

Smart LPG Gas Monitoring and Automatic Booking with Alert System

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Abstract - In recent years there has been a rapid development in science and technology which has made human life easier in several aspects. LPG fuel is widely used for domestic cooking, in several industries and other sectors. Users have a quite difficult time in determining the gas available in the cylinder, which normally creates delays in day to day work. This paper is based on the application of IOT used for continuous monitoring the amount of LPG available in household cylinder and is helpful in booking a new LPG cylinder based on the user configuration settings. This system provides both manual and automatic mode of LPG gas booking that allows the users to select the type of mode from the interactive webpage.

This system will also alert the users to inform about the availability of gas amount in real time by sending an SMS message to the registered mobile number when the LPG level gradually falls low depending on the usage. LPG status can also be checked in dynamic webpage.

Key Words: ESP32S, Internet of Things (IOT), GSM module, Load Cell, Booking Configuration, Web interface.

1. INTRODUCTION

Internet of things (IOT) has a numerous benefit to human life wherein smart services are deployed to utilize every activity anywhere and anytime. All these activities and services are conveyed through the diverse applications are performed in the IOT environment and the most important utilities achieved by the IOT applications are monitoring and suitable decision making for an efficient management. Liquefied petroleum gas (LPG) cylinder plays a major role in our day to day life. The weight of the gas cylinder is 14.2 kg for domestic purposes and about 19 kg to 47.5 kg for commercial and industrial purposes. Petroleum companies in India have introduced the customer-friendly services to the users such as online booking and Interactive voice Response technique for reserving new cylinder by the users manually based on the number of days and its usage. However, in most of the times it has been found difficult for the users to book a new LPG cylinder manually as well as to judge the quantity of LPG available in the cylinder leads to confusion when the gas goes sudden empty and this is followed by an anxious wait as the cylinder would be dispatched based on its availability.

The aim of this paper is to design a smart and cost-effective system for a constant monitoring of LPG levels in cylinder and notifying the users at regular intervals through IOT in real time. The system places an order for a new gas cylinder when the gas level is critically low with minimal human intervention. This project eliminates the manual approach followed and hence there is no need for the users to call the distributor to reserve the gas.

2. RELATED WORK

In paper [1], the proposed system uses Arduino microcontroller and load cell to make the entire LPG cylinder booking procedure automated without human intervention. This system continuously measures the weight of the cylinder and once it reaches minimum threshold it will automatically sends message to the authorized LPG distributor so that they can deliver the LPG cylinder in time. The alert messages are notified by buzzing the buzzer and through SMS to the house holders.

In paper [2], the proposed system comprises of Arduino, load cell and LCD display to measures the weight of the gas cylinder. The Objective of the system is to continuously measure the weight of the cylinder and as soon as it reaches the minimum threshold it will automatically sends an SMS alert to the user as well as Authorized LPG dealer so that they can act accordingly.

In paper [3], the proposed system continuously measures gasoline content within the cylinder on regular basis. The system framework consists of weight measuring Load sensor interfaced with Arduino Nano microcontroller and the Bluetooth module for connectivity. The load cell is interfaced with Microcontroller for data reading and processing. The current status and booking notifications are notified to user on their mobile phones via Bluetooth module.

In paper [4], the proposed system will make the whole LPG booking system computerized with less human intervention. This framework uses Arduino Uno and load cell for constantly measuring gas present in the chamber. Users can check the day by day utilization of gas level through android application that is programmed to make automatic booking when the gas is exhausted and result is also displayed in LCD to notify nearby people.

In paper [5], the system uses PIC 16F877A microcontroller, load cell, GSM module and ESP8266 for LPG monitoring and detection purpose. This system ensures automatic booking of new gas cylinder using GSM module. Gas level is

monitored with the help of the load cell. The current level of the cylinder can be viewed at any time by using a mobile application (blynk). The booking of gas is made with the help of the GSM module and sends message to user and the gas agent regarding new cylinder booking.

3. EXISTING SYSTEM

There are several methods available now days to book a new LPG cylinder post empty of the cylinder. At present LPG refill can be booked immediately by using an Advanced LPG cylinder booking system from the comfort of customers. Most of the Gas Agencies have their own online LPG booking services, which enable customers to book a cylinder for refill without the hassle of calling or going to the gas dealership in person. Booking of new cylinder can also be done through IVRS system in which consumer will simply have to call on the designated number for the region/state and follow the instructions to book a cylinder. The customer must provide his/her customer ID after calling from the registered mobile number. The order number and estimated delivery date for a new LPG cylinder will be communicated to the customer at the time of booking and the payment is made on the day of delivery.

With all these existing services, consumers cannot keep the track of LPG consumption rate that helps to make early booking of new LPG cylinder. As a result, consumers cannot judge the amount of gas available in the cylinder leading to gas emptiness without notice.

4. PROPOSED SYSTEM

The proposed system comprises of an ESP32S microcontroller, load sensor, HX711, power supply board and GSM Module. Power is supplied to the system using voltage regulator, which will cut down the voltage from 12 V to 5 V DC that is used in the system. Load cell is placed under base of the cylinder. When the system is powered on, power supply board distributes the power to all components connected to it. The main role of the GSM module is to send SMS messages, containing current LPG level status to registered mobile number when it is executed from the microcontroller. Load cell will convert the weight upon it into an electrical voltage. This electrical voltage is converted into digital signals by HX711 amplifier to get measurable data values from the load cell. This digital signal is passed as an input to the microcontroller device, which compares the measured value with a threshold. The result is then transmitted to the cloud using IOT technology. Interactive dynamic webpage is designed to display all the real time data and it also provides the user to select any one from the below mentioned options for cylinder booking configuration.

Manual mode: The system does not place an order for a new cylinder but only alert SMS will be sent to user to notify the current gas level status and to book for a new cylinder,

user needs to login to the webpage and provide necessary user credentials.

Auto mode: The system will automatically book a new cylinder when the LPG level is less than threshold value and upon booking, successful SMS will be sent to the user.

4.1 Block Diagram

The below diagram represents the block of Smart LPG gas Monitoring and Automatic Booking with Alert system. In this, the weight of the cylinder measured by load cell module. The GSM module sends alert message to the user.

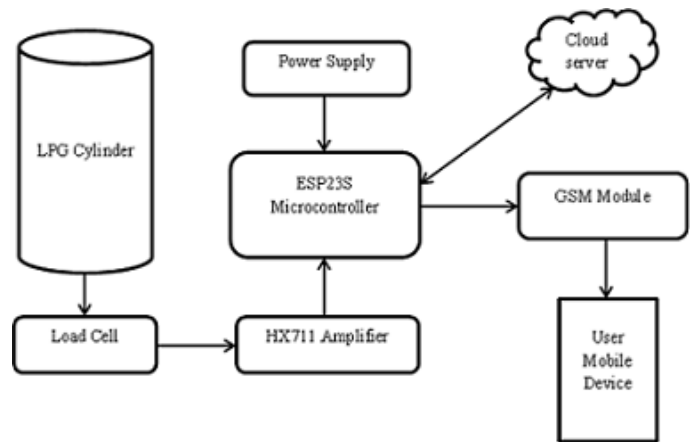


Fig-1: Block Diagram of the proposed system

4.2 Description

This system consists of the following components

4.2.1 Load sensor



Fig-2: Load Cell

Load sensor is a transducer that acts as a weight sensor with a capacity of 40kg. This converts an input mechanical force such as load, tension, compression, or pressure into an electrical output signal that can be measured. The electrical signal changes proportionally to the force applied upon it. Load cell sensor continuously measure weight of cylinder if

weight of cylinder is below particular level then it will send sensor value to microcontroller interface port from where the data from sensor is fetched for processing. By connecting the module to the microcontroller, it is possible to read the changes in resistance of the load cell and with some calibration.

4.2.2 ESP32S Microcontroller



Fig-3: ESP32S

ESP32S is a microcontroller with integrated Wi-Fi and dual-mode Bluetooth. It has 38 digital input/output pins, a USB connection, enable, boot pin, a power jack, and targets a wide variety of IOT applications. It has 2 CPU cores that can be individually controlled or powered. The clock frequency is about 80 MHz to 240 MHz. ESP32 integrates with different kinds of peripherals, ranging from different touch sensors, low noise sense amplifiers, SD card, interface, Ethernet, UART, I2S and I2C.

4.2.3 Global System for Mobile Communication (GSM) module



Fig-4: GSM

A GSM Module is used to enable communication between a microcontroller and the GSM / GPSR Network. A GSM Modem comprises of a GSM Module along with some other components like communication interface (like Serial Communication), power supply and some indicators. With the help of this communication interface, GSM module can connect with an external computer (or a microcontroller).

4.2.4 HX711 Module

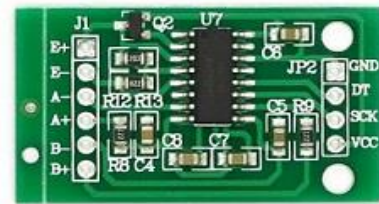


Fig-5: HX711

HX711 is the amplifier specially designed for load cell interfacing. This allows electrical voltage from the load cell into measurable weight. This amplifier is used for converting the Analog signals received from load cell to digital signals for functioning of microcontroller.

5. EXPERIMENTAL OBSERVATIONS AND RESULTS

The hardware connection and system implementation are shown in the figure. LPG cylinder is place on top of the load cell. This continuously monitors the weight of cylinder. Analog signals from the load cell is converted to digital signal using HX711 amplifier and passed as an input to the ESP32S microcontroller device, which compares the measured value with a pre-determined threshold value and response is updated to server. If the measured load cell value is less than threshold and according to type of booking mode configuration set by the user, the microcontroller will execute GSM module to send SMS alerts to the registered user to notify current LPG level and booking status.



Fig-6: Prototype model of the proposed system



Fig-7: Interactive web user interface

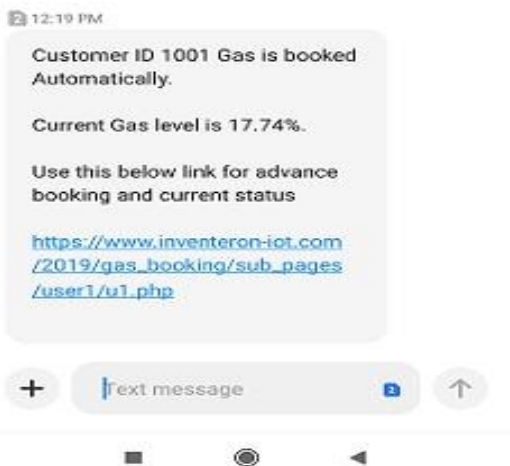


Fig-8: SMS alert sent to user mobile for auto mode

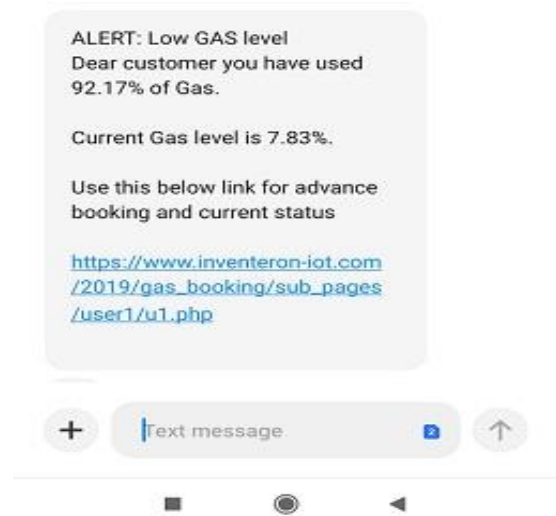


Fig-9: SMS alert sent to user mobile for manual mode

6. CONCLUSIONS

The objective of the proposed model is to develop a system for continuous monitoring, alert and automatic/manual user configured booking of LPG cylinder. The web interface is designed with multiple features such as user authentication, LPG level display in real time, provide the user to select either automatic or manual type of booking, history of bookings details. If measured load cell values is below the threshold then SMS alerts is sent to user and booking is done based on the user's booking configuration setting.

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