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Smart LPG Gas Cylinder Monitoring System using Internet of Things

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Abstract: ***LPG cylinder are an integral parts of our home now. LPG can cook faster than any other fuels because of its calorific value. At the same time gas leakage and gas level detection is major problem in our lives. Also gas wastage is a major issue that needs to be countered. In this fast growing technology, it is not feasible for person to spend time booking manually when this technology can be used to do such tasks.***
In this paper the proposed system that will make entire LPG cylinder booking procedure automatically without human intervention.
The system continuously measures the weight of cylinder if weight of the cylinder goes below the threshold value it will automatically sends message to the authorized LPG agent so they can deliver the LPG cylinder on time. This system uses the GSM modem to alert the user. we also designed feature related to the safety of the user in which it continuously monitor the leakage of LPG gas and alerts the user about leakage to avoid major accidents which costs human lives mostly.
Keywords: Arduino uno R3, Load cell, GPRS, LCD, MQ-2 gas sensor

I. INTRODUCTION

In today's life food, clothes and shelter were considered as basic needs. Preparing food or boiling water was done using Chulha, using coal or wood, but these methods are not suitable as it generates smoke. Smoke is very dangerous for our health. LPG, first produced in 1910 by Dr. Walter Snelling is having saturated as well as unsaturated hydrocarbons. LPG has very useful in nature and because of its properties it is used to fulfill daily needs.
LPG is used in domestic applications, Industrial applications as fuel. With development of technology now a day's automobiles are also developed which uses LPG as fuel. Demand of LPG is increasing day by day. So in addition to food, cloth and shelter now LPG is also becoming basic need.
There are total 30 crore LPG users in a country in which only 40% of the population. LPG is a mixture of propane and butane. The main motive of the proposed system is to continuously measure the weight of the cylinder if the weight of the cylinder goes below the threshold value it will automatically sends an SMS alert to the user as well as Authorized LPG agent for booking a new cylinder. For the purpose measuring weight of cylinder used load cell.
Also with the Automatic cylinder booking procedure we also designed feature related to the safety of the user in which it continuously monitor the LPG gas cylinder if the gas is leaked the system alerts the user regarding leakage to avoid major accidents which costs human lives mostly. For the purpose of gas leakage used MQ-2 gas sensor it is sense the combustible gas.

II. OBJECTIVES

A. It is useful to alert the LPG gas user about gas leakage.
B. This system is useful to LPG gas user because there is no need to do book cylinder manually, system will automatically book the new cylinder.

Following hypotheses are proposed to attain the above objectives using survey analysis: -

1) *H1:* use a smart device which detect the amount of gas present in the cylinder which will send the notification to the LPG agency so it will be much beneficial for the consumer because there no need to manually inform the booking office for new registration.
2) *H2:* use a MQ-2 gas sensor which detect the leakage of gas so it automatically inform the consumer about the leakage to avoid the leakage can be harmful for the consumer and for the surrounding community.

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III. RELATED WORK

In[1],Unnikrishnan et al. authors proposed of LPG monitoring was mainly intended for household purposes where the use can be notified of the amount of LPG remaining in the cylinder so that necessary actions can be taken to pre- book a new cylinder without any hurdles. In[2], Naik et al. authors proposed a system that will make entire LPG cylinder booking procedure automated without human intervention. In [3], salvi et al. authors proposed that systems continues monitor the leakage of LPG gas and alerts user. Measure the gas present in cylinder. In [4], Ravichandran author proposed Low weight alert is useful in avoiding low weight gas cylinder at the time of delivery. In [5], kanaklakshmi et al. authors proposed that IOT was the latest and emerging internet technology. Fully automated smart LPG gas system using IOT was a system that uses computers and mobile devices to monitor the gas leakage , gas level and control the n cylinder through internet from anywhere around the world. Keywords : Arduino board , Load cell , RF module , LCD , Android app , MQ-2 sensor , Temperature sensor. In [6], Malladi et al. authors proposed that If we have not noticed of completion of gas we need to book a cylinder in black for more money. In [7], Agarwal et al. authors was used AVR microcontroller that control all the module and components and peripherals that was connected to it. Sensor module is used to sensed the gas leakage. In this module they used gas sensor MQ-6 to perform the leakage detection operation. Two software that was used to developed this system was ATMEL studios and proteous. In [8], Joshila Grace et al. authors proposed the innovative robot that very closed to the outer surface of the gas pipe and monitor gas leakage. In[9], T. et al. authors proposed that by using IOT system continues measure the quantity of gas present in cylinder if quantity goes down to the low level then message goes to the LPG agent for new cylinder. In[10], B.d. et al. authors proposed that by using GSM module works on simple AT commands which can be implemented by interfacing Rx and Tx pins. In[11], Bairagi et al. authors proposed that by using wireless sensor network we can also sensed the gas leakage in a specific area.

IV. COMPONENTS

A. MQ-2 Gas Sensor

It is a gas detector device that detects the gas in combustible area. Gas sensor(MQ-2) module is useful for gas leakage detection device which detect the leaked gas in home and industry. This sensor is also suitable for detecting H2 , LPG, CH4, CO, alcohol ,smoke or propane. It is a high sensitivity and fast response time ,measurements can be taken as soon as possible.

B. Arduino UNO R3

It is an open-source microcontroller board. on the board microchip ATmega328P microcontroller is mounted. The board has 14 digital I/O pins (six capable of PWM output) and 6 analog I/O pins. It is programmable device with the Arduino IDE (Integrated Development Environment). By using this microcontroller we can perform many program and projects. It also have reset button to reset the all the functions in a system.

C. Load Cell

Load cells have pressure gauge. It is deforms when pressure is applied on it. Load cell available in various ranges like 5kg,10kg,100kg and more. With the help of this gauge you will be able to tell just how heavy an object is. If an objects weight changes over time, or if you simply need to sense the presence of an object by measuring strain or load applied to a surface.

D. GSM Module

It is mostly used for mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile data , voice and message. Data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands levels. GSM module is also known as GPRS module. It is used to establish communication between mobile devices and computing machine.

E. Buzzer

It is an audio signal device. It produces the noisy sound according to voltage variation applied to it. It is normally used for alarm devices ,timers. There are various types of buzzer include electromechanical, mechanical, piezoelectric.

F. LCD

LCD means Liquid Crystal Display. It is normally used for displaying some message on a display. In various matrix the LCD are available but I used 16x2 LCD display. A 16x2 matrix means it can display 16 characters per line and there are two such lines on the display and each character displayed in 5x7 pixel matrix.

V. SYSTEM OPERATION

Fig 1: Gas leakage detection System

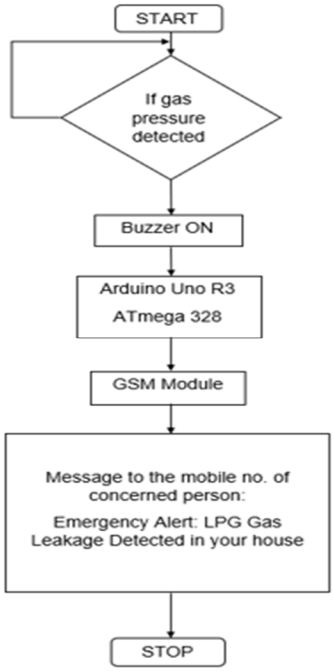
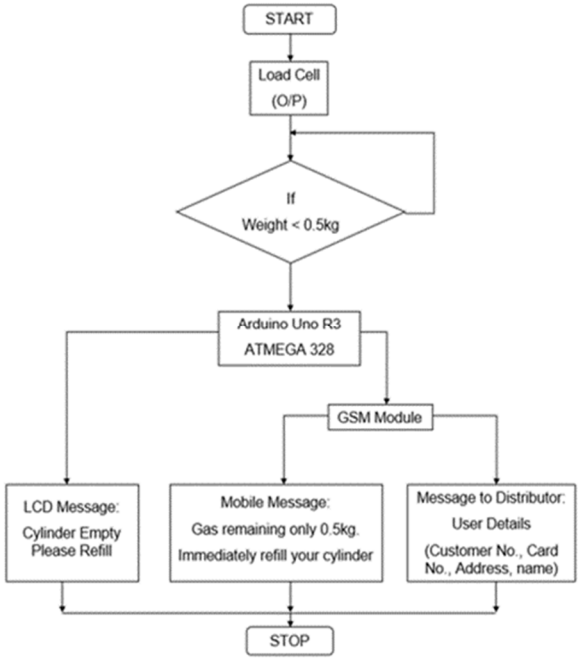


Fig 2: Automatic gas booking system



VI. METHODOLOGY

An online survey was held using Google Form. The link of the form was circulated in social media platform. The questionnaires in the form were designed to test the proposed hypothesis which verified certain parameters.

A. Participants

To test the proposed hypothesis, this study used two conditions i.e. Helpful and Not Helpful. A total of 72 participants data was collected from different states of India. Among the 72 participants 56.9% were male and remaining 43.1% were female.

B. Measures

Table I

Gender	Yes	No	Total
Male	30	11	41
Female	19	12	31
Total	49	23	72

There exists a simple formula to calculate the expected for any value in the above table.

1) Formula

Expected Value = (row total)* (column total)/(grand total)

E_{11} = (41*49)/72 = 27.90

E_{12} = (41*23)/72 = 13.09

E_{21} = (31*49)/72 = 21.09

E_{22} = (31*23)/72 = 9.90

Having obtained these expected values, we now need to compare them with what has actually been observed. To do this, we calculate the x^2 statistic, which is shown below.

$$x^2 = \sum \frac{(observed\ value - expected\ value)^2}{expected\ value}$$

That is, take each expected value and subtract from the corresponding expected value. Square the result and divide the result by the corresponding expected value. Calculate this quantity for each cell in the table and add together.
The calculation for the example above, are shown below in table.

Table II

Obs	Exp	Obs-Exp	$(Obs-Exp)^2$	$(Obs-Exp)^2/Exp$
30	27.90	2.1	4.41	0.15806
11	13.09	-2.09	4.36	0.33307
19	21.09	-2.09	4.36	0.20673
12	9.90	2.1	4.41	0.44545
Total				1.14331

Thus, the value for x^2 is 1.14331.
Degree of Freedom = (no. of rows -1)*(no. of columns)
Degree of freedom = (2-1)*(2-1) = 1

VII. EXPERIMENT

The test scores of independent samples were calculated at the significance level of 95 percent using Chi-Square Test. By using the Chi-Square test calculate chi value(x^2). The participants presented multiple questions to test the parameter in the test (e.g. Have you experience gas leakage in your house ? How do you handle if gas leakage in your house ? Have you face any problem related to the gas cylinder booking system ? what problem you faced related to gas cylinder booking system ?). so, the calculated chi value is 1.14331 and tabulated chi value is 3.84 at significance level 95 percentage with the degree of freedom 1.

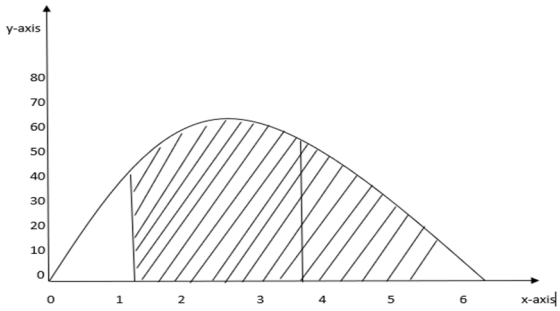


Fig 3: Statistics of chi-square test

VIII. RESULT

The test scores of independent samples calculated using Chi-Square Test using survey analysis resulted that the participants have facing many problem related to LPG gas cylinder booking i.e Network issue, don't know status of gas present in the cylinder, delay in booking new gas cylinder, give a more money to agency for booking cylinder in black). Therefore , the hypothesis "H1" is accepted.
The test scores of independent samples calculated using Chi-Square Test using survey analysis resulted that the participants have facing many problem related to LPG gas leakage i.e. they experience gas leakage once in a year, many times in a year and they don't know what precautions can be taken to avoid gas leakage. Therefore, the hypothesis "H2" is accepted.

IX. FUTURE SCOPE

This monitoring system can be further enhanced by using Bluetooth in place of GSM to send the alert message to the user, which support another real-time application. For industrial purposes mobile robot can be developed for detecting gas leakage in industry.

X. CONCLUSION

In this paper IOT technology is used for enhancing existing safety standards. The system gives a fully automated approach towards the gas booking. Along with the gas booking procedure this system gives safety towards gas leakage. This system is useful in home and industry to detect gas leaks and automatic gas booking procedure.

XI. ACKNOWLEDGEMENT

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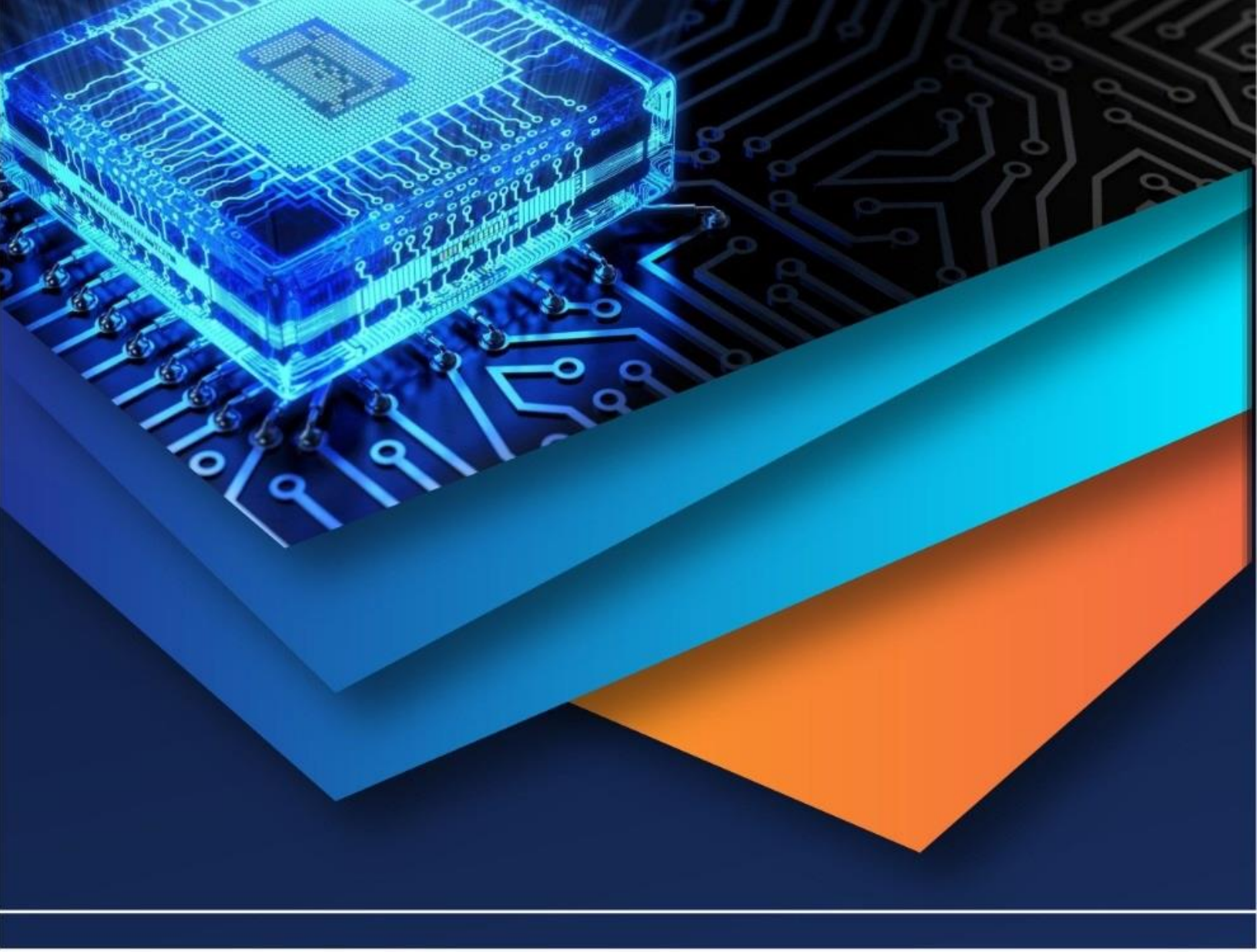

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