IOT based Manhole Detection and Monitoring System

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Abstract: The sewage system must be monitored in order to maintain the city clean. Uneven sewage system monitoring causes drainage to become clogged. Blockages in the sewer system are a major source of sewer flooding and pollution. Workers may be involved in an accident as a result of their ignorance of the situation inside the manhole. To get the necessary output from the module, this model uses a regulator circuit, sensor driver circuit, microcontroller, serial communication devices, and IoT module. Overflowing drains in the sewage system are one of the most prevalent difficulties identified, which become more severe during the monsoon seasons when the authorities are ignorant of the overflowing drains. It is unsanitary for the adjacent residents and creates waterlogging, which leads to bug breeding. Our answer to this problem is an IoT system that warns municipal officials about overflowing drains immediately by email or notification at the city control centre, as well as citizens via social media or a mobile app. The essential component of this system is a low-power IoT-based portable gadget that is mounted below the manhole cover.\cite{2}\cite{7}

1. INTRODUCTION

For a clean and healthy environment, many Indian cities have an underground drainage system that is controlled by the Municipal Corporation. The water in the drainage system is occasionally mixed with pure water due to poo upkeep. Infections and diseases can be spread through the drainage system. Because of climate change, drainage is affected throughout the year, and the environment is dynamic, people's daily lives are disrupted. To fix all drainage system concerns and to send Blynk notifications to the municipal corporation informing them of the state of the drainage system so that officials can take the necessary steps to restore the drainage system. A gas sensor was used to detect the gas produced within the bio-waste drainage system, preventing it from escaping. The pressure inside the drainage system produced an explosion. The purpose of this design is to track the drainage system using the sensor. When the sewage system is obstructed, water overflows, or the drainage lid is removed, sensors monitor the drainage and send the data to a nearby municipal corporation official via integrated Wi-Fi, where the water overflow and gas value are presented live in the cloud for later examination. The Blynk Server also provides the drainage's GPS location.\cite{5}

The sewage system exhibits instability and uncertainty due to multivariable, nonlinear, temporal variation, and random treatment processes. This model's purpose is to create a low-cost, customizable solution for detecting obstructions and stinky or foul-smelling gases. Two ultrasonic sensors detect the water level, and if the difference between the two levels exceeds the threshold value, an alert message is delivered to the person in charge. The Arduino microcontroller is connected to the sensors' output. It looks at the previously set threshold level and sends a GSM alarm message to the person in control, which is tracked via IoT. Thing-speak, an IoT server analytics solution, displays the graph for clog detection and gas detection on the monitor. The most significant benefit of this technology is that it can save sewage workers from dying from harmful gas exposure. \cite{7}

On the other side, the ARM family offers unique hardware logic control, real-time performance, and synchronicity, allowing it to collect many sensor data simultaneously and boost system real-time performance significantly. In the IoT world, the Raspberry Pi board has
surpassed the MCU in terms of multi sensor data collection. In an IoT setting, however, different industrial WSNs use a significant number of complicated and diverse sensors. At the same time, each sensor has its own readout requirements, and different users have applications that necessitate different sensor kinds. It involves the development of complicated and time-consuming sensor driver code and data collection procedures for each sensor that is newly connected to the interface device, providing several challenges to researchers.[6]

Manhole covers are an important feature of the city drainage system because of their large quantity and widespread distribution. However, every year, hundreds of people suffer various losses as a result of the manhole cover's complex form and ineffective function. We established the integration of urban drainage manhole cover to solve this problem. Intelligent monitoring system to improve urban management and protect people's travel safety capacity. This system features real-time monitoring, timely alarms, precise positioning, and quick processing, etc. [8]

- The sensors' intelligence and predictive system identify the drain clog and provide us with the information we need to proceed.
- In a real-time scenario, sensors will monitor water levels, drainage blockages, and the amount of harmful gases.
- Urbanization leads to increased flood risk because of the impervious surfaces in urban areas

Because metropolitan cities have chosen an underground system, the municipal government is responsible for keeping it clean. If drainage outlet management is poor, H2O becomes contaminated and can lead to disease transmission. Drainage blockages during the monsoon season disrupt the final public's routine. As a result, there should be a facility within the city corporation that alerts officials to sewer blockages and their precise location. It primarily recognizes within the sector of warning people about a gas explosion, an increase in water level, and thus an increase in temperature. It makes use of IOT to create a drainage monitoring system in an extremely high automotive by using sensors to detect and send alerts to authorities via GSM and GPS module.[12]

This project eliminates the disadvantages by installing water rate of flow sensors at node junctions to identify drainage water blockage. When there is a blockage in a specific node, the flow of drainage water changes, and if it exceeds the set value, an alert is displayed on the station management. Other faults are solved by monitoring temperature changes inside the manhole and alerting the necessary parties, which is available in both urban and rural settings. If a drain becomes clogged and sewage water overflows, the sensors detect it and send a notification to the municipal. Traveling inside the manholes to assess the current situation is consequently perilous. A distant alarm system is essential for communicating data collected by sensors installed inside the manhole to the management station in order to tackle all concerns associated to underground sanitation. This includes power-supply components such as the controller, memory, transceiver, and battery.

The benefits of this type of technology are

1. Reduces the risk of death for manual scavengers who clean underground drainage, as well as benefiting the general public.
2. Detection of drainage water levels and drainage blockages
3. Continuously checking the water flow rate and sending automatic mail, as well as displaying on the monitor if the water level is outside of the expected normal range.
4. Keep track of your manholes, report on them, and improve them.
5. High adaptability and dependability, suitable for both urban and rural settings.
### 2. RELATED WORK

| Authors | Journal Publication | Approach | Advantages | Limitations |
|---------|----------------------|----------|------------|-------------|
| Gaurang Sonawane Chetan Mahajan, Anuja Nikale, Yogita Dalvi | IRE Journals | With the support of the Internet of Things, the application and design function of a smart and real-time drainage and manhole monitoring system. | • help proprietors, contractors and workers to prevent gas poisoning in drainage work | As a result of the high maintenance requirements. However, it is not clarified. |
| D.Sakthipriya, V. Logeswari, K. Nishanthi, B.Reethika | International Conference on Emerging Trends in IOT & Machine Learning | To create an effective accident-avoidance system in large cities by prohibiting open manholes. The ultrasonic sensor that determines whether or not the manhole is open or closed. The command and control The Internet of Things is used for maintenance. | • The process of the manhole can be viewed anywhere at any time • As sensors are used, the size will be of less size | More computation time is required |
| Memane Abhishek Ganpat, Aher Omkar Ganpat Bansoe, Sumit Shivaji | International Journal of Engineering Applied Sciences and Technology | The suggested system is a low-cost, low-maintenance, IoT-based real-time system that sends a message to the managing station if a manhole's threshold values are exceeded. This technology | • It's sensed by the sensors and message is distributed to the municipal | High dimensionality |
| Authors | Journal | Summary |
|---------|---------|---------|
| Aarthi M, Bhuvaneshwaran A | Annals of R.S.C.B | The equipment checks for blockages between the two manholes, detects the volume and depth of various dangerous gases, and delivers information via alerts. City Hall is located in the city's centre. |
| J. Bonta, H. Thurston, E. Warnemuende, D. R. Smith, | Urban Water Journal | Increased impervious surface area is a result of urbanisation, and it has substantial consequences for the hydrologic cycle. |
| Rutvik Patel Jay Prajapati, Meha Dave, Ishwariy Joshi, Jagdish M Rathod | Journal of Physics: Conference Series | The suggested technology simplifies the management and monitoring of underground drainage networks, saving the lives of hundreds of manual scavengers who die each year while cleaning them. |

- Various parameters such as temperature, poisonous gas, flow rate, and water level are monitored.

- Its highly non-scalable.

- Digital assistance more sophisticated modelling methodologies.

- Solving dataintensive problems.

- The computation time is longer since earlier data must be obtained.
3. EXPERIMENT SETUP

Nowadays, accidents due to broken and missing manhole covers are quite frequent. Manholes are not monitored properly in developing countries. These collisions can result in serious injuries and even death. As a result, we offer a system to address this issue. We’ve included a slew of sensors to keep track of the manhole cover in real time, preventing similar mishaps [1]. This project includes a tilt sensor, a level sensor for measuring the level of water that may require crack information, and a tilt sensor to indicate whether the manhole can tilt. If any of the parameters trigger an alarm, we send an SMS to an application over WIFI. Also, all the parameters are continuously updated on the application [4].

This project’s major goal is to create a system that monitors water level, air temperature, water flow, and harmful substances. When drainage becomes clogged and sewage water overflows, the manhole lid opens, which is detected by the sensors and transmitted to the corresponding managing station through a transmitter in the region [2]. Sewage systems, gas pipeline networks, water pipelines, and manholes are all part of underground drainage. Temperature sensors are used to keep track of underground electric power lines. Pressure sensors are used to prevent manhole explosions caused by chemical and electrical energy release [3].

![Fig: Block diagram of experimental setup](image)

We use a tilt sensor to detect orientation and inclination. Their simplicity distinguishes them from common toys, gadgets, and appliances [5]. Arduino is a controller board with an ATMEGA 32 CPU. It is utilized to regulate all of the sensors as well as to transmit the sensor signal. A float switch is a sort of level sensor that detects the amount of liquid in a container. The sewage vent’s obstructions and water level are detected by this structure. It also monitors the rate of continuous flow of water [5].

When a specific sensor reaches the individual edge level, the sensor’s estimation will be sent off the microcontroller. The live estimations of the plethora of sensors using IoT are updated by the microcontroller. If a problem arises in the sewage vent, the sensor detects it and sends the information to the ESP8266 [7].
4. ARCHITECTURE OF IOT BASED MANHOLE DETECTION AND MONITORING SYSTEM

This framework detects sewage vent blockages and water levels. It also monitors the continuous water flow rate. Temperature, mugginess, and gas leaks can all be detected with sensors. To address the issue of open drainage, most cities have implemented an underground drainage system in order to maintain the city clean, safe, and healthy. This is an internet-based design for monitoring manholes. The previous system failed to deliver low cost, minimal maintenance, quick deployment, a large number of sensors, long lifetime, and high service quality [1].

![Prototype](image)

To get the necessary output from the module, this model uses a regulator circuit, sensor driver circuit, microcontroller, serial communication devices, and IoT module [7]. If drainage is not properly maintained, clean water becomes contaminated by drainage water, and infectious diseases may develop. It will cause problems in everyday life. Traffic may get congested, the environment may become polluted, and the general people may become irritated [5].

The ATmega328P microcontroller gets real-time data from several sensors. Water level sensing sensors and gas sensors are two types of sensors. The current conditions of the manholes are sensed by the water level detection sensor and the gas detection sensor [4]. When the system is powered up by an external source, all of the sensors will begin to function. The gas sensor detects and reports dangerous gases to the microcontroller. The ATmega328P microprocessor and ESP 8266 Wi-Fi module output are exhibited on the application as the water level detecting sensor checks the flow of water and sends the value to the microcontroller [5].
CONCLUSION:

Nowadays, underground observation is tough. This idea suggests a completely new approach to manage the subsurface system. This system offers a clever solution. Clog, foul gas, and temperature can all be detected with this device. This may be the case. Smart cities have been introduced, and they are simple to operate. anybody. It is a low-cost, time-saving, and human-friendly option. system of intervention The system that has been presented identifies the sewer water level and thus detects the obstruction quickly present on the inside It also identifies the foul gas produced as a result of sewage-contaminated water The temperature inside the manhole was also rather high. Temperature sensors can also be used to detect it.

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