Smart Garbage Bin With Real Time Monitoring System

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Abstract- *The project aims to design and implement a smart garbage monitoring system that can automatically detect the level and type of waste in a bin, and perform UV sanitization, vehicle tracking, and automatic lid opening functions. This system consists of two bins, one for dry waste and another is for wet waste. This system is equipped with ultrasonic sensors, servo motors, UV lamps, GPS and WI-FI modules. The system can communicate with a mobile application and central server to provide information of real-time on the waste status and current location and alert to the web server when the bins are full. The system has two bins to segregate the waste into biodegradable and non-biodegradable categories and for sanitize the bins using UV light to prevent the spread of odors and diseases. The system can improve the waste management efficiency and the efficiency of waste management and disposal plays an important role in creating a healthier and cleaner environment.*

Now a day, Indian Government agenda is to create smart cities. SWACCH BHARAT is a mission started by our P.M, while promoting this, waste management is the most complicated problem for municipals, which are facing serious issue from pollution due to the huge quantities of wastes. Its aims to clean up the roads, streets and to develop the infrastructure digitally of India's city and rural areas. We see that in our cities public bins are overloaded and it create unhygienic conditions for people and that place leaving a bad smell. To avoid all these things, we are going to implement a project Internet of things, based garbage monitoring System

Keywords- IOT, Real time monitoring, UV Sanitization, Vehicle tracking, Location tracking, level detection.

I. INTRODUCTION

Waste management is a significant issue, particularly in urban regions of developing countries. As per the Central Pollution Control Board (CPCB), India produces approximately 62 million tons of municipal solid waste annually. Of this, only 43 million tons are collected and 11.9 million tons are treated. The remaining waste is discarded in landfills or open spaces, leading to environmental and health risks.

The problem of environmental distress is particularly relevant in areas where the majority of the population and production are concentrated - urban areas. Cleanliness is a crucial concern in contemporary society. Solid waste is the primary factor negatively affecting people's health and environmental hygiene. Despite numerous efforts to manage waste effectively, it remains a daunting challenge for all nations.

The Internet of Things (IoT) offers a promising solution to this ever-increasing problem. An IoT-based automated process in waste management is essential for maintaining a clean environment. IoT enables real-world objects to communicate with each other and connect to the global network using various protocols and standards. Whenever there is a need to dispose of trash in the dustbins, a notification will be sent to the relevant authorities.

In nearly all cities with a population exceeding 1 million, environmental distress is rated as very high. The urban environment is closely and organically linked with the land, which holds value and is a fundamental factor of comfort.

The escalating population, ongoing industrialization, and urbanization have led countries like India to generate a large amount of garbage and pollution. Unregulated dumping of waste in organizations and cities results in overflowing landfills, leading to severe environmental repercussions. Waste can be a valuable resource when it is appropriately treated and reused. For effective garbage management, households and industries must regularize the waste monitoring process

II. LITERATURE REVIEW

Several studies and projects have been conducted on the development and implementation of smart garbage monitoring systems using IOT technology. Some of the important studies are mentioned below:

The project, as described by Kousheek Chakraborty, [1] utilized an Arduino Uno board, an ultrasonic sensor, and a

Wi-Fi module. These components were used to gauge the amount of garbage in a bin and transmit this data to a webpage. Additionally, a servomotor was employed to automatically open the bin lid when someone neared it. The primary objective of this project was to minimize the human labor, time, and expenses associated with waste collection and disposal.

The project mentioned in [2] utilized an Arduino Nano board, an ultrasonic sensor, a GSM module, and a GPS module to gauge the garbage level in a bin and transmit this data to a cloud server and a mobile application. It also employed a load cell to determine the garbage weight and a buzzer to notify the user when the bin is full. The project's goal was to enhance the efficiency of waste collection routes and schedules, and provide real-time updates on the waste status and location.

The project discussed in [3] incorporated an Arduino Mega board, two ultrasonic sensors, two servomotors, two UV lamps, and a GSM module to measure the garbage level in two separate bins - one for wet waste and the other for dry waste. The data was then sent to a cloud server and a mobile application. The project also used a moisture sensor and a color sensor to segregate the waste into biodegradable and non-biodegradable categories. The bins were sanitized using UV light to eliminate germs and bacteria. The project aimed to enhance the hygiene standards and quality of waste management and disposal.

The project outlined in [4] involved setting up a solid waste bin monitoring system in a public place with a camera installed at the garbage bin location. The camera captured images of the garbage bin. The RFID reader and camera, mounted on the truck, communicated with the RFID tag when the truck approached the bin, sending all the information to the control station. This system used SMS technology and a GPS and GPRS mapping server to analyze data from various locations. The control station compiled all the information and stored it in the system database. The bin status and waste truck were monitored.

The project discussed in [5] revolved around a laser diode, a p-n junction diode that produces a narrow, intense, focused, and coherent beam of light. In a LASER diode, a mirrored resonant chamber is utilized to amplify the light waves, ensuring that the light emitted by the device is of a uniform frequency and phase. A photo detector, a device that converts light signals into electrical signals, was used, which could be amplified and processed. The technology used included Dustbins, LASER Diode, Photo Detector Diode, Road Side Units (RSU), and Garbage Collecting Vehicle (GCV). It only supported the simulation of Transmission Control Protocol (TCP), routing, and multicast protocols over wired networks. The dynamic routing of GCV, compared with a static solution, was much more efficient and would be much more effective when more than one dustbin was involved.

OUTCOMES FROM LITERATURE REVIEW-

From above literature we got following outcomes-

Arduino Uno board can be used to interfacing of several components for smart garbage monitoring system. GPS can be used to track garbage bin locations and garbage vehicle location and communicate data to a central work station for analysis and management.UVlamp can be used to sanitize wet and dry waste bins, improving hygiene and quality of waste management and disposal. Use of Arduino UNO, ultrasonic sensor, Wi-Fi module, servomotor to automate garbage lid opening and waste level measurement, aiming to reduce human effort and waste collection costs.

III. OBJECTIVES

The primary aim of this project is to promote a clean and hygienic environment by developing and automating a cheap, easy to use garbage management system.

The main objectives of the project are:

- To design and implement a smart garbage monitoring system that can automatically detect the level and type of waste in a bin, and perform UV sanitization, vehicle tracking, and automatic door opening functions.
- To use two bins, one for wet waste and one for dry waste, that are equipped with ultrasonic sensors, servo motors, UV lamps, Wi-Fi module, and GSM modules.
- To communicate with a central server and a mobile application to provide real-time information on the waste status and location, and alert the authorities when the bins are full or need maintenance.
- To segregate the waste into biodegradable and non-biodegradable categories, and sanitize the bins using UV light to prevent the spread of diseases and odors.
- To improve the efficiency and effectiveness of waste management and disposal, and contribute to a cleaner and healthier environment.

IV. METHODOLOGY

The proposed methodology for the project is as follow:

The system consists of two bins, one for wet waste and one for dry waste, that is equipped with ultrasonic sensors,

servo motors, UV lamps, GPS module neo6m, WI-FI modules esp8266, a static relay and a choke. The system is being powered by a 12V power supply. The system is controlled by an Arduino UNO R3 board i.e. programmed using the Arduino IDE software.

The ultrasonic sensors are placed on the top of the bins to measure the distance of the garbage from the top. The distance is converted into the percentage of the bin filled and displayed on the web server (www.adafruit.io). The Arduino board also sends the data to the central server and the mobile application using the WI-FI module. The central server and the mobile application can monitor the status and location of the bins in real time.

The servo motors are attached to the lids of the bins to open and close them automatically. The Arduino board trigger the servo motors to open the lids when the ultrasonic sensors detect an object within a certain range, such as a human hand. The lids close automatically after a delay of 5 seconds. The servo motors also prevent the lids from opening when the bins are full or under sanitization mode.

The UV lamps is placed inside the bins to sanitize them and kill the germs and bacteria. The static relay activates the UV lamp for 5 seconds after delay of 5 seconds when the lid is open. The UV lamps emits ultraviolet rays.

A notification is sent with longitude and latitude of the garbage bins whenever the garbage bins become full i.e. it reaches to about 80 percent of the total volume by the help of an application named IFTTT.

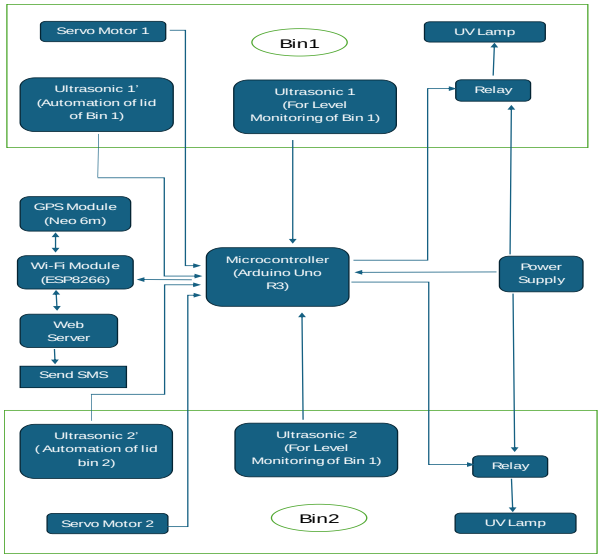

Figure 1: Workflow Diagram

V. RESULT / OUTCOMES

The outcomes of this project are mentioned below:

Both the garbage bin indicate the level of garbage filled inside it. In case the level is between o% to 80% then data is updated to the cloud and it shows the Bin is Empty. If the garbage bin is full i.e. it the level reaches above 80%Garbage is Full. It will also send signal to concern authority through Wi-Fi module which is controlled by Arduino Uno.

The bin consists of automated lid if any person come near the bin for use it the bins lid automatically open, and when the operation is performed the bin closed their lid.

The system aims to improve the effectiveness and efficiency of waste management by providing real-time information about the garbage level and location of the bins, and by automating the verification and notification process of the cleaning task.The pilot of garbage vehicle can track the dustbin and can see the how much garbage in the bin.

The Android app allows the users to access the web page (www.adafruit.io) and monitor the status and location of the bins and the vehicles. The system also sends alerts to the users and the authorities via an application (IFTTT) when the garbage level reaches a threshold or when the bin is emptied.

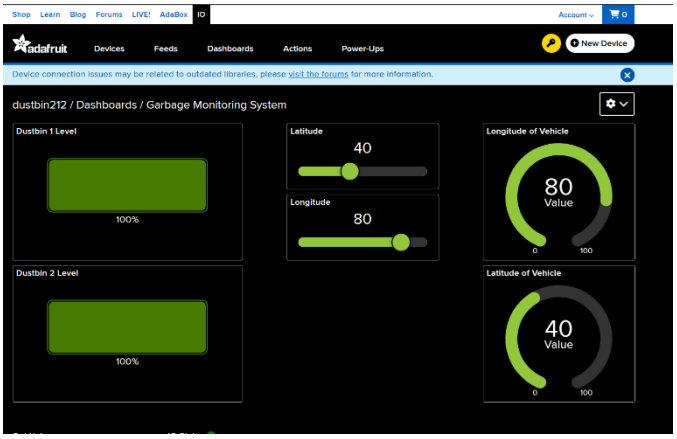

Figure 2: Webserver Layout

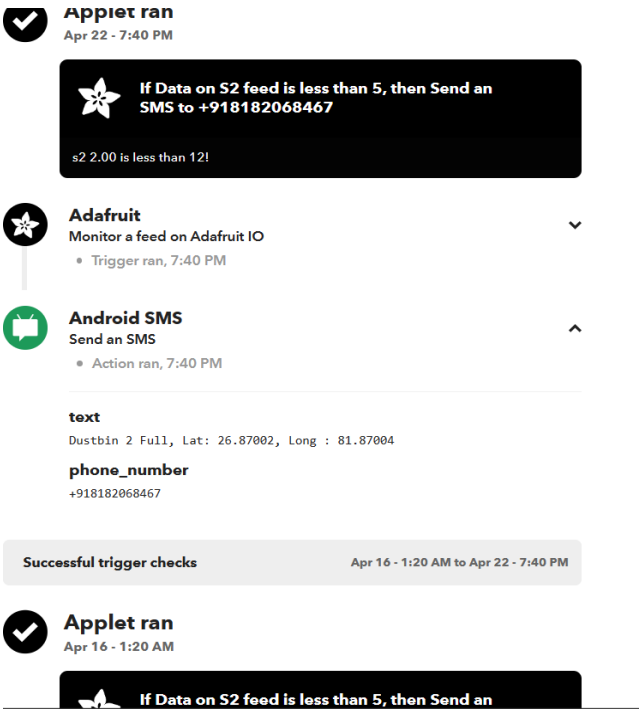

Figure 3: Notification Panel

VI. ADVANTAGES AND DISADVANTAGES

ADVANTAGES -

Implement Data-Driven Collection Routes: Waste collectors often send garbage trucks to each litter bin in the city to check fill levels, which is very exhausting and hectic work, often for little benefit. These bins provide us information about litter bins fill levels and the location by using IOT. This data is used to optimize routes for waste collectors instead of wandering the road to check each bin.

Save Time & Reduce Cost: When garbage trucks only go to the filled containers, a considerable amount of time and money can be saved. The data collected from the smart litter bin sensors provides insight into exactly when bins should be collected, reducing costs for wages, fuel and vehicle maintenance.

Reduce Co2 Emissions & Traffic Congestion: Smart litter bins reduce vehicle emissions by eliminating the need to drive to litter bins that are far from full. This also leads to reduced traffic congestion on the streets and less noise pollution in cities.

Reduce Overflowing Bin Complaints: Bins that are overflowing can be unpleasant to the eye, emit foul odors, and serve as a perfect habitat for pests. It's not surprising that such conditions can lead to grievances from the public! The use of smart bins contributes to keeping the environment clean and free from waste. This approach can significantly reduce the number of complaint calls from unhappy residents.

Understand Waste Generation Patterns: Another benefit that comes with 13 using smart bin sensors is the software platform behind the devices, which tracks the waste generation of bins. Software such as Waste Hero's Asset Management enables users to view fill-level graphs and 3D topology maps for all containers equipped with sensors, enabling local authorities to better understand waste generation patterns over time so they can organize resources accordingly.

DISADVANTAGE -

The system has some limitations/challenges that need to be addressed-

- The system depends on the availability and reliability of the network and the power supply.
- The system also requires the installation and maintenance of the hardware and software components.
- The system also faces the issues of security, privacy, and scalability.
- The system also needs to be tested and evaluated in real-world scenarios and with different types of waste and bins.

VII. FUTURE SCOPE AND APPLICATION

The system provides us with the real time information and status of garbage bins located in different areas. With the help of this real time information, we can monitor the bins and once the bins are full the workers can collect the garbage and set them to empty again. These type of binsare cost effective and can be accessed from server. Traffic can be controlled as the workers collect the garbage only when the bin is full whereas in traditional way workers collect the garbage daily whether the bin is filled or not. The system has potential for future enhancements, such as incorporating a timestamp feature. This would provide real-time updates to the authorities, indicating when the garbage bins reached capacity and the exact time when the waste was collected from the smart bins.

This initiative can be effectively utilized in the development of "Smart Cities". It aligns well with the government's "Swachh Bharat Abhiyan" initiative. The project can be implemented across various settings, including campuses and industries. It plays a substantial role in advancing the nation's "Clean India Mission". It's also suitable for deployment within college or university campuses.

When put into action, this project minimizes human intervention and enhances the efficiency of waste collection.

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