



GAS LEAKAGE DETECTION SYSTEM USING 8051 MICROCONTROLLER

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Abstract: Nowadays, Gas leakage has turned out to be a major problem with the industrial sector as well as households. The paper has been stipulated in order to ensure that the supervisor of the gas plants or the owner of the household is notified of the gas leakage which has occurred and at the same time an SMS notification is sent to the concerned person. This paper holds even more relevance in the current pandemic situation because industries are facing paucity of workmen due to social distancing norms and such a system would enable them to aware of any mishaps at the industrial site. The research has been implemented on a software basis and the outputs are realized in Proteus software. This gas sensor has high sensitivity for propane and iso-butane and also can sense smoke in industrial scenarios.

Index Terms - Gas leakage detection, 8051 microcontroller, Keil IDE, Gas sensing, Proteus.

I. INTRODUCTION

We designed a system which essentially detects LPG leakage and emphasis by measures such as SMS, Buzzer sound, LED Blink. This prototype turns out to be price effective and has a high degree of accuracy. In this system we are using 8051 microcontroller as our host. It is connected to five other modules: MQ6 gas sensor, GSM module, exhaust fan, buzzer, LED pins on one side of the gas sensor are connected to the power supply. On the other side one of the pins is connected to the analog input of the microcontroller and the other two pins are connected to the ground. The remaining modules are connected to the output pins of the microcontroller. In recent families, the use of LPG has taken over again and accident cases due to LPG are increasing. From the use of piping cylinders, a serious safety threat as well costs. Our prototype will be a blessing to many homes as it is saving.

II. LITERATURE REVIEW

The safest way to detect gas leaks and to remove gas before burning. In this study, a gas leak detection model and a transport system are introduced. The researcher had used a 8051 MC-based system, wherein the system activates buzzer when gas leaks are detected, closes gas supply the solenoid valve stops the further gas leakage and also removes the gas by changing the evacuator fans. (Md. Ashraf et al, 2017) Ensuring that the occupant of the household is informed suitably in case of gas leakage. The gas leakage detection process is programmed in a manner such that it transmits a text message (SMS) to a pre-saved phone number. The user has also been provided with the privilege to remotely monitor the test environment by sending necessary codes. (Aderibigbe I. Adekitan et al, 2018)

Another researcher discussed about the fact that gas leaks are a major problem in the industrial sector, residential areas and also gas-powered vehicles such as CNG cars and buses. The aim of this paper is to build such a machine that can automatically detect and stop gas leaks in those areas where they can. The system detects LPG (Liquefied Petroleum Gas) leaks using a gas sensor and uses GSM (Global system for mobile communications) module to notify a person of gas leaks via SMS. When the concentration of the LPG in the air exceeds the pre-set level, the gas sensor senses a gas leak and the discharge senses it active low. This is detected by the microcontroller and the LED and buzzer are turned on simultaneously. (Vasudev Yadav et al, 2016)

One way to prevent gas leaks is to introduce a gas leakage detection kit in high-risk areas. The purpose of this particular paper was to introduce a design wherein user can automatically sense and prevent internal gas leaks in endangered areas. High sensitivity gas sensors for detecting propane (C₃H₈) and butane (C₄H₁₀). The gas leak system contains a GSM (Global System for mobile communication) module, i.e. warns by sending SMS. However, the previous gas leak system cannot respond in time. This paper provides design in both software and hardware. (L. Fraiwan et al, 2011)

In this particular paper, the researcher proposed a rule that uses the flexible capsule of the MQ-4 and MQ-8 nerves to measure the maximum concentration of methane and hydrogen respectively. This method involves mixing gas to be studied in a known air volume. Three methods are suggested and are compared in terms of coherence and duplication of values. The first method is performed in an airtight enclosed room, the second method consists of direct injection of a gas sensor placed in an open area, and the last method is achieved by direct injection of a gas sensor placed in a slightly closed capsule. Comparison analysis concludes that the first procedure yields excellent repetition, with a typical high deviation of 13.88% in the range of CH₄ and 5.1% in H₂. However, its proportion is weak (i.e. R² = 0.8637 for CH₄ and -R² = 0.5756 for H₂). The second method has better linearity but is poorly duplicated. The third

method shows good results with values of R² of 0.9973 in the CH₄ and 0.9472 H₂ values. The use of a slightly closed capsule has resulted in an acceptable line of nerve response up to 20% for CH₄ and up to 13.33% of H₂ concentration in the studied environment. (A. Banik et al, 2018)

The researcher aims to show what a microcontroller can look like one is hired to install a lot of external items at a time adding additional functionality at costs such as simplicity integrated components. In the paper researcher is going to meanwhile, hardware and microprocessor firmware have been around designed to use smart LPG alarm system (LPG stops Liquefied Petroleum Gas) for CNG and LPG automobiles so as to create an alert notification before any unwanted mishap. (Hitendra Rawat et al, 2018)

III. METHODOLOGY

Figure 1 displays our design of gas detection using 8051 MC .It clearly displays all the interfacing that are attached to the central unit(8051 MC) ,which processes all the data it has received and gives the alert feedback in different forms.

Here, we have interfaced LCD, led and buzzer for generating the public alert when the gas leakage has been detected by the system. Relay module interfaced with MAIN power had been used as a safety precautionary measure in the case of gas detection because malfunctioning of any circuitry line ,during the event of leakage can cause fire which can worsen the situation more. At times, they may even lead to a wild explosion due to vigorous reaction of gases like LPG Gas (propane, butane) with the fire. In order to hold the situation under control, relay module (acts as a circuit breaker for the main power supply) had been turned off during the gas leakage.(Geeta Loshali et al,2017)

Human monitoring may not be always possible in manufacturing industries for example, in nuclear reactors of atomic power plants. In these situations, some form of alert had been dissipated to the workers who may be working at a distant range, or even away from the site. Buzzer and LED feedback, may not serve the purpose of alert in these conditions. So we have used GSM modules for sending alert messages to the responsible pupil and even to the nearest response (rescue) teams like fire services, local police stations, so that the hazard can perfectly be mitigated at least to a safer level. (Shinde et al, 2012)

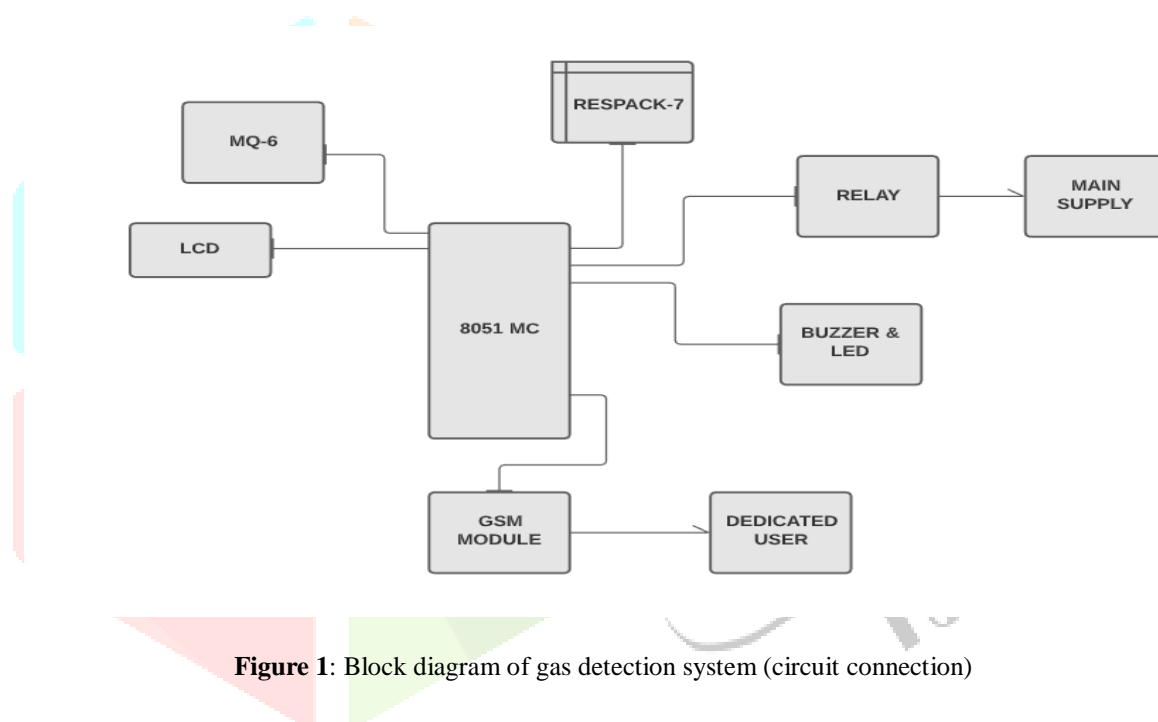


Figure 1: Block diagram of gas detection system (circuit connection)

3.1 Circuitry and Functionality

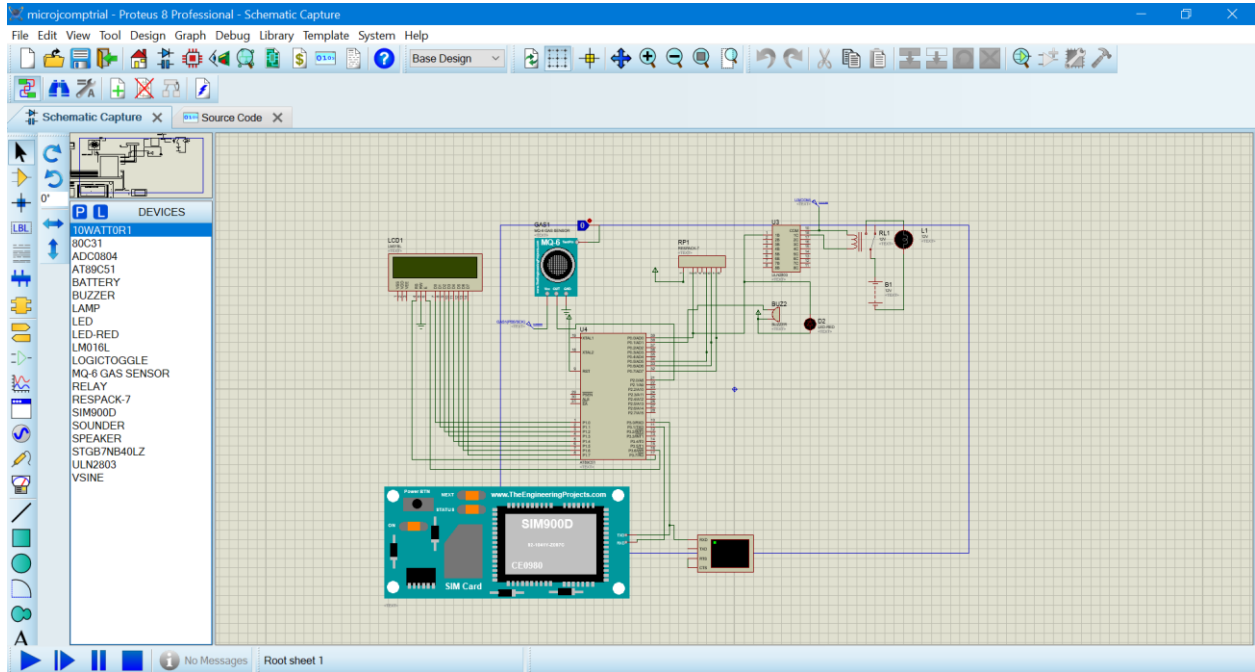


Figure 2: Schematic of the proteus design (inactive)

The above figure shows the schematic proteus design of our gas detection circuit. All the required interfacings have been done based on their need in the working of the circuit.

Table 3.1: Components interfaced

Sensor name	Pins	Functionality
LCD (16*2) display	Pins 1.0 to P1.7	Display of Message
MQ6 (GAS) sensor	Pin 2.0	Gas detection
GSM module	Pin 3.0(RXD) and Pin 3.1(TXD)	SMS alert generation
BUZZER	Pin 0.0(Synced with Relay)	Alarm
ULN2803 with relay circuitry	Pin 0.0	Low level TTL signals to High level (for Relay operation)
LED	Pin 0.1	Display of alert generated
RESPACK-7	Port 0 (1,5,6,7)	Supply of Resistance to the circuit
LOGIC ANALYSER	Test Pin (GAS)	Manual logic generation

3.2 Process flow

In Figure 3, the process flow of the Gas Detection System is clearly Illustrated, Initially the Modules (GSM, LCD, RELAY, MQ6 gas Sensor) will be initialized after Initialization of modules the output of Gas sensor is taken as Input by 8051 (Digital input) and checked with the condition given in Table 3.2.1.

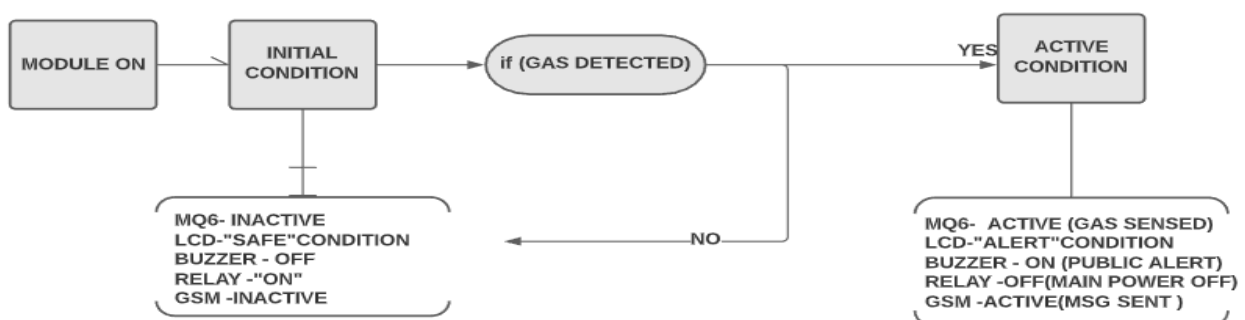


Figure 3: Block diagram of Gas Detection System (Circuit Connection)

Table 3.2.1: Alert Status

Digital Output of gas sensor	Alert Status
0	Alert not generated
1	Alert generated

If the alert is not generated:

- 1) LCD displays “No alert detected”
- 2) Buzzer is in OFF state
- 3) Relay is ON (Electricity turned on)
- 4) GSM module does not send any message

If the alert is generated:

- 1) LCD displays “Alert detected Sending Msg”
- 2) Buzzer is in ON state
- 3) Relay is OFF (Electricity turned off)
- 4) GSM module sends message to the supervisor

IV. RESULTS AND DISCUSSION

4.1 Schematic of designed Proteus Circuitry

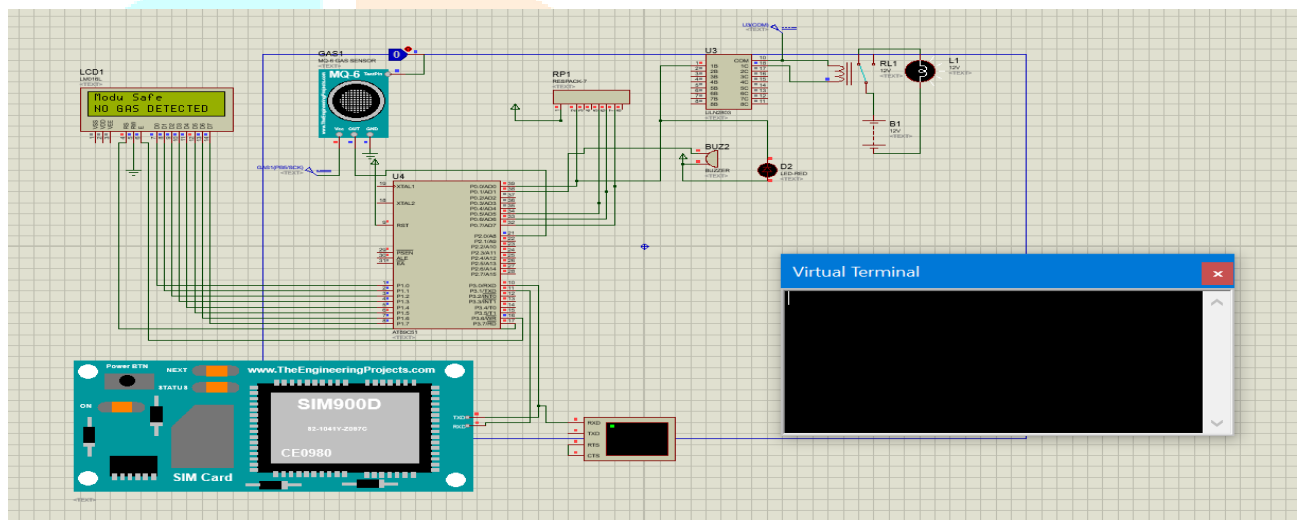


Figure 4: Schematic of the proteus design

Figure 4 represents the active state-1 of the circuitry, which means the entire circuit had been turned on with the supply from 8051 MC. Once, the circuitry is on module has been pushed to the initial state (i.e. No gas detected). The display of lcd shows the initial state along with the condition (“SAFE”) Relay circuitry is turned on and that can be witnessed from the LED output attached with the relay circuitry. If the implementation of this idea is done in real time, the configuration of the system can be extended to a much higher level. If this is going to be an hardware implementation, we will be able to detect the exact level or amount(in PPM) of gas present in the surroundings. We can also set a threshold and compare the obtained values from the sensor with these threshold values in order to increase the accuracy of the system to a higher level. Because the vulnerability of accidents depends on the significant amount of gas detected. As we have made our design with a simulation-based platform, sensors can only output the digital values (either ‘0’ (not detected) or ‘1’(detected)).

In that context we have attached the logic analyzer to the output pin of the MQ6 gas sensor. By default, the logic toggle is off.

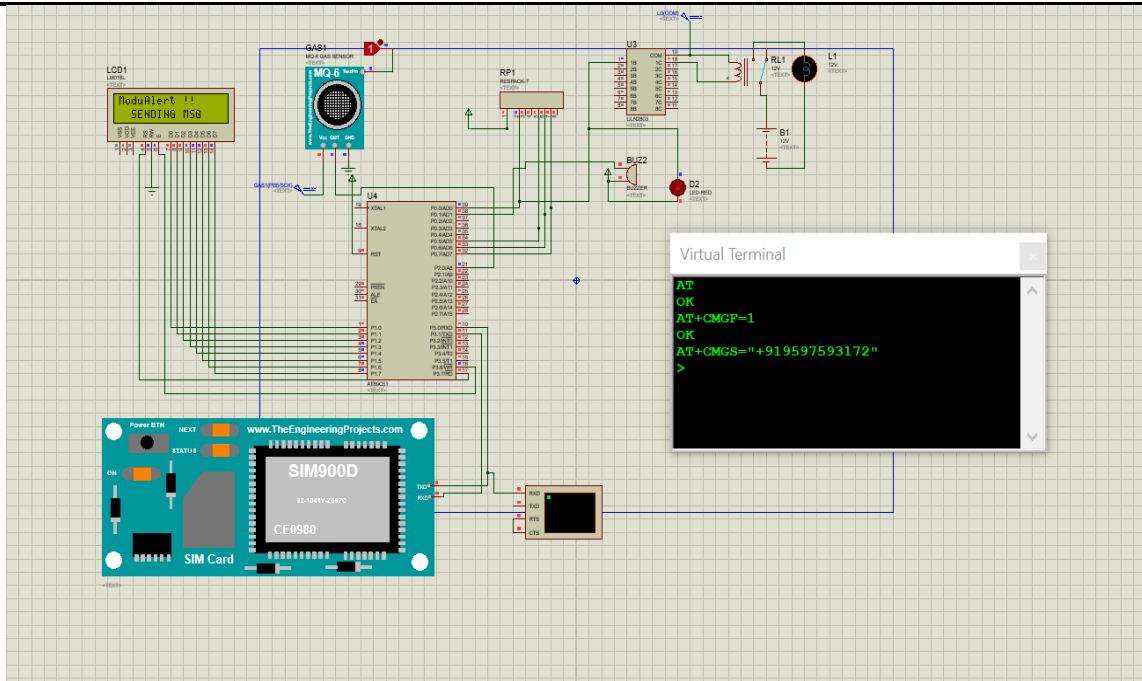


Figure 5: Schematic of the proteus design (Active stage -1)

The above figure displays the simulation result of our design in proteus, when a gas had been detected. When the logic is turned on manually by the user, the design gets excited and the entire module starts with the process as per the flow process diagram.

So, whenever the logic toggle is activated, it means that the gas has been detected. In that case, LED and buzzer is enabled as the instant form of output sensed. Led attached to the relay circuitry changes the state from, on to off which shows that the main supply had been turned off when the gas had been detected. It can be observed from the above screen that the virtual terminal outputs the message that has to be sent, with the mobile number of the desired person along with acknowledgement received from GSM module that the message had been successfully reached the other end.

IV. CONCLUSION

The theme of the paper when merged with certain established embedded technologies can be quite effective in a number of industries which possess a large working population in their manufacturing industries. Finally, we conclude in recent households and industries the use of LPG is taking a big toll. From the use of cylinders to the use of petroleum pipelines in industries. The biggest threat in using this technology is security. And our prototype will prove to be a blessing for numerous production sectors.

A wide variety of gas leakage detections are available in the real time for surety implementation but all these methods come up with their own advantages and disadvantages. A wide variety of gas leakage detections are available in the real time for surety implementation but all this method comes up with their own advantages and disadvantages. Most are system are operational in external implementation through visual detection or portable based leakage detection but the detection time is very long. But the design that we have proposed using 8051 proved reliable, accurate as well as delay efficient in terms of detection, which will be a suitable choice for real time implementation.

V. FUTURE WORK

This work is limited to the design of an efficient system for monitoring LPG leakage in a susceptible area, alerting the user and shutting down the gas supply using a microcontroller-based detection system. Future work can be a weighing scale (or its equivalent) be incorporated into the design to measure the amount of gas used or left in the gas tank or cylinder. Digital signal processing concepts can also be applied to the existing paper to extend the methodology further and be of extrinsic use to the industrial sector (gas plants).

VI. ACKNOWLEDGMENT

Foremost, we would like to express our sincere gratitude to our professor Dr. Debashish Dash for the continuous support and guidance for our microcontroller and its applications research paper work. His guidance and immense knowledge in this field helped our team to accomplish the paper within the stipulated timeline.

Besides our professor, we would like to thank and acknowledge Dean Sense and the other faculties of SENSE for giving us the golden opportunity to undergo this paper in the field of microcontrollers. We are certain that the skills we acquired during the course of this paper will help us in our future endeavors. We thereby acknowledge all the people who were involved in this paper in some way or the other.

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