An IoT Based Automatic Waste Segregation and Monitoring System

Riyaj Multani[1], Akash Sonawane[2], Ganesh Shegokar[3], Gaurav Sangale[4], Prof. P. B. Palve[5]

[1,2,3,4] Students & [5]Asst. Prof. of Department of Computer Engineering,

Adsul's Technical Campus, Chas, Ahmednagar, Maharashtra

Savitribai Phule Pune University, Pune

Abstract: In The Proposed System represents a pioneering solution to address the growing challenges of waste management and environmental sustainability. Leveraging the Internet of Things (IoT) technology, this system offers an automated, efficient, and environmentally responsible approach to waste segregation and monitoring. In this innovative system, IoT sensors are strategically integrated into waste collection bins and containers, enabling real-time monitoring of waste composition and fill levels. These sensors, equipped with various sensors such as ultrasonic sensors, accurately classify waste into dry and wet categories.

The data collected from these sensors is transmitted wirelessly to a central data processing unit. Users, including waste management authorities and environmental agencies, gain access to a comprehensive dashboard that provides real-time insights into waste composition, fill levels, and collection status. Data analytics tools process this information, offering actionable insights for optimizing waste collection routes and schedules, reducing operational costs, and minimizing environmental impact.

The system's automation extends to waste collection trucks, which receive optimized route plans based on real-time data. Furthermore, the system enhances public engagement in sustainable waste management practices. Mobile applications allow residents to receive notifications for waste collection schedules, access educational resources on proper waste disposal, and track their own waste contributions.

The proposed system is a transformative solution that promotes waste reduction, recycling, and sustainability. By leveraging IoT technology, automation, and data analytics, it enables efficient waste segregation, optimized collection processes, and improved environmental stewardship. This project represents a significant step toward smarter, more sustainable waste management practices for a cleaner and greener future.

Index Terms - *Internet of Things (IoT), Waste Segregation and Monitoring, Ultrasonic Sensors, etc*

I. INTRODUCTION

The trash generated in India today presents a number of environmental difficulties, including poor waste collection, treatment, transport, and disposal. The entire challenge, from conception to disposal, is the most challenging. Our nation cannot exist under the current system, which leads to damage of the environment and public health, because of the growing urban population. Garbage can be liquid or solid, and each sort of garbage has a unique way of being disposed of. Human welfare will be threatened by waste. To live a healthy lifestyle, proper waste management is essential and crucial. If the dustbins are often flooded, an unsanitary environment will be produced. Separating dry and moist trash is a crucial part of waste segregation. Waste segregation lowers the amount of waste dumped in landfills and lowers pollution of the air and water. Compared to mixed waste, it is simpler to dispose of waste that has been separated.

This program aids in the management and classification of garbage. Dustbins are positioned across the city; they are delivered with a low-cost embedded mechanism to help with rubbish bin tracking. When the trash can is fully loaded, an SMS text message is | delivered to the municipal corporation. When the state of the bin is made known via the Internet, the relevant authorities will then take immediate action. The ultrasonic sensors, node MUC, and servo motor used to construct the suggested system.

Traditional waste management practices often struggle to cope with the increasing volume and complexity of waste streams. Proper segregation of dry and wet waste, critical for recycling and minimizing landfill usage, frequently relies on manual labor and inconsistent practices. Moreover, monitoring waste bin fill levels and optimizing collection routes can be resource-intensive and environmentally inefficient.

In response to these challenges, the Proposed System offers a holistic solution. It deploys IoT sensors within waste collection bins, empowering them to autonomously classify waste into dry and wet categories. These sensors, equipped with cutting-edge technology like ultrasonic and image recognition, ensure precise and consistent segregation.

II. RELATED WORK

The existing system for waste management predominantly relies on manual practices for waste segregation and monitoring. In this conventional approach, waste segregation into categories such as dry and wet waste is a manual task performed by residents or waste management personnel at the source. Monitoring of waste collection and disposal is carried out through manual record-keeping, which can be prone to errors and does not provide real-time insights. Automation is absent from the process, and the entire system depends on human effort. This manual segregation can lead to inefficiencies, including contamination of recyclables and organic waste, diminishing the effectiveness of recycling programs. Moreover, real-time data on waste generation, collection schedules, and bin statuses are not readily available, making it challenging to optimize waste management operations and hold individuals or entities accountable for improper waste disposal or missed collections. The proposed IoT-Based Automatic Waste Segregation and Monitoring System seeks to revolutionize this existing system by introducing automation, real-time data tracking, and improved waste segregation, ultimately enhancing the efficiency and effectiveness of waste management practices.

III. PROBLEM STATEMENT

Dustbins are containers for temporarily storing waste. Due to urbanization, there is an increase in production of waste. Managing waste is a crucial task at public places. When the massive amount of waste material is collected, it is difficult to separate and unhygienic. The Proposed work aims to address these challenges by introducing an automated, data-driven, and sustainable approach to waste management. It seeks to revolutionize waste segregation, monitoring, and collection processes while engaging the public in responsible waste disposal practices.

IV. PROPOSED SYSTEM

The proposed system for the project aims to revolutionize waste management by leveraging the power of Internet of Things (IoT) technology. This innovative system is designed to address the growing environmental concerns associated with improper waste disposal and the need for efficient waste segregation.

The core functionality of the system involves the deployment of smart waste bins equipped with IoT sensors and cameras at various collection points within a community or city. These sensors will detect the type of waste being disposed of, distinguishing between dry and wet waste.
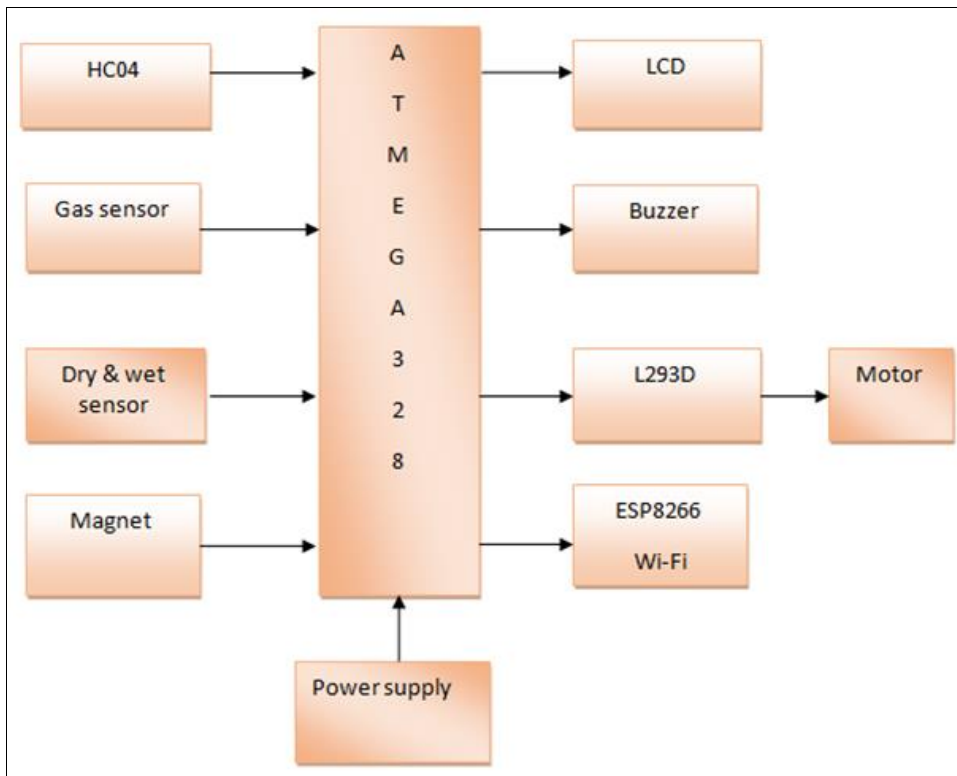
Fig.1: Proposed System Architecture

Once the waste is deposited into the smart bins, the data collected by the sensors will be transmitted to a central cloud-based platform via wireless communication protocols. Machine learning algorithms will then analyze this data to verify the accuracy of waste segregation if possible. If any discrepancies are identified, alerts can be generated to prompt manual intervention.

The system will also include a user-friendly system and a web-based dashboard in thinks speck server for waste management authorities and residents. The system will allow residents to locate the nearest smart bins, receive notifications for waste collection schedules, and access educational resources on proper waste disposal. Waste management authorities can use the dashboard to monitor the real-time status of waste bins, track waste generation patterns, and optimize collection routes for efficiency.

By implementing this IoT-based waste segregation and monitoring system, we aim to achieve several objectives. Firstly, it will promote responsible waste disposal among residents by raising awareness about the importance of segregation. Secondly, it will improve the efficiency of waste collection and transportation, reducing operational costs and environmental impact. Lastly, the data collected will enable data-driven decision-making for waste management authorities, leading to more sustainable and eco-friendly practices.

Finally, the proposed system represents a significant step forward in modernizing waste management processes. It harnesses the capabilities of IoT technology to automate waste segregation, monitor waste disposal practices, and empower communities to contribute to a cleaner and greener environment. This project aligns with the broader goal of sustainable urban development and environmental conservation.

V. RESEARCH METHODOLOGY

The proposed system, is designed to overcome the limitations of the existing manual waste management practices. It introduces automation, real-time data monitoring, and improved waste segregation techniques to enhance the efficiency and effectiveness of waste management. Here are the key components of the proposed system:

Key components and features of the proposed system include:

- **IoT Sensors:** The system integrates IoT sensors into waste collection bins to monitor the fill levels in real time. These sensors transmit data to a central control system, providing insights into the status of waste bins.

- **Automated Segregation:** The system uses automated segregation mechanisms to sort waste into categories such as dry waste (e.g., paper, plastic) and wet waste (e.g., organic matter). This automation reduces the reliance on manual sorting and improves the accuracy of waste categorization.

- **Real-time Monitoring:** Through the IoT infrastructure, the system enables real-time monitoring of waste generation, collection schedules, and bin statuses. This data is accessible to waste management authorities for efficient resource allocation and scheduling.

- **Data Analytics:** The collected data is analyzed using data analytics techniques to identify trends, optimize collection routes, and predict future waste generation patterns.

- **Environmental Impact:** The system promotes recycling and waste reduction by providing users with information on the environmental impact of their waste disposal practices. This encourages sustainable behaviour.

- **Efficiency and Accountability:** Automation and real-time data enable waste management authorities to allocate resources efficiently, reducing costs and improving service quality. It also enhances accountability by tracking waste disposal practices.

- **Scalability:** The system is designed to scale with the growing needs of communities and urban areas, ensuring that waste management remains effective as populations increase.

IV. CONCLUSION

In this paper, we have proposed Automatic waste management and segregation system using IOT to improve the cleanliness of smart cities. Waste disposal is a serious challenge due to urbanization and population growth. The suggested method effectively separates dry and moist garbage without the need for human interaction or interference. It offers prompt collection and elimination. The suggested method can be set up domestically in a home or extensively in public areas. In response to these challenges, the Proposed System offers a holistic solution. It deploys IoT sensors within waste collection bins, empowering them to autonomously classify waste into dry and wet categories. These sensors, equipped with cutting-edge technology like ultrasonic and image recognition, ensure precise and consistent segregation.

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