



National Teacher College

RESEARCHER:	Evangelista, Mark Angelo R. Zamora, Kurt Armon C. Iglesia, John Paul Z. Ragos, Marc Leo C. Cruz, John Harry V.
Proposed Capstone Title 1:Development of Smart LPG: TinyML-Based Leak Detection and Fire Alert System	

1. Title Proposal Document

1.1. Statement of the Problem

1.1.1 LPG (Liquefied Petroleum Gas) is widely used in residential and commercial settings for cooking and heating. However, LPG leakage poses serious risks, including fire hazards, explosions, and potential loss of life and property. Existing systems rely primarily on fixed-threshold sensors, lacking hybrid SMS/IoT alerts and multi-sensor integration for comprehensive gas and fire detection. The absence of real-time monitoring and automated alert mechanisms increases the likelihood of accidents due to unnoticed gas leaks.

- How can an AI-powered IoT system effectively detect and predict LPG leaks and fire hazards in real time?
- What machine learning techniques can improve gas leak detection beyond fixed-threshold sensors?
- How can TinyML and IoT integration improve safety while maintaining cost efficiency for residential and commercial LPG users?

1.2. Objective

1.2.1. The primary objective of this study is to develop a TinyML-based Smart LPG system that provides early gas leak detection and fire alert notifications. Specifically, this project aims to:

- Implement a gas leak detection system using smart sensors to monitor LPG concentrations in real time.
- Integrate a fire detection feature utilizing multi-sensor technology for enhanced accuracy.
- Deploy real-time alert notifications via SMS alerts for gas leaks, exclusively notifying users. IoT-based alerts (Telegram) to notify fire departments. A local buzzer alarm for immediate hazard awareness.
- Develop a mobile dashboard for real-time monitoring of gas concentration and temperature levels.
- Evaluate the effectiveness of the TinyML-enhanced system in improving gas leak detection and fire prevention.

1.3. Scope and Limitation of the Study

Scope

The Smart LPG TinyML-Based Leak Detection and Fire Alert System is designed for residential homes and small-scale commercial establishments, such as restaurants and hotels. The system integrates TinyML, IoT, and GSM for real-time monitoring and prediction of LPG-related hazards. The functionalities include:

- Gas Leak Detection: The system continuously monitors LPG concentrations and triggers an alert if a threshold is exceeded.
- Fire Detection: The system detects open flames and monitors temperature variations for early fire warnings.
- Real-Time Notifications: Instant SMS Alerts via a GSM module. IoT-based Alerts (Telegram) via Wi-Fi connectivity. Buzzer Alarm for immediate local notifications.

- Mobile Dashboard Monitoring: A real-time monitoring dashboard accessible via mobile devices for tracking gas levels and temperature fluctuations.

Limitations:

Despite its advantages, the system has several technical and operational limitations, which must be considered:

- Limited to Indoor & Small-Scale Use – Designed for homes and small businesses, not industrial gas plants.
- Network Dependency – SMS and IoT notifications require stable cellular or Wi-Fi networks.
- No Automated Gas Shut-Off Mechanism – The system only detects and predicts leaks; users must manually shut off the gas.
- Sensor Accuracy & Environmental Factors – Readings may be affected by humidity, temperature, and ventilation.
- Power Dependency – Requires continuous power; backup solutions like batteries or UPS are recommended.
- Data Privacy & Security Risks – IoT data transmission must be encrypted to prevent cyber threats.
- User Intervention Required – The system notifies users and emergency responders, but human action is needed to prevent hazards.

1.4. Significance:

This study is highly significant in improving LPG safety through AI-powered early leak detection and fire alert mechanisms. The Smart LPG system provides a proactive approach to preventing gas-related hazards, benefiting various groups. Households and tenants who rely on LPG for cooking and heating can experience enhanced safety and reduced fire risks through instant SMS alerts. Small business owners, particularly in the food and hospitality industry, can ensure compliance with LPG safety regulations while protecting their employees and customers.

Emergency responders, such as fire departments, will receive real-time alerts via Telegram notifications, enabling faster incident detection and more efficient emergency responses. Lastly, LPG suppliers and distributors can utilize this system to implement better safety compliance measures, reducing potential liabilities and improving service reliability.

1.5. Target Beneficiaries:

- Homeowners and tenants using LPG for cooking.
- Small business owners like restaurants and food stalls.
- Fire departments and emergency response teams.
- LPG distributors and suppliers for better safety compliance.