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# An Experimental Investigation and Analysis of Proposed Gas Leakage System

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## Abstract

LPG is a particularly effective fuel, mainly used for cooking in residential and commercial areas. It is imperative that due care is taken when using it safely. LPG is often filled with cylinders that are solid and can't be damaged easily. However, leakage from gas cylinders, regulators and gas pipe connections may occur when they are not in good repair and may cause an accident. Accident can lead to health complications, such as suffocation, and may cause an explosion in the ignition of any flame or electrical supply. The purpose of this paper is to establish a device capable of detecting leakage of Liquefied Petroleum Gas in the vicinity where it is placed into operation and to take the appropriate measures to prevent calamities. The proposed framework is planned and enforced to meet health and safety requirements in order to protect life from fire hazards.

**K*eywords:*** *LPG, Cylinders, ARM, ADC, Sensors, Zigbee*

## Introduction

In the existing scenario, the gas sensors are leading the way from home monitoring to industry monitoring. The gas sensors are indispensable for various applications such as monitoring of various environmental parameters, detection of toxic gases etc. There are different semiconductor gas sensors available in the market having got outstanding position, seeing that they are speedy, consistent, 6 cost-effective and bare minimum maintenance. Hitherto, ceramic gas sensors were used for detection of gases. The gas sensors are mainly oxidizing and reducing in nature. Whereas oxidizing sensors results in the creation of acceptor states and the reducing sensor results in donor states. The resistive, potentiometric and amperometric sensors are most sensitive sensors.

The olfactory system of humans is outstanding for the recognition of odors which can be observed merely at towering concentrations or can't detect at all. For the protection of human life, to take preventive measure against the explosive concentration of gases and for poisonous gas applications, a gas sensor is essential for the detection of gas in low concentration range. To prevent the gas leakage that happens at homes, industries etc, detection of various gases at low concentration is possible only due to gas sensors. Hence, gas sensor becomes the part and parcel of today's life. The literature survey reveals that, many research devotions have been put on gas leakage detection using wired networks. Nevertheless, there are numerous drawbacks to using wired sensors and monitoring systems, including a long deployment time, high maintenance costs and a reliance on cable telemetry systems. In addition, cables are prone to damage, making repairs more difficult and more expensive, and there is a high demand for cable supplies in remote locations. Many wireless GPS and GSM-based devices have been developed to detect gas leaks. As a result, the current research project aims to replace a non-compatible wired network system with WSN (Wireless Sensor Network). Advanced low-power microcontrollers are also available for use in smart WSN nodes. Monitoring the system and creating an interactive user interface using LabVIEW tool improves the system's efficiency and usability.

## Research Methodology

The Figure 1shows the Prototype of gas leakage, here three gas sensors (MQ6) and are interfaced to ARM Micro Controller through ADC channel pins ADC1, 2, 3. Buzzer and DC Motor are interfaced through GPIO pins to the controller. Through UART the Zigbee is connected. LCD is connected through IO pins. The names of the places have been chosen for example.



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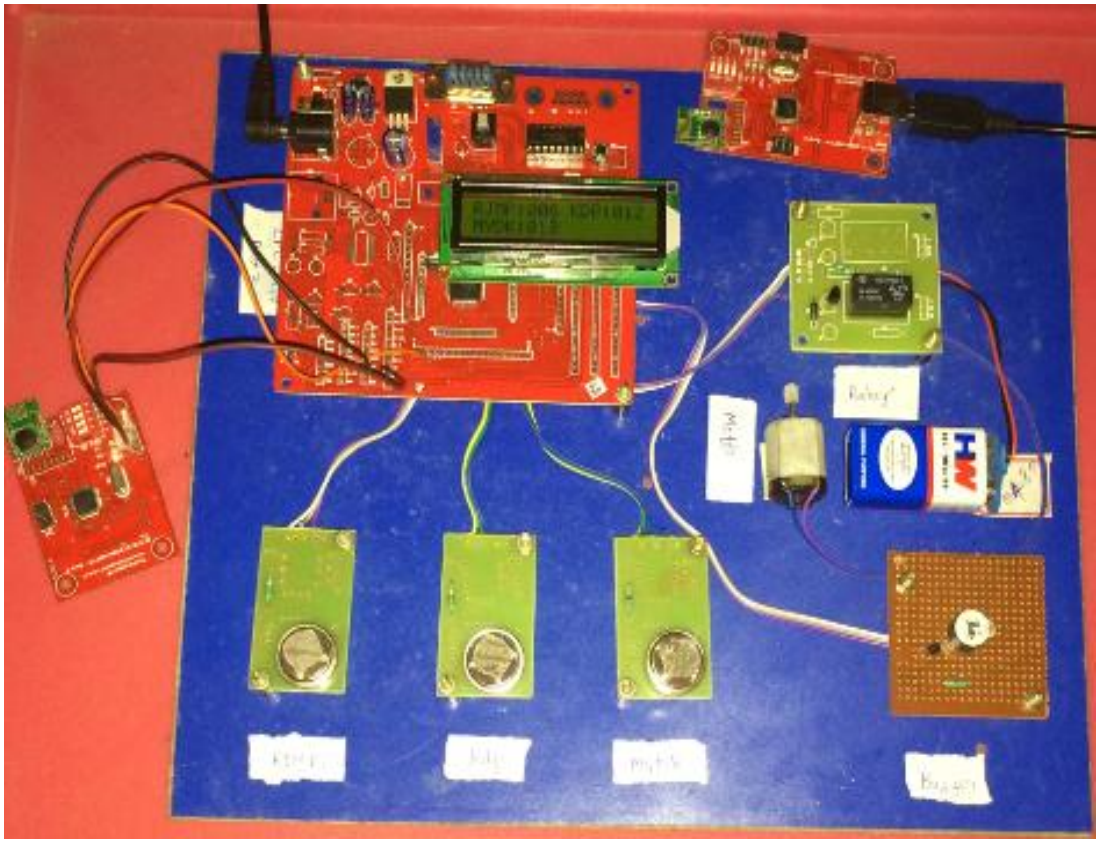

**Fig 1: Prototype of Project**

When the power is on the LCD glow and shows the gas leakage detection statement as the figure 2 shows below


**Fig 2: Status of Leakage Detection**

**Leakage Detection:** In this project three places are located to check the gas leakage. The places are Rajampalam (RJMP), Kodandapuram (KDP), Mydukur (MYDK).

**Leakage At Rajampalam**

If the leakage occurred at rajampalam (RJMP), the status of the detection prototype is shown as in fig 3.



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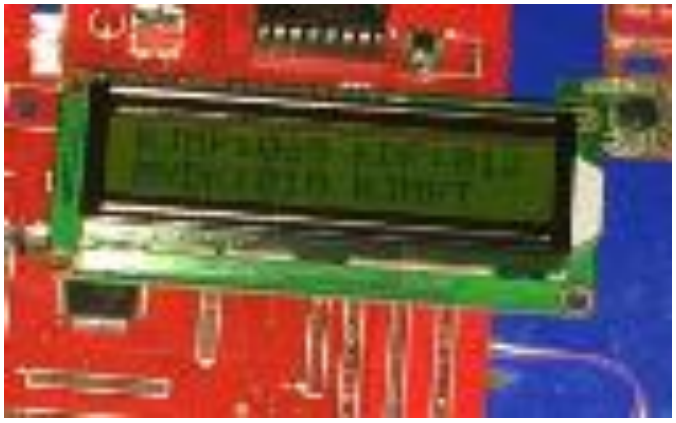

**Fig 3: Leakage at Rajampalam (RJMP)**

**Leakage At Kodandapuram**

If the leakage occurred at Kodandapuram (KDP), the status of the detection is shown as in fig 4.

**Fig 4: Leakage at Kodandapuram (KDP)**

**Leakage At Mydhukur**

If the leakage occurred at Mydhukur (MYDK), the status of the detection is shown as in fig 5.

**Fig 5: Leakage at Mydhukur (MYDK)**

Whenever the leakage is occurred the buzzer will give an alarm sound to the nearby people to vacate the location. The relay will switch on the DC Motor the motor will stop the input flow of the fluids and it locate the leakage occurred and stops the leakage of gas.



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**Monitoring Section:** The data will be stored in the computer with the help of hyper terminal. Through zigbee the data transmitted from micro controller to the computer in the industries with the help of RS232 serial communication. The monitoring section is shown in below Fig 6.

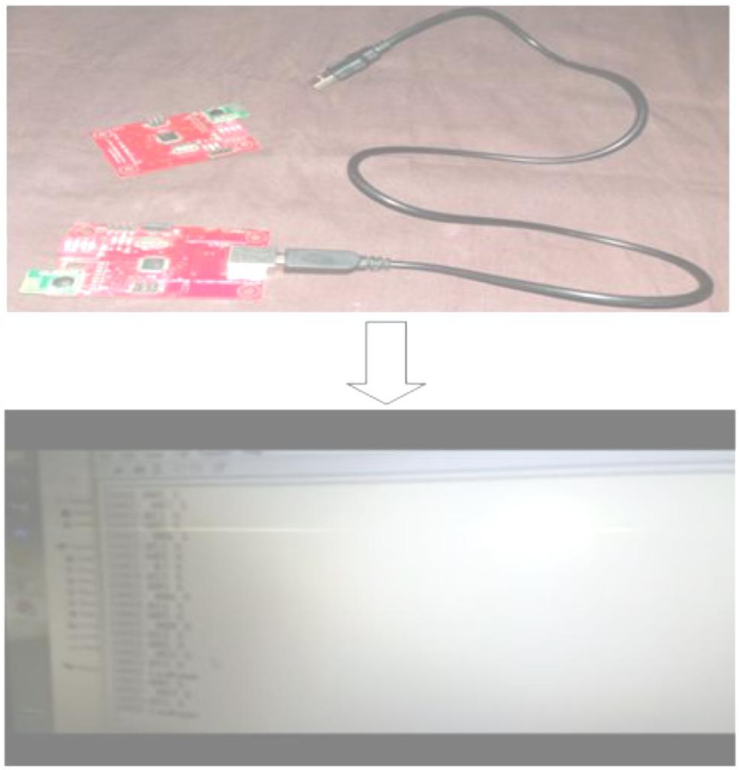

**Fig 6: Monitoring Section**

Gas leaks can be detected with this model's sensor, which is placed near the pipeline. When the gas leakage detection system detects a leak, data from the accident scene can be quickly collected and shown in the system's monitor.

Most studies on gas leak detection in wired networks have been done, according to a literature review. Despite these advantages, connected sensors and surveillance systems have a number of drawbacks, such as slow response times, high maintenance costs, reliance on cable-based telemetry systems, cable damage resistance issues, and a high demand for cable. It is also not possible to use the monitoring system in remote locations without a power source. As a result, incompatible wired network systems were replaced with a WSN for the purposes of this study. Smart WSN nodes, on the other hand, are equipped with microcontrollers that consume very little power. A system capable of dependable communication and process control without the usage of connected devices has been proposed in light of this and the lab's limitations. Sensor knots in the wireless gas sensing system, as previously mentioned, collect data on gas leaks and demonstrate an embedded technology that is equally significant in hardware and software.

The IEEE 802.12.4 Personal Area Network (PAN) standard is used to guide this model's use of ZigBee technology. Testing the signal strength of the Xbee Series 1 is done by connecting a USB to UART converter to it, then comparing it to two conditions: indoors and outdoors. This system's Zigbee signal strength is being tested using the graph in Fig. 2.7, which depicts the RSSI value as a function of distance. It has a maximum detection range of 9.89 meters, and a captured RSSI value of -87dBm. In general, the signal intensity degrades with increasing separation between the transmitter and the receiver. There is also some interference from the building's wi-fi, which will reduce the signal strength. Data on signal strength for a Zigbee module was gathered using X-CTU software, as shown in Table 1.



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**Table 1: Indoor Distance and Reading Of RSSI For Zigbee Module**

| Distance (Meters) | RSSI (dBm) |
|---|---|
| O | -40 |
| 4.6 | -77 |
| 2.8 | -78 |
| 8 | -89 |
| 9.89 | -87 |

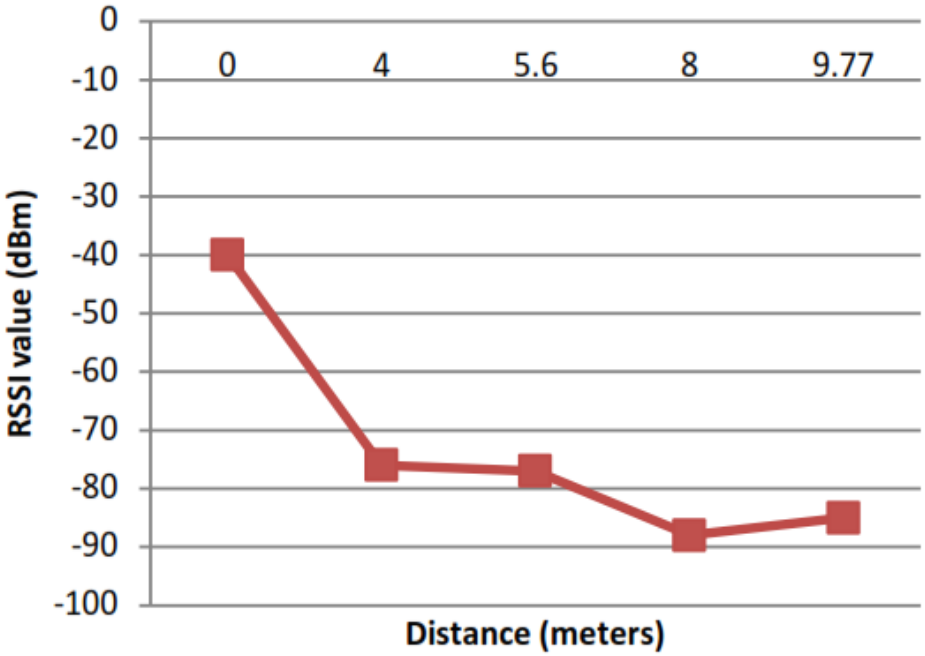


**Fig 7: Graph on receive signal strength indicator of Zigbee module in decibel-milliwatt(dBm) versus distance from indoor of one room to another**

Although the RSSI value is -89dBm, there are some poor signals detected in Fig. 6. Largest outside detectionrange, can detect up to 100 metres. In other words, the signal is most steady at a distance of 0 to 70metres. For the enhancement of this system, the results in Table 2 can be compared with future advanced technology, based on their receive signal strength. RSSI values between -40dBm and -76dBm are considered to be stable and robust in signal strength.

The data monitoring of gas concentration in parts per million (ppm) vs time is depicted graphically in fig. 9, which was exported to Microsoft Excel using the LabVIEW built-in export function. As can be seen in the graph, there is a leakage as the concentration of the gas increases in the atmosphere. The activation of the exhaust fan serves as a preventative measure to keep matters from growing worse. It does so by rapidly reducing the gas concentration. As the severity of the leak increases, the concentration of gas in the air grows, and the system sends an alarm signal to inform the users when the concentration of gas approaches the threshold of a dangerous state. Additionally, consumers can view the current condition of the room in real time, and a backup record is maintained for the purpose of maintaining it.



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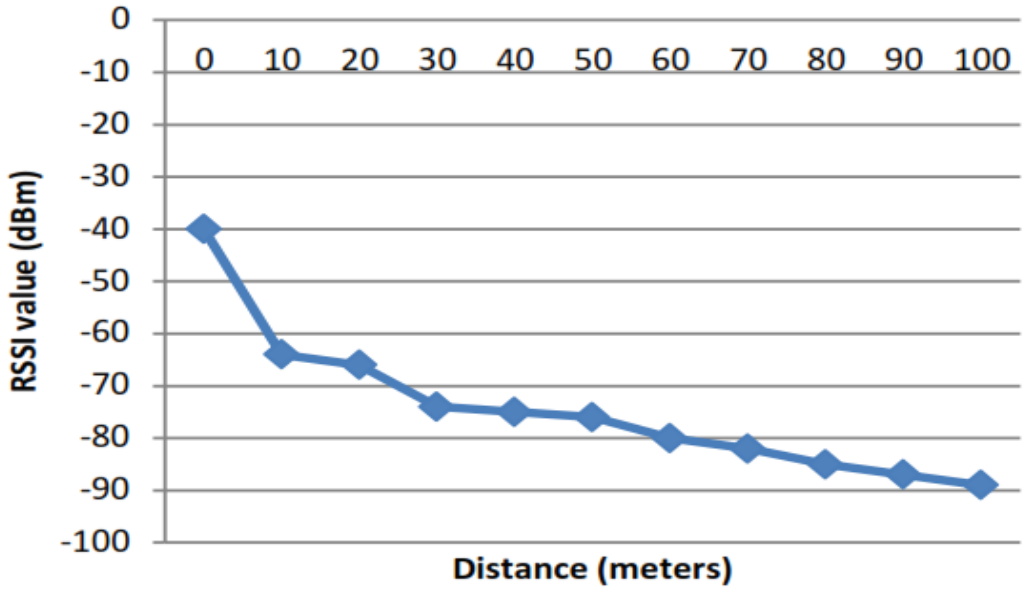


**Fig 8: Graph on receive signal strength indicator of Zigbee module versus distance outdoor of the building**

**Table 2: Outdoor Distance And Reading Of Rssi For Zigbee Module**

| Distance (Meters) | RSSI (dBm) |
|---|---|
| 0 | -40 |
| 10 | -65 |
| 20 | -68 |
| 30 | -74 |
| 40 | -75 |
| 50 | -76 |
| 60 | -81 |
| 70 | -82 |
| 80 | -87 |
| 90 | -88 |
| 100 | -89 |



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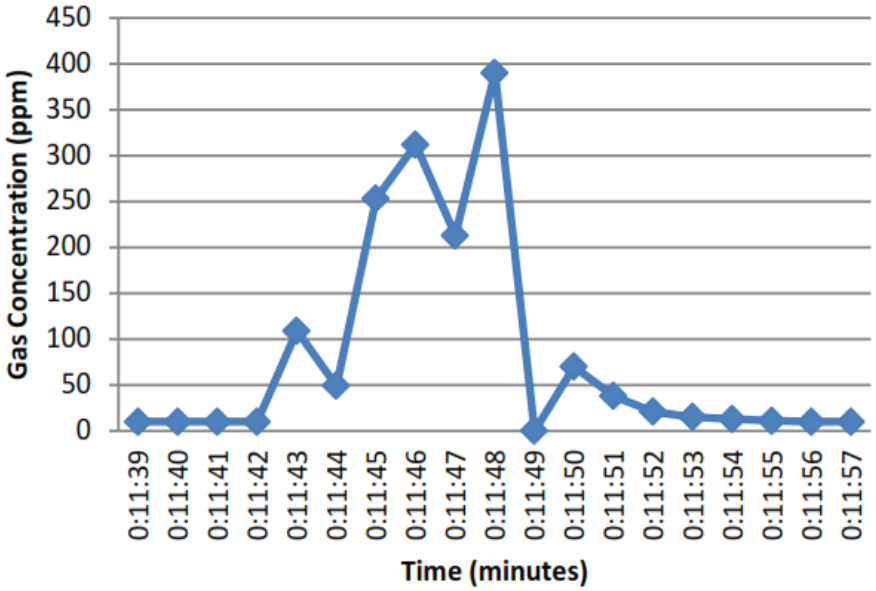


**Fig 9: Graph of gas leakage detection**

The graphs in Fig 9 and 10, illustrate that when the leakage of gas concentration surpasses the dangerous condition threshold value, which exceeds 512ppm, the system will issue an alarm signal to notify the users.

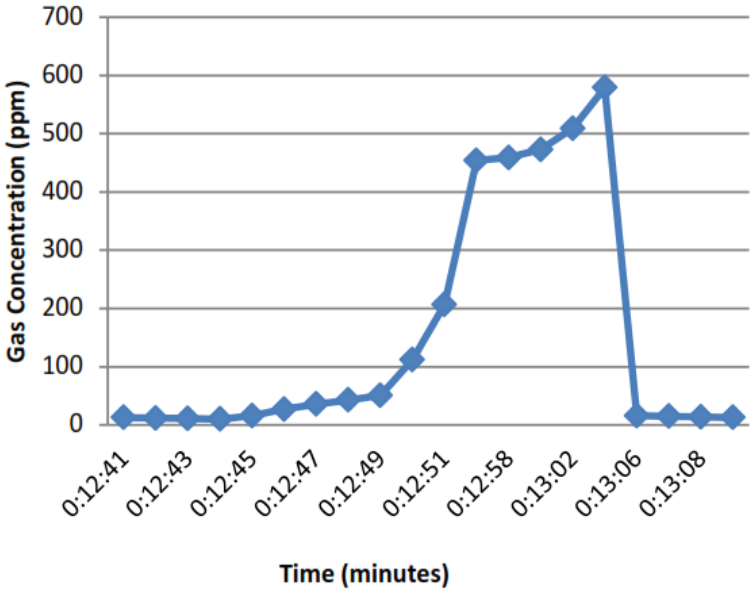


**Fig 10: Graph of gas leakage detection in serious condition**

## Conclusion

Sensors in the air detect LPG gas leaks, and if they exceed the limit of safety, the ARM microcontroller activates a buzzer and sends an alert to the monitoring section through ZigBee. In the event of a hazardous or abnormal situation, this user will be alerted to take the appropriate action. We can avoid gas leak-related accidents with the help of this equipment. We will use GPRS and GSM on the microcontroller to locate the leakage precisely in this project. In addition to informing adjacent stations in the industry, the warning message is broadcast across the airwaves. The leakage can be easily located in the field because to the latitude and longitude measurements. The project deals with the design and implementation of the WSN node hardware. Emission levels of various gases at manufacturing facilities, chemical plants, food processing facilities, and other establishments can be monitored. The design of the sensor node and the coordinator node are addressed separately. The Arduino GSM shield also explains the fundamental research in great detail. CNG and LPG, two



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often found household gases to cause fatalities in gas leaks, are among the many. As in most cases, odourless substances cannot be identified by human olfactory senses. A leak detection, warning, and monitoring system is provided by this gadget. The MQ-6 sensor was found to be a low-cost LPG sensor, which decreased the cost of the WSN nodes and hence the WSN nodes' cost. The system has been properly calibrated and implemented. The arduino nano microcontroller is connected to the computer, which serves as the hub of the WSN node. The microcontroller has a 10 bit analogue to digital converter chip. For self-sufficient functioning, the WSN nodes use rechargeable batteries with a DC voltage of 12 volts.

**Future Employments**

1. Also the security features of the LPG gas release / detection system can be improved by adding a different function to check the condition of the sensor, if the sensor is not working correctly or the sensor has been displaced / controlled intentionally.
2. Our motto in the next future is the automatic opening of the windows system when a gas leakage in the room is detected.
3. Introduction of android applications.

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