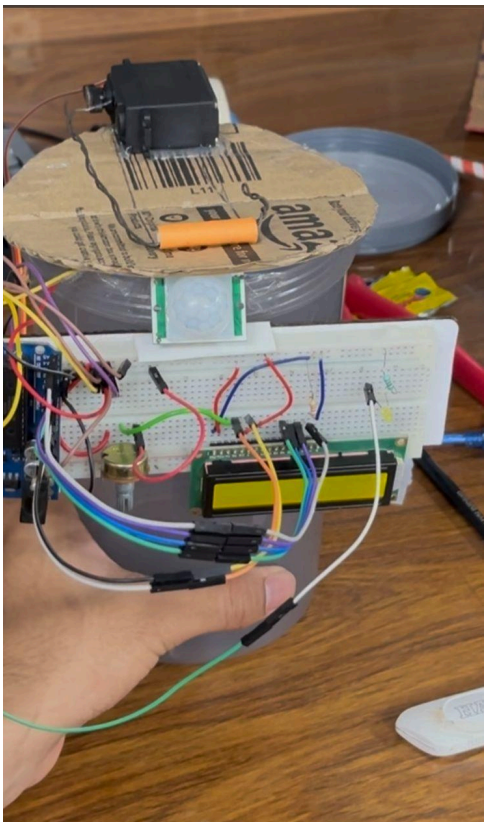
EC Project Report
Smart Dustbin

Table - 7 (Monday batch)



Team Members:

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Core Idea:

Our project is a smart dustbin that uses a motion sensor to automatically open the lid and an ultrasonic sensor to measure waste levels. The current fill level is displayed on an LCD screen attached to the dustbin, allowing easy On-site monitoring. In the future, a Bluetooth module can be integrated to send real-time data to the cloud, enabling centralized tracking by government authorities.

- *Complete Video can be found here :* *EC Project.mov*
- *Complete Code can be found here:* Code

1. What problem are you trying to solve, and why is it important/ interesting?

Waste management in shared spaces like hostels, public areas, and institutions often suffers due to the improper use of dustbins. One common issue is users touching the bin lid to open it, which is unhygienic and can lead to the spread of germs—especially in high-traffic areas. Additionally, overflowing dustbins go unnoticed until they become a sanitation problem, causing foul odors and attracting pests.

Our project aims to address both these issues by building a smart, touchless dustbin. The lid automatically opens when it senses nearby movement, ensuring hygienic disposal without physical contact. An ultrasonic sensor inside the bin continuously monitors the fill level, and the current waste level is displayed on an LCD screen.

This makes it easier for cleaning staff or users to know when the bin needs to be emptied, improving cleanliness and maintenance efficiency.

The idea is simple yet impactful—it promotes hygiene, encourages responsible waste disposal, and reduces manual monitoring efforts. By integrating basic sensors and a microcontroller, we create an affordable solution with real-life utility, especially in environments where cleanliness and efficiency matter.

2. What are the existing solutions? Describe a few of them and list any shortcomings in them. Is your solution approach unique in some way?

Existing solutions include traditional dustbins that require manual operation and some commercial smart bins used in cities, which use sensors and IoT for monitoring. However, these are often expensive, complex, and primarily deployed in large-scale public areas.

Basic automatic dustbins using IR sensors exist, but they lack real-time waste level monitoring or feedback display. Most don't indicate when the bin is full, leading to overflow and hygiene issues.

Our approach is unique in its simplicity and practicality—it combines motion-based lid automation with ultrasonic level detection and an LCD display for immediate visual feedback. It's affordable, easy to implement in small-scale environments like hostels, and can be upgraded with Bluetooth/cloud modules in the future for wider applications.

3. What resources do you require to complete the project? Give a breakdown of the tasks that you need to accomplish week by week to complete the project.

Resources Required:

1. Arduino Uno (Microcontroller)
2. Ultrasonic Sensor (HC-SR04) – for waste level detection
3. PIR Motion Sensor – to detect user proximity and trigger lid opening
4. Servo Motor (SG90) – to control the dustbin lid
5. 16x2 LCD Display – to show waste level readings
6. Dustbin casing for mounting components, cardboard, straws, metal wires
7. Jumper wires, Breadboard, Resistors
8. Basic tools: Soldering iron, glue gun, cutter, etc.

Week-by-Week Timeline:

Week 1: Familiarization & Initial Setup

- Understand and test individual components: Arduino Uno, Ultrasonic Sensor, PIR Sensor, Servo Motor, and LCD Display.
- Learn basic interfacing and run simple test codes for each module.
- Finalize the circuit design on a breadboard.

Week 2: Hardware Assembly & Code Development

- Begin integrating sensors and modules on a common circuit.
- Write code to control the servo motor using PIR input.
- Implement ultrasonic sensor code to measure garbage level and display it on the LCD.
- Perform unit testing on individual functionalities.

Week 3: Final Integration & Optimization

- Assemble the entire circuit and mount it on the dustbin body.
- Refine code for smooth sensor coordination and stable LCD display.
- Calibrate threshold distances for accurate waste level detection.
- Final testing, bug fixing, and project demonstration preparation.

Code Snippits

```
// Initialize the LCD object
#include <Servo.h> // include servo library to use its related functions
#define Servo_PWM 6 // A descriptive name for D6 pin of Arduino to provide PWM signal
Servo MG995_Servo;
const int led = 11; // Led positive terminal to the digital pin 9.
const  int sensor = 5; // signal pin of sensor to digital pin 5.
int state = HIGH;
int val = 0;
const float depth=(15.80)/100;
const int trigPin = 9;
const int echoPin = 10;
```

```
val = digitalRead(sensor);
 if  (val == HIGH) {
   digitalWrite(led, HIGH);
   delay(500);  // Delay of led is 500

   if (state == LOW) {
     Serial.println("  Motion detected ");
     MG995_Servo.write(180);

     state = HIGH;
   }
 }
```

```
else {
    digitalWrite(led, LOW);
    delay(500);

    if  (state == HIGH){
      delay(2000);
      Serial.println("The action/ motion has stopped");
       MG995_Servo.write(90);

      state = LOW;
   }
}
```

Suggestions / Modification / Usecases

While the current version of the project displays the waste level locally on an LCD, several impactful enhancements and real-world use cases can be implemented to improve its utility and scalability:

Suggestions & Modifications:

1. **Bluetooth Module Integration:** By integrating a Bluetooth module (like HC-05), the system can wirelessly transmit dustbin status to a mobile device or central server. This feature will eliminate the need for physically inspecting each bin and enable remote monitoring.

2. **Cloud-Based Monitoring (Future Scope):** The Bluetooth module can be further extended to an IoT framework using Wi-Fi (ESP8266 or NodeMCU) for cloud data logging. Waste level data from multiple dustbins can be sent to a centralized dashboard in real-time.

3. **Buzzer Alerts:** An automatic alert system can be introduced using a buzzer that triggers when the bin reaches a pre-defined maximum level. This ensures timely emptying without manual inspection.

4. **Battery-Powered or Solar-Based Operation:** Making the device battery-operated or powered via a small solar panel would allow it to be placed anywhere without dependency on wall power.

Use Case: Government-Level Waste Management System

In urban areas and large campuses, municipalities or sanitation authorities manually check hundreds of dustbins daily. This leads to inefficiencies such as:

- Delayed collection and overflowing bins
- Unnecessary dispatch of cleaning vehicles to already empty bins
- Increased manpower and transportation costs

With the smart dustbin system, each unit could communicate its fill status wirelessly to a central dashboard via Bluetooth/IoT. Government officials can view a real-time map of bins, color-coded by their waste level (e.g., green for empty, red for full). This data-driven system allows:

- Smart scheduling of waste collection, focusing only on full bins
- Reduced operational costs and labor
- Cleaner environments, especially in high-traffic public areas

- Data analysis for optimizing bin placement and frequency of collection

This system can scale from hostel rooms to smart cities with minimal modifications, making it a low-cost, high-impact solution.