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LPG GAS LEAKEAGE DETECTION AND MONITORING SYSTEM

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Abstract: This paper presents the design and implementation of an integrated multifunctional system using an Arduino microcontroller. The system integrates load cell, gas sensor, buzzer, OLED display, 12V DC fan, servo motor for a complete solution for environmental monitoring and responsive operation The main goal is to create a system that more work for real-time data acquisition, processing and appropriate response action capabilities does so.

The load cell is used to measure loads, providing critical data for applications that require precise load control. The gas sensor is designed to detect the presence of hazardous gases, keeping the environment safe. Data from these sensors are sent to the Arduino, which processes the information and triggers the necessary responses. When a certain limit is exceeded, the system activates a buzzer to alert users to potential hazards. Real-time data from the sensors are also displayed on the OLED screen, giving users an immediate visual picture of the monitored parameters.

In addition to power monitoring, the system has a 12V DC fan and a servo motor, both controlled by an Arduino. A 12V DC fan is used for ventilation, and automatically activates when the gas sensor detects harmful gases, thus helping to reduce potential hazards The servo motor is used for controlling machinery, such as air conditioners or other control devices based on sensor data. This combination ensures a robust response to the changing environment.

Overall, this Arduino-based system exhibits a robust environmental monitoring and automation system. The modular design allows for easy expansion and customization, making it suitable for a wide range of applications. The paper details the design, components, and operational performance of the system, and provides insights into design considerations and practical implementation challenges The results show the real-time effectiveness of the system research and practice in practice, and emphasizes the potential for widespread application across sectors.

Keywords: Arduino microcontroller, Environmental monitoring, Load cell, Gas sensor, Real-time data acquisition, Responsive actuation, Automation, Safety monitoring.

I. INTRODUCTION

Liquefied Petroleum Gas (LPG) is a widely used fuel in residential, commercial and industrial situations due to its high efficiency and relatively cheap LPG despite its advantages poses a high risk of not being consumed proper use of, especially due to its high flammability and the possibility of explosion or fire if moisture therefore, ensuring safe handling of LPG is of utmost importance.

Traditional LPG leak detection methods rely on manual inspection and basic sensors, which are generally inadequate in accident prevention. Advances in sensor technology solutions have opened up new possibilities for enhancing safety measures against LPG leaks.

II. LITERATURE PAPER

[1]: (Luay Fraiwan, et al., (2011)) proposed “Wireless Home Safety Gas Leakage Detection System”. This method has the design built with detection and transmission modules for gas concentration in household devices like Gas and heaters. From this paper, we learn that depending on the sensor values showing the variation in the gas concentration measurements and audiovisual alarms were activated.

[2]. (Rahul Verma and et al., (2013)) proposed “GSM Based Gas Leakage Detection System”. This system continuously monitor leakage level of LPG gas by using MQ6 sensor. If the gas level increase beyond threshold value then this system turn on the alarm, sends SMS to the user by GSM module and turn of the main power supply.

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The servo library is introduced after the application is developed by creating a string variable that contains the unique device ID for the lock. The essential concept underlying the door lock's operation is the ID supplied by the Android phone via the created app.

[3] (R. Naresh Naik, et al., (2016)) proposed "Arduino Based LPG gas Monitoring and Automatic Cylinder Booking with Alert System". This system continuously monitors LPG gas leakage by MQ4 sensor and room temperature by LM-35 sensor. If the sensor value increase beyond threshold value the system alert user by sending SMS by GSM module, turn on the alarm, and open the room window and door by DC motor. In addition, load cell sensor monitor weight of the cylinder. If the weight is less than specific value, the system sends booking SMS to the LPG agent. Areed and Marwa F. has proposed "A Keyless Entry System Based on Arduino Board with Wi-Fi module, and the PHP programming language to provide access to a closed door.

[4] (Kumar Keshamoni, et al., 2017)) proposed "Smart Gas Leakage Monitoring Booking and Gas Leakage Detector over IoT". This System identifies the emptiness of GAS container by creating awareness to the user, with the continuous weight measurement of the container integrated with the principle of piezo electric sensor which is

[5]. (Samruddhi Bhor, Omkar Domb, Rutuja Ganage, Hrushikesh Pathade, Shilpa Khedkar) has proposed "Automated Bird Species Identification using Audio Signal Processing and Neural Network". interfaced with a microcontroller. The system is designed with an MQ-2(gas sensor) and LM-35 (temperature sensor), which will detect the surrounding environment for any chance of error.

[6]. (Adigun J. Oyeranmi , Oloyede A. Olamid, Oluwatoyin Akinade, Adetokunbo Oloyede) has proposed "Gas Leakage Detector and Monitoring System (2021)" In this paper they have used MQ2 sensor interfacing with Arduino is implemented in this project they have uploaded to cloud. It is limited to find gas leakage. But we are monitoring the gas level and uploading on o-led.

III. METHODOLOGY

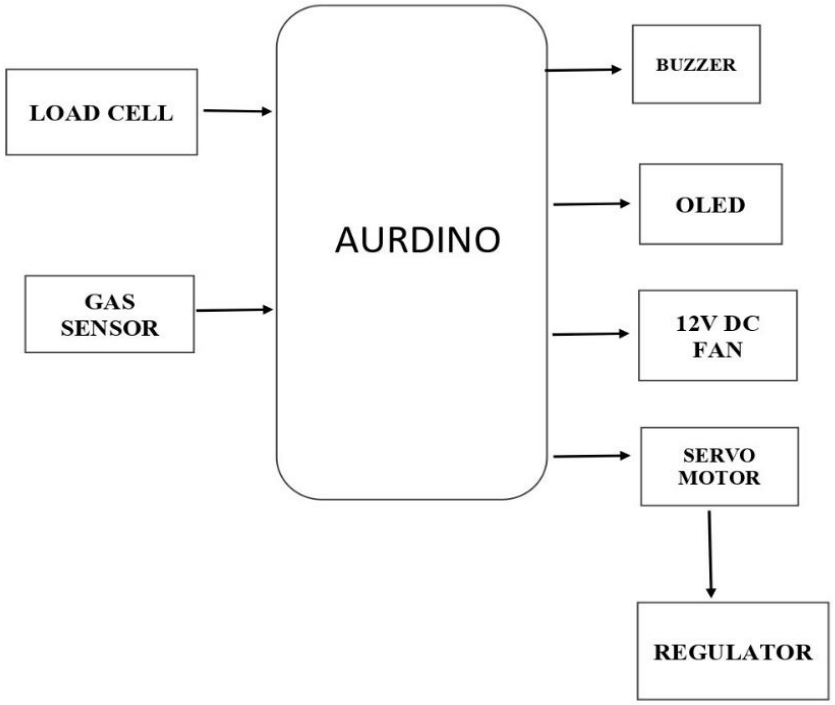

Fig 1: BLOCK DIAGRAM

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The design of an integrated multifunctional system begins with the selection of appropriate components, with Arduino microcontroller, load cell, gas sensor, buzzer, OLED display, 12V DC fan, servo motor Each component is selected for its compatibility and for the specific functions of the system.

The load cell and gas sensor are connected to the Arduino's analog input pins, while the buzzer, OLED display, fan, and servo motor are connected to the digital output pins The voltage regulator ensures stable power. The circuit design simulates these interactions to facilitate proper communication and interaction between the components and the Arduino.

The Arduino is programmed to perform several tasks through the Arduino IDE: read and process data from the load cell, monitor gas levels, compare against preset thresholds and based on sensor data the Arduino triggers a buzzer operates the fan, and controls the servo motor. Real-time data is displayed on the OLED screen for the user to see. For the load cell, calibration is done with a known weight and a controlled amount of gas in the gas sensor to ensure accurate readings. The system is tested under various conditions to ensure functionality, responsiveness and reliability. Data logging features are used to record sensor data and system responses, which are analyzed and necessary adjustments are made to verify the accuracy of the operation. Detailed documentation of design schemes, circuit diagrams, design codes, calibration procedures, and test results ensures reproducibility and serves as a model for future development.

IV. WORKING

The multifunctional integrated system is designed to operate through an Arduino microcontroller, which controls the communication between the sensors and the output devices Core Functionality The sensor data acquisition system is initiated. A load device measures the weight of an object placed on it and converts this weight into an electrical signal. This signal is sent to the Arduino, which processes it to determine the actual load. At the same time, the gas sensor monitors the environment for specific gases, producing an analog signal that corresponds to the detected gas concentration. This signal is also sent to the Arduino for manipulation and analysis.

During the data processing phase the Arduino uses its analog-to-digital converter (ADC) to convert the analog signals from the load cell and gas sensor to digital values the weight measured by the load cell and the amount of gas detected by the gas sensor. The Arduino satisfies these criteria to make real-time decisions based on sensor data. For example, if the amount of gas exceeds a set threshold, the Arduino recognizes this as a potential problem and initiates an appropriate response.

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V. FLOWCHART

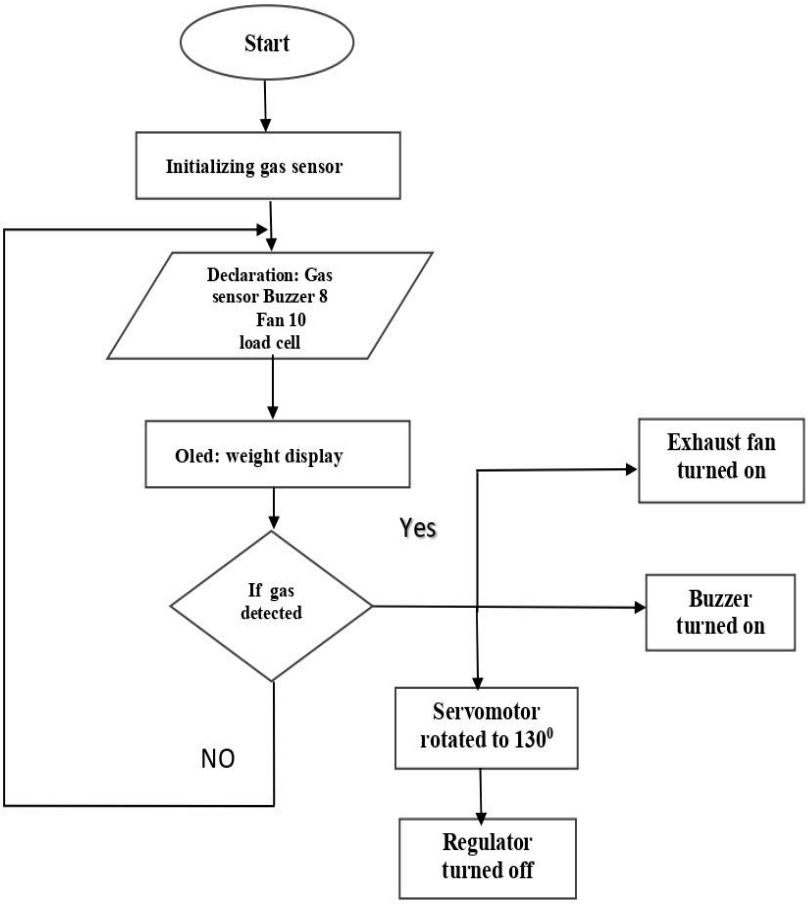

Fig 2: FLOWCHART

VI. RESULT

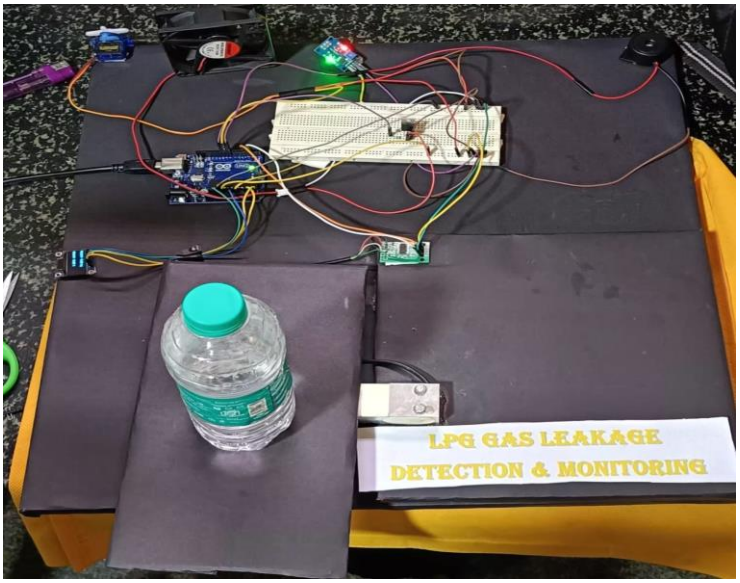

Fig 3: RESULT PICTURE

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VII. APPLICATION

1. Residential units: Protecting homes from possible fuel leaks in kitchens, water heaters, or other LPG-powered appliances.

2. Commercial premises: To ensure safety in restaurants, hotels, and other establishments where LPG powers cooking equipment or heating systems.

3. Facilities: Inspect LPG pipelines, tanks and fixtures to prevent leaks that could cause accidents or disruption of operations.

4. Petrol stations: LPG storage and distribution systems are protected from leakage during refueling operations.

5. Logistics: Inspection of LPG tankers and vehicles carrying LPG to ensure safety during loading and loading/unloading.

6. Laboratories: Ensure safe use of LPG in research and technical laboratories where it is used as fuel or solvent.

7. Agricultural applications: LPG-powered equipment and systems used in agriculture, such as crop dryers or generating machines.

8. Marine Services: To ensure the safety of vessels and boats using LPG for cooking or heating.

9. Data centers: Protect critical infrastructure from potential hazards associated with LPG-powered backup generators or cooling systems.

REFERENCES

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[2]. Gas detector – Wikipedia] *This Wikipedia article provides an overview of gas detectors, explaining their purpose, types, and the technology used to identify the presence of hazardous gases in various environments.*

[3]. [An Introduction to Gas Leakage Detection Systems - Control.com] *This article offers a comprehensive introduction to gas leakage detection systems, covering their importance, types, working principles, and applications in industrial settings.*

[4]. [Automatic LPG Gas Leakage Detection and Cut-off System – IJERT]:*This paper describes an automatic system designed to detect LPG gas leaks and cut off the supply to prevent accidents, detailing the system's components and operational methodology.*

[5]. [Smart LPG Leakage Monitoring and Control System Using Gas Sensor MQ-X, AWS IoT, and ESP Module – ResearchGate]: *This research focuses on a smart system that monitors and controls LPG gas leakage using an MQ-X gas sensor, AWS IoT, and an ESP module, emphasizing its smart features and IoT integration.*

[6]. [Load Cells - Omega Engineering]: *This page from Omega Engineering provides information about load cells, including their types, applications, and how they are used to measure force or weight in various industries.*

[7]. [The Working Principle of a Compression Load Cell – HBK]: *This article explains the working principle of compression load cells, detailing how they measure force through deformation and the various applications where they are used.*