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Design and Implementation of Automated GPS Enabled Gas Monitoring and Booking System with Loadcell Integration

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Abstract: This study method available for booking a Gas refill methods include online booking, telephonic booking etc. But sometimes we may forget to do the booking due to the various reasons. It will be difficult situation for the one who uses LPG gas for cooking regularly. So, we have proposed a new system which automatically book a cylinder when the gas is about to empty by sending a SMS. In our project we have used load cell to monitor the weight of the LPG gas regularly. The values are next feed to the microcontroller. If the gas level is cross below the threshold level, then a SMS will be sent to gas agency automatically to book the new cylinder. Then a reply SMS will be sending to the customer about the booking status. In addition to that gas sensor is used to detect gas leakage in the home. If any gas leakage detected automatically, it will send SMS to the fire station. GPS will track the live location and update the location of the incident through GSM. At the same time application software is developed in the gas agency to inform and record the booking.

I. INTRODUCTION

LPG is made up of Commercial Propane and Commercial Butane having saturated as well a sun saturate hydrocarbon. Because of its versatile nature of LPG it is used in many needs such as domestic fuel, industrial fuel, auto-mobile fuel, illumination etc. and the demand for LPG is continuously increasing day by day. The liquefied petroleum gas is used widely in homes, industries and in auto-mobiles as fuel because of its desirable properties which include high calorific value, it creates very less smoke and does not cause much harm to the environment. Natural gas is another widely used fuel in homes. Both burns to produce clean energy, however there is a serious threat about the leakage. The gases being 5 times heavier than air do not disperse easily and may lead to suffocation when inhaled also the leakage gases when ignited may lead to explosion. The number of deaths due to the explosion of gas cylinders has been increasing in recent years. There is a need for a system to detect and also prevent leakage of LPG. Our system provides security from the gas leakage; it detects leakage and takes control action over it. It also intimates the live location to the fire station. It is helpful for us to avoid explosion it also has provision for automatic gas booking.

II. LITERATURE SURVEY

The LPG Gas Monitoring and Booking System with Loadcell Integration is a novel approach to managing LPG gas consumption in households and commercial settings. This system is designed to monitor the level of LPG gas in the cylinder and provide timely notifications for refilling, as well as integrate with a loadcell to accurately measure the amount of gas consumed[2].

The loadcell integration feature of the system ensures accurate measurement of LPG gas usage, thereby enabling consumers to better manage their gas consumption and costs. The system also includes a booking feature that allows consumers to schedule refills in advance, eliminating the need for manual monitoring and reordering.

The LPG Gas Monitoring and Booking System with Loadcell Integration is built on a microcontroller-based platform that uses wireless communication to transmit data to a centralized monitoring system[2]. This system is designed to be user-friendly and can be easily installed in any household or commercial setting, providing a cost-effective solution for LPG gas management.

The system monitoring capabilities allow for proactive maintenance and timely replacement of gas cylinders, ensuring that consumers never run out of gas unexpectedly. In addition, the system's loadcell integration feature ensures that gas usage is accurately measured, enabling consumers to better manage their gas consumption and costs[8].

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Overall, the LPG Gas Monitoring and Booking System with Loadcell Integration is a highly innovative and practical solution for LPG gas management, providing accurate monitoring and timely refill notifications, as well as accurate measurement of gas consumption. This system is expected to significantly improve the efficiency and effectiveness of LPG gas management in households and commercial settings[13].

III. EXISTING SYSTEM

Various methods for gas booking are there in current system. This system shows that there is more time required to deliver LPG after booking. There is no such facility of continuous gas level monitoring system, no provision for gas leakage detection and control action on gas leakage. We all are very busy in our daily life and it is difficult to know the status of LPG gas cylinder. If LPG is going to finish without informing us it can create very difficult condition for cooking etc. There is no facility for gas leakage detection and control action.

IV. PROPOSED SYSTEM

Our proposed design can help us to avoid such kind of problem in our daily life. Our design is based on microcontroller, it can track LPG emptiness all the time if LPG is very close to finish or at empty level then it can alert us by sending SMS to owner along with location and call to the concerned person indicating that low gas level. In addition to it can provide safety also by using gas sensor it can detect LPG leakage & start alarm and send SMS and calls continuously. It will automatically close the volve using servo motor and CPU fan will automatically ON. GPS will track the live location and update the location of the incident through GSM.

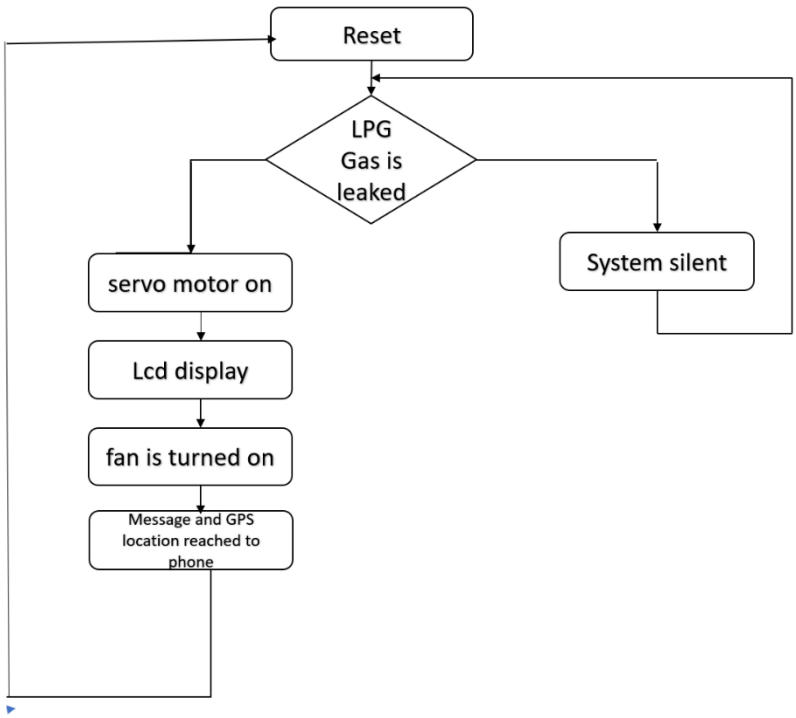

Fig 1: Flow chart of proposed system

V. BLOCK DIAGRAM

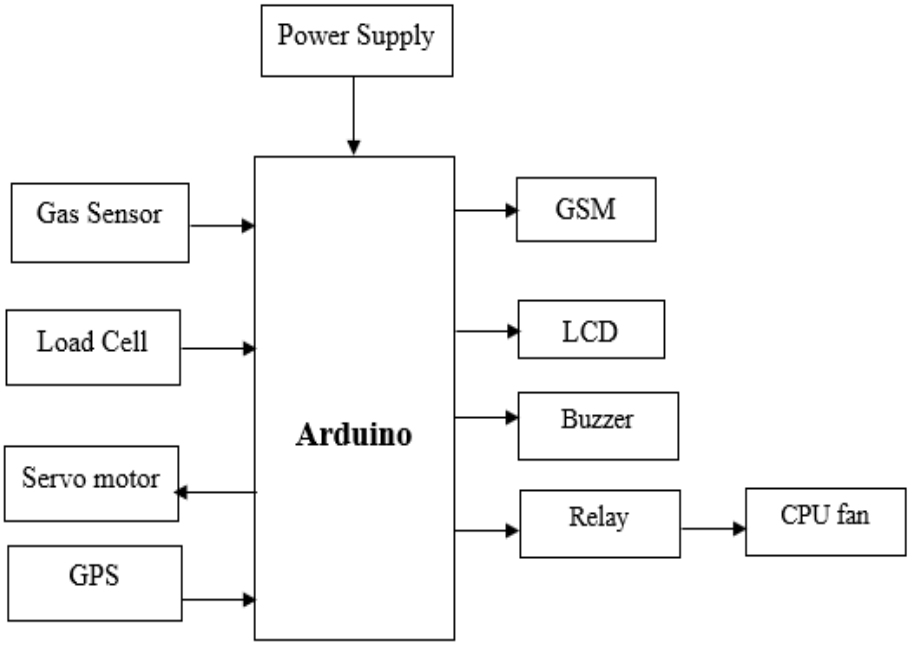

Fig 2: Block diagram of proposed system

VI. HARDWARE ARCHITECTURE DISCRIPTION

Arduino uno:

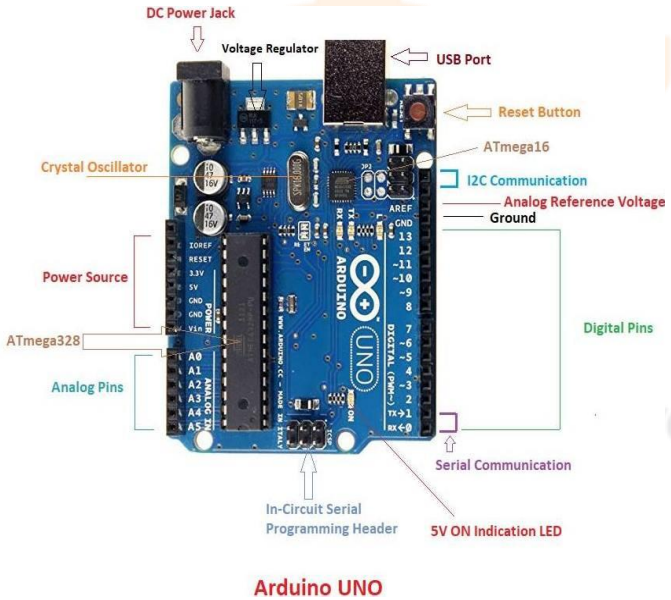

Fig 3: Arduino uno

The Arduino uno board is a popular open-source microcontroller board that is designed to be easy to use for beginners in electronics and programming. The board is based on the Atmega328p microcontroller chip and has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, and a power jack. The digital pins can be used for digital input/output, pulse width modulation (PWM), and communication with other devices via protocol such as SPI, I2C, and UART, Additionally, the analog inputs can be used to measure voltages within rages of 0 to 5 volts.

13KB of flash memory is used to store the number of instructions in the form of code. The board is powered up in three ways i.e USB, Vin pin the board or DC power jack. Arduino uno comes with built-in LED providing HIGH value when it gets turned ON and LOW when it gets turned OFF. Serial communication is carried out through two pins called pin 0(Rx) and pin (Tx). Here Rx pin for receiving data and Tx pin for transmitting the data.

MQ2 gas sensor:

The MQ-2 sensor is a gas sensor that can detect various gases, including smoke, propane, methane, and carbon monoxide. It uses a small heater to heat a sensing element made of a metal oxide semiconductor. When a gas molecule comes into contact with the sensing element, it causes a change in its resistance, which is then measured and converted into an analog voltage output. The MQ-2 sensor is widely used in gas leakage detection systems, fire detection systems, and air quality monitoring systems due to its high sensitivity to combustible gases.

Fig 4: MQ2 Gas sensor

However, the MQ-2 sensor has some limitations. Its sensitivity to different gases can vary, and it requires periodic calibration to ensure accurate readings. Additionally, the sensor has a warm-up time of around 24-48 hours before it can provide reliable readings. Furthermore, the sensor can also be affected by environmental factors such as temperature and humidity, which can affect its readings.

Load cell:

A load cell is a device that measures force or weight by converting it into an electrical signal. It is used in various applications, such as weighing scales, industrial automation, and laboratory testing. Load cells come in different shapes and sizes, but most of them consist of a metal body and one or more strain gauges.
The strain gauges are attached to the metal body and change their resistance when a force is applied to the load cell. This change in resistance is proportional to the force applied and is measured using a Wheatstone bridge circuit. The output voltage of the load cell is then amplified and sent to a microcontroller or a digital display.

Load cells can measure both static and dynamic forces and can have a high degree of accuracy and precision. They can be calibrated to measure different ranges of force and can withstand harsh environments. Additionally, load cells can be used in combination with other sensors, such as temperature and humidity sensors, to provide more accurate readings.
There are different types of load cells, including compression load cells, tension load cells, and bending beam load cells. Compression load cells measure force by compressing a metal body, while tension load cells measure force by stretching a metal body. Bending beam load cells measure force by bending a metal beam and are commonly used in weighing scales.

Fig5: Load cell

Servomotor:

A servomotor is an electromechanical device that is used to control the position of an object. It is a rotary actuator that uses a control signal to precisely control the speed and position of its output shaft. The servomotor consists of a motor, a gearbox, a control circuit, and a feedback mechanism.

Fig 6: Servomotor

The control circuit of a servomotor receives a signal from a microcontroller or other control device, which determines the position and speed of the output shaft. The feedback mechanism, which is usually a potentiometer, provides information about the actual position of the shaft to the control circuit. The control circuit compares the desired position with the actual position and adjusts the output signal to the motor to achieve the desired position.

Servomotors are used in a wide range of applications, such as robotics, industrial automation, aerospace, and automotive industries. They are known for their high accuracy, precision, and repeatability, making them ideal for applications where precise control of position and speed is required.

GPS:

GPS (Global Positioning System) is a satellite-based navigation system that provides accurate location and time information. It is widely used in embedded systems for various applications, such as vehicle tracking, asset tracking, and navigation systems.
GPS works by receiving signals from multiple satellites in orbit around the Earth. The GPS receiver calculates its position based on the time it takes for the signals to reach it from the satellites. The accuracy of GPS depends on the number and position of the satellites that are in view of the receiver.

Fig7: GPS

In embedded systems, GPS is typically used in combination with other sensors, such as accelerometers and gyroscopes, to provide more accurate and reliable navigation information. The GPS receiver provides information about the device's location, while the other sensors provide information about its orientation and movement.
GPS is available in different formats, including modules that can be easily integrated into embedded systems. These modules typically provide a serial interface for communication with the host device and can be programmed to provide different levels of accuracy and functionality.

GSM:

GSM (Global System for Mobile Communications) is a standard for digital cellular communications used for mobile devices. It is widely used in embedded systems for various applications, such as remote monitoring, control, and communication.
GSM works by transmitting data over a cellular network using radio waves. The data is encoded and transmitted over a series of base stations, which are connected to the public switched telephone network (PSTN). The GSM standard includes various features, such as voice communication, text messaging, and data transmission.

In embedded systems, GSM is typically used for remote communication and control. For example, a device with an embedded GSM module can send and receive data over a cellular network, allowing it to be controlled or monitored from a remote location. This is particularly useful for applications such as remote monitoring of industrial equipment, environmental sensors, or security systems.

Fig 8: GSM

GSM modules for embedded systems are available in different formats, including compact modules that can be easily integrated into embedded systems. These modules typically provide a serial interface for communication with the host device and can be programmed to provide different levels of functionality, such as voice communication or data transmission.

LCD:

In embedded systems, LCD displays are a popular choice due to their low power consumption and ability to display clear, easy-to-read text and graphics. LCD displays typically require a small number of pins to control, making them well-suited for use in embedded systems with limited I/O resources.

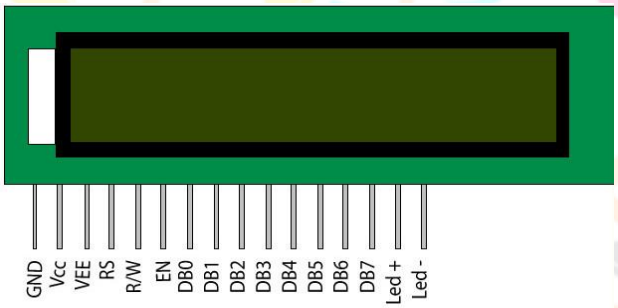

Fig 9: LCD display

Passive matrix LCD displays are often used in embedded systems due to their lower cost and simpler design. However, active matrix displays can offer faster refresh rates and higher resolution, making them a good choice for more demanding applications.
One challenge with using LCD displays in embedded systems is the need to manage the display's power consumption to avoid draining the system's battery. This can be achieved by controlling the backlight and adjusting the display's brightness based on ambient lighting conditions.
Another consideration is the physical size and durability of the display. Small, ruggedized LCD displays are available for use in harsh environments, while larger displays may require protective enclosures.
When selecting an LCD display for use in an embedded system, factors such as cost, resolution, and compatibility with the system's microcontroller or processor should be taken into account.

Buzzer:

A buzzer is a simple but versatile device used in embedded systems to generate audible alerts or notifications. It is an electro-acoustic transducer that converts electrical signals into sound waves. This makes it easy to use in embedded systems, as it can be driven using simple digital signals from the microcontroller or processor. Buzzer is commonly used in applications such as alarms, timers, and notifications. It can produce a range of sounds, from simple beeps to more complex melodies, depending on the type of circuitry and driver used. Buzzer can also be used in combination with other sensors or modules, such as temperature sensors, to create more sophisticated warning systems. Additionally, buzzer is typically small and lightweight, making it suitable for use in portable or handheld devices. It can be made more versatile by incorporating features such as adjustable volume or tone. Overall, buzzer is a cost-effective and reliable component for adding audible feedback to embedded systems.

Fig 10: Buzzer

VII. WORKING OF PROPOSED SYSTEM

When the Gas level reaches certain low level than the threshold weight of gas cylinder, then we receive a message to the mobile number indicates about the status of gas cylinder is empty. Here load cell is used for measuring the Weight of the gas cylinder continually. If gas is leaked out, then mq2 gas sensor detects the gas leakage and gas valve gets turned off automatically with the help of servomotor to regulate the gas leakage from the gas cylinder. GSM send a message to our mobile like gas is leaking. In this system buzzer is used as alarm indicating gas is leaking. Whenever the gas is leaked out fan gets turned on to pump gas leakage towards the outside. It intimates live location to the near fire station whenever heavy gas leakage is happened.

VIII. RESULTS

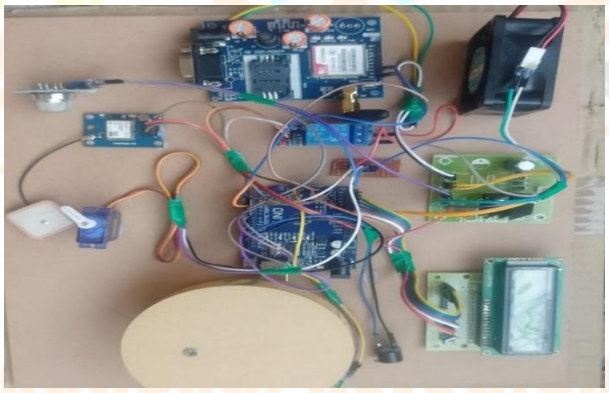

Fig 11: Circuit connections

The above figure shows the connection of the circuit. Gas level reaches certain low level then threshold voltage it sends a message to our mobile phone like to cylinder is empty and buzzer indicates gas reaches certain low level.

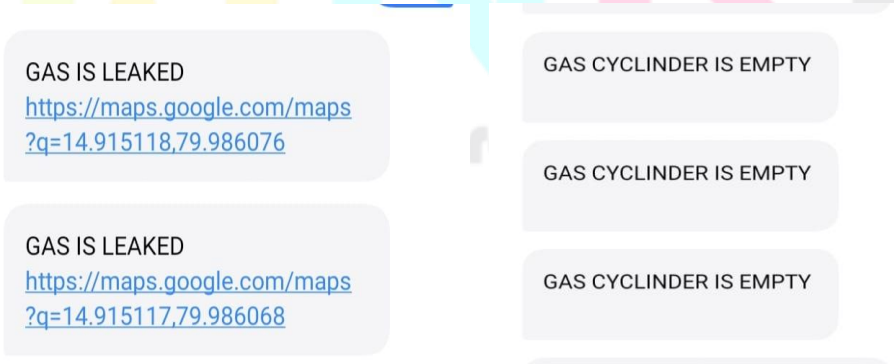

Fig 12: Messages received to our mobile through the GSM

Gas is leaked around the gas sensor immediately servomotor is turned on to switch off the gas valve and fan gets turned on to send the gas leakage to the outside. Whenever gas is leaked, we will get a message to our mobile phone and exact location of the accident place will be intimated to fire station.

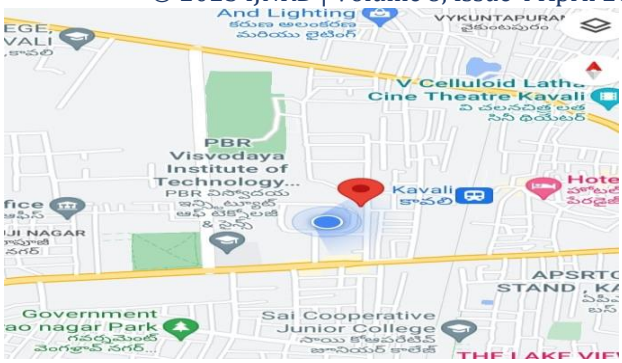

Fig 13: GPS Location

IX. CONCLUSION

This study is to know the status of LPG gas cylinder. If LPG is going to finish without informing us it can create very difficult condition for cooking etc. This project is used to continuously monitor the weight of the LPG gas cylinder. Many times, we observe that in our home whenever LPG gas cylinder is empty, then we give request for new cylinder at the office of LPG gas provider. Many times, it happens that because of shortage of LPG gas cylinder, there is delay in providing gas cylinder. To overcome this drawback, we introduced this system. In this system, we proposed an LPG gas weight monitoring and Leakage detection System. If heavy gas leakage is happened it intimates live location to the fire station. This is useful in various applications in homes and hotels. Our proposed design can help us to avoid such kind of problem in our daily life. Our design is based on microcontroller, it can track LPG emptiness all the time if LPG is very close to finish or at empty level then it can alert by sending SMS to owner In addition it can provide safety also by using sensor it can detect LPG leakage & start alarm.

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