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Trash Tide Collecting System using GSM and GPS - IOT

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***Abstract:** The accumulation of unmanaged waste poses significant health and environmental risks, especially in rapidly growing urban areas. This paper presents a smart waste monitoring system that leverages Internet of Things (IoT) technology to track waste levels in real-time and improve the efficiency of waste collection. By using ultrasonic sensors connected to IoT-enabled devices, this system detects waste levels in garbage bins and sends notifications when bins require servicing. These alerts help in timely waste management, reducing overflowing bins and enhancing public cleanliness. This model's practical implementation can contribute to a cleaner environment and support smart city initiatives.*
***Keywords:** IoT, waste management, ultrasonic sensor, GSM, smart city, real-time monitoring.*

I. INTRODUCTION

Waste management has become a critical issue in urban areas worldwide, especially as populations and consumption levels continue to grow. In many cities, inadequate waste collection and disposal practices lead to the accumulation of trash, which can cause severe public health risks and environmental degradation. Overflowing bins in public spaces not only create unsanitary conditions but also attract animals and insects, further exacerbating hygiene issues. Additionally, inefficient waste collection systems often increase operational costs and contribute to resource wastage, as waste trucks might visit bins that are only partially filled. As cities strive to enhance cleanliness and efficiency, traditional methods struggle to meet the demands of modern urban living.

To address these challenges, smart waste management solutions have emerged as viable alternatives, utilizing advanced technologies like the Internet of Things (IoT) for improved tracking and management. IoT technology enables devices to communicate in real time, providing valuable insights into waste collection needs. By integrating IoT-enabled sensors in garbage bins, authorities can monitor waste levels remotely and receive timely notifications when bins reach their capacity. This approach minimizes the need for manual checks and enables optimized collection routes, reducing unnecessary trips and conserving resources. Furthermore, IoT-based systems can enhance transparency in waste management processes, allowing stakeholders to make informed decisions based on real-time data. This paper proposes an IoT-based garbage monitoring system designed to simplify waste management and improve environmental hygiene. The system employs ultrasonic sensors to monitor the fill levels of bins and transmits data to a central platform, where authorities can view the status of each bin. This real-time monitoring system not only helps prevent overflow but also supports city-wide initiatives such as the Swachh Bharat Abhiyan, which aims to promote a cleaner, greener India. By addressing key waste management challenges through technology, the proposed model demonstrates a scalable and efficient solution suitable for urban areas, college campuses, and public spaces. The following sections discuss the system architecture, components, and implementation details, showcasing the potential impact of IoT in transforming urban waste management.

II. LITERATURE SURVEY

Effective waste management is a fundamental requirement for maintaining public health and environmental quality in urban areas. As traditional waste collection methods struggle with inefficiency, high operational costs, and limited scalability, researchers have increasingly explored IoT-based solutions. IoT technology, with its capacity for real-time monitoring and data-driven decision-making, offers promising advancements for waste management systems worldwide.

Navghane et al. (2017) presented an early application of IoT in waste management through a smart dustbin model. Their system combined a microcontroller and IR sensors with a Wi-Fi module, which allowed real-time waste level data to be accessible via a mobile web interface. This approach significantly reduced the need for manual checks, optimizing waste collection schedules and lowering operational expenses by preventing unnecessary visits to bins that were not yet full.

Building on this concept, Bajaj (2017) developed an automated garbage monitoring system using IoT to promote urban cleanliness. By using sensors to detect waste levels, this system automated the notification process, sending alerts to central control when bins reached capacity.

This level of automation not only streamlined the waste collection process but also supported the goal of enhancing urban hygiene. Bajaj's approach underscored the potential for IoT to create more sustainable waste management systems that reduce manual labor and increase efficiency.

Mirchandani et al. (2017) introduced additional features by incorporating RFID tags with IoT-enabled bins. Their system calculated both waste levels and weight, storing data in a centralized database that authorities could access to track bin usage patterns. Additionally, route optimization algorithms enabled collection trucks to follow the shortest path to bins that required immediate servicing. This system demonstrated how combining IoT and RFID technology could further improve waste collection efficiency by providing accurate data and reducing fuel consumption during collection rounds.

In recent advancements, many researchers have focused on integrating IoT waste management systems with data analytics and artificial intelligence (AI). By employing AI-based algorithms, such systems can predict waste generation trends and optimize collection routes in advance, based on anticipated bin fill levels. This predictive capability offers a proactive approach, minimizing the overflow of bins and improving the scheduling of waste collection. Furthermore, some models now integrate solar-powered sensors, which reduce the energy consumption of IoT devices and make these systems more sustainable.

Anitha (2017) introduced a model that applied ultrasonic sensors to detect bin fill levels, transmitting data to a centralized dashboard via GSM modules. This system allowed authorities to monitor multiple bins across various locations, enhancing control over waste management. Other researchers, like Patil et al., have proposed using cloud-connected sensors and data visualization dashboards, which enable both real-time monitoring and historical data analysis. Such integration allows cities to optimize waste management processes and plan for future waste needs based on data-driven insights.

Overall, the literature reveals a clear trend toward using IoT to create smarter, cleaner cities through advanced waste management. The reviewed studies showcase a range of IoT-enabled systems, from basic waste level detection to sophisticated models that incorporate AI, RFID, and route optimization. These innovations not only enhance waste collection efficiency but also align with sustainability initiatives such as the Clean India Mission. The following sections expand on these concepts, introducing a novel IoT-based model aimed at further improving waste management and environmental health.

III. METHODOLOGY

The proposed IoT-based garbage monitoring system employs ultrasonic sensors connected to an Arduino microcontroller to monitor waste levels within bins. These sensors measure the distance from the bin lid to the garbage, thereby estimating the fill level. When the garbage reaches a set threshold, the system triggers an alert through the GSM module, which sends notifications to a central monitoring station. Each bin is equipped with a unique identifier to simplify tracking across multiple locations. Data from the sensors is transmitted in real-time to a web-based platform, enabling waste management authorities to view the status of bins and optimize collection routes. The system's architecture is designed for scalability, allowing the addition of more bins across various locations while maintaining accurate monitoring and timely alerts. This IoT-driven approach aims to reduce overflow and improve the efficiency of waste collection processes.

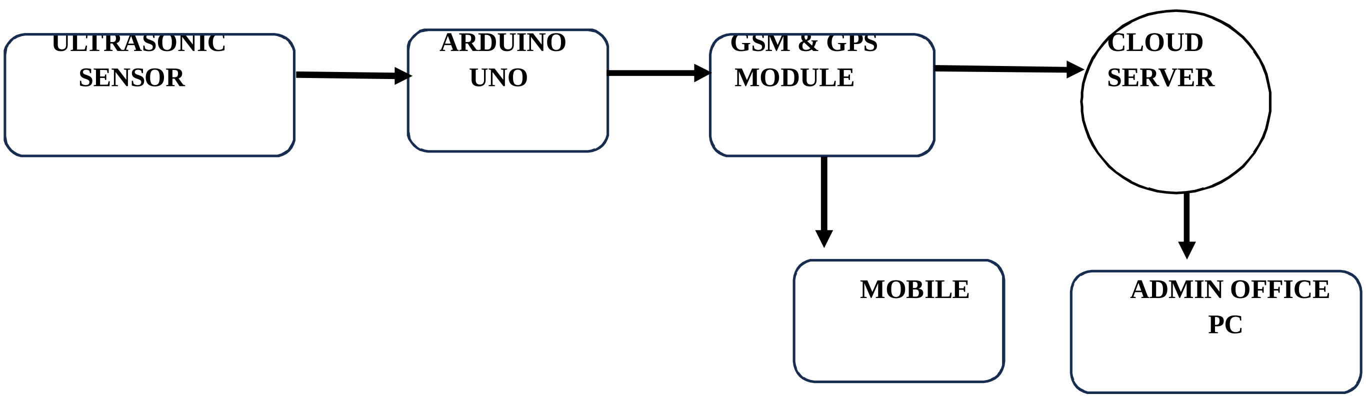

Fig. Block Diagram of Trash Tide Collecting System using IOT

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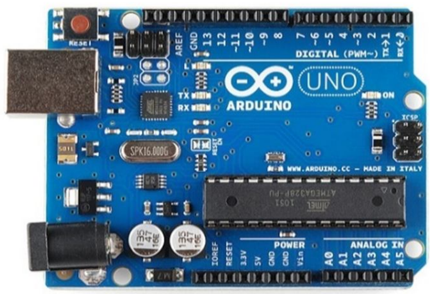
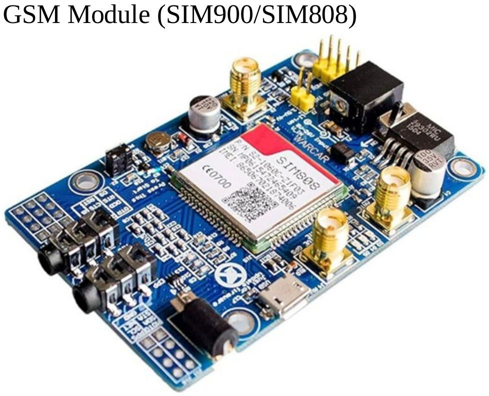
Table: Hardware Components

Sr No.	Product Name	Specifications	Function	Quantity
1	Arduino Uno 	ATmega328P, 5V Operating Voltage, 14 Digital I/O Pins, 16 MHz Clock Speed	Processes sensor data and controls system functions	1
2	Ultrasonic Sensor (HC-SR04) 	Operating Voltage: 5V DC, Range: 2-400 cm, Resolution: 0.3 cm, Frequency: 40 kHz	Measures garbage level in the bin	1
3	GSM Module (SIM900/SIM808) 	Operating Voltage: 3.4V-4.4V, 850/900/1800/1900 MHz Bands, SMS/GPRS Support	Sends bin status notifications to central monitoring station	1
4	GPS Module (NEO-6M) 	Operating Voltage: 2.7V-3.6V, Position Accuracy: 2.5m, Tracking Sensitivity: -161 dBm, Baud Rate: 9600 bps	Provides bin location information	1

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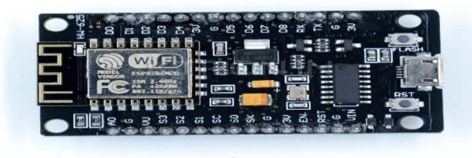
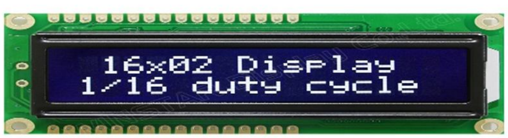
5	ESP8266 	Operating Voltage: 3.3V, IEEE 802.11 b/g/n, Frequency: 2.4 GHz, Data Rate: Up to 72 Mbps	Transmits data to web server	1
6	Power Supply/Battery 	5V (Arduino, sensors), 3.3V (ESP8266), Battery options: Li-ion/Li-Po	Powers the entire system	1
7	LCD Display (16x2) 	4.7V-5.3V Operating Voltage, 16x2 Display Size, 5x8 dot matrix, LED Backlight	Displays local bin status	1
8	Potentiometer 	10kΩ resistance, Rotary or slide type	Adjusts sensor sensitivity	1

IV. CONCLUSION

The proposed IoT-based garbage monitoring system addresses common challenges in waste management by improving efficiency and ensuring timely bin servicing. By providing real-time waste levels, it reduces the need for manual checking, thus saving time and resources. This technology not only minimizes overflow and unsanitary conditions but also contributes to a cleaner environment. Furthermore, integrating solar energy in future versions could make the system more sustainable. Overall, this smart waste management approach aligns with the goals of modern urban development and environmental conservation.

V. ACKNOWLEDGEMENT

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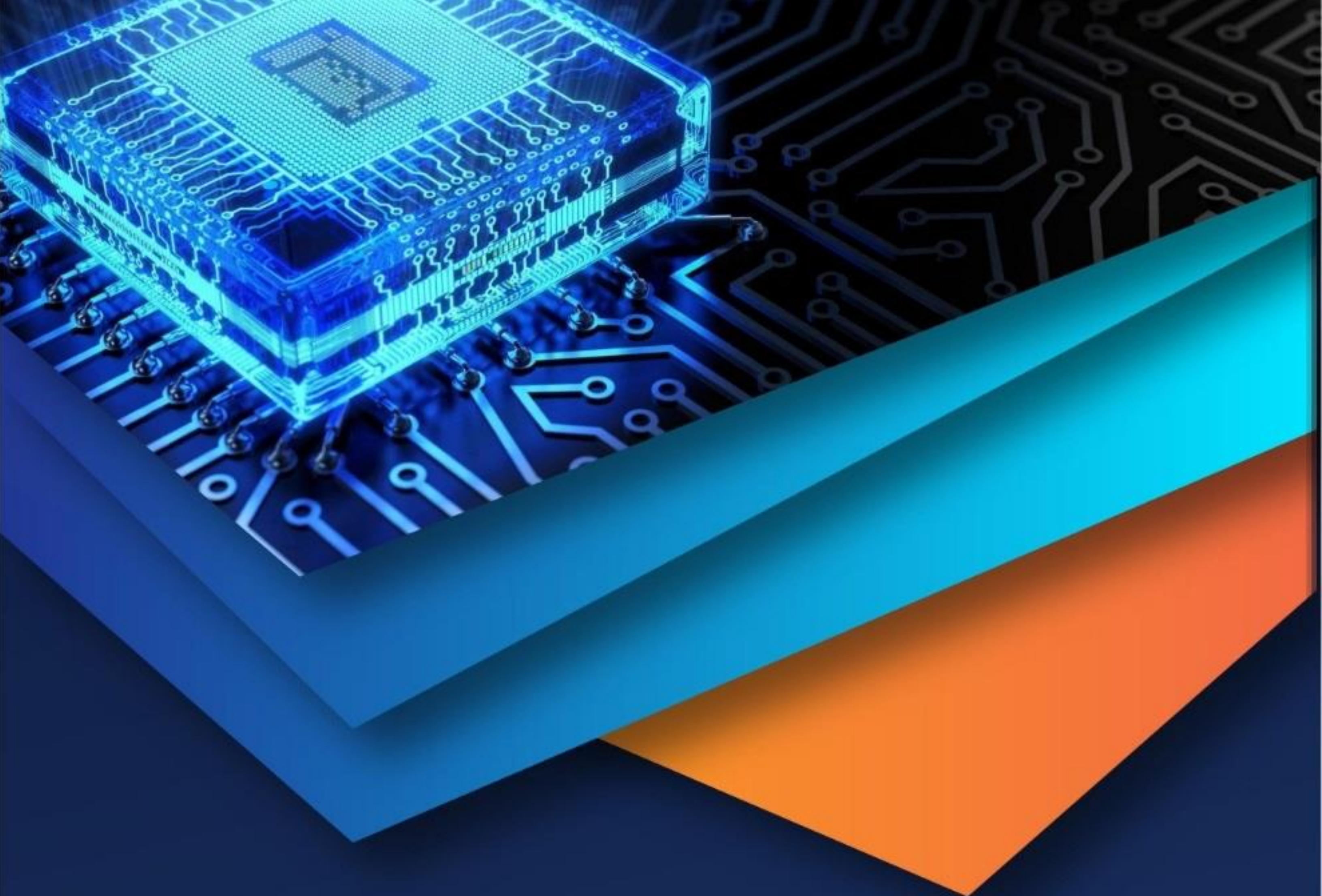

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