IoT-Based Dustbin Monitoring System

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Abstract: The overflowing trash cans in most cities produce an unclean atmosphere. This will also cause various kinds of unidentified diseases to develop. Many types of dustbins, such as swing lid trash cans, pedal trash cans, mesh trash cans and open trash cans are used to dispose of rubbish or garbage these days. The problem with open and mesh garbage cans is that they can harbor a deadly stench for several days if the rubbish is left undisturbed, and children can easily unravel the waste and scatter it everywhere. Another disadvantage for people with children is how difficult it is to keep an eye on them and keep them away from trash cans. These trash cans are frequently used in streets, workplaces, hospitals, and residences. The economical use of dustbins is discussed in this article. The presented work aims to reduce human efforts and to automate the task of ash-bin.

Keywords: Internet of Things (IoT), Waste management, Arduino, GSM/GPRS module, Ultrasonic Sensor

I. INTRODUCTION

An extremely creative technology today that will aid in maintaining clean cities is the IOT-based dustbin monitoring system. This system continues to keep an eye on the trash cans and uses a web page to notify users about the amount of trash that has been collected. To do this, the system compares the depth of the garbage bins with the garbage level using ultrasonic sensors that are positioned over the bins. The Arduino UNO, GPRS module, buzzer, and data transmission are utilized by the system. The Ministry of Urban Wellbeing, Housing, and Local Government claims that these wastes are causing severe air and land pollution, health issues for local populations, and obstacles to economic growth. When combined, Malaysia's inadequate waste management practices represent one of the country's most pressing problems to date. The project's goals are to create a working prototype of an Internet-of-Things (IoT) garbage monitoring system and notify garbage collectors when the bin is full by determining the garbage level based on the bin's depth. Cleaning all of the dustbins as soon as they are filled is crucial. [1]

II. PROBLEM DEFINITION

Solid waste management is a major issue in urban areas. In a traditional waste management system, the person in charge of collecting garbage is unaware of how much waste is in the dustbin. When the dustbins fill up, the garbage spills out and overflows, creating an unsanitary environment in urban areas. Garbage is dumped into the already overflowing dustbin. Untidy trash cans can occasionally give off an unpleasant odor in addition to producing toxic and unsanitary gases, which contributes to air pollution and the spread of some dangerous diseases. The city has a really poor appearance. Using a traditional system leads to an ineffective system that costs money and takes time to use. [2]

In this article, the issue of overflowing solid waste bins that contaminate the environment is addressed. The ultrasonic distance measuring sensor determines how much garbage is in each bin. The microcontroller in each garbage bin sends an alert message to the e-monitoring station when the level of garbage inside surpasses a predetermined threshold. The workstation then arranges for the closest garbage collection truck to pick up the trash from the bins that have sent the alert. The sanitation experts can work more productively and save money by using this information, which indicates when the container is full and needs to be emptied.

III. METHODOLOGY

A system based on the Internet of Things (IoT) will automatically alert and properly dispose of such waste. Every person on the planet disposes of their waste in a dustbin, which they then empty once it is full. This is how a typical dustbin is used in its most basic capacity—all manual operations, no coding, and no use of components. When the waste from the bin overflows the lid, the bin is not being properly maintained. Using dustbins with distinct segregations, such as green and blue bins placed together or a dustbin designated solely for recyclable waste, is the second method. The third method uses Arduino, ultrasonic sensor, GSM module, and servomotor to do the same result and it is not cost-efficient.

A. Hardware

- Arduino UNO
- HC-SR04 ultrasonic sensor
- Connecting wires
- GSM/GPRS module

B. Block Diagram

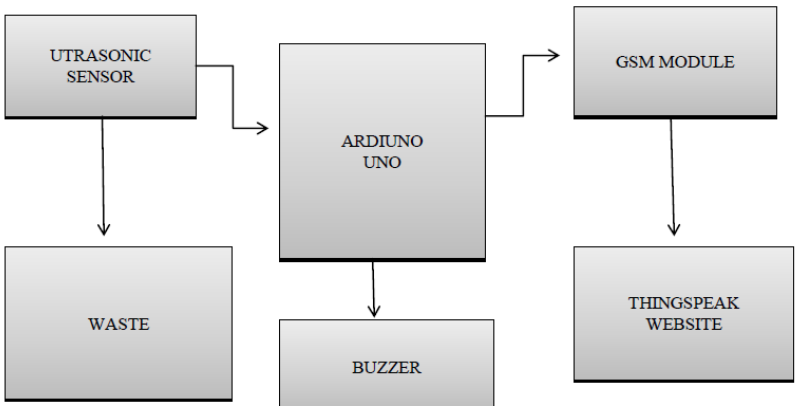

Fig.1. Block diagram of process system

The device that is being shown uses an ultrasonic sensor as an input, which is positioned at the waste can's highest level. An ultrasonic sensor is used to measure the garbage level and an Arduino for system control makes up the system. Everything will be connected to ThingSpeak. The user will be able to see the amount of waste in the dustbin without having to open it at the same time thanks to the level of garbage display. Based on the depth of each bin, the four ultrasonic sensors connected to Arduino determine the garbage level in each one. In order to ensure that data transfers and displays on ThingSpeak, these four ultrasonic sensors are connected to the GSM module simultaneously. Based on the type of waste, the system will attempt to monitor the rubbish's depth in this work. The home garbage should not wait for the bin to be completely full since the longer it is in the bin, the longer it will rot and cause an unpleasant environment.

C. Circuit Diagram

Figure 2 illustrates the circuit and how each component is connected to the others. Here, a logic level converter is used to connect ultrasonic sensors to the Arduino UNO and GSM module. The purpose of the logic level converter is to lower the ultrasonic sensor's 5V voltage to 3.3V. This is a result of the GSM module's PINs only accepting 12 V. In this setup, in order to create data and connect to the GSM module, the ultrasonic sensor requires a minimum of 5V. After being gathered, the data was uploaded to ThingSpeak for analysis and visualization.

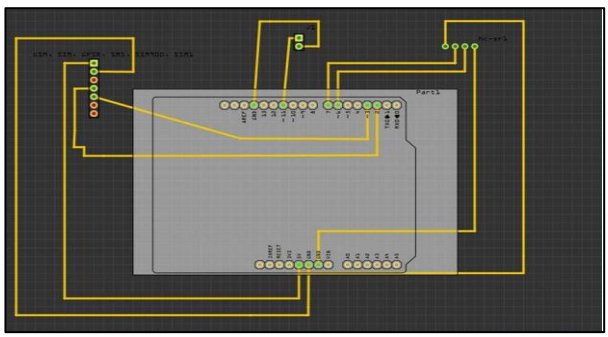

Fig.2. Circuit connection

D. Working Process

The Arduino will read the ultrasonic sensor after the account is created and then send a signal at the speed of sound. Once it hits the object, it reverses direction and travel time is stored. Consequently, the object's distance is computed. The garbage level can be classified as low or high based on distance. To denote the need for the cleaning procedure, we used the term "Overflow."

E. Result

The testing methodologies are referred to as test cases, as Table I illustrates. The operation and assessment results of the IOT-based dustbin monitoring system are displayed in Table I.

TABLE I
SMART GARBAGE BIN STATUS IDENTIFICATION AND EVALUATION RESULTS

TESTCASE DESCRIPTION	TESTCASE NOTATION	INPUT	REQUIREMENTS	TESTCASE STATUS	BUZZER
The garbage bin was found to be “EMPTY”	T1	Null	The Garbage bin should not have waste in it	Pass	NO
The garbage bin was found to be “MEDIUM”	T2	Garbage filling	The Garbage bin should be filled to its intermediated level	Pass	NO
The garbage bin was found to be “NEARLY FULL”	T3	Garbage filling	The garbage bin should be filled to an above intermediate level	Pass	YES
The garbage bin was found to be “FULL”	T4	Filled	The garbage bin should be filled to its maximum level	Pass	YES
The garbage bin was found to be “THRESHOLD CROSSED”	T5	Spillover	The garbage bin should be filled to a level that crosses the threshold limit	Pass	YES

Fig. 3. Hardware components

Testing the rubbish bin's fullness and emptiness serves as an evaluation of the system. The resulting level of garbage will display as empty if the trash can is empty. The buzzer will turn on based on how full the trash can is. Simultaneously, ThingSpeak will receive data from the sensor via the GSM module. As seen in Fig. 4, the data will be displayed in real-time by the ThingSpeak. Thus, waste management is able to keep an eye on the amount of junk that is buried inside the dustbin.

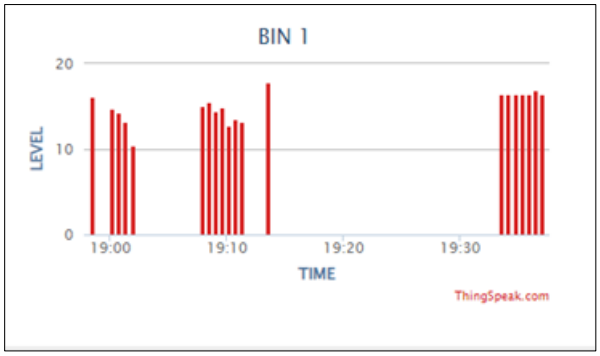

Fig.4. The data on ThingSpeak for bin

F. Advantages

- Quite a basic circuit.
- Helps monitor garbage levels.
- Makes little use of electricity.
- In the end, facilitates improved garbage pickup scheduling.
- It may decrease the amount of overflowing bins.
- Cuts down on travels to locations where the bins still have a lot of capacity.

G. Disadvantages

- The city gets a bad image of being dirty.
- The system requires a larger number of garbage bins for different waste collection according to the population in the city.
- This results in high initial cost owing to the expensive smart dustbin comparison to other methods.
- The dustbin's sensor mode has a small memory capacity.

H. Applications

- The "SMART CITY" can also make use of this initiative.
- The government's "SWACHH BHARAT ABHIYAN" project benefits from this project as well.

IV. CONCLUSION

This article presents a workable system for monitoring the level of garbage. The presented work uses sensors to measure the amount of waste in the dustbin in real time to implement a real-time waste management system. This system allows users to access the dustbin's information at any time and from any location. This system will assist in providing real-time information on each trash can's status. Therefore, when the dustbin is full, waste management can dispatch the garbage collector to pick up the trash. The ultrasonic sensor's detection range is 2cm to 400 cm, and it has a working buzzer. This sensor will display the amount of trash in the dustbin by comparing its depth. At the same time, the sensor will send data to ThingSpeak via the GSM module. Real-time data visualization is possible with ThingSpeak's data. As a result, garbage management is watchable.

V. FUTURE SCOPE

This system helps keep our neighborhood, house, or even the environment clean and green, which leads to a better way for us to live in a hygienic environment. It also provides real-time waste monitoring. The amount of waste containers in the dustbins is tracked using an ultrasonic sensor.

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