LPG CYLINDER AUTO FILLING AND GAS LEAKAGE DETECTION

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Abstract **- The project "LPG Cylinder Auto Filling and Gas Leakage Detection" integrates IoT technology for automating the LPG cylinder filling process and detecting gas leakages. The system utilizes a Load Cell connected to a Node MCU to measure the weight of the cylinder. Concurrently, a gas sensor interfaced with an Arduino board detects any gas leakages.**

Through serial communication between the Node MCU and Arduino, the weight data from the Load Cell is transmitted to the Arduino, which then displays both the weight information and gas leakage status on an LCD display. Additionally, a Python installed PC is employed to facilitate email notifications. Upon detecting a gas leak or a decrease in weight, the Arduino sends this information to the Python PC via serial communication. Subsequently, email alerts are generated and sent to the designated recipients, notifying them of the detected gas leakage and the need for refilling the cylinder.

Moreover, in case of a gas leak, the system activates a pump to initiate the refilling process. Through this integrated approach, the project aims to enhance safety and efficiency in LPG cylinder management.

Keywords **: Node MCU, Arduino UNO, Gas sensor, Load cell, Python installed PC, Buzzer, Relay, DC Motor.**

I. INTRODUCTION

Liquefied Petroleum Gas(LPG) is an explosive mixture of hydrocarbon gases and is used as a source of energy in heating, cooking and in vehicles. Because of advantages, now-a-days in cooking system LPG is widely used in worldwide. As a result the risk is high using LPG.

As per the details provided by the Oil Marketing Companies(OMCs)[1], highest 1,151 such incidents were reported in the year 2017 followed by 1,019 in 2020 and 983 in 2018. In our country India about 62 people die every day due to fire related accidents out of which LPG based accidents account for one sixth of the total. On the whole, there have been 632 such accidents last year.

The "LPG Cylinder Auto Filling and Gas Leakage Detection" project aims to enhance the safety and efficiency of LPG (liquefied petroleum gas) usage in households and industries. LPG is widely used for cooking, heating, and other purposes, but it poses potential hazards due to the risk of gas leakage and mishandling during refilling. This project addresses these concerns by introducing an automated system that ensures safe refilling of LPG cylinders while also detecting and alerting users about any gas leakage.

Traditional methods of LPG cylinder refilling involve manual intervention, which can be prone to human errors and accidents. Moreover, detecting gas leaks in real-time is challenging, as it requires constant monitoring. In this project, we propose an automated solution that integrates sensors and microcontrollers to streamline the refilling process and enhance safety. By leveraging modern technologies such as IoT (Internet of Things) and

automation, we can achieve greater accuracy and reliability in LPG handling.

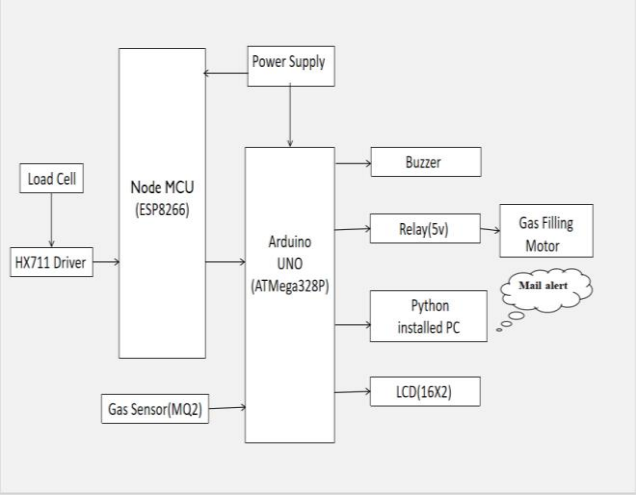
The key components of the project include sensors for measuring gas levels and detecting leaks, microcontrollers for processing sensor data and controlling the refilling process, and a user interface for monitoring and managing the system. By implementing this solution, we aim to minimize the risks associated with LPG usage, improve operational efficiency, and provide users with greater peace of mind regarding their safety.

II. OBJECTIVES

The main objective of our proposed system is to reduce the blastings due to gas leakage and efficient usage of the gas.

a. To monitor the weight of the gas in the LPG cylinder and provide auto re-filling facility and to detect the leakage of the gas if any.
b. To provide pre-safety to the users and alerts the user in case of low volume of the gas in the cylinder and also in the case of leakage of the gas.
c. To reduce the accidents occurred due to cylinder blastings.
d. To provide enhanced safety and security to the users using current technologies.
e. To reduce the loss of life of the people due to cylinder blastings.

III. METHODOLOGY



In our proposed system we are designing our system with ARDUINO UNO and ESP8266 micro-controller and taking ARDUINO UNO as the control unit of our design. However, we use different components for the fulfillment of our design in-order to achieve accurate and satisfying results to reach our goals and objectives.

3.1 BLOCK DIAGRAM AND CONSTRUCTION

Fig 3.1 Block diagram of proposed system.

The above fig 3.1 is the block diagram of proposed system which reflects the entire process and flow of our system.

3.2 COMPONENTS USED

We used several components in our project design such as Arduino UNO, ESP8266 Microcontoller(Node MCU),Gas sensor, Load cell, Python installed PC, Buzzer, Relay, DC Motor.

3.2.1 Arduino UNO

Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common versions are Arduino Uno and Arduino Mega. If you are planning to create a project relating to digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the best, easy and most economical option.

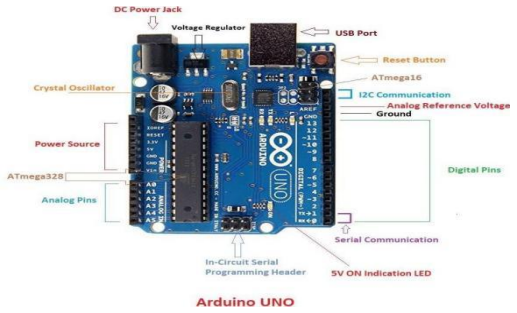


Fig 3.2.1 Arduino UNO

Microcontroller	ATmega328P – 8 bit AVR family micro controller
Operating Voltage	5V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

3.2.2 ESP8266 Microcontroller

The ESP8266 NodeMCU CP2102 board has ESP8266 which is a highly integrated chip designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

Fig 3.2.2 ESP8266 microcontroller

ESP8266 has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors and other application-specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

Its high degree of on-chip integration allows for minimal external circuitry, and the entire solution, including the front-end module, is designed to occupy minimal PCB area.

Specifications	**Range**
Operating voltage	3.0V TO 3.6V
GPIO	17 GPIO pins
Input Voltage	4.5V to 10V
Digital I/O Pins	11
Flash memory	4MB
SRAM	64KB
CLOCK SPEED	Upto 80 MHz
ADC Range	0-3.3V

USB Connector	Micro IUSB
Analog Pins	1

3.2.3 LCD(16X2)

LCD (Liquid Crystal Display) is the innovation utilized in scratch pad shows and other littler PCs. Like innovation for light-producing diode (LED) and gas-plasma, LCDs permit presentations to be a lot more slender than innovation for cathode beam tube (CRT).

LCDs expend considerably less power than LED shows and gas shows since they work as opposed to emanating it on the guideline of blocking light.

Fig 3.2.3 LCD(16X2)

A LCD is either made with a uninvolved lattice or a showcase network for dynamic framework show. Likewise alluded to as a meager film transistor (TFT) show is the dynamic framework LCD.

3.2.4 Relay

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal.

Fig 3.2.4 Relay

Most of the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet

3.2.5 Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

Fig 3.2.5 Buzzer

Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and others.

3.2.6 Gas Sensor

Fig 3.2.6 Gas Sensor

In current technology scenario, monitoring of gases produced is very important. From home appliances such as air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial.

Gas sensors are very important part of such systems. Small like a nose, gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state.

3.2.7 Load Cell

A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. It is basically a device that measures strain and then converts force into electric energy which serves as a measurement for scientists and workers.

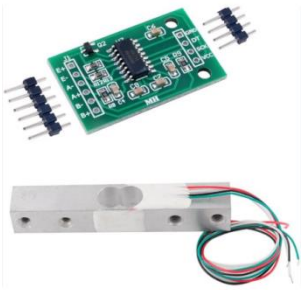


Fig 3.2.7 Load Cell

3.2.8 DC Motor

DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

Fig 3.2.8 DC Motor

3.3 WORKING

The main work of this system is done by the ESP-8266 micro controller and Arduino. The output response of HX711 Driver which is connected to Load cell is given to the ESP-8266 micro controller. This HX711 Driver collects the measurable data from the load cell and gives the data to the ESP-8266 Microcontroller. This is then further forwarded to Arduino UNO for the corresponding action done by the system.

When the weight of the cylinder is less than the predefined threshold weight then the DC motor will turn ON automatically to refill the cylinder and the user will receive a mail alert that the weight is decreased and the buzzer will also ON automatically.

IV. SYSTEM SPECIFICATIONS

S.NO	Tools/Components	Operating Voltage
1	Arduino UNO	5
2	ESP8266 Micro-controller	5
3	Gas Sensor	5
4	DC Motor	9
5	LCD	4.3 - 5.3
6	Load Cell	<=10
7	HX711	2.6 - 5.5
8	Relay	5
9	Buzzer	5

V. DESIGNING AND IMPLEMENTATION

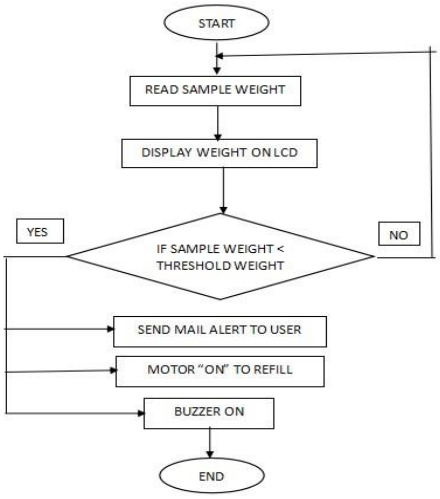


Fig 5.1 Flow Chart of Cylinder Auto re-filling

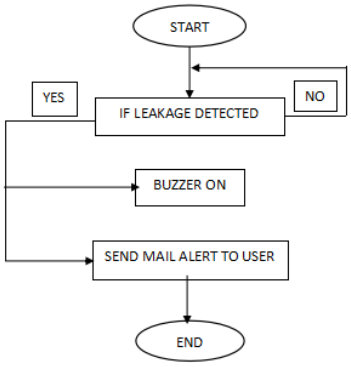


Fig 5.2 Flow Chart of LPG Gas Leakage Detection

VI. RESULTS

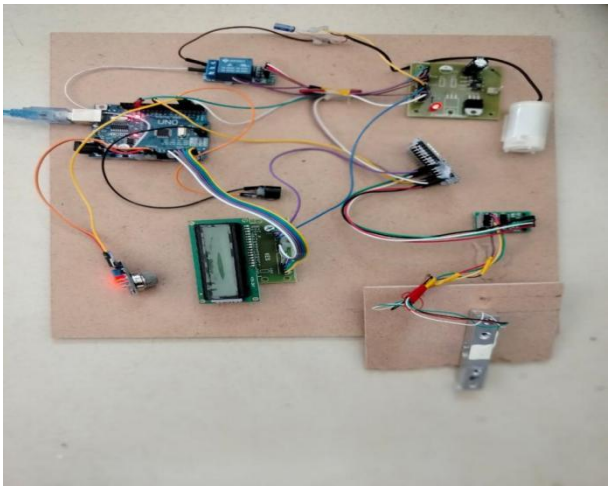


Fig 6.1 Assembled proposed system with all components

The project work on "LPG CYLINDER AUTO FILLING AND GAS LEAKAGE DETECTION" has been successfully designed to prevent accidents and reduce the harmful effects of accidents due to the leakage of the gas.

The result of our design can be described simply as when the weight of the cylinder is less than the predefined threshold weight then the DC motor will turn ON automatically to refill the cylinder and the user will receive a mail alert that the weight is decreased and the buzzer will also ON automatically.

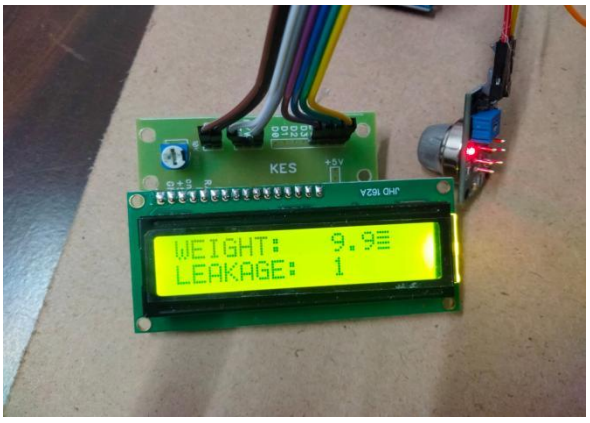


Fig 6.2 Alerting the user in case of gas completion

Fig 6.3 Mail alert for completion of gas

The user will also receive the mail alert when there is leakage of the gas and the buzzer will also ON automatically alerting the user to be careful.

Fig 6.4 Alerting the user in case of gas leakage

Fig 6.5 Mail alert for leakage of gas

VII. CONCLUSION

In conclusion, the development of the LPG Cylinder Auto Filling and Gas Leakage Detection system represents a significant step towards enhancing safety measures in various sectors where LPG is utilized.

By integrating advanced technologies such as sensor-based detection, automated refilling, and real-time monitoring, the system offers comprehensive protection against potential hazards associated with LPG handling and storage. Through its multi-faceted approach, the system addresses key challenges related to gas leak detection, cylinder refilling efficiency, and emergency response, thereby mitigating risks and ensuring operational continuity.

VIII. REFEENCES

[1] DhirendraKumar, https://www.millenniumpost.in/nation/5122-incidents-of-accidents-involving-lpg-in-6-yrs-govt-511914?infinitescroll=1,"Millineum Posts - No Half Themes" 16 March 2023

[2] Saad Ahmed, Md. Jubayer Rahman, Md. Abdur Razzak, IEEE World AI IoT Congress (AIIoT), "Design and Development of an IoT-Based LPG Gas Leakage Detector for Households and Industries" 13th July, 2023.

[3] G. Ramesh, J. Jolin Dorrothi, R. Nithya Shree, S. Sailanjali Ajitha, 2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), "Smart in Sync Cylinder Reserving and LPG Gas Tracking System" 9th March, 2022.

[4] Arpit Kumar Srivastava, Shivam Thakur, Ashutosh Kumar, Arpit Raj, 2019 IEEE International Symposium on Smart Electronic Systems (iSES) (Formerly iNiS), "IoT Based LPG Cylinder Monitoring System", 20th February 2020.

[5] Alan Macker, Anil Kumar Shukla, Sagarika Dey, Jyoti Agarwal, 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI)."ARDUINO based LPG gas monitoring - Automatic Cylinder booking with alert system", 2nd Dec 2018.

[6] MS Kumaran, Jayarama Pradeep, R Hounandan, B Prahatheesh, 2021 12th International Symposium on Advanced Topics in Electrical Engineering (ATEE), "Smart LPG Cylinder Monitoring and Explosion Management System", 12th May 2021.

[7] Jayesh Gupta, Abhijit Patil, Samadhan Rajgire, Tejashree Kadus, International Journal of Engineering Research and V9(04), "Smart LPG Monitoring and Automatic Booking System using IOT", April 2020.