WASTE MANAGEMENT – SEGREGATION OF WET AND DRY WASTE USING SMART DUSTBIN

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Abstract

Trash management systems are facing major issues as a result of the sharp rise in trash creation brought on by the fast urbanization and population growth. Because of insufficient monitoring systems and laborious collection processes, traditional waste management techniques frequently suffer from inefficiencies. This project suggests creating a Smart Dustbin utilizing Internet of Things (IoT) technology for effective trash management in order to address these issues. The Smart Dustbin incorporates a number of sensors, including weight sensors for precise trash content measurement, temperature sensors for environmental monitoring, and ultrasonic sensors for waste level detection. Using Internet of Things communication protocols, these sensors offer real-time data on the dustbin's condition and fill level. The data is wirelessly sent to a central server. A cloud-based software platform forms the basis of the system, processing data from the Smart Dustbins to allow for remote management and monitoring of garbage collection activities. The platform can reduce operational costs and improve overall efficiency by optimizing waste collection routes, scheduling timely pickups, and allocating resources effectively through data analytics and predictive modeling. Additionally, the Smart Dustbin has intelligent features including user feedback interfaces and automatic lid opening/closing mechanisms that improve user convenience and promote good trash disposal behavior. When compared to conventional waste management techniques, the suggested Smart Dustbin system has a number of benefits, such as: **Real-time monitoring:** By keeping an eye on fill levels, proactive garbage collection is made possible and overflowing bins are avoided. **Effective resource allocation:** Data-driven insights enable more efficient resource allocation and route planning, which lowers operating expenses and fuel usage. **Environmental sustainability:** The method lowers carbon emissions and aids in environmental conservation by encouraging effective rubbish collection and cutting down on pointless journeys. Improved user experience Insightful functions and dynamic user interfaces promote community involvement and a sense of environmental responsibility.

I. Introduction

Waste Sorting is the process by which waste is separated into different categories.

Government of India implemented Clean India Movement (Swachh Bharat Mission) in 2014 encouraging the separation of Dry and Wet waste throughout the country. Large Dustbins were replaced by small compact 2 dustbins in every state with 2 different colours symbolising Dry(Blue) & Wet(Green) garbage. This step motivated responsible citizens to dispose trash accordingly in public spaces and made the segregation procedure uncomplicated for the government. A 2019 India Today article states that the nation generates more than 1.50 lakh metric tons (MT) of solid waste every day. Nearly 15,000 MT of trash are left exposed every day, which is a major contributing factor to the increase in pollution. The remaining 80% (1,08,000 MT per day) of the total collected garbage is disposed of in landfills, with only 20% (27,000 MT per day) being processed. It is thought that if we separate biodegradable waste from the other waste, the difficulties might be cut in half. The components of e-waste are non-biodegradable and contain hazardous elements that pose a risk to the health of workers and the environment. These risks include leaching from e-waste in landfills into nearby water tables and toxic smoke from recycling procedures.

According to reports, if civic governments began enabling ragpickers to separate and recycle rubbish at the source, nearly 80% of the waste at landfill sites in Delhi might be recycled.This addresses the following problems of improper waste management: Lack of public awareness, Lack of Waste Management Knowledge among social workers, No monitoring of Garbage system and Dustbins, Negligible usage of technological advancements, Sad truth is that Laziness of acknowledgment of Dry & Wet waste in public.

II. Literature Survey

In [1] Households are the primary sources of rubbish collection. the waste products, either organic or inorganic, generated by domestic or commercial operations. The only option to gather domestic waste while you wait for municipal corporations is to use a dustbin. Due to the daily increase in waste, the majority of dustbins and rubbish cans seen in public areas and in front of homes and businesses in cities are overflowing. Inadequate waste management poses a significant risk to public health, promotes the spread of infectious diseases, and contaminates the environment. When different biodegradable waste combinations are combined and the trashcan is left unattended for several days, toxic gasses like methane are produced.

In [2] This work offers a consumer-internet-of-things (IoT) based smart waste tracking system with an integrated trash sorting mechanism. It is an easy-to-use solution for garbage separation at the household level, allowing waste to be routed directly to the right processing facility. This paper's main goal is to describe and construct an isolation framework that separates trash into three categories: metallic, glass, and plastic. This system sorts plastic and glass debris using capacitive proximity sensors and detects metallic objects using an inductance-detecting component. Given that it is a valuable tool for separating most types of waste, civil organizations will find this framework helpful in sorting the collected rubbish.

In [3] Waste that is not adequately separated has an impact on the waste management process as a whole. Properly sorting waste into different categories at the source makes

it easier to process the waste further, which reduces the amount of waste that needs to be dumped in landfills and increases its recovery and usage. rubbish segregators are machines that automatically sort rubbish, a more recent technology known as automation-based or automatic waste sorting. garbage segregators solve the problem of low citizen awareness regarding the proper bin selection for a given type of garbage, as well as the necessity to assign laborers to the site for segregation.

In [4] The current system lacks sufficient planning for waste collection, which results in an unclean city or town. The authority is not routinely updated by the current system regarding the rubbish bin's level and odor. It merely uses an SMS alert to notify the municipality. Certain systems use an RFID tag and reader to notify the worker inside the truck of the bin's current state whenever the garbage truck approaches the bin. When the trash is full, the employee cleans it. The drawbacks of this approach include higher fuel usage and longer processing times.

In [5] Solid waste management is a major issue in urban areas, not just in India but in the majority of other nations as well. Therefore, a method that can either completely eliminate or drastically lessen this issue must be developed. One of the most effective strategies to maintain a clean and green environment is provided by the project. Though our current Prime Minister proposed the notion of creating 100 smart cities across India a few years ago, the smart city concept is still relatively new in our country. Large amounts of obligations now need to be met in light of the impending rise in smart cities.

In [6] The automated door opening mechanism attests to the fact that disposing of waste by hand is entirely hands-free and, as a result, exceedingly hygienic because there is no contact with the trash can. Trash is arranged in batches based on its capacitance. Wet garbage is immediately unique because it has a noticeably greater capacitance than both dry waste and plastic. Since plastic does not reflect light like other dry garbage does, infrared spectroscopy is the best technique to separate plastic from other dry waste.

The primary topic of this article was home automation systems, which can be implemented on a big scale in the future and are useful in shopping centers and other public areas.

In [7] The Smart-Bin that we have suggested is capable of efficiently addressing the issue of garbage disposal, which is a significant concern in numerous developing nations. Our system notifies the necessary staff when the bin is filled, ensuring that wastes cannot accumulate in the bins. Additionally, our Smart-Bin extremely effectively separates the wastes, enabling the implementation of timely and appropriate disposal procedures. In the future, it will be possible to link several of these bins to the same web server in order to accurately analyze the patterns of trash generation. It is possible to pay private workers to keep an eye on the trash in the bins and stop people from trying to throw away various disgusting things in them.

In [8] Our suggested approach focuses primarily on keeping an eye on the waste management process and offering the shortest route possible to prevent human interference. This saves time and effort and creates a clean and healthy atmosphere. The suggested solution is for smart cities where the populace is too busy with their hectic schedules to manage waste. This system's primary goal is to regulate gas emissions and waste overflow in the trash cans. The Arduino UNO development board and NS2

simulator are used to implement and simulate this project.

In [9] Most of these cities have landfills that are full and cannot hold any more waste. The majority of nations have accepted the "waste management hierarchy" as the step-by-step process for developing municipal solid waste (MSW) management techniques. An Internet of Things-based trash management system lowers the risk of exposure for waste workers. In India, 0.1 million tons of trash are produced daily. However, only 5% of the total garbage gets recycled. In India, collecting rubbish, transporting it, and disposing of it are real problems. Due to concerns about the environment and fashion, as well as the enormous volumes of waste produced daily, city solid waste management in India remains an unsexy problem.

In [10] Despite the fact that 31% of India's population lives in urban areas, the country's 377 million people produce an enormous 1,43,449 metric tons of solid trash every day, and these numbers keep rising as the country's population grows. Waste segregation from the start is one potential remedy for this problem. One could refer to the first phase as the disposal phase. India has established a number of methods for collecting waste materials separately into dry and wet categories. Additionally, the country has given the municipal corporation trucks that are specifically made for collecting rubbish. However, the inhabitants' ignorance and careless actions mean that these strategies are not very beneficial.

In [11] Research has been conducted using a field exploration approach to address understanding the impact of little effort obstacles, such as data organization at the family level, which has not been completed in developing countries. At that point, the examination overlays the standard-setting mediations and financial motivating factors on top of "data" intercession to demonstrate improvement. understanding the impact of mediations.

In [12] The monitoring and segregation procedure are integrated into the technique. We separate the waste materials using a variety of sensors, which are used in the segregation process. Using Internet of Things technology, the monitoring system provides us with information regarding the garbage collection bins' capacity. The platform utilized to complete the monitoring process is called ThingSpeak. Several governing agencies, the trash industry, tenants, producers, vendors, and trade associations have recognized their responsibility for managing hazardous waste. PEARL is an example of one of these.

In [13] suggested a procedure that would only be required by the community organizations to upload the photos of the scrap lockers that were taken and uploaded to the system in order to analyze the scrap's moisture content. The crucial task that machine literacy will be used for is the scrap's contents discovery. An separation system for wastes, specifically biodegradable, essential, and plastic, was proposed by Kumar et al. (8). With the aid of detectors, the waste dumped into the tip is insulated at the panel, and the corresponding member faucets are opened, allowing the trash to be dumped into their own member.

In [14] Using a Smart Bin enables us to dispose of the waste in an efficient and just manner. The automated door opening mechanism guarantees completely hands-free and highly hygienic disposal of scrap by humans, as there is no contact created with the caddy. Trash is arranged in batches based on its capacitance. Kumar, P.A.V. et al. (6) suggested a sensor-based grounded waste

management system. The non-metal sensor is accomplished by jilting them into the Arduino tackle, which is validated for many things calling into the system. The suggested system describes waste orders videlicet essence and non-metal sorted utilizing automatic trash division. It is also less expensive and a better solution for a safe operation.

In [15] The internet is used by our system's smart dust lockers to obtain real-time data on the smart sties. The population has been growing quickly lately, which has increased the need to dispose of waste. Therefore, in order to prevent the spread of some fatal illnesses, a proper waste operation system is required. The majority of the labor used to isolate the trash is done by hand. Homemade isolation has a low efficacy. Mortal mistake increases the likelihood of a waste substance being incorrectly classified. In addition, the workers are subject to conditions and the risk of infection that are genuinely typical of similar working environments. One crucial step in the production of coal products is transportation.

III. Limitations in Existing System

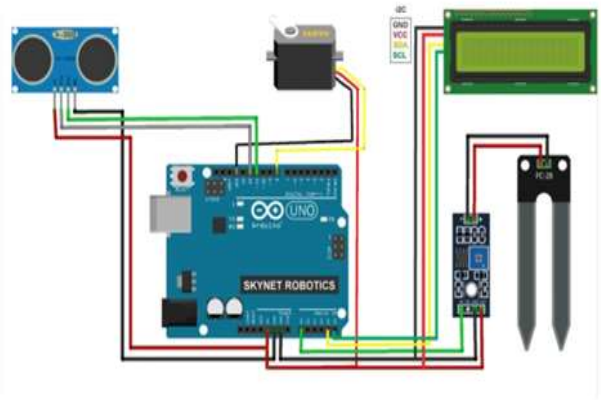
The existing system uses intelligent dustbins in a smart waste management system. The fill level of these bins is determined using ultrasonic sensors. The sound waves from the sensor have a shorter echo time when waste builds up. This data is interpreted by a mini-computer, which then initiates alarms such as sending out internet messages or turning on lights.

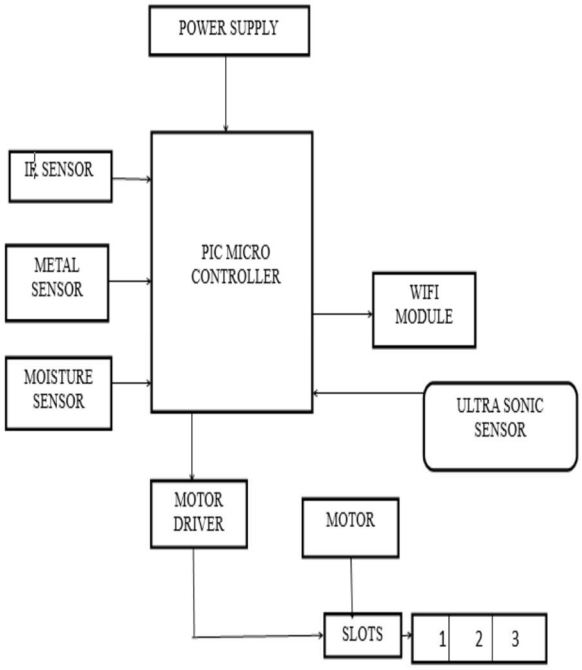
This method provides less overflowing bins, more efficient collection routes, and insightful data for well-informed waste management plans. But factors to take into account include the initial investment expenses, the limitations of the sensor in extreme weather, and the dependence on internet access for notifications. With a focus on enterprises, property managers, and governments, this system can be introduced gradually through data analysis, pilot programs, and full implementation. Smart dustbins present a viable way forward for cleaner cities, with long-term advantages surpassing any drawbacks. Although trash management is enhanced by both smart dustbins, segregated bins present a significant benefit. Recycling operations are hampered by basic fill-level sensors' inability to discriminate between wet and dry garbage. Segregating bins maximize recycling potential by sorting waste according to its type using extra sensors (weight, conductivity). However, there is a cost associated with this extra complexity: segregating bins may require more sensors and a larger initial expenditure.

IV. Proposed System

Smart dustbin is designed using Arduino and IOT based systems for smart operation and monitoring Creating an affordable compact design for cooperative as well as public usage requires the mentioned things. Cardboard box-based design to enable the easiness of usage. Segregate Dry & Wet waste using moisture sensor and Ultrasonic sensor. IOT monitoring of garbage level stored using ultrasonic and Arduino Wifi Module. Components Required are Ultrasonic sensor, Arduino Uno, Servo motor, Moisture Sensor, Micro-servo Motor, Jumper Wires, Breadboard, Battery. When waste is deposited, it falls straight onto the moisture sensor, which is attached to the upper portion of the segregator. Beside it is a touch sensor that detects dry waste. Servo motors are employed as actuators, and their rotation is contingent upon the nature of the waste (dry or moist). Once placed inside the bin, waste falls across the moisture sensor. The moisture

sensor determines whether it is dry or wet based on the threshold that has been set. Servo motors operate in either direction based on the type of trash, and the garbage is placed in the proper compartment as soon as step two is completed. The entire procedure is continuous and autonomous.





V. Work Process

1. Arduino UNO

A basic Arduino Uno microcontroller serves as the system's central component. A microcontroller board is called the Arduino Uno (datasheet). It features a 16 MHz crystal oscillator, 6 analog inputs, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button.

Smart bins ultrasonic sensors measure the echo time while releasing high-frequency sound waves. An empty bin gives the sound a clear passage, lengthening the echo. But the sound returns more quickly when the trash fills the container. The sensor may successfully identify the presence of a trash object by examining this echo time. This low-tech solution assists in determining whether a trash can needs to be emptied without the need for costly or sophisticated extra sensors.

2. Object detection

Ultrasonic sensors measure distance using ultrasonic pulses. The sensor head emits an ultrasonic wave, which the target reflects back. The time interval between emission and reception is used by ultrasonic sensors to determine the target's distance. Unlike an optical sensor, which contains a transmitter and receiver, an ultrasonic sensor uses a single ultrasonic element for both emission and reception.

3. Identifying the waste as wet or dry

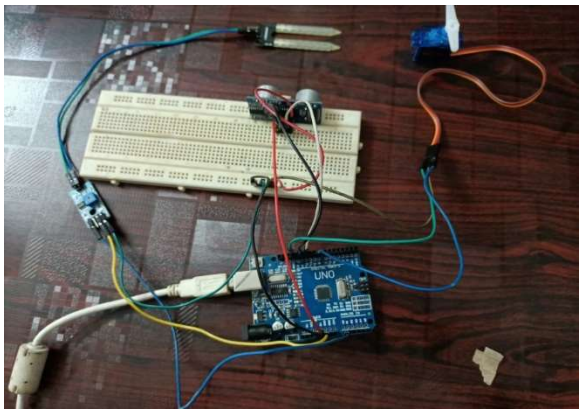
The Moisture Sensor measures the dielectric permittivity of the surrounding medium by using capacitance. Dielectric permittivity in wet waste depends on the amount of water present. The dielectric permittivity and, consequently, the water content of the waste are determined by the voltage that the sensor generates. Therefore, it aids in distinguishing between dry and wet waste. IR sensor for determining level Waste can be detected and its level determined by an infrared sensor. This measures the level and notifies the

microcontroller if it rises above a predetermined threshold.

4. Flipping of Dustbin lid using servo motor

A feedback control that detects mistakes and modifies a system's performance is called a servo. It also requires a very sophisticated controller, usually a dedicated module designed for use with servomotors. DC motors that allow precise angular position control are known as servo motors. They are actually DC motors, and the gears cause them to slow down over time. Servo motors typically have revolution cutoff angles between 90° and 180°. Another feature of some servo motors is a revolution cutoff of 360° or more. On the other hand, servo motors do not spin nonstop. Only inside the confines of the predetermined angles are they able to rotate.

V. Results and Discussion



The Smart Dustbin system, which was created to separate dry and wet wastes using Arduino, showed encouraging outcomes in automated trash segregation. It was able to discern between different types of garbage with a high degree of precision and efficiency by using signals from infrared sensors. The technology reduced the need for manual intervention by automating the segregation process, increasing operating efficiency and encouraging resource conservation. Interactive interfaces and real-time feedback systems were employed to enhance user engagement, promote environmental awareness, and encourage adherence to trash segregation requirements. The IoT integration allowed for remote monitoring and management for optimal tactics, and the system's modular design allowed for scalability and customization to fit a variety of waste management requirements. Notwithstanding difficulties experienced, such as problems with sensor calibration and mechanical malfunctions, the project demonstrates the promise of Arduino-based solutions in changing trash management.

VI.Future Enhancements

A system that enables precise sorting by using a camera and machine learning on the Arduino itself to recognize trash categories like plastic bottles or food scraps in real-time. In order to enable segregation of waste beyond just dry and wet, the system could even be expanded to manage numerous bins with servo motors, allowing for the inclusion of categories like paper, plastic, and metal. Another option is waste disposal that is voice-activated. Offering a pleasant and hands-free experience, the system would identify your voice instructions and open the chosen waste type-specific container. To create an even smarter system, sensor fusion might also combine ultrasonic sensors with

weight sensors or infrared technologies for metal or bulky garbage detection. The technology might send trash data to a cloud platform for analysis by making a connection to the internet. This would make it possible to better identify trash patterns, optimize collection routes, and ultimately increase the effectiveness of waste management as a whole.

VIII. Conclusion

In conclusion, the creation of the Smart Dustbin system, which uses Arduino to separate dry and moist garbage, is a major advancement in contemporary waste management techniques. By combining cutting-edge sensor technologies, automated control systems, and intuitive user interfaces, the system presents a viable answer to the problems associated with waste segregation at the source. The Smart Dustbin system helps to promote environmental sustainability and the conservation of natural resources by encouraging effective resource utilization, decreasing dependency on manual sorting procedures, and increasing user participation. This research highlights the potential of Arduino-based solutions to revolutionize waste management procedures and promote a cleaner, healthier, and more sustainable future, even though more optimization and refinement may be needed to address technical issues and increase system reliability.

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