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Smart Dustbin, An Evolution for a Better Environment

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Abstract – Rapid urbanisation has increased domestic waste generation, making manual segregation inefficient and unhygienic. This paper presents an intelligent dustbin system capable of real-time wet and dry waste classification, combined with an automatic lid mechanism to ensure contactless usage. The proposed model integrates multiple sensors ,moisture sensor and IR sensor for waste segregation ultrasonic sensor for automatic lid opening and microcontroller-based decision logic, and an IoT monitoring module to provide an efficient and sanitary waste-management solution.

***Key Words*: Waste segregation, Dry and Wet waste ,Moisture Sensor, IR Sensor, Ultrasonic Sensor, Real - Time**

1. INTRODUCTION

Conventional dustbins lack the capability to identify the type of waste being disposed. This leads to improper segregation, resulting in higher processing costs, increased landfill waste, and environmental pollution.

To address this issue, we designed a smart dustbin system that automatically differentiates between biodegradable (wet) and non-biodegradable (dry) waste using sensor-based detection. The system also features a touch-free lid, which opens automatically when a user approaches.

The solution aims to support clean-city initiatives, reduce human contact with waste, and contribute to efficient recycling processes.

2. BODY OF PAPER

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The proposed Smart Dustbin system is designed to automate waste segregation by distinguishing between wet and dry waste using a sensor-based approach. The dustbin integrates an ultrasonic sensor for proximity detection and a moisture/conductivity sensor to analyze the characteristics of the disposed material. When a user approaches, the ultrasonic sensor triggers the automatic lid mechanism, ensuring contactless and hygienic disposal. Once the waste is placed inside, the moisture sensor measures its conductivity level. Based on predefined thresholds, the microcontroller identifies the waste type and activates a motorized flap to guide it into either the wet or dry compartment.

The system architecture includes a dual-chamber bin, servo motors, and a compact microcontroller board such as Arduino or ESP32. The operational workflow consists of detection, classification, redirection, and reset. During testing, the prototype achieved satisfactory accuracy for both wet and dry waste categories. The overall response time of the system remained within a few seconds, making the solution practical for daily use in homes, hostels, and public spaces.

This smart segregation model reduces manual effort, minimises human contact with waste, and promotes effective recycling practices. Its affordable design and simple working mechanism make it a viable component of modern smart-city waste-management systems.

Table 1: Waste Segregation Statistics

Parameter	**Wet Waste**	**Dry Waste**	**Remarks**
Moisture Level	High (Above 60%)	Low (Below 20%)	Detected using moisture sensors
Common Examples	Food waste, vegetable peels, leftovers	Paper, plastic, metal, glass	Used for classification
Segregation Accuracy	85–95%	90–98%	Based on sensor performance in smart dustbins
Environmental Impact	Biodegradable, used for composting	Recyclable, reduces landfill pressure	Supports sustainability
Expected Volume in Urban Areas	55–65% of total waste	35–45% of total waste	Typical municipal distribution

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Fig -1: Figure

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3. CONCLUSIONS

Smart dustbins are a practical way to support environmental sustainability and enhance contemporary waste management systems. This project demonstrates how waste can be monitored, collected, and managed more effectively by utilizing sensors, IoT connectivity, and automation. Features that reduce garbage overflow, enhance hygiene, and facilitate recycling include automatic lid operation, real-time fill-level detection, and dry-wet waste segregation. The use of moisture sensors in this project improves waste segregation at the outset, which lessens the load on landfills and promotes better recycling practices when compared to basic systems.
Weight sensors and region-specific threshold levels can be added to smart dustbins in the future to improve their ability to predict waste generation patterns. Waste collection requirements can be predicted and routes can be more precisely optimized with the use of cutting-edge technologies like machine learning and data analytics. Utilizing renewable energy sources, such as solar power, can also improve the sustainability of the system. These systems can give municipal authorities useful information when integrated with smart city platforms, allowing for prompt action and promoting cleaner, healthier, and more sustainable urban environments.

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