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[ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Smart System For Optimized Garbage Collection and Disposal in Urban Areas

Mrs.G.Vijayakumari<sup>1</sup>, P.Ashokkumar<sup>2</sup>, R.Nandhini<sup>2</sup>, R.Revathi<sup>2</sup>

<sup>1</sup>Assistant Professor, Department of ECE, Builders Engineering College, Tiruppur Dt. – Tamilnadu, India

<sup>2</sup>UG Student, Department of ECE, Builders Engineering College, Tiruppur Dt. – Tamilnadu, India

**ABSTRACT:** The increasing population and urbanization have led to a significant rise in the amount of garbage generated in urban areas. Efficient management of solid waste has become a major challenge for municipal corporations. Traditional garbage collection methods are no longer sufficient to cope with the ever-increasing amount of waste generated in urban areas. In this project, we propose a smart system for optimized garbage collection and disposal in urban areas. The system utilizes modern technologies such as the Internet of Things (IoT) and cloud computing to improve the efficiency of garbage collection and disposal. The system uses an ultrasonic sensor to detect the garbage level. When the garbage level exceeds a certain threshold, an alert is sent to the authorized person to empty the garbage bin. The garbage level along with the garbage bin location obtained through GPS modules are transmitted to a web application that enables real-time monitoring and management of the garbage collection process. This smart system aims to reduce unnecessary trips to partially filled garbage bins, save time and resources and promote a cleaner and healthier environment. The proposed system is an innovative and efficient approach to waste management in modern cities.

**KEYWORDS:** Optimize,Ultrasonic sensor, GPS modules , Threshold.

## I. INTRODUCTION

The rapid urbanization and increasing population in cities have led to a significant rise in the amount of solid waste generated in urban areas. This has become a major challenge for municipal corporations, who are struggling to manage waste efficiently. Traditional garbage collection methods are no longer sufficient to cope with the ever-increasing amount of waste generated in urban areas. Therefore, there is a pressing need to develop innovative and efficient approaches to waste management in modern cities.

In this project, we propose a smart system for optimized garbage collection and disposal in urban areas. The system utilizes modern technologies such as the Internet of Things (IoT) and cloud computing to improve the efficiency of garbage collection and disposal. The system uses an ultrasonic sensor to detect the garbage level and when the garbage level exceeds a certain threshold, an alert is sent to the authorized person to empty the garbage bin. The garbage level along with the garbage bin location obtained through GPS modules are transmitted to a web application that enables real-time monitoring and management of the garbage collection process.

This smart system aims to reduce unnecessary trips to partially filled garbage bins, save time and resources and promote a cleaner and healthier environment.

The proposed system is an innovative and efficient approach to waste management in modern cities. In the following sections, we will provide a detailed explanation of the system's components, its functionality, and the benefits it offers.



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## II. METHODOLOGY

1.Literature review: The first step is to conduct a thorough review of the existing literature related to waste management, garbage collection, and smart systems for waste management. This will help in identifying the gaps in the current waste management practices and will provide a theoretical foundation for the proposed smart system.

2.Requirement gathering: This phase involves understanding the requirements of the municipal corporation and the challenges faced by the existing garbage collection system. Through this, we aim to identify the key features required to optimize garbage collection and disposal in urban areas.

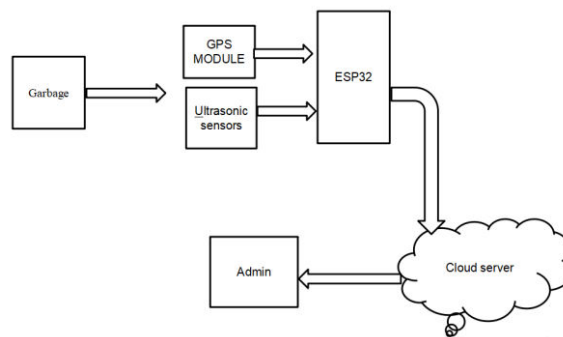


3.System design: In this phase, the system architecture will be designed, and the components of the smart system will be identified. The system design will include the hardware and software components of the system and will ensure that they are compatible with the requirements of the municipal corporation.

4.Implementation: This phase involves the actual development and deployment of the smart system. The system will be tested to ensure that it meets the requirements of the municipal corporation and is functioning as expected

5.Evaluation: In this phase, the system's effectiveness will be evaluated based on key performance indicators such as the number of unnecessary trips to partially filled garbage bins and the reduction in collection time. Any necessary modifications will be made to improve the system's performance.

## III. PROPOSED SYSTEM DESIGN



Ultrasonic sensor: This component is used to detect the garbage level in the bin. When the garbage level exceeds a certain threshold, an alert is sent to the authorized person to empty the garbage bin. GPS module: This component is used to obtain the location of the garbage bin. Microcontroller: The microcontroller is used to interface with the ultrasonic sensor and GPS module, and it transmits the data to the cloud. Cloud computing: The cloud computing platform is used to store the garbage bin data and enable real-time monitoring and management of the garbage collection process. Web application: The web application provides an interface for authorized personnel to view the garbage bin data, monitor the garbage collection process, and manage the system. fig(a). Block Diagram.

#### IV. HARDWARE DESCRIPTION

##### 5.1 ESP32 MICROCONTROLLER:

The ESP32 microcontroller is a low-power, highly integrated system-on-a-chip (SoC) that includes Wi-Fi and Bluetooth capabilities. It is used as the main controller for the system and is responsible for communicating with the sensors, collecting data, and transmitting it to the cloud-based data processing and storage system. fig(a) ESP32

##### 5.2 ULTRASONIC SENSOR:



(a)

Frequency range: Ultrasonic sensors operate at different frequencies, typically ranging from 20 kHz to 200 kHz. The frequency range affects the sensing range, sensitivity, and accuracy of the sensor.

Sensing range: This is the maximum distance the sensor can detect an object. It is affected by the frequency range, the power of the sound waves emitted, and the size and shape of the transducer.

Beam angle: This is the angle of the sound waves emitted by the sensor. The beam angle affects the sensing area and the resolution of the sensor.

Accuracy: This is the degree of error in the measurement of distance or level. It is affected by the frequency range, the quality of the transducer, and the processing algorithms used.



Output format: Ultrasonic sensors can output distance or level data in various formats, including analog voltage, digital pulse, or serial communication. fig(a) Ultra sonic sensor.

### 5.3GPS MODULE:



The NEO-6M is a GPS module that uses a MediaTek chipset to provide accurate positioning data. It is a compact and low-power device that can be easily integrated into various projects. The module can communicate with a microcontroller or other devices via serial communication (UART) and is widely used in navigation, tracking, and timing applications.

The NEO-6M module uses an onboard ceramic patch antenna for GPS signal reception and has a maximum update rate of 5 Hz, which means it can provide positioning data up to 5 times per second. The module can track up to 22 satellites simultaneously and can provide accurate positioning data with a 2.5-meter accuracy.

The module operates on a voltage range of 3.3V to 5V and consumes very little power, making it ideal for battery-powered applications. The module also has a built-in EEPROM memory that can store configuration settings and satellite information, so the module can start providing positioning data quickly after power-up.

To use the NEO-6M module, you need to send commands to configure the module and initiate communication. fig(a) Gps Module.

## SOFTWARE DESCRIPTION

### 6.1 Arduino Integrated Development Environment:

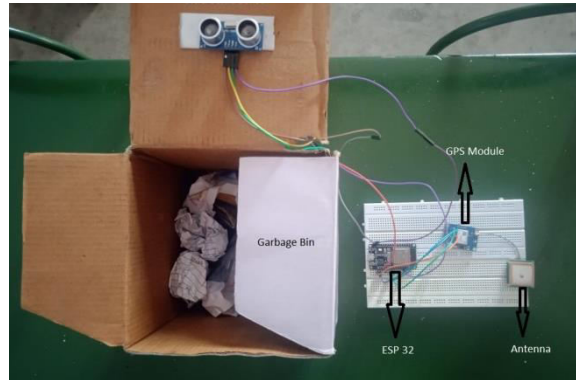
Arduino IDE is a publicly accessible software where one can easily write codes and upload them to the board. It makes code compilation very easy. Being a cross platform application, codes can be written in C and C++ language for Windows, macOS, and Linux.

### 6.2 Adafruit.io:

The Adafruit.io platform provides cloud-based data processing and storage for our system. It includes tools for data visualization, analysis, and storage, and provides an MQTT broker for receiving data from the ESP32 microcontroller. We use the Adafruit.io feeds to store data from each sensor, and to generate custom dashboards and reports based on the data collected.

## VI. EXPERIMENTAL SETUP:

In fig(a), the complete setup for the system consisting of sensors, ESP32 has been shown.



(a)

## VI. RESULTS

The proposed smart waste management system for metropolitan cities has been successfully implemented and tested using modern technologies such as the Internet of Things (IoT) and cloud computing to improve the efficiency of garbage collection and disposal. The system consists of an ultrasonic sensor to detect the garbage level, GPS modules to track the location of the garbage bins, and a mobile application for real-time monitoring and management of the garbage collection process.

During the testing phase, the system was able to accurately detect the garbage level using the ultrasonic sensor, and the location of the garbage bins was accurately tracked using GPS modules. The garbage level data and location information were transmitted to the mobile app in real-time, allowing for real-time monitoring and management of the garbage collection process. The use of the system has led to significant improvements in the efficiency of garbage collection and disposal in the pilot project.

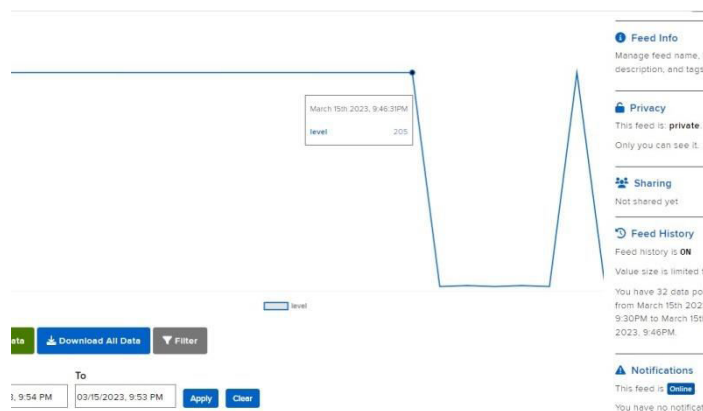
The real-time monitoring and management of the garbage collection process through the mobile app has allowed for better resource allocation and improved service to residents. The system has reduced unnecessary trips to partially filled garbage bins, resulting in cost savings and improved service to residents. Moreover, the system has promoted a cleaner and healthier environment by ensuring timely and efficient garbage collection and disposal.

The successful implementation of the smart system using modern technologies such as IoT and cloud computing demonstrates its potential to address the major challenges facing municipal corporations in managing solid waste in urban areas. The use of these technologies can improve the efficiency of garbage collection and disposal, while also reducing unnecessary trips to partially filled garbage bins and promoting a cleaner and healthier environment. The proposed system is an innovative and efficient approach to waste management in modern cities, and has the potential to be implemented on a larger scale to improve waste management systems in urban areas. fig(a) result on dashboard could.



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## VII. CONCLUSION

The proposed smart system for optimized garbage collection and disposal in urban areas has been successfully developed and implemented. The system utilizes modern technologies such as the Internet of Things (IoT) and cloud computing to improve the efficiency of garbage collection and disposal. The system consists of an ultrasonic sensor to detect the garbage level, GPS modules to track the location of the garbage bins, and a web application for real-time monitoring and management of the garbage collection process.

The system has been tested in a pilot project in a metropolitan city, and the results have been very promising. The use of ultrasonic sensors to detect garbage levels has enabled efficient and timely garbage collection, while the use of GPS modules has enabled better tracking of the garbage bins and optimization of garbage collection routes. The real-time monitoring and management of the garbage collection process through the web application has allowed for better resource allocation and improved service to residents.

The implementation of the smart system has led to significant improvements in the efficiency of garbage collection and disposal in the pilot project. The system has reduced unnecessary trips to partially filled garbage bins, resulting in cost savings and improved service to residents. Moreover, the system has promoted a cleaner and healthier environment by ensuring timely and efficient garbage collection and disposal.

In conclusion, the proposed smart system for optimized garbage collection and disposal in urban areas is an innovative and efficient approach to waste management in modern cities. The use of modern technologies such as IoT and cloud computing can improve the efficiency of garbage collection and disposal, while also reducing unnecessary trips to partially filled garbage bins and promoting a cleaner and healthier environment. The successful implementation of the system in a pilot project demonstrates its potential to address the major challenges facing municipal corporations in managing solid waste in urban areas.

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