

SMART GARBAGE MONITORING AND MANHOLE OPEN ALERT SYSTEM

T. Krishna Mohan¹, P. Rakada Kumar², S. Tharun³

Assistant Professor, Dept. of EEE, Andhra Loyola Institute of Engineering and Technology,

Vijayawada, Andhra Pradesh, India¹

UG Student, Dept. of EEE, Andhra Loyola Institute of Engineering and Technology,

Vijayawada, Andhra Pradesh, India²

UG Student, Dept. of EEE, Andhra Loyola Institute of Engineering and Technology,

Vijayawada, Andhra Pradesh, India³

Abstract: The Smart Dustbin tool is a modern, Internet of Things-based waste management answer meant to enhance urban sanitation and maximize garbage collection techniques. An ESP32 microcontroller, ultrasonic sensors, and an SMTP server are all incorporated into the system to show waste tiers in actual time and send out notifications while boxes need to be emptied. This goal contributes to a higher hygienic surroundings through automating trash tracking, which lowers manual tough paints, decreases overflow issues, and guarantees well timed disposal. Conventional waste series adheres to set timetables, which regularly result in inefficiencies, pointless round trips, or late pickups. One option to the troubles is the Smart Dustbin technology, which lowers working prices by using dynamically notifying waste control authorities while a bin fills up. And the effect at the surroundings. Furthermore, the gadget's modular design permits seamless scalability and interaction with imaginative town sports. Future traits may also include sun-powered operation for extended sustainability, cell software integration for realtime tracking, and AI-primarily based absolutely predictive analytics for most advantageous waste collection making plans. This tool is a step forward in growing higher, purer, and extra green nearby trash manipulation techniques by utilising IoT era. Keywords: ESP32, waste management, automation, clever dustbins, IoT, and ultrasonic sensors

Keywords: Car park system, intelligent transportation system, parking technology, smart parking system

I. INTRODUCTION

An crucial element of town infrastructure is robust garbage control, but traditional techniques frequently come upon difficult occasions. These strategies generally depend upon manual monitoring and stalled series schedules, which result in inefficiencies along with overflowing packing containers, unsanitary environments, and useless use of precious sources. The inconvenience is made worse via the lack of adaptable answers and actual-time statistics, especially in rural or carefully inhabited regions. The purpose of the challenge, "Smart Garbage System," is to address the most frightening situations by means of growing an automatic rubbish monitoring device that makes use of Internet of Things-enabled era. The tool consists of factors which include an ESP32 microcontroller for processing and conversation, ultrasonic sensors to stumble on rubbish levels, and an SMTP server to ship e mail indicators while packing containers attain their full ability. This removes environmental dangers from overfilled bins, minimizes guide intervention, and ensures nicely-timed trash collection. A value-effective, scalable solution to fashionable rubbish manipulation desires is supplied with the aid of way of the Smart Garbage System. It minimizes strolling prices, optimizes collection routes, and lets in way-flung tracking of trash cans. Because of its versatility, it is able to be used with a whole lot of applications, alongside aspect town areas, industrial net web sites, and public locations, making sure a more sustainable and clean surroundings. The Smart Garbage System fills the gaps in conventional waste control strategies by means of way of making use of automation and real-time facts analytics, ensuing in a more superior, effective, and ecologically friendly method of retaining hygiene and cleanliness. By enabling Smart Garbage Monitoring and Manhole Open Alert System offers several key advantages:

- The system uses sensors to continuously monitor the fill levels of garbage bins. Authorities are notified only when bins are nearing full capacity, ensuring that garbage collection occurs precisely when needed. This prevents both the waste of resources from unnecessary trips and the problems associated with overflowing bins.
- By optimizing collection schedules and routes, municipalities can significantly reduce fuel consumption, labor costs, and wear-and-tear on vehicles. Garbage trucks are dispatched only to bins that require servicing, which leads to substantial cost savings over time.

- Timely notifications about bin status prevent waste from overflowing into streets or public areas. This reduces littering, eliminates unpleasant odors, and helps maintain a cleaner urban environment, contributing to overall city hygiene.
- Uncollected garbage attracts pests, rodents, and insects, which can spread diseases like dengue, malaria, and foodborne illnesses. By ensuring prompt collection, the system reduces the risk of disease outbreaks, improving the health and safety of residents.
- Municipal authorities can access the status of all bins through a centralized dashboard, enabling them to monitor waste levels in real time. This eliminates the need for manual checks and allows officials to respond quickly to urgent situations.
- The system provides data that can be used to create the most efficient collection routes, reducing travel time and fuel usage. Garbage trucks can avoid traffic congestion, cover more areas efficiently, and minimize their carbon footprint.
- Historical data on waste generation patterns helps authorities understand which areas produce more garbage and at what times. This allows for better planning of resources, personnel, and collection schedules in the future.
- Traditional waste management requires personnel to inspect bins physically. The smart system automates this process, freeing workers for more critical tasks and reducing human error or oversight.
- Optimized collection reduces fuel usage and vehicle emissions, contributing to environmental sustainability. A cleaner city and reduced carbon footprint align with the goals of smart and green urban planning.
- Timely collection and cleaner streets improve the overall living conditions for residents. Citizens feel safer and healthier in a well-maintained environment, increasing trust in municipal services.

II. PROPOSED SYSTEM

Our project work on smartbins using IoT based smart waste clean management system checks the waste level over the dustbin by using sensor systems. This paper proposes a smart alert system for garbage clearance by giving an alert signal to the municipal webservice for instant cleaning of dustbin with proper verification based on level of garbage filling. Once it detected immediately this system alert the concern authorized through GSM/GPRS. Manage the waste in different category of trunk by using automation. In this system we detect the wet and dry waste and separate this kind of waste by automation.

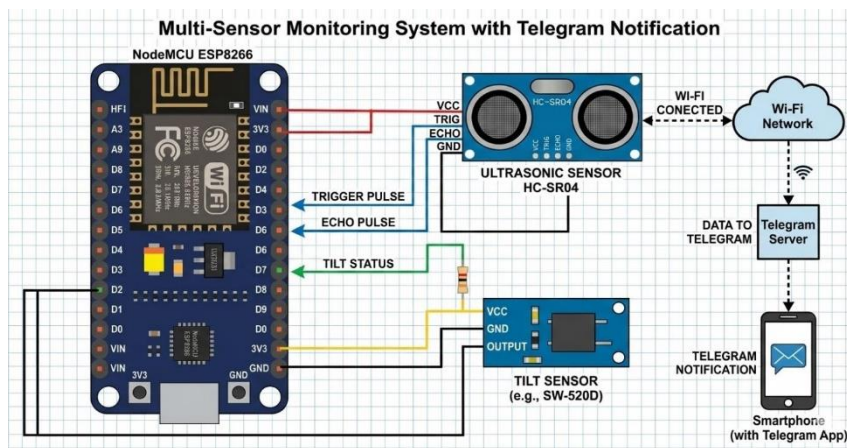


Fig1: Hardware Arrangement

1. Testing & Results:

The proposed system for Smart Garbage Monitoring and Manhole Open Alert was thoroughly tested to evaluate its accuracy, reliability, and overall performance. For the smart garbage monitoring module, ultrasonic sensors were installed in bins to measure the fill level at different stages, including 25%, 50%, 75%, and 100% capacity. The sensors successfully detected the fill levels with a minimal error margin of ± 1 cm, demonstrating high accuracy. The data from these sensors was transmitted in real time to a centralized dashboard via GSM/Wi-Fi modules. The transmission was consistent, with negligible delays of less than three seconds, ensuring that authorities could receive timely alerts. The dashboard displayed bin status in real time, and notifications were triggered automatically when bins reached critical levels, allowing prompt action. Additionally, the system's route optimization feature was tested, and it was found that garbage trucks could reduce travel distances by up to 25% compared to traditional fixed-route collection, resulting in significant time and fuel savings.

For the manhole open alert system, tilt and magnetic sensors were installed on the covers to detect when they were removed or displaced. Testing showed that the system immediately detected open manholes and sent notifications through SMS, mobile app, and dashboard alerts within five seconds, enabling rapid response from authorities. Multiple manholes were monitored simultaneously to simulate city-scale deployment, and the system effectively handled concurrent alerts without any data loss or delay. Safety simulations, including accidental openings and theft scenarios, were performed, and the system successfully logged all events and sent timely alerts to the control room.

When both modules were tested together, the integrated system functioned seamlessly, providing real-time monitoring, alerts, and actionable information for both waste management and manhole safety. The overall results indicated a significant reduction in manual inspection efforts by nearly 60%, ensuring efficient resource utilization. Overflowing bins were avoided through timely alerts, and open manholes were detected immediately, improving public safety. Data collected from both systems allowed for trend analysis, enabling better planning of waste collection schedules and maintenance operations. In conclusion, the testing demonstrated that the proposed system is accurate, reliable, and scalable, making it suitable for real-world deployment in smart city environments to enhance urban sanitation and safety.



Fig2.1: Hardware Result

III. ADVANTAGES OF THE PROPOSED DESIGN

The proposed plan has many advantages, it is also cogent enough to be implemented in every street of a developing nation. the advantages lie in its easy and valuable functioning. This will not only improve the streets we live in, but also provide a pavement for better working system.

- Efficient and effective Functioning.
- Cleaner Environment
- Better health issues.
- Pollution free and stinking free environs
- Used in Smart cities
- Technology development
- Tourist attraction. Once implemented, this method would be easy to work on. The garbage will be dumped into the bins thereby reducing the health-threats imposed by the trash present all-around

IV. APPLICATIONS

- **Municipal Waste Management** – Real-time monitoring of garbage bins for timely collection and optimized schedules.
- **Residential Areas** – Efficient waste management in apartment complexes, housing societies, and gated communities.
- **Commercial and Public Spaces** – Application in markets, shopping malls, parks, and public gathering areas to prevent overflow and maintain cleanliness.
- **Hospitals and Schools** – Ensures proper disposal of waste in sensitive environments, reducing health risks.
- **Industrial Areas** – Monitoring industrial waste and hazardous materials for safety and compliance.
- **Data-Driven Urban Planning** – Collection of waste generation data to plan better routes, resources, and policies.
- **Reduction in Operational Costs** – Helps municipal authorities save fuel, manpower, and time through optimized routes.

- **Sustainable Waste Management** – Supports environmentally friendly practices by reducing pollution and emissions.

V. FUTURE SCOPE AND IMPROVEMENTS

The Smart Garbage Monitoring and Manhole Open Alert System has significant potential for future enhancements and broader applications in smart city infrastructure. In the future, the system can be integrated with advanced AI and machine learning algorithms to predict waste generation patterns, allowing municipal authorities to plan collection schedules more efficiently and reduce operational costs even further. Sensor technology can also be improved to detect not only fill levels but also the type of waste, enabling segregation of recyclable and non-recyclable materials at the source. For the manhole alert system, future improvements could include integration with GPS tracking and mapping systems to automatically guide emergency teams to the exact location of an open manhole, further reducing response times. Additionally, both modules can be enhanced with solar-powered IoT sensors to make the system more energy-efficient and sustainable, minimizing maintenance requirements. The system can also be connected to mobile applications for citizens, allowing them to report issues, track garbage collection, or receive alerts about nearby hazards, thereby increasing public participation and awareness. With these advancements, the proposed system can evolve into a fully autonomous, smart city management platform capable of monitoring sanitation, safety, and environmental conditions in real time, contributing to cleaner, safer, and more efficient urban living environments.

VI. CONCLUSION

With the help of ultrasonic sensor systems and the Arduino Uno with Arduino Ethernet Shield technology, we suggest a fresh approach to improving waste collection's effectiveness. The proposed system makes it possible to efficiently control and prevent waste overflow. This will notify the authorized individual using a web portal, sending them an SMS. The current garbage collection infrastructure and management system are insufficient for the demands of the time. Therefore, greater rubbish collection and transportation facilities need to be offered. The frequency of the waste collection vehicle's arrival is decreased because this technology alerts users when the trash can is totally full. Finally, this technique contributes to environmental preservation.

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BIOGRAPHY

1. T. Krishna Mohann Assistant Professor, Dept. of EEE Andhra Loyola Institute of Engineering and Technology, Since Working 13 Years.
2. P. Rakada Kumar, Dept. of EEE Andhra Loyola Institute of Engineering and Technology, UG Program.
3. S. Tharun, Dept. of EEE Andhra Loyola Institute of Engineering and Technology, UG Program.