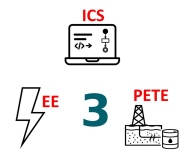


AI-Enabled Methane Leak Detection for Pipelines Using Infrared Spectroscopy

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Introduction

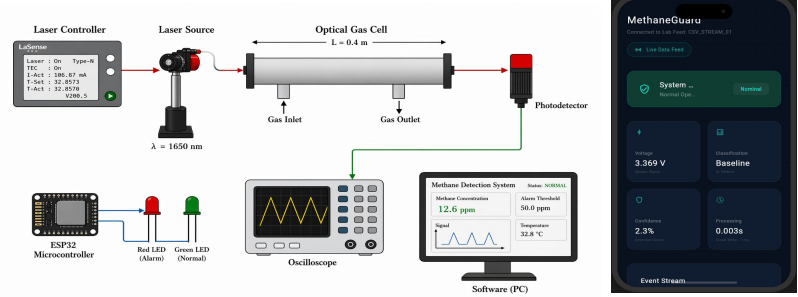
Problem Statement: Methane leaks in pipelines pose serious safety and environmental risks. Methane is about 80x stronger than CO₂ over 20 years and contributes to nearly 30% of global warming, making early leak detection essential.

Proposed Solution: An integrated optical AI monitoring system using infrared sensing provides real-time, high-accuracy leak detection with automated alerting and a dedicated application to ensure rapid industrial response.

Conclusion

The system successfully detected methane leaks using infrared sensing with reliable and fast response. The integration of AI reduced false alarms and improved monitoring performance. The design provides continuous pipeline coverage with lower maintenance compared to traditional sensors.

Prototype Design



Technical Requirements

Specifications	
Alarms triggered at 10% & 25% LEL	
IR Wavelength is 1650 nm	
Fume hood sash is ≤ 50 cm	
Airflow is 0.4-0.6 m/s	App refresh ≤ 2s
Detection and alarm within 60s	
Supports ≥ 20 concurrent users	
API response time ≤ 500ms	
Constraints	
AI model accuracy ≥ 70%	
Distance from leak to sensor ≤ 3 cm	
Total power consumption < 15 W	

Results

Methane leaks were successfully detected
AI improved leak classification and reduced false alarms
Clear voltage drop during methane exposure
Normal conditions showed stable readings

Future Work

- 360° Rotational Ring
- Solar-Powered System
- Leak Localization

Testing & Validation

