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# CSE(CYS)

# 24CYS333 - Internet Of Things

# Team 02

## Lab 1: Fine-Tuning Project Topic, Hardware Resource Mapping, and Literature Survey

## 1. Problem Statement

Design a smart waste management system that utilizes sensor-equipped waste bins to monitor real-time waste levels and use the collected data to optimize waste collection routes, considering factors such as collection frequency, distance, waste volume, fuel efficiency, and potential waste stagnation.

## 2. Hardware Resource Mapping

- **Ultrasonic Sensors:**
  - Measures the fill level of the waste bin by emitting ultrasonic waves and detecting the time taken for the waves to bounce back
  - To monitoring of waste levels in real-time, reducing unnecessary trips to empty bins that are not full.

- **Weight Sensors:**
  - To measure the weight of the waste inside the bin.
  - Provides additional data to complement fill-level information, ensuring that bins are not overloaded and helping optimize collection routes based on actual usage.

- **Raspberry Pi:**
    - Acts as the central processing unit, collecting data from sensors, processing it, and transmitting it to the central server or cloud.
    - Facilitates data integration, computational processing, and communication with the LoRa module, making the system smart and interconnected.

- **LoRa Module (Transmitter and Receiver):**
    - Enables communication between the smart bins and the central server.
    - Critical for sending data over large distances in urban or rural environments where other communication methods (e.g., Wi-Fi) may not be feasible.

- **Solar Panels or LiPo Battery (based on availability)**
    - To supply power to the system.
    - Ensures the system is self-sustainable and operational in remote or outdoor locations.

- **LED Indicators (Red, Yellow, Green):**
    - **Red:** Indicates the bin is full and requires immediate attention.
    - **Yellow:** Indicates the bin is partially full.
    - **Green:** Indicates the bin is empty or has low waste levels.
    - Indicates the waste levels in the bins

## 3. Literature survey observations

We have read two papers “IoT-Enabled Smart Waste Management: A Comprehensive Study on Sensor Technologies and Implementation Strategies” and "IoT-Enabled Intelligent Garbage Management System for Smart City: A Fairness Perspective", both are 2024 papers. Both propose solutions for a smart bin management and route optimization.

Both the papers use the LoRa technology for communication as it is the most cost-effective and energy-efficient communication protocol for long-range data transmission. The other methods like GSM, WiFi and ZigBee were also mentioned, but, LoRa remains the best protocol for the proposed system due to its scalability, energy efficiency, and affordability. So we have decided on using the LoRa technology for communication.

Both papers emphasize IoT-enabled sensors (e.g., ultrasonic and weight sensors) for real-time monitoring of bin statuses.

The first paper uses IoTBinCap algorithm for bin capacity optimization, prioritizing route efficiency. The second paper proposes the Fairness-Based Optimum Solution (FBOS) algorithm. We haven’t decided on which algorithm to use yet as both of these have their own merits and demerits.

The major two challenges encountered by the papers are the issues with scalability and the LoRa’s decrease in packet delivery rate with increase in device numbers.

The solution suggested for LoRa’s packet delivery rate decrease is to use LoRa gateways strategically to enhance scalability.

Solar panels or LiPo batteries can be adopted for sustainable power supply.