Themed Section : Engineering and Technology
© 2018 IJSRSET | Volume 5 | Issue 3 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099

IoT Based Toxic Gases Monitoring System in Underground Sewages Using Wristband

R.Vijayalakshmi[1], Dr.D.Sengeni[2]

[1]PG Student, M.E, Applied Electronics, Department of Electronics and Communication Engineering, CK College of Engineering and Technology, Cuddalore, Tamilnadu, India

[2]Associate Professor, Department of Electronics and Communication Engineering, CK College of Engineering and Technology, Cuddalore, Tamilnadu, India

vijiramaraj111@gmail.com[1], sengeni67@gmail.com[2]

ABSTRACT

Most of the cities adopted the underground drainage system and its the duty of Municipal Corporation to maintain cleanliness, healthy and safety of cities. If the drainage system is not properly managed then pure water gets contaminate with drainage water and infectious diseases may get spread. Drainage cleaning people are not aware of risk of sudden attack of poisonous gas since the gases are odorless if exposed for long time which may cause serious health problems. Due to the lack of using proper gas leakage detection system, a number of dangerous accidents occurred during the last few decades. To overcome all these problems effective monitoring system is needed in the drainage channels. The detected system is proposed with three gas sensors like Carbon Monoxide, Hydrogen sulphide sensors and Methane, one Ultrasonic sensor used for detect obstacle, one Heat Beat sensor used to Calculate the pulse rate of Human. Carbon Monoxide, Hydrogen sulphide, Methane gases are highly toxic to human hence the proposed system will gives alert through the LCD Display after reaching the thershold level of each gas sensors then people gets alerts through the LED glow. Heart Beat sensor will calculate the range of the Pulse rate then output at the abnormal range will give alert through Buzzer and notification message through an GSM . Ultrasonic sensor gives alert through LED glow when obstacles occured. These sensors will be placed at the wristband and performance of varies sensors operations are monitored and stored by using application, for avoiding the future dangerous accidents.

Keywords: Carbon Monoxide Sensor; Hydrogen Sulphide Sensor; Methane Gas Sensor; Ultrasonic Sensor; Wristband; Heart Beat Sensor; LCD; LED; Drainage Channel; Thershold Limit

I. INTRODUCTION

Sewer system is an underground system of pipes commonly used to transport wastewater from homes and businesses either to a treatment facility, where the water is treated and released into natural water bodies like lakes and streams or in any river to permanently drain out from the area. Sewer manhole is one of the most important parts of the sewer system. Sewer manhole is a structure through which a person can gain access to the underground wastewater collection system. Manholes are not designed for someone to work in regularly, but workers may need to enter inside the manhole to complete their jobs such as cleaning, repair, inspection etc.

The lack of prior caring of sewage work is the witness for the deaths of thousands of sewage cleaners throughout the year from accidents and various

diseases such as hepatitis and typhoid due to sudden or sustained exposure to hazardous gases like carbon monoxide, hydrogen sulphide, methane. A better knowledge related to hazards in the surroundings is necessary for the prevention of poisoning of gases. These gases have to be keep on track so that enormous rise in the normal level of effluents should be known and corrective measures can be taken. In contrary, the existing systems available are not much portable and are not affordable. Also it is hard to implement.In the previous the designed Surveillance rover detects the presence of carbon monoxide (CO) gas for monitoring system MATLAB is used. The device consists of a processing section which takes input, processes it and provides output.This system requires base station should near to the sensors.

In this paper an embedded system is designed with ARM Microntroller and various gas sensors for the purpose of detection and altering that helps in eliminating the lives of human which is being endangered. The system is affordable to implement at well-defined monitored. In the existing system, a number of jobs related with gas detection and ensure security system. It has been implemented among these some were theoretical research approach and some were demonstrated in practical field to detect the gas but both approaches were effective manhole gas sensing unit has been developed which is capable to detect the toxic and explosive gases individually within a minute and generate LED glow at the various levels if any of the gas is beyond its threshold limit it gives an alert through LED glow and LCD Display. Harmful gases like carbon monoxide detection, Methane gas detection, and Hydrogen Sulphide gas detection these gases are very toxic to the human. Ultrasonic sensor to determine obstacles in the drainage channel and Heart Beat sensor this will be fixed on the workers wristband who enter into the manholes based on this Heart Beat sensor the alert system Buzzer and Message Notification will be sends to outside workers and Municipal Officers.

II. SYSTEM DESIGN

A) ARM7 Microcontroller (LPC 2148)

ARM Microcontroller (LPC 2138) is needed to continuously sense the sensor output. Also this is used to store some information which can be used for further processing. Interfacing an 5 different sensors such as carbon monoxide sensor, Hydrogen sulphide sensor, Methane gas sensor, Ultrasonic sensor, Heart beat sensor these sensors to be connected in I/O pins and the alert systems such as Buzzer, LED, LCD this to be connected in another I/O pins.The total pin is 64 and 48 I/O pin (port 0 and port 1).sIt has an programming language of Embedded C.

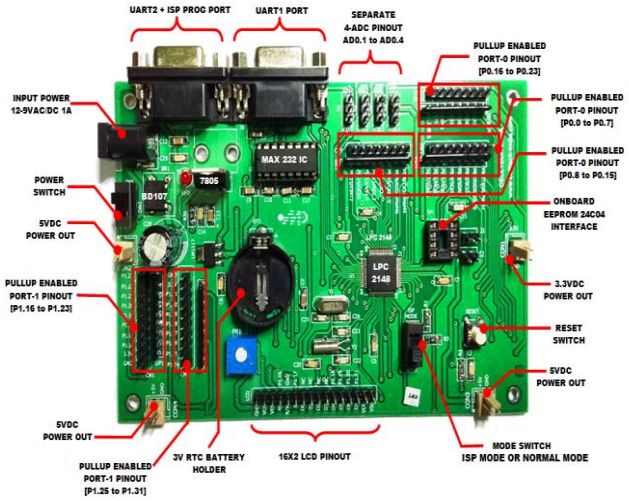

Figure 1. ARM Microcontroller (LPC 2148)

B) System Description

Smart Drainage System helps to alert an workers of various gas levels presents inside the drainage and it measures the distance of Obstacle presents the sensor performance measures and stores by using system application for reduce the future accidents in drainage channel. Efficient Monitoring, High performance, Alert system and safe manner. From the fig:1,The main toxic gases present in drainage is carbon monoxide gas, Hydrogen sulphide gas, Methane gas in ppm range, Ultrasonic sensor and Heart Beat sensor in input block and Output block is an alert system such as LED, LCD Buzzer and messege notification (GSM) these blocks are interfaced with ARM Microcontroller. The block diagram of the complete system. The detailed functioning of the systems will be discussed here with the description of

all the subsystems. The functioning of every subsystems built with the necessary components will be.This paper based on open drains.so, In future looking forward to closed drains and wireless gas sensors at cheaper and easier ways to clean then without the help of mankind.

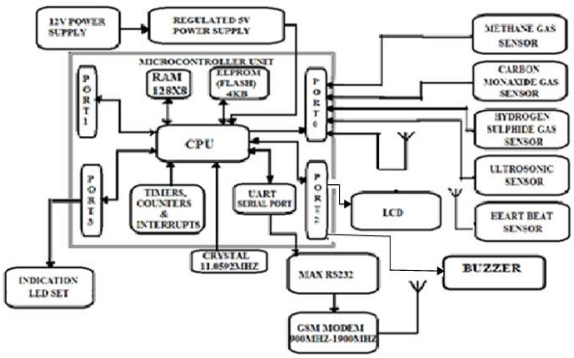

Figure 2. Block Diagram of Proposed System

a) System Modules

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by observer or by an instruments .There are three types of Harmful gas sensor used such as Carbon Monoxide sensor, Hydrogen sulphide sensor and Methane gas sensors. Ultrasonic sensor in drainage channel and heart beat sensor will fixed on workers hand.

The detection range of various harmful gas sensors like carbon monoxide, Hydrogen sulphide and Methane.It can be varied depends on level of gas presents in drainage total detection range of sensor are noted below the table:1 based on sensor used detection will be varied.

Table 1: Detection Range of Gas Sensors

Sensor Name	Detection Range
Carbon monoxide sensor	20-2000 ppm
Hydrogen sulphide sensor	1-200 ppm
Methane sensor	150-10000ppm

The thershold limit of various harmful gas sensors like carbon monoxide, Hydrogen sulphide and Methane.It can be varied depends on level of gas occured in drainage if the gases are beyond thershold limit,workers may have death.so,thershold limit is measured and it shown in Table: 2 based on gas levels low, medium, high.The maximum gas value such as high level is said to be an thershold limit.

Table 2: Threshold Limit For Gas Sensors

SENSOR NAME	THERSHOLD LIMIT
Carbon Monoxide Sensor	35ppm
Hydrogen sulphide sensor	40 ppm
Methane sensor	750ppm

i) Carbon Monoxide Sensor (MQ-9)

Carbon Monoxide (CO) sensor is a simple-to-use, suitable for sensing CO concentrations in the air. From this fig:2, If the CO gas not occured there is no gas affected in LCD display. Then, if the CO gas is occured gas is affected then the LCD display shows Carbon monoxide Gas Leakage and green LED will glow.The gas levels to be divided into three such as Low , Medium, High.Depends on the CO gas presents in drainage value will be displayed in LCD display and LED will glow. If Low level gas is occured 10ppm will display and Green LED will glow, if Medium level gas is occured 20ppm will display and Yellow LED will glow and if High level gas is closed 35ppm will display and Red LED will glow.

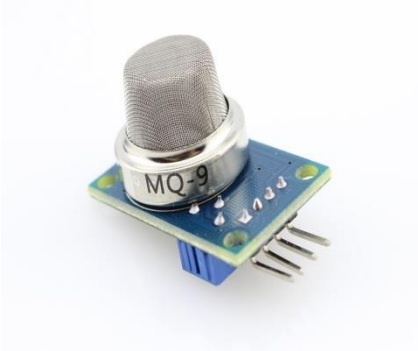

Figure 3. Carbon Monoxide Sensor (MQ-9)

ii)Hydrogen Sulphide Sensor Module(MQ-135)

A hydrogen sensor is a gas detector that detects the presence of hydrogen.From this fig:2, If the H2S gas not occured there is no gas affected in LCD display. Then, if the H2S gas is occured gas is affected then the LCD display shows Hydrogen Sulphide Gas Leakage and green LED will glow.The gas levels to be divided into three such as Low , Medium, High.Depends on the CO gas presents in drainage value will be displayed in LCD display and LED will glow. If Low level gas is occured 10 ppm will display and Green LED will glow, if Medium level gas is occured 25 ppm will display and Yellow LED will glow and if High level gas is occured 40ppm will display and Red LED will glow.

Figure 4. Hydrogen Sulphide Sensor Module (MQ-135)

iii)Methane Sensor Module(MQ-5)

MQ-5 gas sensor modules are used in gas leakage detecting equipments in family and industry, are suitable for detecting of CH4, Natural gas. LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. High sensitivity to CH4, Natural gas, Small sensitivity to alcohol, smoke, Fast response, Stable and long life, Simple drive circuit

From this Fig :4, If the CH4 gas not occured there is no gas affected in LCD display. Then, if the CH4 gas is occured gas is affected then the LCD display shows Methane Gas Leakage and green LED will glow. The gas levels to be divided into three such as Low , Medium, High. Depends on the CH4 gas presents in drainage value will be displayed in LCD display and LED will glow. If Low level gas is occured 150ppm will display and Green LED will glow, if Medium level gas is occured 450ppm will display and Yellow LED will glow and if High level gas is occured 750 ppm will display and Red LED will glow.

Figure 5. Methane Gas Sensor Module (MQ-5)

iv)Ultrasonic Sensor Module

Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.Fig :5,If there is no obstacle in drainage channel intially the LED is off state and displays No obstacles and if there is an Obstacle in drainage then LCD display shows obstacle detected and corresponding LED will glow.

Figure 6. Ultrasonic Sensor

v)Heart Beat Sensor

A heart rate monitor is a personal monitoring device that allows one to measure one's heart rate in real time or record the heart rate for later study. From this Fig:6 ,Initial Heart Beat sensor rate should be in

(65-75) normal condition and if the heart beat rate is below 65 said to be abnormal condition then it shows an output in LCD display shows Attention needed and performance of sensor messege alert through the IoT.

Figure 7. Heart Beat Sensor

vi) LCD Display Module 2X16 and LED Module

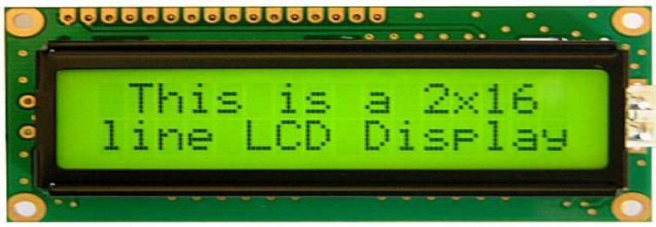

Figure 8. LCD Display Module

Liquid Crystal Display (LCD) is a flat display used in digital watches, cameras and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them advantage of having a low power consumption than the LED. From fig: 7 The gas sensors, Ultrasonic sensor and Heart Beat sensor performance and displayed in LCD. From Table: 3, Gas levels such as low, medium, high value also displayed.

Table 3: Level of Gas Sensors

Sensor Name	Low	High	Medium
Carbon Monoxide	10ppm	20ppm	35ppm
Hydrogen Sulphide	10ppm	25ppm	40ppm
Methane	150ppm	400ppm	750ppm

A light-emitting diode (LED) is a semiconductor device that produces light in different colors. From Table :4, Different gas level Low, Medium, High based on gas levels presents in drainage channels LED will glow.From fig: 8 different color of LED is interfaced with ARM Microntroller based on the gas occured i drainage channel corresponding LED will glow.

Table 4. Gas Level LED Color

GAS LEVEL	LED DISPLAY
Low	Green
Medium	Yellow
High	Red

III. RESULTS AND DISCUSSION

Design and Implementing this project with interfacing of hardware tool. The various devices are arranged in the block diagram. The placing different components as embedded system . The output can run in LCD, LED, Buzzer, Messege notification and sensor performance is measured in system application in the form of graphical representation. The representation shows how the Hydrogen Sulphide gas variation,Carbon monoxide variation, Methane gas variation ,Heart beat sensor variation and Ultrasonic sensor variation. These variations can be identified with the help of Logical representation in software.

The automation technique involving the automatic motoring of all the processes which includes the monitoring and inspection needs provides for a very efficient system. The automation process helps the workers for the to avoid the sudden attack of toxic gases for safety purpose to reduce the amount of errors that occur, reduction in the human resources, increased efficiency and most importantly very cost effective.

i) Carbon Monoxide Gas Levels

Carbon Monoxide (CO) sensor is a simple-to-use, suitable for sensing CO concentrations in the air. Depends on the CO gas presents in drainage value will be displayed in LCD display and LED will glow. MQ-9 gas sensor has high sensitity to Carbon Monoxide. The sensor could be used to detect different gases contains CO and combustible gases, it is with low cost and suitable for different application. From the fig; 9 , If Low level reached 10ppm will display and Green LED will glow, if Medium level reached 20ppm will display and Yellow LED will glow and if High level reached 35ppm will display and Red LED will glow.

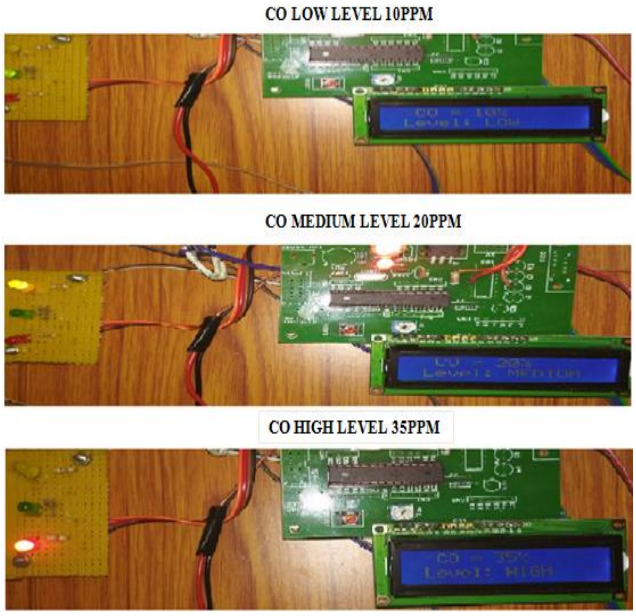

Figure 9. When the CO gas reaches a certain level in drainage channel and display Carbon Monoxide gas and level of gas.If Low level reached then LCD display shows the 10ppm , Medium level reached then LCD display shows 20ppm ,High level reached then LCD display the level 35ppm and corresponding LEDs will glow as per the level of gas persent inside the drainage channels.

ii) Hydrogen Sulphide Gas Levels

H2S Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. Depends on the H2S gas presents in drainage value will be displayed in LCD display and LED will glow. This type of device is used widely in industry and can be found in locations, such as on Drainage channels, oil rigs, to monitor gas levels. Form the fig 10, If Low level reached 10ppm will display and Green LED will glow, if Medium level reached 25ppm will display and Yellow LED will glow and if High level reached 40ppm will display and Red LED will glow.

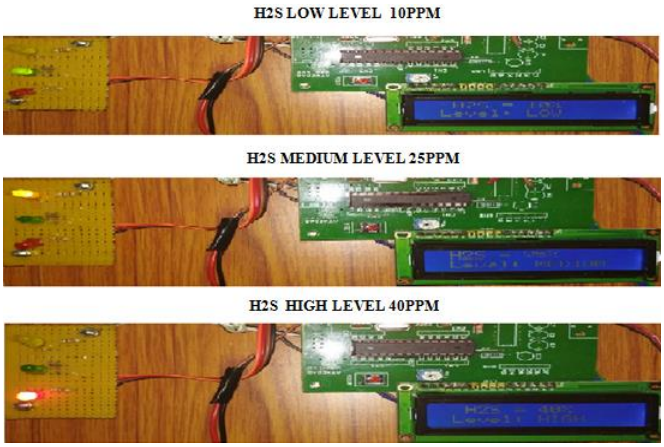

Figure 10. When the H2S gas reaches a certain level in drainage channel and display Hydrogen sulphide and level of gas. If Low level reached then LCD display shows the 10ppm , Medium level reached then LCD display shows 25ppm ,High level reached then LCD display the level 40ppm and corresponding LEDs will glow as per the level of gas persent inside the drainage channels.

iii) Methane Gas Levels

MQ-5 gas sensor modules are used in gas leakage detecting equipments in family and industry, are suitable for detecting of CH4,Natural gas. Depends on the H2S gas presents in drainage value will be displayed in LCD display and LED will glow. High sensitivity to CH4, Natural gas, Small sensitivity to alcohol, smoke, Fast response, Stable and long life. From fig 11, If Low level reached 150ppm will display and Green LED will glow, if Medium level reached 400ppm will display and Yellow LED will glow and if High level reached 750ppm will display and Red LED will glow.

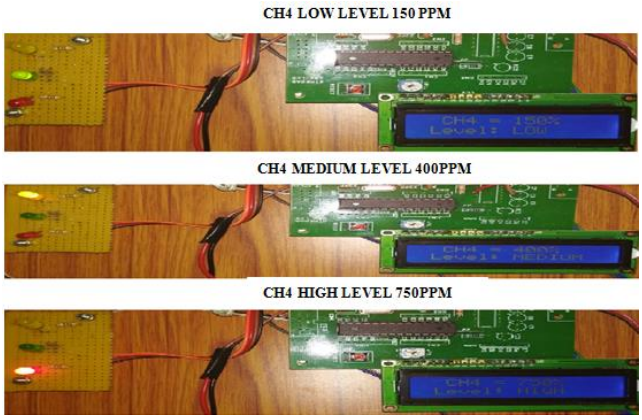

Figure 11. When the CH4 gas reaches a certain level in drainage channel and display Methane gas and level of gas. If Low level reached then LCD display shows the 150ppm , Medium level reached then LCD display shows 400ppm ,High level reached then LCD display the level 750ppm and corresponding LEDs will glow as per the level of gas persent inside the drainage channels.

iv) Ultrasonic Sensor

Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. This performance to be monitored in LCD. It is used to sense the obstacles in drainage channel. From fig 12, LCD display shows obstacles detected then the blue LED is in ON state.

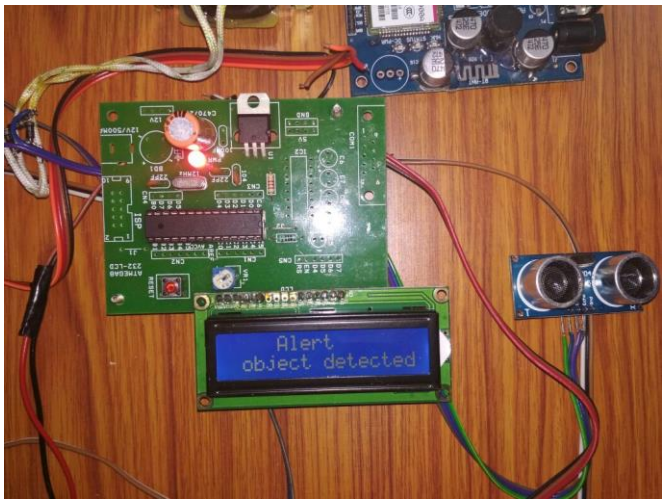

Figure 12. When the input of the Ultrasonic sensor is Low and LCD display shows Obstacle detected and blue LED glow.

v) Heart Beat Sensor

It is used to measure the pulse rate of human. It has an digital input signals Low and High. From Fig:19,If the input signal is Low pulse rate is normal, if the input signal is High there is pulse rate is abnormal then the alert message sends to the municipal officers and outside workers will shows pulse rate in LCD display.

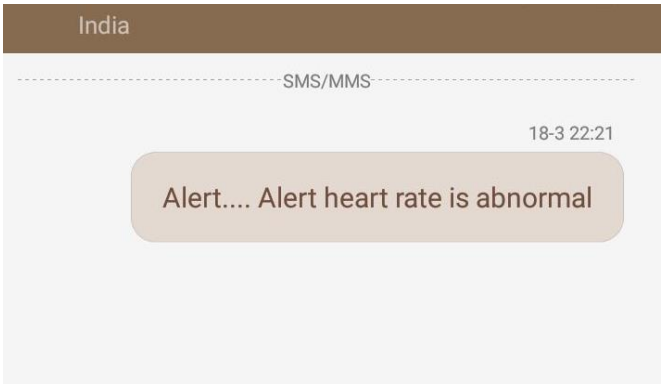

Figure 13. When Heart Beat sensor reaches abnormal range and alert message sends to the municipal officer and outside workers.

IV. HARDWARE IMPLEMENTED

The main aim of the design which is to both automatic and manually read and regulate various sensors and stores and display it on system application was however been achieved. Also all types of sensors are designed in the Emdedded system. There may be other software used for designing system but proteus is the simplest and hardware design in embedded system using different components. The five sensors Hydrogen sulphide gas, Carbon monoxide gas, Methane gas, Ultrasonic sensor and Heart beat sensor are continuously monitored with the help of ARM Microcontroller. Different types of parameter are designed to safeguard the Drainage channel. Improving the sensors efficiency even slightly input voltage varies. Improvement in sensors efficiency can be achieved. In order to automate a alert system and

minimize human intervention, there is a need to develop a proteus software design and implemented in Embedded design system and helps to reduce the errors caused by humans.

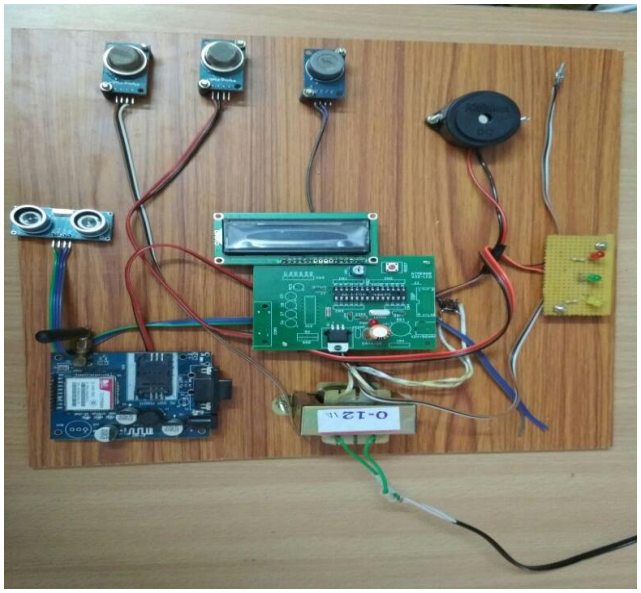

Figure 14. Hardware Implemented

V. CONCLUSION

Smart Drainage Detection system designed and implemented for continuous monitoring and alert system to the drainage-cleaning people. Further it can be monitored in Real time data is acquired by the system and for alert displayed on the LCD , LED ,Buzzer and Messege notifications.

1. Various sensors performs measured by interfacing with ARM Microcontroller (LPC 2148) it will proccess and control programmed in Embedded C and alert by using various alert system to the workers under working in draiange .
2. Various level of gas sensors is measured by using an switches and for alert LED will be used.
3. Obstacle is detected in drainage channel and heartbeat will be measured to the workers.

ACKNOWLEDGMENT

I Would like to express deepest gratitude and appreciation to Guide Dr.Sengeni. For her excellent guidance, caring, patience, suggestions and encouragement with much appeciation to all those who gave us me to complete this project .Last but not least, again I would like to say many thanks go to my guide . Dr.Sengeni., who are given as full effort guiding me to make the goal as well as the panels especially in my presentation that has improved my presentation that has improved my presentation skills by their comment and tips.

VI. REFERENCES

[1] Ali Adid Amb, Sheikh Afrin , F.M Fahad and Hasan U. Zaman, “Acost Effective Way to Build a Web Controlled Search and CO Detector Rover” , IEEE Transcation (2017).

[2] Sugato Ghosh ,Indranil Das, Deepajana Adak, Nillohit Mukherjee, Raghunath Bhattacharrya, Hiranmay Saha “Development of Selective and sensitive Gas Sensor for Manhole Gas Detection” , International Conference on Sensing technology 978-1-5090-0795-0/15/$31.00 ©2016

[3] Sindhoor.S , “IoT Based Garbage Gas Detection System”, Tinternational Journal of Computer Science and Mobile Computing ,vol 5 Issues 9, September-(2016).

[4] Chandler Kemp, Aravind P.Ravikumar and Adam R.Brandt ,“Comaparing natural gas leakage detection technologies using an open-souce virtual gas field simulator” ,Environmental science and technology, vol.4, issues 12, March(2016).

[5] K.Krishnakumari, B.Suganthi, M.Yuganthi P.S.Pooja, “Review of Natural Gas Leakage through gas Pipelines and Various Methods to Detect the Leakage” Internation Conference on Explorations and Innovations in Engineering and technology -2016.

[6] Saransh sharma ,Raja Datta and mrigant Sharad “Avoiding Event Driven Energy Drainage in Wireless Acoustic sensor Nodes for security Applications” International Conference on Communication and Signal Processing, pg no:1991-1996April 6-8, 2016.nishMathew (2012), ‘Internal Model Control of pressure process using ARM

Microcontroller',International Conference Computing, Electronics and Electrical Technologies (ICCEET).

[7] B.Hossain, Saruar J.Shourov, M.Rana, S.Anower ,"Matlab Guidance Based Smart Gas leakage Detection and Security System Using Analog to Digital Technique", International Jounal of Smart Home,vol 9.No 4 .pp.13-24 (2015).

[8] Ali.M.Sadighioon, Nicole metje, David N.Chapman and Carl J.Antony, "Smartpipes:Smart Wireless Sensor Networks for leak Detection in Water Pipelines" Internation Journal of sensors and Actuator Networks, Actuator Netw. , 3, 64-78. 2014.

[9] Sindhu S Kale, Amairullah khan ,"Develpement on Gas Leak Detection and Loation System Based on Wireless Sensor Networks: A Review", International Journal of Engineering Trends and Technology ,vol 12 Number 6- june(2014).

[10] Ashish Shrivastava, Ratnesh Prabhaker, Rajeev Kumar and Rahul verma, "GSM Based Gas Leakage Dection System", International Journal of Technical Reasearch and Application, vol 1, Issue 2 (may-june 2013).

[11] V.Divya, S.Dharanya, S.Shaheen and A.Umamakeswari "Amphibious Surveillance Robot with Smart Sensor Nodes" Indian Journal of Science and Technology" Vol 6 (5) May (2013).

[12] Sheikh Rafik Manihar, Komal Prasd Dewagan, Jayant Rajpurohit,"Multiple gas Analyzer and Indicator",International Journal of Modern Engineering Research, vol.2,Issues 4, July-Aug. (2012).Gowri Shankar (2008),'Controlof Boiler Operation using PLC &SCADA', International Multi Conference of Engineers and Computer Scientists(IMEC).

[13] Jiangwen Wan , Yang YU, yinfeng Wu, Renjein Feng and Ning Yu, "Hierachical Leak Detection and Localization Method in Natural Gas Pipeline Monitoring Sensor Networks" Journal of Sensors, Sensors, 12, 189-214.2012

[14] N.L.T.Lile,M.H.M.Jaafar, M.R.Roslam,M.S.Muhamad Azmi, " Blockage Detection in Circular Pipe Using Vibration Analysis", International Journal on Advancced Science Engineering Information technnology, vol.2,No.3 (2012).

[15] Sidra Rashid, Saad Qaisar, Husnain Saeed and Emad Felemban, " A Method for Distributed Pipeline Burst and Leakage Detection in Wireless Sensor Networks Using Transform Analysis", International Journal of Distributed Sensor Networks, volume , Article ID 9396557, 14 Pages (2012).

[16] Menglong CONG, Shuxu GUO, Yiding WANG, "A novel Methane Detectin System Based on InGaAsP distributed feedback", state Key Laboratory on Intergrated Optoelectronics vol. XLI, No 3 (2011).

[17] Sofian M.kanan,Oussama M.EI-kadri, Imad A.Abu –Yousef and Marsha C.Kanan, "Semiconducting Metal Oxide Based Sensors for Selective Gas Pollutant Detection" Journal of Sensors, Sensors, 9, 8158-8196.2009.

[18] Fei Lei, Lei Yao, Deng Zhao ,Yucong Duan , "Energy –Efficient Abnormal Nodes Detection and Handlings in wireless Sensor Networks" IEEE paper Accepted for Publications.(2006).

[19] Feng Yun,Serguei A.Chevtchenko ,Yong-tae Moon, "GaN Resistive Hydrogen Gas Sensor ", Electrical and Computer Engineering Publications, Applied Physics Letters, 87, 073507 (2005).

[20] Javid Huseynov, Shankar Baliga, Micheal Dillencournt, Lubomir Bic ,Nader Bagherzadeh, "Gas- Leak Localization Using Distributed Ultrasonic Sensors" General Monitors Transnational, Proc. of SPIE Vol. 7293 72930Z1.

[21] Michael B.Frish, "Currect and Emering Laser Sensors For Greenhouse gas sensing and leak Detection'' Physical Sciences Inc.,

[22] Zipeng Zhu, Yuhui Xu and Binqing Jiang , "A One ppm NDIR Methane Gas Sensor with Single frequency Filter Denoising Alogorithm", IEEE control system magzine, pp.80-84 (1898).