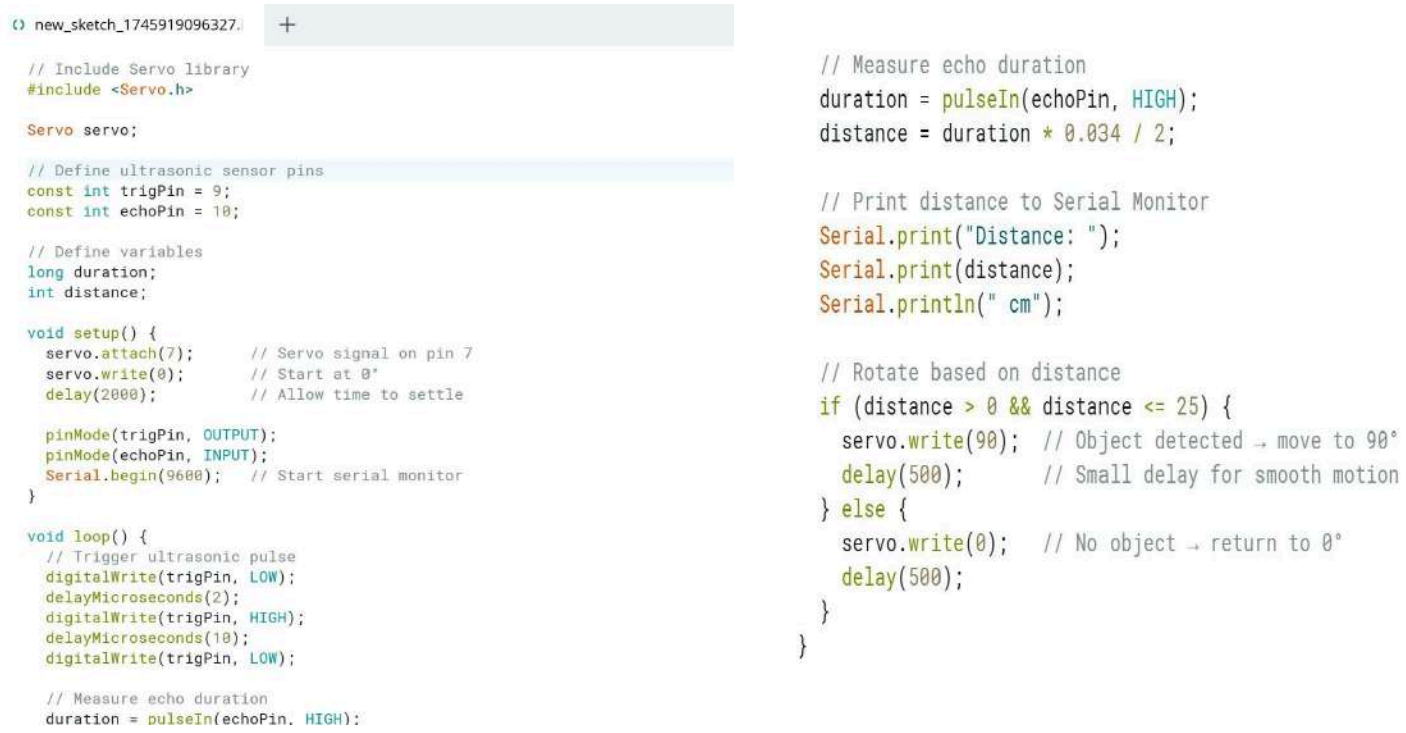
- Ultrasonic Sensor (HC-SR04):
    - VCC to Arduino 5V
    - GND to Arduino GND
    - Trig to Arduino Digital Pin 9
    - Echo to Arduino Digital Pin 10
- Servo Motor (SG90):
    - Control Wire to Arduino Digital Pin 3
    - Power Wire to Arduino 5V
    - Ground Wire to Arduino GND

The Arduino is powered by a 9V battery connected through a battery connector. The ultrasonic sensor continuously measures the distance to detect the presence of an object. When an object is detected within a predefined range (e.g., 20 cm), the Arduino signals the servo motor to rotate, opening the dustbin lid. After a short

delay (e.g., 3 seconds), the servo motor rotates in the opposite direction to close the lid.

Arduino Code

Below is the Arduino code used to control the smart dustbin:



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

Servo servo;

// Define ultrasonic sensor pins
const int trigPin = 9;
const int echoPin = 10;

// Define variables
long duration;
int distance;

void setup() {
  servo.attach(7);      // Servo signal on pin 7
  servo.write(0);       // Start at 0°
  delay(2000);          // Allow time to settle

  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  Serial.begin(9600);   // Start serial monitor
}

void loop() {
  // Trigger ultrasonic pulse
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  // Measure echo duration
  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2;

  // Print distance to Serial Monitor
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");

  // Rotate based on distance
  if (distance > 0 && distance <= 25) {
    servo.write(90);  // Object detected → move to 90°
    delay(500);       // Small delay for smooth motion
  } else {
    servo.write(0);   // No object → return to 0°
    delay(500);
  }
}
```

Testing and Results

The touchless smart dustbin was tested by placing objects within a 25 cm range of the ultrasonic sensor. The lid opened successfully each time an object was detected and closed automatically after a short delay. The system functioned smoothly, confirming its effectiveness in providing hands-free operation.

https://drive.google.com/file/d/1digK6EoSB2dXSb-xBx9qZZmNvM_bMceB/view?usp=drivesdk

Conclusion

The touchless smart dustbin project successfully demonstrates the application of automation in enhancing hygiene and convenience in waste disposal. By integrating an ultrasonic sensor with a servo motor controlled by an Arduino Uno, the system effectively detects approaching objects and operates the dustbin lid without physical contact. This innovation holds significant potential for deployment in various settings, contributing to improved public health and environmental cleanliness. Future enhancements could include integrating IoT capabilities for remote monitoring and adding sensors to detect the fill level of the dustbin.

References

- "How To Make An Automatic Object Sensing Smart Dustbin - DIY Project." YouTube, uploaded by Creative Creator, 10 Oct. 2017, https://www.youtube.com/watch?v=mHaeDoFOVX0.

- Angadi, Ameya. "Smart Dustbin with Ultrasonic Sensor and Servo." Arduino Project Hub, 20 Aug. 2021, https://projecthub.arduino.cc/angadiameya007/smart-dustbin-80b6af.

- "Smart Dustbin Using Arduino and Ultrasonic Sensor." Circuit Digest, https://circuitdigest.com/microcontroller-projects/how-to-make-smart-dustbin-using-arduino.