Electronic NOSE - An IOT Based Smart Drainage Worker Safety System

C.Raveena[1], K .Lakshmi Prasuna[2], P. Likhitha[3]
[1]*Assistant Professor, Department of ECE, R.M.D Engineering College, Tamilnadu 601206*
[2,3]*UG Student, Department of ECE, R.M.D Engineering College, Tamilnadu 601206*

***Abstract*- The sewage system plays an important role in big cities where millions of people live. The process of monitoring and maintaining the drainage system that are available now are making the workers to work at risk. The drainage may contain rainwater and unused water must be monitored and maintained properly. It leads to loss of human life and irregular condition of the drainage system if suppose this may not be conceder means this may lead to various skin infections. The process of unblocking and cleaning processes may lead to much human death because of the gas. This system will help to identify the gas level inside the drainage manholes so that the worker can get some idea of entering into the manholes. The worker can monitor his health and surrounding gas conditions in the LCD display. When the gas limit reaches the threshold limit or worker is in critical condition then an alert message will be sent to both the municipality office and hospital. The pump motor provides the oxygen to the worker until the help arrives.**

***Index terms*- Sewage, Wastewater, Manholes, Drainage Monitoring, Worker Safety, and Gas Limits**

1.INTRODUCTION

Drainage is the disposal of excess water on the land (either used or the form of storm water). There are two sorts of systems adopted for waste water collection which are Separate sanitary and combined systems. In sanitary systems, there is a separate sewer that collects the household, commercial and industrial waste water and disposes of them while other sewer collects the storm water and disposes it. In the combined system, both the storm water and domestic water are conveyed through an equivalent pipe network.

Sanitary sewers should have a self-cleansing velocity of min (-6-1m/s).

This self-cleansing velocity is achieved by the laying drain on a steep slope. Manholes should be placed at an interval of 100-120m for the aim of maintaining and servicing of the sewer. It should be noted that waste water within the sewer is usually transported by gravity instead of mechanical means (pumping) for convenient sake. This is why in laying sewer pipes; the topography of the area should be well understood.

The overall steps in layout sewers include

- Establish a comprehensive map of the area that including road contour, topography and utilities
- Manholes are shown with the dot at all its necessary locations as the junctions and its intermediate point of 100-120m interval
- Sewers are designed to follow the natural topography
- Sewers are mostly branch network
- Sewers or drains are usually located along the road

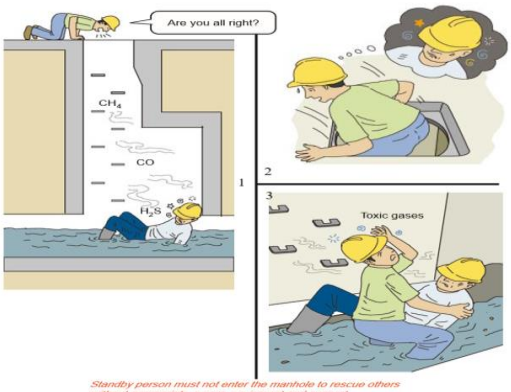
Design approach for sewers is as follows

- Estimate manning constant and select slope
- Compute the section factor
- Get the best hydraulic system section either rectangle
- Check the satisfaction of minimum velocity

The disposal of the waste water might be treated or not treated. However, the treatment is usually by the biological method. The disposal of waste water is of immerse important for the economic process. The treated or untreated waste might be used as a source of irrigation, supplement stream or river flow and will be used as a source of recharge for spring water.

It is obvious within the cities of the developing countries that the foremost of construction industries don't note of all the above mentioned processes. As a result storm water follows drains that aren't specified for them or overflows the drains thereby causing

erosions. On the opposite hand, some storm water is stagnant within the drains thereby becoming a breeding place for mosquitoes and toads. This could end in, an increase in malaria and water related disease within the vicinity. All this is often because; most governments in such cities haven't yet understood the importance of drainage systems and therefore the role it plays in social- economic development.



Standby person must not enter the manhole to rescue others without appropriate rescue equipment and support

Cleaning a drainage has been a dangerous work these days. All places have to be cleaned well so that the health of the people who live there will be good. Hence to clean that drainage a person has to go through all the difficulties. At present in metro cities and also all other places worker has to go inside the drainage without any safety precautions to clean it. Various types of gases are present in the drainage which are harmful to the worker. Municipalities were just appointing workers for cleaning. Worker's health is also important as they inhale a lot of gas from the drainage then it may lead to the pleural effusion disease in the lungs. Their lungs will be filled with the gas which may also lead to death. If the worker lost consciousness which led to death due to inhaling of excess the municipalities will never get a notice about his conditions.


Approved breathing apparatus should be worn in confined spaces where there are risks of the worker being overcome by hazardous gases.

2. RELATED WORK

A chest radiograph is a rapid examination technique used to provide a preliminary diagnosis of lung and heart diseases. Computer-aided diagnosis with the digitalized image is an automated approach that addresses the drawback of manual inspection. In this study, two corner detectors along with a two-dimensional convolution process are used to enhance the chest X-ray image for an accurate extrapolation of the bilateral lung cavities. Based on bounding box pixel analysis, the pixel ratios of the lung anatomy between normal and abnormal conditions can be estimated to identify the pleural effusion size. Next, a smart drainage monitoring system is developed to improve the current functions of the traditional drainage tool and confirm the drainage safety, including (a) drainage volume and required time detection, (b) unplanned removal warning, and (c) physiological status monitoring.[1] The prototype which has WSN and GSM module is used will monitor the water gas level in the sewage system and the measured values will be stored in the cloud storage then analysed and the sewage system condition will be sent to near the corporate office as SMS using GSM module. [2] To overcome the limitations in the drainage monitoring this will help to identify the gas level inside the drainage manholes so that the worker can get some idea of entering into manholes. With the help of IOT and raspberry pi. [3] A prototype IOT system is decided with hardware and software. Experiments are conducted to collect the data. The data is then used to train the artificial neural network. The analysis and predictive maintenance solutions are proposed to help the storm water and drainage management. The results show that a well-trained algorithm can predict the drainage situations. The cross-validated results showed that it is reliable and able to predict most of the testing inputs. [4] The main objective of the human safety monitoring is designing a microcontroller based toxic gas detecting, alerting system, and gas purification. The hazardous gases like H2S, CO, and Methane will be sensed and displayed every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the GSM. The advantage 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 the gas purification process to convert toxic gases into pure air. [5] A new approach consisting of small devices used to collect data. These sensing devices are called node. Here it will update the municipal officer by text message when any manhole crosses the threshold value. This system directly impacts on the health issues of citizens and worker who cleans the underground drainage. The system reduces the accident caused by an exposed manhole. [6] By comparing previous methodologies here an alternative and innovative usage for urban drainage systems was explored, in which barriers were installed and controlled in upstream underground conduits. The developed rule-based control system monitors the drainage system by acquiring data from different locations and performs the necessary control actions on a set of installed barriers. These results suggest the feasibility of the proposed approach for remote monitoring of drainage systems, accommodating the effects of climate changes. [7] The present situation of gas detecting is focused on the set up of a measurement protocol to track microbial contamination development in fish under environmental conditions through a miniaturized, fast, low-power consumption, EN based on two micro machined metal oxide gas sensors integrated into a USB controlled device. The sensors worked with custom temperature profile protocols and provided real time information. [8]

3. SYSTEM ANALYSIS

Existing System:

Manual monitoring and cleaning the drainage is important but this is often a system helps to stop the large accidental death of human thanks to over gas in manholes. The difficulty emerges in such waste lines that can make difficult issues the day by day schedule of the town. Issues, for instance, blockage due to waste, unexpected increment within the water level even as different unsafe gases are often produces if the simplest possible cleaning moves aren't made up of time to time. Workers cannot get help in time once they are crucial condition. No initial check-up whether workers can work or not therein environment. No estimation of what proportion gas is released from the manholes and the way dangerous it's.

DISADVANTAGES:

- Workers cannot get help in time once they are crucial conditions.
- No initial check-up whether workers can work or not therein environment.
- No estimation of what proportion gas is released from the manholes and the way dangerous it's.

Proposed System:

Here we are implementing an electronic nose for the one that enters the sewage manhole for cleaning process. Once the person enters the manhole then the oxygen supply for the person is going to be provided from the oxygen tank only with the assistance of the pump motor. Here we are using 2 smoke sensors fixed within the nose to watch the smoke level within the manhole and therefore the details are going to be collected by the microcontroller. And if the smoke level exceeds the edge range then the microcontroller will create an awareness of the person. All the sensor details are going to be displayed within the LCD and also the status is going to be uploaded within the webpage by using the IOT module.

ADVANTAGES:

- It checks whether the worker can clean the drainage supported his health conditions.
- It provides oxygen at the critical state of the worker.
- It alerts the hospital and municipality office when the worker is in crucial condition using IOT.
- Worker and municipality officers both can monitor the health conditions of workers and environmental conditions within the drainage.

Block Diagram:

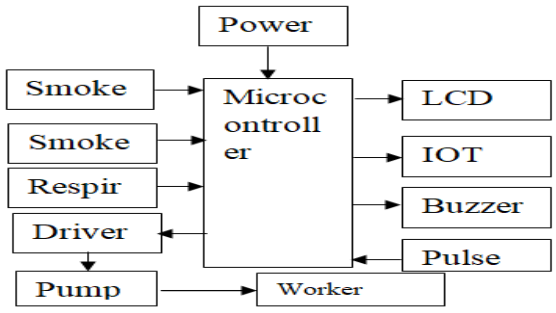
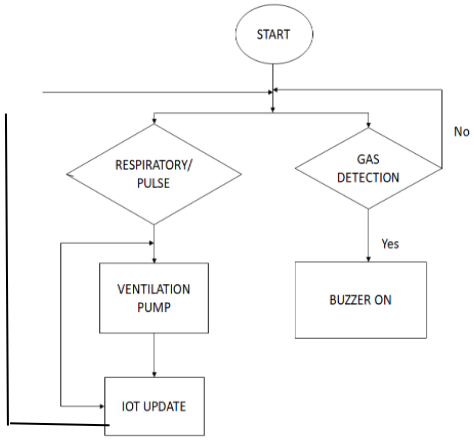


Fig. Block diagram

Here both the smoke sensor will detect the gas level whether it's normal or abnormal. Respiratory sensor will monitor our respiration alongside inhaling and exhaling techniques. The pulse sensor will calculate the heartbeat of the worker. All the info is going to be given to the microcontroller where it'll be updated within the IOT. LCD will display the traditional and abnormal conditions to the worker. Just in case of emergency the buzzer will alert the municipal office and pump motor will generate the oxygen to the worker.

Flow Chart



Hardware Requirements:

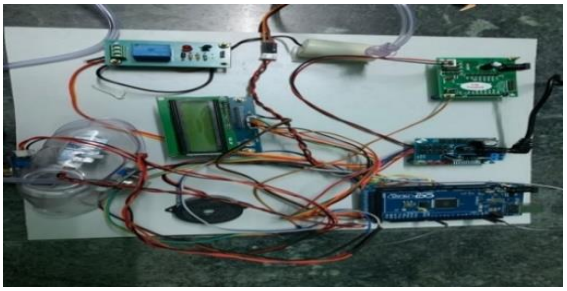
- Power supply
- Microcontroller
- IOT
- LCD
- Driver circuit
- Pump motor
- Smoke sensor

Software Requirements:-

- Embedded C
- ARDUINO IDE / MPLAB IDE

4. RESULT

HARDWARE KIT



The hardware a part of the system has the sensors which are attached to the mask. The oxygen tank is going to be given through the motor to the mask. Using an adapter and an influence supply the facility is given to the circuit. Relay circuit is employed for the motor. Wi-Fi module will update details to the online page and the LCD display will display the conditions of the sensors.

SENSORS CONDITIONS

Fig Conditions

The system works supports the four sensors attached to it.

1. Methane gas sensor (MET)
2. Other gas sensor (GAS)
3. Respiratory sensor (RES)
4. Heart beat sensor (HB)

Methane gas sensor:

Methane is usually generated when organic matter is decomposed by a spread of bacterial processes. It's a colourless, extremely flammable and explosive gas which will cause fire and explosion. The build-up of methane during a poorly ventilated area will displace normal air and end in an oxygen-deficient environment.

Other gas sensor:

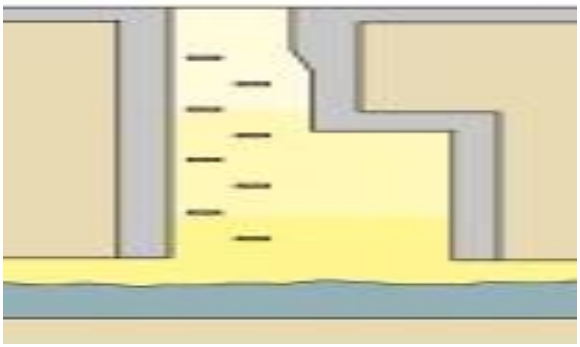
Many hazardous gases, like carbon monoxide gas, are colourless and odourless. On the other hand, some dangerous gases like hydrogen sulphide may have an unpleasant smell at low concentrations but such smell disappears at higher concentrations thanks to olfactory fatigue. It is often very dangerous if drainage workers think they will easily recognise the presence of toxic gases by smell.

In general, Hydrogen sulphide, carbon monoxide gas and, methane are the foremost common hazardous gases found in drainage worksites. Additionally,

oxygen deficiency is another major explanation for illnesses and fatalities. The characteristics of those hazardous gases are listed below.

Hazardous gas	OEL (ppm)	IDLH (ppm)	Relative density (Air = 1.0)	LEL / UEL	Remarks
Hydrogen Sulphide (H2S)	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

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

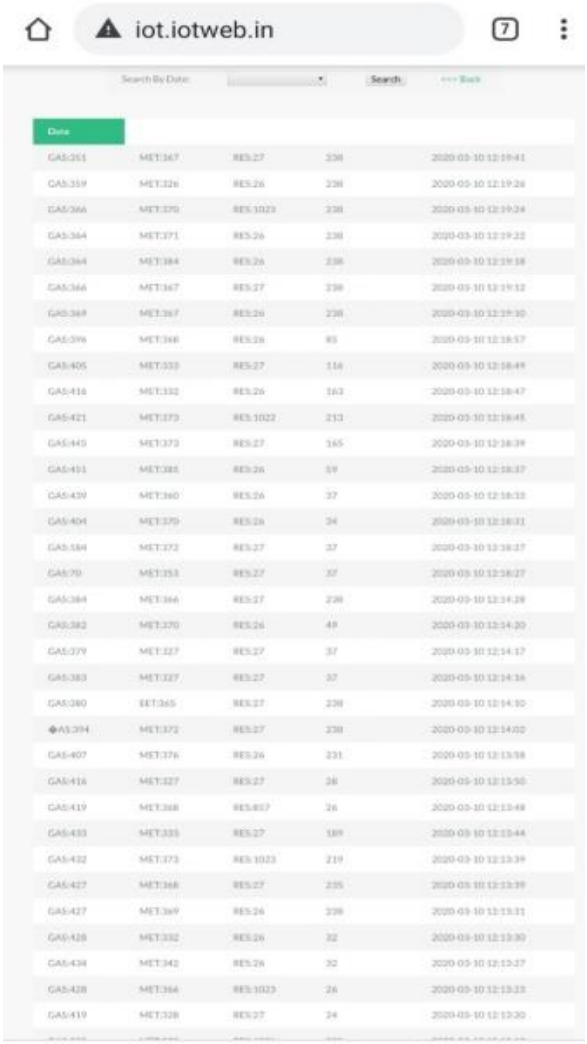


Different hazardous gases accumulate at different levels of a manhole

Respiratory sensor:
This sensor will detect the breathing conditions of the worker. When he stopped inhaling or exhaling for 15sec then an automatic motor pump will send the oxygen.

Heart Beat sensor:
The pulse sensor module features a light which helps in measuring the heartbeat rate. Once we place the finger on the heartbeat sensor, the sunshine reflected will change support the quantity of blood inside the capillary blood vessels. During a heartbeat, the quantity inside the capillary blood vessels is going to be high. This affects the reflection of sunshine and therefore the light reflected at the time of a heartbeat are going to be less compared thereto of the time during which there's no heartbeat (during the amount of your time when there's no heartbeat or the period of time in between heartbeats, the quantity inside the capillary vessels are going to be lesser. this may lead to a higher reflection of light). This variation in light transmission and reflection is often obtained as a pulse from the output of the pulse sensor. This pulse is often then conditioned to live heartbeat then programmed accordingly to read as heartbeat count.

WEBPAGE UPDATE



As shown within the hardware kit the Wi-Fi module is employed to update the info from the kit to the online page. This website will collect the info from

all conditions of every sensor. Generally this website is given to the government municipalities for monitoring the worker. The webpage will automatically update from time to time whenever the equipment is used.

5. CONCLUSION

Monitoring workers while they are working may be difficult in the present situation. With the assistance of our work, we will monitor a worker, especially in metropolitan cities. In metropolitan cities many drainage open and lots of workers are working daily to stay city clean. Hence to assist they work efficiently and to stay safe we will use this drainage worker monitor system. An entire work has been proposed for the checking gas limit and abnormal and normal conditions of a worker.

The oxygen tank will provide the required amount of oxygen through the pump motor for a worker in order that he can survive till the assistance arrives. In future multiple methods are often developed to see the sensitivity of varied gases. An effective way of analysing has got to be implemented in checking the health conditions of workers and a buzzer is required to be installed within the municipality office.

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