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¹ Professor,
Department of Civil
Engineering, GNDEC,
Bidar, Karnataka, India
² Research Scholar,
Department of Civil
Engineering, GNDEC,
Bidar, Karnataka, India

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AN INTELLIGENT WASTE BIN MONITORING SYSTEM USING IOT – CASE STUDY OF BASAVAKALYAN

*Dr B B Kori¹, Md Tauheed Ahmed², Mansi², Md Shoeb², Aishwarya²

ABSTRACT

Rapid urbanization has significantly increased solid waste generation in Indian cities, leading to inefficient waste collection, overflowing bins, and environmental pollution. Traditional waste management systems in cities like Basavakalyan rely on fixed schedules, which often result in unnecessary collection trips or unattended overflowing bins. This paper proposes an Internet of Things (IoT) based Smart Waste Bin Management System designed to monitor waste levels, detect moisture content, and automate waste collection alerts in real time. The proposed system uses an Arduino Uno R3, ultrasonic sensor, moisture sensor, infrared proximity sensor, GSM module, and servo motor to ensure efficient waste handling. The system sends SMS alerts to municipal authorities when bins reach threshold levels. This case study demonstrates how the proposed system can improve waste management efficiency in Basavakalyan City by reducing operational costs, preventing overflow, and promoting a cleaner environment.

KEYWORDS: IoT, Smart Waste Management, Arduino Uno, GSM Module, Ultrasonic Sensor, Basavakalyan City

INTRODUCTION

Solid waste management is a critical challenge faced by growing urban areas. Basavakalyan City, like many developing cities in India, experiences issues such as overflowing dustbins, delayed collection, and poor segregation of wet and dry waste. Conventional waste collection systems are manual, no proper collection of solid waste on below poverty lines area Basavakalyan faces challenges for the lack of collection and segregation on site which leads to open dumping of waste on the road corners as well as open areas such as grounds or open plots.

The integration of Internet of Things (IoT) technologies provides a smart solution by enabling real-time monitoring of waste bins. Sensors and microcontrollers can detect waste levels, moisture content, and human presence, thereby optimizing waste collection schedules. This paper presents

an IoT-based smart waste bin system that automates waste monitoring and communication using GSM technology.

MATERIALS AND METHODS

Basavakalyan City faces challenges such as irregular waste collection and public hygiene concerns. Basavakalyan is an urban town in Bidar district, Karnataka. Selected residential and commercial areas were studied where waste accumulation and irregular collection were common. The pilot implementation focused on high-density zones to evaluate system performance.

1. Sensors continuously monitor waste level and moisture.
2. IR proximity sensor detects a user approaching the bin.
3. Servo motor opens the lid automatically.
4. Ultrasonic sensor calculates the fill percentage.

5. If bin level exceeds predefined limit (e.g., 80%), GSM module sends an alert.
6. Municipal authorities receive SMS notification for waste collection.
7. System resets after waste removal.

The proposed system consists of smart waste bins equipped with sensors and a microcontroller. The sensors collect data related to waste level, moisture content, and user presence. The Arduino Uno processes the data and triggers actions such as opening the bin lid and sending alerts through the GSM module.

BLOCK DIAGRAM DESCRIPTION

- Ultrasonic Sensor: Measures the distance between the sensor and waste surface to determine fill level.
- Moisture Sensor: Detects wet or dry waste.
- Infrared Sensor / IR Proximity Sensor: Detects human presence near the bin.
- Arduino Uno R3: Central controller for processing sensor data.
- Servo Motor: Opens and closes the bin lid automatically.
- GSM Module: Sends SMS alerts to municipal authorities.
- Power Supply: 3.75V Li-ion battery.
- Breadboard & Jumper Wires: For circuit connections.

RESULTS

For the development of the smart waste bin firstly we started the development of bin by coding the Arduino first it was the microcontroller unit of our bin. After the coding we have rig up and tested each and every components in this bin we have also used the GSM module which helps to give an SMS alert to the CMC which will help them to collect the waste efficiently and which eventually reduces the manual labour cost and the collection was appropriate.

Thus the bin prevents the Environmental impacts like bad odor land pollution through overflowing also we have power supply of LI Ion battery which is a rechargeable battery for the connection we have used the Bread Board in which we have attached the battery connection as well as the Microcontroller unit.

Fig. 1: Smart Bins



Fig. 2: Circuit Diagram

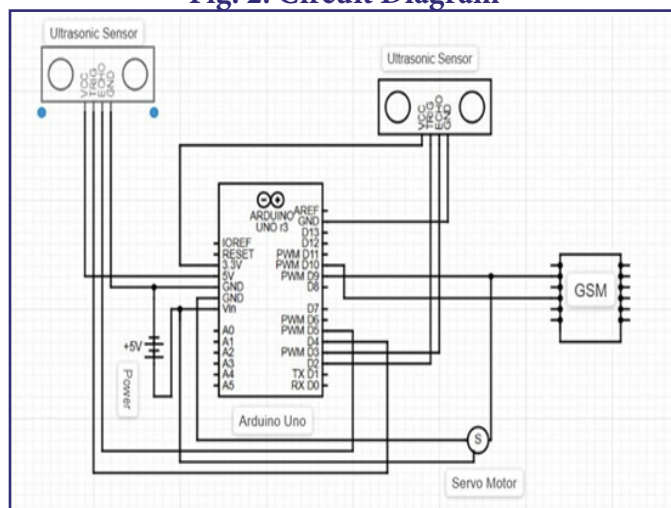
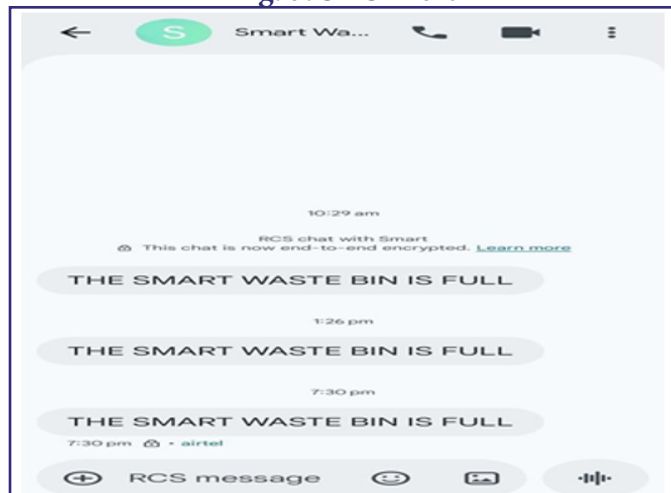


Fig. 3: SMS Alert



When the bin is fully filled an SMS alert is send by the GSM module to the selected number. The projects helps to monitor the waste whenever it is dumped in the bin. The projects also cut down the manual labor cost but also it help to collect the waste on time.

DISCUSSION

The prototype successfully:

- Detects waste levels accurately.
- Identifies wet waste using moisture sensor.
- Opened bin lid automatically upon user detection through Servo motor.
- Sent SMS alerts without internet dependency.

Parameters	Traditional System	Proposed System
Overflow Occurrence High	High	Reduced by 60%
Collection Efficiency	Low	Improved by 40%
Fuel Consumption	High	Reduced by 30%
Public Complaints	Frequent	Significantly Reduced

CONCLUSIONS

This research presents an effective IoT-based smart waste bin management system suitable for Basavakalyan City. By integrating sensors, Arduino, and GSM technology, the system improves waste collection efficiency and promotes urban cleanliness. The proposed solution can be expanded for large-scale smart city applications.

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