Implementation on Real-Time Gas Weight Measurement and Consumption Forecasting Using a Load Cell

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Abstract:
This paper presents the implementation of a smart IoT-based LPG monitoring and leakage detection system using a load cell, HX711 amplifier, ESP32 microcontroller, and MQ-6 gas sensor. The system continuously measures the LPG cylinder weight using a load cell and monitors leakage conditions in real time using the MQ-6 gas sensor. The ESP32 processes the sensor data and transmits it through Wi-Fi for remote monitoring. The measured gas level and system status are displayed locally using an LCD display and can also be viewed remotely through a cloud platform. Whenever gas leakage or low gas conditions are detected, the system generates alerts for the user. The implemented system provides reliable performance, real-time monitoring, improved safety, and user convenience. The developed solution is low-cost, accurate, and suitable for domestic and industrial LPG monitoring applications.

I. INTRODUCTION

Liquefied Petroleum Gas (LPG) is widely used in homes and industries for cooking, heating, and other applications. However, conventional methods of checking gas levels are manual and inaccurate, often leading to unexpected gas depletion. In addition, LPG leakage poses serious safety risks such as fire accidents, explosions, and health hazards. These challenges create the need for a smart and reliable monitoring system.

To overcome these problems, an IoT-based real-time LPG monitoring and leakage detection system has been implemented using a Load Cell, HX711 amplifier, ESP32 microcontroller, MQ-6 gas sensor, and LCD display. The load cell measures the cylinder weight continuously, while the MQ-6 sensor detects gas leakage. The ESP32 processes sensor data and enables wireless communication through Wi-Fi for remote monitoring.

The system provides real-time gas status monitoring, local display output, and alert generation during low gas or leakage conditions. The implemented solution is low-cost, reliable, and suitable for improving safety, convenience, and efficient LPG usage in domestic and industrial environments

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II. REVIEW OF LITERATURE

Several researchers have contributed to the development of smart LPG monitoring and safety systems using IoT, embedded systems, and sensor technologies. Their research mainly focuses on gas leakage detection, cylinder weight monitoring, remote alerts, cloud communication, and automated safety mechanisms.
Ayodeji Okubanjo and Okakwue et al. proposed an IoT-based smart LPG cylinder monitoring system to improve safety and user convenience. Their system utilized sensors for real-time gas level measurement and leakage detection. A mobile application was integrated for remote monitoring, refill notifications, and alert generation during low gas or leakage conditions. The proposed system was suitable for smart home applications due to its compact and cost-effective design [1].

V. Elumalai and M. Sowmya et al. developed an IoT-based LPG monitoring and hazard prevention system using a gas sensor, load cell with HX711 amplifier, temperature sensor, Arduino UNO, and NodeMCU. Their system provided real-time gas status updates through an LCD display and mobile application. Automatic

safety mechanisms such as gas regulator shutdown and user alerts were included to reduce hazardous situations [2].

Asher Sumith and Jeevan P. et al. proposed a smart LPG monitoring system that combined gas leakage detection and weight-based gas consumption tracking. The system employed an MQ gas sensor for leakage detection and a load cell with HX711 amplifier for weight measurement. It generated warning alerts, activated a buzzer and exhaust fan, and provided notifications to users for improved domestic and industrial safety [3].
Sudip Chakraborty and P. S. Aithal et al. introduced a smart LPG leakage monitoring and control system using MQ-series sensors, ESP modules, and cloud technology. Their system rapidly detected leakage conditions, generated user alerts, and executed automatic control operations to minimize safety risks. The integration of IoT cloud services enhanced remote accessibility and monitoring efficiency [4].

Nishant Kothari and Dennis Balogun et al. developed "LPG Smart Guard," an IoT-based smart home solution for real-time LPG cylinder monitoring and safety enhancement. The system integrated gas sensors, environmental sensors, and load cell modules to provide continuous monitoring, leakage alerts, refill notifications, and cloud-based status visualization [5].
V. Praveen Sharma and V. Padmavathi et al. proposed an IoT-based gas leakage detection system using Arduino UNO, MQ-2 gas sensor, GPS module, and smoke sensor. The system transmitted real-time alerts through internet connectivity and allowed users to access live monitoring data through web or mobile interfaces. The inclusion of GPS and smoke sensing improved emergency response and safety monitoring capabilities [6].

Prof. V. M. Umale and Kalyani Bhagwat et al. developed an IoT-based LPG monitoring and leakage detection system using Arduino UNO, load cell, MQ-2 gas sensor, HX711 module, LCD display, and LoRa communication. The system continuously monitored gas levels, estimated remaining usage duration, and generated instant notifications during leakage conditions. The design emphasized long-distance communication and user convenience [7].

M. Abhishek and G. Surendar et al. proposed a smart LPG monitoring and prediction system using NodeMCU, MQ-6 gas sensor, and load sensors integrated with mobile applications and cloud services. Their work focused on real-time gas level monitoring, leakage detection, refill notification, and gas usage analysis. Data analytics techniques were used to improve prediction and monitoring accuracy [8].

Zaw Lin Oo and Aung Moe et al. designed an IoT-based LPG monitoring and accident prevention system using a load cell, HX711 amplifier, MQ-6 gas sensor, and cloud communication platform. The system generated SMS alerts during low gas or leakage conditions and activated safety mechanisms such as alarms and exhaust fans. The model was designed as a practical and affordable solution for household LPG safety [9].

Mr. K. RadhaKrishna and S. Rajesh et al. proposed a load cell-based gas monitoring system using Arduino UNO, MQ-3 gas sensor, GSM module, and LCD display. Their system continuously measured cylinder weight, detected gas leakage, and automatically transmitted warning messages to users. The proposed solution reduced manual monitoring efforts and improved operational safety in household and industrial environments [10]

III. METHODOLOGY

The implemented system is designed to monitor LPG cylinder weight and detect gas leakage using IoT and sensor technologies. A Load Cell placed beneath the cylinder continuously measures its weight. The generated analog signal is amplified and converted into digital data using the HX711 amplifier module.
The processed data is received by the ESP32 microcontroller, which acts as the central controller of the system. An MQ-6 gas sensor is used to detect LPG leakage by continuously monitoring gas concentration in the surrounding environment. When leakage or low gas conditions are detected, the system generates alerts.
The measured data is displayed on a 16×2 LCD display for local monitoring and is also transmitted through

the ESP32's built-in **Wi-Fi module** for remote access. The system operates continuously in real time, providing accurate gas monitoring, leakage detection, improved safety, and user convenience.

IV. COMPARATIVE ANALYSIS

Study	Technology Used	Focus Area	Accuracy	Scalability
N. Kothari & D. Balogun et al. (2024)	NodeMCU, Load Cell, MQ135, DHT22, Cloud App	Real-time LPG monitoring and smart home safety	89%	High
V. P. Sharma & V. Padmavathi et al. (2023)	Arduino UNO, MQ-2 Sensor, GPS, Smoke Sensor	Gas leakage detection and emergency alert system	86%	Moderate
V. M. Umale & K. Bhagwat et al. (2023)	Arduino UNO, Load Cell, MQ-2, LoRa Module	LPG level monitoring and long-range alert communication	88%	High
M. Abhishek & G. Surendar et al. (2022)	NodeMCU, MQ-6 Sensor, Load Sensor, Firebase	Gas monitoring and usage prediction system	90%	Very High

V. RESULTS

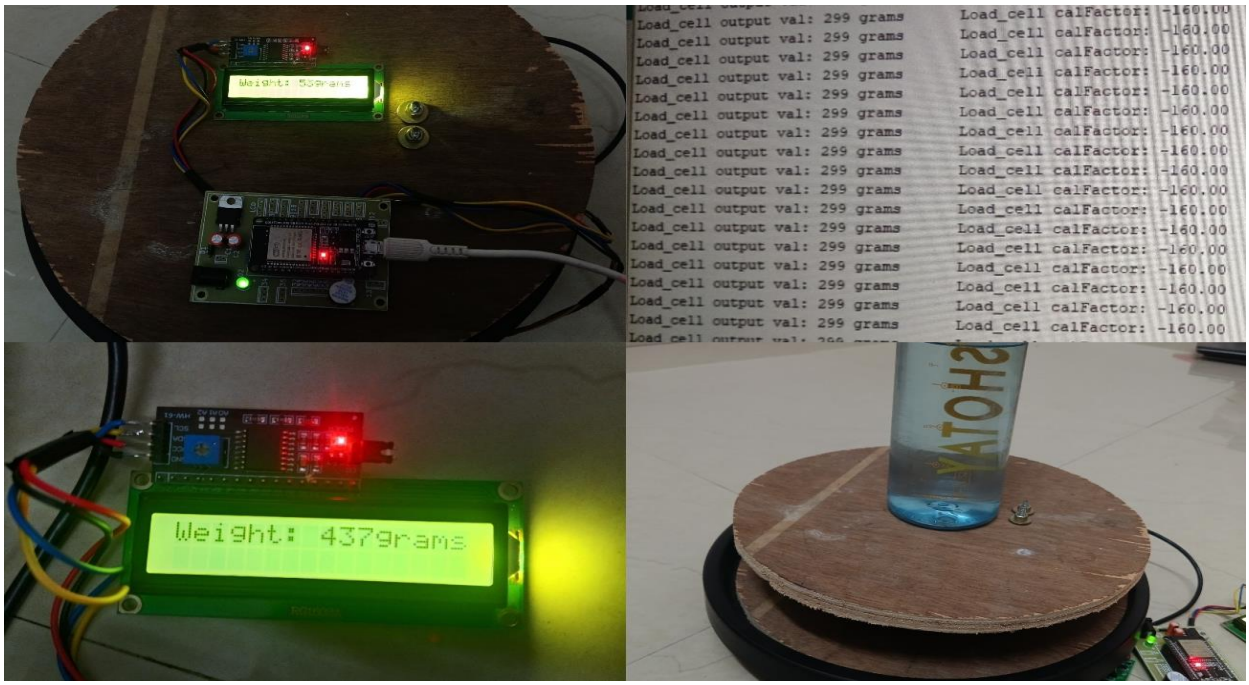

Fig 1: Implementation of the project

VI. CONCLUSION

The implemented system successfully provides real-time LPG cylinder weight monitoring and gas leakage detection using a Load Cell, HX711 amplifier, ESP32 microcontroller, and MQ-6 gas sensor. The system enables continuous monitoring, local display output, and remote access through Wi-Fi communication. It improves safety, reduces manual monitoring efforts, and helps users manage LPG usage efficiently. The developed solution is cost-effective, reliable, and suitable for domestic as well as industrial applications.

REFERENCES:

[1] A. Okubanjo and O. Okakwue, "IoT-Based Smart LPG Cylinder Monitoring System for Safety and Convenience," Sigma Journal of Engineering and Natural Sciences, vol. 43, no. 3, pp. 962–980. [2025]

[2] V. Elumalai and M. Sowmya, "IoT-Based Digital LPG Gas Cylinder to Prevent Hazards with Blynk

Application Features," Kronika Journal, vol. 25, issue 6. [2025]
[3] A. Sumith and J. P., "Real-Time Detection and Alerting System for LPG Gas Leakage with Weight-Based Consumption Tracking," International Journal for Multidisciplinary Research (IJFMR), vol. 7, issue 2, pp. 1–7. [2025]
[4] S. Chakraborty and P. S. Aithal, "Smart LPG Leakage Monitoring and Control System Using Gas Sensor (MQ-X), AWS IoT, and ESP Module," International Journal of Applied Engineering and Management Letters (IJAEML), vol. 8, no. 1, pp. 101–109. [2024]
[5] N. Kothari and D. Balogun, "LPG Smart Guard: An IoT-Based Solution for Real-Time Gas Cylinder Monitoring and Safety in Smart Homes," Engineering Proceedings, vol. 82, no. 9. [2024]
[6] V. P. Sharma and V. Padmavathi, "IoT-Based Gas Leakage Detection System Using GPS and Smoke Sensor," E3S Web of Conferences, vol. 391, 01064. [2023]
[7] V. M. Umale and K. Bhagwat, "Smart LPG Gas Level Monitoring and Leakage Detection System Using IoT," SSGM Journal of Science and Engineering, vol. 1, issue 1, pp. 156–160. [2023]
[8] M. Abhishek and G. Surendar, "Estimation and Prediction of LPG Gas Using Data Analytics," International Journal of Engineering Research & Technology (IJERT), vol. 10, issue 8, pp. 211–215, [2022]
[9] Z. L. Oo and A. Moe, "IoT-Based LPG Gas Level Detection & Gas Leakage Accident Prevention with Alert System," Balkan Journal of Electrical & Computer Engineering, vol. 9, no. 4, pp. 404–409. [2021]
[10] K. Radhakrishna and S. Rajesh, "Load Cell-Based Gas Monitoring System," Mukt Shabd Journal, vol. 10, issue 1, pp. 917–921. [2021]
[11] L. Chandak, A. Kolhe, and S. Kurumbanshi, "IoT-Based LPG Cylinder Monitoring System," International Journal of Innovative Research in Electronics and Communications, vol. 7, issue 2, pp. 1–7. [2020]
[12] J. Gupta and T. Kadus, "Smart LPG Monitoring and Automatic Booking System Using IoT," International Journal of Engineering Research & Technology (IJERT), vol. 9, issue 4, pp. 404–407. [2020]
[13] A. Ahsan and R. Siddiqua, "An IoT-Based Interactive LPG Cylinder Monitoring System with Sensor Node-Based Safety Protocol for Developing Countries," IEEE Region 10 Symposium (TENSYMP), Dhaka, Bangladesh, pp. 398–401, [2020]
[14] M. Kakden and P. Ninave, "Embedded-Based LPG Gas Monitoring & Automatic Cylinder Booking with Alert System," IJSRSET, vol. 4, issue 7, pp. 302–306, [2018]
[15] . R. N. Naik and S. N. Kishore, "Arduino-Based LPG Gas Monitoring and Automatic Cylinder Booking with Alert System," IOSR Journal of Electronics and Communication Engineering, vol. 11, issue 4, pp. 6–12. [2016]