Real-time Oxygen Level Detection in Manhole to Enhanced the Safety

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Abstract
In many developing countries, like India, the sewage infrastructure is essential to daily life. Upkeep of the drainage system is the responsibility of town personnel. When workers enter the sewage system, the municipality has an obligation to protect their health and well-being. It's essential to comprehend the process and the jobs that the staff members are carrying out. Maintaining ecological balance, sustaining life, and ensuring the health of several ecosystems depend on regulating the amount of oxygen in the atmosphere. "Real-time Oxygen Level Detection in Manhole to Enhanced Safety" is an all-inclusive real-time oxygen level monitoring system designed to use the Internet of Things to improve drainage safety protocols in a range of circumstances. By combining innovative sensor technology, data processing, and simple user interfaces, the system offers precise and quick oxygen level monitoring. The design helps in determining the oxygen levels since the worker in the drainage system can see where he needs to start. The worker can see the oxygen levels on the Screen. The oxygen level in a manhole may be determined using the display panel. Once the worker has entered the manhole to evaluate his condition, the oxygen threshold limit value may be obtained. The signal is sent by the user interface as a help-seeking message. The abstract focuses into the data handling abilities and network connectivity of Internet of Things-based oxygen sensors. Efficiency and simplicity will be the design principles for the system's user interface. With user-friendly interfaces, users may access notification logs, and current oxygen level statistics.

***Keywords* —: *IoT,* Drainage monitoring system, IOT, Monitoring smart city, accidents, Oxygen sensor, *Internet of Things, Blynk app*.**

I.Introduction

Confined spaces such as manholes pose inherent safety challenges due to factors like limited ventilation, fluctuating oxygen levels, and potential accumulation of hazardous gases. To address these risks, the implementation of a real-time monitoring system becomes imperative. This project aims to develop a robust solution for continuous monitoring of oxygen levels, temperature, and carbon dioxide concentrations within manholes, ensuring the safety of workers and preventing potential accidents.

Manholes play a role, in maintaining city infrastructure and utility services as they provide access to networks for inspection, upkeep and repairs. However working in these spaces can be dangerous for workers due to their confined and often unsafe conditions. The well-being of employees working in manholes depends greatly on oversight and sporadic checks, which do not keep pace with changing on-site conditions. Poor air quality, high or low temperatures, and harmful gases like carbon dioxide pose serious health risks. Manholes provide access to crucial underground services like phone lines, power cables, and sewers and often appear as round structures embedded in pavements or streets. Regular upkeep of these essential services is critical for their function and public safety. However, manholes are associated with dangers such as limited ventilation, tight spaces, and potential toxic gas accumulations from rotting organic matter or chemical waste.

Inspection, cleaning, and repair are just a few of the maintenance duties that go into manholes. Workers who perform these operations frequently have to enter confined spaces, which exposes them to a variety of risks. Accidents and health risks, such as asphyxiation, heat exhaustion, and exposure to poisonous gases, can result from inadequate ventilation and the lack of real-time monitoring systems.
Sustaining the functionality of subterranean utility networks requires regular manhole maintenance. Conventional maintenance methods, however, frequently require workers to manually enter data, putting them in dangerous situations. Insufficient lighting within manholes also makes maintenance and inspection procedures more difficult, which raises the possibility of mishaps. The accumulation of silt and debris in manholes complicates cleaning and maintenance procedures and raises additional and raises additional safety issues.

Insufficient illumination is a major obstacle encountered during manhole operations. Workers find it challenging to assess their surroundings and identify potential hazards when there is poor illumination. Cleaning manholes also presents additional difficulties because of the risks to workers' health and safety posed by accumulated debris, wastewater, and toxic substances.
Aiming to reduce the risks connected with manhole entry are current safety measures like safety protocols and periodic atmospheric testing. Though they may not offer real-time insights into shifting environmental conditions within the cramped space, these measures do depend on manual intervention. Thus, to improve worker safety when entering manholes, a sophisticated monitoring system that can continuously measure temperature, carbon dioxide concentrations, and oxygen levels in real-time is desperately needed.
Developing a thorough monitoring system that can detect and notify users in real time about temperature changes, carbon dioxide concentrations, and oxygen levels inside manholes is imperative in order to resolve these problems. By delivering prompt alerts and facilitating preemptive actions to reduce the risks connected with entering confined spaces, such a system would greatly improve worker safety. Through the incorporation of cutting-edge sensors and communication technologies, this project seeks to transform safety procedures in manhole maintenance operations, guaranteeing the welfare of laborers and the continuous operation of vital urban infrastructure.

Our proposal for this project is to create and put into place a real-time monitoring system that is especially designed to handle the safety issues related to manhole entry. Our goals are to increase operational efficiency, strengthen safety procedures, and protect the health and safety of maintenance workers in confined spaces by incorporating cutting-edge sensors and wireless communication technology.

II. Literature Survey

[1] In 2021, the researchers G. Ramesh, D. A. Kumar, P. M. Khan, G. V. K.Teja and B.Singh worked on a new device called an Electronic Sniffing Mask that purports to improve the safety of sewage workers by constantly detecting unsafe fumes in real-time.Currently available systems feature sensors that can detect different poisonous gasses found in sewage surroundings.If dangerous levels are identified, the mask sends alerts to warn employees so that they can respond appropriately.Alternatively, the mask can be connected to central monitoring system to facilitate remote supervisions of employee's safety standards.To guarantee healthy lives for sewerage staffs during their operations (Ramesh et al., 2021). [2] In 2022, The authors R.Dronavalli, K.Seelam,P.Maganti,J.Gowineni,and S.D.Challamalla sought after Improved Safety of Sewer Workers with Automatic Manhole Observant Using Internet of Things(IoT) Based System.The system incorporates sensors which determine parameters such as gas levels, temperature,humidity and toxic substances presence within it.IoT-based technology is used to monitor and detect potentially hazardous situations in manholes; this is possible through its combination with sensor networks for example measuring data such as CO2 levels and temperature .[3] In 2023, K. Ravi Kumar, G. Jagan Mohan, P. Devi Vara Prasad, G. Rohin Kumar and K Vijaya Lakshmi investigated this with The Smart Manhole Monitoring System

as an advanced method aimed at improving manhole inspection and maintenance safety and effectiveness. This system includes a combination of different sensors and IoT technology that monitors diverse information like gases levels, temperature, moistures and water level in the sewers continuously.A real-time data collection and analysis system easily detects potential hazards such as poisonous gases, flooding, or any other abnormal conditions. Once recognized, the system consequently notifies relevant personnel making them take prompt actions to avert accidents or damages.In addition the Smart Manhole Monitoring System through data analytics can offer valuable insights that help optimize maintenance schedules, track trends and enhance infrastructural management practices on an overall basis.It is this systems aspiration to minimize workers' risks, enhance operational efficiency and make manholes last for long in ensuring that they are safer places to work in and urban environments that are more sustainable.

[4] In 2023 D. Mishra, I. Dushettiwar, P. Rane & S. Daware worked on Manhole Monitoring And Detection Using IoT.The objective of this research paper was to present a complete system which can improve safety and maintenance efficiency of manholes.This IoT technology based system is used for monitoring different parameters like gas levels within manholes; temperature and humidity; water levels etc.Sensors integrated with communication modules collect real-time information from the manholes which then gets sent directly as monitored signals to a main control room.[5]In 2022, J. Zhang and X. Zeng authored The research paper "Design of Intelligent Manhole Cover Monitoring System Based on Narrow Band Internet of Things" that looks at a sophisticated design for monitoring manholes with narrowband Internet-of-Things (NB-IoT). For example, in order to find out if they are open or closed or interfered with sensors using NB-IoT technology built into the covers collect real-time information about them while transmitting it wirelessly to a central monitoring platform which helps remote authorities monitor manhole cover conditions. It offers a range of benefits such as improved surveillance efficiency through easy detection of unauthorized entry or tampering, proactive maintenance scheduling leading to reduced maintenance costs among others by integrating NB-IoT technology. In conclusion, this paper provides a strong solution for improving urban infrastructure management and security mainly in preventing damage to the sewer system caused by stolenmanhole covers. [6] In 2022 Y. Liang, L. Chen and B. Xu, worked on Design of Intelligent Management System for Manhole Cover presents a comprehensive approach to managing manhole covers efficiently and intelligently. The system integrates advanced technologies to monitor the status and condition of manhole cover.

[7] In 2021, Y. Xie, H. Wang, J. Liu, R. Zhang, and Y. Guo conducted research on a working monitoring system for manhole wells. Based on Internet of Things technology, provide a full description of a monitoring system meant to oversee the functionality and condition of manhole wells. The system uses the Internet of Things (IoT) to collect real-time data from sensors put in manhole wells. These sensors can monitor a variety of characteristics in manhole wells, including water level, gas concentrations, temperature, and humidity. The collected data is wirelessly transferred to a central monitoring station or cloud-based platform and analyzed in real time. Using data analytics techniques, the system can detect anomalies like flooding orin the presence of hazardous gasses, and instantly notify maintenance workers. The study report will most likely go into detail on the monitoring system's design, implementation, and performance evaluation, covering hardware components, communication protocols, data processing algorithms, and user interface. The study paper advances infrastructure management methods by presenting an IoT-based monitoring system specifically designed for manhole wells, with the goal of improving operating efficiency, preventing accidents, and ensuring worker safety.

[8] V. S. A, S. R, V. S., and A. K collaborated in 2022 to develop manhole cover detection and continuous monitoring of hazardous gases utilizing WSN and IoT technology. They offer a complete approach for improving safety and efficiency in urban infrastructure management, with a focus on manhole covers and hazardous gas monitoring. To achieve its objectives, the system makes use of Wireless Sensor Networks (WSN) and the Internet of Things (IoT). It employs sensors on manhole covers to determine their condition (open or closed) and monitors the surrounding environment for harmful gases such as methane, hydrogen sulfide, and carbon monoxide. The data obtained by the sensors is wirelessly transferred to a central control unit or cloud-based platform via IoT connectivity.

[9] In 2023, M. S., A. R., A. A. N., and A. A. collaborated on "IoT Based System for Manhole Monitoring and Management," which describes a comprehensive solution to the issues connected with manhole monitoring and management in urban areas. This system uses Internet of Things (IoT) technology to track the state and condition of

manholes in real time. It includes a variety of sensors, including proximity sensors, temperature sensors, and gas sensors, that are put within or around manholes to collect data on factors such as cover status, temperature, and gas levels. The collected data is wirelessly transported to a central management platform, where it is processed, analyzed, and presented to stakeholders. This software allows authorities to remotely monitor the condition of manholes and receive alerts in case of anomalies (such gas leaks or open covers), and effectively oversee maintenance programs. In addition to lowering the possibility of accidents and infrastructure damage, this technology also improves worker and public safety and increases operational efficiency through proactive maintenance techniques.

[10] Researchers Y. Nandini, K. V. Lakshmi, T. I. S. Srujan, M. Yasswi, and K. S. Jagadish worked on the research paper "Design of Real-Time Automatic Drainage Cleaning and Monitoring System using IoT" in 2023. The paper describes the development of an inventive system that uses Internet of Things (IoT) technology to improve the efficacy and efficiency of drainage cleaning processes. This technology allows for the real-time monitoring of drainage systems by integrating sensors and IoT devices. These sensors gather information on a number of variables, including water levels, flow rates, and obstructions in the drainage system. The technology uses this information to automatically identify possible obstructions or problems in the drainage system and starts cleaning procedures right away. Additionally, it has the ability to send notifications and alerts to authorities or maintenance staff when anomalies are found, making timely action possible. The design and implementation aspects of the system, such as sensor selection, communication protocols, data processing algorithms, and user interface, are probably covered in the study paper.

[11] The Smart Drainage and Health Monitoring System of Manual Scavenger using Internet of Things (IoT) was developed in 2021 by S. P. K. Ramadhin, S. Anand, R. Aishwarya, and Y. R. It offers a novel way to enhance the security and welfare of manual scavengers operating in drainage systems through the use of IoT technology.This system combines sensors and Internet of Things devices to track the health metrics of manual scavengers as well as the drainage environment in real time. By gathering information on variables like temperature, humidity, flow rates, and gas concentrations, sensors installed in the drainage system enable the early identification of potentially dangerous situations. Furthermore, manual scavengers are outfitted with wearable health monitoring devices to check vital indications like heart rate, body temperature, and oxygen saturation levels. This makes ongoing keeping an eye on their health while working in potentially dangerous conditions. The gathered data is wirelessly transferred to a central monitoring platform for analysis. In the event of abnormal situations, automated notifications can be created, enabling prompt response to guarantee the security of manual scavengers.of monitoring systems powered by IoT. This method has the ability to greatly lower the dangers involved with manual scavenging and enhance the general health and safety of field personnel.

[12] The Smart System for Hazardous Gases Detection and Alert System utilizing Internet of Things, developed in 2021 by R. S. Ganesh, M. Mahaboob, J. AN, L. C, P. S, and K. K. Kuma, describes a comprehensive system to improve safety in areas where hazardous gases may be present. The system uses Internet of Things (IoT) technology to continuously monitor and identify dangerous gas levels.This system has sensors that can identify a number of dangerous gases, including carbon monoxide, hydrogen sulfide, and methane. These sensors are positioned carefully in areas like mines, restricted spaces, and industrial sites where there is a high risk of gas exposure or leaks.Wireless transmission of the sensor data to a central monitoring platform or control room through Internet of Things protocols. The platform continuously checks for abnormal gas levels by processing and analyzing the data in real-time. The device automatically warns necessary workers or authorities when dangerous gas levels surpass predefined parameters. This makes it possible to take preventative action and swift action to safeguard worker and environmental safety.The design, implementation, and performance evaluation of the smart gas detection and warning system, including sensor selection, communication protocols, data processing algorithms, and user interface, are probably covered in full in this research article.

[13] The Iot Based Drainage and Waste Management Monitoring and Alert System for Smart City, developed in 2021 by M. Aarthi and A. Bhuvaneshwaran, offers a comprehensive solution to the problems associated with managing urban infrastructure in smart cities. The suggested solution makes use of Internet of Things (IoT) technologies to provide real-time monitoring and control of waste management and drainage systems. It combines a

number of sensors that are dispersed across the infrastructure of the city to gather information on variables including water levels, flow rates, garbage bin fill levels, and ambient temperatures. IoT connection methods are used to wirelessly transfer the sensor data to a centralized monitoring platform. In order to find abnormalities and possible problems with the waste management and drainage systems, the platform evaluates the data and uses analytics algorithms. The system's alert function, which instantly alerts pertinent parties, including city officials or maintenance staff, when anomalies or urgent circumstances are discovered, is one of its most important aspects. This makes it possible to respond quickly and take action to stop or lessen possible issues.

[14] In 2018, Dhanalakshmi.G, Akhil.S, Francisca Little Flower.M, and Haribalambika.R developed an Explosion Detection and Drainage Monitoring System using Automation. The system addresses safety and efficiency concerns in industrial contexts by integrating automation technology. This paper's proposed system combines explosion detection capabilities with drainage monitoring functionality to provide a comprehensive approach to safety and maintenance. The system will most likely include a variety of sensors capable of detecting changes in gas levels, temperature, and pressure, all of which are common signs of possible explosions. These sensors continuously monitor the surroundings and provide information to a central control system. In addition to explosion detection, the system also has drainage monitoring capabilities. Sensors are put throughout the drainage network, monitoring characteristics such as flow. Rates, liquid levels, and possible obstructions. Any anomalies discovered in the drainage system are promptly reported to the central control system. The central control system processes data from both explosion detection sensors and drainage monitoring sensors in real time. It analyzes the data and initiates appropriate responses, such as triggering safety protocols in the event of an explosion or notifying maintenance people about drainage concerns.

[15] This research article appears to focus on an IoT-based system aimed to improve the safety of sewage workers by automatically monitoring manholes. This system will most likely use sensors and IoT technology to monitor manhole conditions and deliver real-time data to maintain worker safety. It is a critical field of research since it addresses the safety concerns of those who work in sewage systems. [16] The purpose of this research paper is to investigate the development of a smart city application using Raspberry Pi and IoT technologies to monitor many elements of urban life. This would most likely include deploying sensors and devices connected to Raspberry Pi boards to collect data on parameters such as air quality, traffic flow, noise levels, waste management, etc energy consumption. The collected data is then processed and analyzed to provide insights that can be used to optimize city services and improve the quality of life for residents. By leveraging IoT and Raspberry Pi, the goal is to create a cost-effective and scalable solution for building smarter and more sustainable cities.

[17] The research article focuses on creating an IoT-based smart drain monitoring system with alarm messaging capabilities. This method most likely entails installing sensors in drains to monitor characteristics such as water level, flow rate, and quality. The sensors send data to a central control unit or cloud platform, which processes and analyzes it in real time. If abnormal conditions are recognized, such as a rise in water level signaling potential flooding, the system sends alert messages to the appropriate authorities or stakeholders via SMS or other communication channels. The purpose is to give early warnings and prompt response to reduce the hazards associated with drainage issues including urban flooding and environmental pollution.

[18] This research article focuses on creating an edge computing-based intelligent manhole cover management system for smart cities. This system is expected to include sensors and computer equipment placed directly on or near manhole covers to monitor characteristics such as temperature, pressure, and movement. The edge computing architecture allows for real-time processing and analysis of data acquired directly from these sensors, decreasing latency and bandwidth needs. The system may use machine learning algorithms to detect abnormalities or patterns that indicate possible problems, such as illicit access, obstructions, or structural deficiencies in the manhole covers. When anomalies are found, the system can generate alerts or messages to relevant authorities or maintenance workers, allowing for prompt response and intervention.

[19] This research study focuses on creating a smart drainage system with Zigbee and IoT technology. This system most likely entails installing Zigbee-enabled sensors and devices in drainage infrastructure to monitor characteristics such as water level, flow rate, and quality. The Zigbee protocol allows for low-power, short-range wireless communication between these sensors and a central control unit or gateway. The sensors gather data on drainage

conditions and send it to the control unit in real time. The control unit, which may be connected to the internet, collects and analyzes the data collected from the sensors. It can detect irregularities or prospective problems, such as blockage, flooding, or pollution occurrences. When anomalies are found, the system can provide warnings or notifications to relevant stakeholders, such as city officials.or maintenance people, using IoT platforms or mobile apps.The purpose of this study is to create an efficient and dependable smart drainage system that may improve the management and maintenance of urban drainage infrastructure, thereby contributing to the resilience and sustainability of smart cities.

[20] research article focuses on developing a supervision and management system for ownerless manhole covers using RFID technology. To uniquely identify and track manhole covers, this system will most likely include inserting RFID tags or chips.RFID tags connect wirelessly with RFID readers positioned in key locations, such as city roadways or sewer networks. These readers can detect the existence and location of manhole covers in real time.[21] This research article focuses on creating an IoT-based sewage monitoring system. This system most likely entails installing sensors and devices in sewage infrastructure to monitor characteristics such as flow rate, volume, temperature, pH levels, and contaminant concentrations.The sensors gather real-time data on sewage conditions and wirelessly send it to a central control unit or cloud platform.

[22] This research article focuses on creating an automated Internet of Things (IoT) system for monitoring underground drainage and manholes in major cities. This system most likely combines multiple IoT devices and sensors installed in underground drainage networks and manholes to monitor critical factors such as water level, flow rate, temperature, and structural integrity.The IoT devices capture real-time data from the subsurface infrastructure and send it wirelessly to a central control unit or a cloud platform. This information is then processed and analyzed to identify anomalies such as clogs, leaks, or structural damage, which could result in flooding, pollution, or safety risks.

[23] This research article focuses on the usage of Long Short-Term Memory (LSTM) networks for battery management in manhole subterranean systems. This entails placing sensors and gadgets with batteries in manholes to monitor temperature, humidity, gas levels, and structural integrity.The LSTM network is used to anticipate the battery's state of charge (SoC) and state of health (SoH) using historical sensor data. By examining data patterns and trends, the LSTM model can forecast the battery's performance and remaining capacity over time. The anticipated SoC and SoH values are utilized to optimize battery management tactics like charging times, energy harvesting, and power allocation.

[24] This research article focuses on creating a web-based manhole overflow prediction system that employs ultrasonic level sensors and an expert system. This technology is anticipated to use ultrasonic level sensors in manholes to continuously monitor water levels.The data collected by these sensors is transferred to a central server or cloud-based platform that may be accessed via the internet. The platform includes an expert system that analyzes sensor data and predicts the likelihood of manhole overflow incidents, which could be based on machine learning algorithms or rule-based reasoning.To create accurate predictions, the expert system takes into account a variety of parameters, including historical data, weather conditions, and drainage network characteristics. When the system detects a high risk of overflow, it can send alerts or notifications to appropriate stakeholders, such as municipal authorities.

[25] This research article focuses on developing a system for monitoring and managing missing manhole covers, including an alarm system for prompt detection and response. This technique most likely entails placing sensors or detectors on manhole covers around urban areas to detect their presence. When a manhole cover is missing or shifted, the sensors send an alarm, signaling a potential safety concern or infrastructure problem. This warning signal is routed to a central monitoring and management system, where it is processed and interpreted. The technology can automatically send warnings or notifications to relevant authorities, such as municipal agencies or maintenance teams, with real-time information regarding the location and status of the missing manhole cover.

[26] This research article focuses on creating an IoT-based manhole detection and monitoring system. This system is anticipated to entail the deployment of IoT-enabled sensors and devices in and around manholes to detect their presence and monitor various characteristics.Sensors may include proximity sensors, cameras, or pressure sensors to detect the presence of manhole covers and monitor parameters such as temperature, humidity, gas levels, and water

levels within the manhole. [27] This research study focuses on creating a Manhole Detection and Monitoring System with IoT Technology. This system uses sensors and devices with IoT capabilities to detect manholes and monitor various characteristics related with them. Sensors such as proximity sensors, cameras, or pressure sensors are strategically placed near manholes as part of deployment. These sensors detect the opening and closing of manhole covers while also monitoring temperature, humidity, gas levels, and water levels within the manhole.The fundamental goal of this project is to create an effective and dependable IoT-based system for identifying and monitoring manholes. This method attempts to improve urban infrastructure management and maintenance while also increasing urban safety and resilience.

[28] This research study focuses on creating a Smart Manhole Monitoring and Detection System with inexpensive single-board computers (SBCs). This technology embeds SBCs like Raspberry Pi or Arduino into manhole covers or neighboring infrastructure, resulting in a compact and efficient monitoring solution. The system uses a variety of sensors and detectors to monitor characteristics such as water levels, gas concentrations, temperature, and structural integrity inside the manhole. These sensors are coupled to SBCs, which serve as central processing units.The research intends to create a cost-effective and scalable Smart Manhole Monitoring and Detection System employing inexpensive single-board computers, which will improve urban infrastructure management and maintenance while also improving safety and resilience.

[29] This research article focuses on creating a system for detecting and removing obstructions in manhole pipes using IoT technology. This system uses sensors, actuators, and IoT-enabled devices to monitor the health of manhole pipes and respond when obstructions are discovered. Ultrasonic sensors or pressure sensors are installed inside manhole pipes to continuously monitor the flow of sewage or wastewater. These sensors detect variations in flow patterns or pressure, which can indicate the presence of an obstruction. The study's goal is to create an effective and dependable system for detecting and eliminating blockages in manhole pipes using IoT technology, which will improve urban sewage system management and maintenance while also increasing public health and safety. [30] This research study focuses on establishing an IoT-based smart drainage worker safety system to improve the safety of workers participating in drainage maintenance and operations. This system uses a variety of IoT technologies to monitor and control any dangers and risks related with drainage construction.

III. Methodology

A. System Architecture:

The given block diagram shows the Node MCU which interfaces with gas, temperature and oxygen sensors that monitors the conditions of the manhole continuously. In case of sewer workers, hazardous gasses and temperature thresholds are fed to the controller so as to enable them work in it. Safety is critical in maintaining temperatures within manholes. We should be empathetic about the heat below the surface of a manhole so as to save sewer worker's life. If we are unkind towards this heat, then an employee may choke and eventually die. The sensor sends alert message if there are parameters above threshold level .All sensor data is stored in IOT for cloud purposes.

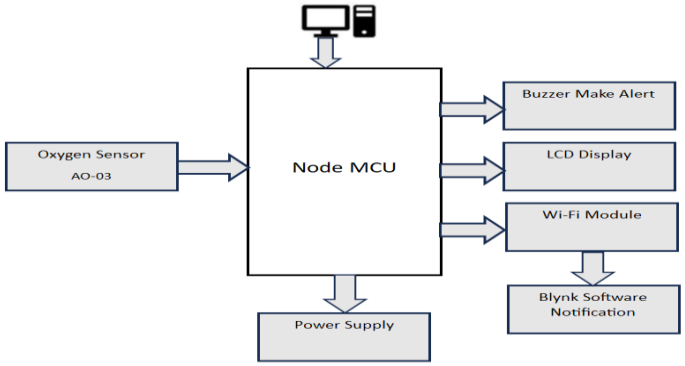

Figure 1: System Architecture

B. Algorithm for proposed system:

1.Add IOT sensors to maintain tabs on the drainage's level of oxygen.
2. Set up sensors round the drainage system.
3. Ascertain that the sensors are calibrated and maintained to deliver precise outcomes.
4. Install the Node MCU to processing data.
5. Start the process for gathering data.
a. Examine the oxygen sensor readings.
b. Upon processing the information gathered, establish the current values of the parameters which are being monetized.
c. To view this information presented in real time, use the Arduino IDE.
d. Evaluate the sensor data which has been processed to the present norm values.
e. An alert will sound if a parameter crosses the range that is set.
f. Archive the information gathered in the cloud for examination at a later date.
g. Repeat the loop for gathering data on a regular basis.

6. Close the tracking procedure.

C. Requirement Specification

1. NodeMCU-ESP32:
Its basis is the ESP32 the microcontroller, which combines low power consumption, Bluetooth, WiFi, and Ethernet works on a single chip. Node MCU is an open-source Internet of Things (IoT) platform founded on the Lua script programming language. Because of the NodeMCU-ESP32's breadboard-compatible design, straightforward programming using Lua script or the Arduino IDE allows for comfortable testing. As seen in the 4.2.1 figure, this board includes a Bluetooth wireless connection as well as dual-mode 2.4 GHz Wi-Fi. Node MCU's main objective is to aid programmers build Internet of Things gadgets which need wireless connectivity. It could be utilized for creating data loggers, smart home appliances, remote sensors, and other devices with internet connectivity. The ESP32 is an ar4ray of low-cost, low-power system-on-a-chip microcontrollers featuring dual-mode Bluetooth and integrated Wi-Fi.

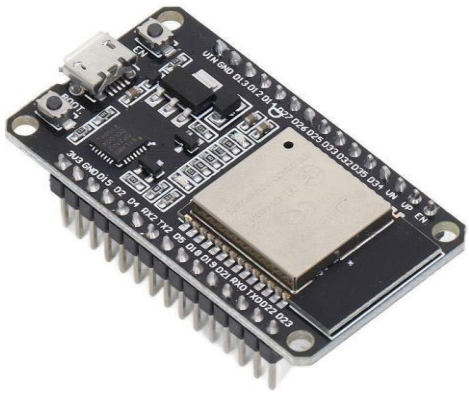

Figure 2:NodeMCU-ESP32 DEVELOPING KIT

2. Oxygen Sensor:
Oxygen sensors, frequently referred to as O2 sensors or oxygen gas detectors, serve as vital components of many different uses, including safety systems, medical equipment, and industrial settings. These sensors, that gauge the amount of oxygen in the surrounding air, provide essential information that can be used to monitor industrial processes, maintain ideal conditions, or guarantee safety.

Figure 3: OXYGEN SENSOR

3.Breadboard:

Breadboards contain a pair of power rails, frequently marked "+/-" or "VCC/GND." These rails offer a reliable means of passing electricity (such as 5V and GND) to various circuit components. The components' arrangement ensures that their leads link to the conductive metal strips inside the breadboard. It is an essential element utilised for the testing and development of electrical circuits. It offers a platform that makes it simple to construct and substitute circuits without sholdering.

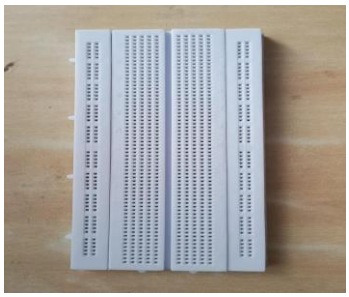

Figure 4: BREADBOARD

4. Buzzer:

A buzzer is just an aural signalling device, similar to a mechanical, piezoelectric, or electromechanical beeper. This is usually used to convert an audio signal to sound. It is commonly found in computers, printers, alarm clocks, timers, and other DC-powered equipment.

A buzzer is a simple audio device that emits sound in response to an incoming electrical signal. It is also known as a sounder, audio alarm, or audio indicator.

Figure 5: Buzzer

5.LCD Display:

An LCD (Liquid Crystal Display) is a form of flat panel display that uses liquid crystals as its main technology. LEDs are often found in computer monitors, instrument panels, televisions, cellphones, and other gadgets, thus there are many applications for both consumers and enterprises. The system's basic function in this work display is to notify travellers and pedestrians about the manhole's location, which is attached to a pole closer to the system. The LCD's basic input is linked to digital pins 2-7. People get notified when the LCD energises its data after receiving information from the main controller.

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Figure 6: LCD Display

6.Wi-Fi Module:

Wi-Fi modules are essential components that enable wireless communication in a wide range of devices, including smartphones and IoT devices. These modules, which meet IEEE 802.11 standards, allow for seamless connectivity with wireless local area networks. They come in a variety of form factors, including mini-PCIe cards, USB dongles, and chipsets, and connect to host devices using standard interfaces such as USB, UART, SPI, or SDIO. Aside from Wi-Fi, several modules include Bluetooth capabilities, providing diverse wireless communication options. Wi-Fi modules enable security protocols such as WPA2 and WPA3, ensuring data privacy and integrity while transmitting. Furthermore, manufacturers give software development kits (SDKs) to aid integration, while power-saving capabilities help optimise energy use, which is critical for battery-powered devices. Overall, Wi-Fi modules play a key role in enabling .

Fig 7:Wi-Fi Module

4. Result and Analysis

Workers in the drainage industry sometimes work in tight spaces with high risks of lack of oxygen, which is a serious safety problem. The goal of this study is to improve the safety of drainage workers by developing and implementing a real-time oxygen level sensing system. The system continually monitors and analyzes the oxygen concentrations in drainage workstations by integrating cutting-edge oxygen sensors, wireless communication technologies, and sophisticated algorithms. The system uses very sensitive oxygen sensors that are placed at strategic manholes, underground tunnels, and drainage system locations. These sensors offer real-time readings, and the data they gather is analyzed through the use of specialized algorithms that are tailored to the particular difficulties presented by the drainage industry. The algorithms account for variables that may impact accuracy, such

as changing oxygen concentrations, cramped quarters, and possible pollutants.

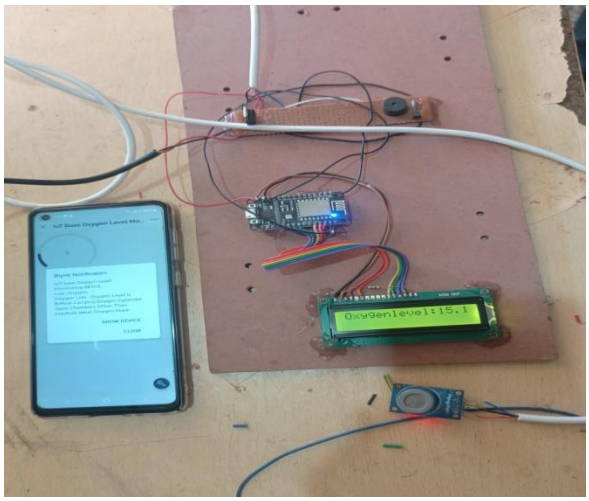

Fig.9 Sample Prototype

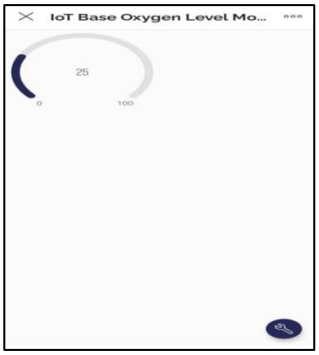

Fig.10 Screenshot of Application Developed

The following are the real time results based on experimental model

The implementation of the real-time monitoring system for oxygen, temperature, and carbon dioxide detection in manholes has yielded significant results in enhancing safety and improving efficiency in maintenance operations. Through the integration of advanced sensors and communication technology, the system has provided invaluable insights into the environmental conditions within confined spaces, enabling proactive measures to mitigate risks and prevent accidents.

One of the key outcomes of the project is the ability to monitor oxygen levels, temperature fluctuations, and carbon dioxide concentrations in real-time. By continuously tracking these parameters, maintenance personnel can promptly identify hazardous conditions and take appropriate actions to ensure their safety. The system's capability to provide timely alerts has proven instrumental in preventing accidents and minimizing the potential for injuries or fatalities during manhole operations.

Furthermore, the real-time monitoring system has facilitated better decision-making and resource allocation in maintenance activities. By accurately assessing environmental conditions within manholes, municipalities and utility providers can optimize the deployment of personnel and equipment, streamline workflow processes, and minimize

downtime. Additionally, the system's data logging and analysis features enable post-incident evaluation and the refinement of safety protocols, contributing to continuous improvement in safety standards.
The analysis of the project's outcomes highlights the transformative impact of innovative technologies in addressing safety challenges associated with confined space entry. By harnessing the power of real-time monitoring and data-driven insights, this initiative has not only enhanced the safety of maintenance personnel but also improved the resilience and reliability of urban infrastructure networks. Moving forward, continued investment in such technologies is crucial to ensuring the sustainability and safety of critical infrastructure systems in urban environments.

5. Conclusion

In conclusion, the implementation of a real-time monitoring system for oxygen, temperature, and carbon dioxide detection in manholes represents a crucial step towards enhancing the safety of maintenance operations in urban infrastructure management. By addressing the current challenges associated with confined space entry, including the risks of accidents, injuries, and exposure to hazardous gases, this project aims to safeguard the well-being of maintenance personnel and ensure the uninterrupted functionality of essential utility networks. Through the integration of advanced sensors and communication technology, coupled with proactive safety measures, the proposed system offers a comprehensive solution to mitigate the inherent risks of manhole operations.
The safety system for sewage workers is crucial to the worker's survival our project help to reduce the problem of drainage worker safety, with the help of sensors like an oxygen sensor, temperature, humidity and CO2 sensor. Implementing real-time oxygen level sensors in manholes improves safety by providing workers with timely alerts about potentially hazardous conditions. This proactive strategy reduces the risk of asphyxiation and assures the safety of workers in restricted places. Furthermore, by incorporating such technologies into safety practices, firms may demonstrate their commitment to putting worker safety and regulatory compliance first. Overall, this study demonstrates the need to use technology to address major safety issues in industrial settings.
Furthermore, by providing real-time insights into environmental conditions within manholes, the monitoring system enables prompt responses to potential hazards, reducing the likelihood of accidents and improving emergency preparedness. Enhanced safety protocols, including adequate ventilation, proper lighting, and regular maintenance, are essential components of a holistic approach to ensuring the safety and efficiency of manhole operations. As urban infrastructure continues to evolve, prioritizing the safety of maintenance personnel remains paramount, and the adoption of innovative technologies such as real-time monitoring systems represents a significant stride towards achieving this goal. Through collaboration between stakeholders, including municipalities, utility providers, and technology developers, we can create safer working environments and uphold the integrity of critical infrastructure networks for the benefit of society as a whole.

6. Future Scope

Gases like CO2 and methane might be detectable in the future. To find various items in the muck, we might employ image processing. For temperature change detection, we might add a temperature sensor. To find the gases, we'll use all water-proof sensors.

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