LPG Gas Monitoring and Cylinder Booking Alert System

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Abstract: - LPG is widely used in our everyday life. It should be handled with care as it is highly flammable which causes a fire or explosion. The above circumstances can be overcome by implementing techniques for detecting accurate gas leaks. The main aim of this paper is to put forth an IOT gas management system that will be able to sense gas leakage and fire detection. Whenever leakage of gas is detected, the user will be alerted through SMS and call so that the user can turn off the gas valve immediately. Temperature and gas sensors are designed to detect and respond to the presence of flame, fire, and gas leakage. LCD is used to display the amount of gas present and the following alert message is displayed. The buzzer is triggered whenever it encounters leakage of gas. Furthermore, automatic booking of gas cylinders is facilitated with the aid of a load sensor, which notifies the gas-booking agency through the Internet of Things. Customers would also be able to tell whether the gas agency is defrauding them by supplying them with less LPG using the proposed system. In addition, it notifies the gas cylinder going empty when it reaches below the threshold value, which is also displayed in the LCD. At the same time, the user through the app will receive regular notifications, which is the additional advantage of the system.

Key Words: —*LPG gas monitoring, Automatic Cylinder booking system, Gas leakage detection.*

I. INTRODUCTION

LPG was first discovered as a significant component of gasoline, which included propane, butane, and other hydrocarbons in addition to LPG. Natural gas is widely used as fuel in homes for cooking, as they are efficient, portable, and cleaner than most other fuels and possesses greater caloric value. It is also used in industry, heating, and motor fuel. Since gases are heavier than air, they do not disperse easily and can cause an explosion if they leak [1][2]. LPG catches fire quickly and has a serious threat to the lives of the people whenever it admits a leakage, which leads to an explosion [11]. Since LPG is heavier than air it is not easy to disperse quickly and so it gets to settle on the low points of the floor. When the leakage gas is inhaled, it causes suffocation. Therefore, detection of gas leakage has gained prime importance in the recent technology in the fields of industry, safety, household, and environment and emission control. [3]

The proposed system aims at the detection of gas leakage and fire [1-11].

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Added to it auto-renewal system of the gas cylinder is employed whenever the weight of the LPG gas cylinder reaches below the threshold value.

This reduces the burden of the customer [5-7]. (LPG LEAKAGE DETECTION, ARDUINO Based LPG, and smart gas) the heart of the project is the Arduino, which responds quickly to certain actions, which is obtained from the sensor. Fire is detected using LM35 whenever there is a sudden rise in temperature above the room temperature. Using the MQ-4 sensor the leakage of gas is detected. The following actuators such as LCD, buzzer, and LED are used to get the viable responses from the sensor whenever fire and leakage of gas are detected. A circuit with an instrumentation amplifier along with few resistors is interfaced with Arduino is used to estimate the weight of the LPG cylinder. LCD shows the weight of the LPG gas regularly and notifies to book the cylinder whenever the cylinder is going to be emptied. By activating the signal, the buzzer alerts the general public at home, and LED is triggered when LPG fixation and fire are noticeable and shows a similar message on LCD to prompt the user to take action. GSM module (sim900) is interfaced with Arduino to alert the user by initiating a phone call or through an SMS on the registered mobile number of the user and addition to it automatically books the gas cylinder from the gas-booking agency also giving the information to the consumer [6]. This system also enlightens another important feature which is nothing but the App interface. The App gives regular notifications about the

alert messages, temperature, weight of the gas cylinder, notifies the people around the vicinity of the gas cylinder whenever it encounters fire and leakage of gas. In addition, it intimates the user to book the gas by providing the phone number and address of the gas-booking agency.

This device aids in the advancement of safety regulations, and its most significant and fundamental purpose is to deter injuries and save lives. Anyone that uses gas in his or her home will benefit from this application. It detects gas leakage from a gas cylinder, which is particularly useful for the welfare of elderly people who live alone at home [7].

II. PROPOSED METHODOLOGY

The Gas Sensor (MQ4 Sensor), INA122, and Temperature Sensor are all connected to the Arduino microcontroller in the proposed device. The device receives data from these sensors. Via the mobile data network, the interfaced GSM module will link to the Internet. A gas leak is detected by a gas sensor. The consumer is alerted as soon as a gas leak is detected, allowing him or her to switch off the gas valve. The INA122 continuously tracks the weight of gas in the cylinder and sends a warning to the booking agency and customer to book a gas cylinder if the weight falls below a certain threshold. When the temperature sensor senses a fire, the buzzer begins beeping to alert the user to the problem in their house, and the LED turns on if one of the sensors fails the threshold value condition. All of these sensors' responses can be seen on the LCD-Display. The AT commands are used by the GSM Module to send phone calls and SMS. [5].

The PROTEUS software package was used to digitally test the microcontroller program and its functionality in a simulation environment. The hex file created by building the program in ARDUINO IDE was used to simulate the program with PROTEUS. [8].

A. MQ-4 Sensor

The MQ-4 Gas Sensor has a high sensitivity for detecting LPG, Propane, and Hydrogen. As a consequence, it is the tool of choice for detecting gas leakage. The potentiometer's sensitivity can be modified. The high sensitivity and fast response time of the MQ-4 Sensor are its main features, allowing measurements to be taken as soon as possible. It can detect the presence of natural gas levels in the range of 300-1000ppm.[6].

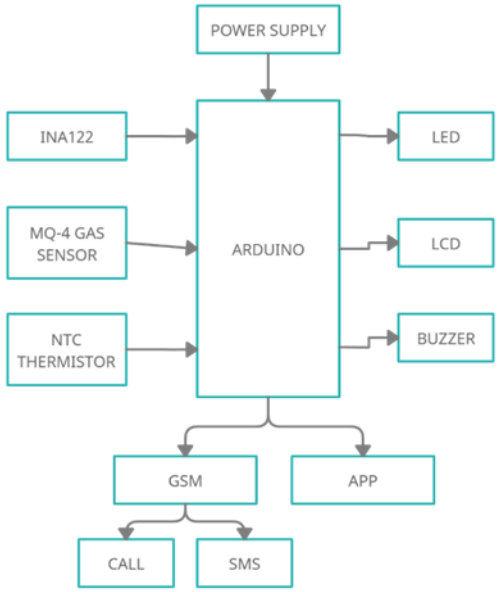

Fig.1. Block diagram of the proposed system

Fig.2. MQ-4 Sensor

B. Thermistor

The model template Temperature sensors are made up of thermistors. The resistance of NTC thermistors decreases as their temperature rises, while the resistance of PTC thermistors rises as their temperature rises. A thermistor works on the idea that its resistance is proportional to its temperature. Within the -50°C to 150°C range, and up to 250°C for glass encapsulated thermistors, NTC thermistors can achieve the highest accuracy. Accuracy ranges from 0.05°C to 1.00°C [12][13].

C. INA122

The INA122 is a low-noise differential signal acquisition precision instrumentation amplifier. Its two-op-amp architecture offers excellent performance while consuming very little quiescent current, making it suitable for portable instrumentation and data acquisition systems. This

instrumentation amplifier is commonly used in load sensors and is used to estimate weight.

Fig.3. INA 122

D. LCD

The LCD Monitor is used to show the results of various sensors such as the gas sensor (MQ-4 sensor), temperature sensor (LM35 sensor), and the weight of the LPG cylinder. [1-4]

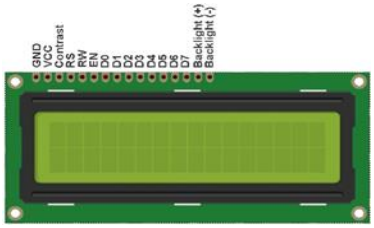

Fig.4. LCD

E. Buzzer

A buzzer, also known as a beeper, is a mechanical, electromechanical, or piezoelectric audio signaling system. It converts electrical energy into sound energy using a transistor and a capacitor [4], [6]. Alarm clocks, timers, and confirmation of user feedback are among the most common uses for is completed, it begins to beep. (For example, in our proposed subject, the buzzer begins to beep when gas leakage is detected.)

Fig.5. Buzzer

F. LED

When an electric current is passed through a light-emitting diode (LED), it emits light. It is an actuator that is activated by the sensor. [8].

G. Arduino

The Arduino UNO is a microcontroller board based on the ATmega328P microprocessor from Microchip. There are 14 digital pins and 4 analog pins on this board. Using a form B USB cable, it can be programmed using the Arduino IDE. It is powered by a 12-volt battery. [5-7][10].

Fig.6. Arduino Uno

H. GSM

The GSM module is connected to an Arduino UNO in this project, which can link to the Internet through the mobile data network. AT commands can be used to communicate with controllers. It can be fitted with a SIM card, allowing it to perform functions such as making phone calls and sending SMS [10]. Foreign roaming and increased spectral performance are among the key features of the GSM module, which uses encryption to make phone calls more secure, high-quality speech, and ISDN compatibility (Integrated Services Digital Network) [1-7][9].

III. SYSTEM FLOW CHART

MQ4 Sensor reads the gas concentration value when the power supply is turned on. If the surrounding area is on fire, the LM35 Sensor can detect it. The weight of gas in the cylinder will be continuously monitored by INA122. When a gas leak or fire is detected, immediate steps are taken, such as sending SMS and making a phone call via GSM module, as well as beeping the buzzer and lighting the LED.

When the instrumentation amplifier (INA122) detects that the gas in the cylinder has fallen below the threshold value, a message is sent to the booking agency and the customer to book the gas cylinder for the specified address [7]. All of the most recent updates are reflected in the software, and all of these

sensors include the following alerts. The flowchart in Fig. 11 depicts the entire system's operation.

Fig. 7. System flow chart

IV. Results And Discussion

The system's experimental configuration is depicted in the diagram. An LCD displays the results of all sensors. SMS and phone calls are sent to the registered mobile number as soon as a gas leak or fire is identified. At the same time, the buzzer begins to beep. The booking agency is informed to book a gas cylinder when the weight of gas inside the cylinder falls below a threshold value.

A. Tinkercad Simulation

Tinkercad is a web-based 3D design and modeling software that allows a wide range of users to build projects.

Tinkercad was used to construct the system's experimental configuration, it includes Arduino uno, buzzer, LCD, MQ-4 sensor, Breadboards, LED, wires, and potentiometer. The simulation is designed for detecting Gas leakage, the circuit is shown in Fig 8.

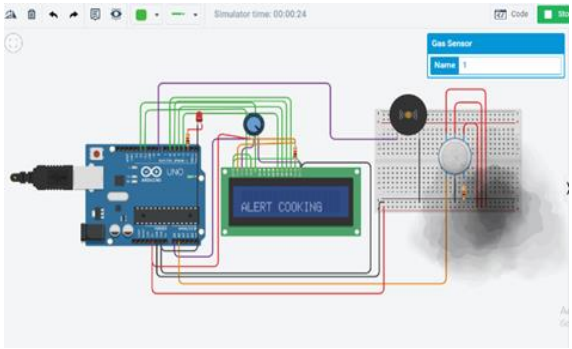

Fig.8. Tinkercad Simulation

The output of the Tinkercad circuit is shown in fig 9. It gives an alert when the MQ-4 sensor detects the gas leakage. When gas is detected, an alert is given using a buzzer, LCD, and an alarm in the mobile phone application.

Fig. 9. Output in LCD

B. Proteus Simulation

The Proteus Design Suite is a proprietary software tool suite that is mainly used to automate electronic design. The software is primarily used by computer design engineers and technicians to produce schematics and electronic prints for the production of printed circuit boards.

The experimental setup of the system is also designed in Proteus, which consists of Arduino uno, MQ2 sensor, load sensor, thermistor, LED, buzzer, and LCD. Whenever gas leakage is detected, the buzzer gets activated as well as the alert message is shown on LCD. The weight of the cylinder is continuously displayed in LCD through the load sensor. Thermistor continuously measures surrounding temperature to monitor if in any way fire has occurred. In case of fire, it will give an alert in LCD as well as the user's mobile phone application.

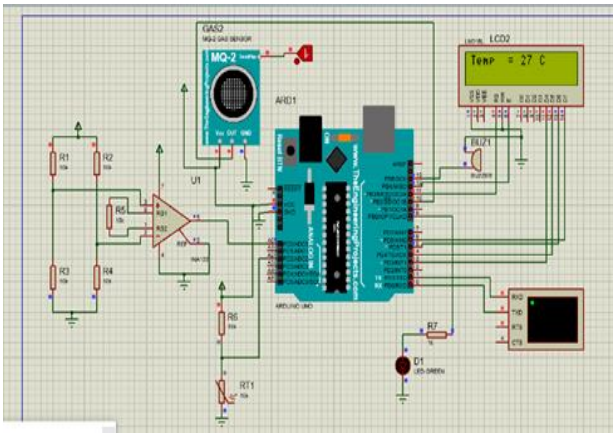

Fig. 10. Proteus circuit design

The output of the Proteus circuit is shown in fig. 11 and fig. 12.

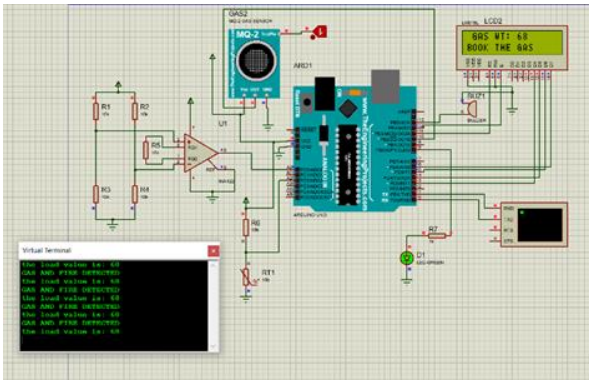

Fig. 11. Proteus Simulation- the weight of the gas

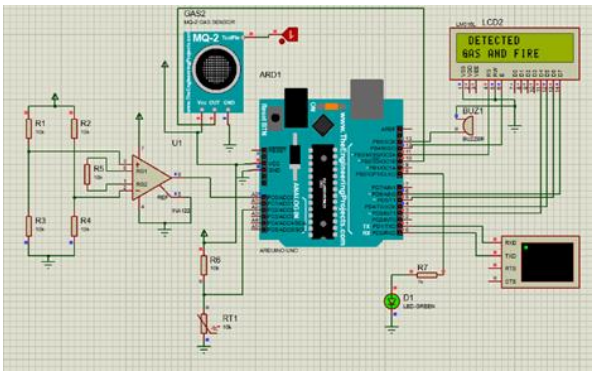

Fig. 12. Proteus Simulation-gas leakage detected

C. App Interface

MIT App Inventor, a web application optimized development environment, was used to build the mobile app interface. This app will be downloaded to the user's phone and will show the cylinder's weight, gas leakage status, ambient temperature, and emergency contacts.

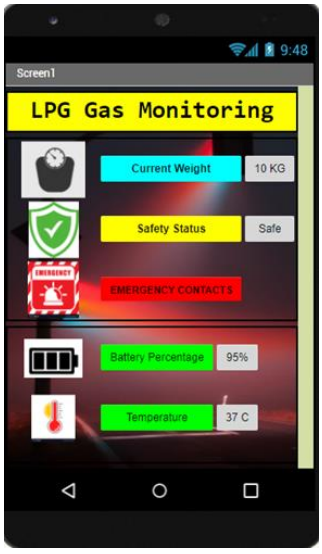

Fig. 13. App interface

Via the GSM module, the message will be sent to the gas agency, alerting them to book gas for the customer. The sample message that will be sent to the agency is shown in Fig. 14.

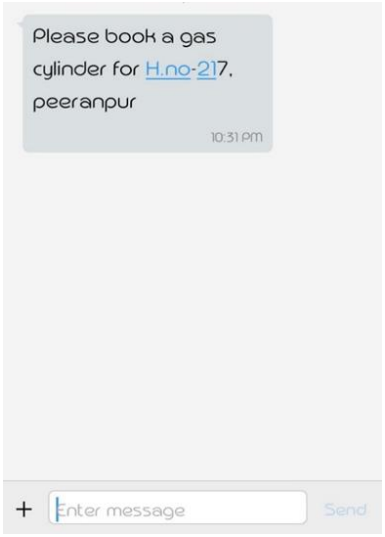

Fig. 14. Message sent to gas agency

V. CONCLUSION

The system, which is capable of monitoring leakage of gas and fire as well as the weight of LPG present, is successfully designed and is, implemented using various software- Proteus, Tinkercad as well as MIT App Inventor. In either case (Fire, gas, or low weight of cylinder), the user will receive an error message or a phone call so that he or she can turn off the gas valve before the situation worsens, which is caused by leakage, and book their gas when they encounter the gas being emptied. It is possible to view the level of gas in the LPG cylinder through the app. Thus, the cost-effective framework can rectify the carelessness and reduce the burden of the user. In addition, it saves the lives of people and minimizes the damages caused due to gas leakage and the spread of fire.

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