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IoT Based Smart Dustbin *"Swachh Bharat Initiative"*

Mr. Rohit Sevakrao Sondge
Electronics and Telecommunication Engineering
Ajeenkya D Y Patil School of Engineering and Technology
Pune, India

Prof. Dr. Sanjay Koli
Electronics and Telecommunication Engineering
Ajeenkya D Y Patil School of Engineering and Technology
Pune, India

Mr. Aditya Santosh Hirade
Electronics and Telecommunication Engineering
Ajeenkya D Y Patil School of Engineering and Technology
Pune, India

Mr. Prasad Dhananjay Kulkarni
Electronics and Telecommunication Engineering
Ajeenkya D Y Patil School of Engineering and Technology
Pune, India

ABSTRACT
The "Smart Dustbin for Smart Cities" project aims to revolutionize urban waste management by introducing an intelligent system for segregating and notifying authorities about waste collection. Using soil moisture sensors to detect wet, dry, and metallic waste, this system sorts garbage into designated bins mounted on a servo motor for automated rotation. Additionally, a GSM module is used to notify waste collection authorities when bins are full, ensuring efficient operations. The system, powered by a Raspberry Pi, provides a sustainable solution to urban waste challenges, integrating automation and IoT technologies to promote smart city initiatives..

General Terms
IoT**,** Automation**,** Embedded Systems**,** Waste Management

Keywords

Smart Mirror, Raspberry Pi, Face Recognition, IoT, Home Automation

1. INTRODUCTION

Waste management is a significant challenge in growing urban areas. Conventional methods are laborintensive, inefficient, and often fail to address the need for proper segregation of wet, dry, and metallic waste. Improper waste segregation leads to environmental degradation, inefficient recycling, and increased costs for waste management. Smart solutions can reduce human intervention, promote recycling, and improve waste management efficiency. Automating waste segregation requires reliable detection systems, efficient hardware integration, and real-time communication. Existing systems often lack accuracy or scalability for urban needs. This project introduces an automated system using a soil moisture sensor and IR proximity sensor for precise segregation of wet, dry, and metal waste, combined with a servo motor-driven bin rotation mechanism. Additionally, it integrates a GSM module to notify authorities when bins are full, enhancing operational efficiency. The paper is structured as follows: Section II reviews related work, Section III describes the proposed system and methodology, Section IV presents results and discussions, and Section V concludes with future directions.

2. LITERATURE SURVEY

Previous systems for smart waste management have utilized IoT-based methods for waste monitoring and segregation.

[1] Systems with ultrasonic sensors have been used for level detection, but they often lacked precise segregation mechanisms.

[2] Systems with arduino-based automation and using Blynk app for alerts , but this system only monitors garbage levels and does not attempt to classify or segregate waste.

[3] Prior works have largely focused on bin status monitoring and waste level detection, but they do not consider the proper waste segregation.

[4] System is based on arduino and microcontroller using RFID and sensor based waste segregation system.

[5] Attempts using RFID-based segregation showed promise but were expensive for widespread implementation.

[6] Integration of machine learning for waste categorization provided insights but required complex datasets. These approaches, while innovative, often fell short in costefficiency or practical deployment. Our proposed system bridges these gaps with simpler hardware components and effective segregation logic.

3. METHODOLOGY

The proposed **IoT-based Smart Dustbin** system uses a combination of sensors, actuators, and communication modules orchestrated by a Raspberry Pi to automate the process of waste segregation and notification. The step-by-step working of the system is as follows:

1. **Start & Idle State**
   - The system initializes and waits for user interaction.
   - IR sensor constantly checks for motion or waste near the bin.
2. **Garbage Detection**
   - When the IR sensor detects motion, it triggers the waste processing sequence.
3. **Moisture Detection**
   - The raindrop moisture sensor checks the deposited waste for moisture content.
   - If no moisture is detected, the system assumes the waste is dry and prepares to route it to the dry bin.
4. **Metal Detection**
   - If the waste is not dry, the inductive proximity sensor checks for the presence of metal.
   - If metal is detected, the system diverts the waste to the metal bin.
   - If no metal is detected but moisture is present, the waste is categorized as wet and diverted accordingly.
5. **Segregation Mechanism**
   - Based on sensor data, the Raspberry Pi commands the servo motor to rotate the gate mechanism to the designated bin.
6. **Fill Level Check**
   - After dumping the waste, the ultrasonic sensor measures the bin's fill level.
   - This ensures bins are not overfilled and alerts are sent when nearing capacity.
7. **Notification System**
   - If a bin is full, the GSM module sends a text message to the concerned waste management authority for timely collection.
8. **Reset and Ready State**
   - The system resets to its initial position, ready for the next round of waste input and processing.

BLOCK DIAGRAM:

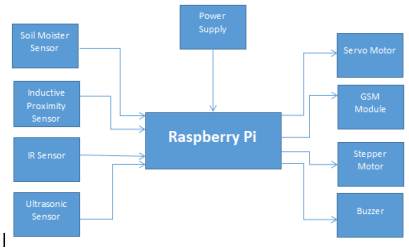

Fig 1: Block Diagram

Hardware Components :

1.Raspberry Pi: Central processing unit for decisionmaking and control.
2.Rain Drop Moisture Sensor: Detects waste type.
3.Inductive Proximity Sensor: Detects metallic waste.
4.Servo Motor: Controls bin rotation.
5.Ultrasonic Sensor: Monitors bin fill levels.
6.GSM Module: Sends SMS alerts to authorities.
7.Power Supply: Battery-operated system with charging support.

Flowchart :

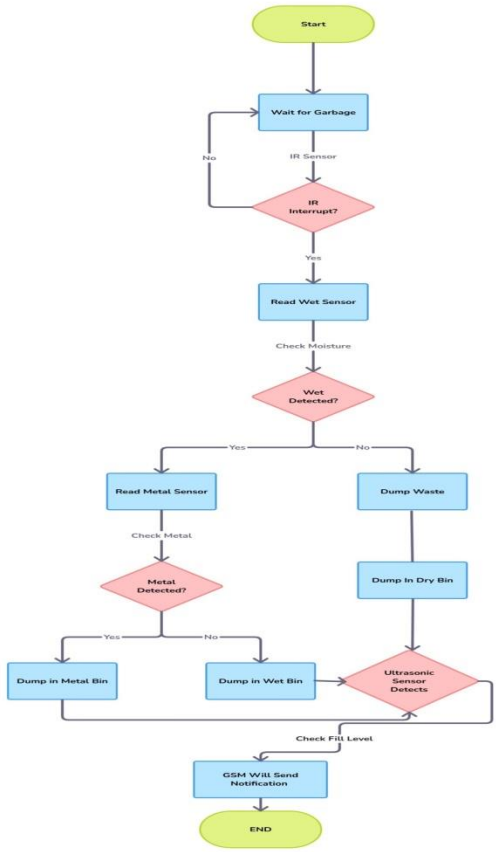

Fig 2 : Flowchart

Flowchart Summery :

The sequence of operations is visually represented in the paper (Figure 2) and follows this logic:

1. **Start System**
2. **Detect Garbage via IR Sensor**
3. **Check for Moisture**
4. **Moisture Present?**
   - No → Route to **Dry Bin**
   - Yes → Proceed to next step
5. **Check for Metal**
   - Yes → Route to **Metal Bin**
   - No → Route to **Wet Bin**
6. **Activate Servo to Rotate Gate**
7. **Check Fill Level Using Ultrasonic Sensor**
8. **Send Alert via GSM if Full**
9. **End Cycle and Reset**

RESULT AND DISCUSSION:

Accuracy of Segregation: The raindrop moisture sensor achieved an 75 to 80% success rate in identifying wet, dry, and metallic waste during testing.

System Response Time: Waste detection and bin rotation occurred within 7 seconds of disposal.

Notification Efficiency: The GSM module reliably sent alerts within 10 seconds of the bin reaching full capacity.

Fig3: Dustbin Prototype

CONCLUSION:

The IoT-based smart dustbin provides a scalable and automated solution to waste segregation and notification. It reduces human effort, enhances efficiency, and contributes to cleaner urban environments. Future improvements may include AI-based classification, solar power, and mobile integration.

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