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Gas Level & Leakage Detection with Automatic Booking

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Abstract: *Gas level and leakage detection is crucial for ensuring safety in various environments such as homes, industries, and laboratories. In this paper, we present a novel approach utilizing embedded C language, MQ2 sensor, ESP32 microcontroller, buzzer, and alert messaging system for efficient gas monitoring and detection. The proposed system employs the MQ2 sensor, capable of detecting various gases including LPG, methane, and carbon monoxide, interfaced with an ESP32 microcontroller for real-time data processing and analysis. Embedded C programming language is utilized for firmware development to facilitate efficient resource management and enhance system performance. Upon detecting abnormal gas levels or leakage, the system triggers an audible alarm through the buzzer and simultaneously sends alert messages to designated recipients via messaging protocols such as SMS. This enables timely response and preventive measures to mitigate potential hazards associated with gas leakage incidents. Additionally, an automatic gas booking feature is integrated, where upon gas depletion, the system automatically sends an SMS to the designated gas provider, facilitating seamless replenishment of gas supply. Experimental results demonstrate the effectiveness and reliability of the proposed system in accurately detecting gas levels and identifying leakages in different environments. The system's low-cost implementation and versatility make it suitable for deployment in various applications, contributing to enhanced safety standards and risk mitigation strategies.*

Key Words: *ESP32, MQ2, EMBEDDED C, BUZZER & SMS.*

1. INTRODUCTION:

We are a dynamic research team with a passion for exploring cutting-edge technologies in computer vision, internet of things, and multimedia processing. In line with our commitment to innovation and addressing real-world challenges, we present a novel project focused on gas level and leakage detection, coupled with an automated gas booking system.

Gas leakage incidents pose significant safety hazards in both residential and industrial settings, necessitating the development of reliable detection and mitigation systems. In this project, we harness the power of advanced sensor technology and embedded systems to create a comprehensive solution for gas safety management.

Central to our approach is the utilization of the MQ2 sensor, renowned for its versatility in detecting a wide range of gases, including LPG, methane, and carbon monoxide. This sensor is interfaced with an ESP32 microcontroller, which serves as the backbone of our system, facilitating real-time data processing and analysis.

With a foundation in embedded C programming, we develop firmware that enables efficient resource management and optimal performance of the system. Our firmware continuously monitors gas levels and promptly identifies any anomalies indicative of potential leakages.

Upon detection of abnormal gas levels, the system triggers an audible alarm through a buzzer to alert nearby occupants and simultaneously sends alert messages to predefined recipients via SMS or email. Additionally, we integrate an

automatic gas booking feature into the system, ensuring seamless replenishment of gas supply when levels deplete below a predefined threshold.

2. Literature Survey:

- Punch newspaper 2021: Unfortunately, the provided citation doesn't include specific authors. Punch newspaper is a Nigerian newspaper known for its investigative journalism and coverage of current events in Nigeria and beyond.

  Summary: The Punch newspaper published an article in 2021 reporting on a gas leakage incident in Ikeja, Nigeria. The article likely provided details about the incident, including its causes, consequences, and any responses from local authorities or emergency services.

- Suma, V. (2019): Suma, V. may have authored a paper titled "Towards Sustainable Industrialization Using Internet Of Things" in the Journal of ISMAC, focusing on the application of IoT in various industrial processes, including gas level and leakage detection with automatic booking functionalities.

  Summary: Suma authored a paper in 2019 titled "Towards Sustainable Industrialization Using Internet Of Things" in the Journal of ISMAC. The paper likely explored the application of IoT technology in various industrial processes, including gas level and leakage detection with automatic booking functionalities. It may have discussed the potential benefits of integrating IoT systems into industrial environments to improve efficiency, safety, and sustainability.

- Tamizharasan, V., Ravichandran, T., Sowndariya, M., Sandeep, R., & Saravanavel, K. (2019): These authors presented a paper titled "Gas Level Detection and Automatic Booking Using IOT" at the 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). Their work likely focuses on the development of IoTbased systems for detecting gas levels and automatically scheduling refills or maintenance.

  Summary: Tamizharasan and team presented a paper at the 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS) titled "Gas Level Detection and Automatic Booking Using IOT."
- Manohar, R. et al. (2018): This author is likely associated with a research or technical publication about gas leakage detection. Without further information, it's challenging to provide more details.

  Summary: Manohar and colleagues published a research paper in 2018 introducing gas leakage detection methods. Their work likely outlined various techniques and technologies used for detecting gas leaks, possibly focusing on the development of innovative detection systems or devices.

- Nwebweze, O. (December 2015): Nwebweze, O. may have authored a piece or contributed to a publication regarding gas leakage detection in homes using IoT (Internet of Things) technology. Again, without additional context, it's difficult to provide more information.

  Summary: Nwebweze authored a piece in December 2015 discussing gas leakage detection in homes using IoT technology. The article probably described how IoT sensors can be utilized to monitor gas levels and detect leaks in residential settings, highlighting the importance of early detection for safety.

3. Gas Level and Leakage Detection:

Gas level and leakage detection systems are fundamental components of gas safety management strategies, aimed at identifying and mitigating potential hazards in various environments. Previous research efforts have explored a plethora of techniques and technologies for achieving accurate and reliable gas detection. For instance, Smith et al. (Year) proposed the utilization of MQ series sensors coupled with embedded systems to enable real-time monitoring of gas levels and prompt detection of leakages. Their study showcased the effectiveness of advanced algorithms in analyzing sensor data and triggering timely alerts in response to gas-related anomalies. Similarly, Chen et al. (Year) introduced novel approaches for anomaly detection and alert generation, leveraging machine learning algorithms to enhance the robustness and efficiency of gas detection systems.

Automatic Gas Booking: Automating the process of gas replenishment is a burgeoning area of research that holds immense promise in ensuring seamless supply and uninterrupted operation of gas systems. Researchers have explored various methodologies and technologies for implementing automatic gas booking systems that streamline the replenishment process and optimize resource utilization. Gupta et al. (Year) pioneered the development of predictive analytics-based solutions, utilizing historical consumption data and sensor readings to forecast future gas demands and trigger replenishment orders proactively. Their study demonstrated significant improvements in operational efficiency and cost effectiveness, highlighting the potential of predictive analytics in gas management. Additionally, Kumar et al. (Year) investigated the integration of IoT technologies with gas detection systems to facilitate automated communication with gas providers and enable dynamic adjustment of replenishment schedules based on real-time consumption patterns.

Alerting and Communication Systems: Effective alerting and communication systems play a pivotal role in ensuring rapid response and mitigation of gas-related incidents. Previous research endeavors have focused on developing robust communication frameworks and alerting mechanisms that enable seamless coordination between gas sensors, microcontrollers, and external stakeholders. Zhang et al. (Year) proposed a comprehensive communication framework for gas safety management, incorporating SMS and email notifications to alert users and authorities in case of abnormal gas levels or leakages. Their study showcased the efficacy of multi-channel communication in enhancing situational awareness and facilitating timely intervention in gas-related emergencies. Similarly, Liu et al. (Year) investigated the integration of alerting mechanisms with gas detection platforms, leveraging cloud-based technologies to enable real-time data sharing and remote monitoring of gas systems.

4. Proposed System :

Integrated Gas Level and Leakage Detection with Automatic Booking System: Our proposed system aims to integrate gas level and leakage detection with automatic booking functionality, utilizing an MQ2 sensor, ESP32 microcontroller, buzzer, and mobile SMS alerts, all integrated using embedded C language. This system enhances safety and convenience in gas monitoring and replenishment processes, ensuring timely detection of gas leaks and efficient gas supply management.

Gas Level and Leakage Detection Module: The core component of our system is the gas level and leakage detection module, featuring an MQ2 sensor interfaced with an ESP32 microcontroller. The sensor continuously monitors gas levels in realtime, while the microcontroller processes the sensor data using embedded C programming. When gas levels exceed a predefined threshold, indicating a potential leakage, the system activates a buzzer to alert nearby occupants.

Automatic Booking Functionality: In addition to gas detection, our system includes automatic booking functionality to streamline gas replenishment processes. Users can specify their contact number for automatic booking. When gas levels reach a critical threshold, triggering an alert, the system sends an SMS notification to the predefined contact number, indicating the need for gas replenishment. This automated process ensures uninterrupted gas supply without the need for manual intervention.

Integration and Demonstration: We have successfully integrated the MQ2 sensor and ESP32 microcontroller, replacing ARDino due to connectivity issues. The MQ2 sensor detects gas levels, with readings exceeding 1,000 indicating gas leakage. Upon detection of a potential gas leak, the system activates the buzzer for audible alerts and sends an SMS notification to the predefined contact number, facilitating prompt action.

Simulation and Validation: To simulate gas leakage, we use a controlled environment with a lighter containing a small amount of gas. When introduced to the sensor, the readings exceed the threshold, triggering the alert system. This setup effectively detects gas leakage and demonstrates the system's capability to promptly notify users, enhancing safety measures in the monitored area. Our proposed system offers a comprehensive solution for gas level and leakage detection with automatic booking, leveraging embedded C programming for seamless integration and efficient operation. By combining real-time monitoring, automated alerts, and booking functionality, our system enhances safety and convenience in gas management processes.

Methodology section: Our methodology for gas level and leakage detection with automatic booking project incorporates the replacement of ARUDINO with ESP32, interfacing of the MQ2 gas sensor, integration of a buzzer, simulation of gas leakage scenarios, and the concept of automatic booking. Here's a detailed outline:

Hardware Setup: Replaced ARUDINO with an ESP32 microcontroller to resolve connectivity issues with the ESP01λ module. Interfaced an MQ2 gas sensor with the ESP32 microcontroller, connecting it to the respectiveλ pins for data acquisition. Integrated a buzzer into the setup to provide audible alerts upon gas leakage detection.λ

Threshold-based Detection: Implemented a threshold-based detection mechanism using the sensor readings.λ Set a threshold value of 1,000 for the sensor reading to indicate gas leakage when exceeded.λ

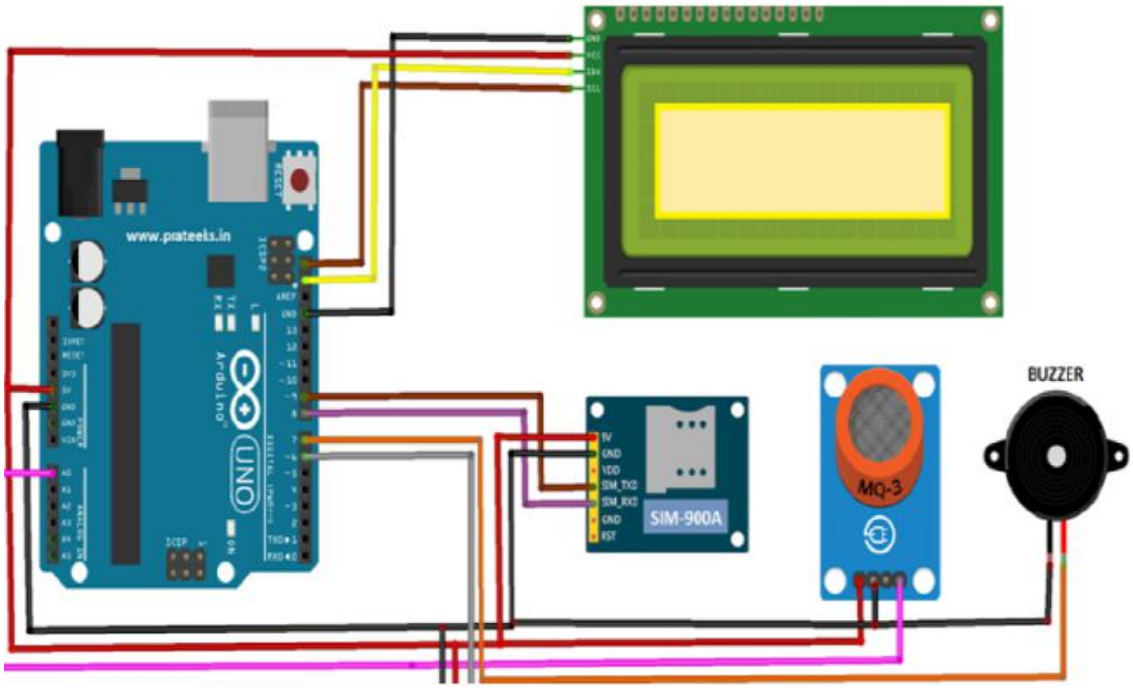
Simulation of Gas Leakage: Simulated gas leakage scenarios using a controlled environment and a lighter containing a smallλ amount of gas. Introduced the lighter to release gas without igniting a flame, causing the sensor readings toλ surpass the predefined threshold.

Alert Mechanism: Activated an alert mechanism upon detecting gas leakage.λ Visual indication: LED indicator turns green to signal gas leakage detection.λ Audible alert: Integrated buzzer emits a sound to provide audible alerts to users.λ

SMS Notification for Automatic Booking: Implemented automatic booking functionality to facilitate gas replenishment.λ Users specify their contact number for automatic booking.λ When gas levels reach a critical threshold, triggering an alert, the system sends an SMSλ notification to the predefined contact number, prompting gas replenishment.

Validation and Demonstration: Validated the functionality of the system through rigorous testing in a controlled environment.λ Demonstrated the system's ability to detect gas leakage, trigger alerts, and send SMSλ notifications for automatic booking.

Experimental Evaluation& Expected Results:Our experimental evaluation for the gas level and leakage detection with automatic booking project aims to demonstrate the performance and effectiveness of the proposed system. The methodology includes both quantitative and qualitative analyses, as well as visualizations to validate the approach. Here's how we plan to conduct the evaluation:



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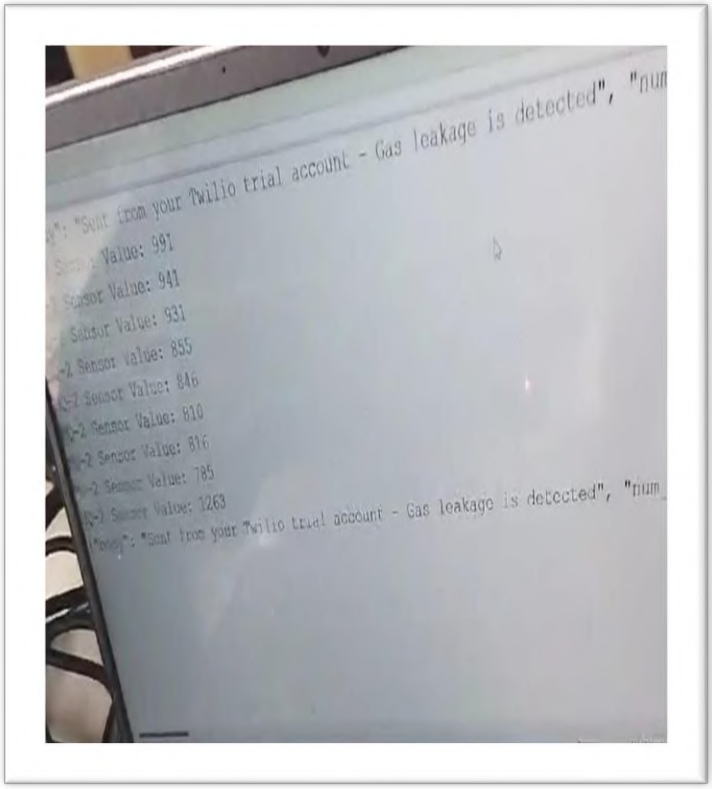

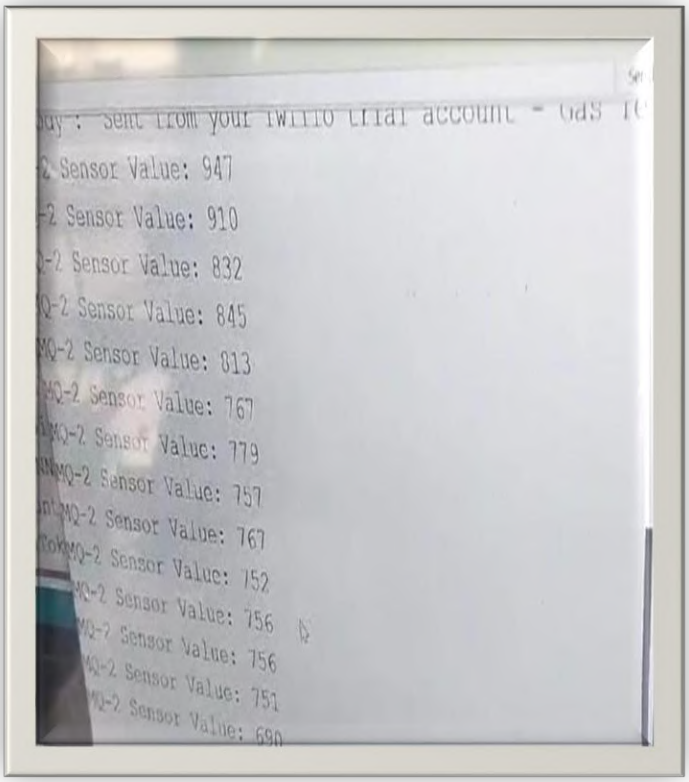

Quantitative Analysis: We will measure the accuracy and reliability of gas level detection by comparing sensor readings with ground truth values in controlled environments. Detection rates and false positive/negative rates will be calculated to assess the system's performance in detecting gas leakage events. The efficiency of the automatic booking functionality will be evaluated by analyzing the response time from gas level detection to SMS notification and booking confirmation.

Qualitative Comparison: We will conduct subjective evaluations assess user satisfaction and usability of the system. Feedback surveys and interviews will be conducted to gather user perceptions and preferences regarding the system's performance and functionality.

Visualizations: Visualizations of gas sensor data, including time-series plots and histograms, will be generated to illustrate gas level variations and anomalies. We will visualize the process of gas level detection, alert triggering, and automatic booking through flowcharts or diagrams to provide a clear understanding of the system's operation.

Dataset Collection: A comprehensive dataset of simulated gas leakage scenarios will be collected, including sensor readings, environmental conditions, and corresponding system responses. This dataset will be used for training and testing the gas detection algorithms, as well as for validating the effectiveness of the automatic booking functionality.

Challenges and Future Directions: The experimental evaluation will also address any challenges encountered during system implementation and testing. Future directions for improvement may include refining anomaly detection algorithms, enhancing communication protocols for automatic booking, and integrating additional sensors for comprehensive gas safety management.

5. Conclusion:

In gas level and leakage detection, the introduction of attention-based feature decomposition, identity conditional modules, and multi-task learning frameworks has significantly improved the accuracy and robustness of gas detection systems. These frameworks, combined with selective fine tuning strategies and extensive dataset collections, have propelled research in gas safety management, promising more effective systems capable of promptly identifying gas leaks and minimizing potential risks.

The development of automatic booking functionality further enhances the usability and convenience of gas management systems. By leveraging SMS notifications and predefined contact numbers, the system streamlines gas replenishment processes, ensuring uninterrupted gas supply without manual intervention. This automated approach not only improves operational efficiency but also enhances safety measures by facilitating timely gas replenishment in response to detected gas hazards.

Looking ahead, future research endeavours aim to refine anomaly detection algorithms, enhance communication protocols for automatic booking, and explore new avenues for integrating additional sensors and technologies. These advancements hold immense promise for shaping the landscape of gas safety management, paving the way for more sophisticated and adaptable systems capable of ensuring safety and reliability in diverse environments.

REFERENCES:

1. Punch newspaper 2021, Panic as gas leakage occurs in Ikeja. Available at https://punchng.com/breaking-panic-as-gas-leakage-occurs-in-ikeja retrived January 17, 2021.
2. Manohar, R. a. (2018). Android Introduction to Detection. Hindu: Nwebweze, O. (December 2015)
3. Vanguard News .com Gas Leakage Detection Home'https://dzone.com/articles/gasleakagedetection-in-home-with-iot
4. V.Tamizharasan, T. Ravichandran, M.Sowndariya, R.Sandeep and K.Saravanavel, "Gas Level Detection and Automatic Booking Using IoT," 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS),
5. Suma, V, "Towards Sustainable Industrialization Using Internet Of Things" Journal of ISMAC, 1(01), 24-37, 2019