SRI LANKA INSTITUTE OF ADVANCED TECHNOLOGICAL EDUCATION

Software Requirements Specification (SRS) Document

Gas Leakage Call and Alert System

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1.0 INTRODUCTION

1.1 Purpose of the Document

This Software Requirements Specification (SRS) document outlines the functional and non-functional requirements, design constraints, and scope of the Gas Leakage Call and Alert System developed using Arduino. The purpose of this document is to Serve as a reference for developers, testers, and stakeholders during the system's lifecycle.

1.2 This SRS includes

- Scope: Boundaries, services, and constraints of the system.
- Functional Requirements: Core features (gas detection, alerts, notifications).
- Non-Functional Requirements: Performance, safety, and reliability standards.

1.3 Target Audience

- Developers: To implement the system as per requirements.
- Testers: To verify functionality against defined criteria.
- Clients/Stakeholders: To validate the proposed solution.

1.4 Problem Statement

Gas leaks in homes or industries pose life-threatening risks, including explosions or poisoning. Traditional detectors lack remote alerts, delaying emergency response. Manual monitoring is inefficient and prone to human error.

1.5 Proposed System

Our Arduino-based system addresses these gaps by:

1. Detecting leaks in real-time using gas sensors.
2. Triggering local alarms (buzzer, LED) for immediate awareness.
3. Sending automated SMS/call alerts to users via GSM, enabling swift action.
4. Operating autonomously with minimal power consumption.

2.0 SCOPE OF THE PROJECT

2.1 Proposed Solution

The Gas Leakage Call and Alert System is an Arduino-based safety device designed to detect hazardous gas leaks (e.g., LPG, methane, propane) in residential or industrial environments. The system will trigger alarms (visual & audible) and send emergency alerts (SMS/call) to predefined contacts when gas concentration exceeds a safe threshold.

2.2 Boundaries and Limitations

Detection Range: Limited to gases detectable by the MQ-series sensors (e.g., MQ-2, MQ6). Communication: SMS/call alerts depend on GSM module (e.g., SIM800L) network availability. Power Supply: Requires a stable 5V–12V power source (battery or adapter). Environment: Indoor use only; not designed for extreme temperatures or corrosive environments.

2.3 Characteristics of the Product

- Hardware: Arduino (Uno/Nano), Gas sensor (MQ-2/MQ-6), GSM module, Buzzer, LED indicators.
- Software: Arduino IDE (C++), AT commands for GSM communication.
- Response Time: Near real-time detection (≤10 seconds delay).

2.4 Services Provided

- Local Alerts: Buzzer and LED warnings for immediate on-site awareness.
- Remote Alerts: SMS/call notifications to registered users.

2.5 End Result

A functional prototype that:

- Detects gas leaks and triggers alarms.
- Sends emergency alerts to 2–3 phone numbers.
- Provides visual (LED) and audible (buzzer) warnings.

2.6 Execution Conditions

- Development: Requires Arduino IDE, compatible hardware, and a stable internet connection for GSM testing.
- Testing: Conducted in a controlled environment with simulated gas leaks.
- Deployment: Indoor installation near gas sources (e.g., kitchen, boiler room).

2.7 Constraints

- Budget: Limited to low-cost components (Arduino, sensors, GSM module).
- Technical: GSM module reliability depends on cellular network coverage.
- Scope: Excludes gas leak suppression (e.g., automatic valve shutoff).

2.8 Assumptions

- Users will provide valid phone numbers for alerts.
- Gas sensors are calibrated for the target environment.
- Power supply remains uninterrupted during operation.

2.9 Acceptance Criteria

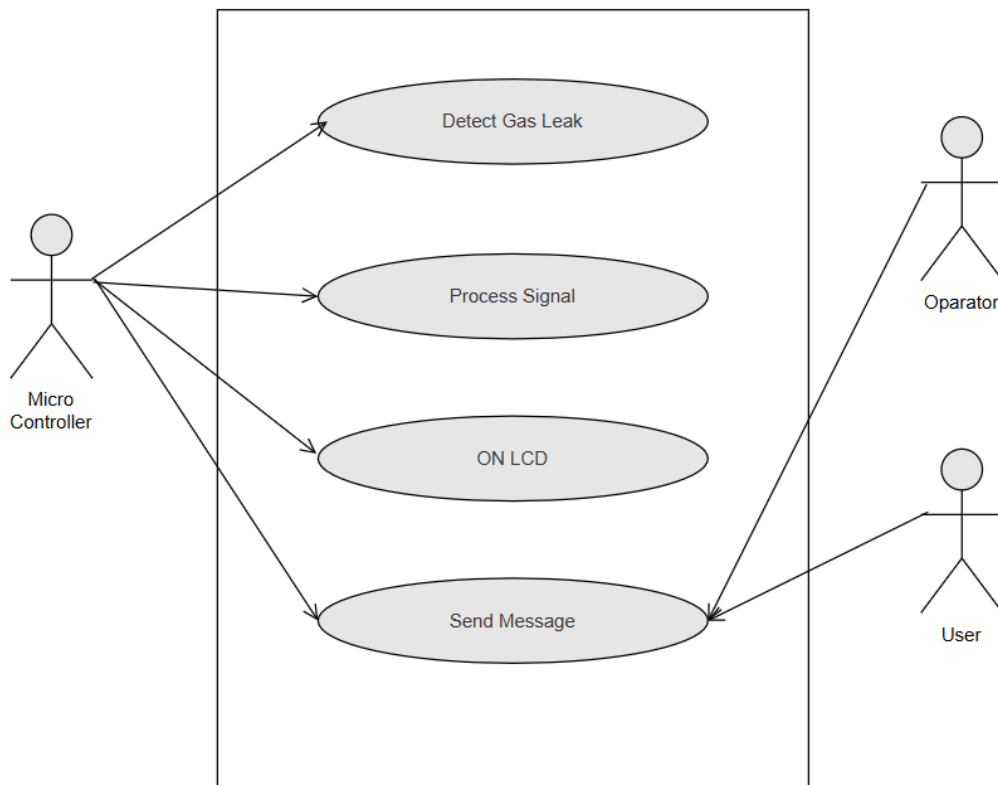The system will be considered successful if:

- Detects gas leaks above the threshold (e.g., 300 ppm) within 10 seconds.
- Triggers local alarms (buzzer + LED) immediately upon detection.
- Sends SMS/call alerts to all registered numbers within 30 seconds.
- Operates continuously without hardware failures for 48+ hours in testing.

3.0 FUNCTIONAL REQUIREMENTS

The Gas Leakage Call and Alert System shall perform the following functions to ensure reliable gas detection and emergency response:
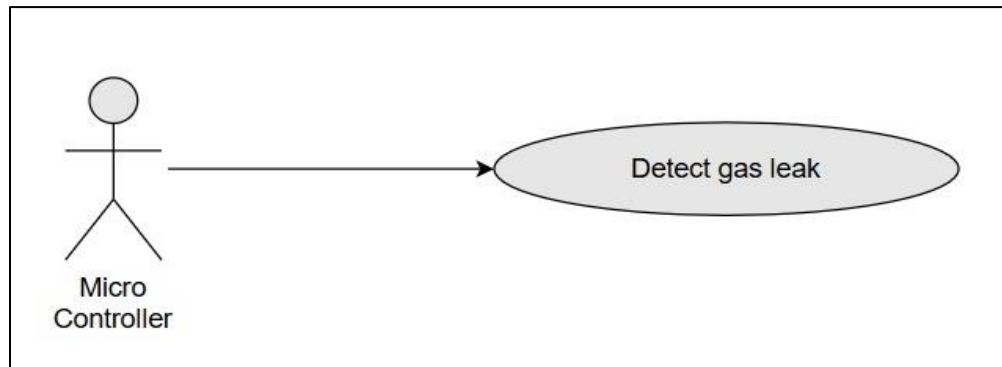
- The system shall be able to detect gas leaks using MQ-7 sensor.
- The system shall be able to send Call and SMS via GSM to predefined numbers.
- The system shall be able to auto dial emergency contacts if the gas levels are critical.
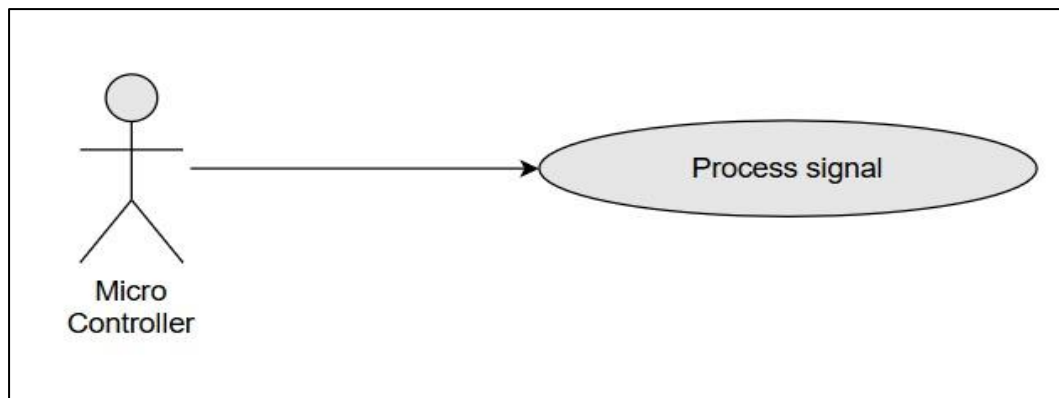
3.1 Use-Case Diagram

3.2 Use-Case Descriptions

3.2.1 Use Case 01

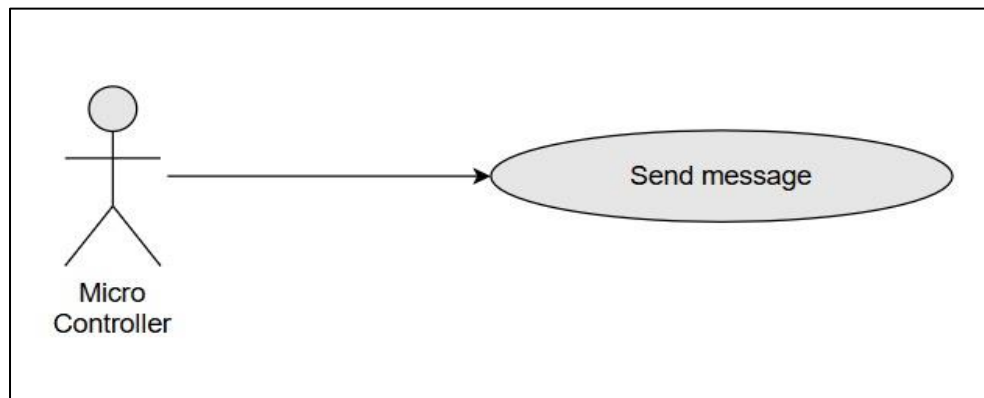| Use Case Name	Detect Gas Leak
Actor	Gas Sensor (MQ-7)
Overview	The gas sensor detects hazardous gas levels and sends an analog signal to the microcontroller
Pre-Conditions	Gas sensor is powered and calibrated Microcontroller is operational
Description	1.Gas sensor continuously monitors the environment 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.

3.2.2 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.

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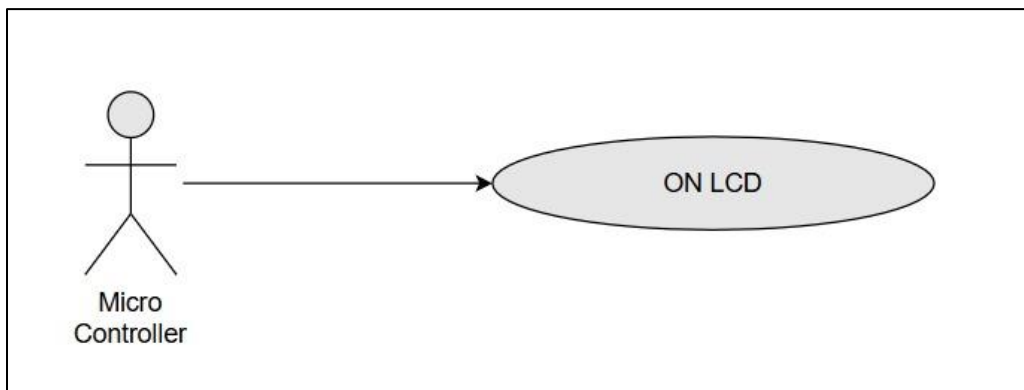
Use case 03	
Use Case Name	Display Alert on LCD
Actor	Arduino Output (LED)
Overview	Visual alerts nearby users of a gas leak.
Pre-Conditions	1.Microcontroller confirms gas leak. 2.LED is connected.
Description	1. Arduino turns on red LED. 2.Continues until gas levels normalize or reset.
Alternative flows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

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.

4.0 NON-FUNCTIONAL REQUIREMENTS

1. Handle False Alarms

The system should be able to distinguish between actual gas leaks and false triggers (e.g., alcohol vapor, cooking fumes)

2. Operate in Power Failure Scenarios

The system shall be able to have a backup battery (9V/18650 Li-ion) to function for at least 1 hour during power outages. Automatically switch to battery power and send an alert if main power is cut.

3. Self-Testing & Diagnostics

The system shall be able to run a self-check on startup (sensor, GSM, buzzer functionality) Log errors (e.g., "GSM not connected") and indicate via LED blink codes.

4. User Customization

The system should be able add/remove phone numbers for alerts without reprogramming Arduino.

5. Wireless Connectivity (Optional)

The system should be able to support Wi-Fi/Bluetooth for remote monitoring via a smartphone app. The system should be able to integrate with home automation systems (e.g., Alexa/Google Home for voice alerts).

4.1 Hardware Requirements

• Arduino Uno R3 ATMeag328p Development Board

• Sim 900 GPRS/GSM Module

• MQ7 Gas Sensor

• Connecting Cable

• 12V Adapter

• 5V 2A AC-DC Adaptor

4.2 Software Requirements

• Arduino IDE 1.8.18

• Programming Language – C Language