



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 5, May 2025

A Smart Waste Management System with Automated Sorting with Anti-Littering Mechanism

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ABSTRACT: This is an era with speedy urbanization so that there is an increasing environmental issue where we need the efficient waste management system. There is a need for proper waste disposal techniques. This project propose an automated sorting technique with anti-littering mechanism for waste management to optimize the waste handling, it improves recycling and discourage improper disposal habits. The system has the core feature of automated separation using the sensor. This reduces human intervention and improves the hygiene and reducing the contamination of waste streams. To address the issue of throwing the waste outside the dustbins the system includes the anti-littering mechanism which is powered by the sensor and promote the responsible waste behaviour in public places. The system aims to create a clean and green environment by automating waste segregation, enhancing operational efficiency, and fostering civic responsibility. With its scalable architecture, the system can be deployed in urban areas, commercial areas, or educational institutions, contributing to smarter and more sustainable cities.

KEYWORDS: waste management-automated sorting-anti littering- dustbins- reduce human interaction.

I. INTRODUCTION

There is a huge problem in the disposal of waste during this current years. Due to the huge volume of waste disposal there is an adverse effect in the environment. The common method of waste disposal in many of the cities is that the dumping of waste in open areas and at landfills. Due to this unhealthy disposal technique the life of humans, plants and animals are affected a lot. This harmful disposal method produces various harmful chemicals which affect and pollutes the land and the groundwater. This type of disposal of waste in the open areas gives raise to several diseases which affect both animals and human. The environment's aesthetic value is reducing due to the disposal of waste in the open areas.

In India, sanitation workers are responsible for collection, disposal and recycling of waste. They play a vital role in the cleanliness if the cities. The sanitation workers and the workers in the municipal corporations are frequently affected with infections in the skins, some respiratory issues, allergic disorders, eye and skin problems. The sanitation workers are exposed to the hazardous materials such as medical waste. The wastes that we are generating has a high economic value which is not known until the wastes are recycled properly. It is necessary to segregates the waste for recycling. If the wastes are separated at the source of waste generation such as homes, schools, organizations the dependency on the sanitation workers is reduced. There are technological advancements that allow the reuse of waste into energy. Syngas is produced from the wastes that we are disposing. Steam and electricity are generated when this type of gas is brunt.

The major target of this proposed system is that to implement an automatic sorting mechanism by separating of biodegradable and non-biodegradable waste. This project includes some actions to prevent the waste thrown out of the dustbin by the public people. This intelligent waste management solution aims to promote hygiene, reduce cross-contamination and encourage responsible waste disposal practices, ultimately contributing to a cleaner and more sustainable environment.

At present already we are having large separators at industries but it is better to have the separators at the source itself it enhances the hygiene and cleanliness of the cities. By doing this the materials with higher quality is retained easily. From the waste many valuable materials are recovered. This type of segregation process at the initial stage reduces the hazards for the sanitation workers.

II. LITERATURE SURVEY

Susan Shiny et.al[1] said that Management of waste is secondary. By using various sensor the waste must be segregated at the initial stage itself. The wastes are segregated as metallic waste, dry waste, wet waste. The limitation of the project is that the bin size becomes large and suits for all places.

V. Sowndarya et.al.[2] proposed a system which monitors the garbage collection using the ultrasonic sensor. There is a requirement of improvements in the segregation using the image processing technology.

ShreyaGhavghave et.al[9] said there is a requirement for the development of smart dustbin where the information is send to municipal corporation based on the level of bin level. The limitation of the is that information send to the employees may be corrupted.

G.V.V.S.L.Rupesh et.al[12] proposed a project which contain two types of sort such as public bin level and the home bin level monitoring units. The limitation of this project is the as it is implemented for household also it has a very huge database to management which is difficult one.

NurulNazihahAhamad et.al[10] propose a system to automatically separates the waste into residual and recyclable. This proposed system focus on household which has the high volume of waste disposal among all others. The limitation in this project is that it is only suits for household it not suits for other places like street bins, in industries.

Soundarya B; K. Parkavi et.al[11] proposed a system that segregates the waste at the origin itself. This system uses the Raspberry Pi to determine every waste and detects whether the waste is degradable or non-degradable waste and the detected waste is fall into their respective bins. The limitation of it has to capture image and process it and that it segregates the waste it takes quite more time.

Singh Karan Belsare; Manwinder et.al[5] proposed a system uses Internet Of Things (IOT) to segregates the waste into moist waste and dry waste and the management of medical waste. The waste in the bin is detected then it is separated using sensors and information is send to the cloud storage. The limitation in this project is that requirement of the cloud storage is too large.

III. PROPOSED SYSTEM

This proposed system uses Ultrasonic sensors to detect the approaching individual and opens the dustbin lid automatically, this eliminates the need for manual intervention. Moreover, the system incorporates a proximity sensor-based waste segregation mechanism, accurately distinguishing between biodegradable and non-biodegradable waste. A pressure sensor detects the whether the waste is thrown inside or around the dustbin and warns the people with the sound.

3.1. ARDUINO UNO (MICROCONTROLLER)

The central and heart part of the proposed system is the Arduino Uno ATmega328 microcontroller. The Arduino board consist of 14 digital input/output pins, also consists of 6 analog inputs and crystal oscillator of 16MHz frequency. It also contains some additions features such as USB connection, reset button. The system integrates ultrasonic, proximity, piezoelectric sensor.

3.2 ULTRASONIC SENSOR

The distance can be calculated using two parameters such as speed of the sound and travel time. The travel time is obtained by sending a sound wave of 40000Hz which travel through air and bounce back if there is an obstacle in their path. When a person comes within a set range (usually 10-30cm), the sensor detects the individual. Based on the signal from the sensor the microcontroller controls the rotation of servo motor to open and close the lid.

3.3 CAPACITIVE PROXIMITY SENSOR

The objects which both metallic and non-metallic are detected using the capacitive proximity sensor. The operation of the sensor is based on the electromagnetic field that is near to the sensing surface which is created by coil and oscillator. When the sensor detects the materials which are non-mettalic induces the oscillation amplitude. The change

in the output is based on the rise or fall of oscillations which is identified by a threshold circuit. Based on the nature of the materials the operating distance of the sensor is varied. The plastic and other wastes are separated automatically using this capacitive proximity sensor.

3.4. PIEZOELECTRIC SENSOR

The operation of the piezoelectric sensor is based on the piezoelectric effect, when mechanical stress applied to certain materials it produces an electric charge. It is used in various applications like knock detection, impact sensing, and acoustic pickups. This sensor detects pressure, vibrations, or force and converts them into electrical signals. It is used to detect whether the waste is around the dustbin or not.

3.5 BUZZER:

The buzzer is one electric instrument that produces sound. The buzzer is categories into two types: Piezo and magnetic buzzers. DC voltage is used to power the buzzers. Magnetic buzzer is used in the project. When the current is passed through the coil of wire the vibrating disc in the magnetic buzzer is drawn to coil of wire. The sound is produce by movement of disc when there is no current passing through it. It is used to produce sound when the waste to throw outside the bin.

3.6 SERVO MOTOR (SG 90):

A servo motor is an electronic device which produces velocity and torque depends on the input which it receives. This motor operates as the closed loop system. The servo motor position is depend on the response system. Gear configuration is used to regulate the speed of servo motor unlike the DC motors.

This is used to open and close the lids also the separate the waste based on the signal from the ultrasonic and capacitive proximity sensors. The servo motor has a rotation range of zero to one-eighty degrees.

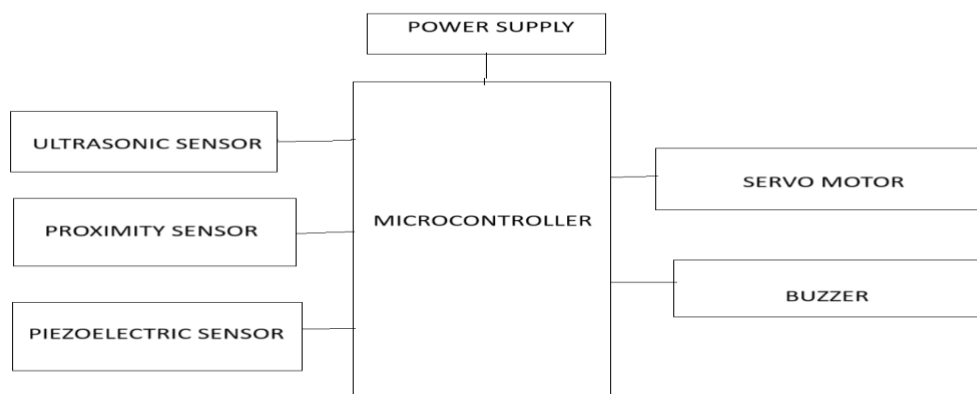


Fig3.1. Proposed System Block Diagram

IV. RESULT DISCUSSION AND OUTPUT

The developed project was successfully tested under various controlled conditions to ensure its accuracy and efficiency. If the user is in the predefined range it is detected by using the ultrasonic sensor. This control the servo motor to open and close the lid automatically with minimal delay. This reduces the physical contact and improves the hygiene. In the segregation part of the project the proximity sensor is tested with various sources of waste and categorize as the biodegradable and non-biodegradable. This system achieved a high accuracy in identifying and categorizing the waste correctly.

The anti littering mechanism using the pressure sensor proved the effectiveness in detecting improper disposal. Whenever the waste is thrown near but not inside the dustbin the system successfully produces a buzzer sound.

Although it currently work within a narrow radius, we can expand the sensitivity range and usage of camera based identification system might strengthen its impact further.

Overall the experimental results validate the system's viability for supporting the management of waste in cities. While the proposed system in works well in the controlled environment, the real world implementation require some considerations such as waterproof, power efficiency. This system represents the significant step towards the cleaner, greener, sustainable and automated and responsible waste management practices in cities.

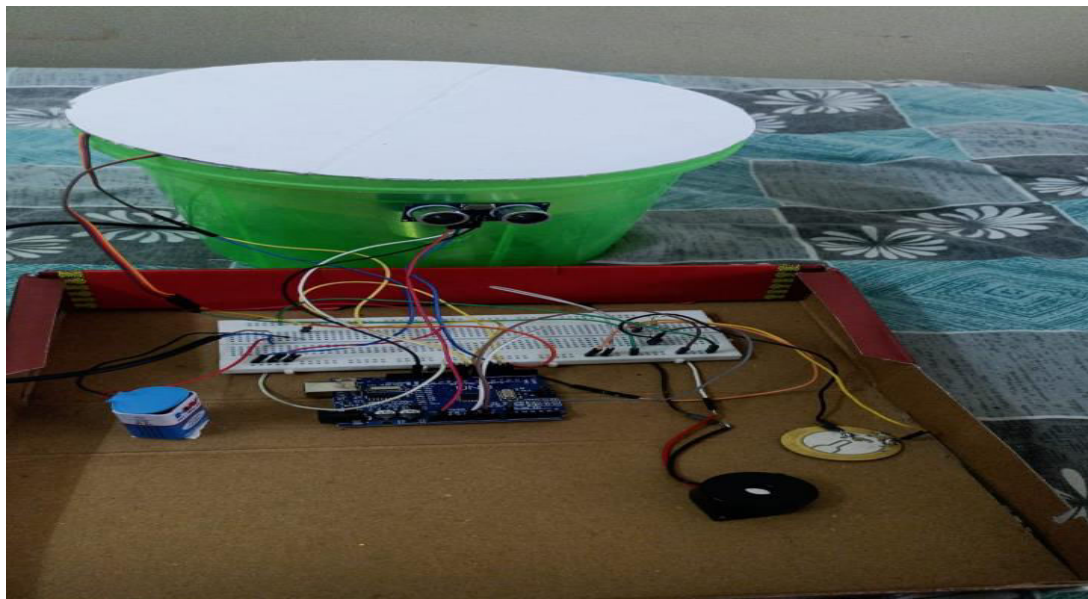


Fig 4.2. Hardware output

V. CONCLUSION

The key challenges in urban waste disposal are addressed using this innovative project. By using the various sensors this system automatically opens the lid as the individual approaches and by the usage of proximity sensor the waste is separated into biodegradable and non-biodegradable waste. The system also warns the people if they throw the waste out of the dustbin can using the buzzer sound. This proposed project shows how the automation is made using the several sensors and develop the user-friendly environment. This system provides the impactful solution to the waste management technologies. With some more advancements this system effectively changes the waste management in urban areas. It supports the city towards cleaner, greener and pollution free society.

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