Gas Leakage Detection And Alerting System Using Arduino Uno

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Abstract: Commercial Propane and Commercial Butane, both of which contain saturated and unsaturated hydrocarbons, make up LPG. Because of the versatile nature of LPG, it is used for many needs such as domestic fuel, industrial fuel, auto-mobile fuel, illumination, etc. and the demand for LPG is continuously increasing day by day. Liquefied petroleum gas is used widely in homes, industries, and automobiles as fuel because of its desirable properties which include high calorific value, it creates very less smoke, and not causing much harm to the environment. Natural gas is another widely used fuel in homes. Both burn to produce clean energy, however, there is a serious threat of leakage. The gases being 5 times heavier than air do not disperse easily.

Index Terms: Load Cell, MQ-2 Gas Sensor, Fire Sensor, IoT

I.INTRODUCTION

LPG Commercial propane and commercial butane, both saturated hydrocarbons, make up LPG. Due to LPG's adaptability, it may be used for a wide range of applications, including household heating, industrial heating, transportation fuel, lighting, and more. LPG demand is also steadily rising over time. LPG is widely utilized as a fuel in homes, businesses, and automobiles due to its attractive characteristics, which include a high calorific value, minimal smoke production, and low environmental impact. Another fuel that is frequently utilized in homes is natural gas. Both burn to provide clean energy, but the leakage poses a major risk. Since the gases are five times heavier than air, they are difficult to spread and for the detection, monitoring, and warning of a variety of petrol leaks. These days, ordering an LPG cylinder only takes a text message. For their clients, petroleum companies have introduced IVRS (Interactive Voice Response), a user-friendly service. Our system protects from gas leakage; it detects leakage and takes control action over it. It is helpful for us to avoid explosions, and it also has provisions for automatic gas booking. It can be challenging to regularly check the fuel level in a petrol cylinder and determine how much fuel is left over for a reservation. LPG provider In People even neglects to make the reservation in the hectic lives and occupied schedules of today. Our system provides the solution in such circumstances. This is a real-world functional module that is being prototyped. The main goal is to create a low-cost system that can keep track of a particular household's cylinder level (weight) and send out an alarm if the cylinder becomes empty. Being safe and secure is essential right now, so we worked hard to design and create a device for this system that is so small that it may serve as a personal monitoring system. This item will be quite handy for the household. This will prove to be a multi-pronged strategy.

The Raspberry Pi combines a controller and a processor. It is a collection of single-board computers the size of a credit card that is simple to connect to a TV or computer monitor and many other displays, including TFT screens and LCD screens created especially for the Raspberry Pi in a range of sizes. Every computer has an operating system (OS) to direct the machine, and the Raspberry Pi has OSs like "RASPBIAN" and "NOOBS" as well. The Raspberry Pi Foundation, which supports the teaching of basic computer hardware capable of running the Linux operating system, developed these operating systems in the UK. A keyboard, mouse, and monitor can all be connected. Through its Ethernet port, it can also be used as a desktop computer and run its operating system remotely. a group of programmers who are fond of Raspberry Pi hardware.

Internet of Things (IoT) is is the developing and reliable technology that gives each machine with an IP address a unique identity. IoT is adept at facilitating internet-based communication across all universe-existing items so that the systems

may be audited, logged, and controlled for a variety of areas of interest. Three essential components make up an IoT system: sensors, network connectivity, and data storage applications. The IoT devices' sensors can speak with the central server directly or via gateway devices for data storage. Different IoT devices use a variety of sensors, including those for temperature, power, force, humidity, proximity, etc. A single gateway can manage multiple technologies and numerous sensors. Gateways keep an eye on different wireless standard interfaces. Backbone wireless or wired technologies, such as mobile, WI- FI, DSL, or fiber, are used by gateways to connect to the cloud. As seen in Fig 1, IoT also supports IPv4 and IPv6 protocols. There are enough addresses available to accommodate the rising demand for IoT devices because IPv6, which has a 128-bit IP address length, is supported. One of DTN's unusual properties is present in IoT. (delay-tolerant Tolerant Networks). It handles the logic variables' delay.

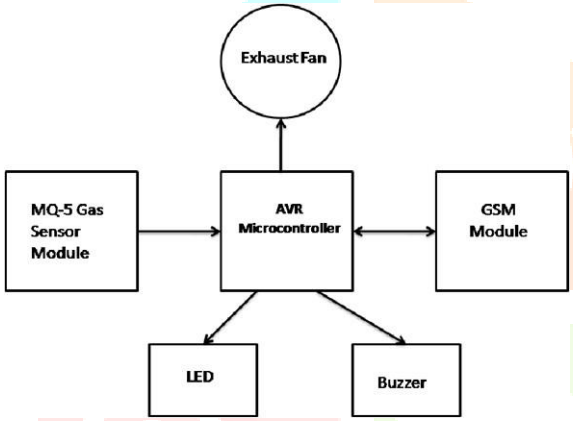


Figure: 1 Simplified IoT Architecture

II. PROPOSED WORK

Under the gas, cylinders are a pressure sensor and a weight scale sensor. It weighs the cylinder and gauges the force the petrol cylinder applies to the ground. At the appropriate time intervals, experimental values are recorded from the pressure sensor and weight scale sensor. To the Raspberry Pi board, these values are transmitted. When the petrol in the cylinder drops below the limit value, an alert is sent to the consumer's mobile number by putting up a weight limit or pressure limit based on the experimental values that were recorded. It can be operated using a safety mechanism, and if there is a gas leak, the gas sensor and stepper motor attached to the device automatically detect the leak.

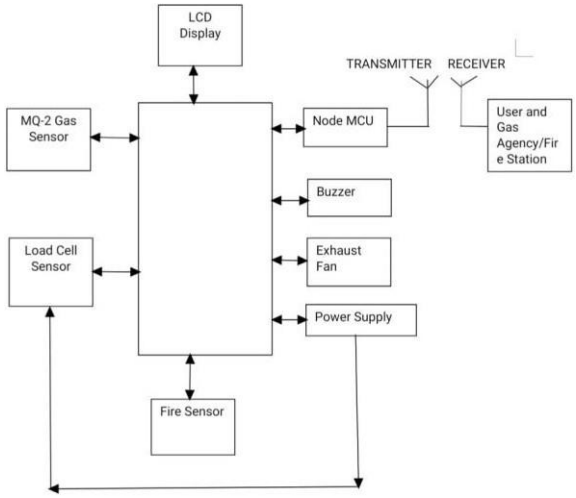


Figure: 2 Proposed Block Diagram

A.ARDUINO UNO

A microcontroller board called Arduino UNO is based on the ATmega328P. It contains 6 analog inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB cable, an AC-to-DC adapter, or a battery to power it. You can experiment with your UNO without being overly concerned about making a mistake; in the worst case, you can replace the chip for a few dollars and start over.

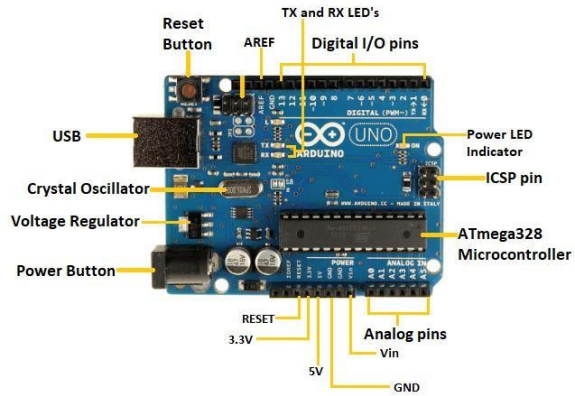


Figure: 3 Arduino Uno

B. Internet of Things

The Internet of Things (IoT) is a network of individually identifiable embedded computing systems that are a part of the actual Internet infrastructure.

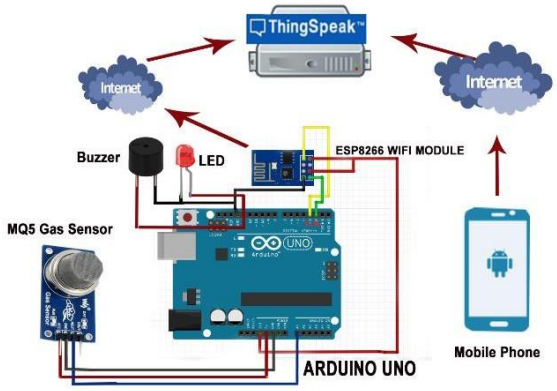


Figure: 4 IoT Architecture for LPG Monitoring System

C. Load Cell

An electrical signal produced by a load cell is directly proportional to the force being measured. Hydraulic load cells, pneumatic load cells, and strain gauge load cells are some of the several types of loadcells.

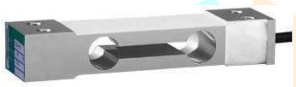


Figure: 5 Load Cell

Th The force being sensed deforms a strain gauge via a mechanical design. A change in resistance, which is a measure of the applied forces, is how the strain gauge determines the degree of contortion. Four strain gauges are often arranged in a Wheatstone bridge configuration to form a load cell. There are also half-bridge or quarter-bridge load cells available. Before it can be subjected to additional processing, the electrical signal output, which is normally in the range of a few millivolts, must be amplified using an instrumentation amplifier. To calculate the force delivered to the load cell, scale the output of the loadcell.

Figure: 6 Load cell Setup

Electrical signals corresponding to the load exerted on the strain gauge load cell will be produced. The strain gauges are secured to a beam or other structural component that deforms under load. for greatest sensitivity and four strain gauges are utilized for temperature correction. Two of the four are in compression, while the other two are wired for compensation adjustments and will be in tension. A spring is used in the strain gauge load cell to measure the strain. Compression or tension may be monitored so precisely in the strain gauge load cell. Measurement gauges are used in the differential bridge for accuracy. The electrical resistance is related to the applied weight that varies with strain. Strain gauge load cells are more expensive per unit and have lower accuracy levels than other load cells.

Nonlinearity: At the low end of their range, load cells tend to be nonlinear. This is crucial for cells that can handle transient overloads or shocks, such as those caused by rope clamps, or cells that can sense very wide ranges of objects. Thus, the calibration curve needs more points.

Wiring: Four-wire configurations are often available for full-bridge cells. The wires at the top and bottom of the bridge are used for excitation, and the wires on the sides are used for the signal (labeled S+ and S). The voltage differential between S+ and S should ideally be zero under no loads and increase in direct proportion to the mechanical load acting on the load cell.

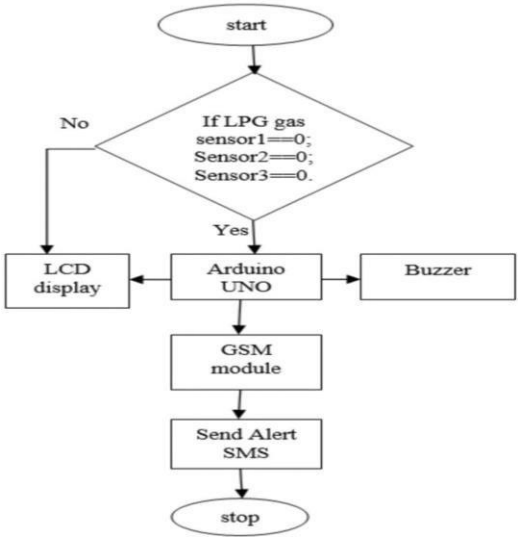
Wiring colors: Black, red, white, and green are the most frequently assigned colors for Ex, Ex+, S, and S+, respectively. White for Ex, red for Ex+, blue for S, and green for S+, or red for Ex+, blue for S, green for S+, and yellow for S, are less frequent assignments.

D.GAS SENSOR (MQ-2)

A petrol sensor is a sensing device that is a component of a safety system and that detects the leaking of gases in an area. This kind of gadget can be combined with a control system to automatically stop a process when it detects gas exposure or other pollution. When there is a leakage incident in the work area, a gas detector beeps to alert the operators. This kind of apparatus is necessary since many gases can be fatal to organic life, including people and animals.

Figure: 7 Gas Sensors (MQ-2)

E. Flow chart for LPG Gas monitoring and control system



III. SOFTWARE

A tollgate for developing GUI apps is Arduino IDE. It combines the popular IDE library and the Python programming language. One of the most reliable GUI libraries is the IDE library. Riverbank Computing develops Arduino IDE.

A group of IDE modules makes up Arduino IDE. There are 6000 methods and 440 classes in it. This multiplatform tollgate runs on all major operating systems. Arduino IDE has dual licensing. A GPL or a commercial license are the two options available to developers. The GPL version was previously restricted to UNIX systems. Beginning with Arduino IDE version 4, the GPL license is available on all platforms that are supported.

The QtCore module contains non-GUI features. Time, directories and files, streams, URLs, different data kinds, mime types, and threads or processes can all be handled by this module. The QtGui module is made up of linked classes and graphical elements. Button, window, status bar, toolbar, slider, bitmap, color, and font additions are a few examples of what they add. The Qt network module contains the classes needed for network programming. By improving the network, these classes accelerate the development of

TCP/IP and UDP clients and servers. programming clearer and easier to carry. XML files are housed in cases in the QtXml. Both the DOM and SAX APIs are compatible with this module. Classes for displaying the contents of SVG files are provided by the QtSvg package. The OpenGL library is used to interpret 3D and 2D graphics through the QtOpenGL module. The module can also make it possible to integrate content for the open GL library with the Qt GUI library. The QtSql module offers classes for working with databases.

IV.WORKING ON THE PROJECT

Then, connect the MQ-2 gas sensor to the Arduino. As a result, you need to attach the petrol sensor's VCC pin to the Arduino's 5 V pin. The petrol sensor's GND pin should then be connected to the Arduino's GND pin. Connect the MQ-2 gas sensor's OUT/A0 pin to the Arduino's analog-0 pin. Now, as shown in the diagram, connect the 162 LCD to the Arduino's digital pins. For further details, see our article on how to link an Arduino to a 162 LCD panel. After that, attach the digital pin of the Arduino to the green LED's positive leg. Connect the positive leg of the red LED to it.

The buzzer is attached to the Arduino Uno so that it can alert customers of gas leaks. With the proposed system, we made use of a web application that allowed us to access a cylinder valve and control it from anywhere in the world. The server receives updates from this webpage on the weight of the cylinder and the status of leak detection. We have an LX Terminal and Main Window that show the gas leakage detection and cylinder volume.

Example: The "queuing hypothesis" can be used to solve the issue of reducing congestion and delays in serving customers for cylinder refills.

a. The number of consumers waiting for cylinders and the number of employees working on cylinder refills

b. The typical number of customers that arrive for refills and the total number of customers served in a given period

d- b/c (circulation density) (circulation density) number of servers

N: The total number of clients A (a)average number of customers using the refilling service.

the average amount of patrons waiting for cylinder refills

The number of arrivals as of a specific time, T (t).

(I) FIFO [m/m/1/∞]: i) $P(N \geq a) = \sum_{N=a}^{\infty} p_a = p^n$

ii) $A(a) = \sum a p_a$

iii) $A(b) = \sum_{a=1}^{\infty} (a-1) p_a$

iv) $W_t = \frac{A(a)}{b}$ (In system)

v) $W_{tq} = W_t - \frac{1}{c}$

(II) Average length of the queue for cylinders

$$A(b) = \frac{b^2}{c(c-b)} = \frac{(\frac{11}{6})^2}{2(2-\frac{11}{6})} = \frac{121}{12} = 10.08$$

(III)Average time customers waiting in queue for service

$$W_t = \frac{A(a)}{b} = \frac{11}{11/6} = 6 \text{ min}$$

(IV) Average time customer waits in queue, before reaching this service

$$W_{ts} = W_t - \frac{1}{c} = 6 - \frac{1}{2} = 5.5 \text{ min}$$

2) FIFO [m/m/1/N]: i) $A(a) = \sum_{a=0}^{N} ap_a$

ii) $A(b) = \sum_{a=1}^{N} (a-1)p_a$

iii) $W_t = \frac{A(a)}{b^1}$ [b^1=b $(1-p_a)$]

iv) $W_{ts} = \frac{A(b)}{b^1}$

3) FIFO [m/m/c/∞]: i) $P(a \geq c) = \sum_{n=c}^{\infty} p_a$

ii) $P(a<c) = 1 - p(a \geq c)$

iii) $A(a) = \sum_{a=c}^{\infty} (a-c)p_a$

iv) $A(a) = A(b) + \frac{b}{c}$

v) $W_t = \frac{A(b)}{b}$

vi) $W_{ts} = W_t + \frac{1}{c}$

V. HARDWARE RESULTS

To make booking the refill easier, it was constructed so that the load value from the load cell lowers from a predetermined number supplied in the code.

Figure: 8 Pictorial views of kit

Figure: 9 Web page-based app for monitoring and control system

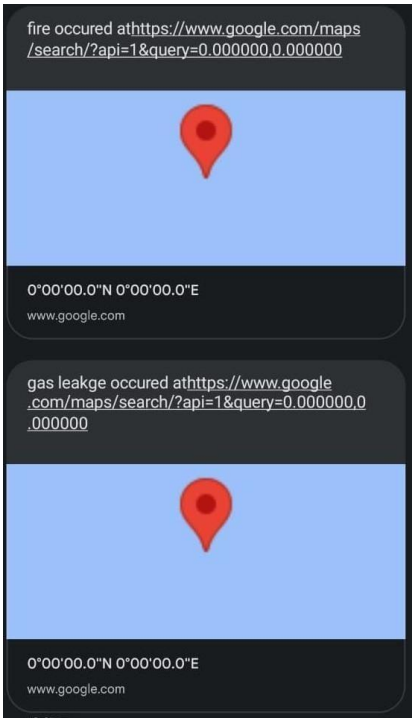


Figure: 10 SMS displaying instantaneous gas leakage and fire leakage location

Figure: 11 When there is no load (initial stage)

Figure: 12 when the load is shown of the latitude

Figure: 13 When there is no load with gas leakage

Figure: 14 when there are load shows the longitude

Figure: 15 When there is fire is leakage

VI. CONCLUSION

This method can regulate the leakage of LPG gas by employing a DC motor to control the regulator while simultaneously detecting the leak. We all rely on LPG cylinders for our daily activities, but we lack adequate safety precautions. An innovative way to guarantee that this system will have future potential and be scalable is to leverage the Internet of Things, as it might be integrated with other home automation systems. This system was successfully planned, suggested, and implemented with a cost-effective gas leakage detection system. This provides a method for gas booking, and real-time weight measurement of the gas, and maintains the information in a database using a web page. It also detects gas leaks. We created a web application to make sure we could check.

VII. FUTURE SCOPE

For the commercial sector, speech recognition has long been a challenge. The tools frequently fall short of expectations, largely because the speech recognition environment as a whole is immature compared to where businesses would like it to be. Interactive voice response systems have at least created a product in the market. IoT applications using cloud computing technologies have a wide range, as is well known. More accurate measurements are required for cataloging cylinders in the proposed system. For precise measurement of the cylinder volume, the load cell calibration must be flawless. For immediate cataloging from the distributors of cylinders, we require a server coder.

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