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SMART WASTE SEGREGATOR

Sreejaa N*1, Poorana Senthilkumar S*2

*1UG-Student, Department Of Computer Applications. Dr. N.G.P. Arts And Science College, Coimbatore, India.

*2Assistant Professor, Department Of Computer Applications. Dr. N.G.P. Arts And Science College, Coimbatore, India.

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ABSTRACT

This project focuses on developing a Smart Waste Segregator that automatically classifies waste into dry, wet, and metal categories using sensors. The system efficiently detects and sorts of waste based on its properties, ensuring proper disposal and recycling. By integrating various sensors, the segregator enhances waste management, reducing manual effort and promoting environmental sustainability.

Keywords: Smart Waste Segregator, Sensors, Waste Management.

I. INTRODUCTION

Waste management is a critical aspect of environmental sustainability, and improper segregation leads to pollution and inefficient recycling processes. Traditional waste disposal methods rely on manual sorting, which is often inaccurate, time-consuming, and labour-intensive. This project aims to develop a Smart Waste Segregator that automatically classifies waste into dry, wet, and metal categories using sensors. By leveraging sensor-based technology, the system enhances waste sorting efficiency, reducing human effort and minimizing errors in classification. The automation ensures proper segregation at the source, which improves recycling rates and contributes to a cleaner environment. Additionally, real-time waste classification can aid in better waste management planning and disposal, reducing landfill overflows and promoting sustainability. This smart system eliminates the need for manual intervention by using sensors to detect and classify waste based on its properties, making the process more efficient, accurate, and eco-friendly.

II. METHODOLOGY

The Smart Waste Segregator follows a structured approach to automatically classify and separate waste into dry, wet, and metal categories. The system integrates sensors, an Arduino microcontroller, and a sorting mechanism to efficiently process waste. Below is a breakdown of the methodology:

1. Waste Detection and Classification

The segregation process begins when waste is placed in the system. The moisture sensor detects wet waste, the inductive proximity sensor identifies metal waste, and the infrared sensor distinguishes dry waste based on its reflectivity. These sensors send signals to the Arduino, which processes the data and determines the category of the waste.

2. Arduino-based Control System

The Arduino microcontroller acts as the central control unit, receiving input from the sensors and making real-time decisions on waste classification. It processes sensor readings and triggers the appropriate sorting mechanism to direct the waste into the correct bin.

3. Sorting-Mechanism

Once the waste type is identified, the Arduino activates the sorting mechanism to direct the waste into the appropriate bin. Servo motors control the movement of flaps or partitions, ensuring proper segregation. If the waste is wet, it is directed into the compost bin. If the waste is metal, it is sent to the recycling bin. Dry waste, such as plastic and paper, is collected in a separate bin for further processing. The automated sorting process ensures efficient waste separation, reducing the need for manual intervention and promoting proper disposal.

4. Waste Collection and Disposal

After segregation, the waste is collected in designated bins. The system ensures proper disposal by keeping each type of waste separate, reducing contamination, and improving recycling efficiency.

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5. Diagrams

Block Diagram

It automates waste sorting by using an Arduino Uno SMD as the primary CPU. Three parts make up the system: input, processing, and output. The input part has a raindrop moisture sensor (with a voltage comparator) to detect whether the waste is wet or dry, an IR sensor to detect objects, and a proximity sensor to detect waste. The Arduino Uno SMD, which collects sensor data and regulates activities accordingly, is in charge of the CPU part. The system is powered by a battery. A buzzer for notifications, a stepper motor with a driver for movement, and a servo 9g motor for lid control are all included in the output area. By effectively automating waste segregation, this configuration lowers the need for manual intervention and enhances waste management.

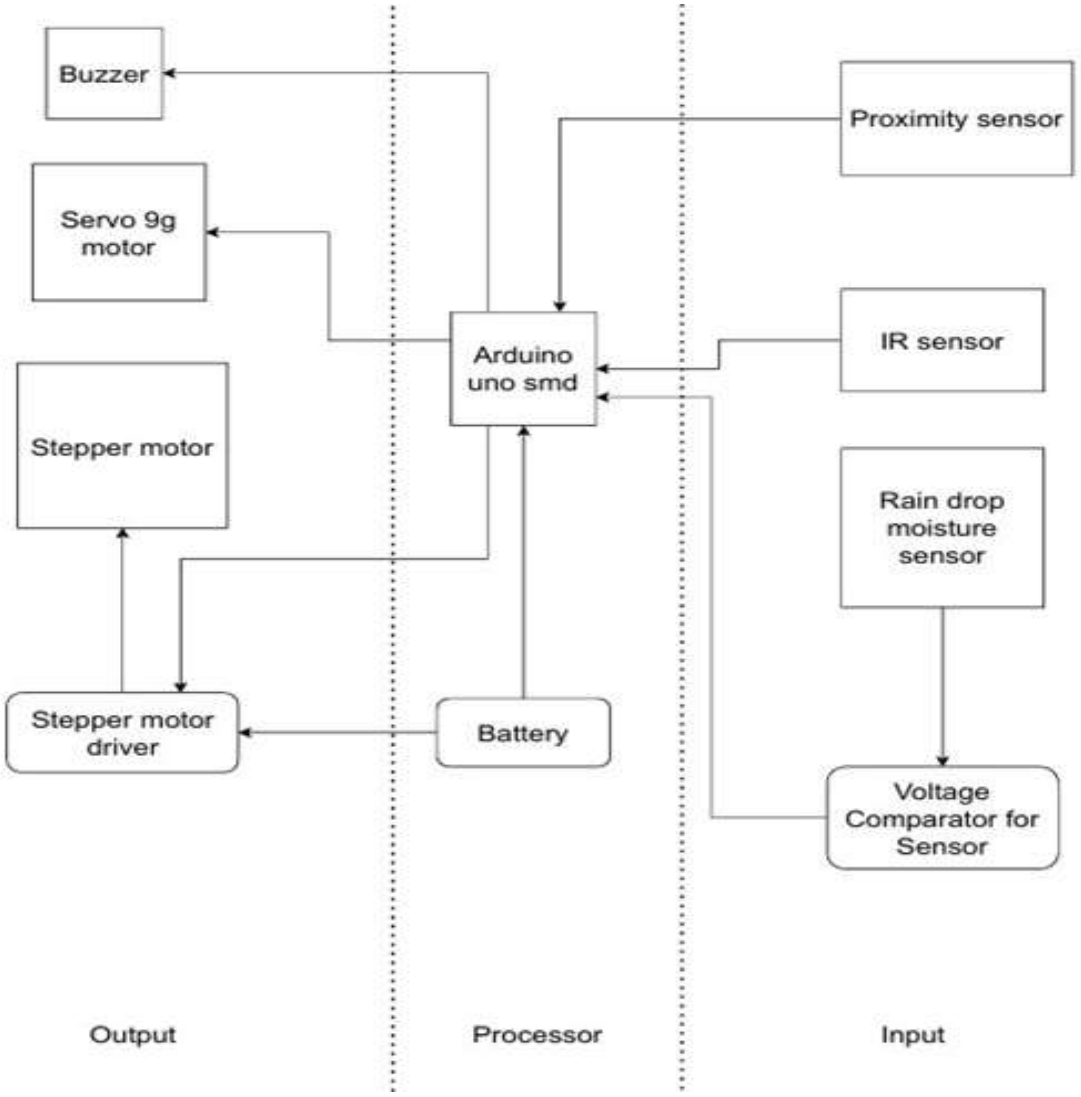

Fig 1: Block Diagram

System Flow Diagram

The waste disposal input, which introduces waste into the system, is where the process starts. The device then uses sensors to identify the waste's characteristics. It initially determines if the waste is dry; if it is, the process proceeds; if not, it repeats for a second assessment. The system then uses the same procedure to detect whether the waste is wet. It then looks for metal waste if the garbage is verified to be moist. The garbage moves on to the storage phase and is put in the appropriate bin if it is metallic. After sorting is finished, the procedure finally comes to an end. For effective garbage management, this system automatically separates waste into metal, wet, and dry categories and places it in the proper bin.

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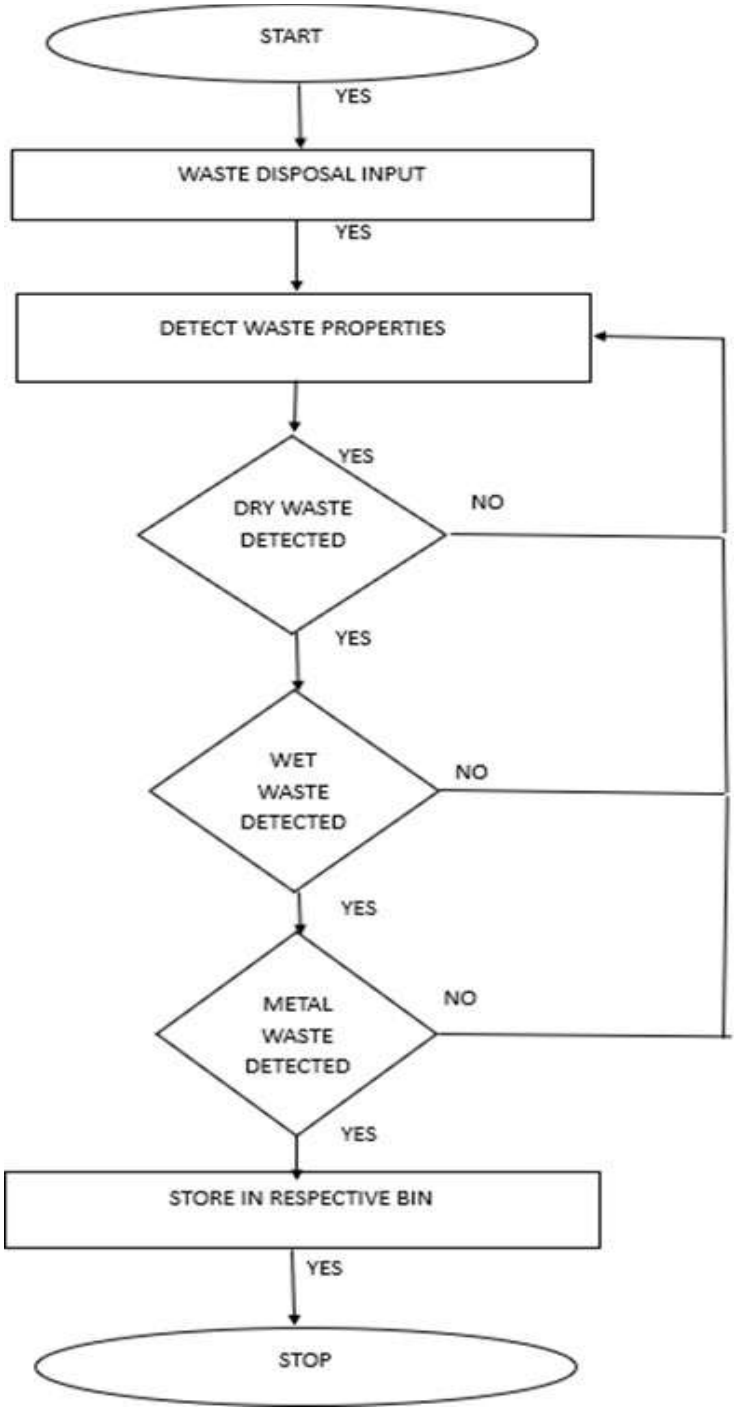

Fig 2: System Flow Diagram

Circuit Diagram

This circuit diagram represents an Arduino Uno-based automation system integrating various sensors and actuators. The Arduino Uno acts as the central controller, receiving inputs from sensors and controlling outputs accordingly. The system includes an IR sensor for object detection, a proximity switch for sensing nearby objects, and a raindrop sensor to detect moisture or rain. Actuators in the circuit include a stepper motor controlled via a stepper motor driver, a servo motor for precise movement, and a buzzer for audio alerts. The circuit is powered by a 3.7V Li-ion battery, while the stepper motor driver requires an additional 5-12V power supply. The interconnected components suggest that the system is designed for automation, possibly for a smart weather-responsive or object-detection based mechanism.

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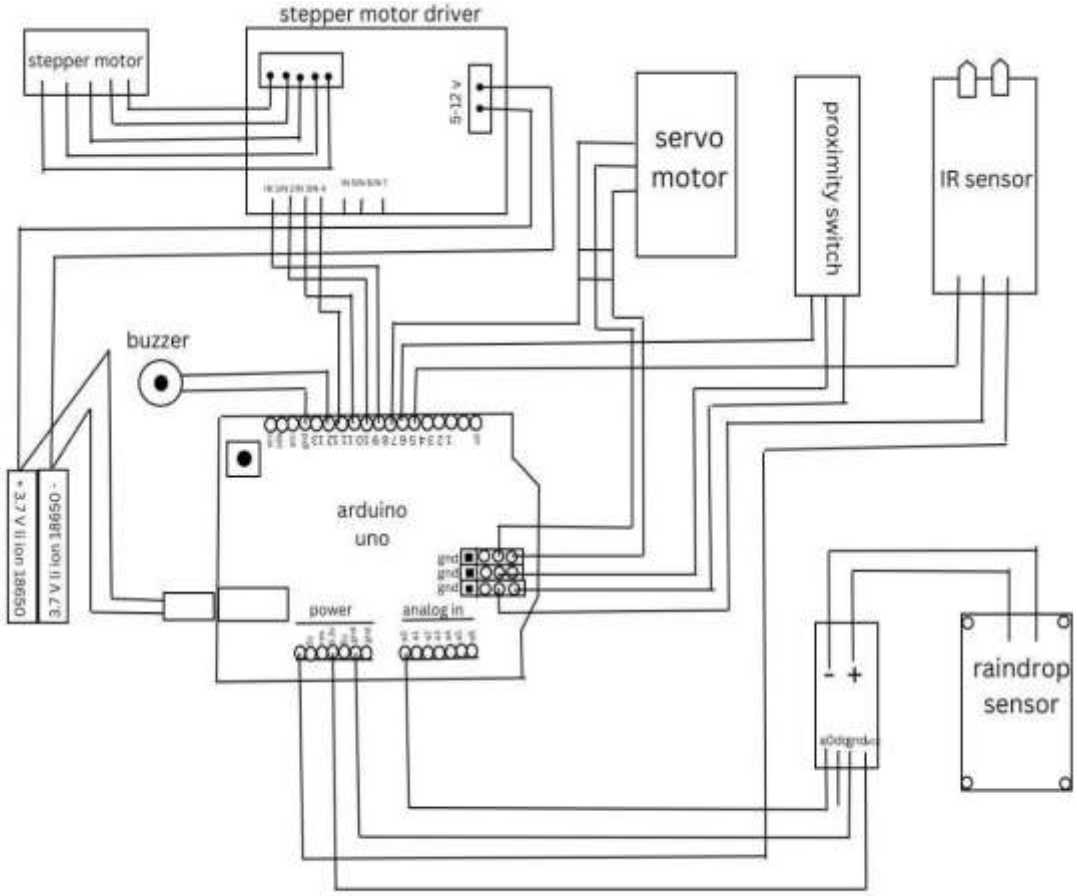

Fig 3: Circuit Diagram

III. MODELING

Prototype

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Dry Waste Detection

Wet Waste Detection

Metal Waste Detection

IV. RESULTS AND DISCUSSION

The benefits of such systems include increased efficiency by automating the segregation process, reducing manual labor and associated errors, and improving environmental impact by enhancing recycling rates and reducing landfill usage. Additionally, they help lower waste management costs over time through improved sorting accuracy. Recent research and developments in this field have focused on enhancing sensor technology and incorporating machine learning algorithms to improve material recognition. Efforts are also being made to develop compact and cost-effective designs suitable for urban environments. Implementing these systems in cities like Coimbatore can significantly contribute to better waste management practices, aligning with sustainable development goals.

V. CONCLUSION

The Smart Waste Segregator is a creative and effective device that separates waste into metal, wet, and dry categories, automating the process. By reducing the need for human sorting, this system enhances waste management overall and improves efficiency and hygiene. For environmentally responsible and sustainable trash disposal, automated waste segregation has become crucial due to growing urbanization and garbage volumes. To guarantee precise classification, the Smart Waste Segregator system makes use of sensors including IR sensor, moisture, and inductive proximity sensors. The inductive proximity sensor finds metal waste, while the moisture sensor separates dry and wet waste. Waste is separated into specific sections after classification, which makes recycling and disposal easier. By guaranteeing appropriate segregation, this not only lessens the strain on waste management personnel but also lowers environmental contamination. Waste management procedures can be greatly enhanced by municipal corporations, businesses, and homes putting such a cuttingedge system into place. Reducing landfill waste, encouraging recycling, and protecting natural resources are all made possible by the Smart Waste Segregator. By stopping organic waste from breaking down in landfills and generating methane, it also aids in reducing greenhouse gas emissions. Overall, the Smart Waste Segregator is a vital step toward sustainable waste management, ensuring a cleaner, greener, and healthier environment for future generations.

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