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WASTE MANAGEMENT SYSTE USING IOT

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ABSTRACT:
Smart dustbins help keep cities clean by using sensors to monitor waste levels and improve garbage collection. Traditional waste collection often fails because bins are emptied at fixed times, leading to overflow, bad odors, and health hazards. Smart bins solve this problem by detecting when they are full and sending alerts to waste collection teams for timely emptying. They also have motion sensors that automatically open the lid when someone approaches, making disposal easier and more hygienic. If the bin is full, it prevents more waste from being added and alerts people to avoid overflow. A GMS module sends real-time notifications to authorities, while a mobile app allows for easy monitoring and efficient route planning. This system reduces unnecessary collection trips, prevents garbage overflow, and ensures cleaner, healthier environments in cities.

Keywords: **IOT, Dustbin, ESP8266 Wi-Fi, ultrasonic sensor, HDD, waste.**

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I. INTRODUCTION:
Efficient waste management is essential for maintaining a clean and healthy environment, but outdated methods often lead to overflowing garbage, pollution, and health risks. To address this issue, a smart dustbin system powered by IoT technology has been developed. These smart bins are equipped with sensors that detect waste levels and automatically send alerts to authorities when they need to be emptied. This ensures timely garbage collection, preventing overflows and reducing environmental hazards. The system allows remote monitoring, helping authorities optimize collection routes, reduce operational costs, and improve overall efficiency. As rapid urbanization leads to increased waste generation, real-time data from these bins enables better planning and smarter waste management strategies. By leveraging IoT, cities can minimize unnecessary collection trips, lower fuel consumption, and decrease their ecological footprint. Additionally, these smart dustbins promote public hygiene by reducing direct contact with waste, lowering the risk of disease spread. Adopting this innovative solution can lead to cleaner streets, healthier communities, and a more sustainable future, improving the overall quality of life for urban residents.

II. LITTERATURE SURVEY:
H. N. Saha, et.al [1], Waste management focuses on efficiently treating and reusing waste as a resource while safely disposing of unusable materials. Key methods include reduction, reuse, recycling, composting, landfills, and incineration. IoT enhances these processes by optimizing waste monitoring, collection, and disposal for smarter, sustainable solutions.

P. Ramesh, J. M. Sahayaraj, et.al [3], India generates 62 million tons of waste annually, with much disposed of unhygienically. This IoT-based system uses Arduino and sensors to segregate waste into categories like wet, dry, and plastic, improving recycling and enabling efficient waste management through cloud-based monitoring.

M. Adam, M. E. Okasha, O. M. Tawfeeq, et.al [4], Waste accumulation is a major issue in populated cities due to poor container management. This paper uses Wireless Sensor Networks (WSN) and IoT technologies for real-time monitoring of container contents. Sensors display results on a website, and the data is analysed for optimized container distribution.

G. K. Shyam, S. S. Manvi and P. Bharti, et.al [5], This paper proposes an IoT-based smart waste collection system with sensor-equipped bins that optimize waste management through data analysis. Simulations using Pune's open data highlight its benefits over traditional methods and its potential for smart city innovation

Teoh Ji Sheng, et.al [6], This research proposes a smart waste management system that uses IoT and AI to improve waste sorting and collection. The system features separate compartments for different waste types, monitored by sensors and controlled by motors. TensorFlow AI identifies and sorts the waste, while LoRa transmits data like fill levels and location. A GPS module tracks the bin's position, and an **R**FID module helps identify waste management staff. This approach makes waste management more efficient, reducing costs and improving recycling.

P Haribabu, Sankit R Kassa, et.al [7], This research proposes using a mobile app connected to Smart Trash Bins to improve waste management in cities. The smart bins compress waste automatically, preventing overflow and reducing the spread of diseases. This system helps keep cities cleaner, reduces the need for manual labor, and supports the development of smarter cities.

Deepti Aggarwal, Prateek Chaudhary, et.al [8], Littering creates an unhygienic environment and health risks. To solve

this, IoT (Internet of Things) offers a promising solution. This paper explores how IoT can be used to improve waste management and public cleanliness, addressing both the challenges and benefits of different methods.

Table 2.1 Summarization of waste management system

Technology	Author	Advantages	limitation
IoT, Ultrasonic Sensors, Servo Motors	H. N. Saha, Supratim Auddy, Subrata Pal, Shubham Kumar et.al[1]	Optimizes waste monitoring and collection. Supports smarter waste solutions.	Requires maintenance and sensor calibration.
IoT, Arduino, Sensors, Cloud Monitoring	P. Ramesh, J. M. Sahayaraj, S R Mugunthan et.al [2]	Enables improved waste segregation. Supports cloud-based monitoring.	Requires reliable internet and cloud infrastructure.
WSN, IoT	M. Adam, M. E. Okasha, O. M. Tawfeeq et.al [3]	Provides real-time monitoring. Optimizes waste container distribution.	Relies on stable wireless network connectivity.
IoT, Sensor-equipped Bins	G. K. Shyam, S. S. Manvi and P. Bharti et.al [4]	Optimized waste collection through data analysis.	Dependent on data accuracy. Risk of sensor malfunctions.
IoT, AI, TensorFlow, LoRa, GPS, RFID	Teoh Ji Sheng, et.al [5]	Ensures efficient sorting and collection. Reduces operational costs.	Complex integration of multiple technologies. High power dependency.
Smart Bins, Mobile App, Automatic Waste Compression	P Haribabu, Sankit R Kassa et.al [6]	Prevents waste overflow. Keeps cities cleaner.	Limited to areas with high-tech infrastructure. Requires power for compression.
IoT, Waste Management Systems	Deepti Aggarwal, Prateek Chaudhary et.al [7]	Enhances public cleanliness. Improves waste management through IoT.	Needs continuous monitoring. Requires internet connectivity.

III. CONCLUSION:

This smart dustbin system is a revolutionary solution for managing waste more efficiently. By using sensors and IoT technology, it helps ensure that trash is collected on time, reducing overflowing bins, lowering costs, and keeping the environment clean. Cities struggling with waste management, especially in densely populated areas like India, can greatly benefit from this system. The smart bins monitor waste levels in real time and send alerts when they are full, preventing littering and improving hygiene. By adopting this technology, cities can enhance public health, protect the environment, and create cleaner and more liveable urban spaces. This is a crucial step toward a cleaner, greener, and more sustainable future.

IV. FUTURE SCOPE:

1. **Improved Waste Management:** More data can help predict when bins will fill up, making collection schedules more efficient.
2. **Self-Driving Waste Trucks:** In the future, waste trucks could collect bins automatically when they are full, reducing the need for human drivers.
3. **Global Use:** This system could be used in cities around the world, helping to improve waste management everywhere.
4. **Better App Features:** The app could have more features like traffic updates and help manage waste collection in multiple cities.

V. REFERENCES:

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2. P. Ramesh, J. M. Sahayaraj, N. Subash, S. R. Mugunthan and S. J. Partha, "IoT based Waste Management System," 2022 International Conference on Electronics and Renewable Systems (ICEARS), Tuticorin, India, 2022, pp. 587-592, Doi: 10.1109/ICEARS53579.2022.975209
3. G. K. Shyam, S. S. Manvi and P. Bharti, "Smart waste management using Internet-of-Things (IoT)," 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), Chennai, India, 2017, pp. 199-203, Doi: 10.1109/ICCCT2.2017.7972276
4. Lee and Wu (2014) presented a design and development approach for waste management systems in Hong Kong, focusing on optimizing operations.
5. Kumar et al. (2017) proposed a smart garbage monitoring and clearance system using IoT, enhancing waste management efficiency.
6. Balamurugan et al. (2017) introduced the design of a smart waste management system incorporating advanced technologies for waste collection.
7. Thakker and Narayana Moorthi (2015) discussed wireless solutions for waste management, leveraging technology for real-time monitoring.
8. Omara et al. (2020) explored sensor-driven systems for smart waste management, particularly focusing on mobility and trajectory assistance for municipal agents.
9. Chowdhury and Chowdhury (2007) developed an RFID-based real-time waste management system for effective tracking and management.

