Drainage Monitoring System Using IoT

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Abstract- In the present-day scenario, where the concept of a smart city is implemented with parameters such as smart traffic analysis, smart farming, smart emergency services, etc. A smart drainage automation system should also be part of a smart city as the Drainage system is one of the essentials of society. Drainage cleaning and monitoring is a strenuous job usually done manually which leads to horrible long-lasting diseases or in many cases death of manual scavengers. As there is no proper monitoring or tracking system available for drainage cleaning. Which leads to overflowing state of pipes and these hazardous situations can be avoided by proper monitoring of sewage pipes with help of various IoT sensors along with many features such as real-time monitoring, checking whether it is safe for cleaners to enter manhole, and many such issues.

Keywords- Internet Of Things(IoT), Sewage Monitoring, Arduino , Sensors.

I. INTRODUCTION

According to The Guardian, since the beginning of 2017 at least one Indian worker has died while cleaning sewers or septic tanks every five days, according to the first official government statistics on the work, considered one of the country's deadliest and riskiest job. To mitigate the death rates, we are proposing a system that helps in identifying the dire situations which mandatorily require safety precautions [5]

Our research purpose is to develop a system based on the concept of Drainage Water Automation. The system will consist of hardware in order to capture various harmful gases by sensors in Sewage lines that can cause human breathing systems, and software to analyse the capture data by different sensors on the display screen. Our major goal is to receive and capture data from sewage lines and to perform analysis on the received data to extract and interpret useful harmful gases by various sensors and use them in real-time applications. By using various sensors such as gas detection, water level as well as blockage detection we can monitor the real-time scenario of the drainage system by detecting the problems in the drainage system. By doing this we are able to take a particular action on the problems as we will receive the early alerts of blockage as well as increase. This paper can be used to design a smart and real-time drainage system for monitoring as well as troubleshooting purposes.

II. LITERATURE REVIEW

Paper1:Monitoring Smart City Applications using Raspberry PI Based on IOT

In this research paper implementation of Internet Of Things (IoT) is shown for monitoring various applications in Smart City using Raspberry PI. which leads to improvement in efficiency as well as reducing cost and maintaining economic value. Using easy wireless communication system information can be shared faster. There are various types of sensor present in smart city and collecting data from all those variety of sensor and transferring it to Raspberry PI3 controller which further send this to control room via email can be done.

Paper 2: Automated Internet of Things for Underground Drainage and Manhole Monitoring System for Metropolitan Cities.

This research paper discusses the importance of sensor networks in the IoT world. Since there are a lot of devices that too of different varieties which sometimes leads to issues in defining common requirements for the WSN nodes and platforms. Real world approach to resolve this issue and making system more accurate, less costly and easy to maintain. This model checks water level, temperature as well as pressure in drainage system

IoT technology for improving and maintaining sewage conditions and providing solutions to fatal issues that will have features like low maintenance, low cost, fast deployment, and a high number of sensors, long life-time and high quality of service. There can be improvement by provide more features like blockage preventions, safety precautions, and concerns for sewage cleaners by checking sewage lines conditions, live analysis of every sewage line analysing sewage waste.

III. PROBLEM STATEMENT

The drainage system is an important part of a Smart City which should be maintained clean and safe for the healthy and clean city but if it's not properly cleaned and maintained it will lead to the spread of infectious disease and an unhygienic environment it is the duty of managing station (Municipal Corporation) to maintain the cleanliness of the cities and in order to clean sewage lines usually, the

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manual way is chosen due to no safety precautions it results in severe disease or in worst cases death. This research aims to provide a safety precaution and a real-time alerting system for easy and safe options in the future. Commencing from most basic challenges such as temperature inside drainage is it appropriate for a cleaner, Concentration of harmful sewer gases such as sulphur dioxide, carbon monoxide ammonia, etc which are deadliest, Apart from that other main issues are leakage in sewage lines and overflowing of it which causes a traffic jam, filthy environment and accidents as well .even after installing sensors after some period of time battery dies and send unaware of this situation leads to harmful situations all these issues will be nullified by the proposed research..

IV. PROPOSED SYSTEM

The proposed system provides you an interconnected web of various sensors which will bring us real time values of the environment which can be compared to concentration of gases and temperature up to point that does not harm human body and provides workable conditions. These threshold values can be classified into various categories such as workable and dangerous. Apart from providing safety precautions to cleaners our proposed system will have record of water level with sudden water level change in any two adjacent sensor can be blockage or leakage which both are hazardous can be avoided and crossing threshold height of drainage a notification will be sent to government authorities which are responsible for maintaining sewage lines and take care of potential overflow and similar to gases we can have a database for battery of sensors which will lead to ease in maintaining process and over underground system will become smart which will contribute to making a city smarter.

V. METHODS/ TECHNOLOGY

Hardware Tools

1. **Arduino Uno**

Figure 1Arduino Uno

Arduino Uno is an ATmega328P based microcontroller. It has 14 digital pins of which 6 can be used as PWM outputs, 6 analog inputs, a USB connection, a 16 MHz quartz crystal, a power jack, an ICSP header and a reset button.

2. **Ultrasonic Sensor**

Figure 2Ultrasonic Sensor

The ultrasonic sensor and radar system work on the same principle. It is used to measure distance with the help of ultrasonic waves of frequency more than 18kHz.IN our research it will be used to detect water level in sewages.

3. **Temperature Sensor (DTH 11)**

Figure 3Temperature Sensor

The DHT11 is a basic digital temperature and humidity sensor. It is used to detect temperature as well as humidity under a manhole and determine whether it is safe for cleaner to get in.[8]

4. **Carbon Monoxide Sensor (CO)**

Figure 4 Carbon Monoxide Sensor

This Carbon Monoxide (CO) gas sensor detects the concentrations of CO. The sensor ranges concentration from 10 to 10,000 pp. Operating temperatures for the sensor are -10 to 50°C and consumption is less than 150 mA at 5V.

5. **Ammonia Sensor**

Figure 5 Ammonia Sensor

Ammonia detectors work on electrochemical principle. Electrochemical sensors are electrochemical measuring transducers for measuring the partial pressure of gases under atmospheric conditions.

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6. **Methane Sensor**

Figure 6 Methane Sensor

This methane gas sensor detects the concentration of methane gas in the air and outputs its reading as an analog voltage. The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection.

7. **Propane Sensor**

Figure 7 Propane Sensor

This propane gas sensor detects the concentrations of LPG, isobutane, and propane in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of 300 to 10,000 ppm.

8. **Sulphur Dioxide Sensor**

Figure 8 Sulphur Dioxide Sensor

Sulphur Dioxide, is a colourless gas with a strong odour. Sulphur dioxide is not combustible but it is considered an extremely toxic gas. Sulphur dioxide is heavier than air and PemTech uses electromechanical technology to detect it

Technology Stack

1. **Java Firebase Realtime Database:**

Firebase provides a real-time database and back-end as a service with the help of this service's API application data is synchronized across clients and stored in Firebase's cloud. Android, iOS, JavaScript, Java, Objective-C, Swift and Node.js applications can be integrated because of client libraries provided by Firebase. The database is accessible via REST API and binds several JavaScript frameworks such as AngularJS, React, Ember.js and Backbone.js.for creating HTTP connections for receiving push notifications from a server Server-Sent Events protocol is used by REST API. company's server-side-enforced security rules are enforced for security of data [3].

2. **Android Studio**

Android Studio is an IDE for mobile operating systems named Android. For devices like touchscreen mobile devices such as smartphones and tablets, Android is used. Android is based on an updated version of the Linux kernel and other open source software. Android is open source and that's why it can be customized to work with different electronic devices. Android is the world's most widely used operating system for mobile devices such as smartphones and tablets. Using android studio, we can develop our android application.[6]

3. **JAVA:**

Java is a programming language that has its own structure, syntax rules, and programming paradigm. The Java language's programming paradigm is based on the concept of OOP, which the language's features support. And because of this it is used for coding in our application.

VI. SYSTEM ARCHITECTURE

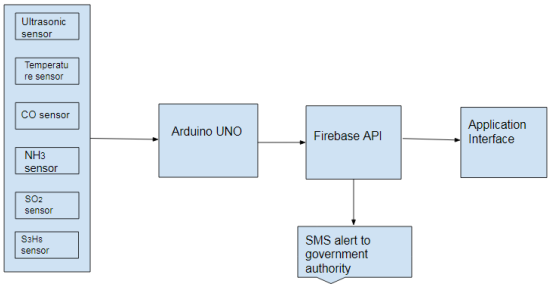

Figure9System Architecture

This figure shows workflow of the system initially all the hardware modules are initialized and mounted on an Arduino board which passes on continuously fetched data to Arduino UNO which work as intermediate between nodes and sent it to Firebase API where all comparisons takes place based on those comparisons SMS alert is sent to government authorities and Application interface is used as graphical user interface in this proposed system.

Workflow

Initially all the hardware modules are initialized and mounted on an Arduino board. As all sensors continuously fetch data from the environment using microcontroller. And passes on to firebase. Firebase provides a real-time database as well as back-end as a service. This service API allows application data to be synchronized and stored on its cloud. Where it compares live fetched data to threshold values of respective hazardous sewage gases. If live data of any sensors exceed the threshold value the nearby municipal corporation is informed by sending a notification to respected authority. Not only data about sewage gases but temperature water level is also obtained if the water level is above some specific level it will notify the authority about which can be tracked with help of GPS and GSM system. If there is sudden fall in water level of

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adjacent sensors in sewage line there could be two reasons behind it one is blockage and other is leakage and water level crosses threshold height the nearby municipal corporation is informed as mentioned above. If the batteries of sensors reduce to minimum threshold same procedure will be followed.by admin and user credentials of all participants are stored as well as checked in firebase API with help of android application and every activity performed is stored and maintained in application with details like place, reason, time of incident etc.

VII. RESULTS

In our application it will initially start with the main page in which login facilities are there. For this prototype there are two types of participants that are user and Admin. And if you are not a new user you can tap on sign up which will redirect you to the registration page where you have to provide credentials which are essential for registration. And if you are already registered you can sign in by providing your credentials. If you have signed in successfully as a user you will obtain a real time map where by tapping on hotspots you can get sensor's real time data which is the amount of presence of sewer gases like methane, carbon monoxide and others along with water level and temperature of that surrounding. And if you are Admin as a participant you will have various tasks in your hand such as user maintenance which will maintain user's data as well as tasks. In the battery report you will get a percentage of battery life remaining of each sensor which will help in maintaining sensors and if they find any defect in sewage lines task manager will send notification to respective authorities and inform them about where and when and what task is to be performed and have record of it.

System Output:

Module 1-

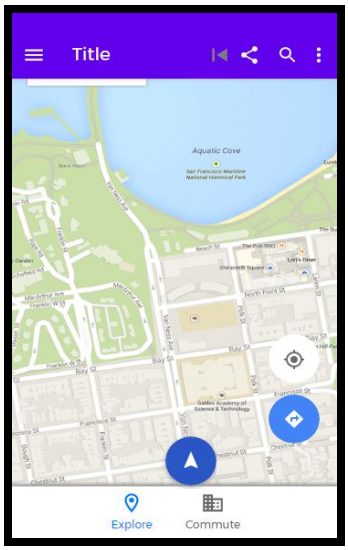

Figure 10Map Page

Module 2-

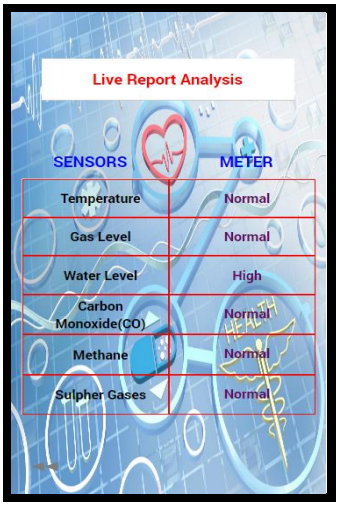

Figure 11Live Report Analysis

Module 3-

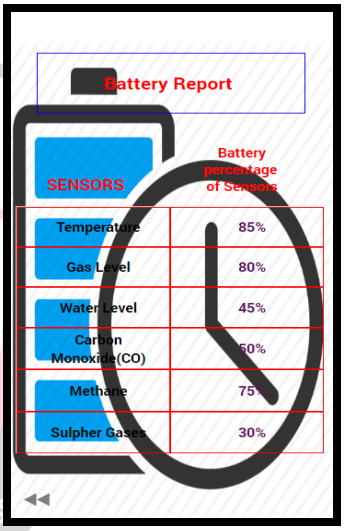

Figure12Battery Report

Module 4-

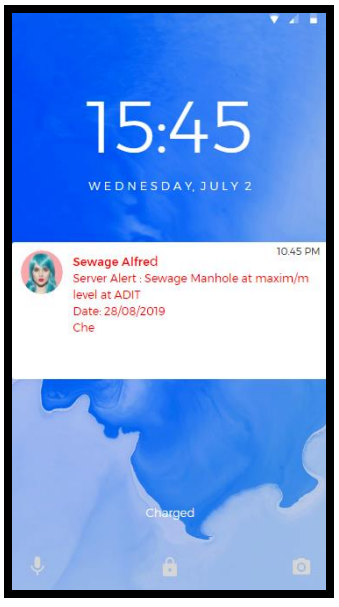

Figure 13 Notification

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Module 5-[1]

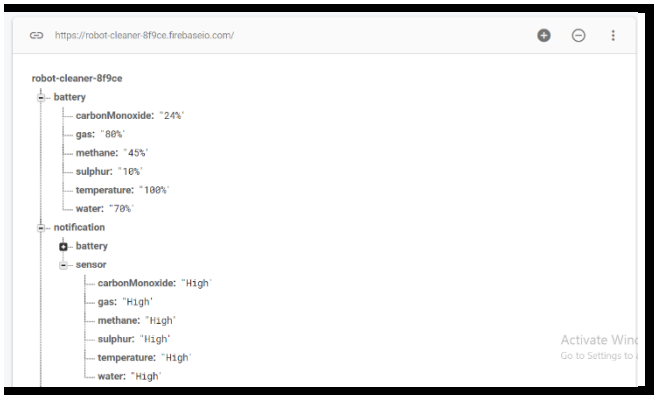

Figure 14 Battery & Notification Database

VIII. ADVANTAGES

1. Increment in safety precautions for manual cleaning
2. Real time monitoring and analysis of whole drainage system
3. Detecting the pollutants, we can determine the level of risk in deploying the workers in particular manhole
4. Battery monitoring for easy maintenance
5. Easy interpretable GUI for every type of users
6. Automation and alerting in case for emergency and potential hazardous situations.

IX. LIMITATIONS AND FUTURE WORK

In the future after securing underground drainages from harmful gases and other contaminants. We can go to work on another issue that is sewage water overflows in which divert wastages from the busiest sewage line to others which are capable of flowing that extra sewage waste. In the future, our idea will be concentrating on the consumption of water which is other main issue or else automating whole sewage cleaning system with help of robotics and monitoring wastes before dumping it into sea whether it is harmful to marine flora and fauna , If someone go against dumping rules we can track them and penalty can be sent with minimal manual help.

X. CONCLUSION

The Underground monitoring is a challenging problem. This project proposes different methods for monitoring and managing underground drainage systems. It explains various applications like underground drainage and manhole identification in real time. Various parameters like temperature, toxic gases, flow and level of water are being monitored and updated on the internet using the Internet of Things. This enables the person in-charge to take the necessary actions regarding the same. In this way the unnecessary trips of sewage workers are saved and can only be conducted as and when required. Also, real time updates on the internet helps in maintaining the regularity in drainage check thus avoiding the hazards.

XI. REFERENCES

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