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Smart Garbage Monitoring with Manhole Open Alert System

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ABSTRACT

A smart city is the future goal to have cleaner and better amenities for the society. Smart underground infrastructure is an important feature to be considered while implementing a smart city. Drainage system monitoring plays a vital role in keeping the city clean and healthy. Since manual monitoring is incompetent, this leads to slow handling of problems in drainagendconsumes more time to solve. To mitigate all these issues, the system using a wireless sensor network, consisting of sensor nodes is designed. The proposed system is low cost, low maintenance, IoT based real time which alerts the managing station through message when any manhole crosses its threshold values. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the people

KEYWORDS-

ESP32,GSM,GPS,Buzzer,MPU 6050,Ultrasonic Sensor

I. INTRODUCTION

With the rapidly urbanizing world, effective waste management is crucial for maintaining public health, environmental sustainability, and urban aesthetics. Traditional waste collection methods often face challenges such as inefficient routing, delayed pickups, and lack of real-time monitoring, leading to overflowing bins and environmental hazards. To address these issues, the integration of **Smart Garbage Monitoring Systems** has emerged as a transformative solution.

A **Smart Garbage Monitoring System** leverages IoT (Internet of Things) technology, sensors, and data analytics to optimize waste management processes. This system employs smart sensors to monitor the fill levels of garbage bins in real-time, providing data that can be accessed remotely by waste management authorities. This allows for dynamic scheduling of waste collection routes, reducing unnecessary trips, fuel consumption, and operational costs while ensuring timely collection before bins overflow.

An advanced feature of this system is the **Manhole Open Alert System**, designed to enhance safety and security in waste management infrastructure. Manholes are critical access points for underground waste collection and sewage systems. However, unauthorized access or accidental openings can pose significant safety risks. The Manhole Open Alert System utilizes sensors to detect when a manhole cover is opened without proper authorization or outside of scheduled maintenance times. This triggers immediate alerts to the relevant personnel, enabling quick response to potential hazards or security breaches.

Together, these technologies create a comprehensive smart waste management solution that not only improves operational efficiency but also ensures the safety of urban environments. By harnessing real-time data, predictive analytics, and automated alert systems, cities can move towards more sustainable, responsive, and intelligent waste management practices.

II. PROBLEM STATEMENT

Urban areas face significant challenges in waste management, including overflowing garbage bins, inefficient collection schedules, and safety hazards associated with open manholes. Traditional waste management systems lack real-time monitoring capabilities, leading to delays in response times, increased operational costs, and environmental concerns.

The problem is further compounded by the risks posed by open manholes, which can lead to accidents, injuries, and security threats, especially in densely populated areas. Current systems do not provide immediate alerts to municipal authorities or maintenance teams when manholes are left open, posing safety risks to the public.

To address these issues, there is a need for an integrated **Smart Garbage Monitoring with Manhole Open Alert System** that enables real-time tracking of waste levels and ensures manhole safety. The system should provide timely alerts, automate data collection, and support efficient waste management and public safety operations.

III. METHODOLOGY

The Smart Garbage Monitoring with Manhole Open Alert System uses IoT sensors for real-time data collection. Ultrasonic or IR sensors monitor garbage bin levels, while magnetic or tilt sensors detect open or tampered manholes. Data is transmitted via GSM, Wi-Fi, or LoRa to a central server, where algorithms analyze it to identify overflow or safety risks. When thresholds are breached, the system triggers alerts sent via SMS, email, or app notifications to municipal authorities. A user-friendly dashboard allows monitoring and management. The system undergoes prototype testing, field deployment, and regular maintenance to ensure efficiency and reliability.

IV. BLOCK DIAGRAM

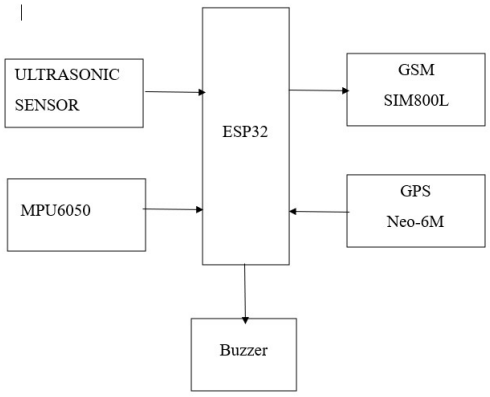
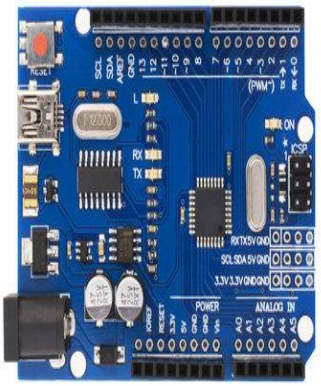


Fig: Block Diagram

V. COMPONENTS USED

1. ARDUINO UNO

The Arduino UNO is a widely used open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20



volts.

Fig: ARDUINO UNO

2. ULTRASONIC SENSOR

Ultrasonic sensors [2] are widely used in robotics, automation, and security systems for distance measurement. They use sound waves to determine the distance between the sensor and an object. The most common ultrasonic sensor used with Arduino is the **HC-SR04.**

Fig: ULTRASINIC SENSOR

3. ESP 32

The **ESP32** is a powerful microcontroller.It interfaces with sensors like **ultrasonic sensors** (for garbage level detection) and **manhole cover sensors** (to detect open/close status). The ESP32 processes sensor data in real-time, triggering alerts when garbage overflows or a manhole is open. Its built-in **Wi-Fi and Bluetooth** enable wireless data transmission to cloud servers or mobile apps for monitoring. Additionally, it supports **low-power operation**, making it ideal for outdoor, battery-powered installations.

Fig: ESP 32

4. GSM

It works with the microcontroller (like ESP32) to transmit SMS notifications to maintenance personnel when the garbage bin is full or a manhole is open. The GSM module uses a **SIM card** to connect to the cellular network, ensuring reliable communication even in remote areas without Wi-Fi. This feature is crucial for prompt responses to critical issues, enhancing the system's efficiency and reliability in smart city applications.

Fig: GSM

5. MPU-6050

The MPU-6050, featuring a 3-axis accelerometer and gyroscope.The accelerometer detects bin tilt, indicating fullness or improper handling, while the gyroscope monitors angular motion, identifying tampering or movement of manhole covers. Its Digital Motion Processing (DMP) reduces processing load, enhancing efficiency. Communicating via I2C with microcontrollers, it sends real-time data for analysis. When abnormal motion is detected, the system triggers alerts, ensuring timely responses. This integration improves waste management, safety, and operational efficiency in urban environments.

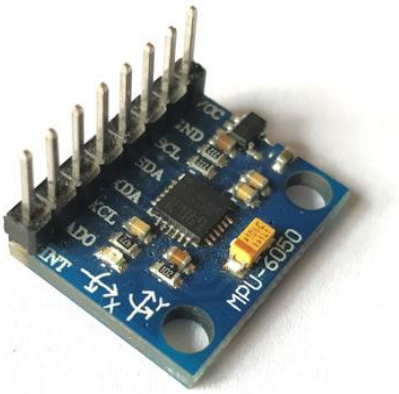


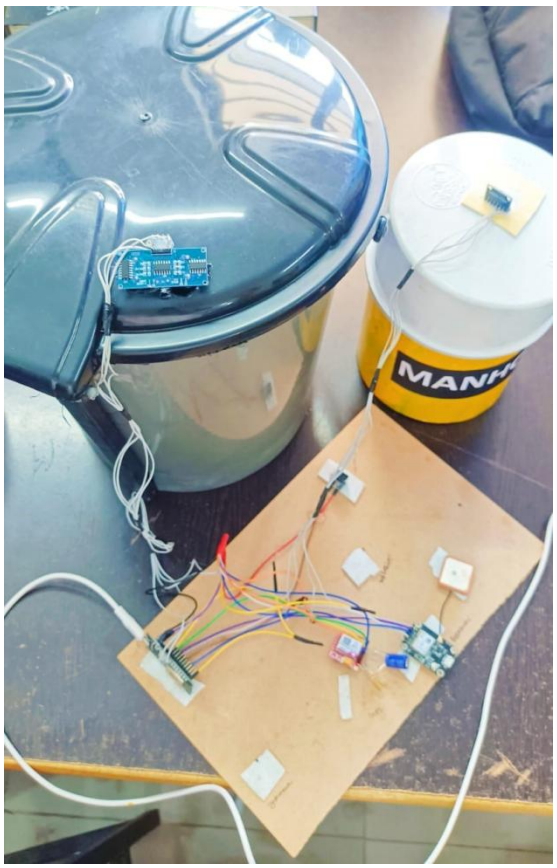
Fig: MPU 6050

6. GPS

The GPS module provides real-time location tracking. It receives signals from multiple satellites to determine precise coordinates of garbage bins and manholes. This helps monitor the movement of waste collection vehicles, track bin locations, and ensure efficient routes. In case of a manhole open alert, the GPS can identify the exact location of the incident, aiding quick response. Integrated with microcontrollers, the GPS data is sent to cloud servers or mobile apps, enabling real-time monitoring, improving safety, and optimizing waste management operations.

Fig:GPS

RESULT: -



CONCLUSION: -

Underground monitoring is challenging problem. This project proposes different methods for monitoring and managing underground drainage system. It explains various applications like underground drainage and manhole identification in real time. Various parameters like temperature, toxic gases, flow and level of water are being monitored and updated on the internet using the Internet of Things. This enables the person incharge to take the necessary actions regarding the same. In this way the unnecessary trips on the manholes are saved and can only be conducted as and when required. Also, real time update on the internet helps in maintaining the regularity in drainage check thus avoid the hazards. IoT has been gradually bringing a sea of technological changes in our daily lives, which in turn helps to making our life simpler and more comfortable, though various technologies and applications. There is innumerable usefulness of IoT applications into all the domains including medical, manufacturing, industrial, transportation, education, governance, mining, habitat etc. Though IoT has abundant benefits, there are some flaws in the IoT governance and implementation level. The key observations in the literature are that (1) There is no standard definition in worldwide (2) Universal standardizations are required in architectural level (3) Technologies are varying from vendor-vendor, so needs to be interoperable (4) For better global governance, we need to build standard protocols. Let us hope future better IoT.

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