

# Manhole Monitoring System

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**Abstract** - - A smart city is the future goal to have cleaner and better amenities for the society. Smart underground infrastructure is an important feature to be considered while implementing a smart city. Drainage system monitoring plays a vital role in keeping the city clean and healthy. Since manual monitoring is incompetent, this leads to slow handling of problems in drainage and consumes more time to solve. To mitigate all these issues, the system using a wireless sensor network, consisting of sensor nodes is designed. The proposed system is low cost, low maintenance, IoT based real time which alerts the managing station through message when any manhole crosses its threshold values. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the public.

**Keywords** – Drainage monitoring system, IOT, Monitoring smart city

## I. INTRODUCTION

An integral part of any drainage system is the access points into it when it comes to cleaning, clearing, and inspection. Metropolitan cities have adopted underground drainage system and the city's municipal corporation must maintain its cleanliness. If the sewage maintenance is not proper, ground water gets contaminated causing infectious diseases. Blockages in drains during monsoon season, causes problems in the routine of the public. Hence, there should be a facility in the city's corporation, which alerts the officials about blockages in sewers, their exact location. It mainly acknowledges in the field of alerting the people about the gas explosion, increase in the water level and the temperature level. It uses IoT to make the drainage monitoring system in a highly automotive by using sensor for detecting and sending alerts GSM module to the authorities. This project overcomes the demerits by detecting drainage water blockage by installing water flow rate sensors at the intersection of nodes. When there is a blockage in a particular node, there is variation in the flow of drainage water which when cross the set value will display the alert in the managing station. Other demerits are solved by detecting temperature variations inside the manhole and alerting the same to the managing station. Also, flow rate sensors are used to detect the over flow of the drainage water and alerting the same to the managing station through automatic message. Maintenance of manholes manually is tedious and dangerous due to the poor environmental conditions inside so, the main focus of this project is to provide a system which monitors water level, atmospheric temperature, water flow and toxic gases. If drainage gets blocked and sewage water overflows, it is sensed by the sensors and message is sent to the municipal. It is, therefore dangerous to go inside the manholes for inspection of its current state. To solve all the problems related to underground sanitation, a remote alarm system is

necessary for transmitting data collected by the sensors set inside the manhole to the managing station. This includes components such as controller, memory, transceiver and battery to supply power.

## II. LITERATURE REVIEW

[1] In 2020 He-sheng Zhang; Lei Li; Xuan Liu worked on "Development and Test of Manhole Cover Monitoring Device Using LoRa and Accelerometer". The monitoring device is installed under the manhole cover, three key problems, how to measure the tilt angle or state of resources. For the second problem, long range (LoRa) is adopted. A 433-MHz whip antenna is designed to overcome the shield of manhole cover and the absorption of electromagnetic waves of the earth. The field tests show that the effective communication distance has been extended more than 700 m by using the whip antenna. In addition, the parameter spreading factor (SF) and bandwidth (BW) are configured. For the third problem, sleep mode is used and input output (IO) pin is configured

[2] In 2018 W.Z.Black; Robert E.Snodgrass; Bryan P.Walsh worked on Thermodynamic Analysis of Explosive Events in Manholes and Electrical Vaults. A computer code is used to simulate the conditions that exist during a manhole event consisting of an electrical fault and a gas explosion. When energy is generated within the structure, pressures can reach levels sufficient to propel the cover from its frame. The code quantifies the effects of the event and provides guidelines for the design of safety devices that can minimize the potential danger of the event. Differences between chemically-driven and electrically-driven events are shown to require different design criteria for cover restraint systems. Devices designed to restrain the cover must be able to withstand explosive forces and react in sufficient time to reduce internally generated pressures.

[3] In 2019 Glen Bertini worked on "Manhole explosion and its root causes". The phrase "manhole events" is a euphemism for fires and explosions that occur in utility manholes in urban areas. All fires and explosions require three elements: fuel, oxygen (or another oxidizer), and an ignition source. Further, the fuel and oxygen must be within a specified range of concentrations to support combustion. Figure 1 lists most of the significant compounds (flammable or not) that are likely to be encountered in a manhole environment and, where applicable, their upper and lower explosive limits (UELS and LELs, respectively).

[4] In 2018 N Nataraja; R Amruthavarshini; N L Chaitra; K Jyothi; N Krupaa; S S M Saquaf worked on

“Secure Manhole Monitoring system Employing sensor and GSM Techniques”. Nowadays manhole problems in the populated cities is the major issues. Opening of manholes due to breakage of manhole cover, manhole explosions are major threat in recent days. Manhole cover opening leads to accidental fall of vehicles, pedestrians leading to accidents or loss of life. Manhole opening detection and alerting is mainly based on detecting the manholes which are opened due to overflow of sewage / rain water during heavy rainfall and alerting When a manhole opening is detected either due to overflow of sewage water, increase in pressure or temperature, it leads to the breakage of the manhole lids. To avoid such incidents even before it could affect the public, an alerting system is built wherein the buzzer alerts the surrounding and sends the sensed data to the managing authorities using GSM techniques. So, they can take precautionary action to close the manhole considering public safety.

[5] In 2016 Sugato Ghosh; Indranil Das; Deepanjana Adak; Nillohit Mukherjee; Raghunath Bhattacharyya worked on “Development of selective and sensitive gas sensors for manhole gas detection”. worked on Loss of life of the workers inside manhole is a common problem for many parts of the world. To resolve this issue a portable, low cost, simple manhole gas detection unit has been designed and developed which is capable to detect the poisonous gases like carbon monoxide, hydrogen sulfide, and explosive gas like methane within a minute and raise alarm if the concentration of any gas is beyond the threshold limit.

### III. EXISTING METHOD

Detecting a struck in the manhole pipe, due to blockage of sludge in a pipe. It is also necessary to alert the concerned authorities in case of opened/displaced/ breakage of manhole lids for necessary and immediate action. This enables to maintain a safe and user-friendly environment. To monitor water level in manhole sensors are to be deployed which will detect and transmit necessary data for immediate attention to clear the clogs well before it over flows.

### DISADVANTAGES OF EXISTING SYSTEM

In this system, the Open manhole cause flooding in the area. Flooding itself may displace populations and lead to further health problems. This means high labour cost and time consumption. Many times, the data is not maintained properly due to manual entering of the data in the registers or systems. Poor drainage often occurs when contractors remove topsoil during construction of new homes, leaving only subsoil. Chance of mixing of groundwater and drainage water .if not taken proper care.

## IV. METHODOLOGY OF PROPOSED SYSTEM

A new automated system is presented to solve the aforementioned shortcomings. The manhole is monitored by sensors in the proposed system, and data is automatically updated on a remote server. The microcontroller Arduino Mega interfaced with the several types of sensors (flow, level, temperature, and gas sensors). When the various sensors hit the threshold level, the microcontroller receives an indicator of that value and sensor is being sent to the microcontroller. Furthermore, Arduino Mega then sends the signal and location of the manhole to the municipal corporation through Alert and the officials could easily locate which manhole is having the problem and could take appropriate steps. Also, Arduino Mega updates the live values of all the sensors. We have included an array of sensors for complete monitoring of the manhole cover so that such accidents can be prevented. This project includes a gas cover to monitor the gas emitted from the sewage systems so that toxicity can be monitored, the internal temperature is also monitored if a check for a change in the temperature as the property of manhole change with temperature which could need to crack formation, a tilt sensor is introduced to indicate whether the manhole can tilt.

### A. GPS interface with microcontroller

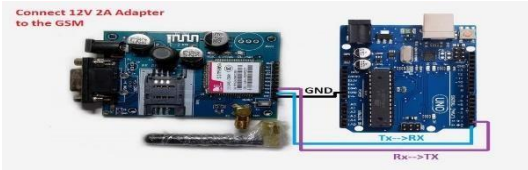
The system is equipped with GPS. This GPS is a made-up location that can hold data in the form of a link. The information to be added to the link is the location of the plugged manhole. The result is then accessed via a web server on a PC/Laptop.

Along with the arduino mega, which is placed in a manhole, the GPS is bannered. The location is communicated to the web server and can be viewed there.

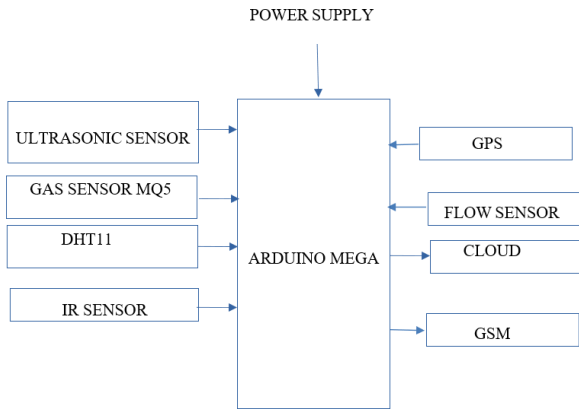


### B. GSM interface with microcontroller

The system is equipped with GSM module. There are different kinds of GSM modules available on the market. We are using the most popular module based on Simcom SIM900 and Arduino Uno for this tutorial. Interfacing a GSM module to Arduino is pretty simple. You only need to make 3 connections between the gsm module and Arduino. the first method, you have to connect the Tx pin of the GSM module to the Rx pin of Arduino and the Rx pin of the GSM module to the Tx pin of Arduino. GSM Tx->Arduino Rx and GSM Rx->Arduino Tx. Now connect the ground pin of Arduino to the ground pin of the gsm module.



V. BLOCK DIAGRAM OF THE PROPOSED SYSTEM



VI. ALGORITHM

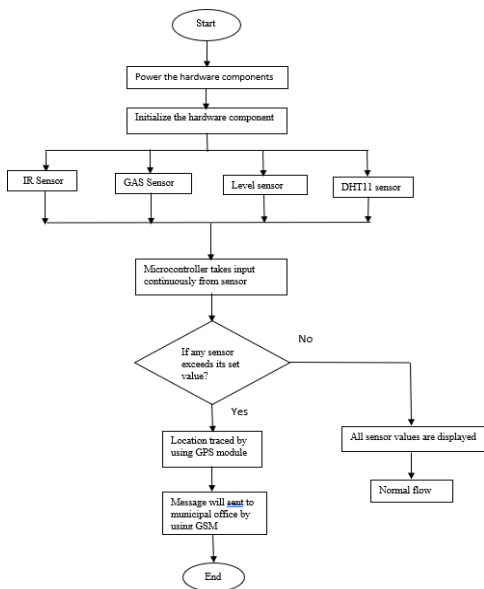


Fig Flow diagram

VII. RESULT

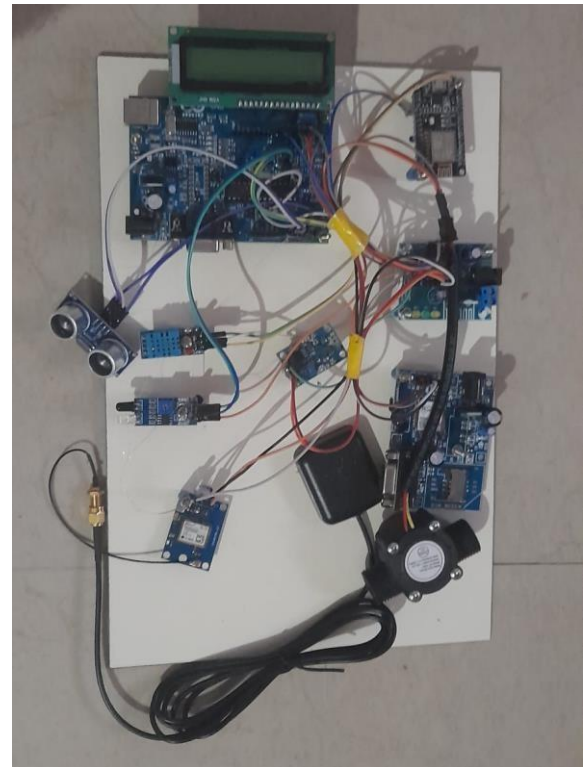


Fig The setup of proposed system

The prototype of smart drainage system the sensors sense the information and report that information to Arduino Mega. The gas sensor senses the harmful gases; water flow rate sensor will check the flow of water and also check the level of water and sends the values to the Arduino Mega. It designed with inbuilt wifi module will process the information sent by the all the sensors and store that information in the cloud. Also that value will be displayed in web server. The recorded values will be displayed in 16X2 LCD .If sensed values exceed the threshold values then sends information to local municipal officer and directly to the concern area worker via SMS .The worker directly can check the status of Drainage system in their smart phone using web page and also via SMS Alert. they can take further action based on the status and also they can identify the location.



Fig LCD display of Drainage block .



Fig LCD display

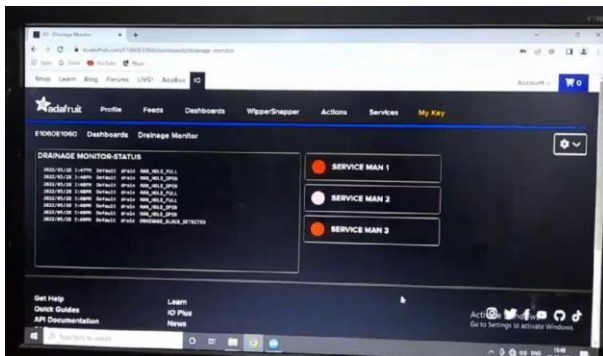


Fig web page alerts

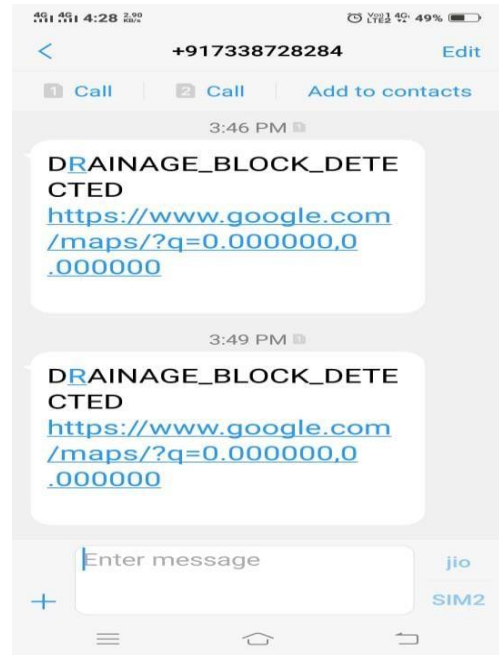
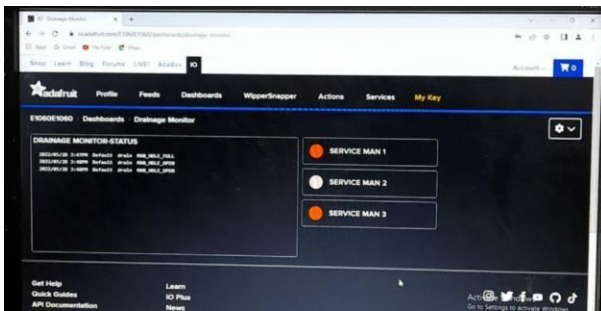


Fig SMS alert of manhole block detected



### VIII. CONCLUSION

This project proposes different methods for monitoring and managing underground drainage system. 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 on the manholes are saved and can only be conducted as and when required. Also, real time update on the internet helps in maintaining the regularity in drainage check thus avoid the hazards. Our project helps to reduce the problem of drainage system with the help of sensors like water level detection sensor and gas sensor our mechanism helps to notify the connected network, when the harmful gases are detected to gas sensor .By this project the underground drainage system can be easily organized

### IX. FUTURE SCOPE

A new method combined with multi-view matching and feature extraction technique is developed to detect manhole covers on the streets using close-range images combined with IMU and LINDAR data. The covers are an important target on the road traffic as same as transport signs, traffic lights and zebra crossing but with more unified shapes. However, the different shoot angle and distance, ground material, complex street scene especially its shadow, and cars in the road have a great impact on the cover detection rate. The paper introduces a new method in edge detection and feature extraction in order to overcome these difficulties and greatly improve the detection rate.

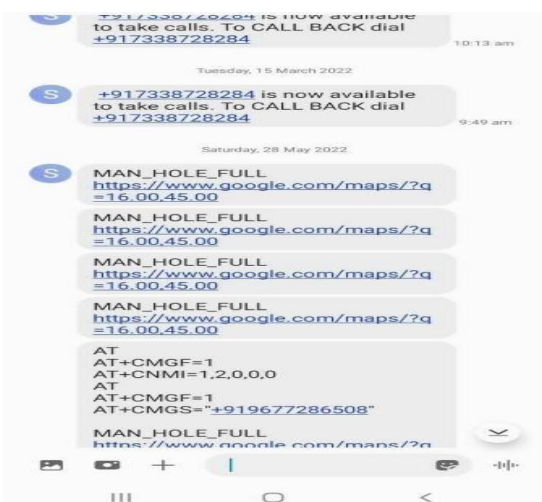


Fig SMS Alert of manhole filled

## X. REFERENCES

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