MINI PROJECT REPORT

ON

"IOT BASED SMART DUSTBIN"

SUBMITTED IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS OF DEGREE OF

BACHELOR OF ENGINEERING

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Certificate

This is to certify that the Mini Project-1B entitled "**Iot Based Smart Dustbin**" is a bonafide work of **Smitesh Gajakosh, Prajwal Halle, Prathmesh Chaudhari** submitted to the University of Mumbai in partial fulfilment of the requirement for the award of the degree of **"Undergraduate"** in **"Computer Engineering.**

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Mini Project-1B Report Approval

This project report entitled "IOT-BASED SMART DUSTBIN" submitted by **"Smitesh Gajakosh, Prajwal Halle, Prathmesh Chaudhari"** is approved for the degree of Bachelor of Engineering in Computer Engineering.

Examiners

1. _____

2. _____

Date:

Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included. We have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will because for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Smitesh Gajakosh

Prajwal Halle

Prathmesh Chaudhari

Date:

Abstract

In the face of escalating urbanization and the resultant surge in waste production, effective waste management has emerged as a critical challenge. Conventional waste disposal methods often prove inadequate in terms of efficiency, hygiene, and user convenience. In response to this pressing need, we present a novel solution: a Smart Dustbin system built upon an ESP8266 microcontroller platform, interfaced with IR sensors, ultrasonic sensors, and a servo motor. Our Smart Dustbin prototype utilizes these integrated components to detect the presence and level of waste within the bin. Upon detection, the system triggers the servo motor to facilitate hands-free lid opening, ensuring convenient and hygienic waste disposal. Through the utilization of these advanced sensors and actuators, our project aims to optimize waste management processes, prevent overflow, and promote a cleaner environment. Furthermore, the implementation of our Smart Dustbin system lays the foundation for a scalable and efficient Smart Waste Management infrastructure. By seamlessly integrating hardware and software components, we aspire to revolutionize waste disposal practices, enhancing efficiency, and contributing to the creation of cleaner, more sustainable urban environments.

Keywords : IoT-based Dustbin, Waste Management, Hygienic, Waste Disposal, Smart Waste Solution, Environmental Sustainability, Sensor Technology

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Chapter 1

Introduction

1.1 Background

In contemporary urban environments, the issue of waste management has become increasingly challenging due to the rapid growth in population and urbanization. With more people residing in cities, the volume of waste generated has surged, straining existing waste management infrastructure. Traditional waste disposal methods, relying heavily on manual monitoring and collection, often prove inadequate to cope with the scale and complexity of modern urban waste streams. Overflowing bins, littered streets, and unsanitary conditions not only detract from the quality of life but also pose significant environmental and public health risks. Furthermore, inefficient waste management practices contribute to environmental pollution, resource depletion, and greenhouse gas emissions, exacerbating the global challenge of climate change. Against this backdrop, the urgent need to develop smarter and more sustainable waste management solutions has become increasingly apparent.

1.2 Motivation

The inefficiencies and challenges inherent in traditional waste management systems have motivated researchers and innovators to explore novel approaches leveraging modern technology. The emergence of IoT (Internet of Things) presents a promising opportunity to revolutionize waste management practices by enabling real-time monitoring, automated processes, and data-driven decision-making. By integrating sensors, actuators, and communication technologies into waste management infrastructure, it becomes possible to monitor waste levels, optimize collection routes, and improve operational efficiency. Furthermore, the growing awareness of environmental sustainability and public health concernshas heightened the urgency of developing smarter and more efficient waste management solutions. Addressing these challenges requires interdisciplinary collaboration, innovative thinking, and a commitment to leveraging technology for the greater good. Our project is motivated by a desire to contribute to these efforts by developing an IoT-based smart dustbin system that enhances efficiency, promotes hygiene, and advances sustainability in urban waste management. Through our research and innovation, we aim to play a role in creating cleaner, healthier, and more sustainable cities for present and future generations.

Chapter 2

Literature Survey

2.1 Basic Terminologies

1. **Lid Opening Sensor:** Sensor detecting when the lid of the dustbin opens, triggering data collection.
2. **Fill Level Detection:** Technology measuring the amount of waste inside the dustbin, usually utilizing ultrasonic sensors or weight sensors.
3. **Blynk Integration:** Incorporation of the Blynk platform for IoT applications, enabling remote monitoring and control of the smart dustbin.
4. **Notification System:** Mechanism for sending alerts and updates regarding the fill level or other status changes of the dustbin to the Blynk app.
5. **Real-time Monitoring:** Continuous tracking of the dustbin's status and activity, providing up-to-date information to users via the Blynk app.
6. **Mobile Alerts:** Notifications sent directly to users' smartphones through the Blynk app, ensuring timely awareness of the dustbin's status.
7. **User Interface (UI):** Graphical interface within the Blynk app allowing users to view the fill level, control the dustbin remotely, and receive notifications.
8. **IoT Connectivity:** Utilization of Internet of Things technologies to connect the smart dustbin to the Blynk app, facilitating data transmission and control.
9. **Waste Management Stakeholders:** Individuals or entities involved in the management and oversight of waste disposal, including authorities, municipalities, and environmental agencies.

2.2 Existing system

The current waste management system primarily relies on traditional methods of waste collection and disposal, which often involve manual labor and limited technological intervention. In most urban areas, waste collection is scheduled based on predefined routes and timings, with municipal workers manually emptying bins into collection vehicles. However, this system faces several challenges, including inefficient waste collection routes, irregular waste disposal, and inadequate monitoring of waste levels in bins. As a result, overflowing bins, littered streets, and unsanitary conditions are common occurrences, leading to environmental pollution and public health hazards. Moreover, the lack of real-time monitoring and data-driven decision-making hampers the optimization of waste collection processes and resource allocation. Additionally, the reliance on manual labor for waste collection poses risks to the health and safety of workers, particularly in hazardous or unsanitary environments. Overall, the existing waste management system is characterized by inefficiency, environmental degradation, and limited scalability, highlighting the need for technological innovations to address these challenges and improve the effectiveness of waste management practices.

2.3 Problem statement

The current waste management practices in urban environments are plagued by inefficiencies and shortcomings that compromise cleanliness, public health, and environmental sustainability. Traditional methods of waste collection and disposal rely heavily on manual labor and static scheduling, leading to issues such as overflowing bins, irregular waste collection, and unsanitary conditions. Furthermore, the lack of real-time monitoring and data-driven decision-making impedes the optimization of waste collection routes and resource allocation. Inefficient waste management practices not only contribute to environmental pollution but also pose significant health risks to communities, including the spread of diseases and contamination of air and water sources.

2.4 Survey

According to our Project “IoT Based Smart Dustbin”, we studied various papers related to Iot Based Smart Dustbins. The main 4 papers are as follows :

- Iot Based Smart Dustbin published in International journal of scientific & technology research volume 9, issue 02, February 2020 ISSN 2277-8616

- A survey of Smart dustbin systems using the IoT and deep learning published by Vellore Institute of Technology in February 2024

- IOT Based Smart Dustbin published in Vardhaman College of Engineering in March 2021 ISSN:1583-6258

- IOT BA.SED SMART WASTE MANAGEMENT SYSTEM published in Journal of Emerging Technologies and Innovative Research in March 2021 eISSN:2349-5162

1. Iot Based Smart Dustbin

The integration of visual feedback mechanisms in smart dustbins revolutionizes waste management by providing real-time status updates, ensuring timely disposal. With remote monitoring capabilities, users gain valuable insights into waste accumulation patterns, enhancing efficiency. However, the inability to segregate waste within the bin poses limitations on recycling efforts. Additionally, the absence of a GPS tracker diminishes the bin's utility in locating it efficiently. Despite these drawbacks, visual feedback and real-time monitoring significantly improve user experience and streamline waste management practices, marking a significant advancement in the domain of smart city infrastructure.

2. A survey of Smart dustbin systems using the IoT and deep learning

The incorporation of waste segregation capabilities in smart dustbins marks a pivotal step towards promoting sustainable waste management practices. With the project's expansive scope covering the entire city, it promises to revolutionize urban waste disposal systems. However, the absence of automatic cleaning and sanitization features poses challenges in maintaining hygiene standards. Additionally, concerns regarding object detection accuracy may impact the efficiency of waste sorting processes. Despite these limitations, the project holds immense potential in fostering cleaner and greener urban environments, showcasing a commitment to advancing smart city initiatives.

3. IOT Based Smart Dustbin

The system's capability for real-time monitoring represents a significant advancement, allowing for prompt response to waste management needs. Its simplified design streamlines operation and maintenance processes, ensuring user-friendly functionality. However, the absence of an automatic lid opening mechanism may impact convenience. Nonetheless, the system compensates by sending notifications via email, enhancing user engagement and facilitating efficient waste management practices. Overall, it presents a balanced blend of advanced features and user accessibility in the realm of smart waste management.

4. IOT BA.SED SMART WASTE MANAGEMENT SYSTEM

The Renowned for its efficiency and reliability, the system offers a seamless approach to recycling through waste segregation, simplifying the process for users. However, its high cost presents a barrier to widespread adoption. Additionally, the absence of a smart route system for waste collection limits optimization opportunities. Despite these drawbacks, its commitment to enhancing recycling practices underscores its potential to contribute significantly to sustainable waste management initiatives, albeit with considerations for cost-effectiveness and operational efficiency. significant

Sr No	Name of Paper	Name of Authors	Advantages	Limitations
1.	Iot Based Smart Dustbin published in International journal of scientific & technology research volume 9, issue 02, February 2020 ISSN 2277-8616	Telugu Maddileti, Harish Kurakula	1. Visual feedback, indicating the status of dustbin 2. Real Time Monitoring is possible	1. Segregation of waste is not possible 2. Lacks GPS tracker to locate dustbin,
2.	A survey of Smart dustbin systems using the IoT and deep learning published by Vellore Institute of Technology in February 2024	Menaka Arthur, Aru Pandey, S. Shobha	1. Segregation of waste is possible 2. Project is planned for entire city	1. Lacks automatic cleaning and sanitization 2. Object detection accuracy
3.	IOT Based Smart Dustbin published in Vardhaman College of Engineering in March 2021 ISSN:1583-6258	Srinivasan P, Thiyaneswaran B, Jaya Priya	1. Real Time Monitoring is possible 2. Less complex System design	1. Lacks Automatic lid opening mechanism 2. Sends notification through e-mail
4.	IOT BA.SED SMART WASTE MANAGEMENT SYSTEM published in Journal of Emerging Technologies and Innovative Research in March 2021 eISSN:2349-5162	Zareena Banu, Meghana SL, Pooja CV	1. Efficient and reliable 2. Provides the easiest way of recycling through segregation	1. Very high in Cost 2. No Smart route system for waste collection is provided

Table 2.1 : Literature Survey

Chapter 3

Requirement Gathering

4.1 Software and Hardware Requirements

Here we will discuss everything we will need in order to execute. Below we list thenecessary software requirements.

1. Software Requirements:

- Arduino IDE
- Blynk App

2. Hardware Requirements:

- ESP8266 Node MCU
- Ultrasonic Sensor (HC-SR04)
- Servo Motor (SG90)
- IR Sensor
- Power Supply (USB Cable, Power Bank)
- LEDs
- Miscellaneous (Wires, breadboard, resistors)

Chapter 4

Plan of Project

4.1 System Architecture

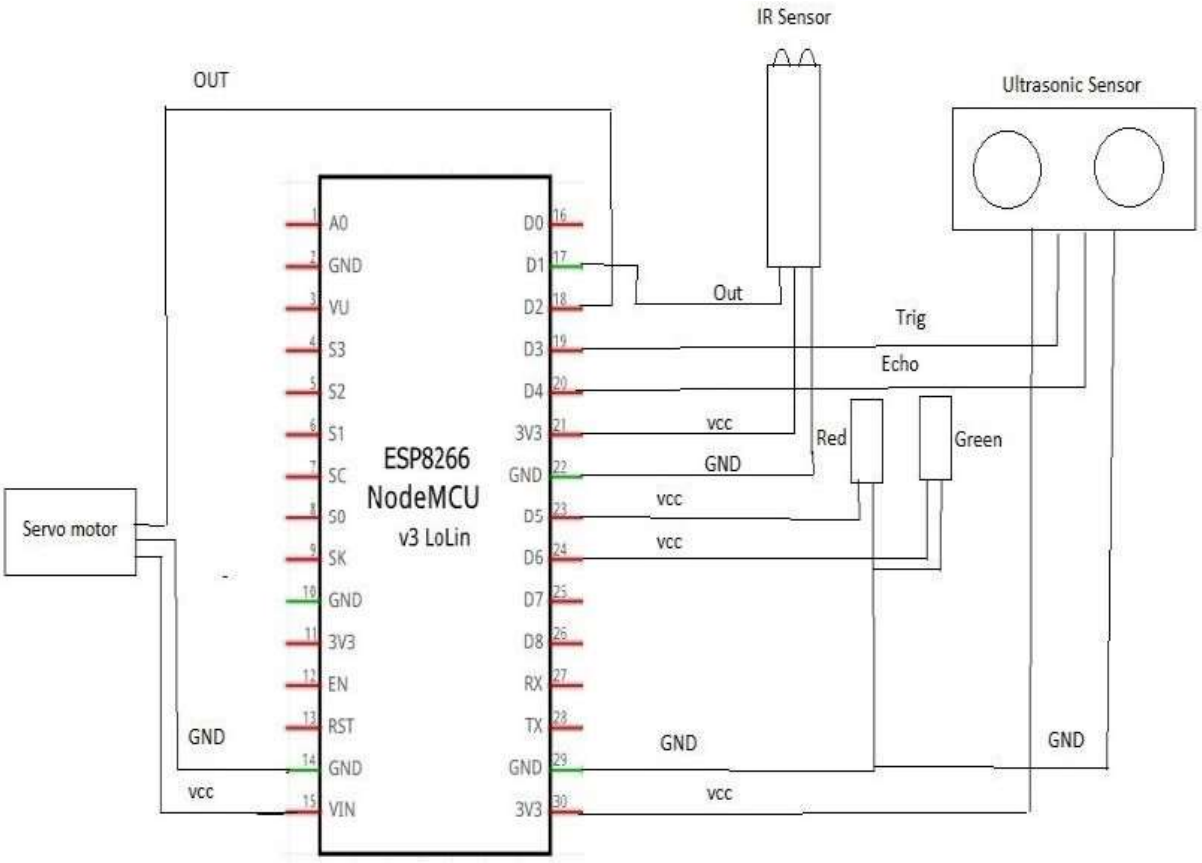

Figure 4.1 : System Architecture

4.2 Methodology

The methodology for developing the IoT-based dustbin project involves the following steps :

1. **Requirement Analysis:** Analyze functional and non-functional requirements for the smart dustbin system, considering waste detection accuracy, notification mechanisms, and power efficiency.

2. **Component Selection:** Choose suitable components such as ultrasonic and IR sensors, servo motors, and ESP8266 microcontrollers based on performance, compatibility, and power consumption.

3. **Hardware Design**: Design a compact and durable hardware architecture, integrating sensors, actuators, microcontroller, power supply, and communication modules.

4. **Sensor Integration:** Integrate sensors for waste detection and proximity sensing, calibrating them for accurate and reliable operation.

5. **Actuator Implementation:** Implement servo motor control mechanisms for automated lid opening, optimizing for smooth operation and minimal power usage.

6. **Microcontroller Programming:** Program the ESP8266 microcontroller to manage sensor data acquisition, actuator control, and Wi-Fi communication for notifications.

7. **Notification System Integration:** Integrate a notification system to alert municipal authorities when the dustbin reaches full capacity, transmitting relevant data such as location and waste level.

8. **User Interface Design:** Design a simple LED-based user interface to provide visual feedback on the dustbin's status, ensuring accessibility for users of all backgrounds.

9. **Testing and Validation:** Conduct thorough testing to validate functionality, reliability, and performance under various conditions, including waste detection accuracy and notification responsiveness.

10. **Deployment and Evaluation:** Deploy the smart dustbin in real-world settings, gathering feedback from users and authorities to evaluate effectiveness in improving waste management practices and cleanliness. Iteratively refine the system based on feedback for continuous improvement.

Lid Opening Mechanism

- **Servo Motor Activation:** The lid opening mechanism of the IoT-based smart dustbin employs a servo motor, a precise and controllable device, to initiate the lid's movement
- **Sensor Triggering**: Sensors, such as ultrasonic or infrared, detect the presence of waste or a person within a predefined range, sending signals to the microcontroller
- **Microcontroller Control:** The microcontroller, such as the ESP8266, interprets the signals from the sensors and sends commands to the servo motor, dictating the angle and duration of lid movement
- **Mechanical Linkage**: The servo motor's rotational motion is transmitted to the lid via a mechanical linkage system, ensuring synchronized and smooth lid opening action in response to the motor's movement
- **Customizable Parameters:** Parameters controlling the servo motor's operation, such as rotation angle and speed, can be adjusted programmatically to optimize lid opening performance according to specific requirements and environmental conditions

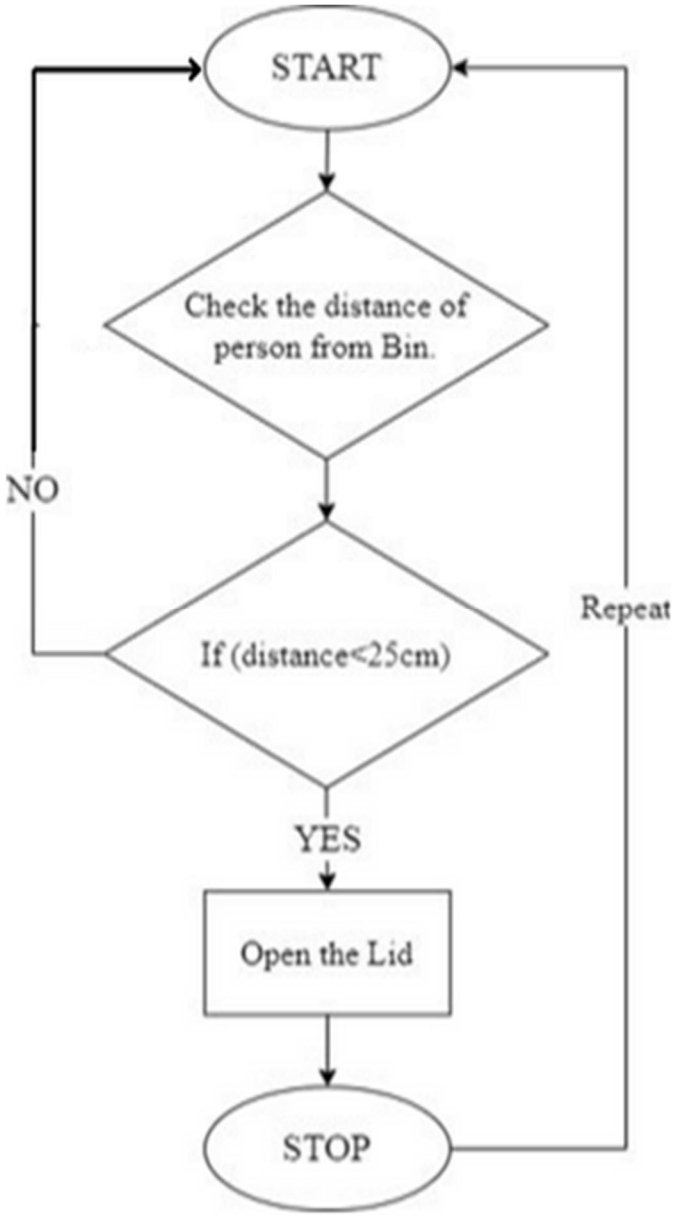

Figure 4.2.1 : Flowchart on Lid Opening Mechanism

Waste Level Monitoring

- **Sensor Deployment:** Ultrasonic sensors are strategically positioned within the smart dustbin to accurately measure the level of waste present.
- **Data Acquisition:** The sensors continuously emit ultrasonic pulses and measure the time taken for them to bounce back from the surface of the waste, providing real-time data on the waste level.
- **Microcontroller Interpretation:** The microcontroller, such as the ESP8266, processes the data received from the ultrasonic sensors, converting it into meaningful waste level measurements.
- **Threshold Setting:** Threshold levels are predefined within the microcontroller's programming to determine when the waste level reaches critical points, triggering subsequent actions.
- **Notification System Integration:** Once the waste level surpasses a predefined threshold, the microcontroller activates the notification system to alert relevant stakeholders, such as municipal authorities, for timely waste collection and management.

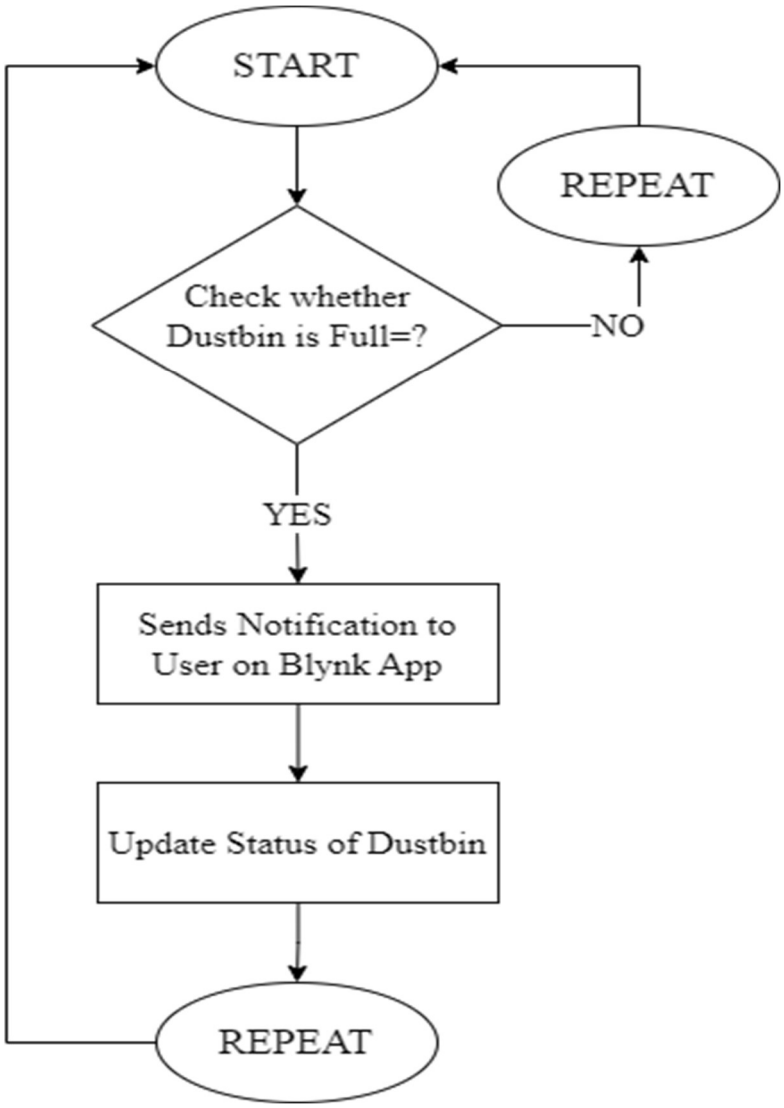

Figure 4.2.2 : Flowchart on Waste Level Monitoring

Chapter 5

Result Analysis

5.1 Results

Lid Opening Mechanism

Figure 5.1.1: Lid Opening Mechanism

The image demonstrates the servo motor-driven mechanism of the smart dustbin, elegantly opening the lid in response to detected waste or user proximity, enhancing convenience and promoting hands-free waste disposal.

Live LED Feature

Figure 5.1.2: Live LED Feature

The image showcases the LED indicator feature of the smart dustbin system, with a green LED indicating the bin is usable and ready for waste disposal, while a red LED signals that the bin is currently not usable, prompting users to seek alternative disposal options.

Live Waste Monitoring

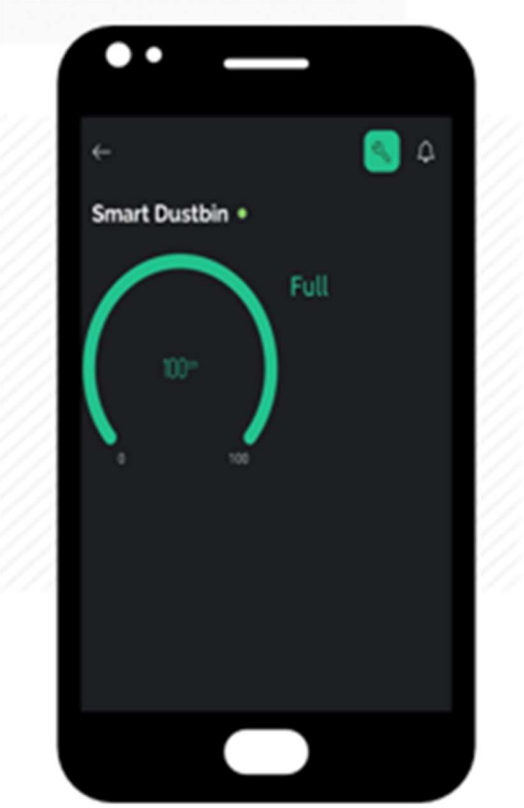

Figure 5.1.3: Result of Live Waste Monitoring

The image demonstrates real-time waste monitoring capabilities of the smart dustbin system, showcasing its ability to accurately detect and monitor waste levels, facilitating efficient waste management practices.

Chapter 6

Conclusion

Conclusion

The advent of IoT-based Dustbins marks a significant advancement in waste management, offering people an efficient means to manage waste and fostering a healthier living environment. By eliminating the need to wait for specific individuals to clean up areas, these smart bins facilitate prompt waste disposal, reducing the risk of diseases associated with unmanaged waste. The implementation of such systems aligns with the mission of Swachh Bharat, ensuring timely cleaning of bins as they reach capacity. Powered by batteries, these systems contribute to maintaining cleanliness in the surroundings, ultimately easing waste management efforts.

Chapter 7

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