

ABSTRACT

Natural gas leaks are a major safety hazard, causing fires, explosions, and methane exposure. With around 125,000 residential gas leak incidents annually in the U.S., early detection is critical. This research develops an IoT-based methane detection system that identifies leaks in real time and instantly alerts both homeowners and emergency services. By combining accurate detection with rapid emergency response, the project aims to enhance residential safety and prevent casualties from gas leaks.

PROBLEM STATEMENT

Persistent Residential Risk: Natural gas leaks pose ongoing dangers, especially in densely populated apartment complexes.

Delayed Emergency Response: Current detection systems lack real-time alerts and automated emergency notifications.

Escalation of Hazards: Without immediate action, leaks can lead to fires, explosions, or harmful methane exposure.

False Alarms: Existing solutions often suffer from either missed detections or frequent false positives.

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SOLUTION

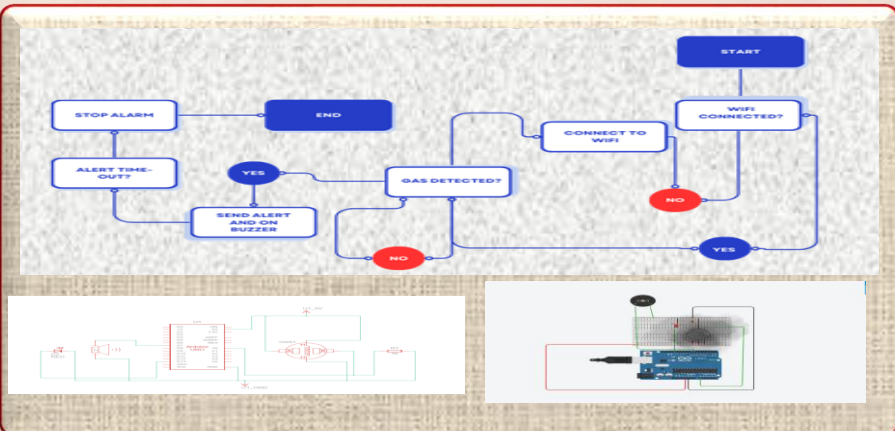
This research proposes an IoT-based methane detection system that leverages strategically placed MQ-4 sensors to detect methane concentrations and transmit signals to a microcontroller upon detection

METHODOLOGY

1. **Sensor Calibration:** MQ-4 sensors are strategically placed and calibrated to accurately detect methane in high-risk areas.
2. **Circuit Design:** Tinker Cad provided the circuit outline, simulations, and parts list for streamlined hardware integration.
3. **Arduino Programming:** The Arduino IDE handles microcontroller logic to read sensor data and initiate alerts.
4. **Alert Mechanism:** A buzzer and LED provide on-site warnings, while Blynk and Twilio enable remote notifications and SMS alerts.
5. **Power Supply:** A 5V lithium-ion battery ensures uninterrupted operation during power outages

IMPACT

1. **Increased Safety:** Early detection dramatically reduces the risk of fires and explosions.
2. **Real-Time Monitoring:** IoT connectivity provides instant alerts, even if residents are away.
3. **Automated Communication:** Automatic notifications to relevant authorities minimize human error.
4. **Scalability:** The same setup can be expanded for larger apartment complexes or different hazardous gases (with appropriate sensors).
5. **Data Logging & Analytics:** Historical data can help identify recurring leaks and improve maintenance planning.



FUTURE WORK

Looking ahead, we plan to expand the system to detect multiple hazardous gases using additional sensors, integrate machine-learning algorithms for more accurate leak prediction, and further refine power management for longer battery life and continuous operation. Additionally, advanced networking features such as edge computing and broader integration with smart home systems will be explored, enabling more robust data analytics, reduced false alarms, and automated safety measures (e.g., shutting off gas supply) to enhance overall residential safety.



REFERENCES

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