

## SMART MANHOLES SYSTEM USING IOT

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**Abstract:** *The Internet of Things (IoT) consists of real life objects, communication devices attached to sensor networks in order to provide communication and automated actions between real world and information world. IoT came into existence because, without human interaction computers were able to access data from objects and devices, but it was aimed at, to overcome the limiting factors of human entered data, and to achieve cost, accuracy and generality factors. Sensor Network is a key enabler for IoT paradigm. The system represents the implementation and design function of an Underground Drainage and Manhole Monitoring System for IoT applications. The vital considerations of this design are low cost, low maintenance, fast deployment, and high number of sensors, long life-time and high quality of service. The proposed model provides a system of monitoring the water level inside a manhole and to check whether a manhole lid is open. It also notify to people who close to manhole when manhole is open. In real time, this can remotely monitor current states of the manholes.*

**Keywords:** *IOT, Ultrasonic sensor, Distributed System, protection from open manhole, Underground drainage and manhole monitoring system*

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### I. INTRODUCTION

Manhole which is meant to carry out inspection, cleaning and removing obstruction in the sewer line is also becoming the reason of accidents, taking lives and affecting them. Most of the systems in the developing countries are not automated. Most of the cities is currently using a poor underground drainage system and it is the duty of managing station to maintain cleanliness of the cities. If the drainage maintenance is not thorough, the pure water gets contaminated with drainage water and infectious diseases may get spread. The drainage gets blocked during rainy season, it might overflow and create problem for routine life such as traffic may get jammed, the environment becomes dirty, and consequently public become upset. Usually, manholes are covered with metal lids that keep it safe for passersby. If the lid is not closed properly, then there is a chance of accidents and also people may get fall into the drainage. Often during dark, people may not notice an open manhole which increases the number of accidents. There are several accident occurred in the past all over the world because of falling into the manholes. In 2016, a sanitary sewer cleaner was found dead after falling in a manhole in Humble, a city in Texas, USA. Another accident happened in Bengaluru, India, where four motorists fell due to damaged manhole cover in July 2017. In 2017, teenage girl died after falling into an open manhole in Gazipur, Bangladesh. In Bangladesh, it is reported that there are many open and unprotected manholes in the capital city and many accident occurrences has come to light. The manhole cleaning process is a big issue. The project depicts that manhole gas mixture found in the sewerage pipes is mainly containing toxic gases like, Carbon Monoxide(CO), Hydrogen Sulphide (H<sub>2</sub>S), Methane(CH<sub>4</sub>), Ammonia(NH<sub>3</sub>), Carbon Dioxide(CO<sub>2</sub>), Nitrogen Oxides, etc. Exposure to these gases may cause threats to human lives. Usually to clean the sewerage, a cleaner has to go down through the manhole and the presence of the toxic gases leads to serious health issues including Carbon Monoxide poisoning that causes death. Explosions in sewer have been occurred in almost every large cities. In 1916, an explosion occurred in a gate valve manhole in Montreal[5], in which two men were injured which was caused by an illuminated lantern that ignited the gases of manhole. Such explosions are usually followed by high rise in the temperature and pressure inside the manhole which can lead to smoke explosion. Giving less emphasis on monitoring manholes all over the country causes greater problems than it is realized. Automated manhole monitoring system lessens these problem stated above to some greater extent. The automated manhole monitoring system proposed in this project will help the OFFICIALS of Municipal Corporation by informing them immediately after garbage overflow and the exact location where the sewerage or manhole needs to be cleaned up. If at any time, the cover of the manhole gets lost or stolen, then the authority will be notified immediately by using the system. By using a motion detection system, human presence near an open manhole can be recognized and the system can warn people by triggering an alarm system. Thus, the manholes can be kept secured. The system will detect presence of poisonous gases and let the cleaners know the current state of the manhole environment by using an LED indicator. It will also monitor the fluctuation of temperature and pressure inside the manhole. The presented system in this project creates an user friendly environment to make life easy for every person walking on streets as well as people related to the maintenance of manholes, i.e. municipal OFFICIALS, sweepers, cleaners etc. The organization of the rest of the project is as follows. The previous work related to manhole monitoring system is presented in Section II, Section III represents the overall experimental environment of the system and the system architecture. Section IV discusses the

implemented system, the results of the experiment done. Finally, Section V concludes the project with a discussion about any DIFFICULTY that may be faced while implementing the whole idea in the system structure or the process that can be followed to ease the task.

**ARCHITECTURAL DESIGN:**

A description of the program architecture is presented. Subsystem design or Block diagram, Package Diagram, Deployment diagram with description is to be presented.

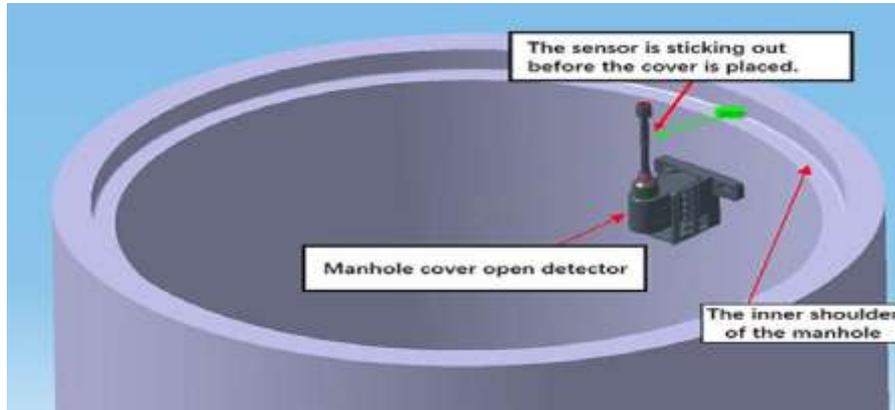


Fig.1 Architecture Design

**II. CONCEPTUAL DESIGN OF THE SYSTEM**

The automated manhole monitoring system helps with peoples’ anxiety while walking on the streets as accidents may occur because of the absence of the lid as well as it helps the accountable authority. The goal of this system is to establish an automated system to reduce accidents caused by the stealing of manhole covers by detecting open manholes, notifying the authority if a manhole is in danger of overflow and others. The system is intended mainly for the safety of the passersby and sweepers who work in the sewerage cleaning team. The proposed system will also help the proper authority of the city to monitor the conditions of all manholes remotely. The concerned authority to control the system and receive data or notification varies from countries to countries. For example, Bangladesh is subdivided into more than 200 municipalities [12]. Outside of Dhaka, Chittagong and Khulna, each municipality is directly responsible for its own water supply, sewerage and storm drainage. Water supply and sanitation in the three largest cities is carried out by semi-autonomous municipal utilities. In the cities of Dhaka, Chittagong and Khulna, the semi-autonomous Dhaka Water Supply and Sewerage Authority (DWASA), the Chittagong Water Supply and Sewerage Authority (CWASA) and the Khulna Water Supply and Sewerage Authority (KWASA) provide water and sanitation.

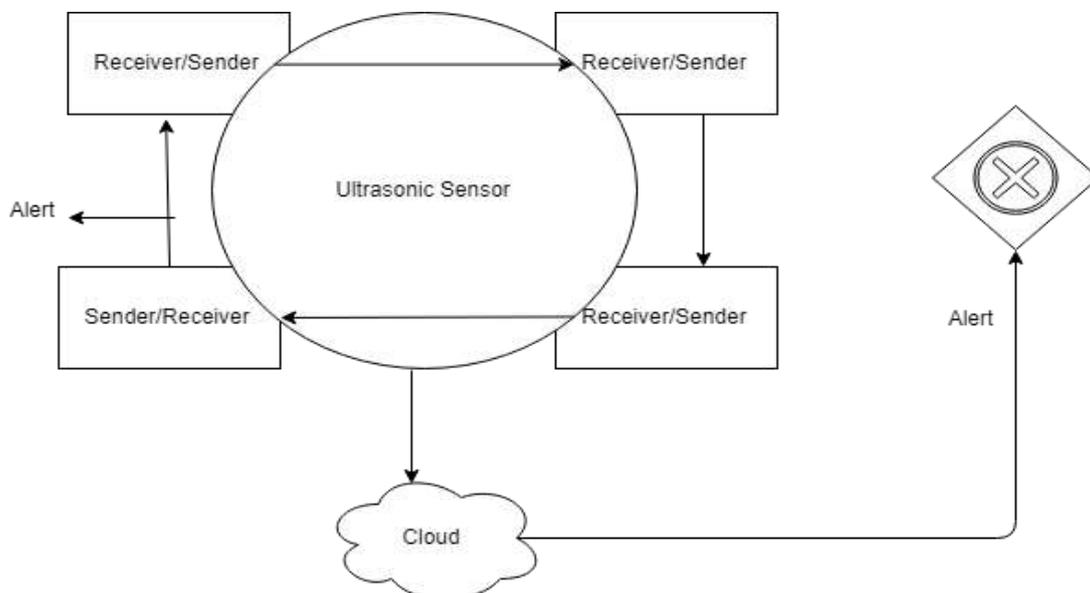


Fig.2 Block Diagram

An open manhole creates problem for the pedestrians. Hence, a method is used to detect the presence of the manhole cover on top of the manhole. In case of thievery, a notification will be sent to the concerned authority about the stolen lid with the location of the open manhole. Again, many a times people don't realize of missing manhole cover and accidents can occur. To prevent this, human presence is checked near the open manhole. Mainly, this is how the entire system is designed to work.

### COMPONENTS:

- **Cloud** :-A cloud server is a logical server that is built, hosted and delivered through a cloud computing platform over the Internet. Cloud servers possess and exhibit similar capabilities and functionality to a typical server but are accessed remotely from a cloud service provider.
- **Ultrasonic Sensor** :- As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.
- **Admin** :- When manhole open detected by system, the system send notification to the higher authority and if there any human being detected the alarm get start.
- Page Layout

### SYSTEM IMPLEMENTATION:

A prototype of the system was developed to test the working process of the system in an academic environment. The system includes a sensor circuitry, a processing unit and a database to store data. The sensor circuitry includes all the sensors that are necessary to detect temperature, environmental pressure, garbage overflow and excessive increase of lethal gasses etc. The processing unit processes all the data and takes decision of sending alert to the authority and storing data in the database. The database keeps information about all the variables to keep the authority updated about the current status of the manholes. The total system consisted of two major parts.

- 1) Database and Web Interface
- 2) Hardware Implementation

#### A. Database and Web Interface:

All the data from the sensor circuitry are read, processed and stored in the database. Then all the necessary decisions are taken based on the data. The database keeps all the information about all the variables to keep the authority updated about the current status of the manhole. The data is then imported from the database and shown in the implemented sample web interface in real time. A web interface has also been created to demonstrate how proper authorities can check the status of any manhole at any point of time. The website fetches data from the database and shows it to the user in a simple and understandable manner.

#### B. Hardware Implementation:

The hardware part includes sensor circuitry and processing unit. Micro controllers were used as processing units. Standard concrete manholes are of 48-inch diameter, minimum depth of four(4) feet and maximum depth of twenty(20) feet [13], measured from the rim to the invert of the manhole. A prototype of this exact size would not have been feasible so the size of the manhole in the prototype was reduced proportionately and the sensors and equipment were placed accordingly. Several test cases were experimented to check the results of the implemented system. To implement the proposed system, it required the following main components.

1. Temperature sensor
2. Alarm / Speaker
3. Ultrasonic sensor
4. GSM module

To detect the probable overflow of rain water or sewerage water, a water sensor was put inside one quarter height of the manhole. So, when the water reaches the three quarter height of the manhole and the water level touches the height of the sensor then the said system sends an SMS to the authority to clean it up in the previously mentioned manner.

**SCREENSHOTS:**



Fig 3:Temprature

In Above Fig show the Temperature get from the sensor under the Manholes and shows it. Temperature sensors are used to monitor electric power lines that are installed underground. Pressure sensors are deployed to avoid manhole explosions due to chemical release and electrical energy.



Fig 4:Humidity Display

In Above Fig Sensor get the value of Humidity and display it from the under the manholes.

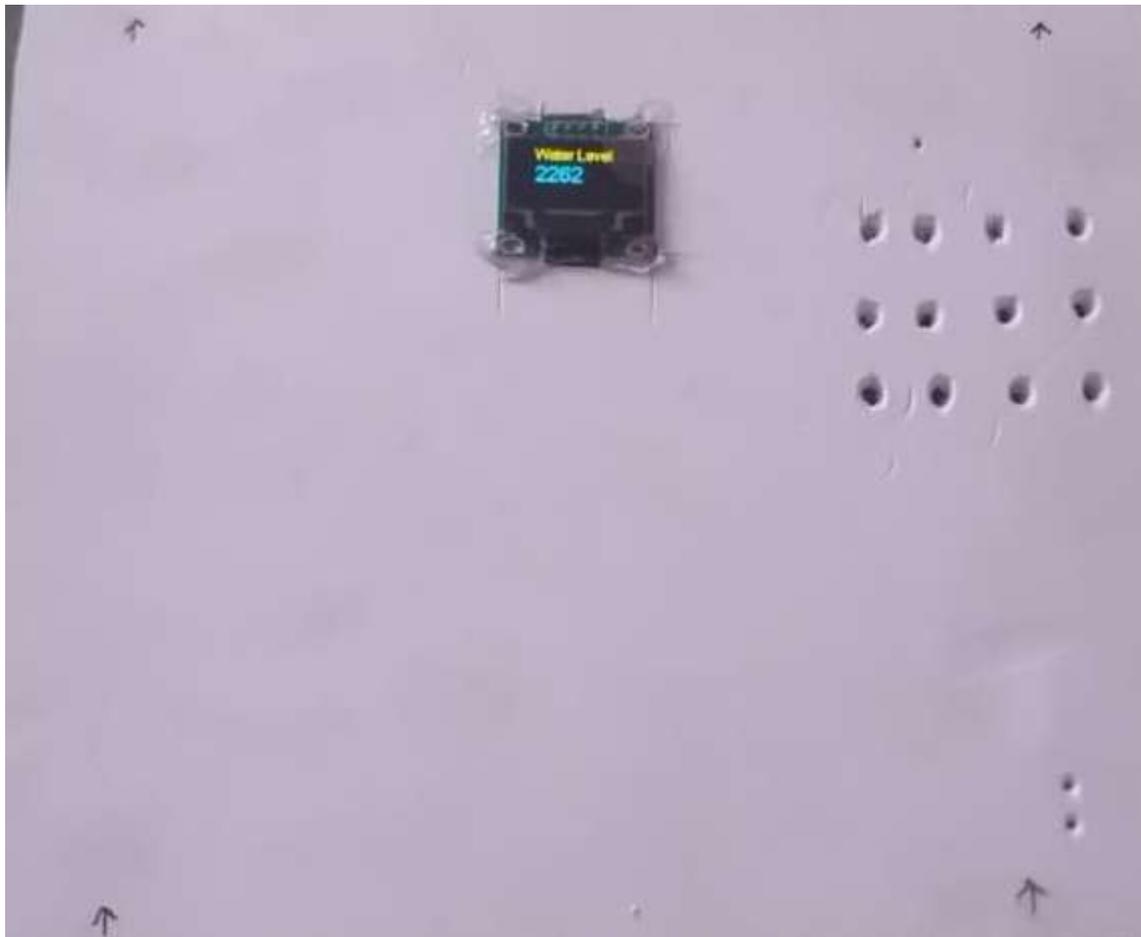


Fig:5 Water Level Display

In Above figure Shows the Water level under the manhole.

Uses a sensor attached within a sewer manhole to collect water-level data, and wireless communications that transmit this data.



Fig: 6 Motion Display

In Above figure it show the value of motion.

If the motion of a human or an animal is detected very close to the manhole chamber, such that the motion intrigues the sensing area of the sensor, then the sensor is activated electrical pulses are generated which is fed into the inverter circuit and the system is activated.

### CONCLUSION

The Automated Manhole Monitoring system if implemented properly can bring revolutionary changes in the environment as well as in the day-to-day life of people. The proposed system ensures securing the human lives of the passersby through prevention of accidents which has become a common occurrence nowadays. The Automated Manhole Monitoring system if implemented properly can bring revolutionary changes in the environment as well as in the day-to-day life of people. The proposed system ensures securing the human lives of the passersby through prevention of accidents which has become a common occurrence nowadays in Bangladesh and also other developing Countries. It prevents the very, considers safety of the sweepers and makes cleaning process easier by predicting unnecessary water and garbage overflow. While testing all the features, The reason behind this delay is that some sensor tends to create delays in operation and the WiFi module that is used in this particular system needs 500 milliseconds to execute a data exchange command. However, the delay is very less comparing with day-to-day life. Again, all sensors and equipment need to be water and dust proof so that they can sustain inside a man- hole. The main drawback of not using water and dust proof sensors are that they can easily get destroyed. Therefore, maintainability is a matter of concern.

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