

LPG LEAKAGE DETECTION SYSTEM WITH AUTOMATIC CLOSING OF VALVE AND ALERTING THROUGH GSM

Meng Joo*, Navid Nikaein*

*Chemnitz University of Technology, Germany

Email: Mengjoo13@gmail.com

ABSTRACT

The main objective of this paper is to develop a system for LPG leakage detection to save human life. Till now there are modules either there are modules to detect the leakage and alert the user (or) to detect the leakage and close the valve automatically. But both these modules have some drawbacks. Though the valve is closed automatically, the leaked gas remains in that room which only need a minimum spark to explode. This being dangerous to human life while switching ON or OFF other household electrical appliances without the conscious that the gas has leaked. So by informing the user through GSM that the 'LPG gas leakage detected'. This will make the user to cautiously take action, to avoid the explosions. The exhaust fan can also be made ON as soon as the leakage is detected, so that the gas can be cleared to some extent to decrease the degree of danger to the users.

Keywords: LPG. ARDUINO. GSM. Gas Sensor. SIM

1. INTRODUCTION

Home security has been major issue where crime and accidents takes place and everybody wants to take proper measures to prevent such intrusions. This project is aimed at developing the security of home against LPG leakage and fire. In our project the gas sensors are used to detect the leakage. This gas sensor is used to detect the level of LPG and gives us the concentration of LPG in that place. The stepper motor is attached with the knob of the cylinder. As soon as the gas detector detects the gas leakage, the stepper motor is activated through motor driver and relay switch, which rotates the knob of the cylinder 90degrees clockwise to close the valve. It also has GSM module interfaced with the Arduino which helps the user to know about the leakage of gas by sending a short message service through GSM modem. Then an Exhaust fan is also attached to the system to exhaust the leaked gas, so that the degree of danger is reduced to certain extent. The aim of this paper is to detect the LPG leakage and to arrest the valve of cylinder using stepper motor and also simultaneously alerting the user through GSM. The motivation behind our research work is to reduce the accidents that occurring due to gas leakage in various sectors like automobile workshops, factories, household LPG cylinders, hotels and air conditioned cars using LPG.

The paper has been organized as follows; section 1 revolves around the introduction to background of the work and also describes the objective and

motivation of the research work. Section 2 provides the literature survey of various components and to study the exact utilization and function of a component in an effective manner. Section 3 describes about both the hardware and software design and gives the detailed description of each and every components used.

Section 3 gives the hardware design implementation of gas leakage detection system and clearly describes the circuit. Section 4 gives the result and conclusion of the research findings.

2. LITERATURE SURVEY

The authors in [1], research and development on gas sensors design and fabrication demands that needs for chambers as the characterizing and testing of gas sensors are based on its detection of the concentration of different type of gas sensor are based on its detection of concentration of different type of gas under the influence of temperature and also humidity. This project, a fully temperature controlled test chamber is about the design and development of a system to provide an artificial environment for gas sensor characterization. We are also studied about how user can set the desired temperature in the chamber and then the PIC16F877A microcontroller which acts as the brain of this system will analyze and process the input signal from the sensors and keypad to give the corresponding output to control the heat and display on the LCD screen. When the steady state condition has been reached the chamber will ready for the testing of gas sensors under test. The inlet valve,

vacuum pump and fan integrated in the chamber are fully controlled by the microcontroller. Beside the control system can also be controlled manually by using manual switches. When tested using the sensor under the test, the test chamber and the regulation system of the temperature are working successfully as programmed and give the desired outputs.

In [2] presented a system on a high performance system for stepper motor control in a micro stepping mode, which was designed and performed with high-performed dedicated integrated circuits. The micro stepping control system improves the positioning accuracy and eliminates low speed ripple and resonance effects in a stepper motor electrical drive. The same micro stepping control system can be used for two single-phase DC motors, a variable reluctance motor's and an AC biphasic motor's control. The system clearly defines the exact working principles of a stepper motor and also explains how to interface a stepper motor with microcontrollers.

In [3] proposed a system called a versatile outdoor and indoor position detection mobile prototype. It has been successfully constructed and tested. The receiver consists of a GPS module, a GSM shield, a visible light data receivers and two ultrasonic sensors, all controlled by an arduino mega and an Arduino Uno microcontroller. Each ultrasonic sensor detects distance in the X and Y axis respectively, to an arduino uno which is programmed to transmit the global position relevant to the indoor position of LED lamp. When a person is outdoors, the GPS module receives global position from the satellite. When a person goes indoors, his or her global position will give by the LEDs and ultrasound sensors. The location data can be transmitted via GSM to a monitoring system or to an individual smart phone. This system is extremely useful in elderly care service. It ensures specific accuracy in locating senior citizens during cases of emergency.

The authors in [4] proposed the system for gas leakage detection system which reduces the risk of explosions caused by the leaked LPG. The device is intended for use in household safety where appliances and heaters that use natural gas and liquid petroleum gas (LPG) may be a source of risk. The system also can be used for other applications in the industry or plants that depend on LPG and natural gas in their operations. The system design consists of three main modules. They are detection, transmission module and the receiving module. The detection and transmitting module detects the change of gas concentration using a special sensing circuit built for this purpose. This module checks if a change in concentration of gas has exceeded a certain pre-determined threshold. If the sensor detects a change in gas concentration, it activates and the stepper motor and

sends a signal to the receiver module. The system was tested using LPG and the GSM module was activated as a result of change of concentration. The sensitivity of the entire system can be adjusted by changing the load resistor of the sensor which provides the flexibility to externally calibrate the system to avoid any false activation. The algorithm used in the microcontroller system depends on detecting the change of gas concentration levels and therefore the output voltage of the sensor. This gives the system the advantage of detecting leaks of the gases that the sensor detects. Measuring the actual concentration of a certain gas cannot be easily done with this sensor, since it can detect many gases at the same time.

The development of innovative low-cost home dedicated fire alert detection system (FADS) using ZigBee wireless network is discussed in [5]. Our home FADS systems are consists of an Arduio digital temperature sensor, buzzer alarm and X-CTU software. Arduino and wireless ZigBee has advantages in terms of its long battery life and much cheaper compared to the others wireless networks. There are several objectives that need to be accomplished in developing this project which are to develop ZigBee wireless network and to evaluate the effectiveness of the home FADS by testing it in different distances and the functionality of heat sensor. Based from the experiments, the results show that the home FADS could function as expected. It also could detect heat and alarm triggered when temperature is above particular value. Furthermore, this project provides a guideline for implementing and applying home FADS at home and recommendation on future studies for home FADS in monitoring the temperature on the web server. From this we also come to know about how several experiment were carried out in order to observe the system's behavior and functionality of the heat sensor and also the capabilities of transmission data for Xbee wireless module based on several distance with and without obstacles. The experiments had been conducted based on two scenarios.

Nasaruddin, et al. [6] proposed a system to overcome the issue by analyzing some solutions of eliminating the moisture trapped in the gas detector. In this he discussed about some solutions and the best solution is to include a heating element in the gas detector in order to vaporize the moisture and thus eliminate it from the instrument. The operation of principle used here is CrowconNipe, gas detector(infrared type).This paper also gives the clear description of prototype of Infrared type gas detector from this we conclude that the gas detector prototype will no longer face the trapped moisture issue. Thus, alarm will only be triggered if there is a presence of gas leakage. This study can increase the reliability of gas

detection system .The method used here is very simple and less costly, but the result can increase the reliability and also guarantees the well functioning of gas detector. In similar manner P.A.Shinde, et al. [7] has published the advanced vehicle monitoring and tracking system is designed for monitoring the school from any location A to location B at real time and provide safety environment to the traveler. The proposed system works on Global Positioning system (GPS) and Global System for Mobile communication. In this paper we come to know about the SIM908 module which includes GPS GPRS GSM and also the LPG gas leakage sensor MQ6 and the temperature sensor DS18B20. This paper gives the brief description of students safety mechanism using temperature sensor and LPG gas detect sensor also the LPG Gas leakage sensor get interface with Op-amp LM358N which gives a digital output that output voltage can be controlled by using current limiting resistors which helps the Raspberry pi from damage. Likewise both sensors output driven through Raspberry pi would get compare with threshold values and if limit crosses then the alert message will be given to vehicle owners mobile using GSM of SIM908 module. In following results, the threshold values set at 30 Degree Celsius. This proposed system plays an important role in real time tracking and monitoring of vehicle and also provides safety and secure solution to the traveler using sensors. Whenever there is vehicle theft situation or vehicle's current location, speed to the vehicle owner's mobile. Hence this benefits to track the vehicle as early as possible. In certain situation as per student's safety concern the proposed system given a provision of alert message on student parent's mobile which also plays an important role.

A prototype of a Wireless Sensor Networks (WSN) to monitor and locate gas leaks of a complex indoor environment was proposed in [8]. Specifically, a mobile node is moving inside a building to monitor any leakage of carbon dioxide ($[CO]_{2}$), supporting and displaying the level and the location of the leakage. Throughout the demonstration, the technological advantages of cognitive networking along with multihop routing are explored. This work demonstrates a gas leak detection system with real time location system based on WSN. The location system was recorded and uploaded online. Due to his edibility a gas monitoring system along with an indoor location system can be deployed in buildings, shopping malls, mining tunnels, hospitals, and a number of other applications. In this paper we come to know about various system modules gas leak monitoring board, location system, server and mobile board. This work was supported in part by the Natural sciences and Engineering Research control of councils of Canada (NSERC), and by the MRI-Ontario under an ORF-RE grant.

The authors in [9] build a prototype for detecting hydrogen gas leaks in hydrogen filling stations. The prototype composed of a wireless network with ten sensor nodes that can monitor the spatial distribution of hydrogen gas leakage. To enable each sensor node to be driven by a battery, field-effect-transistors sensors node and a microprocessor with low power consumption have been adopted. Additionally, a function to consume minimum levels of power has been developed and installed in the microprocessor in each node. The use of batteries and wireless communications enables the nodes to be placed at optimal sensing locations without regard to the wiring existing gas sensors. Also we come to know about hot TCF to avoid communication congestion when a gas leak occurs has also been installed in the sensor network system. Additionally software for displaying the distribution of the hydrogen concentration has been developed. After sufficiently evaluating the prototype, we will make the detection system practical enough to apply it to hydrogen filling stations.

The author Badamasi [10], has published the paper on working principle of arduino. In this paper we studied about the components used in the arduino board, the software used to programme it with the guide on how to write and construct our own projects and a couple of examples of an arduino project .From this paper we understand the overall view of an arduino uno. In this paper, we examined the working principle of an arduino both the hardware and software of the arduino, from the components on the arduino Hardware we come to know about how to write the code in the software (IDE), and how to combine both and construct your own project.

3. IMPLEMENTATION OF GAS DETECTION SYSTEM

The step by step implementation and working of components will be explained in this section. Along with this block diagram and hardware connection diagram are also explained. The figure 1 illustrates the block diagram.

3.1 STEP BY STEP PROCESS OF GAS LEAKAGE DETECTION SYSTEM

Hardware and software components for which specification and characteristics have been explained in previous chapter are implemented to perform a specific task in our project. In this part, we have explained about the implementation along with the working of components step by step.

3.2. GAS SENSOR OPERATION

The gas sensor we use is MQ-6 gas sensor, which is discussed in previous chapter detects LPG, alcohol and butane and it is very high sensitive to LPG but less sensitive to smokes. Here, the gas sensor MQ-6

is used to detect the LPG concentration in the room where gas cylinder is used. MQ-6 gas sensor will detect gases at the range of 200-1000ppm.

When the Gas leakage detection is turned on, the power supply for gas sensor i.e. 5V is directly fed from 5V pin of arduino. Then the output of gas sensor being analog, to read that analog reading for processing, output pin of gas sensor MQ-6 is connected to analog pin of arduino say A0. The analog value from the gas sensor can be read by the arduino through analog pin A0 by a line of code 'analog Read(A0)'.

The concentration of LPG is checked for every loop in the program. Then the analog reading measured is used for further processing.

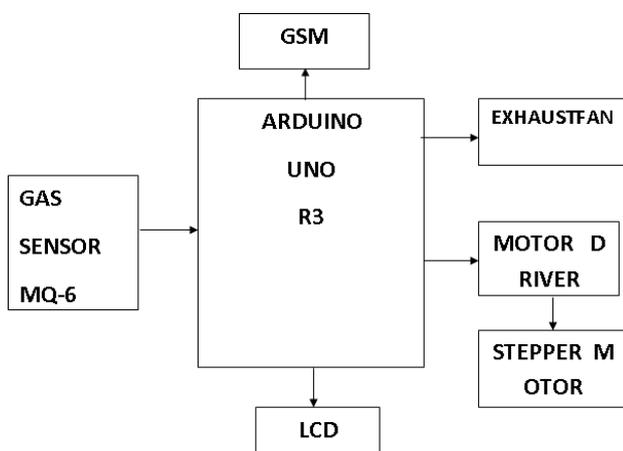


Fig. 1 Block diagram of Gas leakage detection system

3.3. ROLE OF ARDUINO

Arduino UNO R3 is the brain of our project. All input and output components are interfaced with arduino. Input is fed to arduino and arduino process the inputs and controls all peripheral output devices.

Power supply to arduino is given by 12V stepdown transformer using arduino software code developed to read the input process the input and control output. Arduino checks whether the input(analog input) to the pin A0 is within the threshold or above the threshold value, in this case the threshold value is set 700. Sensor first keep on checking the value of gas until it reaches above to700. Once the threshold is reached, it allows the output devices which are all connected with arduino to perform necessary steps. Those steps will be explained below on upcoming steps.

3.4 VALUE DISPLAYED IN LCD

To know the value of gas sensed LCD is also interfaced with arduino to display the value of gas concentration. LCD requires a power supply of 5V which is being fed from arduino or from rectified 5V from the

voltage regulator. 5V is connected to the V_DD of LCD and V_SS is connected to ground.

RS of LCD is connected to digital pin 8 of arduino and E of LCD is connected to digital pin 9 of arduino. RW pin is generally grounded for write operation. Then data pin from D4 to D7 is connected to digital pins 10,11,12 and 13 respectively.

First initially when then Gas leakage detection system is turned on, LCD displays the text 'LPG leakage detection' and then the value of gas sensor output is displayed in LCD. This is done because four data pins in LCD is connected to four digital pins in arduino as mentioned above. Pins in arduino which are connected with arduino is first initialized in the arduino code with the function 'liquid crystal(RS,RW,E,D4,D5,D6,D7)'.

It continuously displays the LPG level and it help us to know the level of LPG and used to demonstrate that closing of value and sms is sent only when the threshold is reached.

3.5 SWITCHING ON THE RELAY

Relay is used because arduino cannot provide power required for the working for some interfaced components. In this case required power supply is connected to relay and once the signal from the arduino to relay is high it gives power to exhaust fan and the motor driver. Exhaust fan and motor driver requires 12V. In order to connect two devices, 2 channel relay is used.

3.6. TURNING ON THE EXHAUST FAN

Once the value of gas sensor output which is fed into arduino in A0 pin exceeds the threshold, it makes the digital pin high, which is connected to the relay which in turn connects the power supply to exhaust fan. Thus on receiving high signal by relay, exhaust fan is connected to the power supply and the exhaust fan starts rotating. The role of exhaust fan in our project is the exhaust the gas leaked in the room. To show demo of this, a small design of room like box into which gas sensor is fixed is made. In one of its side wall, exhaust fan is sixed and the gas is let inside through a hole to check for working. Thus when the gas concentration inside the room increased above threshold exhaust fan is turned ON and gas is exhausted out.

3.7. COMMAND FROM ARDUINO TO GSM MODULE AND OPERATION OF GSM

GSM is interfaced with arduino by connecting RX pin of GSM with TX pin of Arduino and ground pin to any of the ground pin in arduino. This makes the serial communication with arduino by the line of code 'Serialbegin(9600)' in setup block of arduino code.

4 CONCLUSION AND FUTURE SCOPE

Thus as a result a module for gas leakage detection is provided to detect the concentration of LPG in the room. This will help to reduce the frequency of occurrences of accidents due to gas leakage. This system being cheap can be implemented in all household cylinders. Future scope of the research work is that if the user is out and once he came to know that he forget to close valve, he need not wait for the gas to leak and then let the valve to close automatically. His/her can send a text message to the SIM in GSM, and once the message reaches GSM module, it must be designed to close the valve and need not wait until the gas leakage to occur.

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