GSM Based Gas Leakage Detection & Prevention System for Disabled and Handicapped

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***Abstract* ---- Gas leakage and monitoring is a prodigious challenge with a number of industries, habitation areas and vehicles that runs on natural gas and LPG resources especially in developing countries, where gas usage is at sky-high and outrageous level. It is a runtime preventive system that provides hindrance to any causality with handicapped and disabled persons in our surrounding and societies. The purpose of this work is to provide safety to that class of people who themselves are not in position to take precautionary measures to save their precious lives. Specifically, this is a project in which we use a highly sensitive gas sensor with a portable C-16 gas detector which can detect more than 30 different gases or vapours. Also system includes GSM SIM 900 module which can send message so as to take useful cautions. Noteworthy part of this system is that it not only alerts or warns people but the accommodating factor is to provide a runtime safety by evacuating the leaked particles of combustible gas present in air on immediate basis, in case a custodian is not at home to take care of handicapped and disabled one's.**

***Keywords*: LPG – liquefied petroleum gas**

I. INTRODUCTION

Compressed natural gas also abbreviated as CNG and LPG is a mixture of burnable hydro-carbons. Daily use of these gases as a source for satisfying necessities from claiming kin is expanding at a momentous rate. In less developed countries like Pakistan where there are issues of load-shedding, non-availability of basic necessities is usual, people are forced to use gas cylinders containing LPG and natural gas available in homes to produce electricity and also for cooking, heating and fuel purposes. Also the use of gas heaters is increasing rapidly.

We have to utilize our learning, aptitudes and technical advancement to spare the mankind. Lately we read in the news from last year about the tragic accidents and deaths of young and old due to gas leakage [8] and [9]. The explanations for these are the utilization of shoddy and non-dependable gas transporters, for the most part barrels.

In this work we give special attention to people who are handicapped, by birth or on account of some mishap became handicapped. Ratio of disabled and handicapped people is also increasing day by day due to various incidents and some are handicapped by birth. In addition, elderly people are prone to the risk of disability. On account of mobility impairment, senior citizens face numerous issues. Therefore, in this work we have designed a prototype which provides safety and security to the lives of disabled and handicapped. Some people are more susceptible than others to suffer health effects such as heart disease, asthmatics, disabled & handicapped, pregnant ladies, children and elderlies.

There is a lot of work done on gas leakage and detection systems in the past [1], [2], [3], [4], [5], [6], [7]. These works help in detecting gas leakage, however none of them have mentioned a procedure, on how to evacuate and exhaust gas particles from the site. In this work, the designed prototype even operates by taking special measures on instant basis. This system will detect the gas particles and then initiate the alarm, sends a message to caretaker about the leak and on instant basis turn off the supply, evacuating the present gas particles.

The rest of this paper is organized as follows. Section II presents the literature review. Section III shows the proposed methodology. Section IV gives the detail of hardware used. Section V presents discussion followed by conclusion.

II. LITERATURE REVIEW

Many papers have been published on work related to GSM systems and gas leakage detection systems [1], [2], [3], [4], [5], [6], [7]. These works have proved helpful in controlling hazardous impacts. We have built runtime preventive system. [1] Presented a design that can automatically detect and stop gas leakage in vulnerable premises, but lacked the automatic turn off capability. In [2], a wireless sensor based home system has been developed for the elderly but does not take into account gas leakage detection. In [3], ZigBee based smart residential neighborhood system is introduced, but does not work for detecting hazardous gas particles. In [4], a remote wireless security system that can detect theft, leakage of gas and fire but lacks automatic control. In [5], embedded system based detection system for natural gas pipeline at a long distance is presented. However, it also lacks runtime prevention. In [6], an intelligent monitoring system that can monitor and warn fire sparks is discussed, it does have the capability of immediate gas stoppage. Work in [7], presents an odor compass system to detect the direction of odor but don't react in time.

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III. METHODOLOGY

Practically the working of proposed system is split up into four main parts. In the first part the concentration of gas particles is detected by the MQ-5 gas sensor with the help of C-16 portable gas leak detector. Second part consist of micro-controller unit in which a program is written. When a gas sensor detects leaked gas particles it sends signal to the microcontroller. In third part, once microcontroller unit (MCU) traces the difference, it sends a signal directly to the linked alarm unit followed by sending a text message to the owner of the house with the help GSM SIM 900 module. In fourth part, electromechanical (EM) valve and exhaust fan turns on after receiving signal from the microcontroller and EM valve turns off the main gas supply and the exhaust fan evacuate all the existing particles of gas, so as to avoid any causality.

Block diagram and summary of the 4 parts of the system is shown in fig (1).

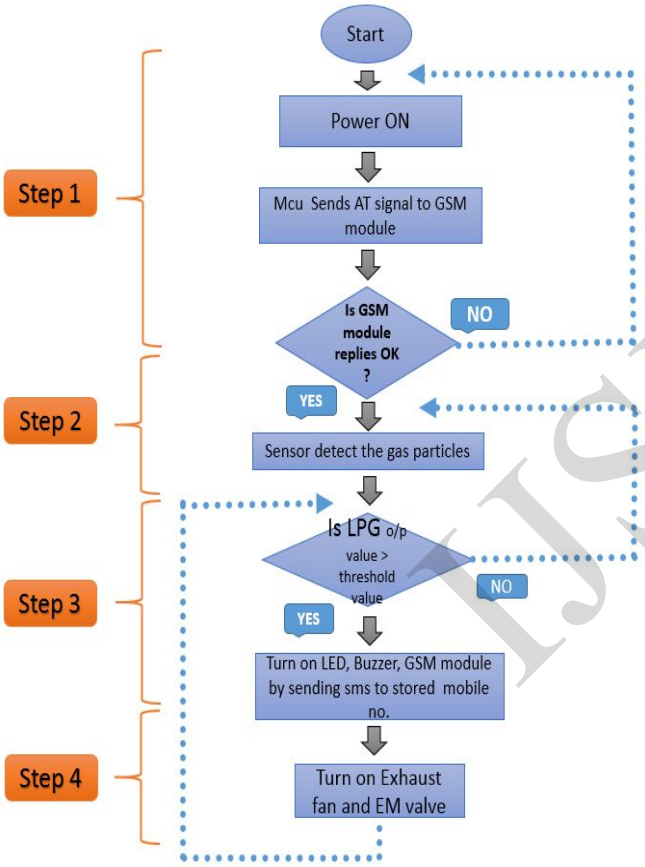


Fig. 1: Flow Chart of gas leakage prevention System

After evacuating gas, the system restores to its initial position according to the instructions and programming in MCU unit, but the main gas supply remains off until someone on his/her own action can turns the supply on and correct the issue so that it does not happen again in future.

III. (HARDWARE) EQUIPMENT USED

1. Micro-controller
2. GSM Module
3. MQ-5 gas sensor
4. Electromechanical valve
5. Exhaust Fan

1. *GSM (GLOBAL SYSTEM FOR MOBILE COMMUNICATION)*

Designed for global market, SIM900D is a quad-band GSM/GPRS engine that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900D features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 33mm x 33mm x 3mm, SIM900D can meet almost all the space requirements in applications, such as M2M, smart phone, PDA, FWP, and other mobile devices as shown in fig (2). The physical interface to the mobile application is a 48-pin SMT pad, which provides all hardware interfaces between the module and boards.

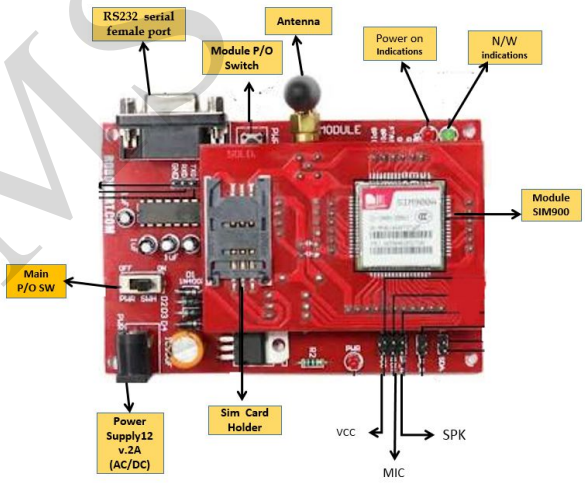


Fig. 2: GSM SIM 900 Module

2. *C16 PORTABLE GAS LEAK DETECTOR WITH MQ-5 SENSOR*

C-16 portable gas leak detector has its ability to measure a variety of different gases by simply inserting the appropriate sensor for that gas. It makes this gas detector capable of measuring over 30 different gases or vapors, reducing the need to purchase individual detectors for each type of gas as shown in fig(3).

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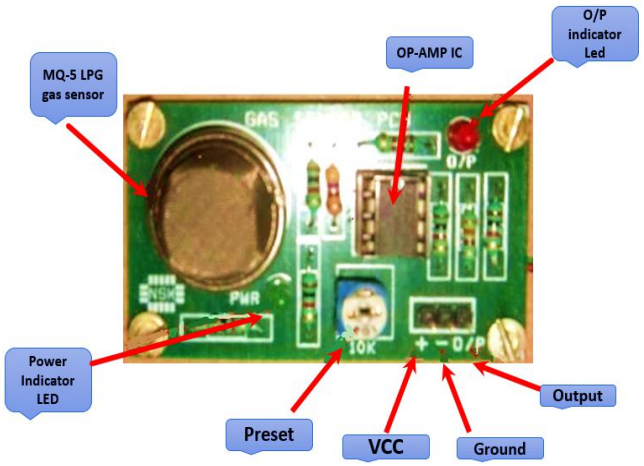


Fig. 3: MQ-5 Gas sensor

We use MQ-5 sensor which has long lifetime, low cost, reliable and high sensitivity to LPG gas. In gas sensors Tin dioxide is the most common material. When any specified gases leak in the air, the electrical resistance in the sensor decreases. The detection range of MQ-5 is 100ppm to 3000ppm and it is most suitable for H2, LPG, CH4, CO, Alcohol due to is fast response. Specification table of sensor is shown in fig (4).

Specification

Item	Parameter	Min	Typical	Max	Unit
VCC	Working Voltage	4.9	5	5.1	V
PH	Heating consumption	0.5	-	800	mW
RL	Load resistance		adjustable		
RH	Heater resistance	-	31±10%	-	Ω
Rs	Sensing Resistance	10	-	60	kΩ
Scope	Detecting Concentration	200	-	10000	ppm

3. ELECTROMECHANICAL VALVE

In an electro-mechanical valve actuated engine, the valves are driven by solenoid-type actuators and cam-shaft is eliminated. Individual control of each valve provides flexibility in valve timings over all engine conditions and fully exploits the benefits of variable valve timing.

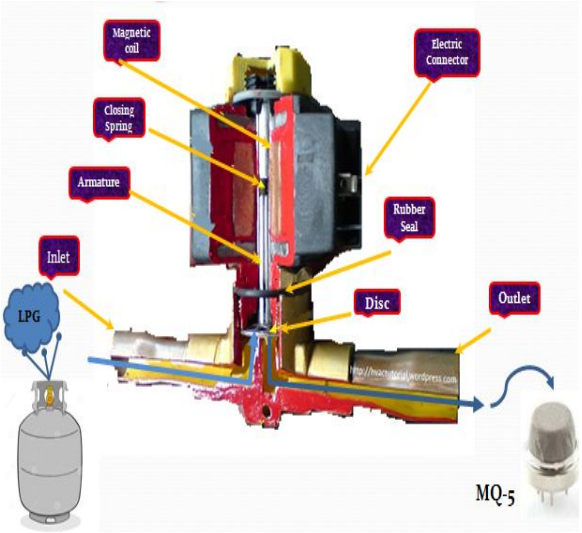


Fig. 5: Internal Structure of Electromechanical Valve

This paper pertains to the closed-loop control of an electro- mechanical valve actuator as shown in fig (5). These electrically actuated valves shut off gas or oil lines in less than one second. Normally open versions of these shut off valves are available for vent or process purge lines with MAXON's long-lasting metal-to-metal seating.

4. EXHAUST FAN

Ventilating, the 'V' in HAVC (Heating Ventilation and Air Conditioning) is a process of vacillation or replacing air in any environment to provide indoor air quality as shown in fig (6). It controls temperature, replenish oxygen, or remove combustible gas particles, moisture, odors, smoke, heat, dust, airborne bacteria, and carbon dioxide. Ventilation is used to remove unpleasant smells, introduce outside air, to keep interior building air circulating, and to prevent stagnation of the interior air to avoid any incident.



Fig. 6: Exhaust fan

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IV. DISCUSSION

The hard format of this designed prototype is shown in fig (7). It was tested by installing it in kitchen area and simulating a real gas leakage scenario. The system responded in a very swift way and within seconds, removed all the gas particles from the area followed by clear alarm and messages written in programming.

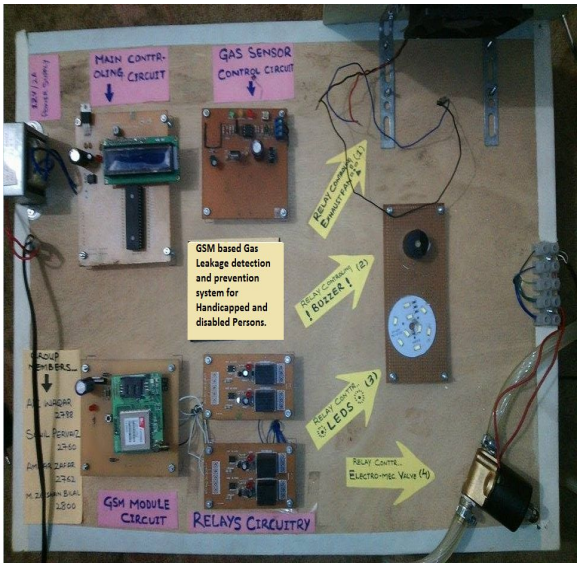


Fig. 7: Model of Gas leakage prevention System

PSEUDO CODE OF THE PROJECT

Sequence 1
V Reference was set 5 volts
The resolution of 18F452 is 0-1024. So the min voltage it can detect is:
(As relation is linear) = 5-0/1024-0 = 0.0048=0.005
Now consider that on leakage, our sensor output is nearly 1.456 volts.
Finding ADC's value at this voltage will be
=1.465/0.005 = 300
So we will work on that cut-off point
Sequence 2
Point 1
While check ==0
{
If ADC's value <300
Check = 0
If ADC's value =>300
Check = 1
Call alarm}
Alarm
{
ON indicator light
Send alert msg using GSM
Closing EM valve
ON Exhaust Fan
Call wait
}
Wait
{
Repeat until time == 10 minutes
}
Jump point 1

V. CONCLUSION

This system proves very helpful for handicapped and disabled personnel who are physically dependent on others for all their needs and care. By installation of the device in those areas where there is a major use of natural gas running equipment. Gas sensor simply detects the concentration of leaked gas particles in air and transfer a signal to other devices so that runtime prevention takes place. The system goes back to its initial stage except the electromechanical valve, which needs to be opened manually after correcting the defect or removing the fault.

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