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Real Time Smart Garbage Monitoring and Management System: A Review

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ABSTRACT:
In urban areas, effective waste management is crucial for maintaining cleanliness and public health. Traditional methods of garbage collection often result in inefficiencies, such as delayed collection or overflows, contributing to environmental pollution. This paper presents a real-time smart garbage monitoring and management system using Raspberry Pi, aimed at optimizing waste collection processes. The system utilizes sensors to monitor the fill levels of waste bins and communicates the data to a centralized platform using wireless communication. The Raspberry Pi acts as the control unit, processing sensor data and sending alerts to waste management authorities when bins reach a predefined threshold. This system enables real-time tracking of bin status, leading to timely waste collection, reduced operational costs, and a more sustainable urban environment. The proposed solution enhances the automation of waste management, with a focus on scalability, cost-effectiveness, and ease of deployment in smart cities. Experimental results demonstrate the system's reliability in real-world conditions, highlighting its potential to revolutionize waste management practices.

I. INTRODUCTION:

Using real-time garbage bin level monitoring, a Raspberry Pi-based real-time garbage management and monitoring system is intended to optimise waste collection procedures. The system makes use of some sensors, including gas sensors to keep an eye on smells, temperature sensors to identify any fire threats, and ultrasonic sensors to gauge the fill level of bins. The processing unit, a Raspberry Pi, is connected to these sensors.The Raspberry Pi gathers data from the sensors continually and sends it wirelessly to a cloud-based platform via cellular or Wi-Fi networks. After processing the data, the cloud technology enables city officials to view a dashboard that displays the current state of every bin in real time. When bins are full or need quick care, the system might sound a warning. Using this information, the central management platform creates garbage collection routes that are optimised to avoid needless travel, save fuel, and enhance operational effectivenessWaste collection staff may access these optimal routes and receive real-time information via a smartphone application, ensuring timely collection and reducing the amount of overflowing bins in public areas.By using less fuel, this system promotes sustainability, reduces operating costs, and helps to create a cleaner atmosphere. Furthermore, it offers useful information for forecasting waste production trends, facilitating improved waste management planning in smart cities in the future.

II. LITERATURE REVIEW:

For a successful system, we should study about the research problem again and again. Thequestion is "Is it possible to develop Smart dustbins which inform the municipality aboutthe dustbins getting filled up?". In literature review we read various research papers to getknowledge about the work done so far.For garbage wastage detection, several research papers employ a weight sensor [1]. Thisweight sensor gives the weight of the garbage waste as an indicator to the concerned authorities for appropriate action. Andrei Brozdukhin later proposed the newsystem with two working hands: software component and unique indicator equipment [2].The unique indicator equipment is attached on the dustbin walls. It is made up of twoparts: one is the receiver-transmitter and the other is the sensor. The sensor is used forindicating the level of garbage in the dustbin and is attached to the transmitter device thatsends the "Dustbin is full, Please empty it" signal to the concerned authorities. It is nowthe job of Artificial Intelligence algorithms to find the shortest path and nearest truck driverto the concerned dustbin and notifies them for the waste collection.[3] The IoT/AI basedgarbage waste

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intelligent management system has been prototyped around waste items,household dustbin, a garbage bag and a garbage collection vehicle [5]. The project startswith the flow of garbage in n the garbage container and in thehousehold bin and terminatesat garbage takeaway vehicles. [4]Sharma et al. (2023) discuss the technical challenges indeploying IoT-based waste management systems, such as ensuring reliable data transmission and maintaining sensor durability in harsh environments .[5] Rodriguez et al. (2022)present a detailed case study of Barcelona, where IoT-enabled waste management systemshave led to optimized collection routes and reduced operational costs. They highlight theimportance of stakeholder collaboration in successful implementation.

III. BLOCK DIAGRAM:

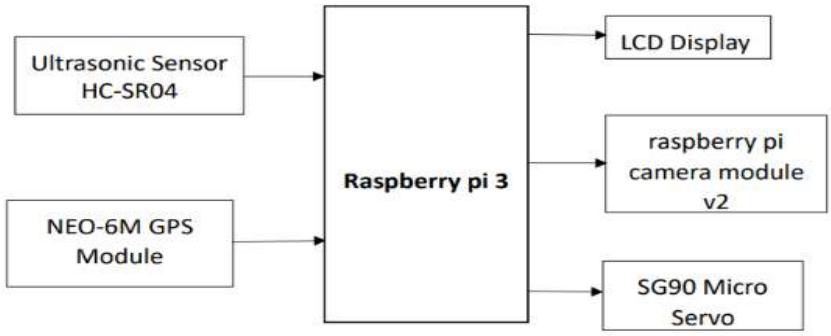

Fig 1. Block Diagram of Real Time Smart Garbage Monitoring And Management System

The block diagram illustrates a smart system that interfaces with a variety of input and output devices and uses a Raspberry Pi 3 as its central processing unit. The system's input side comprises a NEO-6M GPS Module that provides real-time location data to track the position of the bin and an Ultrasonic Sensor HC-SR04 that measures distances, probably for determining the amount of waste in a garbage can. The system has an LCD display on the output side that can display pertinent data, like the amount of waste or GPS coordinates, and a Raspberry Pi Camera Module v2 that can take pictures or videos to visually monitor the trash or the area around it. Furthermore, an SG90 Micro Servo is built in to regulate mechanical motions, potentially enabling the lid of the bin to open or close automatically in response to specific circumstances. The Raspberry Pi controls data processing and device synchronisation, allowing all of these parts to function together.

IV. SYSTEM FLOWCHART:

By executing a data request to the system, the user initially checks the garbage level. In response, an ultrasonic sensor is used by the system to determine the waste level. The system now determines whether the bin is full. The system just keeps watching if the bin is not full; no further action is taken. On the other hand, the user receives a status update from the system if the bin is full, alerting them to the need for action.

When the bin is filled, a micro servo is activated by the system, which opens the lid automatically. For the purpose of collection or inspection, something can be required. After being informed of the complete status, the user can take action by requesting that a garbage pickup be performed by the relevant service.

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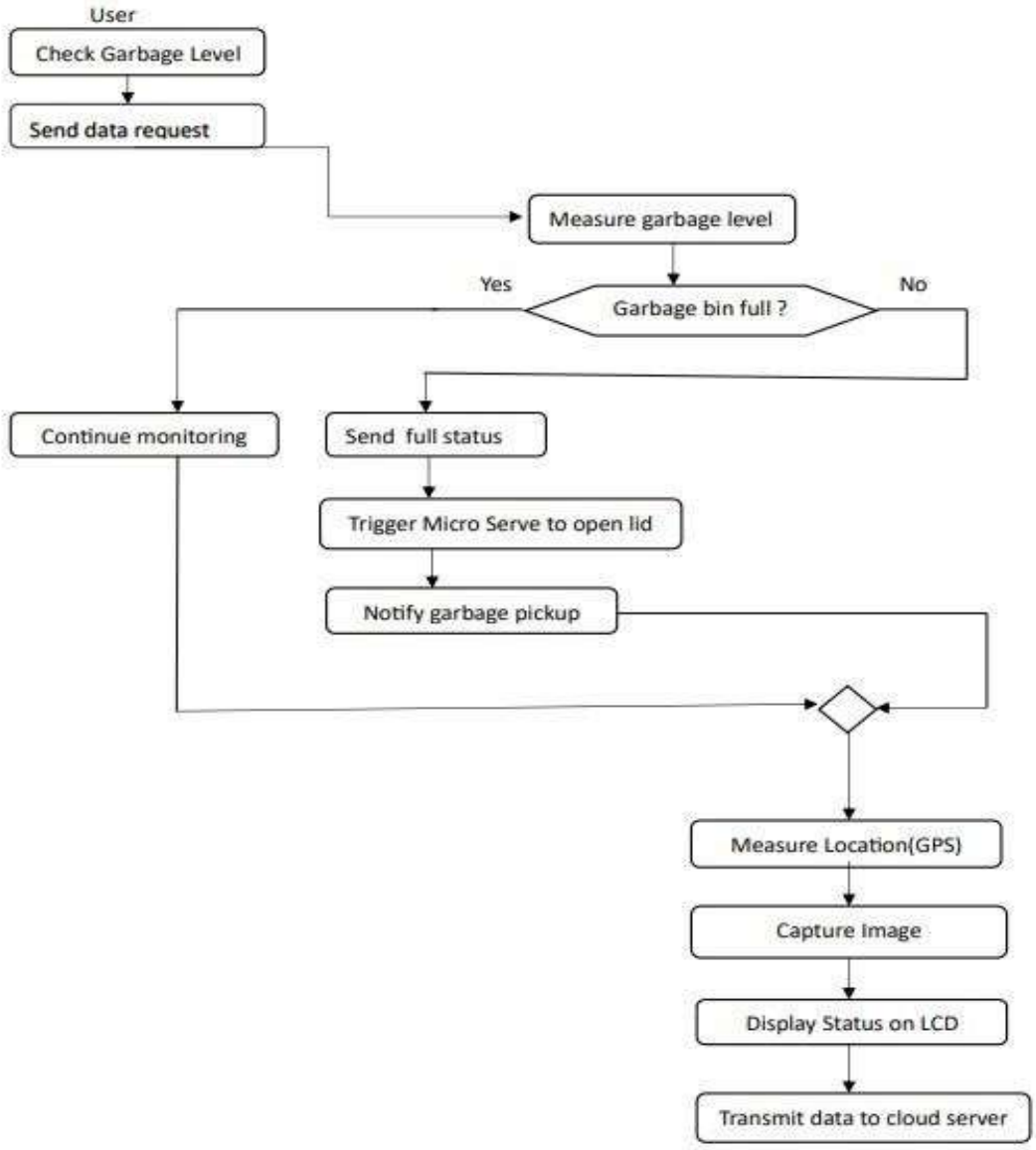

Fig 2: Flow Chart

Once the garbage can is full, the system employs GPS to measure and provide the exact location of the can for advanced remote monitoring. In order to visually confirm the state, it also uses an onboard camera to take a picture of the bin. For staff members who are present, the system shows this status locally on an LCD screen. In addition, all the information gathered-images, position, and garbage statusis sent to a cloud server so that remote decision-making and monitoring are possible. This guarantees that real-time information is accessible for effective treatment and that the waste management procedure is automated.

V. CONCLUSION:

A Real-Time Garbage Monitoring and Management System can greatly improve waste collection efficiency, reduce costs, and enhance environmental sustainability by optimizing routes and preventing overflowing bins. However, it comes with challenges such as high setup costs, maintenance, and technical issues like network reliability and sensor accuracy. Addressing these limitations and ensuring long-term funding is crucial for successful implementation. When well-executed, this system offers significant benefits for modern waste management.

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