

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Volume 5, Issue 7, June 2025



# **Garbage Segregation System**

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**Abstract**: A Waste segregation is a key aspect of sustainable waste management. This article deals with the need for, techniques and effectiveness of separating wet, dry and metal waste and shows how reuse and recycling of such waste can be made profitable. Through a case study based on household and institutional level data from urban areas, we compile patterns of waste generation and seek to suggest up-scale able ways of separating and disposing from such waste.

**Keywords**: Arduino Waste Project, Smart Bin System, Waste Recycling, Solid Waste Management, Eco-friendly Technology, Waste Sorting Algorithm, Green Technology, Waste Awareness, Waste Reduction, Automated Waste Segregation

# I. INTRODUCTION

Rapidurbanization and growing consumerism have given rise to enormous amounts of solid waste generation. Proper waste management is now an international issue, particularly in the developing world where infrastructure usually takes a back seat to population increases.Segregation at source is an important starting point for managing the waste challenge, where one separates the wastes into three broad categories: wet, dry, and metal.This uncomplicated yet effective process helpsto greatly contribute to increasing recycling effectiveness, landfill reduction, and environmental pollution prevention.

Wet waste is usually made up of biodegradable waste like food waste, vegetable peels, garden trimmings, and other organicwaste.Dry waste contains recyclable waste like plastic, paper, cardboard, cloth, and glass. Metal waste, though not as bulky, is very recyclable and contains items like aluminium cans, tin cans, and metal packaging. If not segregated, these streams of waste tend to get mixed up, causing contamination and increasing the cost and difficulty of recycling.

### HOW IT WORK

- 1. Waste is poured into the sensor module chute.
- 2. The moisture sensor tests for wetness.
- If wet, the waste is routed to the wet bin.
- 3. If not wet, a metal sensor tests for metallic content.
- If found, it's routed to the metal bin.
- 4. If neither wet nor metal, it's dry waste.
- The system then routes it to the dry bin.
- 5. An indicator screen or light indicates where the waste was sorted.

### **SENSORS:**

The goal is to automate the separation of waste through sensors that can detect if an object is wet, dry, or metal and then route it to the appropriate bin. This system can be applied in smart homes, schools, or community canters to encourage effective and clean waste management.



DOI: 10.48175/568





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### Volume 5, Issue 7, June 2025



### **Components Required:**

- Moisture Sensor detects wet/organic waste
- Capacitive Proximity Sensor / Metal Detector detects metal waste
- IR Sensor identifies presence of waste (helps with sorting mechanism)
- Arduino/ESP32/Raspberry Pi microcontroller to process data
- Servo Motors- to divert waste to appropriate bins
- Stepper motor to rotated the dustbin
- Stepper Motor Driver to operate stepper motor
- buzzer- After detecting the type of buzzer sound
- Power Supply to power the circuit.

### SOFTWARE AND ALGORITHM:

Algorithm-

1. Start

- 2. Wait for object detection using the IR sensor
- 3. When object is detected:
  - Read the moisture sensor value
  - If moisture > thresholdclassify as Wet Waste
  - Move servo motor to direct waste to Wet Bin
  - Display or log "Wet Waste"
  - Go to Step 8
- 4. Else  $\rightarrow$  Check metal sensor:
  - If metal is detected  $\rightarrow$  classify as Metal Waste
  - Move servo motor to direct waste to Metal Bin
  - Display or log "Metal Waste"
  - Go to Step 8
- 5. Else  $\rightarrow$  classify as Dry Waste
  - Move servo motor to direct waste to Dry Bin
  - Display or log "Dry Waste"

Arduino Code:



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#include <Servo.h> Servo segregator; int irPin = 3; int moisturePin = A0; int metalPin = 2; void setup() { Serial.begin(9600); segregator.attach(9); pinMode(irPin, INPUT); pinMode(metalPin, INPUT); void loop() if (digitalRead(irPin) == LOW) { // object detected delay(500); // debounce int moisture = analogRead(moisturePin); bool isMetal = digitalRead(metalPin); if (moisture > 600) segregator.write(0); // move to Wet bin Serial.println("Wet Waste"); else if (isMetal == HIGH) { segregator.write(90); // move to Metal bin Serial.println("Metal Waste"); else { segregator.write(180); // move to Dry bin Serial.println("Dry Waste"); delay(2000); // wait before returning segregator.write(90); // reset position

#### **OBJECTIVE**

The main purpose of this project is to facilitate and evaluate the effectiveness of wet, dry, and metal waste segregation at the source. Precisely, the project shall:

- 1. Gain the knowledge regarding the waste composition of homes and institutions with special emphasis on its segregation into wet, dry, and metal waste.
- 2. Assess the existing segregation methods in residential, commercial, and academic places.
- 3. Determine the universal challenges and gaps in awareness, infrastructure, and implementation for waste segregation.
- 4. Inculcate responsible waste disposal behaviour among individuals and communities by educating them and conducting outreach programs.
- 5. Establish realistic, sustainable solutions to enhancing waste segregation, such as the employment of color-coded bins and collaborations with recycling agencies.
- 6. Assist local municipalities in waste collection and recycling through actionable suggestions based on research outcomes.

# **APPLICATION:**

### 1. Intelligent Waste Management for Cities

- Supports city councils in sorting and recycle waste effectively at the collection site.
- Relieves pressure on landfills through improved recycling and composting.
- May be incorporated in smart city initiatives with IoT-enabled bins.

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DOI: 10.48175/568



759



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#### Volume 5, Issue 7, June 2025



### 2. Schools and Colleges

- The Implemented as an example in educational institutions to inform children about eco-friendly practices.
- The Promotes early development of environmental awareness in children and youngsters.
- Best for science fairs, project displays, and STEM education.

### 3. Residential Complexes & Societies

- Can be fitted at building lobbies or garbage shafts.
- Facilitates segregation at source in apartment societies.
- The Decreases contamination of a recyclables, making processing simpler.

# 4. Offices & Commercial Complexes

- Useful in corporate campuses to handle cafeteria and office waste responsibly.
- Assists companies in achieving CSR and green building certification.
- Triggers employee engagement in sustainability practices.

# 5. Industrial Waste Handling

- Helpful in small industries where segregation of metal and packaging waste is of prime importance.
- Will be able to automate the handling of wastes in assemblylines or packaging units.

# 6. Public Waste Bins

- Sited in public areas such as parks, bus stands, and railway stations.
- Saves people from littering and increases recycling efficiency at crowded areas.

# 7. Recycling and Composting Facilities

- Aids pre-sorting of materials prior to entering recycling or composting units.
- Saves labour and reduces risks and improves efficiency.

# 8. Environmental Awareness Campaigns

- Nonessential models may be utilized by NGOs, government agencies, and start-ups.
- Activates communities on Swachh Bharat Abhiyan and Earth Day celebrations.

# **II. CONCLUSION**

Segregation of waste into wet, dry, and metal types is a simple but effective practice that can greatlyenhance the efficiency of waste management systems. This project showed how simple sensortechnology can be used with a simple algorithm to automate the segregation process and minimize human error. By sorting and routing waste properly at the source, we can minimize landfill loads, maximize recycling, and encourage composting of organic material.

The employment of moisture sensors, metal detectors, and IR sensors facilitates the segregation process mostly with little or no human intervention. Furthermore, installing such systems in households, schools, office spaces, and public areas can not only enhance environmental performance but also promote a sustainability and responsibility culture.

### REFERENCES

- [1]. Books:"Arduino Robotics" by John-David Warren, Josh Adams, and Harald Molle"Arduino Projects Book" by Scott Ferguson.
- [2]. Skynet Robotics YouTube Channel: Skynet Robotics has an excellent series on Arduino robotics, and you can find tutorials on building Waste segregation system as well as detailed explanations of the coding and hardware.



DOI: 10.48175/568



760