Sri Lanka Institute of Advanced Technological Education

Final Project Report
Gas Leakage Alert & Call System

Advanced Technological Institute – Anuradhapura

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ABSTRACT

This project aims to develop an IoT-based Gas Leak Alert and Call System to enhance safety in households and industrial settings. The system detects gas leaks in real-time using sensors, sends instant alerts to users via mobile notifications, and triggers automated emergency calls to predefined contacts. The solution integrates hardware components (Arduino Uno, GSM SIM900C module, gas sensor) and software (Arduino IDE, C programming) to address the limitations of traditional gas leak detection methods. The system was tested for reliability, accuracy, and responsiveness, demonstrating its potential to reduce gas-related accidents in Sri Lanka.

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LIST OF ABBREVIATIONS

IoT: Internet of Things

LPG: Liquefied Petroleum Gas

GSM: Global System for Mobile Communications

CHAPTER 1

1.0 Introduction

1.1 Background

Gas leaks pose significant safety risks in Sri Lanka, especially in urban and industrial areas. Incidents like the 2022 Colombo restaurant explosion highlight the urgent need for advanced detection systems. Traditional methods lack real-time monitoring and remote alerts, delaying emergency responses.

1.2 Problem Definition

The current gas leak detection systems in Sri Lanka are standalone devices with no IoT integration, leading to delayed alerts and inefficient emergency responses.

1.3 Aim and Objectives

Aim

Develop an IoT-based system for real-time gas leak detection, instant alerts, and automated emergency calls.

Objectives:

Detect gas leaks using sensors.

Send alerts via mobile notifications.

Automate calls to emergency contacts.

Ensure cost-effectiveness.

1.4 Scope

The system targets households and small industries using LPG. It does not cover large-scale industrial gas monitoring.

CHAPTER 2

2.0 System Analysis

2.1 Requirements Gathering

- User Surveys: Interviews with homeowners and restaurant managers revealed dissatisfaction with existing detectors.
- Past Data Review: Analysis of gas-related accidents in Sri Lanka (e.g., 2022 Colombo incident).

2.2 Current System Limitations

- No real-time alerts.
- Lack of IoT integration.
- Manual emergency calls.

2.3 Software Requirements Specification (SRS)

Hardware: Arduino Uno, GSM SIM900, MQ 07 Gas Sensor.

Software: Arduino IDE, C programming.

Functional Requirements:

- Detect gas leaks.
- Send SMS alerts.
- Trigger automated calls.
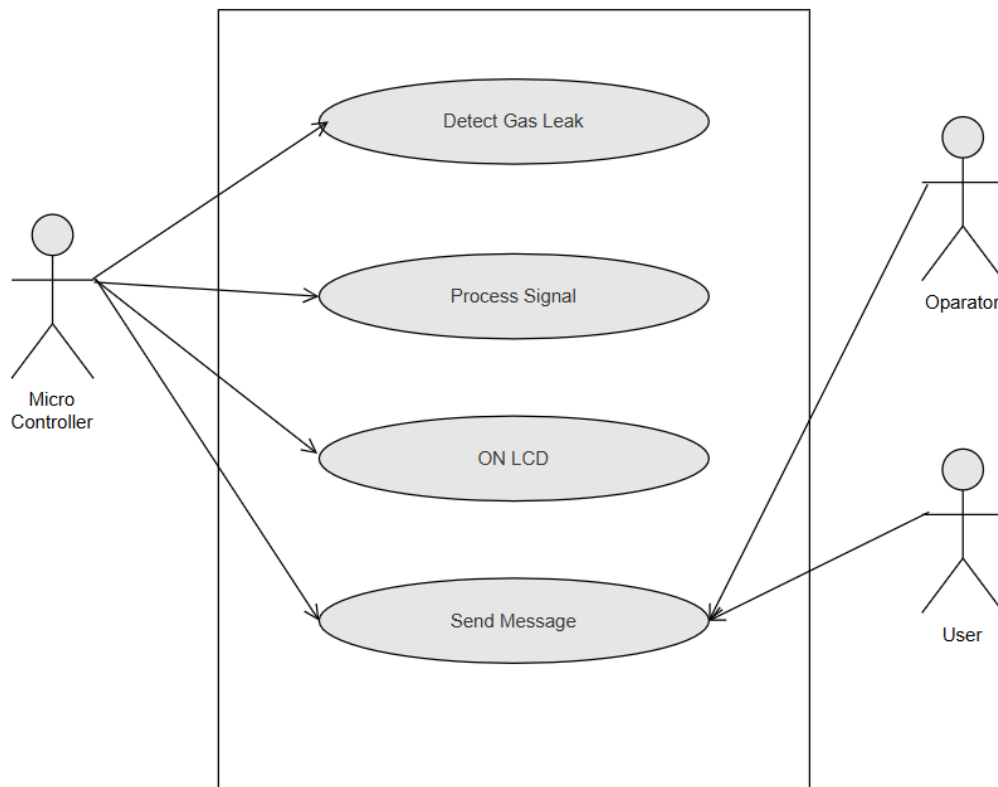
2.4 Use-Case Diagram

Figure 01: Use Case Diagram
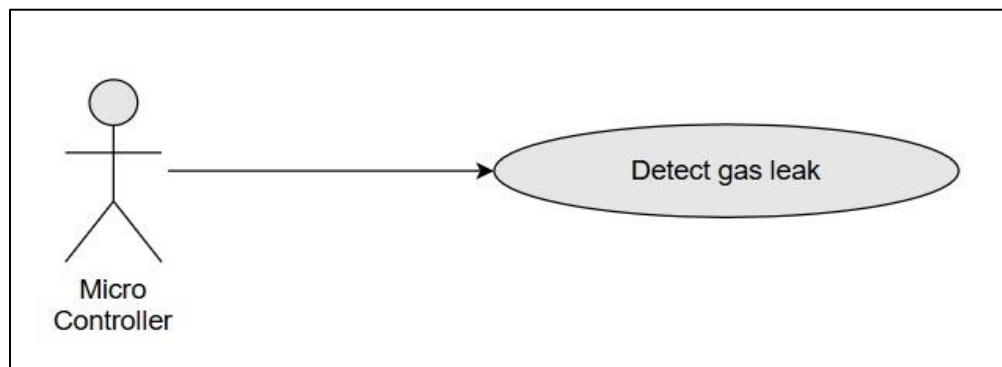
2.4.0 Use-Case Descriptions

2.4.1 Use Case 01

Figure 02: Use Case 01

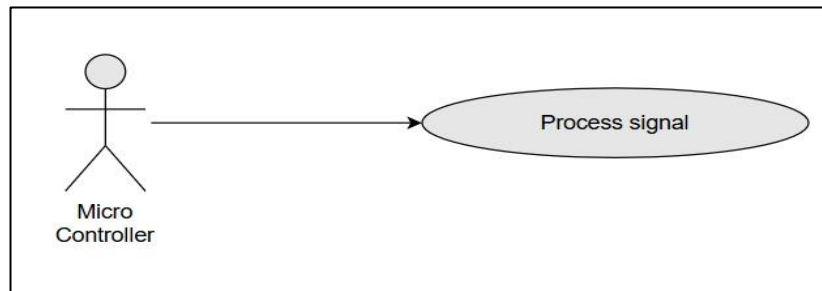| Use Case 1	
Use Case Name	Detect Gas Leak
Actor	Gas Sensor (MQ-7)
Overview	The gas sensor detects hazardous gas levels and sends an analog signal to the microcontroller
Pre-Conditions	Gas sensor is powered and calibrated Microcontroller is operational
Description	1.Gas sensor continuously monitors the environment 2.If gas concentration exceeds a threshold, it sends an analog signal to the microcontroller.
Alternative flows	Description: 1.If the sensor fails, the system logs an error (if debugging is enabled) 2.If gas is below threshold, no action is taken.
Additional Descriptions	Sensor type:MQ-7 (for LPG, smoke, propane)
Post condition	Microcontroller receives the gas leak signal for further processing.

Table 1: Use Case Description 01

4

2.4.2 Use Case 02

Figure 03: Use Case 02

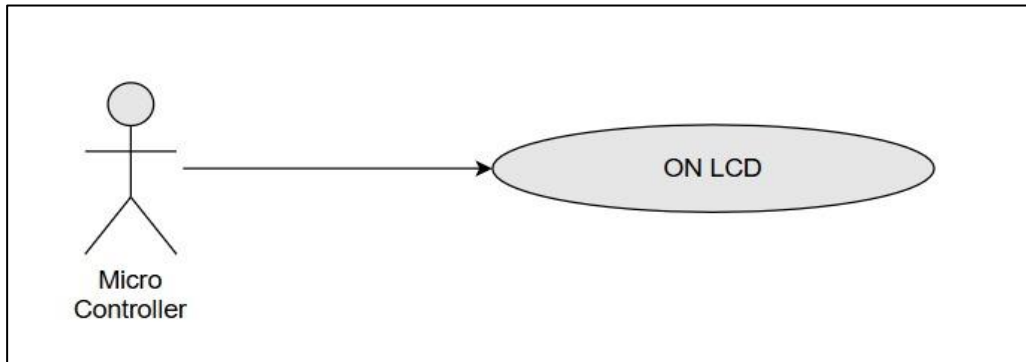| Use case 02	
Use Case Name	Process Signal
Actor	Microcontroller
Overview	The Arduino processes the gas sensor's signal to determine if an alert is needed.
Pre-Conditions	1.Gas sensor has sent a valid signal. 2.ADC (Analog-to-Digital Converter) is functional.
Description	1. Arduino reads the analog signal. 2.Compares it against a predefined threshold. 3.If exceeded, triggers alert actions (LCD, LED, GSM).
Alternative flows	Description: 1.If signal is noisy, apply software filtering (e.g., moving average). 2.If ADC fails, system resets or alerts hardware error.
Additional Descriptions	Averaging multiple readings for stability.
Post condition	Microcontroller confirms gas leak and proceeds to alert outputs.

Table 2:Use Case Description 02

2.4.3 Use Case 03

Figure 04: Use Case 03

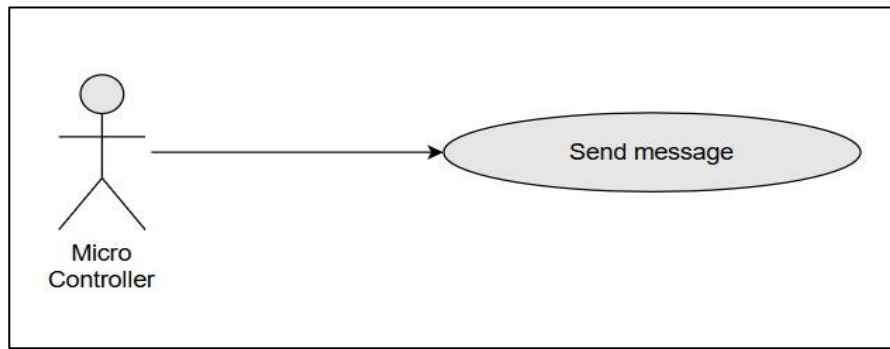| Use case 03	
Use Case Name	Display Alert on LCD
Actor	Arduino Output (LED)
Overview	Visual alerts nearby users of a gas leak.
Pre-Conditions	1.Microcontroller confirms gas leak. 2.LED is connected.
Description	1. Arduino turns on red LED. 2.Continues until gas levels normalize or reset.
Alternative flows	Description: If buzzer fails, blink LED rapidly.
Additional Descriptions	LED Patterns: Slow Blink
Post condition	Users are alerted via sound/light.

Table 3:Use Case Description 03

2.4.4 Use Case 04

Figure 05: Use Case 04

Use case 04	
Use Case Name	Send SMS Alert and Call
Actor	GSM Module (SIM900)
Overview	The GSM module sends an emergency SMS and call to a predefined phone number.
Pre-Conditions	1.GSM module is powered and connected to a network. 2.Microcontroller triggers an alert.
Description	1.Arduino sends AT commands to GSM. 2.GSM module sends "WARNING: Gas Leak Detected!" to the registered number.
Alternative flows	Description: 1.If SMS fails, retry 3 times. 2.If no network, log error and trigger LED.
Additional Descriptions	GSM Module: Sim900 GPRS/GSM shield with Antenna
Post condition	User receives a Call and SMS about the gas leak.

Table 4:Use Case Description 04

CHAPTER 3

3.0 System Design

3.1 Architecture

- Hardware Layer: Sensors and Arduino.
- Communication Layer: GSM module.
- Application Layer: Alert and call logic.

3.2 Data Flow

1. Gas sensor detects leak → Arduino processes data → GSM sends alert/call.
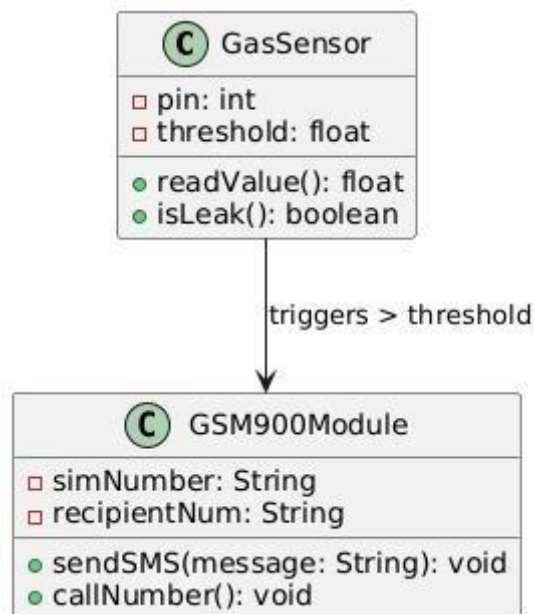
3.3 Class Diagram

Figure 06: Class Diagram

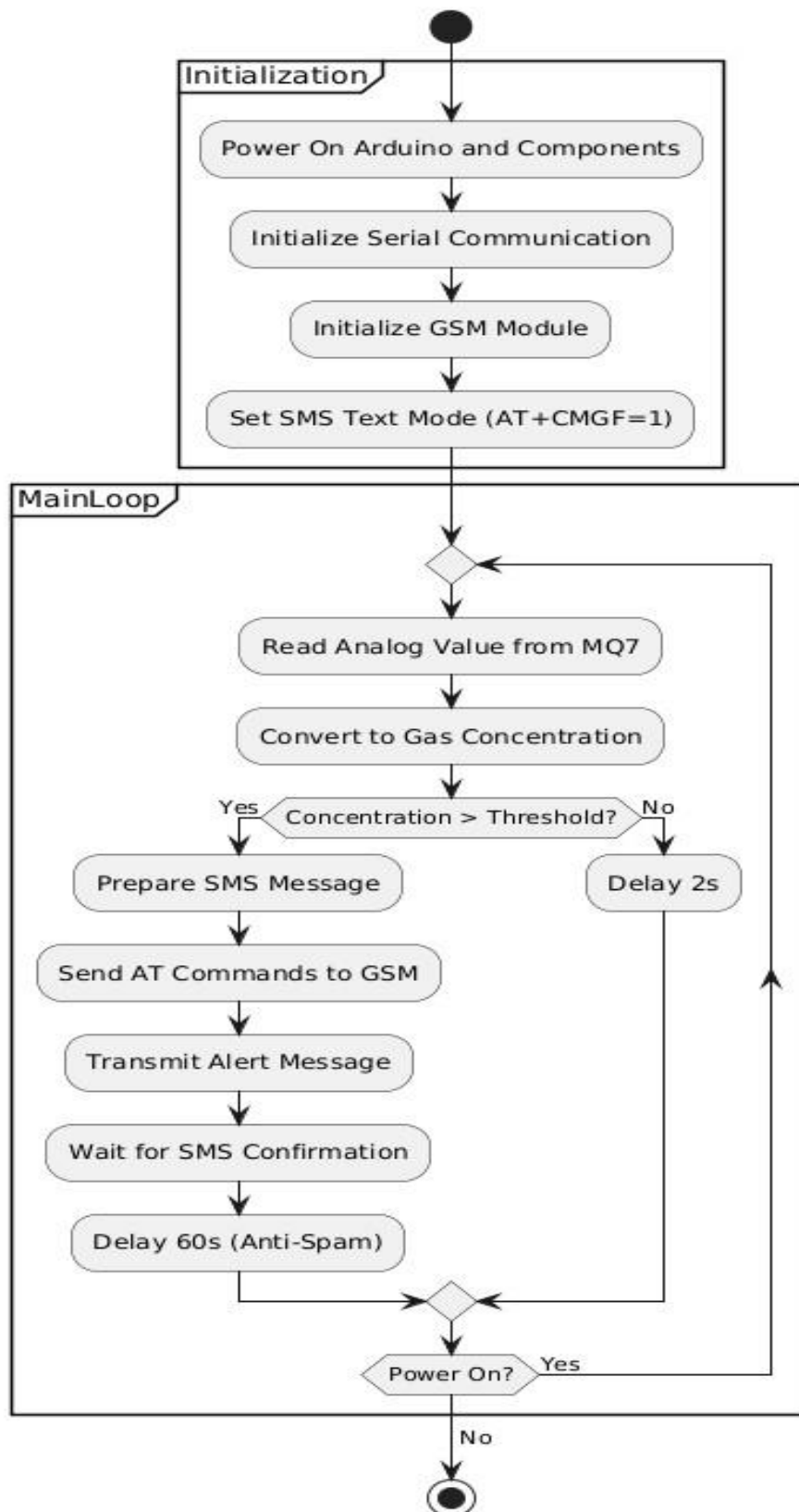# 3.4 Activity Diagram

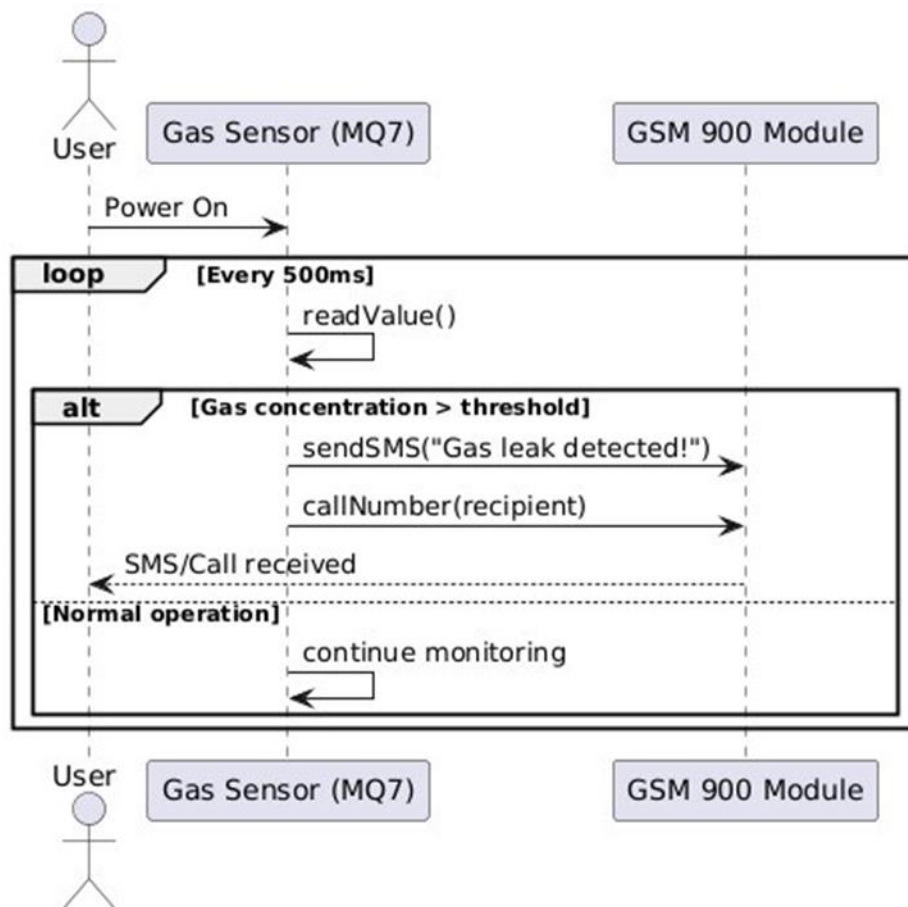Figure 07: Activity Diagram

3.5 Sequence Diagram

Figure 08:Sequence Diagram

CHAPTER 4

4.0 Development, Testing, and Implementation

4.1 Development

Tools Used: Arduino IDE, C language.

Challenges: GSM module connectivity issues (resolved with antenna adjustments)

4.2 Testing

4.2.1 Test Case

Test Scenario ID	GasAlert-1		Test Case ID	GasAlert-1A
Test Case Description	Gas Leakage Detection – Alert System Test		Test Priority	High
Pre-Requisite	System powered ON, GSM module connected, Gas sensor calibrated		Post-Requisite	System reset after test

Test Execution Steps:

`Serial No	Action	Inputs	Expected Output	Actual Output	Test Result	Test Comments
1	Power ON the system	N/A	Power LED turns On, system initializes	Power LED on, Serial monitor logs shows bootup	Pass	System boot verified
2	Simulate gas leakage (use test gas)	Apply test gas to sensor	Serial monitor logs: Gas Leak Detected	Serial monitor logs: Gas Leak Detected	Pass	Gas detected verified
3	Send alert message (SMS)	N/A	Serial monitor logs: Send SMS to 0761088005, received: "Gas Leak Detected"!	Serial monitor logs: Send SMS to 0761088005, received "Gas Leak Detected"!	Pass	SMS detection verified
4	Simulate an incoming call	N/A	Serial monitor logs: Calling 0761088005, Received call	Serial monitor logs: Calling 0761088005	Pass	Call detection verified
5	End the call	N/A	Serial monitor logs: "Call ended"	Serial monitor logs: "Call ended"	Pass	Call terminated verified

Table 5:Test Case

CHAPTER 5

5.0 Evaluation and Conclusion

5.1 Achievements

- Real-time detection and alerts achieved.
- Automated calls functional.

5.2 Limitations

- Limited to LPG (not compatible with natural gas).
- Requires stable GSM network.

5.3 Future Work

- Integrate Wi-Fi for dual connectivity.
- Expand to industrial-scale monitoring.
- When the call ringing emergency sound will hear

5.4 Conclusion

The project successfully addresses gas leak safety concerns in Sri Lanka. Its cost-effectiveness and scalability make it viable for widespread adoption.

References