International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 03 | March - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

AQUACARTA, REAL-TIME URBAN WASTE MAPPING USING INTERNET OF THINGS

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ABSTRACT - At present, population rate in the main cities has increased tremendously. This has increased the production of waste. The management of huge volume of waste has become more difficult and challenging. The public dustbins are overflowing and have become nobody's concern. Due to the lack of responsibility of the corporation people, the overflowing garbage wastes have created unhygienic surroundings and foul smell. So, to overcome this issue, smart dustbin is designed. This smart dustbin is built on Node MCU board and is interfaced with GSM, GPRS and sensors. The sensors are used to check the threshold level of the dustbin. The threshold levels are already set. If the garbage hits the mentioned threshold level, continuous alert is sent to the respective authority until the garbage is recovered and the externally fixed LED is changed into red color. Once, the garbage from the bin cleared the LED changes to green color. This alert system is triggered by the sensors to the GSM modem. By this facility, the higher authority will be able to take action on the irresponsible workers. Features like maps are used to locate the dustbins which make the authority to reach the location easily. Connectivity among the dustbins are given to establish communication among the bins and provides smart system. Thus, the implementation of smart dustbins will create a hygienic society and will make the management of waste easy. The negligence of authorities and the public may be reduced. A clean and disease free environment can be created.

***Key Words*:** Smart Dustbin, Internet of Things, Node MCU, Ultrasonic Sensors, GSM/GPRS, Blynk Application, Waste Management, Location Tracking.

1.INTRODUCTION

This project aims to transform waste management in smart cities by implementing smart dustbins. It leverages hardware components like Node MCU, sensors, along with GSM for SMS and GPRS for location tracking. The system employs ultrasonic and infrared sensors to detect the fill level and presence of objects, respectively. The Node MCU micro controller controls the overall operation. The Blynk application provides remote control, data visualization, and storage functionalities.

The Ultrasonic sensors detects and evaluates the distance of the object. An Infrared sensor emits IR radiation in order to sense any action. An IR sensor detects the thermal radiation from other objects.

The Node MCU**,** micro-controller board is equipped with digital and analog, input and output pins.. The board has 14 Digital pins, 6 Analog pins, and is programmable with the Arduino IDE using a USB cable. It is powered by the USB cable or an external battery as it accepts voltages from 7 to 20.

2. LITERATURE SURVEY

Smart garbage bin concept is a highly debatable topic. IoT has led to the development of Smart dustbin concept. Each idea is mostly similar but varies with the technology used and the efficiency obtained from the model. Since the IoT plays a major role in our everyday life, it helps us to satisfy our daily needs by making things simple. At hardware level, the smart system is a garbage bin with IR sensor, Ultrasonic sensor, Servo motor, Arduino Uno micro-controller, GPRS module and GSM module for transmission of data. IoT enables connection among various devices worldwide using the cloud centric technology[1].

First, a single directional cylinder is suspended next to the lid of dustbin in [2]. The piston is free to move up and down vertically inside the dustbin to a certain level. A plate is attached to the cylinder for compressing the garbage. The shape of this plate depends upon the shape of the dustbin. The compressing plate consists of a side hole through which the leaf switch is suspended upside down.

A second IoT-based smart bin is proposed in [3] where the design is emphasized on the concept of smart dustbin which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. A GSM modem can be an external device or a PC Card / PCMCIA Card. An external GSM modem is connected to a computer through a serial cable or a USB cable. When a GSM modem is connected to a computer, this allows the computer to communicate over the mobile network.

A third IoT based system in [4] had Interfaced RFID with Arduino UNO. Interfacing Serial LCD with Arduino. Sending AT commands to GSM module. Designing a standard DC power supply for common applications.Integrating SPI communication within Arduino for effective data transfer. Multiple Serial Port communication. Circuit Size Reduction. Providing PWM signals to Servo Motor.

A fourth IoT based system in [5] has used ultrasonic sensors used to measure the garbage height. Arduino facilitates the connection of various modules for data transformation. By the GSM module the message will be sent to the user when the dust bin is full. The garbage height is displayed to the user's mobile device using a Bluetooth module. Opting for a lithium battery and solar panel, as opposed to a standard battery, allows for recharging functionality.

In reference [6], a Smart Dustbin is engineered featuring GSM connectivity. This bin autonomously detects the garbage level and transmits messages to the relevant municipal authorities, providing real-time updates on the bin's status.

In [7], the authors discussed that there is no moving dustbin available in the market. It makes work simple for physically challenged people and aged who are unable to use the dustbin and also provides a solution for inappropriate placement of dustbin in the surrounding. A Smart Dustbin using Mobile Application. None of the system contains real time tracking status of the fullness of the bins. No dust bins are present that can detect the odor caused by the bins.

A smart dustbin utilizing Arduino technology is presented as part of an IoT project. Here we are using arduino for code execution, for sensing we used ultrasonic sensor which will open lid and wait for few moment. It will bring drastic changes in terms of cleanliness with the help of technology. The integration of smart technology is enhancing various aspects of human life for improvement and convenience.

3. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Existing systems often lack features like location tracking, user interfaces, and efficient power management. Additionally, they might rely on unreliable methods for alerting authorities.

3.2 PROPOSED SYSTEM

This project addresses the limitations of existing systems by incorporating the following advancements:

MAPS: Enables easy location identification for waste collection.

AUTOMATIC LID LOCK : Prevents overflow and unpleasant odor.

LED INDICATORS: Visually informs users about the dustbin's fill status (red for full, green for empty).

GUI: Provides a user-friendly interface for monitoring dustbin status and managing alerts.

POWER EFFICIENCY: Optimizes power consumption for longer operation.

3.3 HARDWARE REQUIREMENTS:

a. Node MCU
b. Ultrasonic sensor
c. Dustbins
d. GSM module
e. LED lights
f. GPRS module
g. Jumper wires
h. Resistors
i. External batteries
j. Breadboard

3.4 SOFTWARE REQUIREMENTS:

a. Arduino IDE
b. Blynk application

4. ALGORITHM

1. INITIALIZATION:

Set up hardware components (servo motor, ultrasonic sensor, LEDs, etc.)
Initialize software libraries.
Define variables for distance, threshold, phone number, etc.

2. MAIN LOOP:

Read Ultrasonic Sensor:
Trigger the sensor to measure distance to the top of the garbage.
Calculate the distance based on the travel time of the sound wave.

CHECK DISTANCE AND TAKE ACTION:

If the distance is less than or equal to the threshold (dustbin is full):
Turn on red LED to indicate full status.
Send an SMS alert with location information to the designated number using GSM module.
Otherwise, turn on green LED to indicate empty status and keep the lid open.

UPDATE BLYNK APP:

Send sensor data (distance) to the Blynk app for visualization.

READ GPS DATA:

Check for incoming data from the GPS module.
If data is available, decode it and extract location information (latitude, longitude).

DISPLAY INFORMATION:
Print the decoded location information (if valid) along with date and time to the serial monitor.

3. REPEAT:

Continuously loop through the steps mentioned above to monitor the dustbin status, send alerts, and update the Blynk app.

5. METHODOLOGY:

IOT INTEGRATION: Select appropriate IoT sensors and devices for garbage and drainage monitoring. These could include fill-level sensors for garbage bins and water level sensors for drainage systems. Establish a network infrastructure to connect these devices and enable data transmission.

SENSOR DEPLOYMENT: Strategically deploy sensors at various locations, including garbage bins, drainage points, and critical areas prone to flooding. Ensure sensors are securely attached and properly calibrated to collect accurate data.

DATA COLLECTION: Implement continuous data collection from the deployed sensors. Gather information on fill levels in garbage bins and water levels in drainage systems. Ensure real-time data transmission to a central server or cloud platform.

DATA PROCESSING: Process the collected data to convert raw sensor readings into meaningful information. Use algorithms and analytics to identify trends, anomalies, and potential issues.

ALERT MECHANISM: Develop an alert mechanism that triggers notifications when predefined thresholds are crossed. For example, notify authorities when garbage bins are full or when drainage systems are at risk of overflowing.

SYSTEM DESIGN:

The system comprises the following components:

HARDWARE: Node MCU, sensors, actuators, communication modules.

SOFTWARE: Arduino IDE for programming, Blynk application for remote control and data visualization.

6. DATA STUDY:

The data collected from the system includes:

- Ultrasonic sensor readings (distance to garbage)
- Dustbin status (full/empty)
- Location coordinates (latitude and longitude)

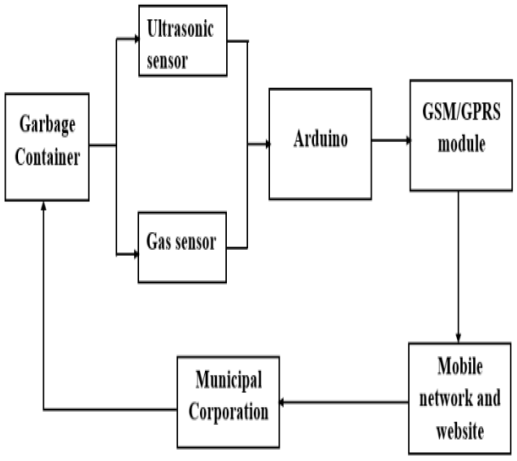

Fig -1: Block Diagram

7. RESULTS AND DISCUSSIONS

Fig -2: Dustbins

Fig -3: Dustbins

ACTIONS TAKEN:

ALERTS: SMS sent with location details when the dustbin is full.

LED STATUS: Changed based on the fill level.

DATA VISUALIZATION: Sent to the Blynk app for monitoring.

Overall, the code demonstrates a system for monitoring smart dustbins, sending alerts when full, and potentially providing location information for efficient waste management.

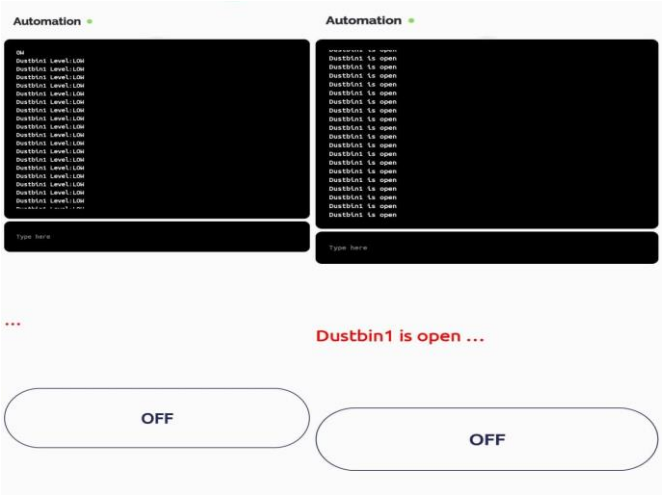

Fig -4: Data from Dustbin.

8. CONCLUSION AND FUTURE ENHANCEMENT

Globally, waste management poses a significant challenge across the entire world. If it is not properly dispose or cleaned which will causes lot of deceases and spoil the green environment. There is need of new mechanism to properly dispose the waste. In our project, we have developed an efficient waste management system [9]. Utilizing technology to enhance garbage disposal methods is becoming increasingly prevalent in urban areas. We have used sensors to indicate if the bins are filled or empty. When filled a truck driver receives a message to clean the bin. This system is eradicating the prevalent issue of bins often being left in a deplorable state, filled with garbage and not regularly cleaned. We have also developed an android application through which the user can find a bin near him to throw the trash. This creates a direct connection where every citizen is doing his part in maintain a clean environment around him. Additionally, a web server has been established to provide municipal authorities with information regarding the bins in their respective areas. This system is much helpful for citizens and Municipal Corporation to manage waste and monitor the dustbin time to time. Smart system provides the filling status of dustbin using message and it will save time, fuel and money of Municipal Corporation. As there was a problem of checking real time status of dustbin so it will be cleaned timely. So, in this project this problem is solved and proper database is managed online. In this way the municipal corporation shall work efficiently. There is one complaint desk for the citizens where they can send their complaint[8].

9. ACKNOWLEDGEMENT

We would like to thank Department of Computer Science and Systems Engineering, Lendi Institute of Engineering and Technology, Vizianagaram for helping us carry out the work and supporting us all the time.

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