

# Embedded Systems Practice

## SMART WASTE MANAGEMENT



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# INTRODUCTION

**Objective:** Design and construct an intelligent waste segregation system that automatically differentiates between wet and dry waste.

- Arduino microcontroller is the brain of the operation, integrating moisture a sensor for wet waste detection, IR sensors for detection of objects, and a servo motor for the operation of the dustbin lid.

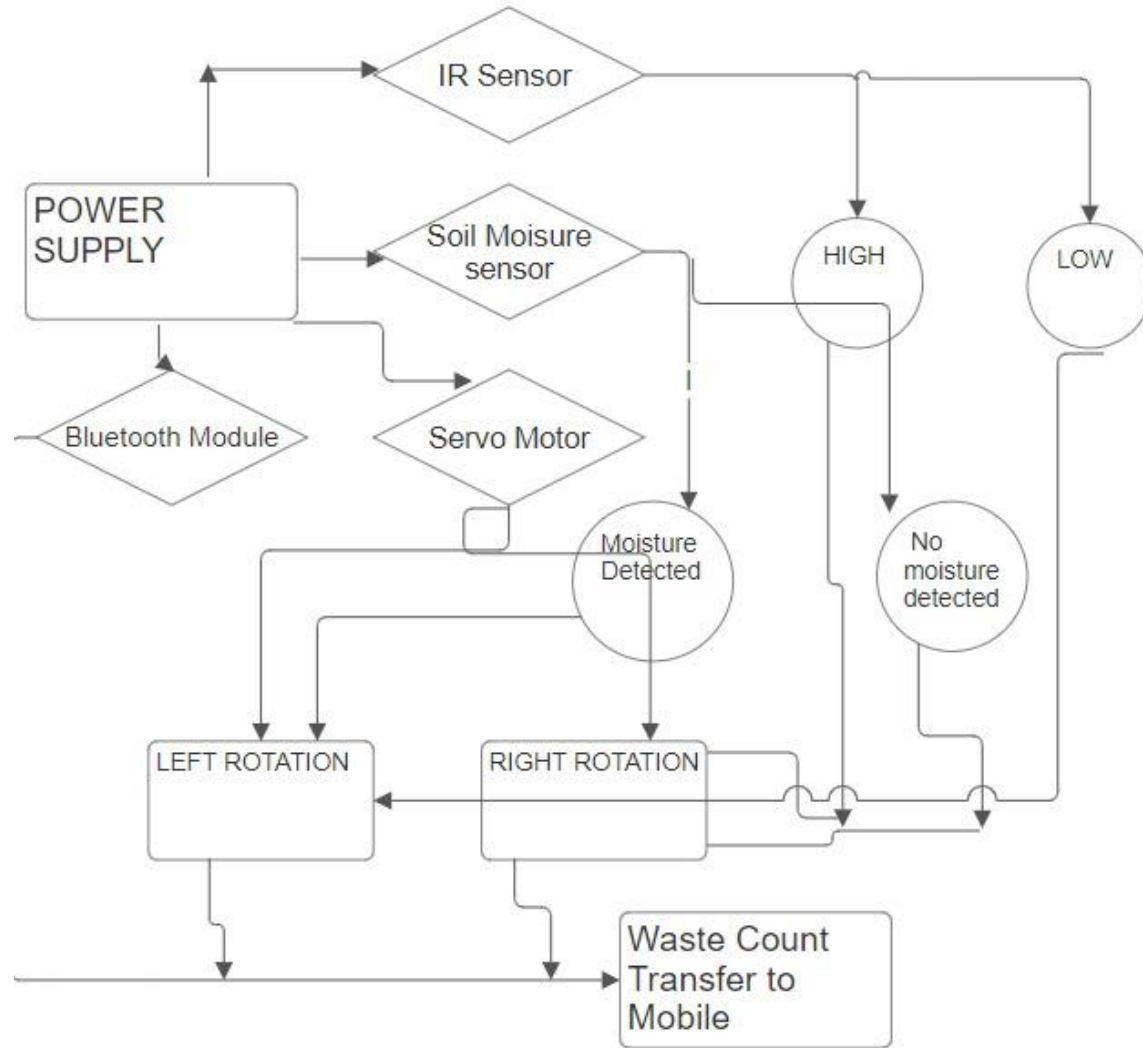
## Key Features:

- Automated lid mechanism to maintain hygiene and convenience.
- Dual compartment system for separate collection of wet and dry waste.

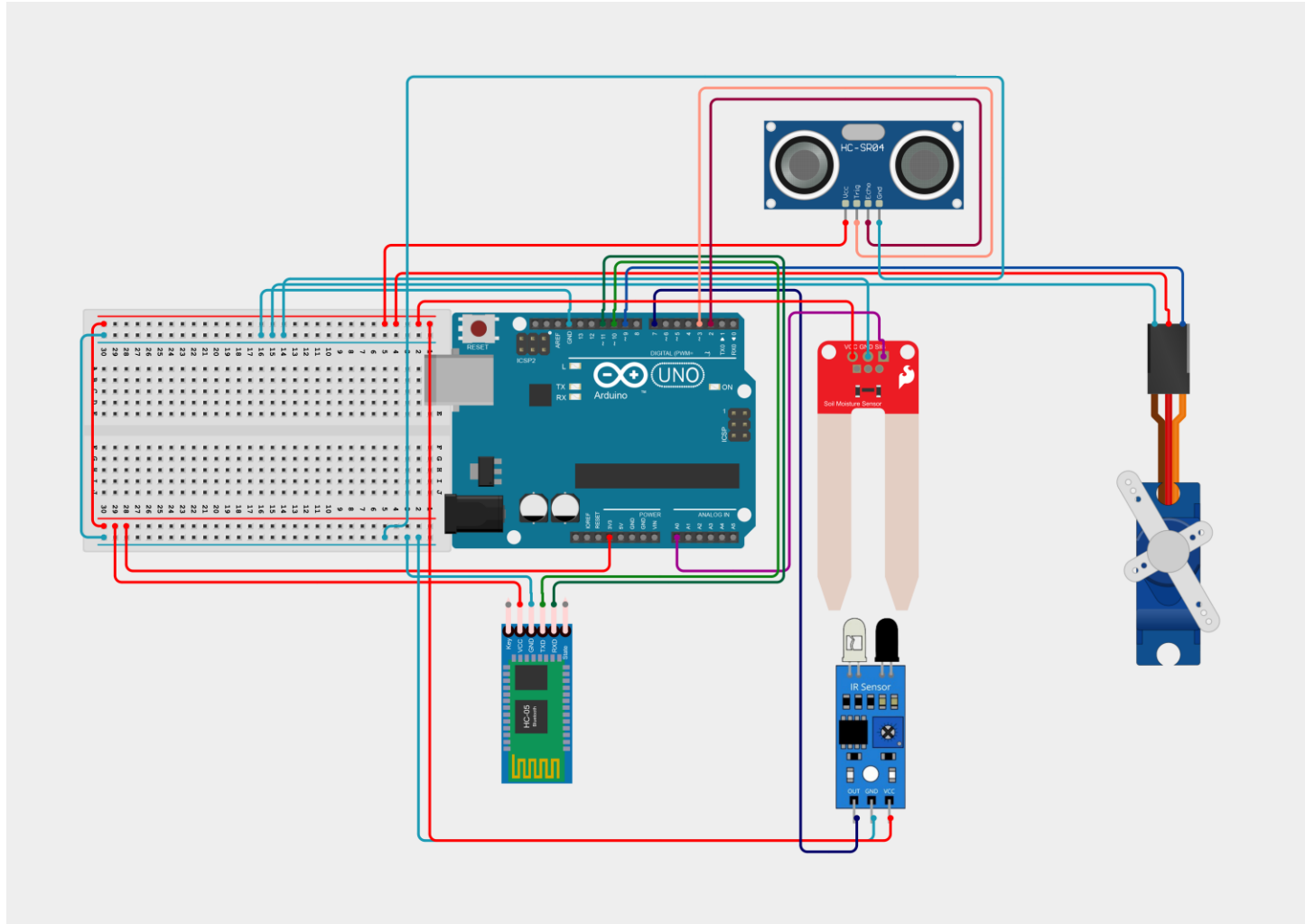
# Components Description

- **Arduino Board:** It processes input signals and sends commands based on the logic programmed into it.
- **Moisture Sensor:** This sensor is used to detect the presence of wetness in waste. The sensor sends an electrical signal to the Arduino when wet waste is detected.
- **Ultrasonic Sensor:** An ultrasonic sensor, such as the HC-SR04. This data allows the Arduino to calculate the level of waste inside the bin and determine when the bin is full.
- **IR Sensor:** Operate the main lid of the dustbin for hands-free disposal when the IR sensor indicates when the waste reaching the bin.
- **Servo Motors:** To open and close the separate lids for wet and dry waste, directing the waste into the correct compartment.
- **Bluetooth Module:** The Bluetooth module, such as the HC-05, is a wireless communication device that enables the Arduino to connect to other Bluetooth-enabled devices like smartphones, tablets, or computers.

# BLOCK DIAGRAM



# CIRCUIT DIAGRAM



## Components Used

Part Name	Quantity
Arduino UNO	1
SparkFun Soil Moisture Sensor	1
HC-05 Bluetooth Module	1
ir sensor	1
Tower Pro SG90 servo	1
HC-SR04 Ultrasonic Sensor	1

# WORKING PRINCIPLE

The Smart Dustbin is an automated system designed to segregate waste into wet and dry categories, utilizing an array of sensors, servo motors, and an Arduino board that serves as the central processing unit.

**CODE :**

```
#include <Servo.h>
#include <SoftwareSerial.h>

#define IR_SENSOR_PIN 7
#define SOIL_MOISTURE_PIN A0
#define SERVO_PIN 9
#define BT_TX_PIN 10
#define BT_RX_PIN 11

Servo servoMotor;
SoftwareSerial BT(BT_RX_PIN, BT_TX_PIN);

int wetWasteCount = 0;
int dryWasteCount = 0;

void setup() {
  pinMode(IR_SENSOR_PIN, INPUT);
  pinMode(SOIL_MOISTURE_PIN, INPUT);
  servoMotor.attach(SERVO_PIN);
  servoMotor.write(90); // Set initial position to neutral (90 degrees)
  Serial.begin(9600);
  BT.begin(9600); // Initialize Bluetooth serial communication
}

void loop() {
  int irSensorValue = digitalRead(IR_SENSOR_PIN);

  // Check if object is detected
  if (irSensorValue == LOW) {
    delay(2000); // Wait for 2 seconds to stabilize
    int soilMoistureValue = analogRead(SOIL_MOISTURE_PIN); // Read soil moisture

    Serial.print("Moisture Reading: ");
    Serial.println(soilMoistureValue);

    if (soilMoistureValue < 800) { // Wet
      rotateServoLeft(); // Rotate towards wet
      Serial.println("Item is Wet");
      wetWasteCount++; // Increment wet waste count
    } else { // Dry
      rotateServoRight(); // Rotate towards dry
      Serial.println("Item is Dry");
      dryWasteCount++; // Increment dry waste count
    }
  }
}
```

```

// Transmit waste counts over Bluetooth
BT.print("Wet: ");
BT.print(wetWasteCount);
BT.print(", Dry: ");
BT.println(dryWasteCount);

// Display waste counts in Serial Monitor
Serial.print("Wet Waste Count: ");
Serial.print(wetWasteCount);
Serial.print(", Dry Waste Count: ");
Serial.println(dryWasteCount);
}
}

void rotateServoLeft() {
  for (int angle = 90; angle <= 180; angle++) {
    servoMotor.write(angle); // Rotate left (towards wet)
    delay(20); // Adjust delay for slower speed
  }
  delay(1000); // Wait for return to complete
  servoMotor.write(90); // Return to initial position (neutral)
  delay(1000); // Wait for return to complete
}

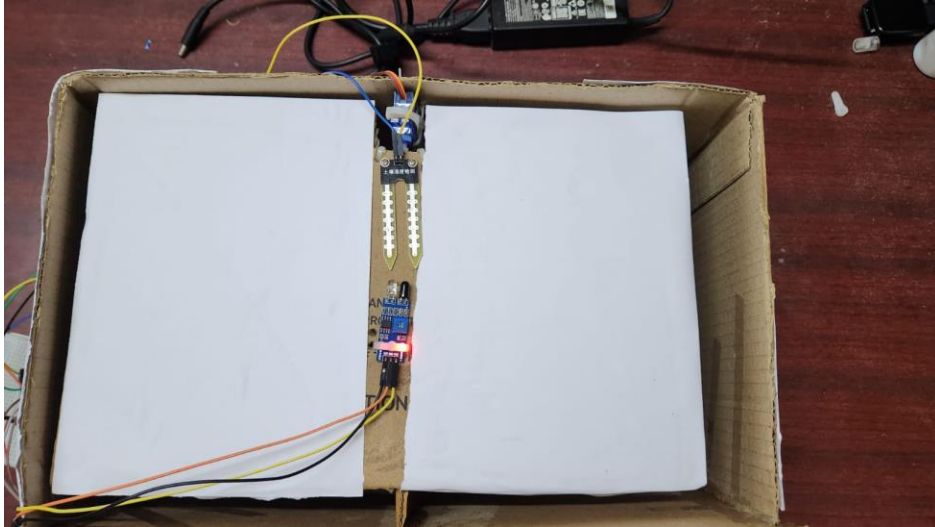
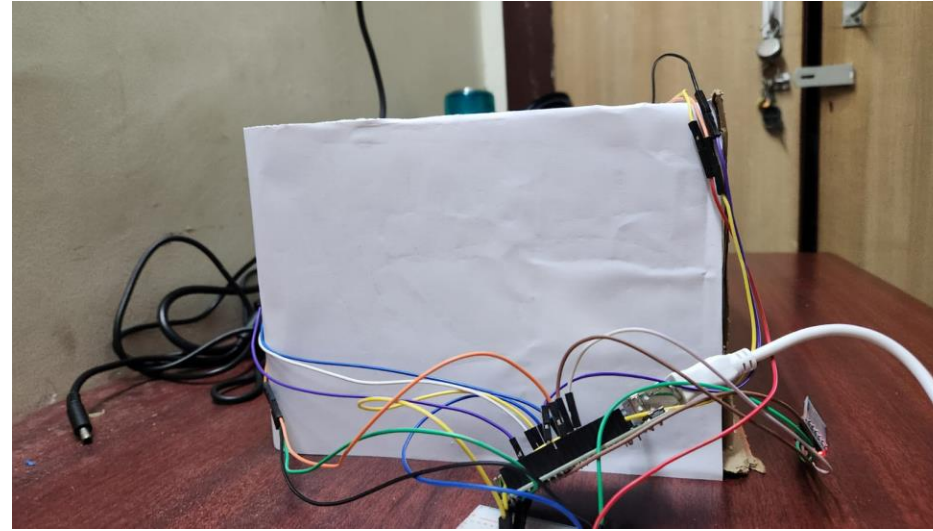
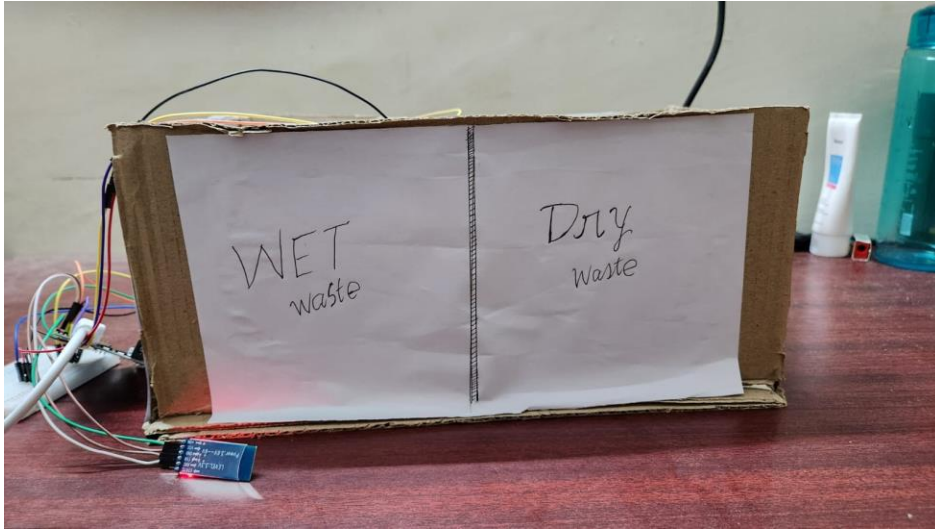
void rotateServoRight() {
  // Rotate right (towards dry)
  for (int angle = 90; angle >= 0; angle--) {
    servoMotor.write(angle);
    delay(20); // Adjust delay for slower speed, same as the down movement
  }

  // Return slowly to neutral position
  for (int angle = 0; angle <= 90; angle++) {
    servoMotor.write(angle);
    delay(20); // Adjust delay for slower speed, same as the down movement
  }

  delay(1000); // Wait for return to complete
}

```

# HARDWARE OUTPUT:



**RESULT:** The Smart Dustbin Arduino project successfully delivers an automated waste segregation system that identifies and separates wet and dry waste using moisture and ultrasonic sensors. Enhanced by a Bluetooth module for communication, the system allows for monitoring and customizing settings via a connected device, fostering efficient recycling and waste management practices.