International Journal of Scientific Research and Engineering Development-– Volume 6 Issue 5, Sep- Oct 2023
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Automatic Waste Segregation System

Shiv Kumar**, Pradeep Yadav**, Dheerendra Kumar**, Anurag Patel**,
Subodh Kumar*, Ankush Gaurav**, Himanshu Tiwari**, Shashank Dubey**
**Department of Mechanical Engineering,UNSIET, Veer Bahardur Singh Purvanchal Univesity , Jaunpur,222003, India*
Corresponding Author* kumarsubodh0512@gmail.com
***Department of Mechanical Engineering, UNSIET, Veer Bahardur Singh Purvanchal Univesity , Jaunpur,222003, India*

----------**********----------

Abstract:

This study addresses the pressing issue of disorganized waste disposal in both urban and rural areas by introducing an Arduino Uno-based automatic waste segregation system. In many communities, waste is often discarded without consideration for its category, leading to environmental pollution and inefficiency in waste management. To tackle this problem, our system employs sensors and mechanical components to efficiently separate wet and dry waste into distinct compartments. The system operates as follows: an IR sensor detects the presence of an object in a dumpster, and a moisture sensor assesses the moisture content of the object. Based on this moisture content measurement, the system classifies the waste as either wet or dry and then directs it into the appropriate bins. By automating this process, our system significantly reduces the quantities of hazardous waste and the emission of toxic gases like carbon dioxide and methane, thereby contributing to a cleaner environment.
Moreover, our study addresses a critical issue encountered in previous waste segregation systems, where metal dumpsters were used and frequently corroded due to moisture content. In our approach, we employ corrosion-resistant materials to ensure the longevity and durability of the waste segregation system, reducing maintenance requirements and costs. Overall, our system not only enhances waste management practices but also minimizes the need for manual labor, making it a valuable addition to waste disposal infrastructure in both urban and rural settings.

Keywords **— Waste Segregation, Arduino, Carbon-dioxide, Methane, Moisture Sensor, IR Sensor, corrosion resistance**

----------**********----------

I. INTRODUCTION

Waste segregation is a crucial component of effective waste management, aimed at sorting and separating different types of waste materials at the source to facilitate recycling, reduce environmental impact, and promote sustainability. This system helps divert recyclable and organic materials away from landfills and incinerators, thus conserving resources and mitigating pollution. It typically involves categorizing waste into categories like organic, recyclable, and non-recyclable to reduce environmental impact and promote sustainability. In this paper, the system contains sensors to check the weight of waste and the level of waste inside the container. Bluetooth is associated for short arrive at correspondence. In this paper, Arduino Uno to check the level of waste filled in the dustbin and sends the caution to the city web labourer once in the event that garbage is filled.

In this paper the system uses Arduino Uno board, GSM modem for sending data. The system is fuelled by a 12V Transformer.

II. LITERATURE REVIEW

A literature review on waste segregation systems would typically involve a comprehensive analysis of existing research, studies, and publications related to the topic. Waste segregation has a long history, with various civilizations implementing rudimentary forms of waste separation and management. Waste segregation has a long history dating back centuries, but modern practices began to emerge in the 20th century. Here's a brief overview.

Early Practices: Waste segregation can be traced back to ancient civilizations where some separation of waste materials was practiced for recycling and disposal. For example, in ancient Rome, there were designated locations for waste disposal.

Industrial Revolution: The 19th century saw the rise of industrialization, leading to increased waste production. However, waste segregation as we know it today was not widespread during this period.

Early 20th Century: The concept of recycling gained traction during World War I and II due to resource shortages. The Salvage for Victory campaign in the United States during World War II encouraged citizens to segregate and recycle materials like paper, rubber, and metal.

1970s Environmental Movement: The environmental movement of the 1970s, spurred by events like Earth Day (founded in 1970), played a pivotal role in promoting waste segregation. Recycling programs were established in many Western countries.

Landfill and Incineration Concerns: The 1980s and 1990s brought increased awareness of the environmental impact of landfills and incineration. This led to a push for more comprehensive waste segregation to reduce waste going to landfills and incinerators.

Legislation and Regulations: Many countries started implementing waste segregation policies and regulations during the late 20th century and early 21st century. Examples include the European Union's Waste Framework Directive (2008/98/EC) and the United States' Resource Conservation and Recovery Act (RCRA). In the European Union, the Waste Framework Directive (Directive 2008/98/EC) serves as a foundational legal instrument for waste management and resource conservation. This directive outlines a holistic approach to waste management, emphasizing waste prevention, recycling, and recovery. It establishes essential principles, such as the waste hierarchy, which prioritizes waste prevention and recycling over landfilling or incineration. The Waste Framework Directive is a pivotal framework for achieving sustainable waste management practices across EU member states.[1]The U.S. Environmental Protection Agency's Resource Conservation and Recovery Act (RCRA) is a crucial regulatory framework that governs the management of hazardous and non-hazardous solid waste in the United States. Enacted in 1976 and updated over the years, RCRA sets standards for the safe handling, storage, and disposal of waste. It also encourages recycling and waste reduction, promoting the principles of sustainability in waste management practices[2].

Modern Practices: In the 21st century, waste segregation has become a common practice in many developed and developing countries. Recycling bins, composting programs, and guidelines for separating different types of waste have become commonplace.

Tchobanoglous, Theisen, and Vigil's comprehensive work from 1993 remains a seminal reference in the field of solid waste management. Their book, "Integrated Solid Waste Management: Engineering Principles and Management Issues," provides a thorough examination of the engineering principles and management strategies necessary for efficient waste disposal and resource recovery. It emphasizes the importance of integrating various waste management practices, including recycling, composting, and landfilling, to minimize environmental impacts and maximize resource utilization.[3]

In the realm of wastewater treatment, "An Introduction to Wastewater Treatment," edited by Pickard and Smith in 2011, offers valuable insights into the techniques and processes involved in treating domestic and industrial wastewater. This reference delves into the intricacies of physical, chemical, and biological treatment methods, highlighting their role in removing contaminants from wastewater before discharge into the environment. It is an essential resource for engineers, scientists, and policymakers involved in ensuring clean water supplies and protecting aquatic ecosystems.[4]

III. CATAGORIES OF WASTE

Waste can be categorized into several types based on its characteristics and source. Here are some common categories of waste with references:

Municipal Solid Waste (MSW): MSW includes everyday household and commercial waste.

Hazardous Waste: Hazardous waste is harmful to human health or the environment. It includes chemicals, toxins, and certain industrial byproducts.

Biomedical Waste: Biomedical waste comprises medical and healthcare-related waste, such as used syringes and contaminated materials.

E-Waste (Electronic Waste): E-Waste includes discarded electronic devices and equipment.

Construction and Demolition Waste: This waste type results from construction and demolition activities and includes materials like concrete, wood, and metals.

Industrial Waste: Industrial waste is generated by factories and manufacturing processes and can vary widely in composition.

Organic Waste: Organic waste consists of biodegradable materials like food scraps and yard waste.

Plastic Waste: Plastic waste includes various plastic products and packaging materials.

Radioactive Waste: Radioactive waste contains materials with radioactive properties, often from nuclear power generation or medical applications.

Hazardous Household Waste: This includes household products that contain hazardous materials, like paints, batteries, and cleaning agents.

These categories help classify waste for proper handling, disposal, and recycling, based on its nature and potential environmental impact. Keep in mind that waste management practices and regulations may vary by region and country.

IV. HARDWARE & SOFTWARE REQUIREMENTS

Arduino Uno

The Arduino UNO is a popular microcontroller board often used for prototyping and DIY electronics projects. It's based on the ATmega328P microcontroller and features digital and analog input/output pins, USB connectivity for programming, and a wide range of compatible sensors and modules.

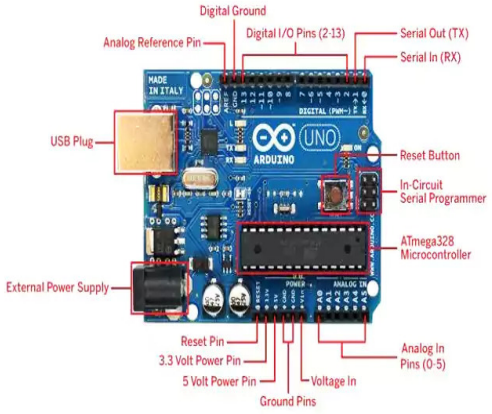

Fig. 1 Arduino UNO

Ultrasonic Sensor

An ultrasonic sensor is a device that uses sound waves with frequencies higher than the human audible range (typically above 20,000 Hz) to detect the distance or presence of objects. These sensors emit ultrasonic pulses and then measure the time it takes for the sound waves to bounce back after hitting an object. By calculating the time delay, the sensor can determine the distance to the object. Ultrasonic sensors are commonly used in various applications, such as in robotics for obstacle avoidance, parking assistance systems in cars, and industrial automation for level measurement or object detection.

IR Sensor

An IR (Infrared) sensor is a device that can detect infrared radiation or heat emitted by objects. These sensors are commonly used for various applications, including motion detection, remote controls, and temperature sensing. Infrared sensors work by detecting changes in the amount of infrared radiation they receive, allowing them to sense movements or changes in temperature. They are essential components in many electronic devices and security systems.

Moisture Sensor

Use for detect the wet waste. Dampness sensor perceives the proportion of water by removing the dry burden from the basic weight, and the sogginess content not set in stone as the proportion of water segregated by the dry weight or full scale weight, dependent upon the declaring technique.

Arduino Ide Software

It associates with the Arduino equipment to transfer programs and speak with them. It permits you to confirm and transfer programs, make, open, and save portrays, and open the chronic screen.

LCD (16*2)

An electronic device that is used to display data and the message is known as LCD 16*2.As the suggests it include 16 columns & 2 Rows so it can display 32 characters (16*2=32) in total &every characters will be made with 5*8 (40) Pixel Dots . So the total Pixel within the LCD can be calculated as 32*40 otherwise 1280 pixels.

Fig. 2 LCD

WI FI Module

Programmed squander isolation framework absolutely IOT based innovation framework. The Arduino Wi Fi permit to convey by means of Wi-Fi with sensors or actuators mounted on board to make effectively and rapidly your IOT Framework .you can utilize Arduino UNO Wi - Fi as a client of Wi-Fi organization , As a server to interact other client devices or you can make an Wi-Fi affiliation.

Fig. 3 Wi- Fi module

V. METHODOLOGY

Flow chart 1 shows the proposed block outline of shrewd waste isolation framework. Arduino Uno ATmega328P is utilized as regulator. The trash level inside the trash container is ceaselessly observed by a ultrasonic sensor set up inside the trash container. The ultrasonic sensor communicates ultrasonic sound, and the sound waves get reflected by the loss inside the trash canister. There is a delay between sending ultrasonic sound and getting the reflected sound waves. With the assistance of this delay, the rate topped off inside the trash container is known. Assuming the level of trash is more prominent than 85%, then Ultrasonic sensor conveys the alarm message to the Arduino Uno. Arduino sends the alarm message to PC. Until trash is purged, process ends. A ultrasonic sensor is appended to the front side of the trash receptacle. IR sensor identifies the item when put on the board. In light of the dampness content present in thearticle, dampness sensor will recognize the kind of waste. The waste is isolated as needs be in to the canisters. Servo engine helps in the most common way of putting the loss in particular receptacles by turning the board.

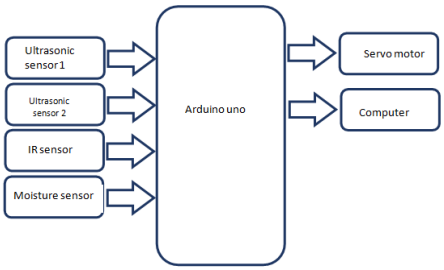

Fig. 4 Flow chart for using Methodology

VI. PROCESS FLOW CHART

Flow chart shows the workflow of the proposed smart waste segregation system. When the object is placed on the plankone by one, servo motor will turn on and IR sensor detects the object. Depending upon the type of object placed on the plank, moisture sensor detects whether the object is wet or dry. Depending upon this result, servo motor sends the waste into corresponding bins. Later ultrasonic sensor measures the distance from the surface of the bin to garbage. When the bin is full, sensor sends a message to Arduino Uno and this signal is passed to computer. The process terminates here until bin is empty.

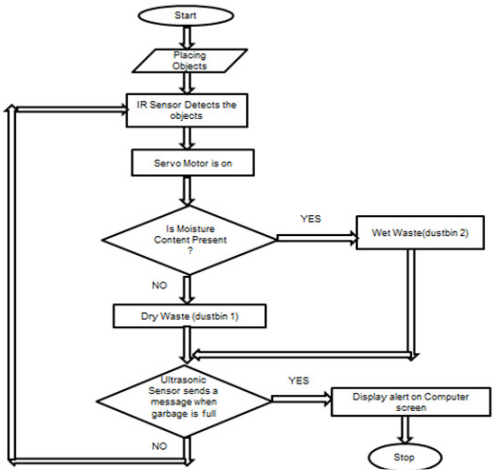

Fig. 5 Flow chart for Process of waste segregation

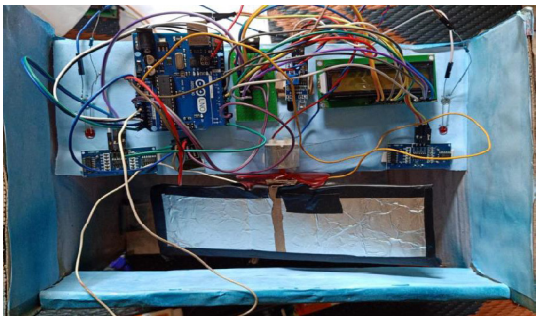

Fig. 6 Top-View of waste segregation system design

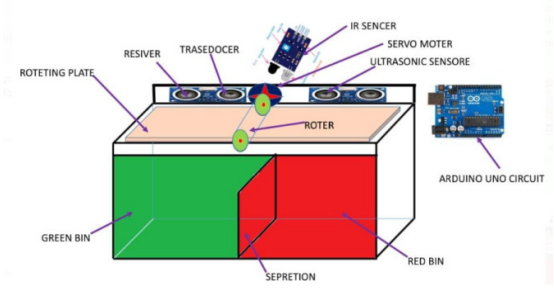

Fig. 7 Top- waste segregation system design

VI. ADVANTAGES OF AUTOMATIC WASTE SEGREGATION SYSTEM

1.Reduce the land occupation .A portion of the materials in the trash bin not be quickly corrupted, which makes the land genuinely disintegrated.
2.Reduce the ecological contamination.
3.Turning waste to love.
4. More productive waste handling.
5.Reduce work cost.
6.Reducing human time and exertion.
7.Promotes wellbeing and sterilization.
8. Make unloading trash all the more spotless

VII. DISADVANTAGES OF AUTOMATIC WASTE SEGREGATION SYSTEM

1.Cost-Executing and keeping up with programmed trash assortment frameworks can be exorbitant
2.May be specialized issue happens.

IXX. CONCLUSION

The shrewd canister was exploratory with different things which are arranged consistently. The squanders like vegetable strips, wet tissue, were utilized to test the viability of isolation of wet waste, it was seen that the framework began to work just proposition the waste is put on the upper container, following a three second defer period, the materials tossed by the client was accurately isolated into its individual wet waste sub receptacle. This framework helps the local metropolitan organization in squander the board framework for isolating dry waste and wet waste. It involves sensors for detecting dry waste and wet waste. The arranged framework is an undertaking to support current waste combination framework in India for "Clean India mission". Savvy squander isolation framework stays away from human mediation, decreasing human time and energy. With developing urbanization presents a savvy and practical answer for squander isolation. The proposed "Smartbin" is a proficient waste isolation framework that requires no human mediation to isolate dry and wet waste furthermore, clears the way for ideal assortment and removal. Legitimate waste evacuation further develops air and water quality also as decreases ozone harming substance discharges. It helps in limiting the extraction of assets alongside decreasing contamination furthermore, energy utilization which is related with assembling new materials. Because of this data, we have some control over the flood of the trash in open regions and the contamination which for the most part happens around the receptacles. This Framework can isolate and disintegrate the decomposable waste material which will be valuable for the clients principally who have a place with the horticulture field. Generally speaking, this philosophy keeps climate perfect and new.

REFERENCES

[1] European Parliament and Council. (2008). Directive 2008/98/EC on waste (Waste Framework Directive).
[2] U.S. Environmental Protection Agency (EPA). (2020). Resource Conservation and Recovery Act (RCRA).
[3] Tchobanoglous, G., Theisen, H., & Vigil, S. A. (1993). Integrated Solid Waste Management: Engineering Principles and Management Issues.
[4] Pickard, S., & Smith, M. (Eds.). (2011). An Introduction to Wastewater Treatment. IWA Publishing.

