

Industrial Chemical Leak Early Warning Device Using IoT

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Abstract - An industrial chemical leak is dangerous for people, the environment, and industrial machinery. An Internet of Things (IoT)-based Industrial Chemical Leak Early Warning Device para satellite will detect the presence of harmful chemical gases in the surrounding area, notify authorities via a notification on a phone or an IoT web application, activate alarms and/or visual indicators, thereby helping with early detection, reducing risk, and enhancing safety in the work place. The IoT will provide real-time monitoring and a fast response to dangerous situations caused by chemicals leaking.

Key Words: Internet of things (IoT), Gas detector, Gas sensor, photonics, Users, GSM.

1.INTRODUCTION

Manufacturing industries use various hazardous materials and gases in their operation, creating different unsafe working conditions. Some of these unsafe conditions stem from inadequate storage methods, improper handling and maintenance of equipment, equipment failure, and equipment that is leaking toxic materials. Any of these incidents can create unsafe places for human beings and, hence, endanger their health and safety as well as threaten the security of the manufacturing facility's infrastructure and surrounding environment. Therefore, if the manufacturing facility cannot identify and eliminate the possibility of one of these incidents occurring, then the manufacturing facility will be faced with the potential of an accident that will result in severe human impact. Therefore, in order for all manufacturing industries to be able to respond quickly to potential chemical leaks caused by one of the aforementioned sources, and protect themselves, early warning systems must be utilized. For that purpose, manufacturing industries have developed and implemented the Industrial Chemicals Leak Early Warning Device for the early detection of chemical leaks, providing early warning of possible exposure to toxic chemical/gas leaks and immediate notification to relevant personnel regarding potential exposure. The Industrial Chemicals Leak Early Warning Device's technology includes gas concentration, temperature, and pressure measuring and monitoring

devices (sensors); continuous monitoring of these parameters will facilitate the detection of abnormal conditions, such as a leak, which, will then trigger the Industrial Chemicals Leak Early Warning Device to alert relevant personnel in the manufacturing facility so as to allow them to take action.

2. Body of Paper

2.1 Literature Review

Numerous scientists have researched using electronics and internet of items (IoT) to detect gases in dangerous settings (e.g. industrial applications). Previously, technology to detect chemical leaks consisted of utilizing basic gas sensors and alarms found mainly at one location for detecting leaks. This was disadvantageous because the alert for a leak was confined to one area with no remote accessibility or monitoring capability.

Recently, studies have also found the application of IoT-type monitoring through a combination of microcontrollers, gas sensors, and Wireless Communication Technology to continuously monitor the atmosphere and send information regarding air quality to cloud platforms as it occurs. Examples of gas detection devices include ESP32/Arduino using MQ Series gas sensors to detect hazardous gases such as ammonia, hydrogen, and nitrogen dioxide. If a gas's concentration is above its limit to be considered safe, then alerts will be sent to users via mobile applications or through a web-based Dashboard.

Some research is still being conducted for integrating cloud-based platforms for storage & analysis of gases over a time frame, thus allowing industries to monitor gas levels as they have been affected by previous safety programs and develop strategies to improve their respective safety programs. With IoT-type systems, there are several advantages, including the ability to

monitor gas levels at all times; the ability to respond quickly to an elevated level of gas and to have access to the data remotely.

As such, it is proposed that the Industrial Chemical Leak Early Detection Device be developed using a combination of gas sensors, microcontrollers and IoT technologies to provide an effective and efficient/acceptable means to detect chemical leaks.

2.2 Problem Definition

Numerous sectors employ potentially toxic materials and gases during their processing and storage operations. Chemical spills may occur because of machinery failures (for example, pumps breaking down), line-breaks (for example, broken pipes), but also because of human mistake. Chemical leaks can create significant harm to employees, damage part of the manufacturing process or facility, and contaminate soil or water. In many instances, the leaks are identified too late due to inaccessibility or lack of a continuous monitoring plan.

The conventional approach to identifying chemical leaks generally utilises both manual inspections and rudimentary alarm systems which do not offer real-time data. Such delays can lead to major incidents (e.g. fires, explosions, health risks) having occurred before they are detected.

Therefore, there is a significant need for an intelligent leak detection system that can identify the presence of hazardous gases 24 hours a day, 7 days a week, which can provide advance notice of dangerous situations prior to those situations arising. To address this challenge, The Industrial Chemical Leak Early Warning System (ICLEWS) using CDE, is designed to combine gas sensors, microcontrollers and CDE technologies, to detect leaks from instruments and then immediately alert both employees and appropriate authorities.

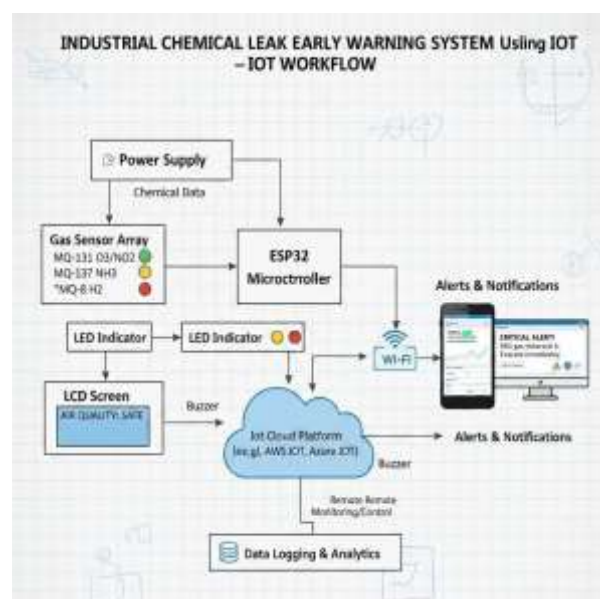
The Industrial Chemical Leak Early Warning System provides real-time monitoring of industrial processes, thereby improving safety by allowing for a quick response and good safety practices for industrial processes.

2.3 Objectives

- To Early detection of potentially hazardous gases such as flammable gases.
- To Immediate Notification of hazardous gas through SMS / Email / Cloud Dash-board.

- To Integrating IoT technology to allow for remote monitoring and storage of hazardous gas data.
- To Assist in reducing the number of industrial accidents by increasing the safety level of all workers in the industrial environment.
- To Enable automatic actions should a hazardous gas leak occur, such as turning on the exhaust fan.
- To Develop and Design an inexpensive chemical leak detection system for use in the industrial environment.

2.4 METHODOLOGY / WORKING FLOW



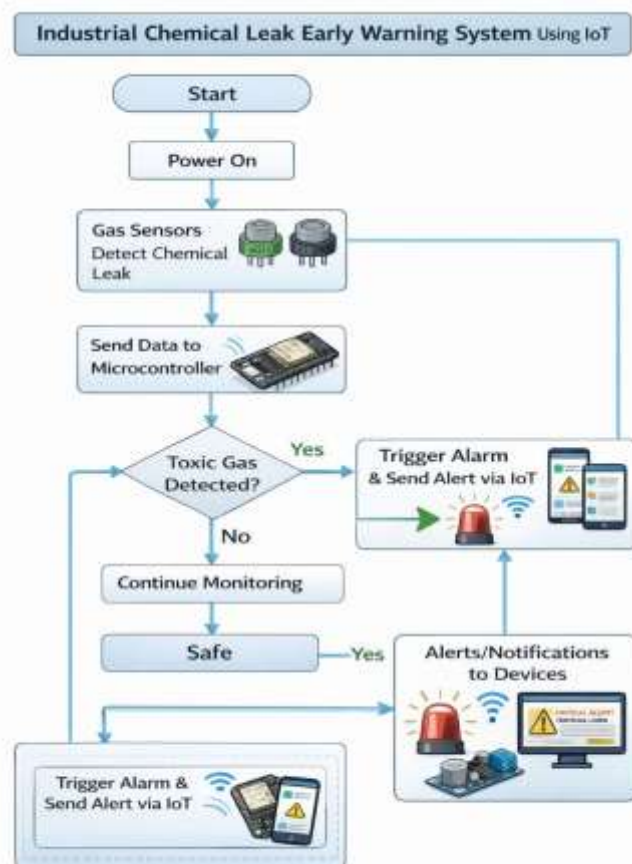
The industrial chemical leak early warning system utilizes IoT technology to provide real-time monitoring of hazardous gases in an industry-based environment. By means of utilizing gas sensors such as MQ-131 for measuring chlorine gas, MQ-137 for measuring hydrogen sulfide gas and MQ-8 for measuring liquefied petroleum gas, this system detects the presence of toxic gases and sends the sensor readings via an ESP32 microcontroller. The microcontroller processes the sensor reading and determines if the gas concentration is higher than what would be considered safe. In the case where a high concentration of gas is detected, local alerts will be activated which include an LED indicator, LCD Display, and a buzzer indicating to persons working in proximity to the detection point that there is a gas leak in the area. At this time the ESP32 microcontroller will also transmit the data collected via Wi-Fi to a cloud-based IoT platform for remote monitoring. Data sent to the cloud platform is stored for historical records and is used to send alerts/notifications to mobile devices or desktop computers to provide authorities with the necessary

information needed to make a timely response to minimize the risk of an industrial accident.

Table 1: Sample Hardware Components

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Sr.no	Component	Description
1	Gas Sensor (MQ Series)	Detects harmful gases such as NH_3 , H_2 and NO_2 in the environment
2	ESP32 Microcontroller	Processes sensor data and controls the system
3	16x2 LCD Display	Displays gas level and system status
4	Buzzer	Provides alert when gas leakage is detected
5	LED Indicator	Shows warning status (safe or danger)
6	Wi-Fi Module (Built in ESP32)	Sends data to IoT cloud platform
7	Power Supply	Provides electrical power to the system
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Table 2: Flow Chart



The Industrial Chemical Leak Early Warning System consists of a flow chart detailing the working method of Industrial Chemical Leak Early Warning System. The working of the Industrial Chemical Leak Early Warning System starts when the system turns on. Gas Sensors continuously monitor chemical gas levels in their environment and detect any presence of toxic gases by sending data from the sensor to the microcontroller (ESP32). The ESP32 checks if gas levels exceed the safe

limit. If a toxic gas is detected, the ESP32 will activate an alarm (buzzer) and send Alert Notifications through the internet of things to your mobile devices or computers. If no gas leak has been detected, the system will continue to monitor the environmental gases. Early detection of chemical leakages, and therefore the protection of industrial environments.

Table 3: Graphical Representation



4. CONCLUSIONS

A practical, reliable, affordable solution to help protect workers and the public from potential industrial accidents can be developed by creating a new device called the Industrial Chemical Leak Early Warning Device. This device will use modern Internet of Things (IoT) technologies to create real-time alerts and monitor chemicals being stored, used or transported in an industrial or laboratory environment. This project will demonstrate how businesses can implement modern technology to improve employee safety, reduce the likelihood of workplace accidents and provide a more robust and effective method for preventing industrial accidents.

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7. BIOGRAPHIES (Optional not mandatory)



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