

A Secured Model of IoT-based Smart Gas Detecting and Automatic Alarm System

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Abstract—A gas leakage detector is a device for detecting gases in an area that is often used in a security system. This type of equipment is used to detect gas leakage or another emission. A gas warning device can alert operators in the vicinity of a possible gas leak and enable them to escape. The device is important because many gases can be harmful to organic life, such as humans or animals. This can be used to detect flammable, flammable, and toxic gases, as well as a lack of oxygen. Identifying potentially dangerous gas leaks through sensors. These sensors often use an audible alarm to alert people when dangerous gas has been detected. The purpose of this paper is to propose and discuss the design of an IoT-based gas leakage detection system that can automatically detect and warn gas leaks. The proposed system also includes a warning system for users. The system is based on sensors that can easily detect gas leaks.

Keywords— Gas leakage detector, Automatic alarm, IoT device, Alert, Gas sensor.

I. INTRODUCTION

Gas leakage is a serious problem in industrial production, departments, and living quarters. Nowadays, due to the increase in gas leakage, home safety has become a major issue. Gas leakage is a serious problem in shops, residential areas, and vehicles such as compressed natural gas (CNG), buses, and gas-powered vehicles [1]. One of the preventive methods to prevent gas accidents is to install gas leakage detection kits in sensitive areas. The gas leak detection and monitoring system is a wireless communication project designed to improve the safety of personnel and machinery in the petrochemical industry [2]. In industry, excess crude oil is stored in confined spaces. Therefore, the presence of external sources that may cause overheating or fire may cause severe disasters [3]. Even the gas present in the refinery is dangerous. The IoT technology in creating a Gas Leakage Detector and Smart Alerting techniques regarding calling, sending text messages to the involved authority, and an ability to are expecting risky conditions so that human beings can be made conscious earlier through appearing information analytics at the sensor reading [4].

Therefore, to avoid any hazards related to gas leakage in the petrochemical industry, we have developed an integrated system that will monitor the gas leakage in any area around the factory in real-time. This is a wireless communication device. The project focuses on the implementation of the newly developed integrated system.

The paper is broken into eight parts, each of which is organized as follows: Section 1 contains an introduction, followed by a brief survey of Gas leakage detection system in section 2, section 3 contains the methodology, section 4 has the field of applications of gas detection, section 5 has the result and simulation analysis of this research, section 6 contains the advantages of gas

detection, section 7 contains limitations and section 8 contains the conclusion and future work.

II. LITERATURE REVIEW

The literature review of the thesis consists of two (02) sections. Firstly, a section introduces the Gas leakage detection System. The second section presents the IoT Based Gas Leakage Detection System.

2.1 Gas leakage detection System

The gas leakage detection system is based on a microcontroller that uses a gas sensor as well as a GSM, display, and buzzer. It detects a gas leak and transmits the information to the microcontroller. It turns out that the microcontroller makes a decision and then displays a warning message on the display [5]. The design of a gas leakage detection system that can automatically detect, warn, and control gas leaks. The system proposed in this study also includes a warning system for users, which is based on sensors that easily detect gas leaks [7]. To develop home security against intruders, gas leaks, and fires. In any of the above three cases, a person you meet while someone other than your device is out of your home will send an SMS to an unprovided emergency. This study consisted of 8051 microcontrollers and background in the field of mobile communications, how they are interconnected, and the AT command set used in communications [8]. A gas leak alarm system to detect gas leaks and alert people on board. In addition, liquefied petroleum gas (LPG) is highly flammable and can burn even at a certain distance from the source of the leak. Therefore, it is very necessary to develop a gas leakage alarm system. A gas leak sensor is such a small tool that distinguishes gas leaks at an initial level and warns the same individuals. In this research, the progress of the

simple gas leak locator at the bottom stage was fundamentally managed, and then this basic gadget was changed to the most advanced gas recognizer framework. The results show that the gas leakage system is composed of a GSM (Global System for General Communication) module. Once a gas leakage is detected, the module will send a short message [9]. However, gas leakage detection and warning people anywhere such as at home, marketplace, and especially on board. The fire accident mainly occurs for the use of low-quality rubber tubes or turning on the gas flow after use. In this paper, an automatic gas leakage detecting system is required which has been prevented dangerous and unpredictable situations [10]. To enhance the gas detector's verdict, the voltage difference between the output signal voltage of the gas detector and the environment detection voltage is divided into several parts. Each of the plurality of detection processes of the gas detector is captured by the microprocessor 10 times in each microsecond at the environmental detection voltage, and the predetermined detection time of each detection process is 10 seconds. If the environment detection voltage changes linearly, the given detection time for each detection process is reduced to 1/10 second/ hour. The warning device is started after three consecutive detection processes change linearly. Otherwise, the microprocessor compensates for the output signal voltage, recovers a given detection time when the environmental detection voltage changes, and keeps the voltage difference at a particular value [11]. An efficient system model that can integrate gas leak and fire detection systems into a centralized M2M home network using low-cost equipment. Then, through machine learning methods, the author uses perceptual information to use data mining methods to detect abnormal air state changes in hidden patterns to predict the risk of early occurrence. This work will help improve the security of smart homes and protect property [12].

2.2 IoT Based Gas Leakage Detection System

To design and build telemetry systems that use the Internet of Things (IoT) technology to monitor GLP and CO gas concentrations in the surrounding air in real-time. I have proved that. In this study, the central hardware is a microcontroller, CO, and PLG sensor in the electronic station. In addition, Amazon Web Services (AWS) was used as the cloud's IoT platform and data storage [13]. As a result, there is a telematics system that monitors the concentration of both GLP gas and CO gas in real-time, and that data can be accessed from any device that can access the Internet through a website. In addition, field testing has been successful, demonstrating that the proposed system is an efficient and low-cost option [14]. The problem description was used to design and implement a carbon monoxide detection system,

investigate the work done by others, and confirm the work done. Shown the proposed methodology. The final design of the study was built and enhanced by real-world environmental tests conducted in several locations. As a result, the entire system was tested and evaluated based on the design and implementation of the system [15]. To conduct the wide-area application of the Internet of Things in gas booking, which is done by using an integrated gas sensor and used for measuring, displaying the gasoline content present in the gas cylinder. Moreover, this is helpful in the automatic booking of the new gas cylinder. In this paper, the level is monitored using an i-sensor (integrated sensor) which is developed using a transducer. As a result, there might be more accurate predictive demand, supply and it also prevents pre-booking and post-booking [16]. This paper employs a variety of integrated detectors for heat, smoke, flame, etc. The signals from these detectors pass-through system algorithms to check for potential fires and use the GSM modem associated with the system to broadcast the predictions to various parties. It implements IoT technology that provides the fire department with the data it needs to get the actual data without endangering human life [20]. Finally, the main function of the proposed system is to minimize false alarms. This makes this system more reliable. Experimental results show the model's superiority in terms of affordability, effectiveness, and responsiveness with the use of the system [17]. A fire detector and collision system tool works when the MQ-135 sensor detects smoke, the fire sensor detects a fire, and the push button detects a collision. In addition to this tool, it also has a GSM SIM 800L module that provides information to security agencies. An Arduino Uno microcontroller to facilitate the operation of the entire system controls it [18]. After conducting an investigation, the MQ-135 sensor detects smoke when it comes in contact with the sensor, and in addition to the MQ-135 sensor of the fire detection system using the fire detection system DFR0076, this module also fires up to a distance of 16 cm [19]. It can be detected. The accident detection system (collision) uses push buttons. This tool system can conclude that the overall design of the accident detection and fire detection device worked properly and that the program used was successfully applied to the system tools according to the design concept.

III. RESEARCH METHODOLOGY

The systematic, theoretical analysis of the procedures used in a field of research is known as methodology. It entails a theoretical examination of a body of methods and principles related with a field of study. It usually includes terms like paradigm, theoretical

model, stages, and quantitative and qualitative methodologies. A methodology is not the same as a technique because it does not seek to deliver solutions. A methodology, on the other hand, provides the theoretical foundation for determining which method, collection of methods, or best practices can be applied to a given situation. We are gaining information about planning, design, execution, and testing using a process.

The main goal of our project is to detect gas leakage and provide a signal at that moment, as well as via SMS and signal to the supplied mobile number. Once we have merged the various architecture and GPS features, it is time to construct the program and develop our concept. In the project, we commit to a workflow for the duration of the project. This workflow is broken down into six steps. These are as follows:

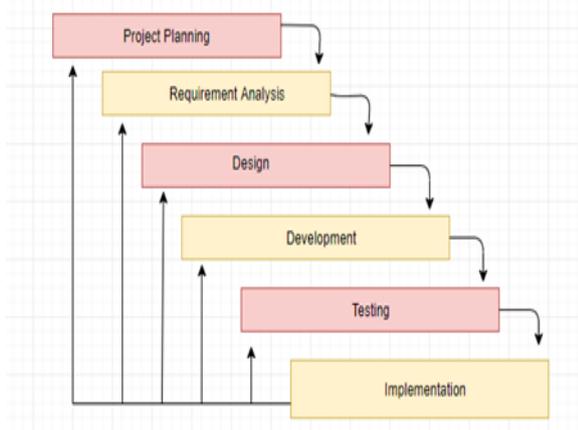


Figure 1. Workflow for this Project.

3.1 Working Principles

Home Gateway, GSM module, Siren, and LED are the main components of the system. The GSM module will send an SMS to a mobile phone number, and the home gateway will manage the signal and interpret the data received from the GSM. The sensor will detect gas leakage once the system is launched, if there is no gas leakage, it will show nothing that means normal condition. If the gas is leaked otherwise, the following scenario will happen. First of all, a signal from the microcontroller will go to the sensor and alert gas leakage message over the mobile then the siren will be beeped and the Red LED will be blinked until the gas leakage closed from the source and finally, the doors and windows are automatic will be opened.

3.1.1 Gas Detector

Gas detectors work through monitoring special fuel line stages in the air. These devices are commonly battery-operated and used for safety. Once they detect a higher than ordinary attention of fuel line in the air.

3.1.2 Fire Sprinkler

Fire sprinklers work on excessive heat that triggers the sprinkler system. When a blaze ignites, the air at once above it heats rapidly. This warm air rises and spreads together with the ceiling.

3.1.3 Siren

Siren alarm structures work by producing a loud, piercing siren sound while they are caused by intruders in and across the environment. When they are set off, a few siren alarms additionally emit flashing lighting fixtures to draw even extra interest to our property.

3.1.4 Smart Phone

The smartphone is a mini radio that is continuously at the receiving end of different indicators and sending messages.

3.1.5 PC

A pc gets information through an input unit and sends it back via an output system after it processes the information.

3.1.6 Server

The function of a server is to share information, in addition, to sharing sources and distributing work. A server pc can serve its pc applications as properly and it relies on the scenario.

3.1.7 Home Gateway

A Home gateway is a small consumer-grade gateway that bridges the network access among related LAN hosts to a WAN through a modem, or without delay connects to a WAN while routing.

3.1.8 Switch

A switch is a device in a pc network that connects different devices.

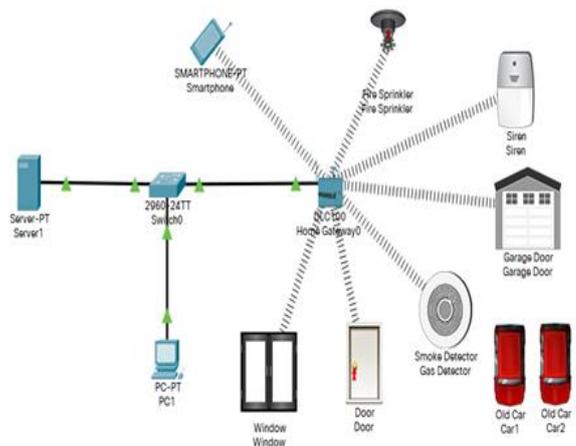


Figure 2. Proposed System Model.

The Home Gateway includes Ethernet ports as well as a wireless access point. To secure wireless connections,

WEP / WPA-PSK / WPA2 enterprise can be enabled. The figure 2 shows the proposed model of the system, which consists of fire sprinkler, siren, gas detector and these things are connected to a Home Gateway. The Internet is accessed through the Home Gateway's Internet WAN Ethernet port. The home gateway will manage the signal and interpret the data received from the GSM module, which will send an SMS to a mobile phone number. Through the Short Messaging Service, a customized Global System for Mobile Communication (GSM) module is built for wireless radiation monitoring (SMS). This module can receive serial data from radiation monitoring devices like survey meters and area monitors and send it to a host server as text SMS.

3.2 Software Based Components Requirements

Table 1. Components Requirements

Name	Quantity
Gas Detector	1
Fire Sprinkler	1
Siren	1
Smart Phone	1
PC	1
Server	1
Home Gateway	1
Switch	1

IV. FIELD OF APPLICATIONS OF GAS DETECTION

Here we can in brief explain the field of applications of gas detection. It may be used to locate the awareness of associated toxic gases in the petroleum, chemical, and textile industries in real-time.

4.1 Safety Industries

Gas detection and monitoring have always been closely related to protecting people who work in hazardous environments where hazardous gases may be present. At the heart of any gas, the detector is a gas sensor specifically designed to monitor and measure gas concentration repeatedly to indicate higher than normal levels and to ensure safety for those working in and around dangerous gases.

4.2 Refineries

The mineral oil industry can benefit from improved mineral oil supply, transportation, processing, distribution, and environmental protection.

4.3 Aerospace Industries

One of the unique industries is aerospace, which

requires the use of gas sensor technology to measure both oxygen and carbon dioxide gas concentrations. In an aerospace environment, gas sensors are used to monitor in-flight conditions and maintenance of air quality to ensure crew productivity and overall passenger comfort.

4.4 Medical and Life-Science Industries

Another industry that makes extensive use of gas sensing technologies is the medical and life sciences fields. Because many gas sensors are incredibly accurate, reliable, and consistent, they can also be easily integrated into fields such as nursery, neuroscience, respiration, respiratory planning, and many other fields.

4.5 Industrial Applications

Many customers are often looking for gas sensor technology for use in the harsh and stable environments commonly found in industrial processes. When working with extreme environments and industrial gases, it is important to note that the gas sensor must be tailored to the specific harsh environment and be durable to withstand the environment.

4.6 Chemical and Petrochemical Plant

It is essential to continuously reduce the risks associated with chemical manufacturing, transportation, and storage. This means checking for possible hazards and performing the necessary tests and inspections to avoid or at least reduce and control them.

4.7 Textile Industries

In the manufacture of textiles from raw materials, bleaching chemicals are widely used. Processes include cleaning, bleaching, oxidative or reductive bleaching. Toxic bleaching chemicals are hazardous to personnel and the environment. Their storage and use often require the use of a stationary gas detector to reduce this risk in the workplace.

Our proposed model can detect the smallest leaks with a very low leak rate, meets the requirements for personal safety, and is issued mainly for the detection of different types of gas.

V. RESULT AND SIMULATION

Several tests were carried out in this part to carry out the study's aims and obtain more accurate and precise values. As a result, efficiency increases with correct readings; hence, testing is conducted on numerous elements because a smart gas detection system is an existing subject, thus accuracy is vital. Since the system is designed based on gas leakage, the theoretical and testing values will always match. If they do not match, then that indicates manufacturing defects on the hardware. We implemented our proposed model by using Packet Tracer. It is a Cisco Systems cross-platform visual simulation application for creating network topologies and

simulating modern computer networks. Users can use the software to replicate Router and switch configurations using a simulated command line interface. Figure 3 shows the circuit diagram created with Packet Tracer. This system is made up of a gas detector and a home gateway. When the sensor detects gas in the atmosphere, it emits a variety of signals, including beeping the siren, blinking the LED, and automatically opening all doors and windows. The siren and blinking LED will not cease working until the atmosphere has cleared. If no gas is detected, the sensor will not produce an output, and everything will continue as before.

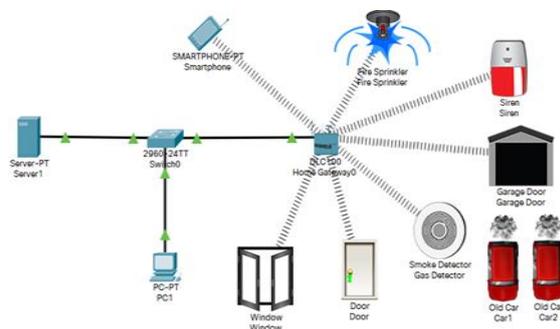


Figure 3. Simulation of Proposed System Model.

VI. ADVANTAGES OF GAS DETECTION

The advantages of our project are –

- Our proposed model inspects the situation, which will be recorded and displayed on the monitor screen. It also facilitates working personnel for effective observation, detection, quick analysis, and diagnosis.
- Save comprehensive investment, improve work efficiency, more accurate detection.
- Operating cost related to other method is low.
- The cost of manufacturing this model is relatively low.
- Our model also has a quick reaction from the sensor. It also has a high-sensitivity high-stability long-life gas sensor.

VII. LIMITATIONS

There is no sub-system where wastage of gas and the uses of gas cannot be monitored by using this system. Our model does not work in water.

VIII. CONCLUSION AND FUTURE WORK

Designing a safety model for gas detection and automatic warning systems proposed and discussed in this paper. This is a low-cost, low-power, lightweight, safe,

user-friendly, efficient, multi-featured, and simple system for detecting gas. A gas detector will not only provide us with significant information for the health department but it will also lead to a significant increase in our economy because when gas leaks, it not only contaminates the atmosphere but also wastes of gases will hurt our economy. The sensor was calibrated, and the program was then run to get the particle per million values. To ensure that the gas levels being detected by the sensor are accurate, the calibration and preheating of the sensor are done. When the system is running, the data from the sensor is uploaded to the webserver. The data collected is in real-time and will display the concentrations of the gases. Buzzer and LED were used as audible and visual alarms. When the concentration of gas crosses a threshold, a buzzer and lead will trigger. When the buzzer and LED light up and send out a text alert to the user via smartphone.

One of the significant functions of the system in the future is to add a subsystem that can monitor gas waste and gas usage systems. The system will have a function to notify emergency services if any accidents occur. In the future, a system will be integrated into this one that will provide more safety and relaxation to the users. The proliferation of handheld devices has led to developments in the field of smart gas sensors that have increased their scope of application. Safety will be needed in workplaces, so the market will grow over the coming years.

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