

# HAZARDOUS GAS DETECTION AND ALERT SYSTEM

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## Abstract

In India most of the cities adopted the underground drainage system. It's the duty of city Municipal Corporation to maintain the underground sewer properly. Manual scavengers are needed for cleaning and maintenance, but these peoples are not aware of poisonous gas present inside the manhole since the gas are odourless. If the sewer exposed to the hazardous gas present inside the manhole like carbon monoxide, hydrogen sulphide and methane may cause serious health issues, which may leads to death. To overcome all these problems effective monitoring system is needed to detect these hazardous gases in manhole. The detecting system is incorporated with gas sensors, which senses the respective gases. When the gas level exceeds the threshold level, the proposed system will give alert through the buzzer. The message will sent to the authorized officer through IoT.

## 1. Introduction

In the presence scenario the advancement of technology is in high scope and it is growing tremendously day by day. Though everything is getting easy by the help of technology yet in many fields the technology has failed to take its place and also play an important role in the safety of human lives. In many fields like municipal department, gas explosion and gases there is no proper safety taken to reduce the dangerous aspects associated with those problems. Considering those aspects and concentrating to one of those fields in particular i.e., in the field of manholes.

Presently due to pollution and health hazards, the environmental awareness and safety are primary concern where the domestic and industrial waste products are drained out through sewer pipeline. Due to the decomposition of waste products in the manholes several hazardous gases are formed such as ammonia(NH<sub>3</sub>), carbon dioxide(CO<sub>2</sub>), carbon monoxide(CO), methane, hydrogen sulphide (H<sub>2</sub>S), nitrogen oxide(NO) etc. These hazardous gases are always producing adverse effect to human health when the concentration of these gases exceeds threshold level it often leads to loss of human lives that is by inhaling these poisonous gases may cause fatigue, headache, dizziness, nausea, sometimes it may leads to death.

In INDIA about 60 million manholes are there. These manholes must be properly maintained, so scavengers are needed to clean or maintain the manhole. But manual scavenging is outlawed in India, yet thousands of people are still engaged in the work and many sewers died during maintenance of manholes. According to Safai Karamachari Andolan, a movement to eradicate manual scavenging, at least 1,470 manual scavengers died at work between 2010 and 2017. There are an estimated 1.8 lakh people in the country working as manual scavengers.

To overcome all these problems effective monitoring system is needed in the drainage channels. The detecting system is incorporated with gas sensors, which senses the respective gases. When the gas level exceeds the threshold level, the proposed system will give alert through the buzzer. The message will sent to the authorized officer through IoT.

### 1.1 Literature Survey

- In the year of 2008, LIU zhen-ya, WANG Zhen-dong and CHEN Rong, "Intelligent Residential Security Alarm and Remote Control System Based On Single Chip Computer", the paper focuses on, Intelligent residential burglar alarm, emergency alarm, fire alarm, toxic gas leakage remote automatic sound alarm and remote control system, which is based on 89c51 single chip computer. The system can perform an automatic alarm, which calls the police hotline number automatically. It can also be a voice alarm and shows alarm occurred address. This intelligent security system can be used control the electrical power remotely through telephone.

- In the year of 2008, Chen Peijiang and Jiang Xuehua, “Design and implementation of Remote Monitoring System Based on GSM”, this paper focuses on the wireless monitoring system, because the wireless remote monitoring system has more and more application, a remote monitoring system based on SMS through GSM. Based on the overall architecture of the system, the hardware and software architecture of the system is designed. In this system, the remote signal is transmitted through GSM network.
- In the year of 2006, Ioan Lita, Ion Bogdan Cioc and Daniel Alexandru Visan, “A New Approach of Automatic Localization System Using GPS and GSM/GPRS Transmission”, this paper focuses on, a low cost automotive localization system using GPS and GSM-SMS services, which provides the position of the vehicle on the driver’s or owner’s mobile phone as a short message (SMS) on his request. The system can be interconnected with the car alarm system which alerts the owner, on his mobile phone, about the events that occurs with his car when it is parked. The system is composed by a GPS receiver, a microcontroller and a GSM phone. In additional the system can be settled for acquiring and transmitting the information, whenever requested about automobile status and alerts the user about the vehicle started engine. The system can be used as a low cost solution for automobile position localizing as well as in car tracking system application.

## 2. Problem Statement and objective

- In early days candle was used to know the oxygen level before entering into the manhole. If candle light is sustained inside the manhole, then the scavengers enter into the manhole for cleaning and maintenance purpose. In this method only oxygen level is detected but there is a possibility of existence of hazardous gases like methane, carbon dioxide, carbon monoxide, ammonia, hydrogen sulphide etc., It leads to the death or any hazardous issue with the sewer one who enter the manhole.
- Later, another method was implemented to know about the other gas percentage in manhole i.e., chemical testing of the drainage sample. In this method the amount of gas is determined in the laboratory but it takes much time to know the result.
- Another preventive method to stop accident associated with the gas leakage is to install gas leakage detection kit at vulnerable places. This device is designed such that it can automatically detect and stop gas leakage in vulnerable premises. In particular gas sensor has been used which has high sensitivity for propane (C<sub>3</sub>H<sub>8</sub>) and butane (C<sub>4</sub>H<sub>10</sub>). Gas leakage system consists of GSM (Global System for mobile communications) module, which warns by sending SMS. But the problem is, it detects only two gases. Here GSM is used; it has disadvantages that it takes microseconds of time to send the SMS to the authorized person.

### OBJECTIVES:

- The main objective to implement this project is to design and develop a low cost, reliable and efficient technique to detect a hazardous gas.
- The aim of this project is to reduce the death causing due to the hazardous gas present in the manhole by incorporate an interactive medium between the authorized officer and maintenance workers to prevent the labor entering into the manhole without the knowledge of presence of hazardous gas.
- This is achieved by using different gas sensors to detect the hazardous gas. After sensing the different gas, the percentage of each gas is displayed in LCD and also send the message to the authorized person through IoT(Internet of Things). This system can be easily implemented in manholes, chemical industries etc., to avoid the danger in human lives.

## 2.1. Methodology and Technology Used

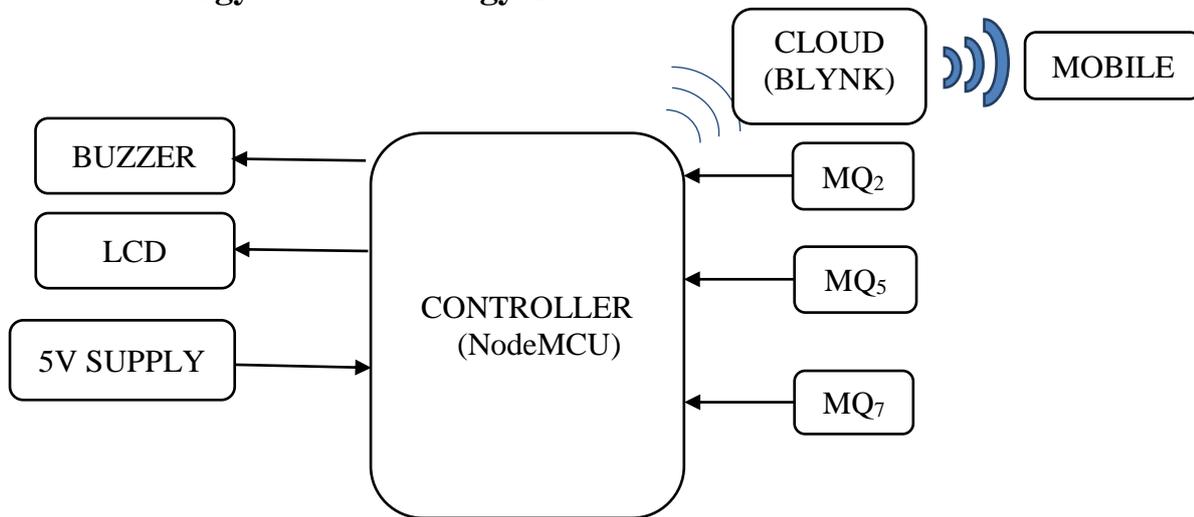


Fig 1. Block diagram of gas detection and alert system

The above block diagram shows the pictorial representation of Manhole Gas Detection System.

The gas is fed as the input to the respective sensors, the sensors detect the gases and that gas is processed into the form of an electronic signal in the signal conditioning circuit where the measurement of the signal can be made, then the signal is given to the microcontroller and the electronic signal is converted to digital form which shows the amount of gases present in that particular area. Firstly, we feed the program in the microcontroller by loading the Arduino program in the Arduino board. The microcontroller is programmed in such a way that the percentage of the hazardous gas will be displayed in the display unit.

If the amount or percentage of gas exceeds the permissible range then, the alert system gets energized and the buzzer will start beeping. Through IoT (Internet of Things) the message is sent to the authorized person.

## 3. Proposed System

The implementation of the project design can be divided into two parts.

- Hardware implementation
- Software implementation

The gas levels are sensed through the respective gas sensors (here MQ2, MQ7 and MQ135 are used for sensing ammonia, carbon dioxide, LPG and methane respectively for demonstration purposes) and it will send to the NodeMCU unit through the multiplexer (4051). The sensed gas levels are displayed in the mobile. If any one gas level exceeds the set point then an alarm is generated immediately and at the same time an alert message is sent to the authorizer officer through IOT.

### 3.1 Working Procedure

Hazardous gas detection and alert system is basically an application of an embedded system that makes things easy in the maintenance of manholes to provide safety for sewer workers.

To avoid the life-threatening of the people who maintain the manhole is the most prominent thing in the present scenario, thus to sense various hazardous gases present in the manhole are necessary.

The major hazardous gas present in the manholes are carbon dioxide, methane, ammonia and nitrogen oxide, to combine these gases the combination of 3 gas sensors are obtained those are MQ135, MQ2, MQ7 where MQ135 gas senses ammonia, sulphide and benzene, MQ2 senses carbon monoxide and nitrogen oxide, MQ7 senses LPG, methane, propane and carbon dioxide.

Firstly the sensor module is brought to the particular area where the air space is to be taken care of. Then the reset knob is operated so that the previous results are to be removed later the sensor senses the gases present in that particular area and is stored in the BLYNK platform if the gas is present in that area exceeds the hazardous range then the notification is sent to the mobiles through open source hardware platform BLYNK which says "The hazardous gas is detected". And if the amount of gas does not exceed the limit the notification says "The path is safe". Through this method the level of life-threatening can be controlled in an effective way.

#### 4. NodeMCU

NodeMCU is an open-source firmware and development kit that plays a vital role in designing your own IoT product using a few Lua script lines. Multiple GPIO pins on the board allow you to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications.

The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module. The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast scripting language that connects with a well-known developer community. And open source firmware gives the flexibility to edit, modify and rebuilt the existing module and keep changing the entire interface until succeeding in optimizing the module as per requirements.

USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication. Instead of the regular USB port, MicroUSB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board.

The board incorporates status LED that blinks and turns off immediately and giving the current status of the module if it is running properly when connected with the computer. The ability of module to establish a flawless Wi-Fi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry Pi.

#### NodeMCU Pinout:

NodeMCU comes with a number of GPIO Pins. Following figure shows the Pinout of the board.

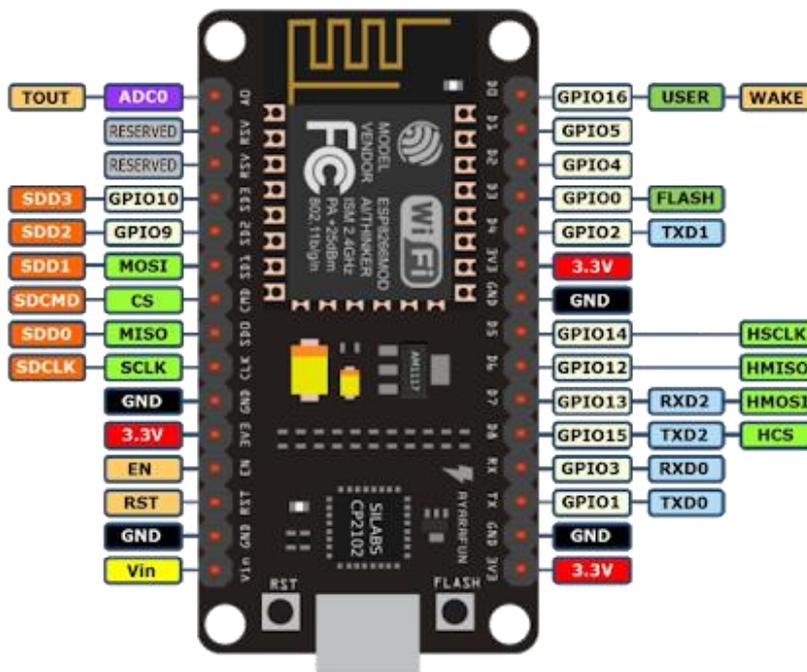


Fig.2 NodeMCU Pinout configuration

### NodeMCU Features:

- Open-source
- Arduino-like hardware
- Status LED
- MicroUSB port
- Reset/Flash buttons
- Interactive and Programmable
- Low cost
- ESP8266 with inbuilt Wi-Fi
- USB to UART converter
- GPIO pins

As mentioned above, a cable supporting micro USB port is used to connect the board. As connect the board with a computer, LED will flash.

### To Power NodeMCU:

It can be seen from the above fig 3.2.2, there are five ground pins and three 3V3 pins on the board. The board can be powered up using the following three ways.

- **USB Power.** It proves to an ideal choice for loading programs unless the project aim to design requires separate interface i.e. disconnected from the computer.
- **Provide 3.3V.** This is another great option to power up the module. If we have our own off-board regulator, we can generate an instant power source for our development kit.
- **Power Vin.** This is a voltage regulator that comes with the ability to support up to 800 mA. It can handle somewhere between 7 to 12 V. You cannot power the devices operating at 3.3 V, as this regulator unable to generate as low as 3.3V.

### Applications:

NodeMCU is mainly used in the Wi-Fi Applications which most of the other embedded modules fail to process unless incorporated with some external Wi-Fi protocol. Following are some major applications used for NodeMCU.

- Internet Smoked Alarm
- VR Tracker
- Octopod
- Serial Port Monitor
- ESP Lamp
- Incubator Controller
- IoT home automation
- Security Alarms



## 5. Conclusion

This paper has introduced an innovational approach for the hazardous gas detection and alert system. The toxic gases like methane, carbon monoxide, ammonia, hydrogen sulphide are sensed by the gas sensor (hardware design). When the normal levels of gases exceeds the data is sent to the receiver through IoT. If it exceeds the alert notification is sent to the authorized person. This system is highly reliable and cost effective.

## 6. Results and Discussions

The output obtained after all the working procedure is as described in the methodology. Due to the lack of time availability the model will have delay in output in the sense notification will be delayed sometimes. By this the thorough knowledge of interfacing the IoT module and the sensors and the other hardware components are gained. The users can improve the project by adding various aspects through continues working with present system.

## 6.1 Advantages

- The inspection is performed without any interruption of plant operation or personnel responsibilities.
- The time required to carry out the inspection is dramatically reduced, reducing the cost.
- IOT link use makes it more preferable over other designs.
- The operating speed of IOT is high compared to GSM.
- This project is easy to use and portable device.

## 6.2 Applications

- It is used to detect the gas in manhole, chemical manufacturing and processing, bio gas plant, leaking underground storage tanks, water and waste water treatment, food processing and cold storage.
- It can automatically detect and stop gas leakage in vulnerable premises.
- Free space exploration
- Domestic usage
- Health and life saving operation
- Also be used in remote areas using wheel Robot like mines and sewers.

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