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DRAINAGE MONITORING SYSTEM WITH IOT

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Abstract - The purpose of a smart city is to provide society with amenities that seem to be cleaner and better. While developing a smart city, an intelligent subsurface infrastructure is an essential component to consider. Monitoring the drainage systems is essential for maintaining the city's cleanliness and hygiene. When manual monitoring is inadequate, drainage issues are handled slowly and take longer time to resolve. To overcome this issue this project introduces the system, which uses a wireless sensor network made up of sensor nodes, to analyze the sewer situation more quickly and intuitively. This system can monitor the sewer level & the concentration of harmful gases inside the drainage. It is low-cost, low-maintenance, and Internet of Things (IoT) based real-time which can alert the managing station via the internet, whenever the sewer overflow has happened & Harmful gases are detected as highly concentrated. This technology benefits the general population as well as lowers the risk of mortality for manual scavengers who clean the underground drainage.

***Key Words*:** optics, photonics, light, lasers, templates, journals

1. INTRODUCTION

Any drainage system's access points are indeed a crucial component when it comes to maintenance, inspection, and cleaning. Drainage is the natural or artificial removal of a surface's water and sub-surface water from an area with excess water [1]. These are the vessels used to transport water from lakes, rivers, and streams. Plant waste, plastic, and certain scums are the wastes that are most frequently discovered [1,2]. The drainage system's job is to collect, move, and get rid of water through an outlet. It is a sizable network that needs to be carefully maintained and watched properly, the urban infrastructure includes an essential component called the subsurface drainage system. It is regarded as the city's lifeblood.

If sewer maintenance is poor, infectious diseases can spread through contaminated groundwater. Most of the underground drainage management is manual, this maintaining a clean and functional subsurface system is inefficient. In addition [2,3], in such large cities, when the blocked channels can influence sewage and waste dilute to go and perhaps come up onto your property & road, it may spread various kinds of infections. It is challenging for government staff to pinpoint the precise drainage overflow happens that is having a problem. Consequently, creating a system that can monitor subsurface drainage without human involvement is crucial [4,5]. Then many tasks involved in maintaining and watching after the subterranean drainage system. It offers a system that can keep an eye on harmful gas levels and sewer levels.

The sensor system can detect if drainage systems become clogged and sewer overflows occur, and push that data into the web servers [6,7]. Then the Municipality or concerned authority employees can quickly determine when a drainage overflow occurs and resolve the problem quickly. So, this system proposes:

- ➢ Determine where the sewage overflow occurred.
- ➢ The system governs the overflow of sewage from the pipes.
- ➢ Get the prior alerts of blockages and locate them using IOT.
- ➢ Monitoring the concentration of harmful Gases.

1.1 OBJECTIVES

- ➢ The important aim is to provide a flexible, effective, and affordable solution for managing the city's infrastructure and condition monitoring.
- ➢ Cleaner cities and smart management of the city's drainage system.
- ➢ Detection of drainage water level and highly concentrated harmful gases are there in the drainage.
- ➢ Continuously monitor sewer level rate, at the same time sending data to the respective servers.
- ➢ Utilize IoT to monitor sewage level changes and gas leaks and update data in real-time.

1.2 PROBLEM STATEMENT

Today's drainage system is not high-tech. As a result, it might be challenging to locate the exact location of a blockage whenever it happens. Moreover, no early warnings of the blockage are received. As a result, finding the blockage and fixing it takes time. When the pipes are entirely blocked, handling the problem becomes quite difficult. People experience a lot of difficulties as a result of such drainage line breakdowns.

1.3 PROPOSED SYSTEM

This project is about monitoring drainage systems. If the sewer (Drainage water) comes out from the drainage, the monitoring system can detect that and feed that data into the respective servers. Data from several sensors (sewer level sensor, MQ-4 Methane gas sensors, MQ-7 Carbon monoxide Sensor) used in the real world are collected from the data and converted from analog to digital signals.

The controller (ESP8266) receives the digital signal and sends it to the web server. All the data is on the server. So, the Municipality or concerned authority employees can quickly determine when the problem has occurred as a result the sewer overflow problem is quickly solved, then no other infections are spread. Each component is calibrated and securely fastened to the manhole cover so that it can carry out its intended function. To verify, the sensor data would be gathered.

- Whether the gas level has risen to a hazardous level.
- whether the water level has gotten too high.
- Either a battery or solar panel could be used to power the controller.
- The gathered data are sent to the respective servers.
- Also, real-time updates on the internet support preserving regularity in drainage checks to reduce risks.

2. LITERATURE REVIEW

Ruheena M, A. et al [1]. This paper discusses the objective of a smart city is to provide society with amenities that are cleaner and better. While building a smart city, intelligent subsurface infrastructure is an essential component to consider. Monitoring the drainage systems is essential for maintaining the city's cleanliness and wellness. Because human monitoring is ineffective, drainage issues are handled slowly and take longer to fix. The system, which uses a wireless sensor network made up of sensor nodes, is created to address all these problems. The suggested system warns the managing station via message whenever any manhole crosses its threshold values. It is low cost, low maintenance, and Internet of Things based.

Pendharkar, A. et al [2]. This survey paper provides One of the primary problems in India is the sewage system; due to inadequate maintenance, sewage water overflows onto the streets and occasionally contaminates drinking water, harming people's health. To solve this problem, we are recommending the Drainage Overflow Monitoring System model (DOMS). The suggested system will test the gas and water levels in the sewage system, store the results in the cloud for analysis, and then send an SMS with the sewage system's status to a GSM module located close to the corporate headquarters.

Pathak, T. et al [3]. This survey paper discusses in India is working hard to automate its society and transform each city into a smart city. We must consider a variety of factors to create a smart city, including smart transportation, smart water management, and smart electricity management. Smart subsurface infrastructure, such as water pipes, communication cables, gas pipelines, electric flow, etc., will be required. Since subterranean drainage systems are used in most Indian cities, they must function properly in order to maintain the city's cleanliness, safety, and health. They risk contaminating the clean water with drainage water and spreading infectious diseases if they do not manage the drainage system.

Sona wane, G. et al [4]. This paper provides an overview of monitoring drainage systems is crucial for maintaining a clean city. Not every region has a drainage monitoring crew. It results in inconsistent drainage condition monitoring. Unreliable monitoring causes drainage to become blocked, which results in overflow and causes flooding. Furthermore, manual monitoring is ineffective. It calls for experts, but they can only keep a very limited eye on things and maintain poor precision. Additionally, a worker may experience an accident through ignorance since they are unsure of the circumstances in the manhole. With the aid of the Internet of Things, deep learning-based method for detecting the most important function of water in daily life. To reduce water waste, the water metering system is used to manage water usage inside the home.

Aarthi, M., and A. Bhuvaneshwaran [5]. A municipal corporation can determine the amount of water that people consume. Your plumbing leaks will be difficult to detect. Usually, sewer leaks are mistaken for water line leaks. Even your property may suffer damage from a sewer leak on your drain line. Additionally dangerous to you and your entire family, standing or ponding water from leaking sewer lines frequently remains undiagnosed. This sensor may be installed in several locations, allowing the location of the water leak to be found and fixed.

Calderon, L. et al [6]. This paper proposed to One of the most fascinating trends in ICT is the Internet of Things (IoT). One of the primary concerns, as we support the increasing dissemination of heterogeneous sensor networks distributed throughout urban areas, is to give the community adaptable and simple-to-use frameworks capable of serving and organizing data acquired. these sensors can. However, as we may have noticed, the biggest IT businesses in the world typically produce user-friendly IoT platforms and services while avoiding disclosing knowledge regarding the design and implementation aspects of these products.

Dario Maio [7]. This paper discusses the objective due to this commercial model, it has become popular for universities and other educational institutions to employ these well-known IoT platforms in their classes "as a service," omitting to disclose the technical specifications and design principles these platforms rely on. In this paper, we introduce IoT Manager, a comprehensive framework for managing sensor networks that were entirely developed and put into use at the University of Bologna. Our main goal is to present a thorough implementation strategy for a particular IoT platform to the scientific community in order to spread such issues in a more accurate and clear manner, both for research and teaching reasons.

Mihai T. Lazarescu [8]. This survey paper discusses Through the Internet Protocol, the Internet of Things (IoT) offers a virtual picture of a wide range of actual items, such as a car, teacup, building, or forest of trees. The ease with which we may get the location and current status of any "thing" we may be interested in makes it appealing. In order to depict the IoT, long-term environmental data can be collected via wireless sensor networks (WSN). The functional design and implementation of a full WSN platform that may be utilised for a variety of IoT applications for long-term environmental monitoring are presented in this study.

Zhenyi Liu, Bingxuan Du [9]. Cities frequently experience gas explosions in manholes. Due to the unique nature of manhole structures, many prior studies on gas explosion are not applicable to manhole explosion. A full-scale manhole model was created to study the explosive overpressure of methane/air mixes in order to explore the gas explosion in manholes. Analysis was done on the blast wave overpressure's temporal variation at various distances. Additionally, the impacts of methane concentration, the location of the ignition, and the weight of the manhole lid on the subsequent external overpressure were discovered. The findings demonstrated that the maximal peak overpressure induced by a manhole explosion at the experimental settings in this work, under the impact of vent mode and flame propagation, was mostly at the third measuring point.

B. Koch, Y. Charpentier[10]. Arcing faults on low-voltage insulated conductors are widely considered to be self-extinguishing and consequently not very hazardous to people or property. Nevertheless, a number of arcing faults recently occurred on Hydro-Quebec's underground secondary 120/240 V and 347/600 V systems and caused manhole explosions in downtown Montreal. To trace the probable cause, a series of staged tests was performed in IREQ's high-power laboratory. The results obtained proved that in wet, dirty ducts an arcing fault can take the form of an interrupted arc which is difficult if not impossible for common overcurrent protection systems to detect. Any such fault that has a long duration produces a significant amount of gaseous by-products which escape to the ends of the duct where they can ignite or form explosive concentrations.

Axinia Radeva, Cynthia [11]. Rudin We introduce a manhole profiling tool that was created as part of the Columbia/Con Edison machine learning project on manhole event prediction and talk about how it can be used to evaluate our machine learning model in three crucial ways: removing outliers, removing features that are falsely predictive, and determining the model's quality. Tens of thousands of manholes in Manhattan are ranked according to their vulnerability to dangerous occurrences like fires, explosions, and smoking manholes by the model. With the use of this tool, we were able to meet the accuracy and intuitiveness requirements that Con Edison had set for the model. The programmed automatically puts together a "report card" or "profile" that highlights information relevant to a particular manhole.

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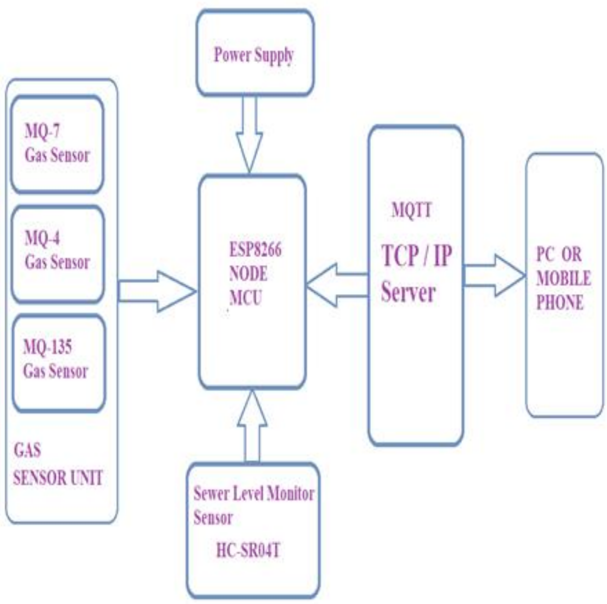
3. SYSTEM DESIGN

The below diagram represents the major components of the underground drainage monitoring system.



Fig– 1: Block Diagram of Drainage Monitoring System using IOT

From the above block diagram, the following steps are involved,

- When the drainage monitoring system gets powered on. The power supply unit act as a power source for the entire hardware.

- The node MCU ESP8266 is the master board. It gets data from the sensor units.
- HC - SR04T is a waterproof ultrasonic sensor. This sensor frequently monitors the level of the Sewer in the drainage. If the sewer level is across its threshold range, the MCU sends that data to the appropriate servers.
- The GAS sensor unit monitors the situation of drainage. If any harmful gases are detected, at a higher concentration range.
- It shows the alert signals and sends that data to the appropriate servers.
- The Sensor unit can detect Methane & carbon monoxide gases.
- MQTT network Protocol is used to transfer data through the internet.
- The ESP8266 act as a node point, it sends data to the server.
- Using the IP Address & Port number we can easily fetch the data by using a mobile Phone.

3.1 METHODOLOGY

3.1.1 FLOWCHART

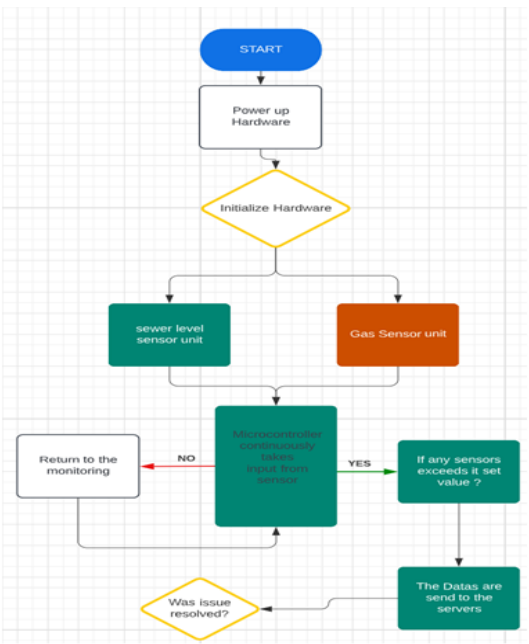


Fig - 2: Flow chart of the proposed model

According to the flow chart above, the following processes take place:

- Click start and after the drainage monitoring system gives the information to Node MCU ESP328266 (Wi-Fi module).
- The hardware's entire power source is the power supply unit.
- The master board is the ESP8266 node MCU. The sensor units provide the data to it.
- Data is obtained from the sensor devices.
- The GAS sensor device keeps track of the drainage status. It displays the alert signals and sends the relevant information to the correct servers if any dangerous gases are found at higher concentration ranges.
- A waterproof ultrasonic sensor is the HC-SR04T. This sensor frequently checks the drainage's sewer level.
- The MCU delivers the information to the proper servers if the sewer level is above its threshold range.

4. HARDWARE DESCRIPTION

4.1 MCU (ESP8266-NODE MCU)

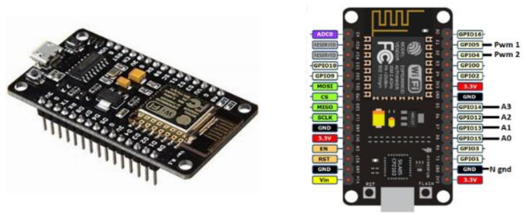


Fig – 3

The ESP8266 MCU & Wi-Fi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor [8].

4.2 Ultrasonic Level sensor

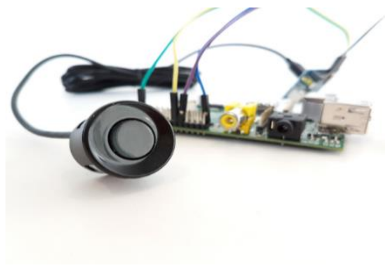


Fig – 4

Liquids, other fluids, and fluidized solids [6] such as slurries, granular materials, and powder that present an upper free surface, are detected by level sensors [9]. Because of gravity, fluids essentially become horizontal in their containers (or other physical limitations), but most of the bulk solids pile at an angle of repose to a peak.

4.3 MQ-7 (Carbon Monoxide Detection Sensor)

The gas sensing material used in the MQ-7 gas sensor is tin dioxide (SnO_2), which has low conductivity in clean air. When carbon monoxide gas exists in the environment where the sensor is located, the conductivity of the sensor increases with the increase of carbon monoxide gas concentration in the air [10].

4.4 MQ-4 (Methane Detection Sensor)

MQ4 methane gas sensor is a MOS (metal oxide semiconductor) type sensor, used to detect the methane gas concentration within the air at either home or industries & generates output like analog voltage by reading it[11]. Here, the range concentration for sensing ranges from 300 pm – 10,000 ppm which is appropriate for the detection of a leak.

5. RESULT & DISCURSION

All the sensors in the system will begin to function as soon as the system is powered up by an external source. The gas sensor detects dangerous gases and notifies the node MCU. The node MCU receives the results from the ultrasonic sensor, which measures the sewer level & the gas sensor unit analyzes the concentration of the harmful gases present in the drainage. The data/ values received by the sensors will be processed by the Node MCU, which has an integrated Wi-Fi module, it sends that data to the servers and is displayed on the appropriate servers. When detected values surpass the threshold values, an alert message is instantly presented to the appropriate officers. On the server web page where the recorded values are displayed.

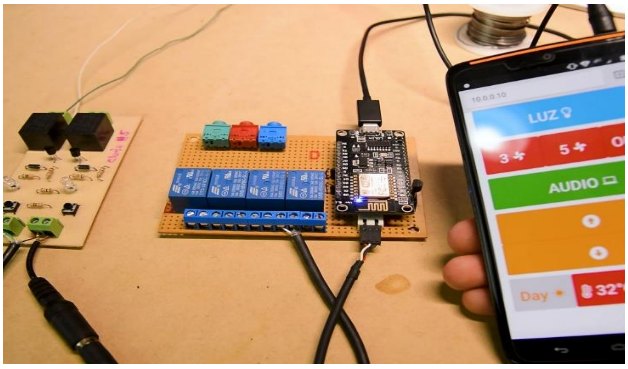


Fig – 5

5.1 The output of ESP8266 Connecting to Network

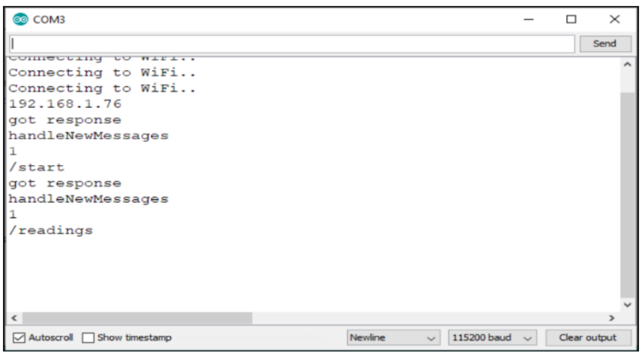


Fig – 6

5.2 output of the Sensor unit values

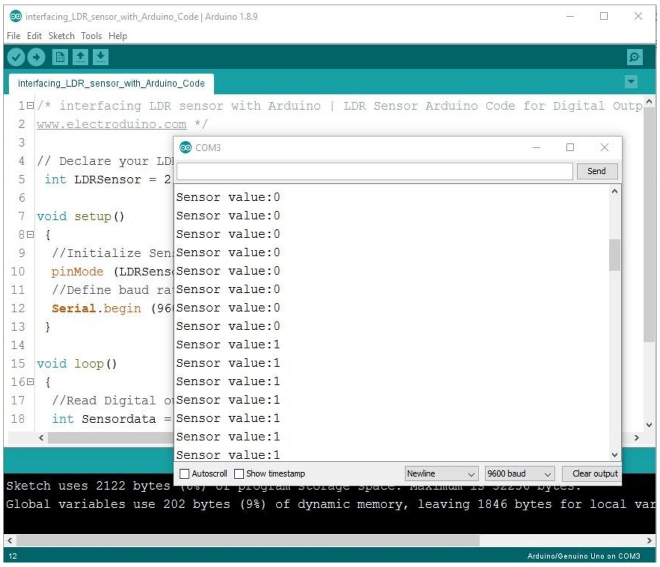


Fig - 7

5.3 Output Graph

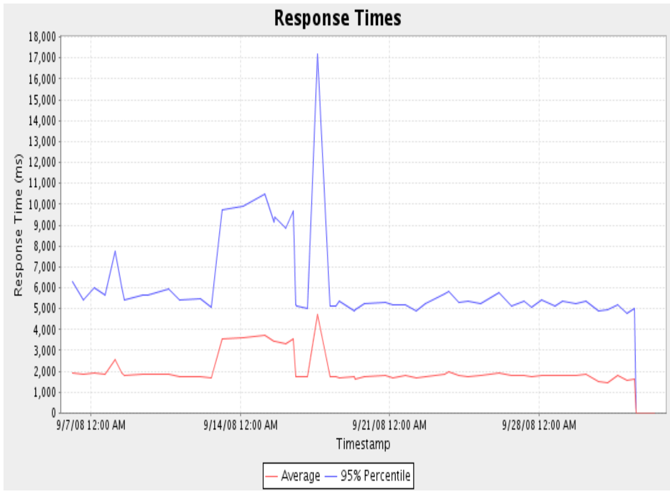


Fig – 8

6. CONCLUSION

Monitoring underground areas is a difficult challenge. The project puts forth various techniques for managing and monitoring subsurface drainage systems. It explains numerous applications like real-time sewer overflow identification and the toxic gases located in the drainage, then collect the data & feeds that data into the respective servers using the Internet of Things. several metrics including harmful gases, and sewer level is tracked and updated online. This makes it possible for the person in authority to act accordingly. Also, real-time updates on the internet support preserving regularity in drainage checks to reduce risks.

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