# SMART SYSTEM FOR DRAINAGE WORKER SAFETY

**A PROJECT REPORT**

*Submitted by*

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## BONAFIDE CERTIFICATE

Certified that this project report " **SMART SYSTEM FOR DRAINAGE WORKER SAFETY"** is the bonafide work of " **R. SATHIYA KIRUBA (422516106037), T. SUBITHA (422516106043), A.TULIP IVELIN (422516106046), R.VARSHA (422516106047)"** Who carried out the project work under my supervision.

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# ABBREVIATIONS

1. CO - Carbon Monoxide
2. $CH_4$ - Methane
3. $H_2S$ - Hydrogen Sulfide
4. PPM - Parts Per Million
5. AR - Advanced Risc Machine
6. GSM - Global System for Mobile communication
7. IEEE - Institute of Electrical and Electronics Engineers
8. NN - Neural Network
9. Pd - Palladium
10. Mg/ml - milligrams per millilitre
11. QCM - Quartz Crystal Microbalance
12. ANN - Artificial Neural Network
13. IOT - Internet of Things
14. WSN - Wireless Sensor Network
15. LED - Light Emitting Diode
16. PID - Proportional Integral Derivative
17. USB - Universal Serial Bus
18. mmHg - millimetre of Mercury
19. RPM - Revolutions Per Minute
20. HZ - Hertz
21. LPG - Liquefied Petroleum Gas
22. LNG - Liquefied Natural Gas
23. DTR - Data Terminal Ready
24. VDD - Voltage Drain Drain
25. OEL - Occupational Exposure Limit
26. IDLH - Immediately Dangerous to Life or Health concentration

27.LEL - Lower Explosion Limit

28.UEL - Upper Explosion Limit

29.RS - Register Select

30.$V_{SS}$ - Voltage Source Supply

31.$V_{EE}$ - Voltage at Common Emitter

# ABSTRACT

Most of the cities adopted the underground drainage system and it’s the duty of municipal corporation to maintain healthy and safety of cities. If the drainage system is not properly managed, then pure water get contaminate with drainage water and infectious diseases may get spread. Drainage cleaning workers are not aware of risk of sudden attack of poisonous gas. Since, the gases are odourless if exposed for long time which may causes serious health problems. Due to the lack of using proper gas leakage detection system, a number of dangerous accidents occurs during the last few decade. To overcome all these problems, effective monitoring system is needed in the drainage channels. The detected system is proposed with these gas sensors like MQ4 sensor, methane sensor, hydrogen sulphide sensor. The gases could be detected with these sensors. CO, CH4, H2S gases are highly toxic to human hence the proposed system will give alert to the LCD display after reaching the threshold level of each gas sensors. Then, people get alert through the buzzer sound. Moreover, the drainage workers are supposed to provide with additional backup oxygen for their safety. The main theme of their project is to evacuate the gases in drainage and it could be performed with the help of Air sucking pump.

# CHAPTER 1

# INTRODUCTION

## 1.1 NEED FOR THE PROJECT

Drainage worker may be exposed to hazardous gases, fumes and vapors resulting in serious poisoning. Incidents of gas poisoning in drainage work often result in multiple death. The project is used to reduce the risks on eliminate it.

## 1.2 OBJECTIVE

To track the presence of hazardous gases, the most threatening among them namely carbon monoxide, methane, hydrogen sulfide present in drainage. To identify the safe limits of these gases and calculate the level in that situation, concentration of these toxic gases present in the air is identified accurately in ppm. To warn the workers about the potential threat that they might face on account of exposure of such gases above a safety limit. Evacuation of gases using Air sucking pump.

## 1.3 SMART DRAINAGE SYSTEM

The ardent passion towards contributing to the society in order to save human life was the main reason behind the origin of this project. Various articles which stated the numerous cessacions of human life while attempting to treat underground sewers intrigued our team to develop the model. For those who work in atmosphere that could be hazardous to their health, selecting the right gas detectors could be the single most important decision they could ever make. Their life could hinge on that decision .

So it is critical that the users make him aware of the hazards that could be encountered and the proper sensors to protect them. Data gathered in the late 70’s and early 80’s indicated that 65% of all those who died in confined spaces where unaware that the space they were entering was a potential hazard over 50% of confined space depths occur to the rescuers and over one third of the fatalities occurred after the space was tested and declared space and the gas detectors was removed.

Gas detectors have been around for a long time starting with the infamous methane sniffing canary, which sadly was a one-shot device, which when subjected to methane, tended to die rather quickly with no audio and visual along capabilities other than being slightly cheap and a total lack of motion. Fortunately, technology has advanced significantly and we find ourselves at this point in time with some sophisticated electronic equipment. But even the most sophisticated technology is useless if the sensors used are to detect the gases present.

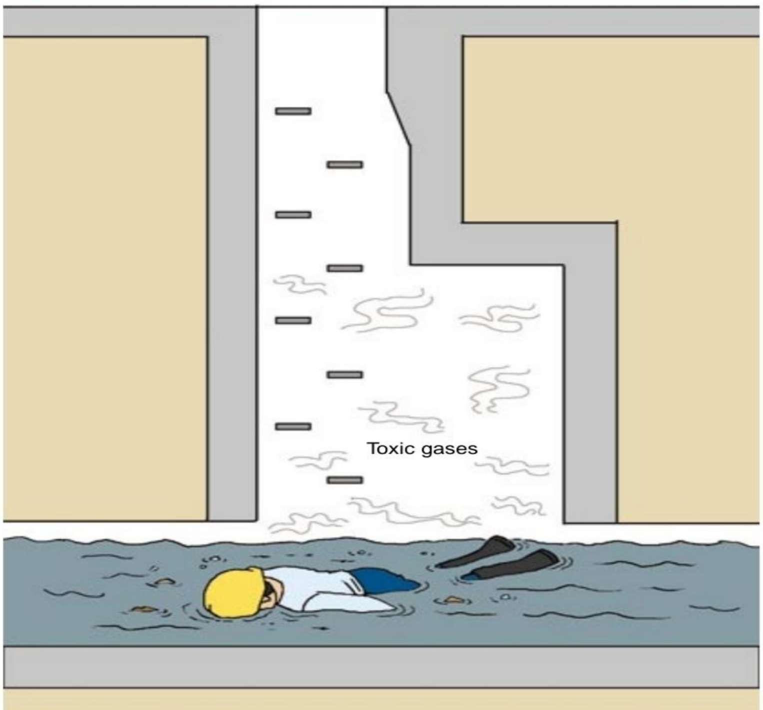



Figure 1.1 Death due to the attack of toxic gases

Such references and may more through light on the fact that the sewer gases contribute a major role in the mortality rate. Overall causal ratio may be small in comparison with others but is till not a good reason to ignore the situation as life, however small it may be till has to be valued.

Like this frequency happen when gas monitors either are used improperly or not used at all, manufactures tirelessly work to make their instruments easier to use in an effort to eliminate such tragedies but no matter how user friendly the instruments become, if employees do not we them properly. Deciding to use a gas detectors is a smart thing to do.

Sewage gas is a complex mixture of toxic and non-toxic gases produced and collected in sewage system the decomposition of organic household or industrial waste, typical components of sewage. Sewar gas may include hydrogen sulfide, carbon monoxide, methane and mineral spirits contributes to sewer gas hazard. Sewar gases are concerned due to their odour, health effort and potential for creating explosions.

In developing countries like India, the sewers are still cleaned by unskilled labourers. Situation may arise where the hazardous gases emitted by the sewage endanger their life.

In this paper, an embedded system is designed with ARM microcontroller and gas sensors for the purpose of detections and alerting that helps in eliminating the lives of human which is being endangered. This system is affordable to implement at well-defined monitored.

The sensing unit which has been develop which is capable to detect the toxic gases individually within a minute and generate buzzer sound if any of the gases is beyond its threshold limit. There gases could be evacuated using Air Sucking pump and again gas testing process will be produced for the workers safety. If all is cleaned, the worker is provided with backup oxygen and allowed to get into the drainage manholes and continuous measuring process will be carried out.

## 1.4 THE FREQUENT DEATHS OF INDIA'S SEWER WORKERS ISN'T A GOVERNANCE FAILURE-THEY ARE ROOTED IN CASTE

Based on a study of the International Labour Organisation, Delhi, it brings together stories of families whose members died during sewage cleaning, and also highlights failures in the implementation of the various laws to protect their rights, dignity and life. You might wonder why faceless and impoverished working men continue to die in sewers with unrelenting regularity – even in the National Capital Region – and why there seems nothing that Central, state and local governments do to end this. Some illuminating and gravely incriminating indications of what governments are not doing and should do come through in a significant and carefully researched .

The PUDR set out to investigate incidents of death of workers who died while cleaning sewers or septic tanks in the National Capital Regions of Delhi in incidents spanning two years. Their findings are remarkably similar to those which emerge from the stories which we have been reporting in these columns, based on our studies (by the Centre for Equity Studies and the International Labour Organisation).

The roll call of deaths in sewers and septic tanks which the PUDR team studied is grim and sobering, of desperately poor men, mostly of the most disadvantaged castes, but sometimes crossing religious divides, all profoundly dispensable lives in the glitter of new India's cities.

In the urban village Ghitorni in South West Delhi, Swarn Singh, Deepak, Anil, Balwinder died while cleaning septic tanks on July 15, 2017. A month later, on August 6, Joginder, Annu and a third unknown man were killed in Lajpat Nagar in South Delhi. Yet another month later, this time in a mall, the Aggarwal Fun City Mall in Anand Vihar in East Delhi, the lives of Mohammed Jahangir and Mohammed Ejaz were extinguished cleaning sewage on August 12.

The next month, on September 9, in DLF Capital Greens, Moti Nagar, New Delhi, sewage cleaners Umesh Tiwari, Mrityunjay Kumar Singh, Mohd Sarfaraz, Vishal and Pankaj Kumar Yadav lost their lives. The same month, on September 18, in the urban village of Mundka in West Delhi, Amarjeet and Makhan Lal were killed doing the same work. The last death studied by them was of Ganesh Saha and Deepak, some months later, on May 7, 2018, in Bhagya Vihar in West Delhi. Each of these workers dies while manually clean sewers, septic tanks and drains.

Figure 1.2 Manual Sewage Cleaning

## 1.5 UNDERLYING PROBLEMS

Broad patterns and contexts in which these incidents commonly occur emerge starkly from the PUDR study. The case studies divulge repetitive underlying problems that are overlooked by state authorities despite death after death. The report sheds crucial light on various aspects of the workers' lives and their labouring conditions, as well as the culpable fault-lines that define urban planning.

Figure 1.3 Workers in Drainage

The first of these is the absence of any arrangements and provisioning for scientific sewerage and septage systems and their regular and effective maintenance. There are swathes of entire areas and institutions in the capital region where state-laid sewerage lines either do not exist or if they do, these are completely inadequate and ill maintained. Sewage disposal is in effect left to the devices of individuals, with no official monitoring, regulation or authorisation operating on the ground.

According to the Sewerage Master Plan of National Capital Region, only about 50% of the population is covered by sewerage network, which suffers from disrepair, siltation and settling or collapse; and only about 57% of the total sewage generated by Delhi sewage is treated through 34 Waste Water Treatment Plants.

The rest of the sewage and waste water from unsewered areas and untreated sewage either flows into drains which mostly end up in the Yamuna River. Other unsewered areas rely on septic tanks. Waste water and faecal sludge accumulates in these tanks and regular cleaning is needed. This is what has led to a spike in the need for the services of sewage cleaning workers.

## 1.6 PRIVATE MAINTAINING

The PUDR report observes that large cities like Delhi maybe expected to have proportionately fewer septic tanks and greater sewerage reach than smaller urban centres. But this is true only for the relatively upmarket colonies of the metropolis. Since many of Delhi's urban areas are also "unauthorised", the precise numbers of such septic tanks are also difficult to establish. Even "authorised'' low-income settlements rarely have sewer lines and rely on septic tanks.

While at least officially, maintaining state sanctioned sewerage is supposed to be a public and municipal matter, septic tank maintenance is reduced effectively into a private responsibility, making both monitoring and ensuring safe practices more difficult.

Adequately linked water supply to support the city's sewerage infrastructure is essential – however, those who designed the government's ambitious policies on sanitation seem to have lost sight of the basic precondition of water supply. PUDR points to the fact that there are a total of 1,725 unauthorised colonies in Delhi, of which 1,230 of these got water pipelines by 2018. But the Delhi Jal Board, which had set a target of laying water pipelines in another 291 unauthorised colonies in 2018-'19 could only complete the work in 144 such localities.

This is essential to understanding the status of these colonies as far as sewerage linkage and toilet construction projects are concerned. It is yet to be seen how the recently decision by the Union government to give ownership rights to those living in 1,731 unauthorised colonies in Delhi will play out in terms of infrastructure and service delivery.

## 1.7 WORKING CONDITIONS IGNORED

Another aspect that policy makers and planners seem to have lost sight of in the much-touted policy push towards sanitation under the present regime is the need for continuous maintenance of sanitation systems and for safe working conditions for those involved in it. The Swachh Bharat Mission entails massive expansion of faecal sludge cleaning work which is, as mentioned, hazardous as well as brutal and stigmatising. The workers are required to work while being often literally immersed in filth, in faecal and other domestic and industrial sludge surrounded by poisonous gases emanating therefrom.

The deaths of workers while trying to keep sewer lines and septic tanks working, and the many ailments and diseases they suffer owing to the nature of the work are not cited once in the policy statements on sanitation.


Figure 1.4 Lack of Awareness

Even in Delhi's projected Sewerage Master Plan for 2031, PUDR notes, there is clear acceptance that some sewers that exist can be (at present and in the future) cleaned only manually and spacing of manholes in these are made accordingly. But no provision for recruiting sanitation workers for these operations has been made in the plan. This has been the practice so far, and as seen in the incidents discussed in the report, leads to completely ad hoc arrangements by which these workers are recruited, rooted in "traditional" caste-based attitudes and notions about sanitation work.

## 1.8 COMPARTMENTALISED APPROACH

In the Master Plan Report, the only way in which sewer and septic tank workers are referred to is extremely tangential as in the "Operations and Maintenance" section. Planners are evidently not required to take any responsibility for the lives and working conditions of those doing the work of maintenance. This peculiarly blinkered and compartmentalised approach of the state in urban planning – in which the design of the Capital's sewerage plan can be made without factoring in its maintenance, or the workers who risk their lives while doing this work, or the laws made to protect their interests, is largely responsible for these incidents.

In view of this, the frequency of their occurrence despite strong laws against such deployment, and the high probability of death of workers while doing this work, leads to a strong suspicion that these deaths are in some ways integral to and a by-product of the city's plan. Sewer/septic tank deaths in Delhi are predictable occurrences, bound to happen under these circumstances. They are chronic and systemic "accidents".

The complete absence of safety gear or provision of protective equipment, absence of training and adequate preparation for this kind of work, persistence of deployment of workers to clean sewers manually appears to be the norm – this is reflected in each one of these cases presented in the report. The workers had to do this work under compulsion – explicit or implicit.

## 1.9 DEATHS GO UNPUNISHED

The blatant denial of their rights persists because of their marginality. This is even more remarkable because the failures of legal redress and protection of these workers is not because of the absence of legal protections. In fact, because of the history of caste and organised resistance, India probably has more laws specifically related to sanitation workers than any other. Despite this plethora of laws, no death is followed by any kind of criminal legal action against those responsible for the deaths.

The PUDR study, as well our own, into a number of sewage worker deaths, never found criminal action taken against employers and contractors who place the lives of these unprotected workers, who do work the city cannot do without, but carry the shame and stigma of caste pollution, apart from the lack of any labour rights. Instead, the state is either absent after these deaths. Or if it is spurred to act by a movement and agitation about such incidents, all that the state does is – if at all - to grant financial compensation. There seems to be no clarity, or administrative will, to identify and prosecute the guilty.

This blinkered and chequered approach towards waste management in India's Capital is laid bare by the PUDR report. It exposes once again the complete failure of planners and policy makers to address the crucial question of maintenance of sewerage, septic tanks, and to provide for the safety, rights and dignity of the sanitation workers (inevitably drawn from the underclass/outcaste sections of society) involved in it.

This is not simply a governance oversight. It is fundamentally rooted in caste. It is caste-based attitudes towards filth, dirt and human and other waste and all those who handle it, which form the basis of the profound and pervasive official and societal callousness towards sanitation workers. It is the culture and philosophy of caste which validates the casual subjection of these workers to hazardous and humiliating manual labour of cleaning sewers and septic tanks. Ultimately caste still renders some human lives expendable.

## 1.10 HYDROGEN SULFIDE ($H_2S$)

Hydrogen sulfide is a deadly gas with a distinctive "rotten egg" odour that can be detected at very low concentrations. At concentrations above 100 ppm, hydrogen sulfide has a paralysing effect on the sense of smell. Even at lower concentrations, hydrogen sulfide can affect the olfactory nerve and workers cannot detect the changes in concentrations. Therefore, it is very dangerous to rely on the smell to detect the presence of hydrogen sulfide. A more reliable method for detecting hydrogen sulfide is by using a calibrated gas detector. An airborne concentration of hydrogen sulfide above 100 ppm is immediately dangerous to life or health and concentrations over 1,000 ppm could cause immediate collapse. As sewage is very often present in a drainage system, workers overcome by hydrogen sulfide could be easily killed by drowning.

## 1.11 CARBON MONOXIDE (CO)

The lethal colourless and odourless gas – carbon monoxide, is given off when charcoal is burnt in poorly ventilated areas. Similarly, it is produced when gasoline/diesel generators or other fuel-driven tools are used in inadequately ventilated workplaces. Exposure to carbon monoxide at concentrations over 350 ppm can cause confusion, fainting on exertion and collapse. An airborne concentration of carbon monoxide above 1,200 ppm is immediately dangerous to life or health.

## 1.12 METHANE ($CH_4$)

Methane is commonly generated when organic matter is decomposed by a variety of bacterial processes. It is a colourless, extremely flammable and explosive gas that can cause fire and explosion. The accumulation of methane in a poorly ventilated area will displace normal air and result in an oxygendeficient environment.

## 1.13 COMMON MISTAKES LEADING TO GAS POISONING INCIDENTS IN DRAINAGE WORK

Most gas poisoning incidents in drainage work occur as a result of improperly identifying the dangers of atmospheric hazards in the workspace or ignoring safety procedures so as to get the jobs done more quickly.

### 1.13.1 POOR EMERGENCY PREPAREDNESS

Incidents of gas poisoning in drainage work often result in multiple deaths because in such incidents, co-workers often instinctively enter the drainage immediately in an effort to help the collapsed victim and thus also succumb to the gas poisoning. Rescue should only be performed by trained personnel with appropriate equipment and support from other rescuers.

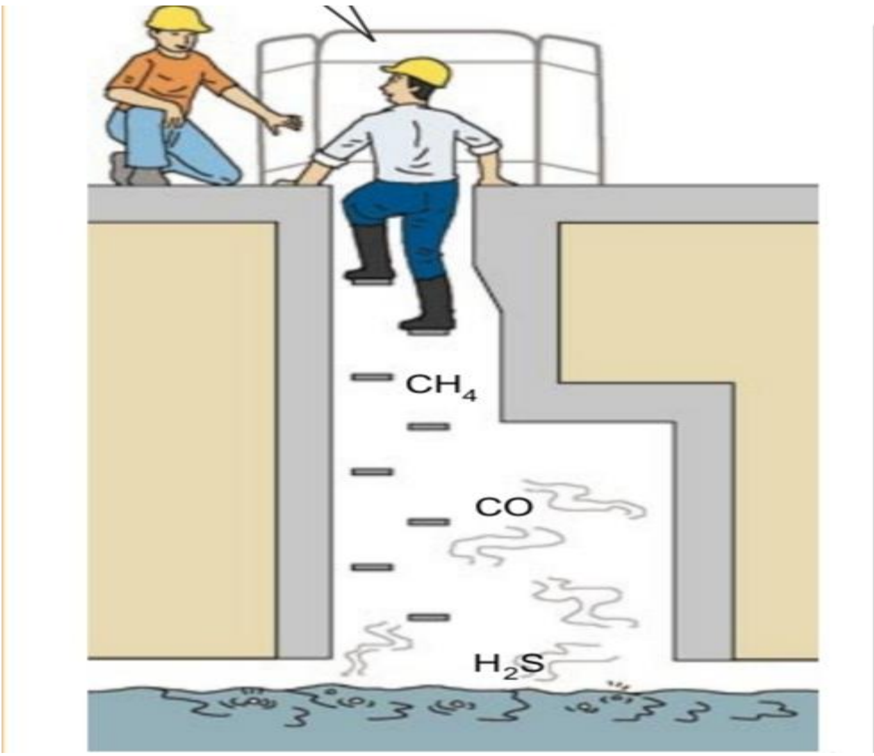



Figure 1.5 Do not rely on the smell to detect the presence of gases

## 1.14 ATMOSPHERIC HAZARDS IN DRAINAGE WORK

Drainage workers may be exposed to hazardous gases, fumes and vapours, resulting in serious poisoning. A good understanding of the related atmospheric hazards is essential for the prevention of gas poisoning.

### 1.14.1 SOURCES OF HAZARDOUS GASES, FUMES OR VAPOURS

Hazardous gases may be present naturally in a drainage system. However, some may arise from the work being carried out. The enclosed nature of the workspace may increase the danger, as hazardous gases can accumulate in the work area and their concentrations in air can rise rapidly. Typical sources of hazardous gases present in drainage work include the following:

- Decomposition of organic matters in sewers, manholes and pits of the drainage system will generate methane and/or hydrogen sulphide. Hydrogen sulphide, being very soluble in water, often dissolves in sewage and can be trapped within sediment and sludge in sewers as gas pockets. Disturbing the sewage, sediment or sludge can release the trapped or dissolved gas.
- Leaks from underground fuel tanks, gas utility pipes, connected sewer systems or contaminated land, such as landfills, may enter the work area.
- Use of generators and fuel-driven tools in poorly ventilated areas may use up oxygen and generate carbon monoxide. Apart from gases, hazardous fumes or vapours can be generated from the work.

## 1.15 FEASIBILITY

The overall cost of the components required by the system to work well is reduced to be as minimum as possible. The components needed for this system is publicly available. So that the prospective users have no difficulty in finding the components required by the system.

# CHAPTER 2

# LITERATURE SURVEY

## 2.1 HUMAN SECURITY FROM DEATH DEFYING GASES USING AN INTELLIGENT SENSOR SYSTEM

In 2019, kumar visvam devados ambeth can be produced in this methods Hazardous gas contamination causes threat to human life. In many developing countries, the sewer are still cleaned by unskilled labours. Situation may arise where harmful gases may get emitted via sewage and can potentially endanger life. Furthermore, in coal mining, there is a possibility of hitting a source of natural gas which cannot be determined unless or until a sensor is utilized. To prevent such hazardous situations, this new gas detection system detects those types of gases, analyses them for us and provides essential details about it.

Our system is designed to track the presence of hazardous gases, identify the safety limit and calculate the level in the situation, thereby preventing hazards to human life. It allows detection of carbon monoxide and methane at the given time, along with their accurate concentration values in ppm. The system also provides a threat detection alert so that the persons immediately evacuate that area, thereby preventing any possible dangers. The alert messages are broadcasted using GSM technology and hence, can be used to notify other rescue workers about the potential hazard the workers is facing at the moment.

## 2.2 A STUDY ON QUANTITATIVE CLASSIFICATION OF BINARY GAS MIXTURE USING NETWORKS AND ADAPTIVE NEUROFUZZY INTERFERENCE SYSTEMS

In 2017 , Ali Gulbag, Fevzullah Temurtas came up with a new methods in , a study on the quantitative classification of volatile organic gas mixtures was made using parallel and cascade neural networks. A single neural network structure was also used for comparison. The quartz crystal microbalance type sensors were used to detect gas mixture. A computer controlled measurement and automation system with IEEE 448 card was used to control the gas concentration values and collect the sensor responses.

Steady-state frequency shifts were used as the input patterns for the neural network structures. The results obtained using parallel NN and cascade NN structures are better than those of the NN structures. It can easily optimize manufacturing process that require changes. They can store multiple profiles and data of many systems. Reliability get demaged and affect many system badly.

## 2.3 WAVELET CO-EFFICIENT TRAINED NEURAL NETWORK CLASSIFIER FOR IMPROVEMENT IN QUANTITATIVE CLASSIFICATION PERFORMANCE OF OXYGEN-PLASMA TREATED THICK FILM TIN OXIDE SENSORY ARRAY EXPOSED TO DIFFERENT ODOUR GAS

In 2016, R.Kumar to produce the process in laid before a new soft computational approach using multiscale principle component analysis for discrimination of gases. The network was found to identify the gas with high success rate. A new soft computational approach for discrimination of odors/ gases is presented. The proposed technique is applied on the raw data obtained from the responses of oxygen plasma treated thick film tin oxide sensor array exposed to four different odors/gases. The data generated from the sensor array response were subjected to wavelet transform and appropriate coefficients were selected using multiscale principal component analysis.

The training and test performances of back propagation trained neural network and radial basis function neural network have been compared. Both the network have been found to identify the odors/gases with a high success rate. Used to find precise linear combination of variable under investigation and to rank them according to their importance. Captured the simultaneously correlation among variable, but ignores serial correlation in data during normal operation.

## 2.4 ANALYSIS OF CO AND CH4 GAS MIXTURES BY USING A MICROMACHINED SENSOR ARRAY

In 2016, S Capone can be obtained this method , an array of highly sensitive and mechanically stable gas sensors based on different sol-gel fabricated Pd-doped $SnO_2$ nanocrystalline thick films has been developed for the analysis of ternary mixtures in the concentration ranges of 0-100 ppm CO, 0-4000 ppm $CH_4$ and 0-50% relative humidity. The selectively of the sensors has been modulated by varying the percentage of Pd content and the contacts geometry, while the use of micromachined hot plates as substrates for the sensors allowed a reduction a heater power consumption and a fast and accurate temperature control.

Principal component analysis as pattern recognition and principal component regression as multicomponent analysis method have been used to analyse these mixtures qualitatively and quantitatively obtaining good results. Proposed an array of highly sensitive and mechanically stable gas sensor based on different SOL-GEL fabricated pd doped. It can be used in vacuum rate of deposition and prediction process is quite precise rapid results under lower hertz. The detection was 3.0mg/ml, which is lower than the alimintarius common regulation reside limit 10mg/l.

## 2.5 FINDING THE COMPOSITION OF GAS MIXTURE BY A PHTHALOCYANINECOATED QCM SENSOR ARRAY AND AN ARTIFICIAL NEURAL NETWORK

In 2015, A. Ozmen the paper presents a system, which is made of an array of eight phthalocyanine-coated QCM sensors and an ANN to find the corresponding composition of a gas mixture. The digital data collected from the sensor responses were preprocessed by a sliding window algorithm, and then used to train a three layer ANN to determine the gas compositions. The system is tested with the following gas mixtures 1.ethanol-acetone, 2. Ethanol-trichloroethylene, 3. Acetone-trichloroethylene.

The success rate of the system in identifying the constituent component amounts is 84.5 and 94.3%. Similarly, overall average prediction error is 10.6%. Presented a system which is made of an array of light phthalocyanine-coated QCM sensory array and ANN to find the corresponding composition of gas mixture. Sensors are packaged at high density. Low thermal conductance, resistance change upon exposure to variety of gases.

## 2.6 HUMAN SAFETY SYSTEM IN DRAINAGE, UNUSED WELL AND GARBAGE ALERTING SYSTEM FOR SMART CITY

In 2014,V.S. Velladurai proposed a new methodology in safety plays a major role in today’s world and it is necessary that good safety systems are to be implemented in places of education and work. This work modifies the existing safety model installed in industries and this system can also be used in homes, villages, cities and officies. Most of the drainage and unused wells are forming toxic gases. The main objective of this work is designing, alerting system and gas purification. The hazardous gases like H2S, CO and methane will be sensed and displayed each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message is sent to the authorized person through the GSM.

The advantages of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation using gas purification process convert a toxic gases into pure air. The garbage alerting system is used to control the air pollution. All the gas sensor values are continuously monitoring through the mobile application using wifi module. This system is very much useful to make a city smart as well as reduce the human death.

## 2.7 EXPLOSION DETECTION AND DRAINAGE MONITORING BY AUTOMATION SYSTEM

In 2013, Dhanalakshmi can to produced the new technology in the internet of things connects all the surrounding smart device to internet. These devices use sensors and actuators to communicate with each other across the internet. IOT helps to control and sense the object remotely over the exiting network, so that it has direct integration of physical world to computer based world. The traditional drainage monitoring system failed to acknowledge in the field of alerting the people about the gas explosion, increase in the water level and the opened lid.

Therefore, we have used the IoT technology to make drainage monitoring system in a highly automative by using sensor for detecting the sending alert messages to the authorities, the data in the cloud and displaying the details in the web browser.

Thus, the proposed system helps in predicting the dangerous situation in drainage system.

## 2.8 LIMITATIONS

- It can easily optimize manufacturing process that require changes. They can store multiple profiles and data of many many systems. Reliability get damaged and affect many system badly.
- Effective self learning mechanism. Reduce computational complexity by architectural modification. Half applications in problems with large input.
- Sensors are packaged at high density. Low thermal conductance. Resistance change upon exposure to variety of gases.

## 2.9 SUMMARY

Numerous studies involving the detection of toxic gas have been carried out with non-invasive technologies, various technique for rapid and precise estimation of toxic content in the gases have been investigated, wavelet coefficient and artificial neural network are the most important and commonly used methods. For predicting the toxic content in the drainage, different types of methods are used, but it can be costly. The research mainly focuses on developing low cost and handiness for easily field use. The existing system mainly focused on the estimation of hazardous gases in the drainage manhole.

# CHAPTER 3

# SYSTEM ANALYSIS

## 3.1 EXISTING SYSTEM

The existing methodology is based on the IoT, which helps to save the life of the drainage workers while working by getting into the manholes. The mixture of poisonous gas will attack them when they try to get into the manhole to clean the drainage. This smart safety system will help to save the workers live and to keep the society clean. This may also monitor the society when the drainage is filled and automatically send the notification to the department so that they will send the concerned worker to clear and solve the blockage of the drainage system.

The sensor is placed under the drainage manhole and it is connected with the WSN so that the sensor sends the notification to the communication department so that they can send the concern team workers to find solutions to the problem. The second part is the major part the ensures the safety of the workers and the save the workers life. The existing process in the form of smart safety IoT device that is made up of raspberry pi which will control the gas sensor and display the gas level on the LED display.

The green light will glow that may confirm the gas level is normal if it is not in the normal level of gas the red light will glow so that workers can enter into the manholes with safety precautions. The device also contains an emergency button that will help to give the emergency notification to the communication department and emergency department via the WSN. That supposes the worker is attacked dangerous gas the man will press the emergency button that will send emergency notification to their department and emergency departments. So that without delay they can be saved.

### 3.1.1 DRAWBACKS

The inherent nature of WSNs introduces practical issues with their deployment. These networks are comprised of low-energy and low-range devices-they need to be inexpensive because there are frequently so much of them deployed in the same network. Some engineers have discovered that periodically toggling the power on the sensor node can extend their operational lifetime, but this practice can lead to network latency and routing overhead.

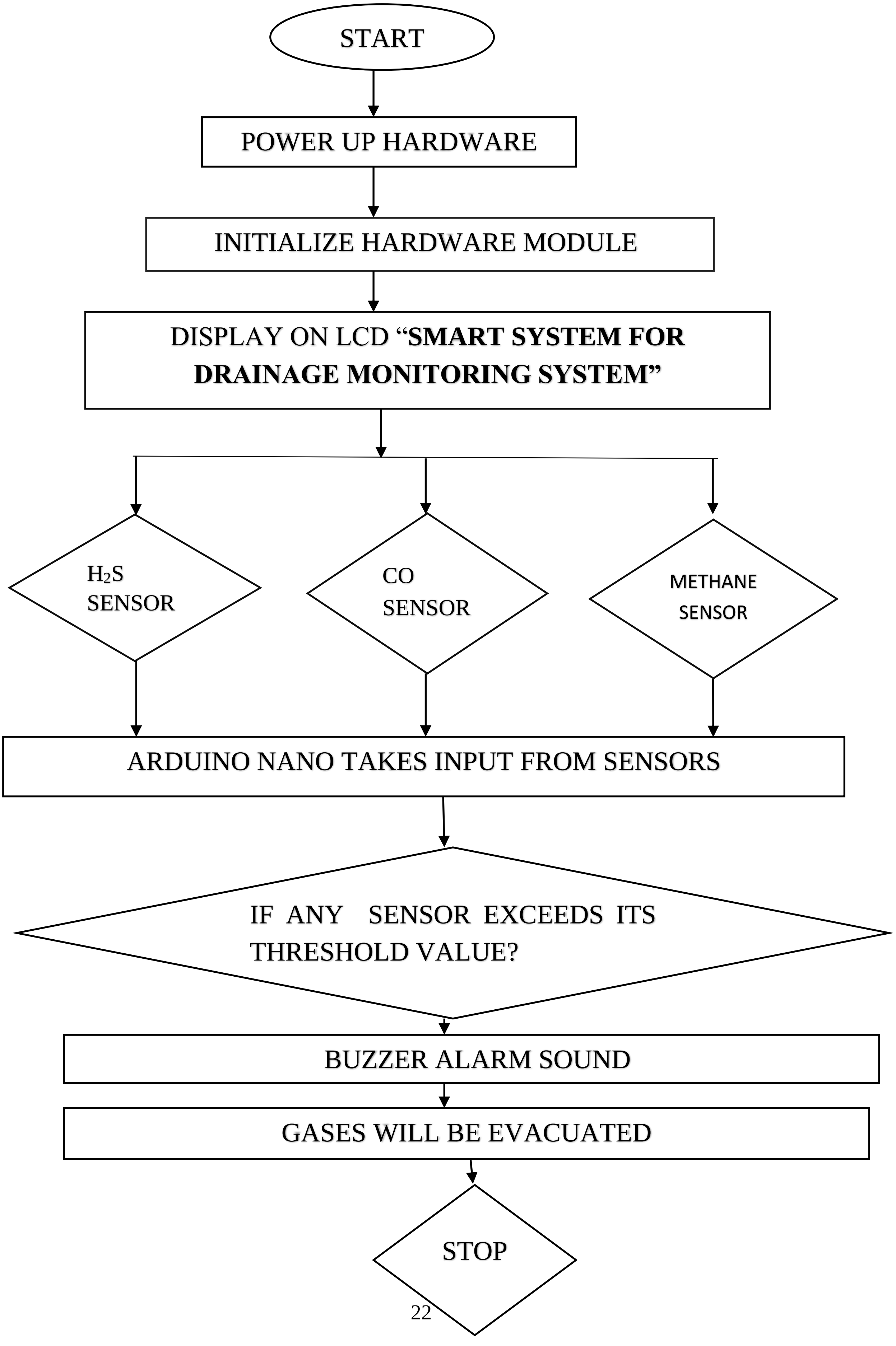
## 3.2 PROPOSED SYSTEM

Our proposed system can be detecting the gas to is develop to protect the life of drainage workers from toxic gases. The basic idea of the system is to calculate a safe limit point, when the system detects a value (near to and less than safe limit) and then alert the  environment. If the value exceeds safe limit, then system should provide a higher level threat detection alert to that person immediately evacuate the area thereby preventing all possible dangers. Further, the toxic gases could be evacuated with the  help of air sucking pump.

The system is designed in such a way to detect the presence of carbon monoxide, hydrogen sulfide and methane. The system uses three sensors namely Carbon monoxide sensor, methane sensor and hydrogen sulfide sensor for the detection of gases. An Arduino board containing atmega 328 microcontroller is used for processing. The Arduino senses the environment by receiving input  from the three sensors, and alert is surrounding by controlling the actuators. The actuators used are buzzer and LCD display.

The actuators are configured in such a way they give up a warning noise only if the gases present in air exceed the threshold value. The whole system is developed using the Arduino programming language in the Arduino developmentenvironment. After an alert, the toxic gases could be evacuated. The components present in the gas detecting system are,

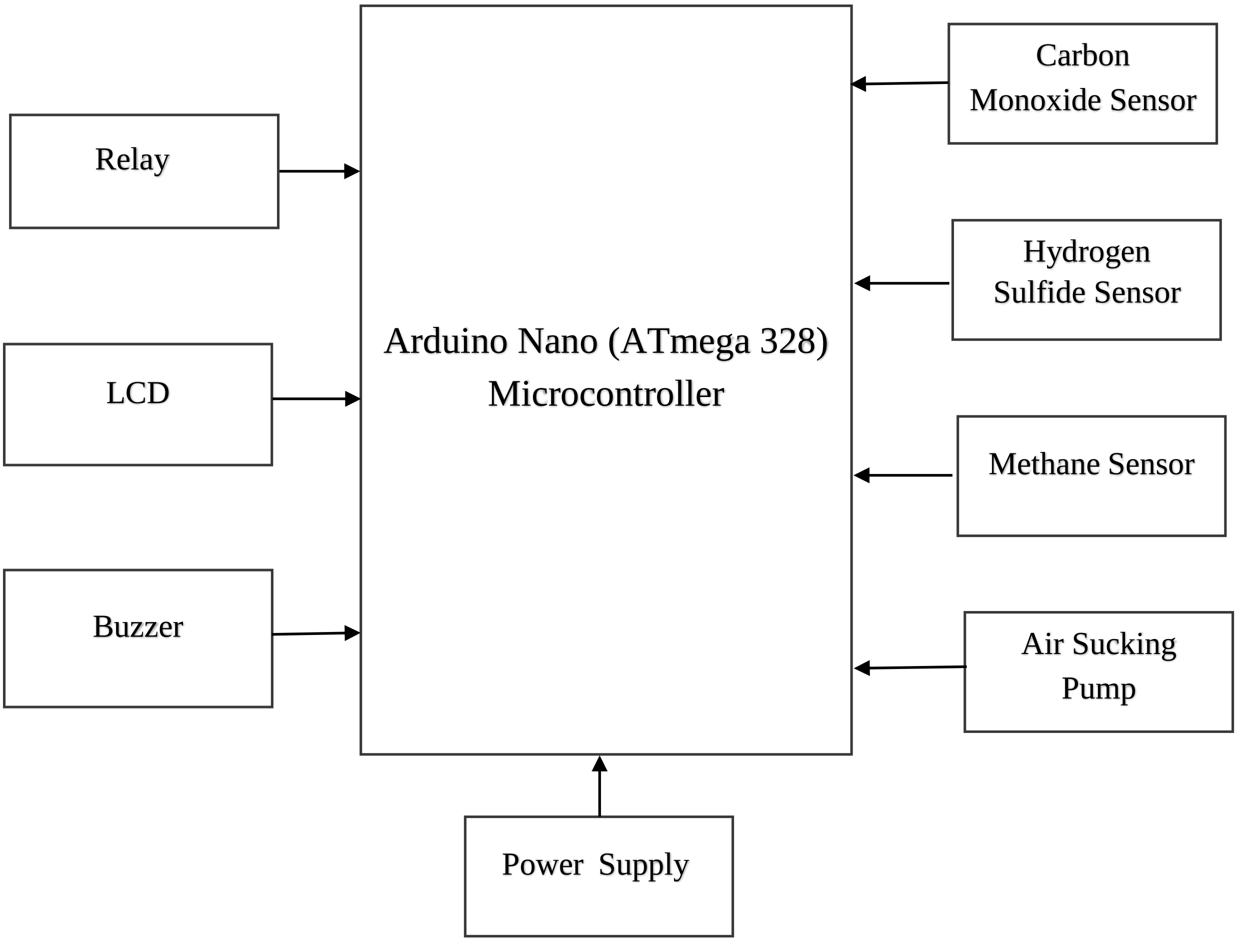
## FLOWCHART


START
POWER UP HARDWARE
INITIALIZE HARDWARE MODULE
DISPLAY ON LCD "SMART SYSTEM FOR DRAINAGE MONITORING SYSTEM"
$H_2S$ SENSOR
CO SENSOR
METHANE SENSOR
ARDUINO NANO TAKES INPUT FROM SENSORS
IF ANY SENSOR EXCEEDS ITS THRESHOLD VALUE?
BUZZER ALARM SOUND
GASES WILL BE EVACUATED
STOP

### 3.2.1 ADVANTAGES

- Can be specified to a particular gas or vapor in the parts-per-million range. The degree of selectivity depends on the type of sensor, the target gas and the concentration of gas that sensor is designed to detect.
- Linear output, low power requirements and good resolution.
- Excellent repeatability and accuracy. Once calibrated to a known concentration, the sensor will provide an accurate reading to a target gas that is repeatable.
- Does not get poisoned by other gases. The presence of other ambient vapors will not shorten or curtail the life of sensor.
- Less expensive than most other gas detection technologies unlike infrared and PID technologies, electrochemical sensors are economical.

## 3.3 BLOCK DIAGRAM




### 3.3.1 ARDUINO NANO MICROCONTROLLER

Arduino Nano is a microcontroller board designed by Arduino.cc. The microcontroller used in the Arduino Nano is Atmega328, the same one as used in Arduino UNO. It has a wide range of applications and is a major microcontroller board because of its small size and flexibility. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors and other actuators. Arduino Nano is a surface amount breadboard embedded version with integrated USB. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper. This new version 3.0 comes with ATMEGA328 which offer more data space.

Figure 3.1 Arduino nano Microcontroller

### 3.3.2 CARBON MONOXIDE SENSOR

Sensitive Material of MQ-7 gas sensor is SnO2,which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). The sensor's conductivity is more higher along with the gas concentration rising.

Carbon Monoxide Sensor is used to sense the Carbon Monoxide gas and it has an digital input signals low and high. If the input signal is low, there is no gas affected then if the input signal is high, gas is affected the worker.


Figure 3.2 Carbon Monoxide Sensor

### 3.3.3 HYDROGEN SULFIDE SENSOR

In an electrochemical sensor the cells combine enclosed electrodes and electrolyte. H2S diffuses through a permeable membrane, the volume of H2S increases in the air, an oxidation or reduction reaction occurs at one of the electrodes, and as a result, a linear current change occurs. A gas monitor helps keep workers safe in hazardous environments. Our single gas H2S monitor is designed to alert workers when the level of Hydrogen Sulfide reaches the high or low level set point.


Figure 3.3 Hydrogen Sulfide Sensor

A H2S gas Sensor is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of gas the Sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor which can be measured as output voltage. H2S sensor is used to sense the H2S gas and it has an digital input signal low and high.

### 3.3.4 METHANE GAS SENSOR

Methane gas sensor detect the concentration of methane gas in the air and outputs its reading as an analog voltage. Methane gas is flammable and combustible with oxygen. Methane one of the primary components of natural gas, so it is readily found in the environment and used in the diverse range of application. Methane has a lower explosion limit of 5.0%.


Figure 3.4 Methane Gas Sensor

A Methane gas sensor is a device used as an integral part of a fixed gas detection. For methane gas it has an digital inputs signals such as low on the high. If the inputs signals low, there is no gas affected then, if the input signals is high the gas is affected then the LCD display shows methane gas is detected.

### 3.3.5 AIR SUCKING PUMP

A Suction pump works by atmospheric pressure; when the piston is raised, creating a partial vacuum, atmospheric pressure outside forces water into the cylinder, whence it is permitted to escape by an outlet valve. Atmospheric pressure alone can force water to a maximum height of about. Materials flow from one location to another when a pressure difference is created between two locations. This phenomenon is the basic working principle of an ideal vacuum cleaner. When a centrifugal fan rotates it makes the air to flow by adding it external kinetic energy. Fill an enclosed pressure capable tank with water. Have the water outlet at the bottom and air pressure inlet at the top. Pump air in and water goes out. Not so much a pump but an effective way to move water from one place to another.

Figure 3.5 Air Sucking Pump

Any high point in the suction line can become filled with air and interference with proper operation of the pump. This is particularly true when the liquid being pumped contains an appreciable amount of air in the solution or of entrained air and the pump is handling a suction lift. Air suction pump is a device which increases the velocity of air or gas when it is passed through equipped impellers. They are mainly used for flow of gas required for exhausting, aspirating, cooling, ventilating, conveying etc. Suction pressure range 400-650mmhg. Speed in rpm = 2880. The voltage level of Air suction pump 415v, frequency range 50 HZ, suction capacity ( cube m per hr) = .1000.

## 3.3.6 LCD DISPLAY

An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16*2 LCD display is a very basic module commonly used in DIYs and circuits. The 16*2 translates a display 16 character per line in 2 such lines. In the LCD each character is displayed in a 5*7 pixel matrix. Methane sensor, Carbon monoxide sensor, Hydrogen sulphide sensor performance are displayed in LCD.


Figure 3.6 LCD display

Why potentiometer is used in LCD?

On an LCD, the potentiometer is used to adjust the basis level of the LCD i.e. In contrast to change the value of the potentiometer. We need to change the value of both resistors. If you reduce one resistor, you need to increase the other so that they still add up to around the same value.

### 3.3.7 RELAY CIRCUIT

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contact in another one. When a relay contact is Normally closed, there is a closed contact when the relay is not energized. Its basic function is to allow a low power control voltage operate a high power switch. The control and the switch are electrically isolated from each other and they have their own voltage and current ratings. Operating voltage 5v,max current 20mA.


Figure 3.7 Relay Circuit

### 3.3.8 BUZZER

Buzzer is used to give alert sound based on the performance. If it is reaches to abnormal state buzzer sound will produced. The buzzer consists of an outside case with two pins to attach it to power and ground. When current is applied to the buzzer it causes the ceramic disk to contract or expand. This causes the surrounding disc to vibrate. the sound that you hear.

Figure 3.8 Buzzer

## 3.4 CHARACTERISTICS OF HAZARDOUS GASES

A number of hazardous gases, such as carbon monoxide, are colourless and odourless. On the other hand, some hazardous gases like hydrogen sulfide may have an unpleasant smell at low concentrations but such smell disappears at higher concentrations due to olfactory fatigue. It can be very dangerous if drainage workers think they can easily recognise the presence of toxic gases by smell. Hydrogen sulfide, carbon monoxide and methane are the most common hazardous gases found in drainage worksites. In addition, oxygen deficiency is another major cause of illnesses and fatalities.

| Hazardous gas | OEL (ppm) | IDLH (ppm) | Relative density (Air=1.o) | LEL/UEL | Remarks |
|---|---|---|---|---|---|
| Hydrogen sulfide ($H_2O$) | 10 | 100 | 1.2 | 4.3% / 45.5% | Rotten egg smell |
| Carbon monoxide (CO) | 25 | 1,200 | 1.0 | 12.5% / 75% | Colourless and odourless |
| Methane ($CH_4$) | --- | --- | 0.6 | 5.3% / 15% | Displace air causing asphyxiation |

## 3.4.1 THRESHOLD LIMIT FOR GAS SENSORS

| SENSORS NAME | THRESHOLD LIMIT |
|---|---|
| Carbon monoxide | 45-150ppm |
| Hydrogen sulphide | 450-750ppm |
| Methane | 35ppm |

**Notes:**

ppm - Parts per Million

OEL - Occupational Exposure Limit - Time-Weighted Average

IDLH - Immediately Dangerous to Life or Health Concentration

Relative density - < 1.0 means lighter than air; > 1.0 means heavier than air

LEL/UEL - Lower Explosive Limit / Upper Explosive Limit

## 3.5 SUMMARY

The proposed methodology helps to prevent the sudden accident of workers. The smart device is cost wise less and fast in accessing. This system will work in a sewage as a safety equipment. This parameters will promptly alert the workers to stay safe and detect toxic gases without any harm.

# CHAPTER 4

# HARDWARE SPECIFICATIONS

## 4.1 MQ8 SENSOR

### 4.1.1 FEATURES

- High sensitivity to Hydrogen ($H2$)
- Small sensitivity to alcohol, LPG, cooking fumes
- Stable and long life

### 4.1.2 APPLICATION

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of Hydrogen (H2), avoid the noise of alcohol and cooking fumes, LPG, CO.

### 4.1.3 SPECIFICATIONS

A . Standard work condition

| **Symbol** | **Parameter** | **Technical condition** | **Remarks** |
|---|---|---|---|
| Vc | Circuit voltage | 5V±0.1 | AC OR DC |
| VH | Heating voltage | 5V±0.1 | AC OR DC |
| PL | Load resistance | 10KΩ | |
| RH | Heater resistance | 31+_5% | Room Tem |
| PH | Heating consumption | 800mW | |

B. Environment Condition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Tao | Using Tem | -10℃-50℃ | |
| Tas | Storage Tem | -20℃-70℃ | |
| $R_H$ | Related humidity | less than 95%Rh | |
| $O_2$ | Oxygen concentration | 21%(standard condition) Oxygen concentration can affect sensitivity | minimum value is over 2% |

C. Sensitivity Characteristic

<table>
<tr><th>Symbol</th><th>Parameter name</th><th>Technical parameter</th><th>Ramark 2</th></tr>
<tr><td>Rs</td><td>Sensing Resistance</td><td>10KΩ- 60KΩ<br>(1000ppm $H_2$)</td><td rowspan="4">Detecting concentration scope<br>:<br>100-10000ppm<br>Hydrogen ($H_2$)</td></tr>
<tr><td>A<br>(1000ppm/<br>500ppm$H_2$)</td><td>Concentration slope rate</td><td>≤0.6</td></tr>
<tr><td>Standard detecting condition</td><td>Temp: 20℃±2℃<br>Humidity: 65%±5%</td><td>Vc:5V±0.1 Vh: 5V±0.1</td></tr>
<tr><td>Preheat time</td><td colspan="2">Over 24 hour</td></tr>
</table>

## D. Sensitivity Characteristic Curve

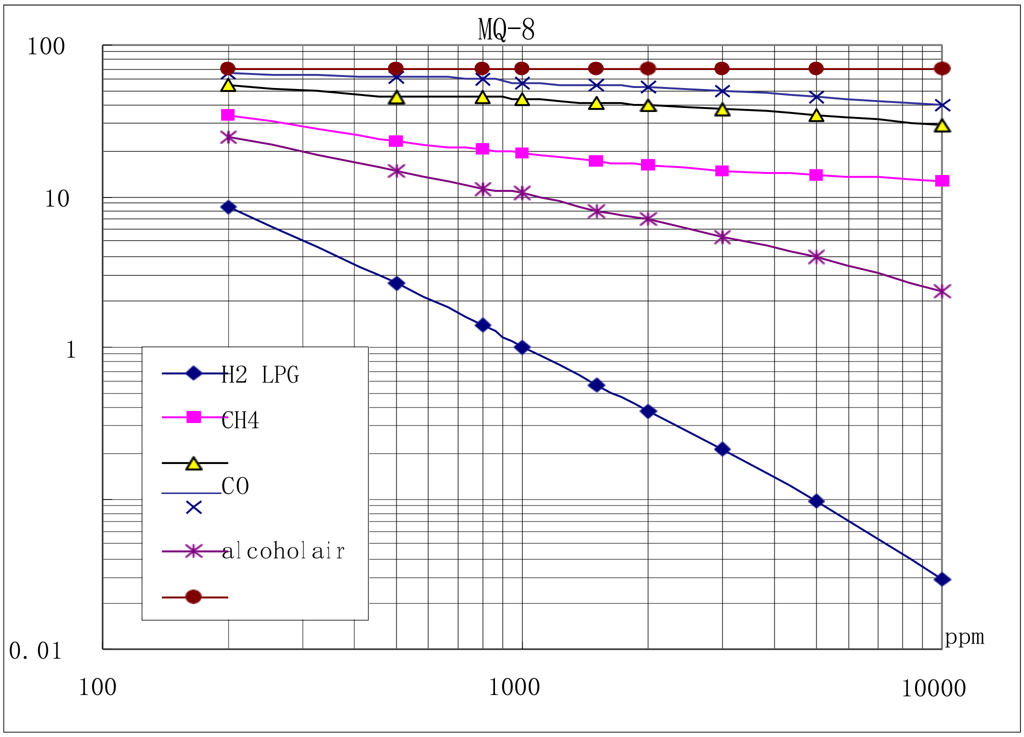



Figure 4.1 Sensitivity Characteristics of the MQ-8 gases

Temp: 20℃、Humidity: 65%、

$O_2$ concentration 21% RL=10kΩ

Ro: sensor resistance at 1000ppm $H_2$ in the clean air.

Rs : sensor resistance at various concentrations of gases.

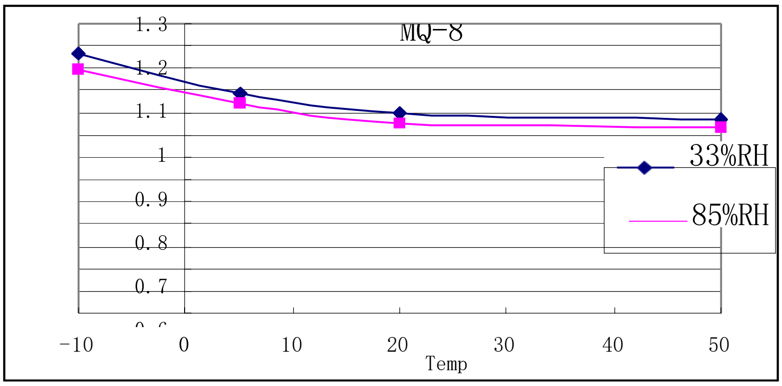



Figure 4.2 Temperature and Humidity of MQ8 gases

E. Sensitivity Adjustment

Resistance value of MQ-8 is difference to various kinds and various concentration gases. So, When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 1000ppm $H_2$ concentration in air and use value of Load resistance ( $R_L$) about 10 KΩ(5KΩ to 33 KΩ).When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

## 4.2 MQ-7 SENSOR

Sensitive material of MQ-7 gas sensor is $SnO_2$, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO at low temperature (heated by 1.5V).The sensor’s conductivity gets higher along with the CO gas concentration rising. At high temperature (heated by 5.0V), it cleans the other gases adsorbed at low temperature. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit.

### 4.2.1 FEATURES

It has good sensitivity to carbon monoxide in wide range, and has advantages such as long lifespan, low cost and simple drive circuit &etc.

### 4.2.2 MAIN APPLICATION

It is widely used in domestic CO gas leakage alarm, industrial CO gas alarm and portable CO gas detector

## 4.2.3 SPECIFICATIONS

| **Model** | | | **MQ-7** |
|---|---|---|---|
| Sensor Type | | | Semiconductor |
| Standard Encapsulation | | | Plastic cap |
| Target Gas | | | carbon monoxide |
| Detection range | | | 10～500ppm CO |
| Standard Circuit Conditions | Loop Voltage | $V_c$ | ≤10V DC |
| | Heater Voltage | $V_H$ | 5.0V±0.1V AC or DC（High tem.）<br>1.5V±0.1V AC or DC（Low tem.） |
| | Heater Time | $T_L$ | 60 S±1S（High tem.），<br>90 S±1S（Low tem.） |
| | Load Resistance | $R_L$ | Adjustable |
| Sensor character under standard test conditions | Heater Resistance | $R_H$ | 29Ω±3Ω（room tem.） |
| | Heater consumption | $P_H$ | ≤900Mw |
| | Sensitivity | S | Rs(in air)/Rs(in 150ppm CO)≥5 |
| | Output Voltage | $V_s$ | 2.5V～4.3V (in 150ppm CO) |
| | Concentration Slope | α | ≤0.6($R_{300ppm}$/$R_{50ppm}$ CO) |
| Standard test conditions | Tem. Humidity | | 20℃±2℃；55%±5%RH |
| | Standard test circuit | | Vc:5.0V±0.1V；<br>$V_H$（High tem.）： 5.0V±0.1V； $V_H$（Low tem.）： 1.5V±0.1V |
| | Preheat time | | Over 48 hours |

## 4.2.4 DESCRIPTION OF SENSOR CHARACTERS

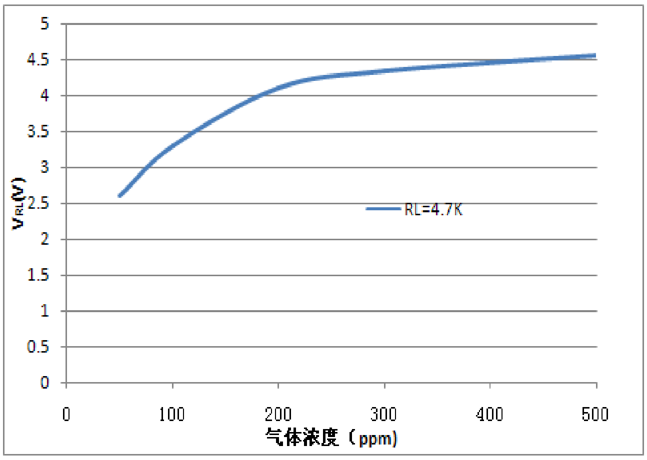



Figure 4.3 Sensitivity Curve

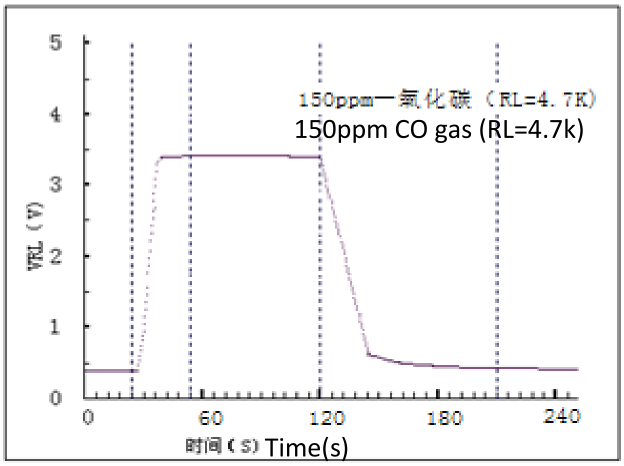



Figure 4.4 Response and Resume

## 4.3 MQ-4 SENSOR

### 4.3.1 FEATURES

- High sensitivity to $CH_4$,
- Natural gas.
- Small sensitivity to alcohol, smoke.
- Fast response.
- Stable and long life.
- Simple drive circuit.

## 4.3.2 APPLICATION

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of $CH_4$, Natural gas. LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke.

## 4.3.3 SPECIFICATIONS

A. Standard Workcondition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Vc | Circuit voltage | 5V±0.1 | AC or DC |
| $V_H$ | Heating voltage | 5V±0.1 | AC or DC |
| $P_L$ | Load resistance | 20KΩ | |
| $R_H$ | Heater resistance | 33Ω±5 % | Room Tem |
| $P_H$ | Heating consumption | less than 750mw | |

B. Environment condition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Tao | Using Tem | -10℃-50℃ | |
| Tas | Storage Tem | -20℃-70℃ | |
| $R_H$ | Related humidity | less than 95%Rh | |
| $O_2$ | Oxygen concentration | 21%(standard condition) Oxygen concentration can affect sensitivity | minimum value is over 2% |

## C.Sensitivity Characters

| **Symbol** | **Parameter name** | **Technical parameter** | **Ramark 2** |
|---|---|---|---|
| Rs | Sensing Resistance | 10KΩ - 60KΩ (1000ppm $CH_4$ ) | Detecting concentration scope: 200-10000ppm $CH_4$ , natural gas |
| A (1000ppm/ 5000ppm $CH_4$) | Concentration slope rate | ≤0.6 | |
| Standard detecting condition | Temp: 20℃±2℃ Humidity: 65%±5% | Vc:5V±0.1 Vh: 5V±0.1 | |
| Preheat time | Over 24 hour | | |

## D.Sensitivity Characteristiccurve

`

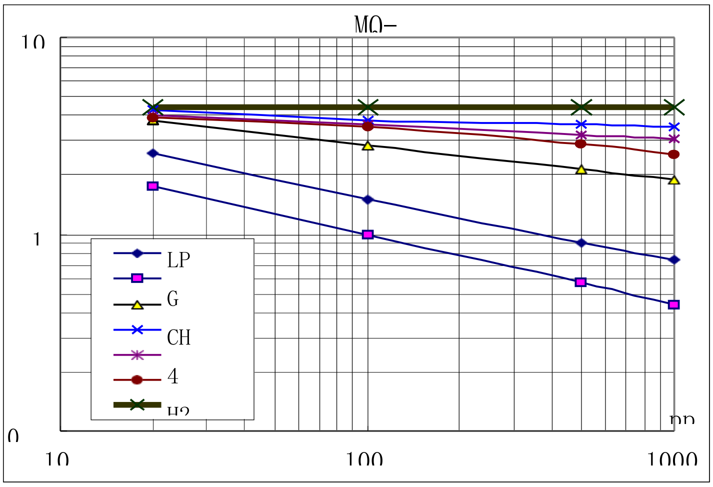



Figure 4.5 Sensitivity Characteristics of MQ4

Temp: 20℃、Humidity: 65%、

$O_2$ concentration 21% RL=20kΩ

Ro: sensor resistance at 1000ppm of $CH_4$ in the clean air.

Rs :sensor resistance at various concentrations of gases

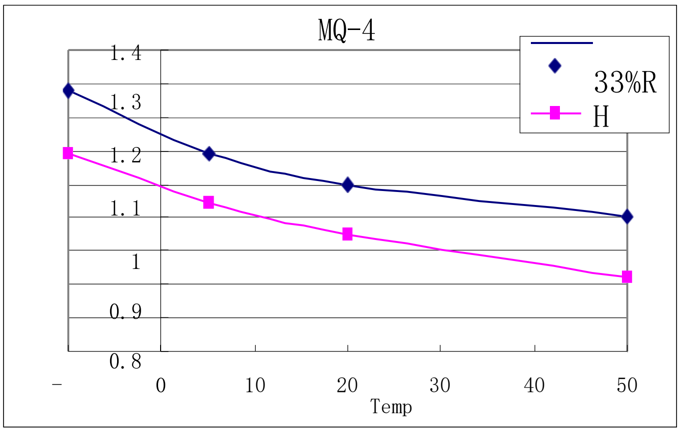
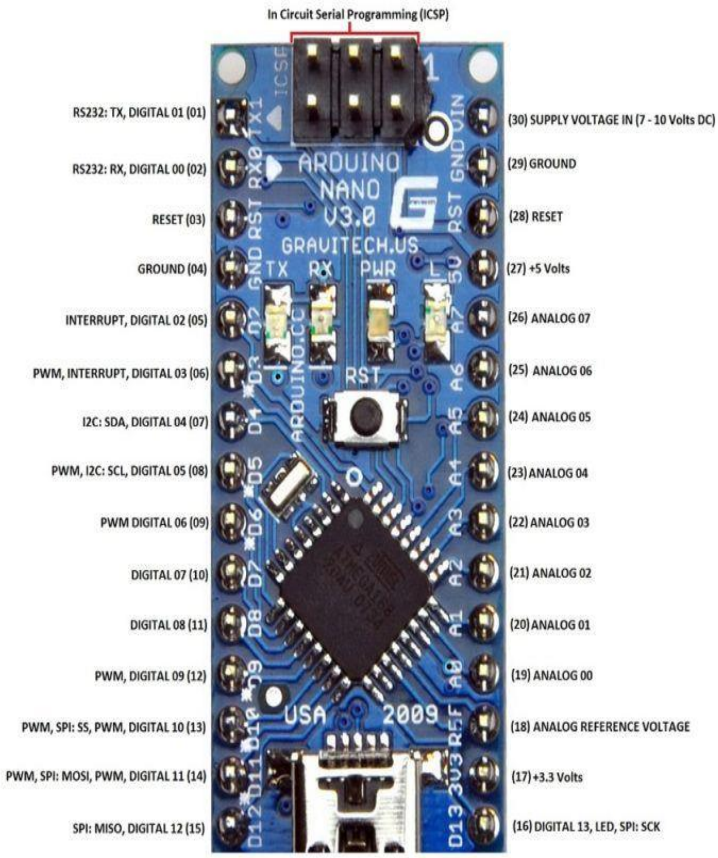



Figure 4.6 Temperature and Humidity

## E. Sensitivity Adjustment

Resistance value of MQ-4 is difference to various kinds and various concentration gases. So, when using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 5000ppm of $CH_4$ concentration in air and use value of Load resistance ( $R_L$) about 20KΩ(10KΩ to 47KΩ). When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

## 4.3 ARDUINO-NANO PIN DIAGRAM




Arduino Nano V3 - Pin Description
www.CircuitsToday.com

## 4.4.1 SPECIFICATION

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Nano was designed and is being produced by Gravitech.

| Microcontroller | Atmel ATmega168 or ATmega328 |
|---|---|
| Operating Voltage (logic level) | 5 V |
| Input Voltage (recommended) | 7-12 V |
| Input Voltage (limits) | 6-20 V |
| Digital I/O Pins | 14 (of which 6 provide PWM output) |
| Analog Input Pins | 8 |
| DC Current per I/O Pin | 40 Ma |
| Flash Memory | 16 KB (ATmega168) or 32 KB (ATmega328) of which 2 KB used by bootloader |
| SRAM | 1 KB (ATmega168) or 2 KB (ATmega328) |
| EEPROM | 512 bytes (ATmega168) or 1 KB (ATmega328) |
| Clock Speed | 16 MHz |
| Dimensions | 0.73" x 1.70" |

Rather then requiring a physical press of the reset button before an upload, the Arduino Nano is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the FT232RL is connected to the reset line of the ATmega168 or ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment.

This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Nano is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Nano.

While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

## 4.4 CIRCUIT DIAGRAM

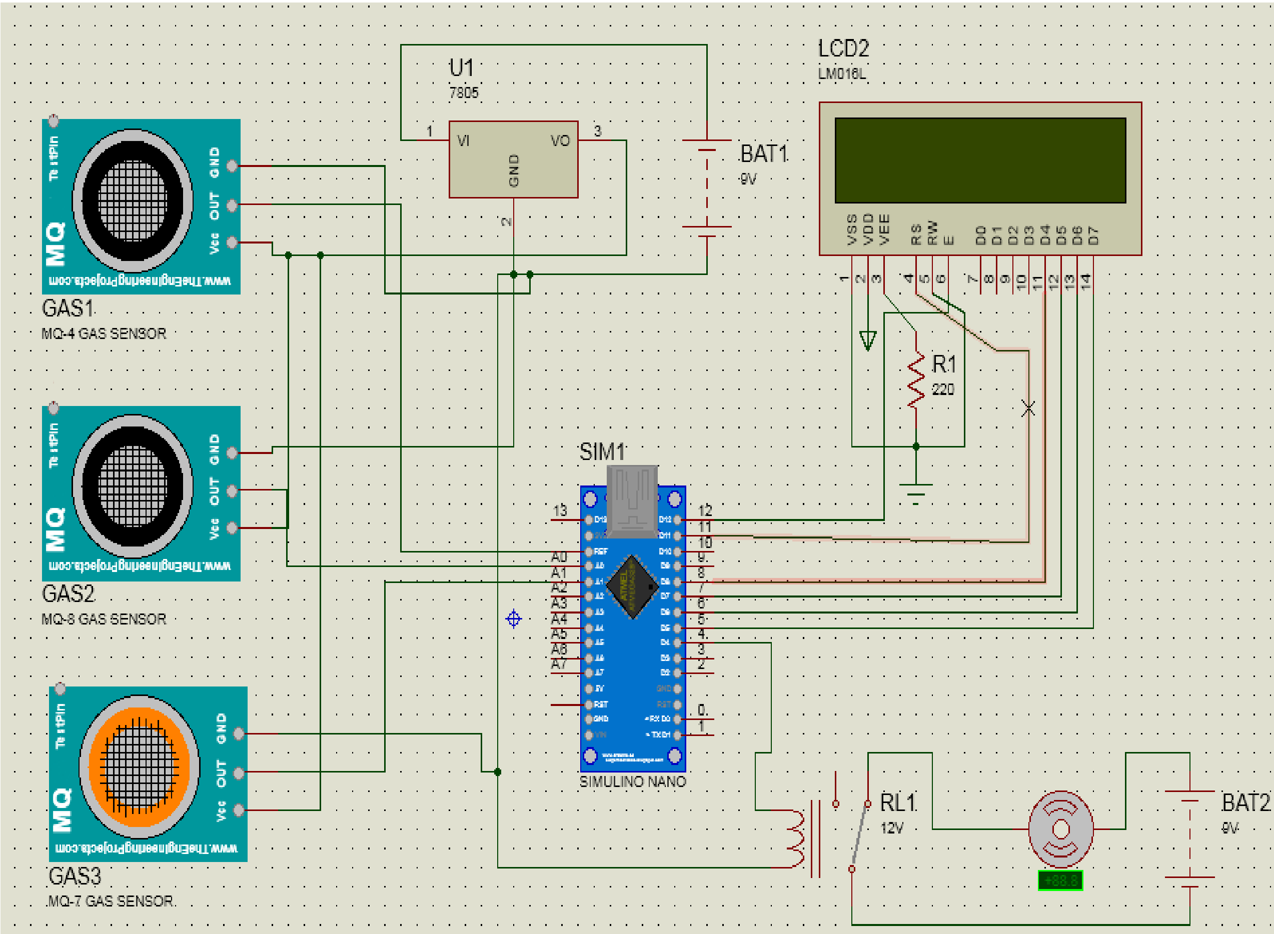



Figure 4.7 Circuit Diagram for Our proposed System

### 4.5.1 WORKING PRINCIPLE

Mq7 sensor, Mq4 sensor and Hydrogen sulfide sensor are used to sense the gases in the drainage manhole. In drainage manhole. These is a possibility of presence of sewer gases. But according to the statistics, carbon monoxide, Methane, Hydrogen sulfide are considered as a toxic substrate so, the perfect sensor used for the detection of these toxic gases are Mq7 sensor, Mq4 sensor and Hydrogen sulfide sensor. These sensors sense the input datas (ie. Toxications of gases) and directly sends these data to the Arduino nano microcontroller. The Mq4 sensor's output connection at VDD and Mq8 sensor's output connection at VDD are in join connection. Mq8 sensor's VDD and output wires are the input datas which has been send as input to Arduino A1 pin. The output of Mq4 sensor has been send as input to Arduino A0 pin.

The ground of Mq4 sensor has been send to the negative terminal of the power supply. The ground datas of Mq7 sensor has been directly send to the ground of power supply. Similarly, the input datas from the VDD of $H_2S$ sensors are connected to the VDD of Mq4 sensor. The output pin of $H_2S$ sensor is connected to the Arduino A2 pin. The ground of power supply and one end buzzer are connected to the ground $H_2S$ sensor and in the same way, one end of the motor and one end of the buzzer are connected to the ground $H_2S$ sensor. The $4^{th}$ pin of the Arduino is connected with the another end of the Arduino.

The motor's positive terminal of the second power supply is connected to the RL1 of the negative terminal the RL1 is connected with other end of the motor. If the threshold level of the gases all identified, then the buzzer will alert the workers. In this case, the $3^{rd}$ pin of the Arduino connected to the output of the buzzer. For the purpose of displaying the level of toxic gases, $5^{th}$ pin of the Arduino is connected to the $D_7$ of display, $6^{th}$ pin of Arduino is connected to the $D_6$ of display, $7^{th}$ pin of the Arduino is connected to the $D_5$ of display, $8^{th}$ pin of the Arduino is connected to the $D_4$ of display, $11^{th}$ pin of Arduino is connected to the RS pin of display, $12^{th}$ pin of

Arduino is connected to the E pin of display. The $V_{SS}$ pin of display all in connection with RW, ground, $V_{EE}$ respectively. The $2^{nd}$ pin of the display is grounded. After the detection of gases, the air sucking pump suck the gases and the gases will be evacuated.

## 4.5 PROGRAM

```
#include <LiquidCrystal.h>

const int rs = 12, en = 11, d4 = 8, d5 = 7, d6 = 6, d7 = 5;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

int ch4_pin = A0, h2s_pin = A1, co_pin = A2;

int pump_relay_pin = 4;

int buzzer_pin = 3;

int co_data, h2s_data, ch4_data;

String pump_status = "OFF";

int co_threshold = 512, h2s_threshold = 512, ch4_threshold = 512;

void setup()

{

 lcd.begin(16, 2);

 pinMode(pump_relay_pin, OUTPUT);

}

void display_lcd() {

 lcd.setCursor(0, 0);

 lcd.print("CO:");
```

```
lcd.setCursor(3, 0);
lcd.print(co_data);
lcd.setCursor(7, 0);
lcd.print(",H2S:");
lcd.setCursor(13, 0);
lcd.print(h2s_data);
lcd.setCursor(0, 1);
lcd.print("CH4:");
lcd.setCursor(4, 1);
lcd.print(ch4_data);
lcd.setCursor(8, 1);
lcd.print(",PUMP:");
lcd.setCursor(14, 1);
lcd.print(pump_status);
}
void loop() {
co_data = analogRead(co_pin);
h2s_data = analogRead(h2s_pin);
ch4_data = analogRead(ch4_pin);
if (co_data > co_threshold || h2s_data > h2s_threshold || ch4_data > ch4_threshold ) {
digitalWrite(pump_relay_pin, HIGH);
pump_status = "ON";
```

```
}
else {
digitalWrite(pump_relay_pin, LOW);
pump_status = "OFF";
}
display_lcd();
}
```

# CHAPTER 5

## 5.1 FIELD WORK

We were keen to collect the information about the practical difficulties of drainage workers by consulting assistant engineer in municipality office and they were continuously refusing to give details due to the high mortality rate. And we were tried to use these toxic gases an efficient manner. But we were failed to separate gases, then only we could be able to neutralize the gases and due to the short span of time we would not be able to do this process. And we also had an idea about evacuating the gases in the atmosphere. But there is a possibility of contaminating gas and we left this idea.

## 5.2 RESULT AND DISCUSSION

The system developed was able to work with a power supply of 5V while most detectors need a minimum of 24 V for proper functioning. The life of sensor is also stable and with proper calibration has a minimum lifetime of 5 years. The response time for the system is 20-30 sec and it does not need any laboratory experiments to predict concentration of the gases present. The cross sensitivities of the sensor is eased. The system is designed in such a way the optimal working condition are the temperature and humidity of South India. Different working conditions would require different kind of calibration procedure. The concentrations of the gases were predicted with a high level of accuracy and the deviation in percentage was less than 4 % for carbon monoxide in low concentration of gases. In methane the deviation is less than 10% for lower concentration of gases. In $H_2O$ the deviation is less than 8% for concentration of gases. The deviation in percentage was found to be higher in higher concentration of gases.

It has a high level of accuracy. The accuracy in detection of methane and carbon monoxide is very high. It requires very less amount of power and can operate with a power supply of 5V while other systems need a minimum of 24V. The response time of the system is between 20 and 30 secs. The delay is typically set to avoid nuisance alarms. Cross-sensitivity is managed between methane and carbon monoxide. The detector can be made to go on monitoring the environment while the workers are working due to the low amount of power needed.

## 5.3 CONCLUSION

The accuracy of our sensor system owes to the calibration procedure. This system was able to detect carbon monoxide and methane at the same time adding to its efficiency. The system provides the user with potential health hazards on continuous exposure to a certain concentration of the gas in addition to its existence amount. Thus, the workers using the detector not only get the concentration of the toxic gases present in air but also the health hazards it could bring. The concept of providing the user with the effect it could cause eliminates the effect of illiteracy and carelessness. The system can be enhanced by increasing the number of gases which can be detected by the detector. Thus system can be extended to multiple purposes and can be modified according to the environment by adding or removing the sensors in the system. Thus the detector would have the same goal of defecting toxic gases but would find its applications in many fields.

### 5.3.1 FUTURE ENHANCEMENT

In future, for implementation of this project in a efficient manner, we could be do the following procedures. Separating hydrogen sulphide and carbon monoxide and letting them into the outer surface, they will be evaporated due to their chemical reactions on atmosphere. Methane could be used as a natural gas. Because of our project time duration, we could not be carry out these process.

## CONFLICT OF INTEREST

No conflict.

## REFERENCE


1. K. Kumar Visvam Devados, Human security from death defying gases using and intelligent sensor system 2019.
2. W. Khalaf, Sensor array system for gases itendification and quantification 2018.
3. A. Gulbag, F. Temurtas, A study on quantitative classification of binary gas mixure using networks and adoptive neurofuzzy interference system 2018.
4. R. Kumar, Wavelet co-efficient trained neural network classifier for improvement in quantitative classification performance of oxygen-plasma treated thick film tin oxide sensory array exposed to different odour gas 2016.
5. S. Capone, P. Siciliano, Analysis of CO and $CH_4$ gas mixtures by using a micromachined sensor array 2016.
6. A. Ozmen, Finding the composition of gas mixture by a phthalocyaninecoated QCM sensor array and an artificial neural network 2015.
7. V.S. Velladurai, Human safety system in drainage, unused well and garbage alerting system for smart city 2014.
8. N. Dhanalakshmi, Explosion detection and drainage monitoring by automation system 2013.