Chapter 3
Intelligent Gas Detection Systems:
Leveraging IoT and Machine Learning for Early Warning of Hazardous Gas and LPG Leakage

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ABSTRACT

The chapter explores the integration of internet of things (IoT) and machine learning (ML) algorithms in hazardous gas detection systems, specifically LPG leakage. The gas detection systems industry is undergoing a significant transformation due to technological advancements, innovative sensor technologies, and intelligent solutions. This shift is crucial for safety in residential and industrial environments. The integration of gas sensing technologies with IoT devices has led to real-time monitoring, data analytics, and smart automation. Smart homes and industrial facilities benefit from interconnected gas detection systems that detect anomalies and trigger automated responses. Regulatory bodies are implementing standards to integrate advanced gas detection technologies into the automobile sector, focusing on sensor capabilities, data analytics, and automation integration. This integration will create a safer environment, prioritizing safety in connected living and working spaces. The chapter also discusses real-world case studies using automobiles.

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INTRODUCTION

The ever-increasing demand for energy resources, coupled with the widespread use of liquefied petroleum gas (LPG), has necessitated the development of robust and intelligent gas detection systems. This chapter introduces the concept of Intelligent Gas Detection Systems, emphasizing their pivotal role in enhancing safety and preventing potential hazards associated with the leakage of hazardous gases, particularly LPG. As the consequences of gas leaks can be severe, ranging from environmental pollution to life-threatening situations, the need for advanced technologies to provide early warnings becomes paramount (Baballe & Bello, 2022).

LPG, widely used in residential, commercial, and industrial sectors, poses inherent risks due to its flammable nature. Intelligent gas detection systems can mitigate these risks and safeguard lives and property. Traditional systems often lack timely alerts, necessitating a paradigm shift towards intelligent systems for better response times and incident severity. The paragraph highlights the integration of IoT and Machine Learning technologies in intelligent gas detection systems, enabling real-time monitoring and data collection, and improving detection accuracy, offering a dynamic approach to gas leak prevention (Tang et al., 2020).

It delves into the fundamentals of gas sensing, discussing various types of sensors, their applications, and their working principles, providing insights into gas detection mechanisms. The introduction introduces the chapter, detailing IoT integration in gas detection systems, ML algorithms for gas leak prediction, practical implementation considerations, and real-world case studies. It provides a comprehensive understanding of intelligent gas detection systems. Hazardous gas detection is crucial for preventing potential disasters and promoting safety in various settings, including industrial facilities and residential spaces. It is essential to detect hazardous gases to prevent fires, explosions, and health hazards, ensuring a secure living and working environment (Ha et al., 2020).

The paragraph discusses hazardous gas detection's objectives, including preventing accidents and providing early warnings for evacuation. It emphasizes the need for sensitivity and specificity to minimize false alarms. The evolution of gas detection technologies, including advanced sensors, communication technologies, and data analytics, has transformed it into a proactive field (Khan, 2020).

This summary delves into hazardous gas detection in various industries like manufacturing, petrochemicals, and utilities, emphasizing the significance of regulatory standards in shaping the industry landscape, mitigating risks, and fostering a safety culture, while providing a foundation for understanding hazardous gas detection technologies.

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