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DRY AND WET WASTE SEGREGATION: A Comprehensive Overview of an Advanced Automatic Waste Segregation System

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ABSTRACT

The rapid urbanization and population growth in cities worldwide have led to an unprecedented increase in municipal solid waste generation, posing significant environmental, health, and economic challenges. Conventional waste management systems, relying heavily on manual labour and outdated infrastructure, are often ineffective, resulting in overflowing landfills, pollution, and the spread of diseases. To address these issues, this study proposes an innovative intelligent waste management system, integrating cutting-edge technologies and sustainable practices to optimize waste collection, segregation, and disposal.

The proposed system utilizes smart sensors and monitoring technologies to track waste generation patterns, dumpster fill levels, and waste composition in real-time. This data is used to optimize waste collection routes, reduce overflow, and promote efficient segregation of waste into recyclable, organic, and non-recyclable categories. The system also incorporates advanced data analytics and machine learning algorithms to identify trends, predict waste generation patterns, and provide insights for policy-makers and stakeholders.

The intelligent waste management system is designed to be scalable, adaptable, and user-friendly, with a focus on promoting community engagement, education, and participation in waste management practices. The system's effectiveness will be evaluated through a comprehensive pilot study, assessing its impact on waste reduction, recycling rates, and community satisfaction.

The proposed system has the potential to transform the way urban waste is managed, providing a sustainable, efficient, and community-driven solution to the pressing issues of waste management in cities worldwide. By leveraging cutting-edge technologies and promoting community engagement, this system can help reduce waste, promote recycling, and create a cleaner, healthier, and more sustainable urban environment.

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I. INTRODUCTION

1.1 PROJECT IDEA

The burgeoning global population, particularly in rapidly urbanizing nations like India, has exacerbated the critical issue of solid waste management. Traditional, often inefficient, waste disposal methods contribute to overflowing bins, the spread of diseases, and severe environmental degradation. The urgency to address this challenge is underscored by the vision of smart cities, where cleanliness and efficient resource management are paramount. A fundamental component of this vision is the transformation of

conventional dustbins into intelligent systems capable of optimizing waste collection and processing. This paper proposes an innovative approach to urban waste management by integrating analytics and electronics into dustbin infrastructure, specifically focusing on the automatic segregation of wet, dry, and metallic waste. The current reliance on unhealthy and often haphazard waste collection practices, including the reliance on rag pickers who face significant health risks, necessitates a shift towards automated, source-segregation solutions. The world is grappling with the critical issue of garbage management, which poses significant environmental, health, and economic challenges. The rapid urbanization and population growth in countries like India have led to an unprecedented increase in solid waste generation, resulting in overflowing landfills, contaminated water sources, and adverse impacts on public health. The conventional waste management practices, relying heavily on manual segregation by rag pickers, are not only inefficient but also hazardous to their health. By implementing a compact, low-cost, and user-friendly waste segregation system, this project aims to

streamline the waste management process, reduce environmental impact, and pave the way for a cleaner, more sustainable urban future. This system will not only minimize the reliance on manual labour but also ensure that segregated waste is efficiently directed to recycling plants, maximizing resource recovery and minimizing the harmful effects of traditional waste disposal methods. To address this pressing concern, there is an urgent need for an innovative, efficient, and sustainable waste management solution. This project aims to design and implement a smart dry and wet waste segregation system, integrating analytics and electronics to optimize waste collection methods. By automating the segregation process, this system seeks to reduce the dependence on manual labour, minimize environmental pollution, and promote a healthier and more sustainable urban ecosystem.

II. LITERATURE SURVEY

2.1 AUTOMATIC WASTE SEGREGATION SYSTEM:

Authors Kabilan M, Lokesh B and Kishor has discuss Modern metropolises worldwide encounter a shared challenge in efficiently handling urban waste while maintaining cleanliness handle this manually is hard so they create the Automatic waste segregation system and the system is useful for the proposes a waste management system wherein each dumpster is integrated with a monitoring system that notifies the relevant personnel when the container is full. in this project west maintain not properly segregate.

2.2 DRY AND WET WASTE SEGREGATION AND MANAGEMENT SYSTEM:

Authors Md Abdullah Al Rakib, Md. Sohel Rana, Md. Moklesur Rahman, and Fysol Ibna Abbas has development the project of a solar-powered, automated waste segregation system to address the problem of inefficient and unsustainable waste management. The system to automatically separate wet and dry waste at the source, monitor waste levels, and provide GSM- based notifications. This solution promises to increase recycling, reduce manual labour, improve the quality of recyclable materials, and contribute to a more sustainable and environmentally friendly waste management process, ultimately reducing landfill waste and health risks but this system need the solar panels so the cost of the system is increased.

2.3 SMART DUSTIBN-WET AND DRY(METAL) WASTE SEGREGATION WITH ALTERT SYSTEM:

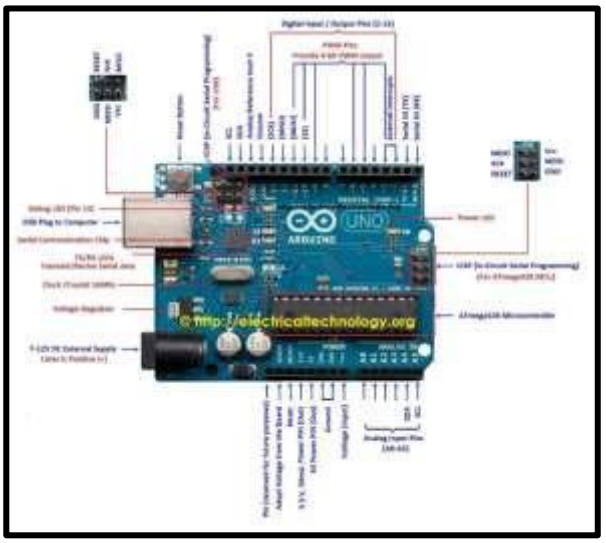
Authors Mrs.Susan Shiny, Mr.M.R.mohamedShahidhMeeran, Mr.S.Rajeshwaran here discuss that what are the cause of inefficient west disposal. and they give solution on this problem the system proposed by them provide automatic waste separation in metallic, wet, dry categories, and improving recycling and reuse of the west.

III. HARDWARE AND SOFTWARE COMPONENTS

3.1 HADWARE :

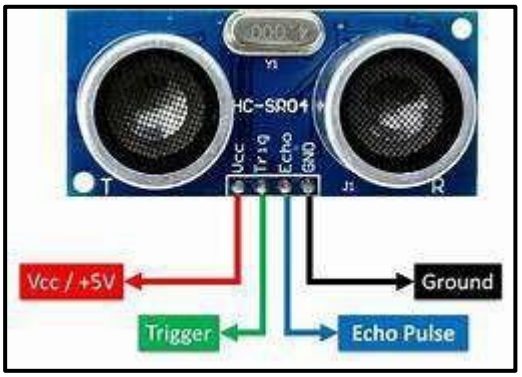
3.1.1. ARDUINO UNO

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board. Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits. The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.



3.1.2. UTRASONIC SENSOR

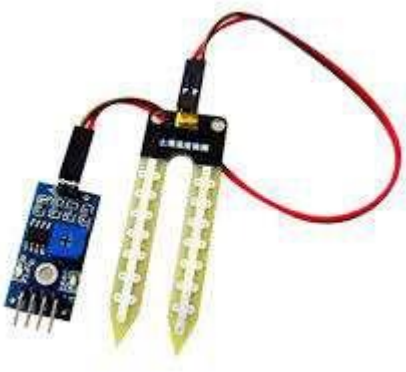
Ultrasonic sensor can monitor any type of waste it utilized inside waste container ultrasonic sensors send signals to Arduino uno. Arduino uno understands the signal and sends a signal to the servo motor which opens the flap on top of dustbin and enables smart bins to accurately detect waste. The sensor can monitor any type of waste in containers, bins and waste compactors of various types and sizes. The casing made from recyclable glass fibre in polyamide that provide recycling.



3.1.3 MOISTURE SENSOR

Moisture sensors are designed to assess the volumetric water content present in soil. Unlike the direct gravimetric method, which involves removing, drying, and weighting a soil sample, these sensors indirectly measure water content by utilizing other soil properties like electrical resistance, dielectric constant or interaction with neutrons as indicators of moisture content. The correlation between the measured property level and soil moisture requires calibration and may vary based on environmental factors like soil type, temperature, or electric conductivity. Remote sensing on hydrology and agriculture utilizes the impact of soil moisture on reflected microwave radiation. Farmers or gardeners can employ portable probe

instruments to gauge soil moisture levels. The moisture sensor determines the amount of waste subtracting the dry waste from the initial waste, and the moisture present in it is then calculated as the amount of waste which was divided by the dry waste or total weight, present on the chosen reporting method.



3.1.4. SERVO MOTOR (SG90)

Servo motors are devices that can rotate to a specific angle or position. They can be used to move robotic arms, steering wheels, camera gimbals, etc. Servo motors have three wires: power, ground and signal. The power wire is usually red and should be connected to the 5V pin on the Arduino board. The ground wire is usually black or brown and should be connected to a ground pin on the board. The signal wire is usually yellow or orange and should be connected to a PWM pin on the board.

It works like this: The microcontroller sends out PWM signals to the servo, and then the embedded board in the servo receives the signals through the signal pin and controls the motor inside to turn. As a result, the motor drives the gear system and then motivates the shaft after deceleration. The shaft and potentiometer of the servo are connected together. When the shaft rotates, it drives the potentiometer, so the potentiometer outputs a voltage signal to the embedded board. Then the board determines the direction and speed of rotation based on the current position, so it can stop exactly at the right position as defined and hold there.

3.2 SOFTWARE

3.21. ARDUINO IDE SOFTWARE

The Arduino IDE serves as the software hub for programming Arduino microcontrollers, offering a streamlined environment for developers of all skill levels. At its core, the IDE facilitates the creation and deployment of "sketches," which are essentially the programs that dictate the Arduino's behaviour. This process begins with the built-in text editor, where users compose their code. Once written, the IDE's compiler translates the human-readable code into machine-executable instructions that the Arduino board

can understand. Crucially, the IDE simplifies the uploading of this compiled code directly to the connected Arduino board, eliminating the complexities of manual programming. Beyond basic coding, the IDE also provides a serial monitor, enabling communication between the computer and the Arduino. This feature is invaluable for debugging, monitoring sensor data, and exchanging information during program execution. Available as an open-source application across various operating systems, the Arduino IDE fosters a vibrant community and promotes accessibility, making it a cornerstone for anyone venturing into the world of embedded systems and physical computing.

IV. METHODOLOGY

Presently, waste dumping has emerged as a significant and urgent issue in our environment, posing a potential crisis for current and future generations. A variety of waste types, including perishable and recyclable materials, are indiscriminately mixed and dumped on land, resulting in substantial negative impacts. Consequently, effective waste management has become a crucial concern for the well-being of society. Notably, there is currently no established system for segregating household waste into categories such as dry and wet waste. To address this issue, an Automated Waste Segregator (AWS) can be implemented at the any household level, facilitating the direct processing of waste. However, this system has limitations, as it can segregate one type of waste at a time, with a predefined priority for wet and dry waste. To handle mixed waste types, buffer spaces can be employed. Recognizing the swift sensing capability for metal objects, the entire sensing module can be positioned along a single stable platform to enhance results. Initially, a standing model was proposed for system implementation. However, to improve accuracy, feasibility, and cost-effectiveness, a decision was made to adopt a conveyor belt system. This involves mounting various sensors on the sides of the belt to effectively segregate waste.

V. PROPOSED MODEL

Below diagram specify what exactly done in the project, The main goal of this study is to automate the efficient sorting of different types of waste. to automate west segregation, need the sensor. The ultrasonic sensor detects the presence of waste, then the moisture sensor measures the moisture content to determine if the waste is wet or dry. The Arduino receives data from both sensors and processes it. Based on the Arduino's instructions, the servo motor activates, moving a mechanism to direct the waste into the correct bin(dry or wet)

5.1.1. BLOCK DIAGRAM

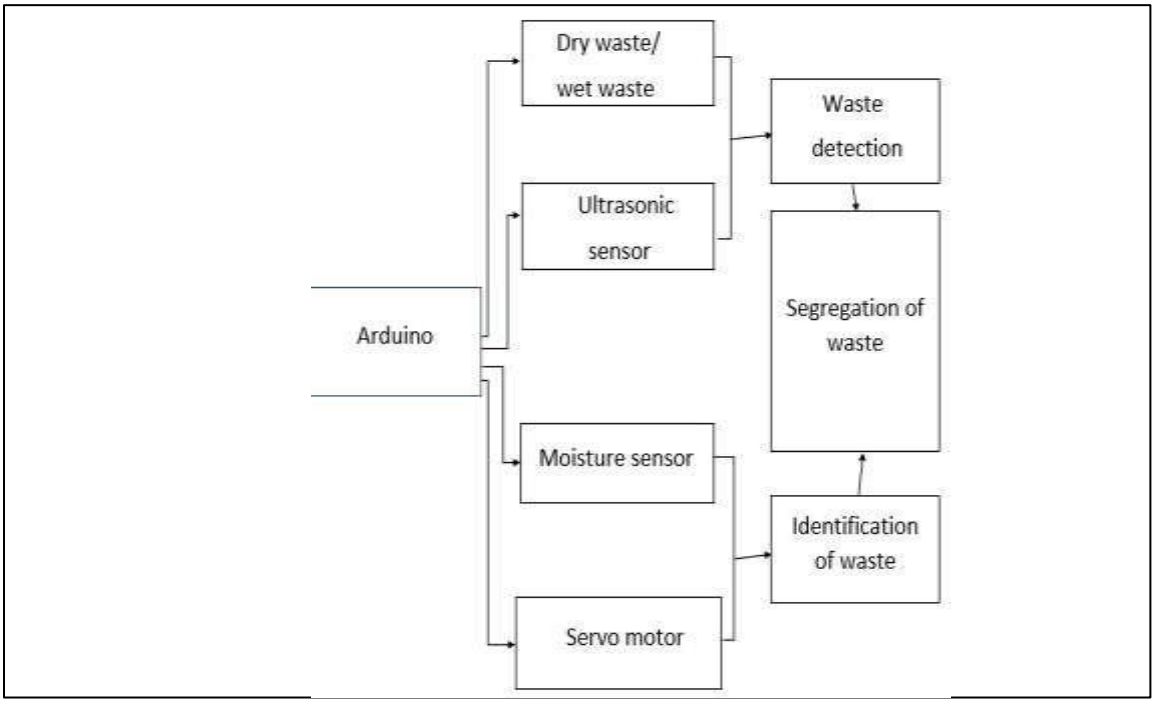


Figure 1: Block diagram of the proposed system

5.1.2. FLOWCHART

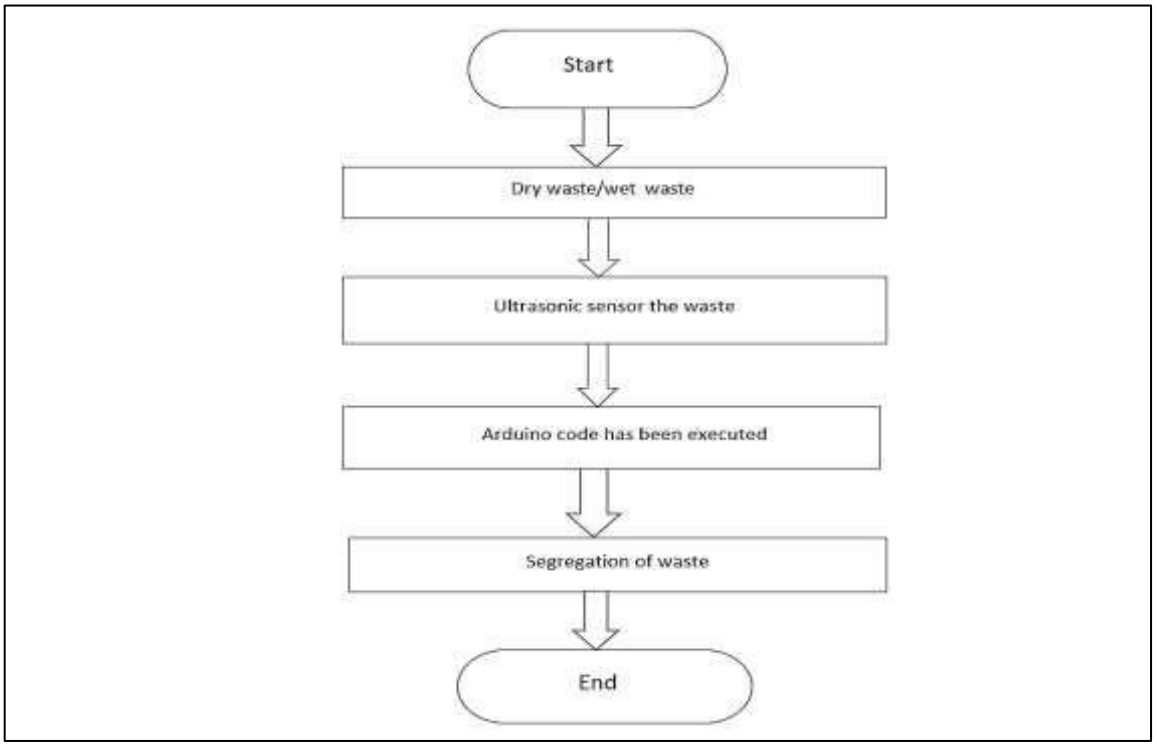


Figure 2: Flowchart of the proposed system

VI. CONCLUSION

With the rapid growth of cities and population, Waste management has emerged as a critical challenge. Manual waste Segregation is a time-consuming, costly and the ineffective process. This paper introduces a smart and budget -friendly method for separating a waste. The proposed smart waste container is an automated waste segregation system that efficiently separates dry and wet waste without human involvement, enabling timely collection and disposal. The proposed system is scalable and can be used in domestic environment, such as homes as well as in public places such as garden and park.

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