LPG Leakage Detection and Alert System Using IoT

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Abstract: Accidental explosions in the home are not uncommon which may be associated with gas leaks, the storage of explosive material such as propane. In the modern world, human adopted LPG (Liquid Petroleum Gas) supply system for cooking. During the usage of the LPG system, number of occurrence that will happen around us that may cause death of human beings. Hazards due to gas leakage are dangerous and can become uncontrollable if timely actions are not taken. But this gas leak mostly remains unnoticed and there should be some means to observe them so that a quick action can be brought. To prevent this to happen knowingly or unknowingly, this document gives the detection of leakage of LPG cylinders in particular areas like kitchen and alert the user regarding leakage. Along with LPG leakage detection this document also gives LPG booking alert to the user. This document basically deals with the development of a gas leak detector and booking notification to the user which can prevent major accident and save time for LPG booking.

Keywords: Arduino Uno, Temperature sensor, Wifi module, Gas Sensor, Load Cell, Stepper motor.

I. Introduction

LPG is a flammable hydrocarbon which is composed of propane, butane, iso-butane and mixtures of these gases. It has high calorific value, which produces less smoke, less soot, and does not cause much environmental damage. Having these desirable properties, leakage of this gas is very dangerous and increases the risks to fire explosion. This leads to both financial and human loss. The number of reports of death due to gas leak explosions has increased in recent years. The reason for such explosions is the lack of substandard cylinders, old valves, worn out regulators and lack of awareness using gas cylinders add to the risks.

The purpose of this project is to detect the presence of LPG leakage as a part of a safety system. Apart from sound alarm, an SMS alert will inform the authorized person and the stepper motor will be triggered to shut down the gas supply to prevent any harmful effects due to gas leakage.

Descriptively, we use a gas sensor to monitor the LPG if the gas leak reaches beyond the normal level. the authorized person will be informed about the leakage via alert notification and the gas supply will be automatically shut down. The people can be saved from a potential explosion caused by gas leakage.
II. Literature Survey

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<th>Year</th>
<th>Author</th>
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<th>Deliverables</th>
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<tr>
<td>2011</td>
<td>Shashi kumar, Pranita Padole, Shweta Salve, Aditya Sachdev</td>
<td>Smart LPG Monitoring &amp; Automatic Gas Booking System</td>
<td>Depending on the sensor values showing the variation in the gas concentration measurements and audio visual alarms were activated.</td>
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<td>2017</td>
<td>Kumar Keshamoni and Sabbani Hemanth.</td>
<td>Smart Gas Level Monitoring, Booking &amp; Gas Leakage Detector over IoT.</td>
<td>Continuous weight measurement of the container integrated.</td>
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<tr>
<td>2017</td>
<td>Shruthi Unnikrishnan, Mohammed Razil, Joshua Benny, Shelvin Varghese.</td>
<td>LPG Monitoring and Leakage Detection System</td>
<td>The user gets alert buzzer whenever a small LPG gas is brought near the MQ-6 gas sensor.</td>
</tr>
<tr>
<td>2017</td>
<td>Mr. Arijit Banik, Mr. Bodhayan Aich, Mr. Suman Ghosh.</td>
<td>Micro-controller Based Low Cost Gas Leakage Detector with SMS Alert</td>
<td>The system then alerts the customer by sending an SMS to the specified mobile phone.</td>
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III. Proposed System

The proposed project is a LPG leakage detection and alert that provide user an easy way to monitor the LPG gas in cylinder with android application. Arduino UNO is the microcontroller board that collects the sensor data. The communication between android mobile and Arduino is take place by WIFI module, so user can monitor sensor values from any remote location. System continuously display all sensor value in android application. System continuously monitors the leakage of LPG gas and alerts user regarding leakage and also turn off the Cylinder knob using stepper motor. In addition to this, user can remotely on/off cylinder knob. The
weight of the cylinder is measured by Load cell sensor and whenever the weight is less than threshold weight then the system send booking alert notification to the user mobile application. This avoids user to wait for another gas cylinder.

Fig 1.0 System Architecture

Fig 1.0 explain the system architecture of the project where we can see sensors and actuators interaction with the system. Sensors provides the input data to the micro controller which is return gives and output via actuators. Wifi module provide the system to interact with the outside the system. Design of the system is shown in the Fig 1.1. This provide the flow chart of the system where you can see the system cycle.
a) Software Requirement

Arduino Uno IDE

Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
BLYNK Framework

BLYNK is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the BLYNK app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen. Using the widgets, you can turn pins on and off or display data from sensors. Whatever your project is, there are likely hundreds of tutorials that make the hardware part pretty easy, but building the software interface is still difficult. With BLYNK, though, the software side is even easier than the hardware.

b) Hardware Requirement

Arduino Uno

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 Analog input pins, a USB connection, a Power barrel jack, an ICSP header and a reset button.

![Fig 2.0 Arduino Uno](image)

WIFI Module

ESP8266 is Wi-Fi enabled system on chip (SOC) module developed by ESPRESSIF system. It is mostly used for development of IOT (Internet of Things) embedded applications. ESP8266 comes with capabilities of 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2), general-purpose input/output (16 GPIO), Inter-Integrated Circuit (I²C) serial communication protocol, Analog-to-digital conversion (10-bit ADC) Serial Peripheral Interface (SPI) serial communication protocol, PS (Inter-IC Sound) interfaces with DMA (Direct Memory Access) (sharing pins with GPIO), UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and pulse-width modulation (PWM).

![Fig 2.1 ESP8266 WIFI Module](image)
Stepper motor (28BYJ-48) and driver (ULN2003)

The 28BYJ-48 stepper motor is a commonly used stepper motor, which converts electrical pulses into discrete mechanical rotation. Why is the name stepper used, you may ask. That is because when electrical signals are applied, the stepper motor rotates in accurate and fixed angle increments known as steps. The motor consists of 4 coils that make a ring around the rotor. The ULN2003 is one of the most common motor driver ICs that houses an array of 7 Darlington transistor pairs, each capable of driving loads up to 500mA and 50V.

Load cell sensor and Amplifier module (HX711)

A load cell (or loadcell) is a transducer which converts force into a measurable electrical output. Although there are many varieties of force sensors, strain gauge load cells are the most commonly used type. There are hydraulic load cells, pneumatic load cells, and strain gauge load cells. Strain gauge load sensors are the most commonly used among the three. A load cell works by converting mechanical force into digital values that the user can read and record. This module uses 24 high precision A/D converter chip HX711. It is a specially designed for the high precision electronic scale design, with two Analog input channel, the internal integration of 128 times the programmable gain amplifier.

Gas sensor(MQ-6)

The MQ-6 module is used in gas leakage detecting equipment in family and industry. It can also be used to detect the presence of alcohol, cooking fumes, and cigarette smoke. The module gives out the concentration of the gases as an Analog voltage equivalent to the concentration of the gases. The module also has an on board comparator for comparing against an adjustable present value and giving out a digital high or low. It can be easily interfaced with your Arduino or Raspberry Pi.
Temperature Sensor(DHT11)

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc... to measure humidity and temperature instantaneously. DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

V. Implementation Result

The sensor used in this project are connected to arduino which continuously monitor the gas leakage, room temperature and weight of the cylinder. If any changes in this sensor values then the application in the mobile sends the notification for the user. The wifi module that act as the communicator for arduino and the blynk server. From blynk server the mobile application data are updated. The temperature sensor used in the project is used to measure the room temperature of the system. MQ6 gas sensor is used to measure the LPG gas in the atmosphere. If the leakage is identified the applications gas indicator level increase to particular value. If the value is greater than threshold value then the system checks MQ6 sensor value for 3 times and notify the user and turn of the cylinder knob using the stepper motor. Fig 3.0 shows the gas leakage level of the atmosphere and Fig 3.1 shows the gas leakage alert notification. This provide the user the awareness of the gas leakage and avoid major accident.

Now the next module is booking alert system. The load cell sensor that used to measure the weight of the cylinder. If the weight is less than the threshold value then booking alert is sent to the user and further booking process is take place by the user. The load cell data are continuously updated to the blynk server and user can see this data from weight indicator in the blynk application. The load cell data is showed in the Fig 3.2. The booking alert is showed in Fig 3.3.
Fig 3.0 Gas Leakage Indicator

Fig 3.1 Gas Leakage Notification

Fig 3.2 Gas level indicator

Fig 3.3 Booking Alert
VI. Conclusion
Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs mainly due to poor maintenance of equipment and inadequate awareness of the people. Hence, LPG leakage detection is essential to prevent accidents and to save human lives. We discussed the methods used for identifying the leakages and automatically closed the regulator which can save many life. This method provide the user live data so the user can be aware any time.

VII. Future Scope
In future work in place of booking notification to user, the booking automation can be replaced, where user can book cylinder using our application which make booking process simple and save time for user. For industrial purposes mobile robot can be developed for detecting multiple gas concentrations.

References