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IOT Based Smart Detection System for Harmful Gases in Underground Sewages

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***Abstract:** Most of the cities adopted the underground drainage system and it's 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 threshold 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 occurred and performance of varies sensors operations are monitored and stored for avoiding the future dangerous accidents. The performance of proposed system through the Simulation.*
***Keywords:** Carbon Monoxide sensor; Hydrogen sulphide sensor; Methane gas sensor; Ultrasonic sensor; Heart Beat sensor; LCD; LED; Drainage Channel; Virtual Terminal; Serial Communicator; 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, 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 hand watch who enter into the manholes based on this Heart Beat sensor the alert system Buzzer and Messege Notification will be sends to outside workers and Municipal Officers.

II. SYSTEM DESIGN

Smart Drainage System helps to alert an workers of various gas levels, Obstacle detection by using system application stores te sensor performs for reduce the future accidents in drainage channel. Efficient Monitoring, High performance Monitoring 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 and Buzzer and 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 sensors at cheaper and easier ways to clean then without the help of mankind.

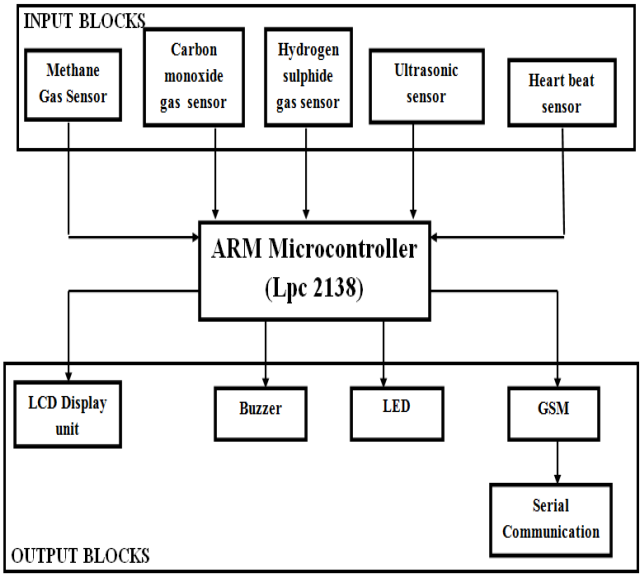

Fig 1: Block diagram of proposed System

A. Sensor Modules

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by ab 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.Some Ultrasonic sensor in drainage channel and another 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 occured 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	10-10000 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	45 ppm
Methane sensor	750ppm

1) *Carbon Monoxide Sensor Module*:This sensors is used to sense the carbon monoxide gas and it has an digital input signals Low and High.From this fig:2, If the input signal is Low there is no gas affected then if the input signal is High gas is affected then the LCD display shows Carbon monoxide Gas Leakage and LED will glow.Based on the switch input corresponding LED's will glow.It has an three level such as low, medium ,high. *f beyond the thershold limit (35ppm) in high state then the LED will glow it shows the alerts to workers.*

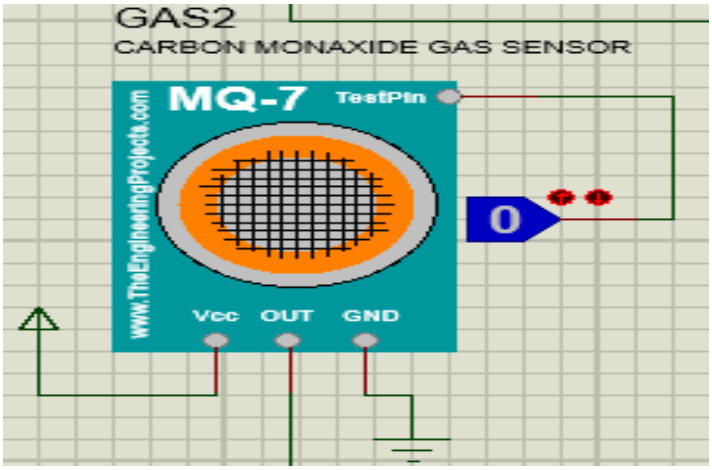

Fig 2: Carbon Monoxide Sensor Module(MQ-7)

2) *Hydrogen Sulphide Sensor Module*: This sensor is used to sense the hydrogen sulphide gas and it has an digital input signals Low and High. From this fig:3, If the input signal is Low there is no gas affected then if the input signal is High gas is affected then the LCD display shows Hydrogen Sulphide Gas Leakage and LED will glow. Based on the switch input corresponding LED's will glow.It has an three states such as low, medium, high. If beyond the threshold limit(40ppm) in high state then the LED will glow it shows the alerts to workers.

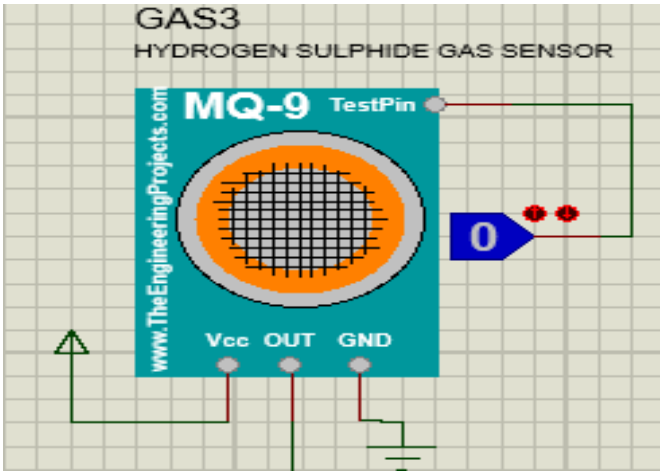

Fig 3 : Hydrogen Sulphide Sensor Module(MQ-9)

3) *Methane Sensor Module*: This sensors is used to sense the Methane gas and it has an digital input signals Low and High. From this Fig :4,If the input signal is Low there is no gas affected then if the input signal is High gas is affected then the LCD display shows Methane Gas Leakage and LED will glow.Based on the switch input corresponding LED's will glow.It has an three states such as low, medium, high.If beyond the thershold limit (750ppm) in high state then the LED will glow it shows the alerts to workers.

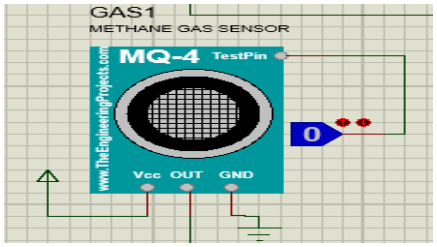

Fig 4: Methane Gas Sensor Module(MQ-4)

4) *Ultrasonic Sensor Module:* It is used to detect the Obstacles in draiange channel.It has an digital input signals Low and High.From this Fig :5,If the input signal is Low there is no Obstacle in drainage channel intially the LED is off state and if the input signal is High there is an Obstacle in draiange then LCD display shows obstacle detected and corresponding LED will glow.

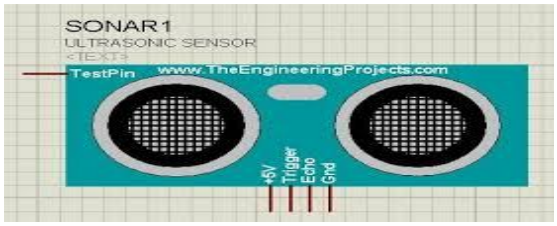

Fig 5 : ultrasonic Sensor

5) *Heart Beat Sensor Module:* It has an digital input signals Low and High. From this Fig:6 ,If the input signal is it in normal and if the input signal is High there is pulse rate is abnormal then it shows an output in LCD display shows Attention needed and Serial monitoring shows pulse rate.

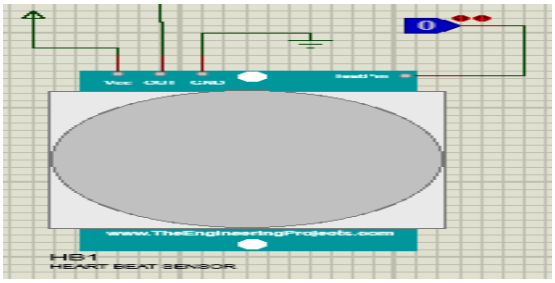

Fig 6: Heart Beat Sensor Module

B. General modules

1) *LCD Display Module 2X16*

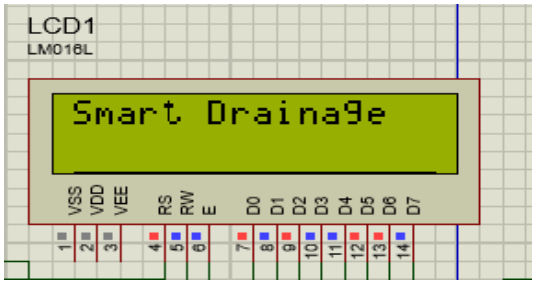

Fig 7: LCD Display Module

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. 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

2) *LED MODULE:* A light-emitting diode (LED) is a semiconductor device that produces light in different colours. LEDs last a long time and do not break easily (compared to incandescent lightbulbs).From Table :4, Different gas level Low, Medium, High it has digital input based on input given to the switch the LED will glow. From fig: 8 different colour of LED is interfaced with ARM Microntroller based on the switch input corresponding LED will glow.

Table 4 : Gas Level LED color

GAS LEVEL	LED DISPLAY
Low	Green
Medium	Yellow
High	Red

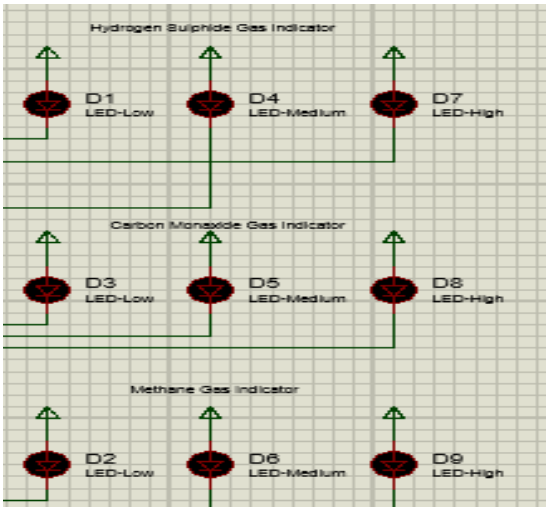

Fig 8: LED Module

3) *Buzzer Module:* Proteus has a builtin component for buzzer and its an animated component means it gives a sound (beep) From fig :9, It is used to give alert sound based on the performance Heart beat sensor it has an two state Normal/Abnormal if it is

reaches to abnormal state buzzer sound will produced. In this process beep sound will measure in the form of voltage variation its voltage varies from (1 to 5v).

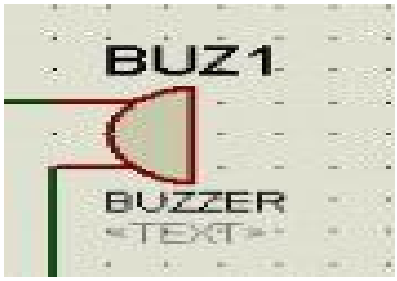

Fig 9: Buzzer Module

4) *Switch Module:* A switch is component that is used to either make or break a circuit path. From fig :10 It consists of three state of Gas levels such as Low ,Medium, High based on the switch input corresponding LED glow.

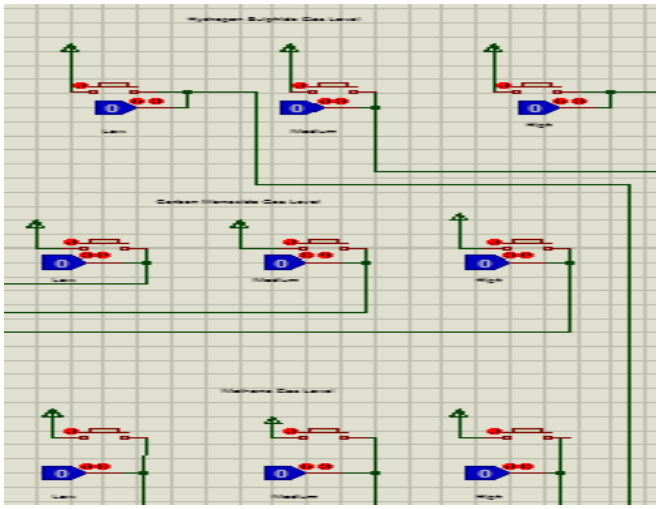

Fig 10 :Switch Modules

5) *Gsm Module:* GSM services are a standard collection of applications and features available to mobile phone subscribers all over the world.From fig:10 GSM is interfaced with Microcontroller this standards are defined by the 3GPP collaboration and implement in both hardware and software by equipment manufacturers and mobile phone operators.

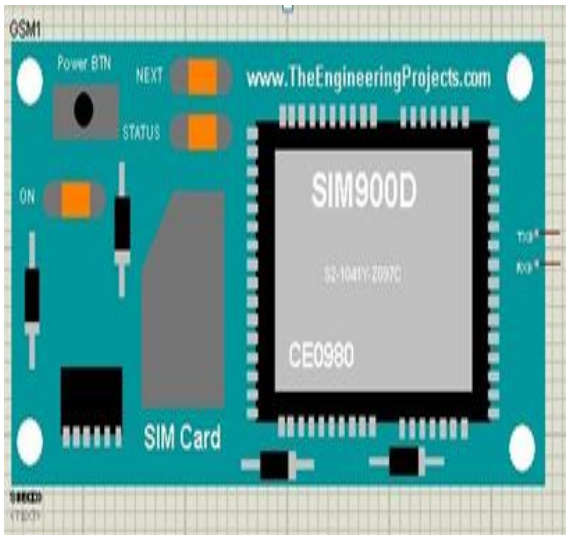

Fig 11 : GSM module

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III. SIMULATION OUTPUT AND DISCUSSION

A. Harmful gas detection

1) *Carbon Monoxide Gas Detection:* This sensor is used the sense the Carbon monoxide gas and it has an digital input signals such as Low / High. From fig :12 If the input signal is Low there is no gas affected then if the input signal is High gas is affected then the LCD display shows Carbon Monoxide Gas Detected based on the input corresponding LED(green) will glow.

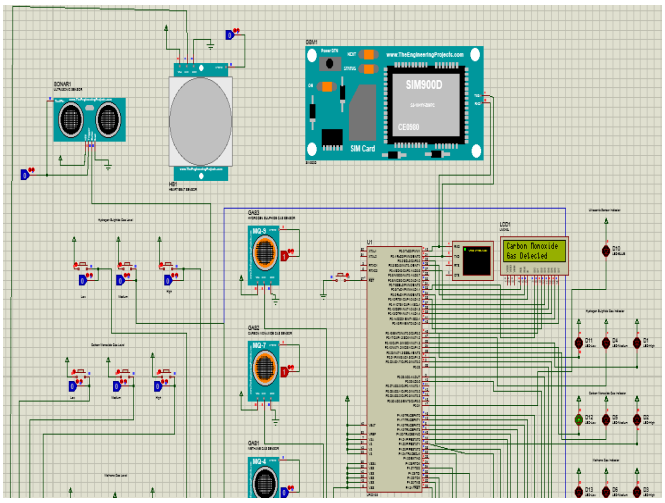


Fig 12: When the input of the Carbon Monoxide Gas sensor is High and LCD display shows Carbon Monoxide Gas detected and *LED glows.*

2) *Hydrogen Sulphide Gas Detection:* This sensor are used the sense the Hydrogen sulphide gas and it has an digital input signals such as Low / High. From Fig:13, If the input signal is Low there is no gas affected then if the input signal is High gas is affected then the LCD display shows Hydrogen sulphide Gas Detected , based on the input corresponding LED(green) will glow.

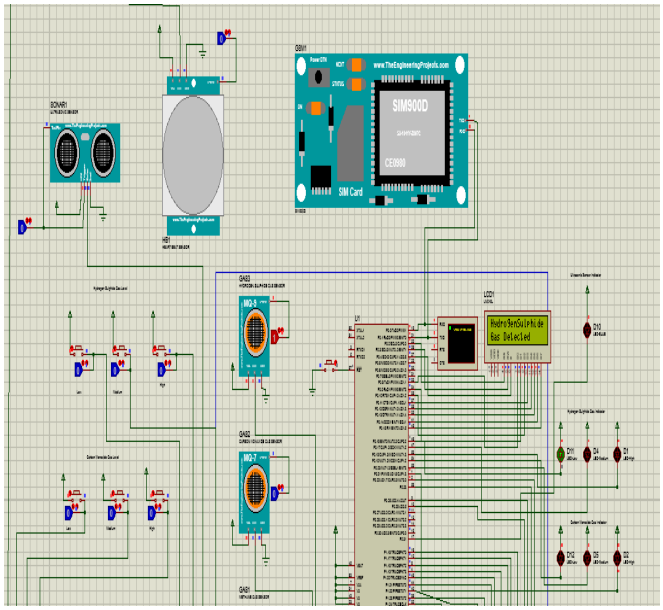


Fig 13: When the input of the Hydrogen sulphide Gas sensor is High and LCD display shows Hydrogen sulphide Gas detected and LED glows.

3) *Methane Gas Detection:* This sensors are used the sense the Methane gas and it has an digital input signals such as Low / High.From fig :14 If the input signal is Low there is no gas affected then if the input signal is High gas is affected then the LCD display shows Methane Gas Detected, based on the input corresponding LED(green) will glow.

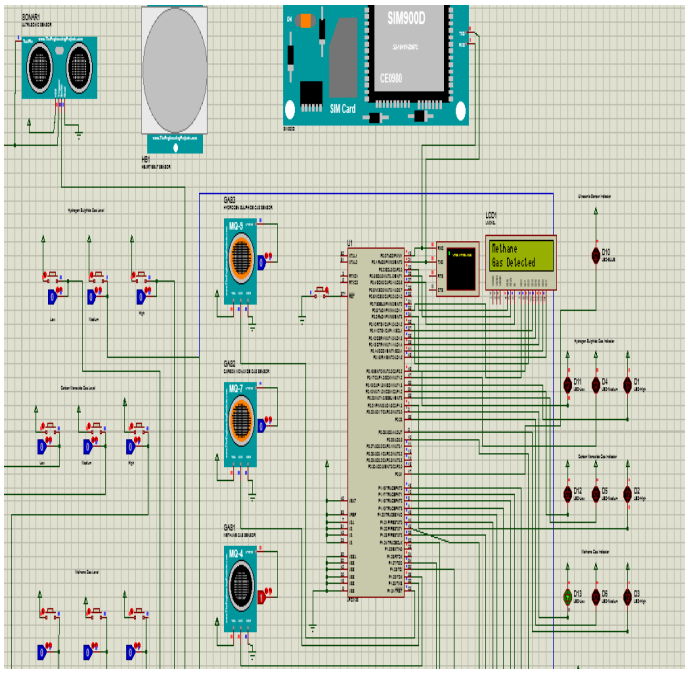
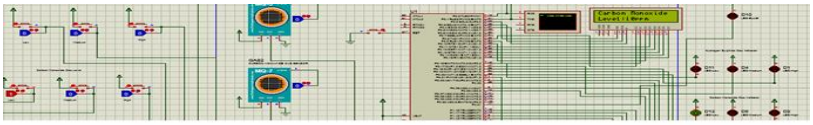


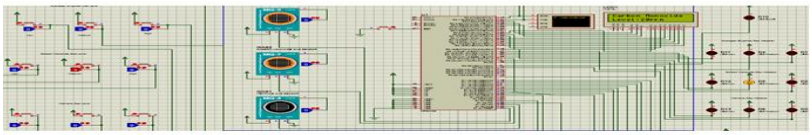
Fig 14: When the input of the Methane Gas sensor is High and LCD display shows Methane Gas detected and LED glows.

B. Various Level of Gas Sensors

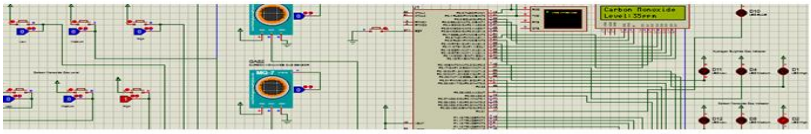
1) *Carbon Monoxide Gas Levels:* Carbon Monoxide gas sensor level is controlled by using an various switches. From Fig:15,The levels to be divided into three such as Low , Medium, High. Depends on the input given to switch gas value will be displayed in LCD display and LED will glow. If Low level switch is closed 10ppm will display and Green LED will glow, if Medium level switch is closed 20ppm will display and Yellow LED will glow and if High level switch is closed 35ppm will display and Red LED will glow.



LOW LEVEL -10 PPM



MEDIUM LEVEL -20PPM



HIGH LEVEL – 35PPM

Fig 15 : When the switch is closed and display Carbon Monoxide gas and level of gas.If Low switch is closed then LCD display shows the 10ppm , Medium switch is closed then LCD display the level 20ppm ,High switch is closed then LCD display the level 35ppm and corresponding LED will glow.

2) *Hydrogen Sulphide Gas Levels:* The hydrogen sulphide gas sensor level is controlled by using an various switches.The levels to be divided into three such as Low , Medium, High. From Fig:16, Depends on the input given to switch gas value will be displayed in LCD display and LED will glow. If Low level switch is closed 10ppm will display and Green LED will glow, if Medium level switch is closed 25ppm will display and Yellow LED will glow and if High level switch is closed 40ppm will display and Red LED will glow.

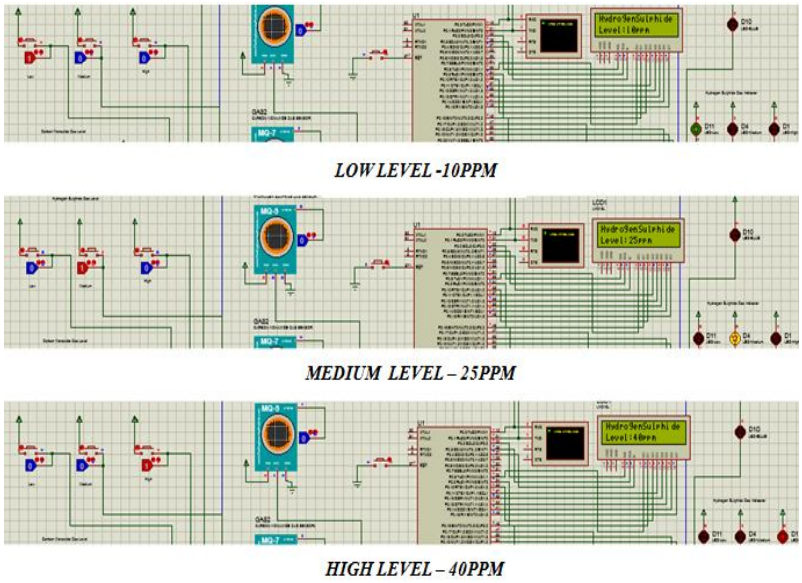


Fig 16 : When the switch is closed and display Hydrogen Sulphide gas and level of gas.If Low switch is closed then LCD display shows the 10ppm , Medium switch is closed then LCD display the level 25ppm ,High switch is closed then LCD display the level 40ppm and corresponding LED will glow.

3) *Methane Gas Levels:* The Methane gas sensor level is controlled by using an various switches. From Fig:17,The levels to be divided into three such as Low , Medium, High. Depends on the input given to switch gas value will be displayed in LCD display and LED will glow. If Low level switch is closed 150ppm will display and Green LED will glow, if Medium level switch is closed 400ppm will display and Yellow LED will glow and if High level switch is closed 750ppm will display and Red LED will glow.

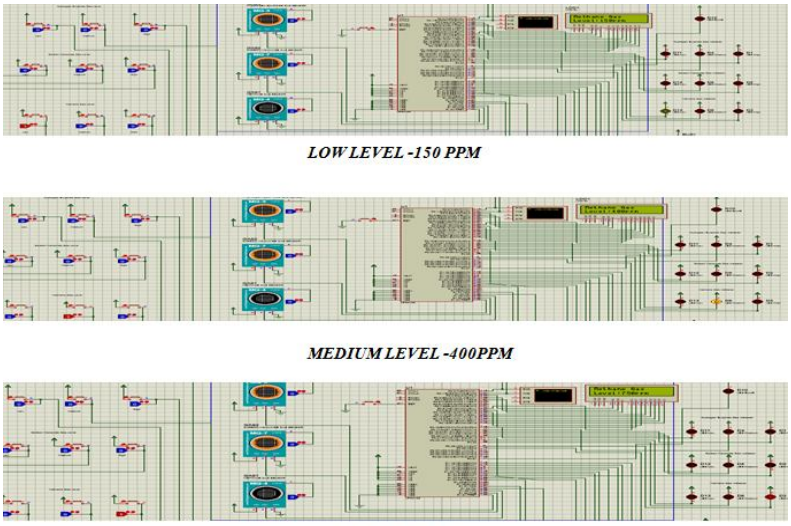


Fig 17 : When the switch is closed and it display Methane gas and level of gas.If Low switch is closed then LCD display shows the 150ppm , Medium switch is closed then LCD display the level 400ppm ,High switch is closed then LCD display the level 750ppm and corresponding LED will glow.

C. Ultrasonic Sensor

t is used to sense the obstacles in drainage channel.It has an digital input signals Low and High. From Fig:18,If the input signal is High there is no Obstacle in manhole intially the LED is in off state and if the input signal is Low there is an Obstacle in drainage channel and LCD display shows obstacles detected then the blue LED is in ON state.

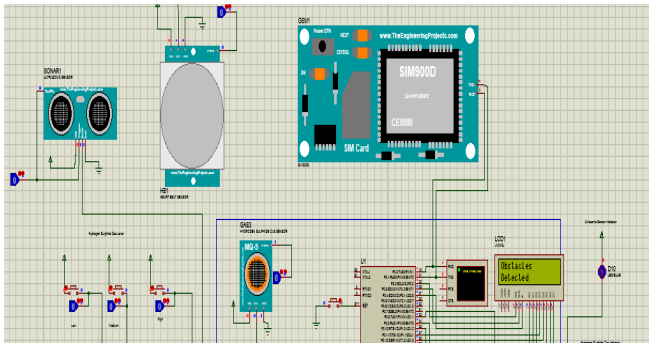


Fig 18: When the input of the Ultrasonic sensor is Low and LCD display shows Obstacle detected and blue LED glow.

D. 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 LCD display shows Attention Needed and Virtual terminal will shows pulse rate.

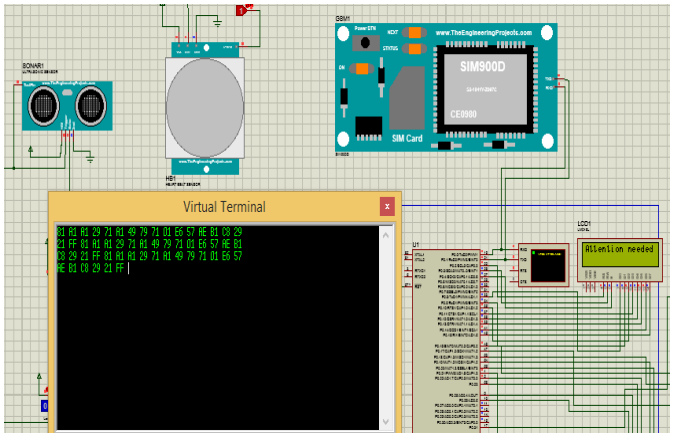


Fig 19 : When the input of the Heart Beat sensor is High and LCD display shows Attention needed and Virtual terminal will shows the pulse rate.

IV. CONCLUSION

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. As the validation is compared with the digital inputs based on this various modules and switches will perform for an simulation software.

A. Various sensors performs measured by interfacing with ARM Microcontroller (LPC 2138) it will proccess and control programmed in Embedded C and alert by using various alert system to the workers under working in draiange .

B. .Various level of gas sensors is measured by using an switches and for alert LED will be used

C. Obstacle is detected in drainage channel and heart beat will be measured to the workers.

V. ACKNOWLEDGMENT

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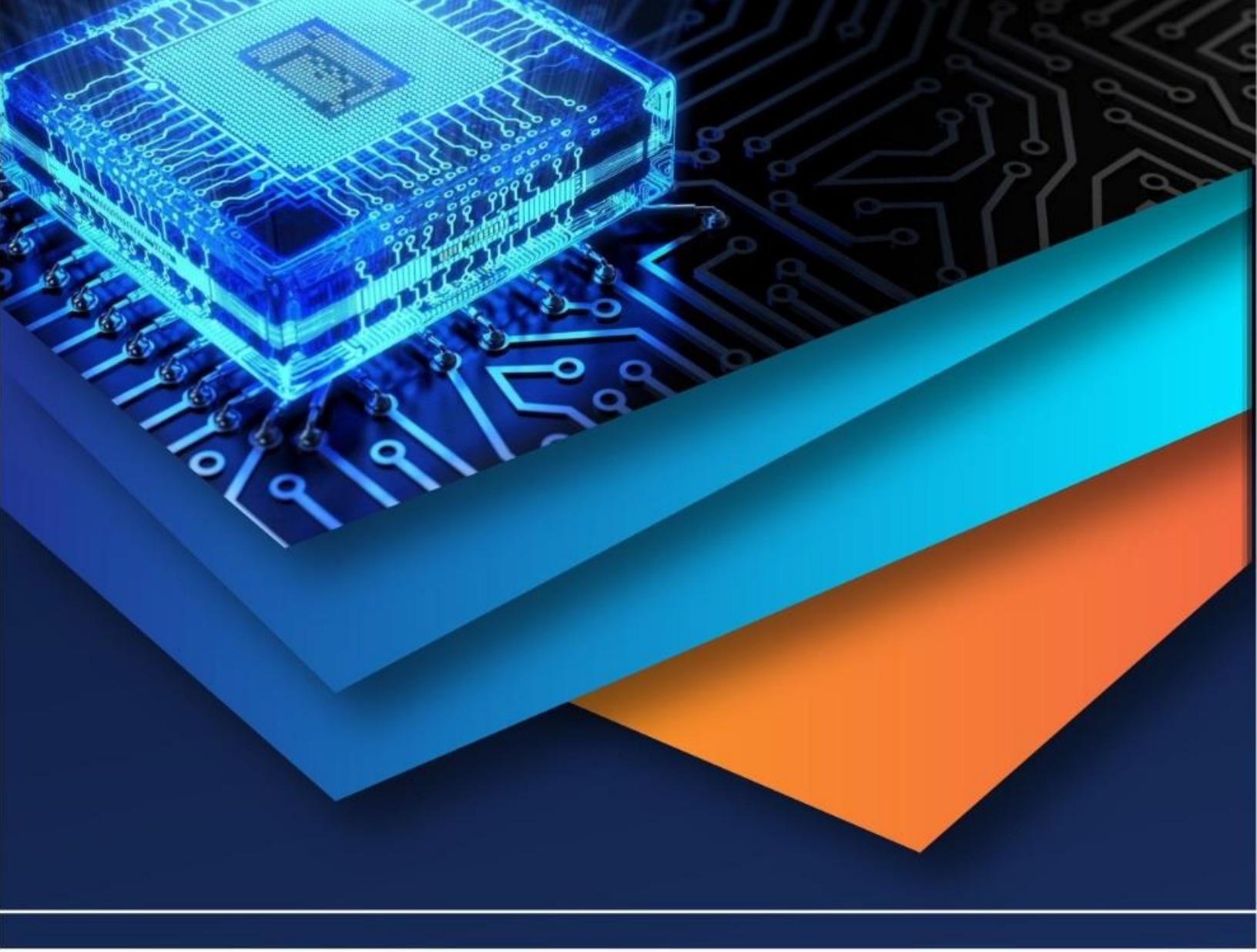

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