TITLE: IoT BASED SMART DUSTBIN MANAGEMENT SYSTEM

PROJECT PROPOSAL

EMBEDDED SYSTEM EC6020

Team Members

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1. Title and Team Members

Title

IoT-Based Smart Dustbin with ESP32: GPS-Enabled Waste Monitoring, SMS Alerts, and Garbage Compression System

Team Members

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2. Problem and Solution

Problem:

Traditional waste collection systems face several challenges, including:

1. Fixed Collection Schedules:

   Bins are emptied on fixed schedules, regardless of their fill levels. This leads to bins overflowing before the scheduled collection, creating hygiene issues and attracting pests.

2. Inefficient Utilization of Bin Space:

   Waste is often not compressed, resulting in suboptimal use of available bin space. This forces more frequent collections, leading to wasted resources.

3. High Operational Costs:

   The need for unnecessary collection trips increases fuel consumption, labor costs, and the overall environmental footprint, especially when bins are not full.

Solution:

- Reduced Overflow and Hygiene Issues: Sensors monitor fill levels and prevent overflowing bins, reducing hygiene risks.
- Optimized Space Utilization: The compression system maximizes bin capacity, allowing for more efficient waste storage.
- Cost and Fuel Savings: The system reduces unnecessary collection trips, lowering fuel consumption and labor costs.
- Real-Time Data and Alerts: IoT integration ensures that waste collection teams are always informed and can plan their routes efficiently.
- Environmentally Friendly: The system minimizes waste collection trips, contributing to a reduction in carbon emissions and other environmental impacts.

3. Novelty

1. Real-Time Monitoring and Alerts:

   The dustbin integrates ultrasonic sensors for real-time waste level tracking and sends SMS notifications via the SIM800L module, including the bin's location using GPS, ensuring timely and efficient waste collection.

2. Automated Waste Compression:

   The innovative servo motor-based compression system reduces the volume of collected waste, maximizing bin space and reducing collection frequency, contributing to cost and resource savings.

3. User-Friendly Control Interface:

   A mobile app or web-based dashboard allows users to remotely monitor and control the bin's status, enabling both manual and automatic compression, enhancing operational flexibility.

4. Scalable and Modular Design:

   The system is designed to be easily scalable and adaptable, allowing for use in a variety of settings, from residential bins to large-scale commercial applications, meeting diverse waste management needs.

4. High-Level Architecture

Architecture Description:

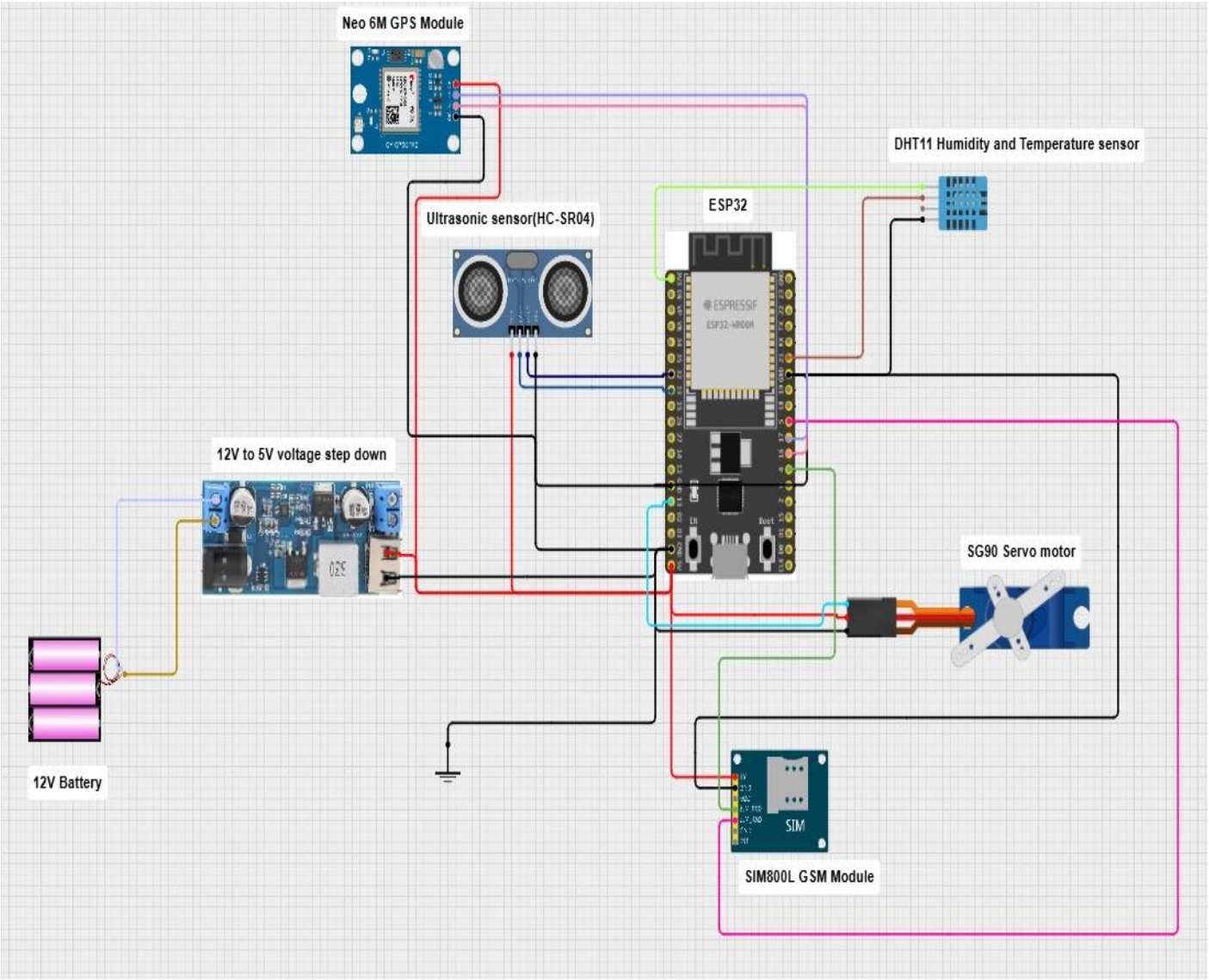
The system combines IoT technology with a mechanical compression mechanism and environmental sensing for smart waste management. Ultrasonic sensors monitor waste fill levels, while a GPS module provides real-time bin location. A DHT11 sensor measures humidity and temperature inside the bin to monitor conditions that could lead to odor or health hazards. When the bin is full, a servo motor compresses the waste to optimize capacity. The system sends SMS alerts with the bin's status, location, and environmental data to waste management teams using a SIM800L module.

Technology Choices:

1. ESP32:
    - Central microcontroller for managing sensors, motor operations, and communication.
    - Compact, cost-effective, and IoT-ready with integrated Wi-Fi capabilities.
2. SIM800L Module:
    - Facilitates GSM communication for sending SMS alerts about bin status, location, and environmental conditions.
    - Suitable for areas with limited or no internet connectivity.
3. GPS Module:
    - Tracks the bin's real-time location, aiding optimized route planning for waste collection.
    - Sends location data with status updates.
4. Ultrasonic Sensors:
    - Detect waste fill levels accurately to trigger necessary actions like compression or alerts.
    - Helps avoid overflows and ensures efficient monitoring.
5. DHT11 Sensor:
    - Measures humidity and temperature inside the bin.
    - Provides additional environmental data to detect potential odor or decomposition risks.
6. Servo Motor:
    - Compresses waste to maximize bin capacity and reduce collection trips.
    - Controlled by the ESP32 for automated or manual operation.

5. Circuit Design and Protocols

Circuit Design:



- Ultrasonic Sensors: Measure bin fill levels and transmit data to the ESP32 microcontroller.
- DHT11 Sensor: Monitors temperature and humidity inside the bin and relays data to the ESP32.
- Servo Motor: Activated by the ESP32 using PWM signals to compress waste when the bin is full.
- SIM800L Module: Sends SMS alerts containing bin status, temperature, humidity, and GPS location to the waste management team.
- GPS Module: Provides real-time location data for optimized waste collection routes.
- Power Supply: Powered via a rechargeable battery or direct AC, with power regulation using a buck converter for energy efficiency.

Protocols:

- SMS Protocol: Used by the SIM800L module to send alerts, including waste level, environmental conditions, and GPS location.
- MQTT Protocol: Enables cloud-based monitoring and future scalability for IoT-based dashboards.
- Servo Motor Control: Operated via PWM signals from the ESP32 for precise compression actions.
- I2C or UART: Used for communication between the ESP32, GPS, and SIM800L modules for seamless data exchange.

6. GitHub Repository

Repository Link: https://github.com/Jesuthan/smartbin.git

The repository will include:

- Source code for ESP32, servo motor integration, and NodeMCU setup.
- Circuit diagrams and connection details.
- Instructions for operating the garbage compression system.
- Documentation and ReadMe file with a detailed project overview.

7. Budget and Timeline

Budget:

Item	Quantity	Unit Cost (LKR)
ESP32 Microcontroller	1	1,950
SIM800L Module	1	1,050
GPS Module	1	1,150
Ultrasonic Sensors	1	500
Rechargeable Batteries	4	1,000
Servo Motors	1	1,150
Voltage Regulator Module	1	180
Miscellaneous Components (LED, Jumper wire, Resistors, Capacitors, Switch)	-	3,000
Total		9,980.00

Timeline:

Task	Duration	Deadline	Details
Requirements Gathering	1 week	January 31, 2025	Identify project needs, components, and goals.
Hardware Procurement & Testing	2 weeks	February 14, 2025	Purchase and validate components.
Software Development	3 weeks	March 7, 2025	Develop code for sensors, SMS, and compression.
Integration and Testing	2 weeks	March 21, 2025	Integrate hardware and software; debug system.
Final Deployment & Documentation	1 week	March 28, 2025	Prepare reports and conduct demonstrations.