Manhole Detection And Monitoring System For Safe And Clean City

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Abstract- *Due to the rapid urbanization and development of country The goal of a smart city is to give society better and cleaner amenities, and intelligent subterranean infrastructure is an essential part of this. In order to keep the city clean and healthy, drainage system monitoring is crucial. Drainage system manual monitoring is ineffective and causes delays in problem solving. A wireless sensor network made up of sensor nodes has been created in order to overcome these obstacles. Using Internet of Things (IoT) technology, this suggested solution is low-cost, low-maintenance, and works in real-time, alerting the control station through messages when manhole levels above predetermined thresholds. By putting this technology in place, the general public is helped and the risks encountered by manual scavengers who clean subterranean drainage systems are decreased.*

Keywords- smart city monitoring, IoT, drainage monitoring system.

I. INTRODUCTION

Access points for cleaning, clearing, and inspecting are an essential part of drainage systems. Large cities have installed subterranean drainage systems, which necessitate careful upkeep by local government agencies in order to stop groundwater pollution and the spread of infectious illnesses. The disruption of public routines caused by seasonal drain jams emphasizes the necessity of a system that notifies authorities of sewage blockages and their exact locations. This system uses sensors to identify problems including gas buildup, rising water levels, and temperature fluctuations. Internet of Things technology is used to automate drainage monitoring. Important locations have water flow sensors that identify obstructions and sound an alarm when thresholds are crossed. Furthermore, overflow sensors automatically notify authorities of emergencies, while temperature sensors keep an eye on the conditions inside manholes. By remotely monitoring water levels, temperatures, flow rates, and gas levels and alerting municipal authorities in the event of blockages or overflow, the project's main objective is to increase safety and efficiency. Owing to the dangerous nature of manholes, a remote alarm system—which includes controllers, memory, transceivers, and batteries for power—is necessary to send sensor data to a central monitoring station.

Existing System

There are a number of significant issues with the current manhole monitoring system that affect its dependability and efficacy. The limited coverage of GSM networks, especially in isolated or underground regions, is a major problem. This restriction may make it more difficult for the system to transmit vital information by causing connectivity issues including sporadic data transfer or total signal loss in areas with poor reception. The system's reliance on the stability of the network also presents a serious risk. The monitoring system might not be able to provide data if the GSM network has problems or stops working completely, which would cause delays or interruptions in operations. Furthermore, there are difficulties with the way that SMS messages are broadcast through GSM modules. When using these modules to send messages to several receivers at once, complicated setup processes are frequently needed, and there can be restrictions on the total amount of messages sent or recipients reached at once. These restrictions may make the system less effective and responsive, which emphasizes the need for upgrades to the manhole monitoring infrastructure's coverage, network resilience, and message distribution capabilities.

Proposed System

A novel approach that is put out to improve upon or swap out the existing manhole monitoring system has a number of significant benefits. First off, by doing away with the requirement for actual hardware and cutting down on maintenance costs related to conventional monitoring setups, the solution highlights cost-effectiveness. This strategy also improves security measures by utilizing cloud-based services, since many of them include strong encryption and defense against cyberattacks, guaranteeing the integrity and confidentiality of transferred data. In addition, the system incorporates Internet of Things capabilities to offer real-time response and monitoring. When sensors identify problems inside a manhole, they send the data to a microcontroller,

which forwards the signal along with the exact position of the issue to a central monitoring station. Data is then sent to the cloud automatically, allowing for extensive remote monitoring and analysis. This simplified procedure improves the effectiveness and dependability of manhole monitoring systems by facilitating preventive maintenance, expediting the resolution of possible problems, and increasing operational efficiency.

REQUIREMENT SPECIFICATIONS

Software Requirements:

1. Arduino IDE
2. Embedded C
3. Thing speak

Arduino IDE: Arduino is primarily an open-source manufacturer of computer hardware and software. The project and user base responsible for creating and utilizing development boards based on microcontrollers is known as the Arduino Community. The open-source prototype platforms known as Arduino Modules are these development boards. There are several different development board packages available for the simplified microcontroller board. Using the Arduino IDE, which makes use of the C programming language, is the most popular programming method. This provides you with access to a vast library of Arduino projects that is always expanding because of the open-source community. Get the most recent version of the Arduino Integrated Design Environment (IDE) at https://www.arduino.cc/en/Main/Software. When the Arduino IDE is opened, it looks like this. When it opens, a blank sketch appears where you may begin programming right away. To enable code uploading, we must first configure the board and port settings. Establish the board and COM port settings after connecting your Arduino board to the PC via a USB wire.

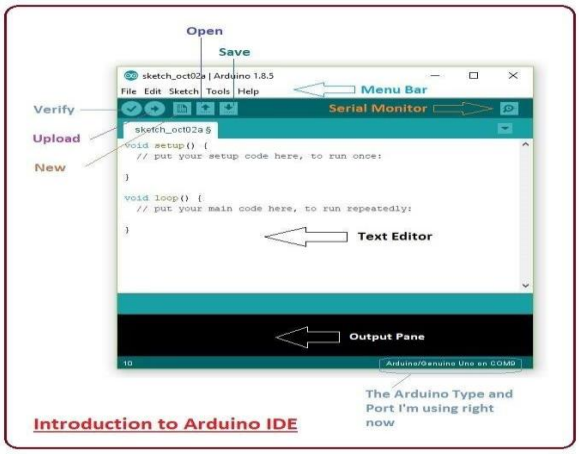


Fig.1. Arduino IDE

Embedded C:A version of the C programming language called Embedded C is specifically designed for industrial automation, consumer electronics, automotive, and aerospace embedded systems. By providing low-level access to hardware peripherals essential to system operation, it maximizes efficiency. It can react quickly to outside events and satisfies tight timing constraints thanks to its real-time capabilities. Because of its portability, code may be moved between several microcontroller architectures and reused. Embedded C facilitates code development, compilation, debugging, and deployment for embedded systems projects with the help of specialized Integrated Development Environments (IDEs). All things considered, it is an effective instrument for developing firmware and low-level software, spurring innovation in a variety of sectors.

Thing Speak: Thing Speak, an open-source Internet of Things (IoT) platform developed by MathWorks, empowers users to seamlessly collect, analyze, and visualize data from connected devices or sensors. Thing Speak's user-friendly web-based interface makes it easy to manage Internet of Things projects and integrates data into analytics workflows or applications. Devices may communicate real-time data to Thing Speak quickly via a variety of protocols, including MQTT and HTTP POST requests, thanks to its RESTful API. Additionally, Thing Speak provides integrated tools that let users see data trends using editable graphs, charts, and maps, giving them a better understanding of how sensor data patterns change over time. Furthermore, the platform allows users to use complex algorithms for machine learning and signal processing right within Thing Speak, thanks to its support for advanced data analysis using MATLAB. ThingSpeak stands as a flexible solution for a wide range of IoT applications, from industrial automation and healthcare to environmental monitoring, thanks to its smooth integration capabilities and active community.

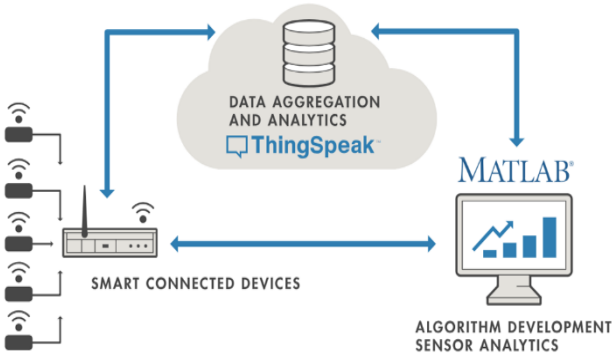


Fig.2. Thingspeak process

Hardware Requirements:

1. Arduino UNO

2. Ultra Sonic Sensor
3. Gas Sensor
4. Temperature Sensor
5. Wi-Fi Module
6. Buzzer

Arduino UNO: In the electronics world, the Arduino Uno, which uses the ATmega328P microprocessor, is a popular and adaptable development board. With so many features, it's a good starting point for people who are new to embedded systems and microcontroller programming as well as experienced professionals. Interfacing with sensors, actuators, and other external devices is made possible by the Arduino Uno's large 14 digital input/output pins, six of which offer PWM capabilities, and 6 analog input pins. Its USB interface makes programming and interacting with a computer simple, and its various power options—which include external and USB power sources—allow for greater project deployment flexibility. Because the Arduino Uno is compatible with the Arduino Software (IDE), users can explore a wide range of projects, let their creativity run wild, and could easily and effectively implement their concepts.

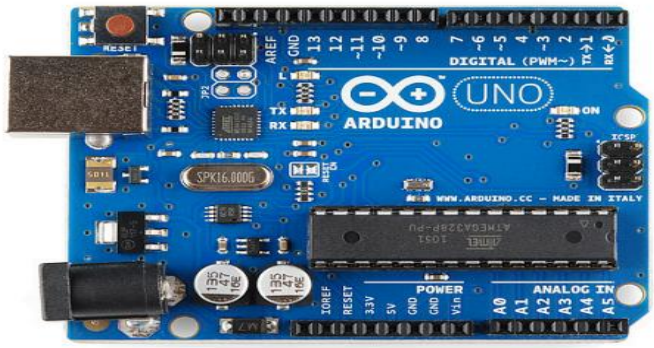


Fig.3. Arduino UNO

Ultra Sonic Sensor: An essential part of wearable technology, fitness trackers, medical monitors, and other health-related applications is a heart rate sensor, which provides real-time heart rate measurement. The pulse waveform produced by the heart's contractions is normally detected by these sensors using a variety of techniques. For example, optical heart rate sensors use photo detectors to assess changes in light absorption or reflection brought on by blood flow, and light-emitting diodes (LEDs) to illuminate the skin. The heart rate is then calculated by processing this data. The electrocardiogram (ECG) sensor is a different kind of heart rate sensor that uses electrodes applied to the skin to monitor the electrical activity of the heart. Heart rate monitors, regardless of technique, offer useful information for tracking and controlling cardiovascular health, exercise intensity, levels of stress, and general health.

Fig.4. Ultra Sonic Sensor

Gas Sensor: An essential tool for determining the existence and concentration of particular gases in the ambient air is a gas sensor. Gas sensors are widely used in many different sectors and applications where they are essential for process control, environmental monitoring, and safety. Different detection principles, such as chemical reactions, optical techniques, thermal conductivity, and electrochemical detection, underpin the operation of these sensors. Chemical reaction-based sensors measure variations in electrical conductivity, resistance, or voltage to offer real-time information on gas concentrations. Thermal conductivity sensors monitor variations in the characteristics of heat transport, whereas optical sensors use infrared absorption or ultraviolet fluorescence to identify certain gases. On the other hand, chemical reactions at electrode surfaces are what allow electrochemical sensors to produce electrical signals proportional to gas concentrations. Gas sensors are essential for averting mishaps, safeguarding public health, and preserving environmental quality because they can deliver precise and timely information regarding gas levels.

Fig.5. Gas Sensor

Temperature Sensor: An essential part of reliably measuring the surrounding ambient temperature is a temperature sensor.

These sensors are widely used in a variety of applications and industries and are essential for monitoring and managing environments and processes that are sensitive to temperature. Temperature sensors make use of a variety of detecting techniques, such as infrared sensors, thermocouples, thermistors, and resistance temperature detectors (RTDs), each of which has special benefits and is appropriate for a particular application. RTDs deliver reliable and accurate temperature readings across a broad temperature range, whereas thermocouples are robust and adaptable in harsh environments. Because of their great sensitivity, thermocouples are frequently utilized in situations where exact temperature control is necessary. Conversely, non-contact temperature monitoring is made possible by infrared temperature sensors, which makes them perfect for situations in which direct touch is impractical or undesirable.In many different sectors and applications, temperature sensors are essential instruments for guaranteeing the best possible working conditions, high-quality products, and safety.

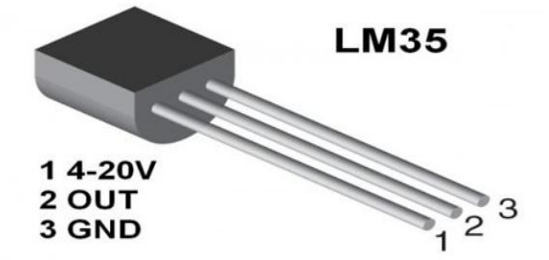


Fig.6. Temperature Sensor

Wi-Fi Module: Espressif Systems' ESP8266 Wi-Fi module has become a popular and adaptable way to enable Wi-Fi connectivity in a variety of applications. Owing to its small size, affordable price, and strong functionality, the ESP8266 module has gained widespread use across multiple industries and the maker community. Its integrated TCP/IP protocol stack, which makes it easy for devices to connect to the internet and allows for smooth communication via Wi-Fi networks, is one of its main advantages. The module is appropriate for a variety of applications since its GPIO ports offer flexibility for integrating with external sensors, actuators, and other peripherals. The low power consumption of the ESP8266 module, along with its tremendous capabilities, makes it perfect for battery-powered and energy-efficient products. Its programmability in widely used programming languages and development environments, such as MicroPython and the Arduino IDE, further increases its attractiveness to developers of various experience levels. With a thriving community of developers and enthusiasts, the ESP8266 ecosystem is growing and offers a wealth of projects, libraries, and tools to help users bring their ideas to life. All things considered, the ESP8266 Wi-Fi module is proof of the democratization of IoT and wireless connectivity, enabling innovators to easily and affordably realize their ideas.

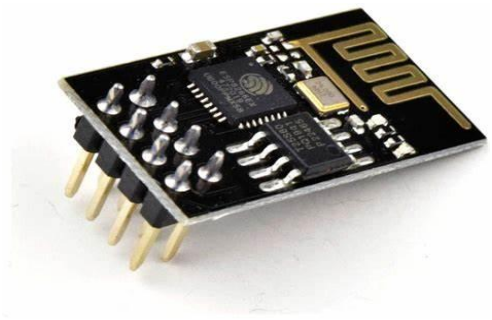


Fig.7. Wi-Fi

GPS Module:A GPS module is a crucial part that receives signals from a network of satellites orbiting the Earth to determine exact geographical coordinates. These modules, which consist of a receiver, antenna, and processing unit, decode signals sent by satellites to determine the precise location of the module, along with its latitude, longitude, altitude, and time. GPS modules provide great position precision by using trilateration techniques and signals from many satellites; under ideal circumstances, some of them can achieve sub-meter accuracy. Numerous applications, such as navigation systems, automobile tracking, drones, smartphones, and Internet of Things devices, heavily rely on these modules. GPS modules ensure precise timing for a variety of applications by synchronizing device clocks to universal time standards in addition to determining position.All things considered, GPS modules are essential to contemporary navigation and positioning since they allow precise location determination and synchronization across various systems and devices.

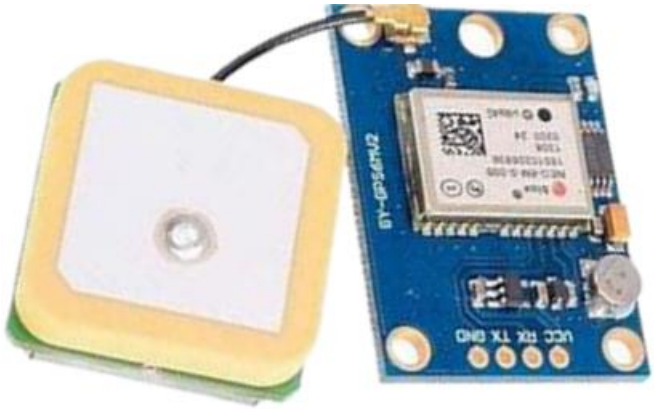


Fig.8. GPS Module

Buzzer: The low power consumption of the ESP8266 module, along with its tremendous capabilities, makes it perfect for battery-powered and energy-efficient products. Its programmability in widely used programming languages and development environments, such as MicroPython and the Arduino IDE, further increases its attractiveness to developers of various experience levels. With a thriving community of developers and enthusiasts, the ESP8266 ecosystem is growing and offers a wealth of projects, libraries, and tools to help users bring their ideas to life. All things considered, the ESP8266 Wi-Fi module is proof of the democratization of IoT and wireless connectivity, enabling innovators to easily and affordably realize their ideas. spanning from electronics for cars to home appliances and more. Buzzers are essential for increasing safety, convenience, and functionality in daily life. They can warn of an emergency, notify users to a doorbell, or indicate a low charge.

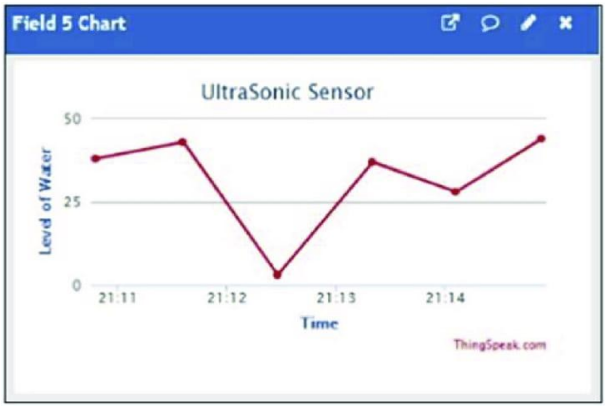
Fig.8. Buzzer

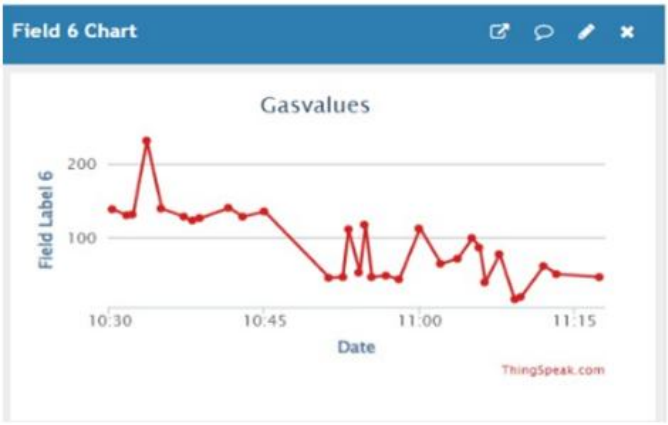
III. IMPLEMENTATION

Working:

Government workers' workloads will be reduced by an underground drainage monitoring system, which will also help maintain the appropriate health and safety of the megacity. A smart system is created by combining the Arduino Uno microcontroller with different colored detector kinds, such as inflow, position, temperature, and gas detectors. When a value or detector approaches the threshold point, the microcontroller receives the recommendation from each individual value or detector. Similar to this, the Arduino Uno communicates with the external pot via GPS and GSM in order to send the signal and manhole position. This enables the police to determine which manhole is broken and take the necessary action.

IV. RESULT





V. CONCLUSION

The efficiency and safety of underground infrastructure operations are expected to be revolutionized by the application of this proposed architecture for drainage system management and underground monitoring. Real-time monitoring of critical factors including temperature, water levels, dangerous compounds, and input rates may be easily accomplished by using new sensor technology and IoT connectivity. This feature makes it possible to identify anomalies and possible threats quickly, which speeds up the process of taking appropriate action to protect the environment and safeguard worker safety. Furthermore, the internet's efficient data transfer facilitates distant access to vital information, enabling accountable staff to maximize resource allocation and make well-informed decisions.

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