

# Smart Manhole Toxic Gas Alerting System And Detoxification

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**Abstract :** Most of the time sewage systems are cleaned by the manual power. Manhole consists of toxic gases which causes health issues and fatal deaths. Sewage workers and other labor risks their health and life while working. Manholes are dangerous to environments that can quickly make a very big difference in environment lack of emergency response protocols and the absence of basic safety equipment leads to death. Contractors are using money for there need and cut the cost of jobs and not equip workers with ventilators, gloves, face masks and hard hats and not keep a person on standby on the outside to help in case of an emergency. The proposed system can easily sense the toxic gases and recognizes the scale of toxicants using MQ-2, MQ-3 ,MQ-7, MQ-135 gas sensors and then intimated to the workers to acquire the safety precautions before entering into the manholes. In order to reduce the toxic gases concentration, Sprinkler mechanism is provided with the resource chemical(sodium hypochlorite) for detoxification treatment. This system instantly reports the concerned authorities about the process took place while entering the manholes through SMS using GSM.

**Keywords :** MQ-2, MQ-3, MQ-7, MQ-135 gas sensors, Sodium Hypochlorite, GSM

## INTRODUCTION

Sewage workers continually risk their health and life to ensure upkeep of the sewerage system. But for years, they have received a little in return Despite proactive orders of the Supreme Court, the implementation of the directives remains unrealized, There are many deaths due to manhole toxic gases, we can see how these deaths leave the workers family alone and yet no one claims responsibility for the deaths.



Fig1. showing a person processing sewer work in manhole.

Due to decomposition of organic matters, industrial effluents, other sewage matters, gas is formed with the combination of different chemical mixtures. Sewer gases may include hydrogen sulphide, ammonia, methane, esters, carbon monoxide, sulphur dioxide and nitrogen oxides. Sewer gases can also potential to create fire or explosions severely apart from normal disturbance such as odour and health effects. Sewer gas consists of varying levels of toxic and non-toxic gases due to low oxygen content. It results from the decomposition of household and industrial waste, and it smells like rotten eggs. Hydrogen sulphide and ammonia are highly toxic components of this gas. Exposure to small levels of hydrogen sulphide irritates the eyes and respiratory tract. . It also causes headache, dizziness, drowsiness, nausea and nervousness. Exposure to high concentrations of hydrogen sulphide sometimes causes people to experience a loss of sense of smell. Sewer gas is fatal at extremely high levels. It contains methane, which decreases the amount of oxygen in the air and leads to suffocation. When oxygen deficiency occurs, a person is likely to experience headache, dizziness, nausea and unconsciousness. Death will occur directly once an individual is exposed to terribly low oxygen concentrations.

## I. LITERATURE SURVEY

Manholes are brutal environments that can quickly translate a callous attitude, lack of emergency response protocols and the absence of basic safety equipment to death. In this we need Embedded systems are computer systems designed to carry out certain tasks that are integrated with hardware. In this project embedded system interfaces sensors and module to microcontroller and connects different components to make it as a complete useable product. To further conclude we selected five papers for the literature survey of the proposed work. To summarize, we survey the current methods of gas detection and it's advantages and disadvantages. Various databases are composed of Manhole problems and to overcome the problem. To brief about the related work few papers as reference has been explained along with the base paper where in we state the methodologies merits and demerits of the chosen paper and we finally conclude the overall literature survey with the intended impact of the proposed work.

## II. SYSTEM DESIGN

One of the most important features of the project is designing the system. The design part provides all the different elements of the system such as architecture and components. System design solves the problem by splitting the components of the complex system into smaller components and will perform and operate on each individual component. Embedded systems are computer systems designed to carry out certain tasks that are integrated with hardware. In this project embedded system interfaces sensors and module to microcontroller and connects different components to make it as a complete useable product.

### A. BLOCK DIAGRAM

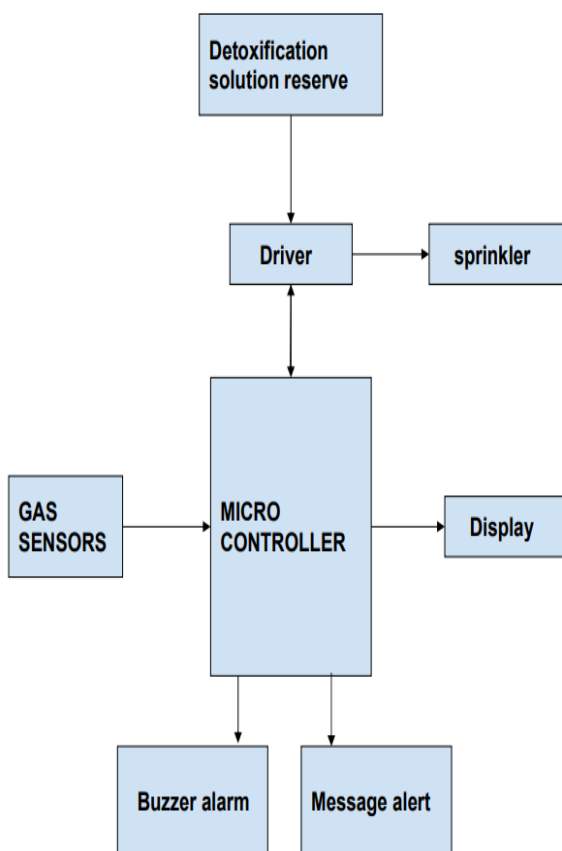


Fig 2. Block diagram showing the process of proposed work

## III. PROPOSED SYSTEM HARDWARE

**Gas Sensor (MQ-02):** MQ-2 is a gas sensor that detects flammable gases such as LPG, Propane, and Hydrogen with high sensitivity. MQ-2 was selected because of its low cost and suitability for a variety of uses, in addition to its high sensitivity.

**Sensor MQ-07:** This is a Carbon Monoxide (CO) sensor that is simple to use and effective in detecting carbon particles gas radiation that is visible all around. For detecting carbon particles gas radiation, the MQ-7 sensor has a range of 20 to 2000 PPM. This sensor has a high affectability and a fast response time.

**MQ-3 Gas Sensor:** The MQ-3 gas sensor's sensitive material is SnO<sub>2</sub>, which has a lower conductivity in clear air. When the target alcohol gas is present, the sensor's conductivity increases, as does the gas concentration. The MQ-3 gas sensor has a high sensitivity to alcohol and is resistant to gasoline, smoke, and vapor interference.

**MQ-135 sensor :** The MQ-135 Gas sensors are used in air quality control equipment and are suitable for detecting or measuring of NH<sub>3</sub>, NO<sub>x</sub>, Alcohol, Benzene, Smoke, CO<sub>2</sub>. The MQ-135 module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas.

**Microcontroller:** Here we are using Arduino Nano, The Arduino Nano is a small, user-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specifications of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-b micro-USB cable, or through a 9V battery.

**GSM Technology:** GSM is an open and digital cellular technology used for transmitting mobile voice and data services operate at the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands. GSM technology was developed as a digital system using the time division multiple access (TDMA) technique for communication purposes. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot.

**Display:** Here we are using LCD display, A Liquid-Crystal Display (LCD) is a flat-panel display that uses the light-modulating properties of liquid crystals combined with polarizers. A 16x2 LCD display is a basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. It is enough to display PPM level of the gas.

**Sprinkler Mechanism:** We are using sodium hypochlorite solution as a detoxification agent. To spray the solution we are using submersible mini water pump. This is a low cost, small size Submersible Pump Motor which can be operated from a 3 ~ 6V power supply. It can take up to 120 liters per hour with very low current consumption of 220mA.

#### IV. WORKING

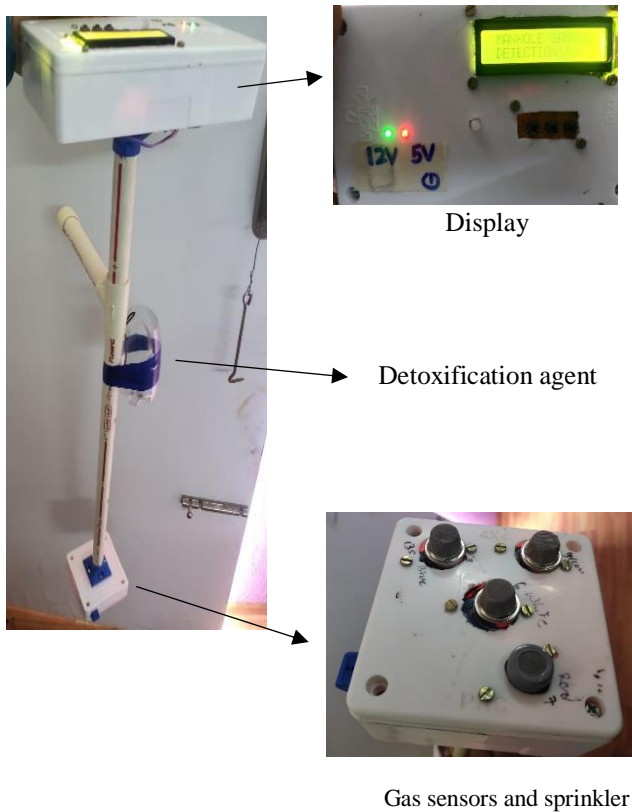
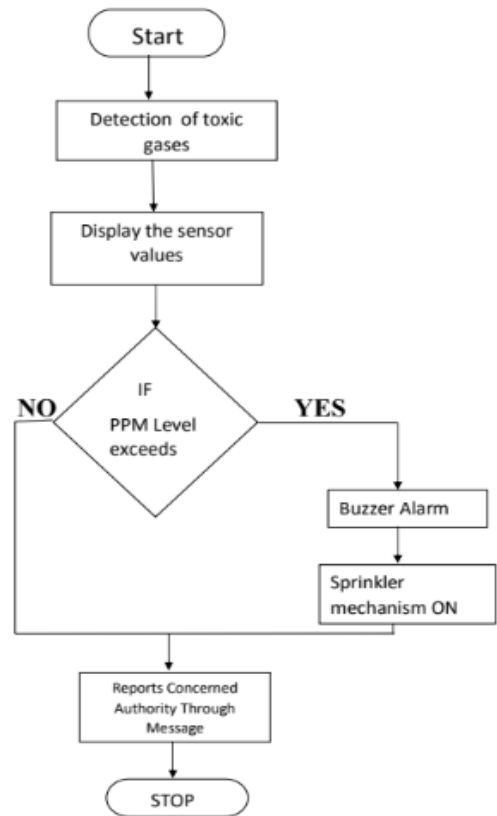


Fig 3. Hardware System

The model manhole safety system is used to measure the concentration levels of different toxic gases, such as Methane, Carbon Monoxide, LPG and Ammonia inside the manhole or Drainages. It incorporates a set of Gas sensors in order to measure the concentration levels of those gases. A microcontroller unit processes the sensor values and displays it. If a displayed value will be more than the specified value, intimation will be given to the worker through Buzzer module.

The concentration level of toxic gases exceeds the specified threshold value means, an actuator gets turn ON and its causes the sprinkler movement. It is preferred to reduce the toxic substance level for some instant. According to the level of concentration workers takes the necessary safety measures before they entered into the manhole. this system reports to the concerned authorities through the message alerts about the process while entering the manhole.

#### A. FLOWCHART



#### V. IMPLEMENTATION

The implementation of the proposed system becomes advantageous because of its simplicity due to the use of commercially available microcontroller manufacturing and portability. The application implemented on Arduino NANO board is to detect gas and display the PPM level and if the ppm level exceeds then sprinkler will be turn on.

The following is the process executed by the system.

- Start
- Sensors detects the toxic gases.
- Sensors ppm values will be displayed.
- If PPM level exceeds:
  - Buzzer alarm is initialized for workers.
  - Sprinkler mechanism will turn ON.
  - Report will be sent to the concerned authorities about the presence of gases.
- If PPM level does not exceeds:
  - Report will be sent to the concerned authorities that there is no presence of gases.

## VI. RESULTS

Sl.No	Name of the gas	Depth range(m)	Safe PPM level
1	Methene	2-6	80
2	Carbon Monoxide	4-6	50
3	Ammonia	8-10	50

Table 1. Gas concentration and Depth range

The device was developed and tested with gases, In order to test the device we created a test bed full of methane ,LPG and ammonia and we inserted the device, following are the result that we got from the test.

SL.No	Name of the gas	Virgin gas concentration (PPM)	After sprinkler mechanism concentration(PPM)
1	LPG	25	5.10
2	CH <sub>4</sub>	65	4.37
3	CO	-	-
4	NH <sub>4</sub>	10	0.08

Table 2. Gas concentration variation before and after mechanism

In the developed hardware system for analyzing gas concentration at sewage system has more advantages like easy to handle for labors, cost effective and convenient to use. In the developing countries like India, sewerage cleaning method should have some advancement in order to reduce the life risk of cleaning laborers.

The principal applications of the device are toxic gases detection, intimation and minimizing gas concentration level for favorable working conditions. From the test results, predominant gases present in the sewage manhole could to reduce with the help of suitable detoxification agent through the sprinkler mechanism, when the gas exceeds its threshold limits and can notify the government authorities through SMS.

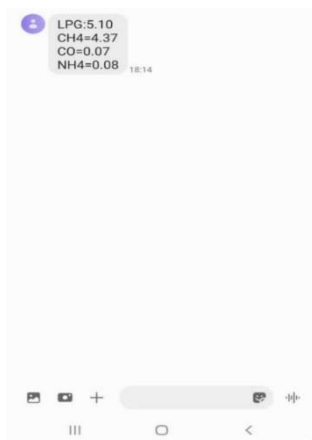


Fig 4. Message to government authority

## VII. CONCLUSION

This system detects the toxic gasses in the manhole and notify the workers and government authority and Automatically switch on the sprinkler containing detoxification agent. With the help of sensors, and gas leakage can be identified. Sensor unit automatically senses and updates the live values of ppm values of various toxic gases. We created a Microcontroller-based Continuous Toxic Gas Monitoring System for this project. We made the device small and inexpensive, and we used an LCD to display the hazardous gas values. Furthermore, the entire device has been engineered to be low-power, portable, and light-weight.

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