Industrial Gas Monitoring with Safety Closure

Mr. Muthuvinayagam M, Meganathan S, Janakiraman S, Dineshraja S

Asso.Professor/HOD B.E Student B.E Student B.E Student

CMS College of Engineering

Abstract- In the title mentioned above it is planned to be deployed in industries with gas usages where the levels of the different cylinders are monitored and if they are changed the change in cylinder is notified to the owner, administrator and the gas agency via GSM communication, gas level quantity indicated through an LED (Red, Yellow, Green) and also count of the gas cylinders being shown in the LCD display.
Also the pipeline through which the gas is delivered or supplied to the industrial unit is continuously monitored using the gas sensors deployed and in case of any leakage the system shuts down the valve at the supply location to prevent further leakage or damage. Further it alerts the user administrator via a buzzer alarm siren so that all people are evacuated safely. The GSM modem then alerts the security, fire department and also uses fire extinguishers. Next it also identifies the occurrence of gas leakage and informs the microcontroller unit and intercomponent signal transmission done through a Zigbee technology.

Keywords: GSM (Global System for mobile communications),LPG (Liquefied petroleum gas), GPRS(General Packet Radio Service),WGSN(Wireless Gas Sensor Network)

I. INTRODUCTION

LPG consists of mixture of propane and butane which is highly flammable chemical. It is odorless gas due to which Ethanethoil is added as powerful odorant, so that leakage can be easily detected. There are other international standards like EN589, amyl mercaptane and tetrahydrothiophene which are most commonly used as odorants. LPG is one of the alternate fuels used now days. Sometimes liquefied petroleum gas is also known as LPG gas, Auto gas etc. This gas is commonly used for heating appliances, hot water, cooking, and various other purposes also.
LPG is also used as an alternate fuel in vehicles due to soaring in the Prices of petrol and diesel. Some people have low sense of smell, may or may not respond on low concentration of gas leakage. In such a case, gas leakage security systems become an essential and help to protect from gas leakage accidents. A number of research papers have been published on gas leakage security system [1-13]. Embedded system for Hazardous gas detection and Alerting has been proposed in literature [8]. Where the alarm is activate immediately, if the gas concentration exceeds normal level if an abnormal state.

II. PROPOSED METHOD

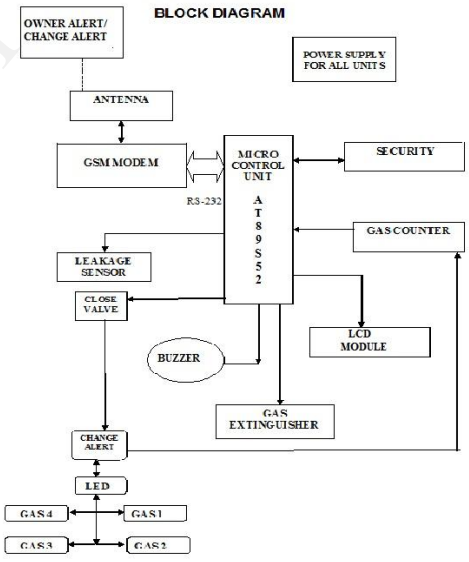

Fig .1.Block diagram of gas monitoring, protecting and controlling system

The functionality of system is divided into three main steps. Monitoring, protecting and controlling system. The fig. 1 shows the block diagram of gas leakage security system.

This system uses Atmel 89S52 microcontroller which has 8K ROM, 256 bytes RAM. The microcontroller hex code is developed using assembly language through Systronix assembler. The CO unit will measure the carbon monoxide

and carbon dioxide level in the industrial environment and its output voltage is conditioned and converted into digital and calibrated to physical units. The Ph electrode is used to measure amount of gas consumed and level of the outlet gas from the industries and recorded in the computer.

III. MONITORING SYSTEM

In this system the main concept is monitoring gas usage for energy conservation. The system consists of gas counter, LED and LCD. Whenever changing the cylinder, counter will be activated that time counter database stored in microcontroller memory unit and display on the LCD. This database information automatically uploaded the server or mobile applications.
The quantity of gas indicated on the port LED.
(red-empty, yellow-medium, green-full).

IV. LEKAGE ALERT

The proposed project fire and gas leakage detection is very useful to identify fire and gas leakages in home or industrial areas and inform to the concerned person very fast and within a short span of short time. Gas sensor is used to sense LPG the corresponding information is given to microcontroller by means of interfacing circuits. Microcontroller detects the fire and gas leakages. It gives the alarm by means of the buzzer which is connected to the controller. At the same time the microcontroller will communicate with GSM modem via serial communication and send SMS is sent to the mobile number which is stored in the controller programming.
This system uses Atmel 89S52 microcontroller which has 8K ROM, 256 bytes RAM. The microcontroller hex code is developed using assembly language through Systronix assembler. The CO unit will measure the carbon monoxide and carbon dioxide level in the industrial environment and its output voltage is conditioned and converted into digital and calibrated to physical units. The Ph electrode is used to measure the amount of gas consumed and level of the outlet gas from the industries and recorded in the computer.

If any lekage occurs in the gas supply unit is automatically shut down the valve and immediately Send SMS to the owner, administrator and security via GSM communication and also siren alert.

V. GSM TECHNOLOGY

In the automatic gas detection phase methods were developed for automatically detecting a target gas.

The sensor node attains early gas detection using an on board semiconductor sensor. Because the sensor consumes a substantial amount of power, which negatively affects the node lifetime, we employ a pulse heating profile to achieve significant energy savings. The relay node receives and forwards traffic from sensor nodes towards the network coordinator and vice versa. When an emergency is detected, the network coordinator alarms an operator through the GSM/GPRS or Ethernet network, and may autonomously control the source of gas emission through the wireless actuator. Our experimental results demonstrate how to determine the optimal temperature of the sensor's sensitive layer for methane/LPG detection, show the response time of the sensor to various gases, and evaluate the power consumption of the sensor node. The demonstrated WGSN could be
Used for a wide range of gas monitoring applications. They present a wireless gas sensor network (WGSN) for early gas leak detection and fast operator alarm. The network consists of four units: a sensor node, a relay node, a network coordinator, and a wireless actuator. The sensor node is equipped with a microcontroller, a wireless modem, a battery power supply, and a semiconductor gas sensor. Since the sensor is the most power 'hungry' component on board, we apply pulse width modulation for the heating of the sensor sensitive layer that significantly reduces its energy consumption. In addition, to support continuous monitoring of the environment, it is carefully chosen to have low power consumption components and energy saving modes during the sensor node development. The range of wireless
transmission is extended using the relay nodes, which support communication between the sensor node and the network coordinator. Whenever a hazardous gas is detected in the atmosphere, the network coordinator alarms an operator by the GSM/GPRS or Ethernet network and/or controls a gas emission source by the wireless actuator.

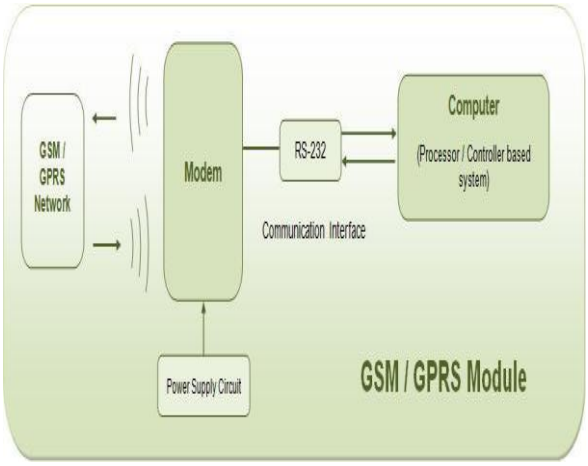

Fig. 2.Gsm/Gprs Module

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting

mobile voice and data services. GSM differs from first generation wireless systems in that it uses digital technology and time division multiple access transmission methods. GSM is a circuit-switched system that divides each 200 kHz channel into eight 25 kHz time-slots; GSM supports data transfer speeds of up to 9.6 kbit/s, allowing the transmission of basic data services such as SMS (Short Message Service). Another major benefit is its international roaming capability, allowing users to access the same services when traveling abroad as at home. This gives consumers seamless and same number connectivity in more than 210 countries. GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available.

VI. CHANGING ALERT LEVEL SENSOR

Level sensors detect the level of substances that flow, including liquids, slurries, granular materials, and powders. Fluids and fluidized solids flow to become essentially level in their containers (or other physical boundaries) because of gravity whereas most bulk solids pile at an angle of repose to a peak. The substance to be measured can be inside a container or can be in its natural form (e.g., a river or a lake). The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low.

There are many physical and application variables that affect the selection of the optimal level monitoring method for industrial and commercial processes. The selection criteria include the physical: phase (liquid, solid or slurry), temperature, pressure or vacuum, chemistry, dielectric constant of medium, density (specific gravity) of medium, agitation (action), acoustical or electrical noise, vibration, mechanical shock, tank or bin size and shape. Also important are the application constraints: price, accuracy, appearance, response rate, ease of calibration or programming, physical size and mounting of the instrument, monitoring or control of continuous or discrete (point) levels. The level sensor in this project does two works, one is to prevent the user from refilling the gas cylinder in the port if any gas is available does not allow the user to change the refill cylinder. It also counts and alerts the owner about the changes made in case a gas is refilled.

VII. GAS SENSOR NETWORK (GSN)

Fig. 3.MQ-2 Gas sensor

MQ2 is a semiconductor type gas sensor which detects the gas leakage. The sensitive material of MQ-2 is tin dioxide (SnO2). It has very low conductivity in clean air. This Gas sensor not only has sensitivity to methane, LPG, smoke and butane but also to other natural gases, low sensitivity to cigarette smoke and alcohol. This sensor can also be used for detection of other combustible gas such as methane. The concentration range of MQ-2 gas sensor is detecting concentration scope :

200ppm-5000ppm LPG and propane, 300ppm-5000ppm butane,5000ppm-20000ppm methane, 300ppm-5000ppm H2, 100ppm-2000ppm Alcohol. This sensor is available in 6 pins package, out of which 4 pins are used for fetching the signals and other 2 pins are used for providing heating current. This sensor has fast response time.

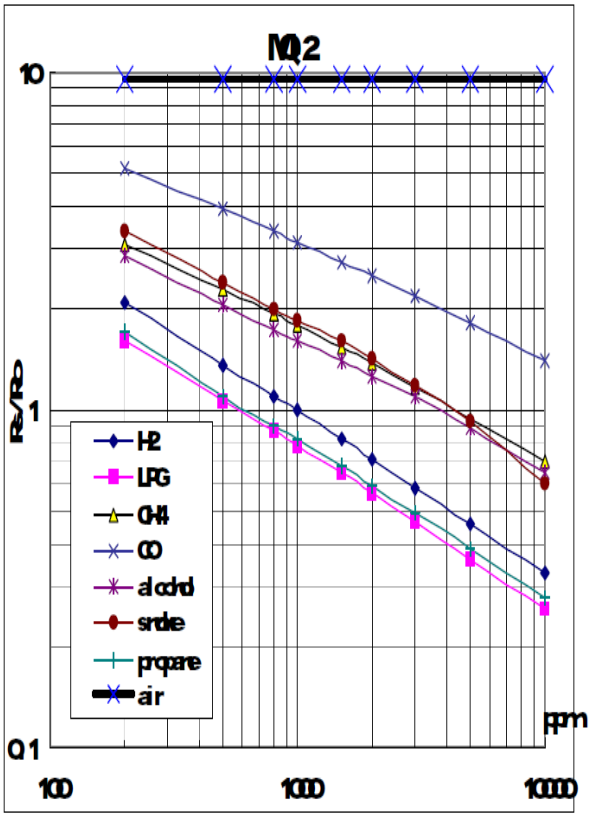

Fig. 4. Shows the typical sensitivity characteristics of the MQ-2 gas sensor for several gases.

VIII. RESULTS

The prototype of the gas leakage security system has been shown in fig. 6. This system has been tested by taking a small amount of LPG gas near to the sensor. MQ-2 gas sensor detects the LPG gas and sends a signal to the microcontroller. After that microcontroller send an active signal to other externally connected devices. As a result a buzzer rings and a message is display on LCD screen. Simultaneously main power and gas supply turns off with the help of stepper motor and GSM module send an SMS . When reset button is pressed, the system refreshes itself and whole system regains Its initial position.

Fig. 5. Prototype kit Module

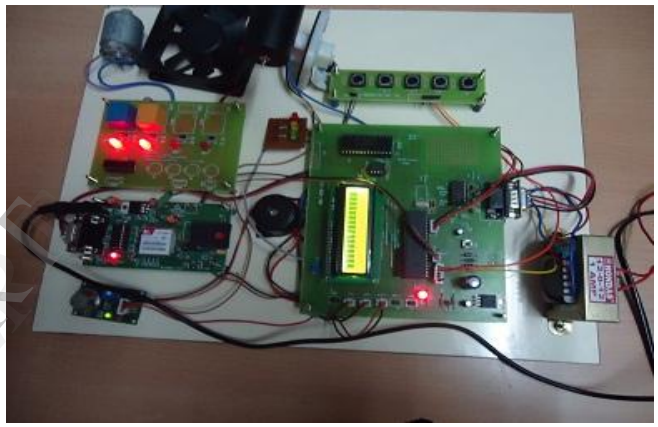

Fig. 6.Prototype kit module at running condition

Fig. 7.Gas leakage is Monitoring on LCD display

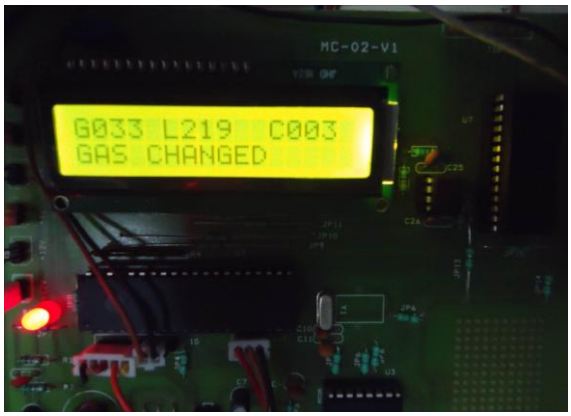

Fig 8.Gas changed is monitoring on LCD display

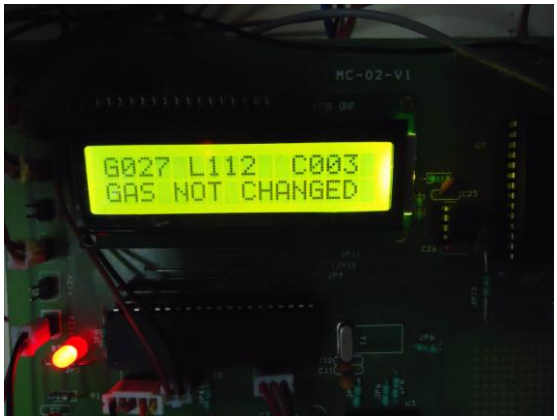

Fig 9.Gas not changed is monitoring on LCD display

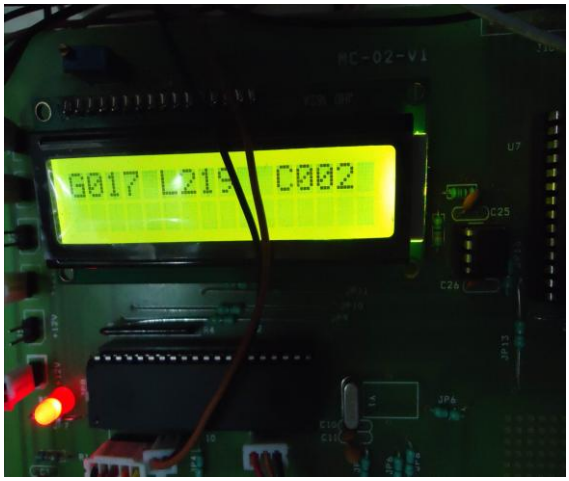

Fig. 10.Gas cylinder counting monitoring an LCD display

IX. SALIENT FUTURE

ZigBee module based on AT89S52 Microcontroller .The monitoring devices use AT89S52 microcontrollers that are both ZigBee and standard IEEE802.15.4 2.4GHz compatible , with 16MHz, 32-bit RISC CPUs, and 96 and 192 kB of RAM and ROM, respectively, along with four input 12-bit analog-to-digital converters (ADCs), two 11-bit digital-to-analog convertors (DACs), two comparators, a temperature sensor, two universal asynchronous receiver transmitters (UARTs), and two-wire serial interfaces.

Fig .8.Zigbee module

X. CONCLUSION

Thus the proposed model can be used in real time and is a cost effective and efficient alternative to detect leakages, monitor changes in gas levels and also provide interactive alerts to security and uses a valve to close all hazardous leaks.

Due to its reasonable simplicity, wireless connectivity, and low power consumption, the GSN can be deployed in a short time without entailing considerable maintenance cost. In addition, the use of Ethernet and GSM technologies makes it easy to manage the network in real-time. The demonstrated WGSN could be used for a wide range of gas monitoring applications.

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Mr Muthuvinayagam is working as Associate Professor/HOD in Department of EEE cms college of engineering,Namakkal. Hs research interest in electric drives, special electrical machines,
hodeee.cmsce@gmail.com
9894014083

Mr.Dineshraja.s
final year EEE(2010-14)
cms college of engineering
Namakkal-637003
Anna university chennai
Tamilnadu,India
dinesheee47@gmail.com
9524263626

Mr.Janakiraman.s
final year EEE(2010-14)
cms college of engineering
Namakkal-637003
Anna university chennai
Tamilnadu,India
janakiramaneee15@gmail.com
8883490476

Mr.Meganathan.s
final year EEE(2010-14)
cms college of engineering
Namakkal-637003
Anna university chennai
Tamilnadu,India
meganeee01@gmail.com
9042793394