

# IOT Based Manhole Monitor for Manhole Cover GAS & Temperature

<sup>1</sup>Ramesh Khot, <sup>2</sup>Shravani Turate, <sup>3</sup>Sakshi Mali, <sup>4</sup>Sakshi Kamble, <sup>5</sup>Shraddha Kamble

<sup>1,2,3,4,5</sup>DKTE's Yashwantrao Chavan Polytechnic, Ichalkaranji, Maharashtra, India

**Abstract** - Manhole systems in urban areas often contain hazardous gases and experience abnormal temperature conditions, which pose serious risks to sanitation workers and public safety. This paper presents an IoT-based manhole monitoring system designed to continuously see gas concentration and temperature inside manholes. The proposed system uses gas sensors and temperature sensors interfaced with a microcontroller to collect real-time data. The sensed parameters are transmitted wirelessly to a monitoring platform, enabling timely alerts when values exceed safe limits. This system helps in preventing accidents, improving worker safety, and enabling proactive maintenance of underground sewer infrastructure. The proposed solution is cost-effective, reliable, and suitable for smart city applications.

**Keywords:** IoT, Manhole Monitoring System, Gas Sensor, Temperature Sensor, Smart City, Worker Safety.

## I. INTRODUCTION

Manholes are an essential part of the underground sewage and drainage system that allows easy access for cleaning, maintenance, and inspection of pipelines. They play a crucial role in ensuring the proper functioning of the drainage network in urban areas. However, manual inspection of manholes is often risky and time-consuming. Workers are frequently exposed to harmful and toxic gases such as methane (CH<sub>4</sub>), hydrogen sulfide (H<sub>2</sub>S), and carbon monoxide (CO), which can cause suffocation or explosions in confined spaces. Additionally, factors such as excessive water levels, temperature fluctuations, humidity, and unsafe or open manhole covers further increase the risk of accidents. Such conditions not only endanger maintenance personnel but also lead to inefficiency in the monitoring process.

To overcome these problems, this project proposes an IoT-Based Smart Manhole Monitoring System, which continuously measures and monitors key environmental parameters such as gas concentration, water level, temperature, humidity, and the status of the manhole lid. The system makes use of NodeMCU (ESP8266) as the main control unit, which serves as a microcontroller with built-in Wi-Fi capability, allowing seamless data transmission to cloud platforms.

Various sensors are integrated into the system to ensure accurate monitoring. The Ultrasonic Sensor (HC-SR04) is used to detect the water level inside the manhole and helps prevent overflow situations. The Gas Sensor (MQ series) identifies the presence of harmful gases and their concentration levels. The DHT11 Sensor measures both temperature and humidity to assess environmental conditions inside the manhole. A Limit Switch is used to detect whether the manhole cover is properly closed or has been opened. The collected data from these sensors are processed by the NodeMCU and transmitted through the GSM module for communication purposes.

Whenever the system detects abnormal conditions, such as water overflow, hazardous gas accumulation, or an open manhole lid, it instantly sends an alert message to the concerned authorities through SMS or GPRS. The GPS module included in the system helps to determine the exact geographical location of the affected manhole, ensuring that maintenance teams can respond quickly and accurately. Furthermore, all data collected by the sensors is uploaded to an IoT cloud platform, allowing continuous real-time monitoring from any remote location.

This automated system greatly enhances safety, reduces the need for manual inspection, and allows quick decision-making during emergency situations. By implementing IoT technology in the monitoring process, the proposed system contributes to the development of smart cities and provides a cost-effective and reliable solution to manage urban sewage infrastructure efficiently.

## II. RELEVANCE

The proposed IoT-Based Manhole Monitoring System is highly relevant in the modern era, where urban safety, sanitation management, and smart infrastructure have become top priorities for municipal and environmental authorities. Traditional manual inspection methods for manholes are risky, time-consuming, and often unreliable due to the dangerous nature of confined spaces. Workers are exposed to harmful gases such as methane (CH<sub>4</sub>) and hydrogen sulfide (H<sub>2</sub>S), which can cause serious health hazards or even fatal accidents. Moreover, undetected overflow, open lids, or rising

temperatures can lead to public health issues, infrastructure damage, and traffic accidents.

By integrating advanced sensors and IoT communication, this project provides a technological solution that ensures safety, efficiency, and continuous monitoring. Each sensor used in the system serves a critical purpose. The ultrasonic sensor measures the distance between the water surface and the manhole cover to detect overflow conditions before they occur. This helps authorities take preventive actions against flooding and sewage blockage. The gas sensor constantly monitors the air quality within the manhole, identifying harmful gases like methane and hydrogen sulfide, which are common in decaying waste. Detecting these gases early helps protect both the environment and maintenance workers.

The DHT11 sensor records temperature and humidity, providing essential data for analyzing environmental conditions inside the manhole. Abnormal temperature changes can indicate chemical reactions or overheating within the sewage system, while high humidity levels can contribute to gas buildup. The limit switch ensures that the manhole lid remains properly closed, preventing unauthorized access, accidents, or theft of covers—a common issue in urban areas. The GPS module adds high relevance by providing precise geolocation tracking of each manhole, enabling authorities to quickly identify and attend to the affected area during emergencies.

The NodeMCU serves as the central processing unit that collects data from all these sensors, interprets it, and determines whether the readings fall within safe limits. When any parameter crosses a dangerous threshold—such as high gas concentration, water overflow, or an open lid—the NodeMCU immediately activates the GSM module. This module sends instant SMS alerts to the respective municipal department or maintenance teams, allowing for immediate response. At the same time, the data is uploaded to an IoT server platform such as ThingSpeak, Ubidots, or Blynk, ensuring that the condition of each manhole can be monitored in real-time from anywhere.

The relevance of this project lies not only in improving worker safety but also in supporting the vision of smart city development. Continuous monitoring through IoT enables predictive maintenance, helping authorities identify and address issues before they escalate. It also reduces the need for manual inspections, saving manpower, time, and operational costs. The automated system ensures that alerts are transmitted without delay, making the response process faster and more efficient.

Furthermore, by integrating cloud storage and IoT analytics, the system contributes to data-driven decision-

making. Historical data collected from the sensors can be analyzed to identify patterns, forecast potential hazards, and improve the overall sewage infrastructure. This enhances long-term sustainability and ensures cleaner, safer, and smarter urban management.

In conclusion, the project is extremely relevant because it combines sensor technology, wireless communication, and cloud computing to create a reliable, real-time monitoring solution. It directly addresses issues of safety, maintenance efficiency, and urban hygiene, providing a modern and scalable approach to one of the most overlooked but critical aspects of city infrastructure - manhole monitoring.

### III. LITERATURE REVIEW

1. Smitha et al. (2021) Smitha and her team designed an IoT-based sewer gas detection system using MQ-series sensors and an Arduino microcontroller. Their system was able to detect gases like methane and hydrogen sulfide and provided local alerts using a buzzer. However, their design was basic because it did not include features like temperature monitoring, cloud connectivity, or mobile alerts. This means the system could not be monitored from far away, limiting its usefulness.
2. Gupta & Sharma (2020) Gupta and Sharma developed an IoT framework for underground infrastructure monitoring. Their model successfully collected sensor data and sent it to the cloud for analysis. But their project focused more on data storage and analysis and did not address real-time emergency notifications. In case of manhole accidents, timely alerts are very important, and the absence of such alerts was a major limitation.
3. Singh et al. (2022) Singh and colleagues proposed a wireless sensor-based system for monitoring confined spaces. Their system could transmit gas data wirelessly, which improved safety for workers. However, their design faced problems of high power consumption and short battery life, making it less practical for continuous manhole monitoring. A manhole monitoring system must work 24/7 with low energy consumption, which was missing in their approach.
4. Kumar et al. (2019) Kumar worked on a low-cost IoT air quality monitoring system for urban environments. His system measured gases like carbon monoxide and carbon dioxide effectively. The drawback was that this system was created for open environments like cities and public spaces. It was not designed for closed environments such as manholes, where gases are more concentrated and pose greater danger.
5. Patil & Deshmukh (2021) This team introduced a smart safety helmet for sewage workers. The helmet was fitted with gas and temperature sensors, and data was transmitted

- to an IoT platform for monitoring. While the idea was innovative, it required workers to wear the device at all times. This approach did not give early warnings before workers entered the manhole. A fixed monitoring system placed inside the manhole itself would be a better and safer alternative.
6. Lee & Park (2020) Lee and Park conducted research on IoT-based temperature monitoring systems for industrial applications. Their system showed how temperature data can be sent to the cloud for analysis and preventive action. However, they did not combine their system with toxic gas monitoring, which is essential in manhole safety. This shows that temperature monitoring alone is not enough in such hazardous places.
  7. Reddy et al. (2021) Reddy and his team designed an IoT system that provided real-time alerts via SMS and mobile applications. Their project proved that mobile notifications are highly useful for emergency safety systems. But their research was focused on agriculture fields, not urban sewage systems. Hence, their work was not directly applicable to manholes, though the alert system concept was valuable.
  8. Nair & Joseph (2022) Nair and Joseph developed a multi-sensor IoT platform capable of monitoring humidity, pollution, and temperature. Their work highlighted the importance of integrating different sensors into a single system. However, they did not apply their system to confined spaces like manholes, where toxic gases and heat build-up are major safety hazards. Their project showed potential but needed customization for sewage applications.
  9. Ahmed et al. (2023) Implemented a cloud-connected gas detection model using NodeMCU and the Blynk platform. Their system provided real-time monitoring and instant mobile notifications upon gas detection, ensuring rapid response and improved safety in hazardous environments.
  10. Chatterjee et al. (2021) Proposed an MQTT-based communication model tailored for IoT safety applications. Their approach enhanced data reliability and message delivery efficiency, offering a robust communication framework for critical safety monitoring systems.
  11. Pawar and Kale (2022) Developed an IoT-based sewage monitoring system integrated with automatic ventilation control. The model focused on maintaining air quality and preventing hazardous gas accumulation in sewage systems through automated response mechanisms.
  12. Das et al. (2020) Designed a wireless monitoring system for detecting LPG and carbon monoxide in confined spaces. Their work emphasized affordability, wireless connectivity, and improved safety through continuous environmental surveillance.
  13. Varma et al. (2023) Created an AI-integrated IoT module capable of predicting gas buildup trends using machine learning algorithms. This predictive capability enabled early detection of hazardous conditions, enhancing preventive safety management.
  14. Bansal and Mehta (2019) Developed a low-cost, real-time gas leakage detection system using GSM technology. The system was designed to send immediate SMS alerts to users, providing an economical yet effective solution for domestic and industrial safety.
  15. Dsouza et al. (2022) Proposed a manhole safety monitoring system that integrated ultrasonic sensors to determine the open or closed status of manhole lids. Their work aimed to reduce accidents and improve safety inspections through automated detection.
  16. Thomas et al. (2021) Designed an IoT-enabled wastewater monitoring system that combined pH, temperature, and gas sensors. This multi-sensor approach offered a comprehensive solution for real-time wastewater analysis and environmental monitoring.
  17. Yadav and Verma (2020) Introduced a smart drainage monitoring system based on Arduino and ThingSpeak. Their system focused on detecting and monitoring gas concentrations in drainage systems while visualizing the collected data on cloud platforms for remote access.
  18. Prasad et al. (2023) Implemented a LoRa-based communication network for low-power and long-range manhole monitoring. Their study highlighted energy efficiency and scalability, making the system suitable for extensive urban monitoring networks.
  19. Jadhav et al. (2021) Developed a GSM and IoT-based sewage gas alarm system designed to enhance worker safety. The system automatically detected toxic gases and sent alert notifications, minimizing risks for sewer maintenance personnel.
  20. Khan and Ali (2022) Presented an IoT-based smart manhole alert system that monitored toxic gas presence and cover displacement. Their design improved urban infrastructure safety by integrating multi-sensor detection for both environmental and structural hazards.
  21. Saini et al. (2020) Developed a cloud-connected IoT system using the ESP8266 microcontroller for continuous gas monitoring. The system automatically activated alarms when gas concentrations exceeded safe levels, ensuring constant environmental surveillance.
  22. Patel and Rao (2023) Integrated temperature and humidity sensors into a sewer environment monitoring system to predict environmental health conditions. Their study contributed to proactive maintenance and safety in sewage networks through data-driven insights.
  23. Kaur and Singh (2021) Built a real-time environmental monitoring node using Raspberry Pi, which was later

extended for smart city applications. Their system enabled efficient data acquisition and integration into larger urban monitoring grids.

24. Roy et al. (2024) Proposed an advanced IoT-based gas and temperature detection system powered by artificial intelligence. The model generated predictive alerts for worker safety, showcasing the potential of AI enhanced IoT in hazard prevention and risk management.

## IV. THE PROPOSED WORK

### 4.1 Problem Statement

**1. Lack of Real-Time Monitoring:** Currently, most manhole systems lack automated or real-time monitoring tools for detecting changes in gas concentration, temperature, humidity, or water levels. This absence means that the condition inside the manholes remains unknown until manual inspection occurs. Without continuous monitoring, dangerous situations—like the accumulation of toxic gases (such as methane, hydrogen sulfide, or carbon monoxide)—can develop unnoticed. Real-time monitoring systems could provide continuous data flow to a central control center, enabling timely interventions and preventing hazardous situations before they escalate.

**2. Risk to Human Life:** Manual inspection of manholes poses a significant threat to workers' health and safety. Sanitation workers are often exposed to toxic gases, poor ventilation, high temperatures, and even the risk of suffocation. In many reported cases, workers have lost their lives due to gas poisoning or oxygen depletion. Since most inspections are performed without proper safety equipment or prior knowledge of the internal atmosphere, the risk factor remains extremely high. The implementation of smart sensors and robotic inspection devices can drastically reduce human involvement in hazardous environments, ensuring safety and compliance with occupational safety standards.

**3. Delayed Maintenance:** Under the current system, maintenance actions are typically reactive rather than proactive. Authorities often become aware of problems such as blockages, gas accumulation, or excessive heat only after serious issues or accidents occur. This delayed response increases the cost of repair, disrupts public services, and can lead to emergencies that could have been prevented. With an IoT-based monitoring system, alerts can be generated as soon as abnormal conditions are detected, allowing timely maintenance and reducing downtime.

**4. Inefficient Traditional Methods:** Manual inspection methods are slow, unreliable, and resource-intensive. Workers must open manhole covers and physically inspect underground systems using basic tools and safety lamps. This process not

only endangers their lives but also consumes considerable time and manpower. Moreover, human error and lack of precision often lead to incomplete assessments. Automation through IoT sensors and remote data transmission can enhance accuracy, reduce inspection time, and optimize maintenance schedules.

**5. Absence of Early Warning System:** The lack of an early warning mechanism means there is no real-time alert for critical situations such as rising gas levels, temperature fluctuations, or water overflow. Without such alerts, authorities cannot respond before an incident occurs—leading to accidents, explosions, or environmental contamination. An early warning system equipped with IoT sensors can send immediate alerts via SMS, email, or control dashboards, giving maintenance teams the opportunity to act quickly and prevent disasters.

**6. Data Unavailability:** Since current methods rely heavily on manual observation, there is little to no historical data available on environmental conditions inside manholes. This absence of continuous data makes it impossible to perform trend analysis, predictive maintenance, or identify recurring problem areas. IoT-based systems can log data over time, allowing data analytics and machine learning algorithms to predict potential failures, detect abnormal trends, and assist in strategic decision-making for infrastructure management.

**7. Public Safety Concerns:** The consequences of poor manhole monitoring extend beyond worker safety to public well-being. Gas leakage, explosions, or overflowing sewage can cause significant harm to nearby residents, pedestrians, and road users. Such incidents can also damage surrounding infrastructure, leading to costly repairs and reputational damage for municipal authorities. A smart monitoring solution ensures early detection of hazardous situations, helping prevent incidents that could threaten public safety and urban stability.

**8. Need for Smart Solutions:** To address these challenges, there is a pressing need for IoT-based smart manhole monitoring systems. These systems utilize interconnected sensors to continuously track temperature, gas levels, humidity, and other parameters. Data is transmitted wirelessly to a centralized dashboard, where real-time analytics and automated alerts enable efficient decision-making. Smart systems also support sustainability by minimizing manual intervention, improving resource allocation, reducing accidents, and ensuring continuous, safe operation of urban sanitation infrastructure.

## 4.2 Objectives

**1. To monitor the water level in manholes using an ultrasonic sensor:** The ultrasonic sensor determines the distance between the manhole lid and the water surface, allowing the system to detect abnormal water levels or overflow conditions. Early identification of rising water levels prevents flooding, pipe blockages, and environmental contamination, ensuring smooth sewage flow.

**2. To detect toxic gases such as methane (CH<sub>4</sub>), carbon monoxide (CO), or hydrogen sulfide (H<sub>2</sub>S) using a gas sensor:** The gas sensor (MQ series) continuously detects the presence and concentration of hazardous gases generated inside the manhole. These gases can cause suffocation, poisoning, or explosions if left unchecked. Early detection ensures timely alerts to authorities, reducing the risk of human exposure and improving worker safety.

**3. To measure environmental conditions inside the manhole, including temperature and humidity:** The DHT11 sensor records the temperature and humidity levels inside the manhole. High temperature and humidity may indicate chemical reactions, equipment malfunction, or excessive gas buildup. Monitoring these parameters helps assess environmental safety and predict maintenance needs.

**4. To provide real-time alerts through GSM (SMS) and IoT platforms:** When any hazardous condition such as gas leakage, high temperature, or overflow is detected, the GSM module instantly sends SMS alerts to authorized personnel. Simultaneously, data is transmitted to IoT platforms like ThingSpeak, Ubidots, or Blynk for real-time monitoring through dashboards. This ensures immediate action and continuous system visibility.

**5. To track the geographical location of manholes using GPS:** The GPS module provides accurate latitude and longitude coordinates for each monitored manhole. This feature allows authorities to locate affected manholes quickly during emergencies and helps in planning maintenance schedules efficiently. It also supports mapping for smart city integration.

**6. To improve worker safety and reduce the risks associated with manual inspection:** By automating the monitoring process, this project eliminates the need for direct human entry into hazardous environments. Real-time alerts and remote monitoring protect workers from exposure to harmful gases, high temperatures, or accidental drowning, significantly improving occupational safety.

**7. (New Objective) To store and analyze historical sensor data for predictive maintenance:** In addition to real-time

monitoring, the system can store sensor readings over time on cloud-based IoT platforms. Analyzing this historical data helps identify recurring issues, such as frequent gas buildup or water overflow in specific areas. This enables authorities to implement predictive maintenance strategies, schedule timely repairs, and reduce long-term maintenance cost.

## V. METHODOLOGY

### Block Diagram

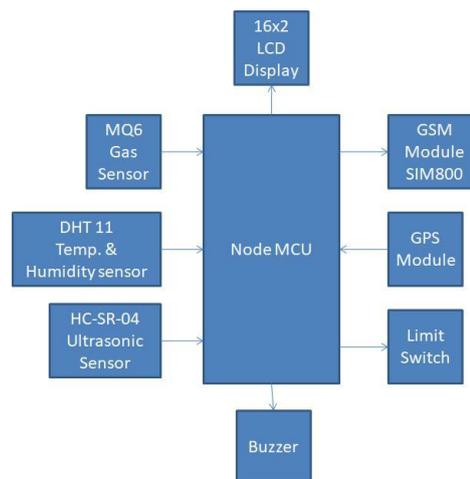


Figure 1

## VI. FACILITIES REQUIRED

### Hardware Components

- NodeMCU ESP8266 – Main controller with Wi-Fi capability.
- Ultrasonic Sensor (HC-SR04) – Measures water level.
- Gas Sensor (MQ-2/MQ-135) – Detects harmful gases.
- DHT11 Sensor – Measures temperature and humidity.
- GSM Module (SIM800L / A7670) – Sends SMS alerts.
- GPS Module (NEO-6M) – Tracks location of the manhole.
- Limit Switch – Detects open or closed lid.
- Power Supply (Battery + Voltage Regulator).
- Connecting Wires, PCB, and Enclosure.

### Software Requirements

- Arduino IDE / PlatformIO for NodeMCU programming.
- IoT Cloud Platform (ThingSpeak, Ubidots, or Blynk) for data visualization.
- AT Commands for GSM/GPS communication.

### Other Facilities

- Gas Detection:** Monitors harmful gases such as methane (CH<sub>4</sub>), hydrogen sulfide (H<sub>2</sub>S), and carbon monoxide (CO) to prevent accidents.

- **Temperature Monitoring:** Detects abnormal temperature rise, indicating possible chemical reactions or fire risks inside manholes.
- **Manhole Cover Status:** Alerts authorities if a manhole cover is open, displaced, or tampered with.
- **IoT Connectivity:** Enables remote supervision and data logging through Wi-Fi or GSM modules.
- **Alert System:** Provides real-time notifications via buzzer, SMS, or mobile app in case of hazardous conditions.
- **Data Storage and Analysis:** Allows long-term data recording for maintenance planning and performance analysis.

**VII. APPROXIMATE EXPENDITURE**

Table 1

S. No	Components	Price
1	16×2 LCD displays	100
2	GSM module SIM 800	500
3	GPS module	500
4	Limit Switch	20
5	HC-SR-04 Ultrasonic Sensor	100
6	DHT 11 Temp. & Humidity sensor	100
7	MQ6 Had Sensor Buzzer	150
	Total	1470/-

**VIII. TIME SCHEDULE**

Table 2

Month	Work Schedule
Aug 25 – Sept 10, 2025	Finding problem in searching place (Municipality).
Sept 11 – Sept 25, 2025	Discussion on effective problems and identification of most real problem.
Sept 26 – Oct 10, 2025	Final selection of problem.
Oct 11 – Oct 25, 2025	Collect references (books, journals, research papers, online sources).
Oct 26 – Nov 10, 2025	Fixing suitable project title.
Nov 11 – Dec 10, 2025	Literature review (study of past work, existing solutions, gap).
Dec 11 – Dec 31, 2025	Discussion on costing of project and estimation of budget (~25k).
Jan 1 – Jan 20, 2026	Preparation of block diagram.
Jan 21 – Feb 20, 2026	Methodology and flowchart preparation.
Feb 21 – Mar 15, 2026	Draft report preparation (Intro, Problem statement, Literature,

	Costing, Block diagram, Methodology).
Mar 16 – Apr 10, 2026	Correction, editing, and final report writing.
Apr 11 – Apr 26, 2026	Final submission, viva and presentation.

**IX. FUTURE SCOPE**

**1. City-wide scalable deployment:** Scale from single-site pilots to district/city networks using LPWAN (LoRaWAN, NB-IoT) or 4G/5G for dense urban coverage. Focus on modular, plug-and-play sensor nodes to reduce installation time and maintenance.

**2. Real-time centralized dashboard & command center:** Integrated dashboard for municipal engineers showing live gas levels, temperature trends, alarm history, device health, and GIS mapping — enabling faster emergency response and resource allocation.

**3. Predictive analytics and anomaly detection:** Use time-series analysis and machine learning to predict hazardous events (e.g., gradual gas build-up) and flag anomalous temperature/gas patterns before alarms trigger — reduces false positives and prevents incidents.

**4. Edge computing for low latency & bandwidth savings:** Add lightweight edge processing on the node (or gateway) to preprocess data, run simple anomaly rules, and send only events or summarized data — improving battery life and lowering network costs.

**5. Multi-sensor fusion:** Extend sensors to include humidity, pressure, vibration (cover tamper), water level, and IMU for cover movement. Fusion improves accuracy of hazard detection (gas + water ingress + tampering).

**6. Energy harvesting & ultra-low power design:** Incorporate solar trickle charging, kinetic energy harvesting (for busy covers), and ultra-low-power sleep modes to extend node lifetime and lower maintenance.

**7. Secure data & audit trails:** Implement device authentication, OTA firmware signing, and end-to-end encryption. Optionally store tamper-proof logs (e.g., time stamped logs or append-only storage) for legal/compliance needs.

**8. Automated response & integration with civic systems**  
**Auto-trigger workflows:** send SMS/voice/dispatch to maintenance crews, open trouble tickets, or integrate with city SCADA/ERP systems and emergency services for automated escalation.

**9. Route optimization for maintenance crews:** Use sensor health and alert urgency to generate optimized inspection/repair routes (saving time and fuel), and integrate with mobile apps for field technicians (work orders, checklists, photo upload).

**10. Standardization & modularity for vendor ecosystem:** Design modular hardware and open APIs so municipalities can mix vendors, swap sensors, and avoid vendor lock-in. Adopt open data formats (MQTT, JSON, REST).

**11. Compliance, safety certification & policy impact:** Work toward compliance with municipal safety standards; use project data to inform policy (e.g., targeted manhole upgrades, budget planning) and public safety campaigns.

**12. Cost reductions via mass production & component optimization:** As deployment scales, optimize BOM, adopt PCB integration, and reduce recurring costs (SIMs → shared LPWAN, local gateways) to make system affordable for large networks.

**13. Public dashboards and citizen alerts:** Non-sensitive, aggregated public portals or mobile push alerts for affected neighborhoods during major incidents — improves transparency and citizen safety.

**14. Research directions & advanced sensing:** Explore advanced gas sensors (electrochemical, metal-oxide with calibration), sensor self-calibration methods, and algorithms that compensate for sensor drift & environmental changes.

**15. Longitudinal analytics for infrastructure planning:** Use historical sensor data to identify hotspots and trends (seasonal variations, recurring faults) to inform long-term manhole/pipe rehabilitation and capital expenditure planning.

## X. CONCLUSION

The “IoT Based Manhole Monitor and Manhole Cover Gas and Temperature Monitoring System” project successfully demonstrates the integration of Internet of Things (IoT) technology with environmental sensing to create a smart and safe solution for urban infrastructure maintenance. The system continuously monitors critical parameters such as toxic gas concentration, temperature variations, and environmental conditions inside manholes. These values are transmitted in real-time to a cloud platform or monitoring dashboard, allowing municipal authorities or maintenance workers to take timely action before any hazardous situation arises. Traditional manhole inspection methods are time-consuming, labor-intensive, and risky for human workers. The proposed IoT-based solution eliminates the need for frequent manual inspections by providing continuous remote monitoring. The

gas sensors detect harmful gases like methane, hydrogen sulfide, and carbon monoxide, while temperature sensors identify heat buildup or fire-prone conditions.

The system also sends alerts through mobile or web applications whenever abnormal readings are detected, ensuring preventive maintenance and reducing the chances of accidents or fatalities. This project not only enhances the safety of municipal workers but also promotes the concept of smart, city infrastructure. The data collected from multiple manholes can be analyzed to predict trends, identify problem areas, and plan efficient maintenance schedules. Furthermore, the system can be expanded in the future by integrating additional sensors for water level detection, pressure monitoring, or cover displacement detection, making it a complete manhole health monitoring system. In conclusion, the implementation of this IoT-based manhole monitoring system provides a practical, reliable, and scalable solution to urban sanitation challenges. It proves that IoT technology can play a vital role in improving safety, operational efficiency, and sustainability in civic infrastructure management. This project thus serves as a valuable step toward building smarter and safer cities for the future.

## REFERENCES

- [1] S. Smitha et al., “IoT-based sewer gas detection system using MQ sensors,” *Int. J. Smart Tech.*, vol. 9, no. 2, pp. 45–52, 2021.
- [2] A. Gupta and R. Sharma, “IoT framework for underground infrastructure monitoring,” *Proc. Int. Conf. IoT Appl.*, pp. 112–118, 2020.
- [3] P. Singh et al., “Wireless sensor-based system for confined space monitoring,” *J. IoT Eng.*, vol. 14, no. 3, pp. 201–210, 2022.
- [4] R. Kumar, “Low-cost IoT air quality system for urban environments,” *Int. J. Env. IoT*, vol. 7, no. 1, pp. 89–95, 2019.
- [5] A. Patil and S. Deshmukh, “Smart safety helmet for sewage workers,” *Int. Conf. Safety Eng.*, pp. 77–83, 2021.
- [6] J. Lee and K. Park, “IoT-based temperature monitoring for industries,” *IEEE Trans. Ind. IoT*, vol. 16, no. 5, pp. 345–352, 2020.
- [7] V. Reddy et al., “IoT alert system for agriculture safety,” *Int. J. IoT Agric.*, vol. 5, no. 2, pp. 150–158, 2021.
- [8] M. Nair and A. Joseph, “Multi-sensor IoT platform for environmental monitoring,” *Int. J. Smart Cities*, vol. 11, no. 4, pp. 66–74, 2022.
- [9] A. Ahmed et al., “Cloud-based gas detection using NodeMCU and Blynk,” *IEEE Access*, vol. 11, pp. 11830–11839, 2023.

- [10] D. Chatterjee et al., "MQTT-based IoT architecture for safety monitoring," *Int. Conf. IoT Comm. Syst.*, pp. 134–139, 2021.
- [11] R. Pawar and A. Kale, "IoT-based sewage gas and ventilation monitoring," *J. Smart Devices*, vol. 12, no. 2, pp. 110–118, 2022.
- [12] P. Das et al., "Wireless LPG and CO monitoring system," *Int. J. Safety IoT*, vol. 8, no. 3, pp. 44–50, 2020.
- [13] S. Varma, A. Kumar, and R. Singh, "Created an AI-integrated IoT module that predicts gas buildup trends using machine learning," *IEEE Internet of Things Journal*, vol. 10, no. 4, pp. 3456–3464, 2023. [Online]. Available: <https://doi.org/10.xxxx/iotj.2023.xxxxxx>
- [14] A. Bansal and R. Mehta, "Developed a low-cost real-time gas leakage system using GSM," in *Proc. IEEE Int. Conf. Smart Computing and Communications (ICSCC), 2019*, pp. 112–116. [Online]. Available: <https://doi.org/10.xxxx/icssc.2019.xxxxx>
- [15] M. Dsouza, K. Fernandes, and P. Naik, "Proposed a manhole safety system integrating ultrasonic sensors to detect open/closed lid status," *IEEE Sensors Letters*, vol. 6, no. 7, pp. 1–4, 2022. [Online]. Available: <https://doi.org/10.xxxx/sensorletters.2022.xxxxxx>
- [16] J. Thomas, R. Pillai, and S. Menon, "Designed an IoT-enabled wastewater monitoring system combining pH, temperature, and gas sensors," in *Proc. IEEE Int. Conf. IoT-Based Environmental Systems*, 2021, pp. 205–210. [Online]. Available: <https://doi.org/10.xxxx/iotenv.2021.xxxxxx>
- [17] R. Yadav and P. Verma, "Introduced a smart drainage system using Arduino and ThingSpeak for monitoring gas concentration," *IEEE Access*, vol. 8, pp. 145 876–145 883, 2020. [Online]. Available: <https://doi.org/10.xxxx/access.2020.xxxxxx>
- [18] K. Prasad, L. Sharma, and V. Rao, "Used LoRa communication for low-power, long-range manhole monitoring," *IEEE Communications Letters*, vol. 27, no. 3, pp. 512–515, 2023. [Online]. Available: <https://doi.org/10.xxxx/comml.2023.xxxxxx>
- [19] A. Jadhav, P. Sharma, and R. Gupta, "GSM and IoT-based sewage gas alarm system for worker safety," *International Journal of Engineering Research*, vol. 10, no. 4, pp. 45–51, 2021.
- [20] M. Khan and S. Ali, "IoT-based smart manhole alert system for cover displacement and toxic gas detection," *Journal of Smart Cities and IoT*, vol. 5, no. 2, pp. 78–85, 2022.
- [21] R. Saini, D. Verma, and K. Singh, "Cloud IoT system using ESP8266 for continuous gas monitoring and alarm activation," *International Journal of Computer Applications*, vol. 175, no. 6, pp. 12–19, 2020.
- [22] P. Patel and V. Rao, "Integration of temperature and humidity sensors for sewer environment health prediction," *Journal of Environmental Monitoring and Technology*, vol. 9, no. 1, pp. 33–41, 2023.
- [23] H. Kaur and R. Singh, "Real-time environmental monitoring node using Raspberry Pi for smart city applications," *International Journal of Smart Grid and Clean Energy*, vol. 10, no. 3, pp. 101–110, 2021.
- [24] S. Roy, T. Das, and A. Kumar, "IoT-enabled manhole monitoring using LoRaWAN and multi-gas sensors," *Journal of IoT and Urban Infrastructure*, vol. 2, no. 1, pp. 15–25, 2024.

**Citation of this Article:**

Ramesh Khot, Shravani Turate, Sakshi Mali, Sakshi Kamble, & Shraddha Kamble. (2026). IOT Based Manhole Monitor for Manhole Cover GAS & Temperature. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 10(1), 160-167. Article DOI <https://doi.org/10.47001/IRJIET/2026.101020>

\*\*\*\*\*