IOT Based Automatic LPG Gas Booking And Leakage Detection System

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***Abstract*— LPG gas is the most commonly used Domestic fuel in every household. Booking of the new gas cylinder manually is time consuming. In this fast growing technology, it is not feasible for a person to spend time booking manually when this technology can be used to do such tasks. So, using IOT gas booking can be done simple. Gas booking can be automated by knowing the status of amount of gas in the cylinder using Load cell, weight sensor. When the weight of the cylinder goes below a specified limit, it is notified to the gas agency directly thus booking the new cylinder. Many of the domestic accidents occur due to the leakage of LPG gas. It is dangerous if it is inhaled and also if its level increases it may explode. So, as the safety plays an important role this IOT project is also designed for detection of LPG gas leakage. The gas is detected using MQ2 gas sensor and the concentration is measured in ppm. When the concentration goes beyond a specified amount, it is notified to the user asking to take the necessary actions.**

Keywords*— IOT, Load cell, MQ2 gas sensor, Nodemcu

I. Introduction

Now a days Technology has advanced such that any work can be done easily and in less time. Manual gas booking is a time consuming process in which the amount of gas in the cylinder is not known exactly and is known only after the gas in the cylinder is empty. Then the cylinder is booked and it may take a week to get the new cylinder. If the amount of gas is known, it is possible to book the cylinder before it is empty and can get the new cylinder. Using IOT this job can be done easily. So, this IOT project is designed for automatic gas booking. Many of the domestic accidents occur due to the unawareness of the leakage of gas. LPG gas is a mixture of propane, butane and propylene and it is highly flammable. The permitted level for butane is 600 ppm above which it is not safe [6]. Whenever the gas leaks, it will mix with the air and form a combustible mixture and explodes when it comes in contact with any spark. As safety plays an important role, this project is also designed to avoid the accidents that occur due to the leakage of LPG Gas.

Amount of gas is known by measuring the weight of gas cylinder. To measure the weight, Load cell a weight sensor is used. It continuously measures the weight of the cylinder and displays on an IOT platform, ubidots. A threshold level is set before the gas is completely consumed. And if the weight of the gas cylinder is less than the threshold, it is indicated using an indicator in ubidots and an email is also sent to the gas agency and the cylinder is booked automatically.MQ2 gas sensor is used to sense the gas leakage.MQ2 sensor module can detect LPG, smoke, alcohol, hydrogen gas etc. In this project it continuously measures the concentration of gases and the concentration is displayed on ubidots. whenever there is LPG gas leakage, concentration increases and the increase is displayed on ubidots. And if the increased concentration is more than a specified level it is dangerous, so an indicator is used to indicate this and an alert message is sent to the user.

II. Literature Survey

LPG gas was first introduced in 1910 by Dr. Walter Snelling. It is a mixture of commercial propane and butane. It is highly flammable and many of the accidents occur due to the leakage of LPG. Thus there is a need to detect and prevent the gas leakage [2], [3]. Gas detectors have been used for a long time and have wide range of applications in homes, paper pulp mills, refineries, industrial plants, refineries, aircraft etc. [8].

The system proposed by Digambar Surse1 et.al [7] uses ARM7 microcontroller. It uses MQ6 gas sensor to measure the concentration of gas. When there is gas leakage, it alerts the user through alarm and through message and turns off the main power supply. Load cell is used to measure the weight of cylinder. When the weight of the cylinder is below a threshold level of 2Kg,it sends SMS to gas agency using GSM module to book new cylinder. The system presented by Abid Khan et.al [4] uses 89C51RD2 Microcontroller, LCD Display, LED, Buzzer and GSM Modem. All the devices are connected to the microcontroller. LCD display continuously displays level of gas inside the cylinder. When the level is below a particular threshold, MS using GSM is sent to the user and gas agency to book cylinder.MQ6 gas sensor is used to detect the leakage of gas. When there is gas leakage, it activates buzzer and a message is sent to user.

The proposed system uses MQ2 gas sensor to sense the gas leakage and Load cell to measure the weight of cylinder. It uses NodeMcu micro controller and ubidots, IOT platform to send message and email to the user and gas agency. The following are the advantages:

- This system avoids the usage of GSM or Bluetooth modules to send messages. It allows to book the cylinder without the intervention of user and provides security from the gas leakage by sending message to the gas agency and the user using NodeMcu and ubidots.
- User gets to know about the gas leakage even without the internet connection in his mobile, only the wifi should be provided to the Nodemcu to which all sensors are connected.
- This system is easy to implement and use.

III. Implementation Setup

A. Block Diagram

The basic block diagram of the “IOT Based Automatic LPG Gas Booking And Leakage Detection System” is shown in the fig 1.

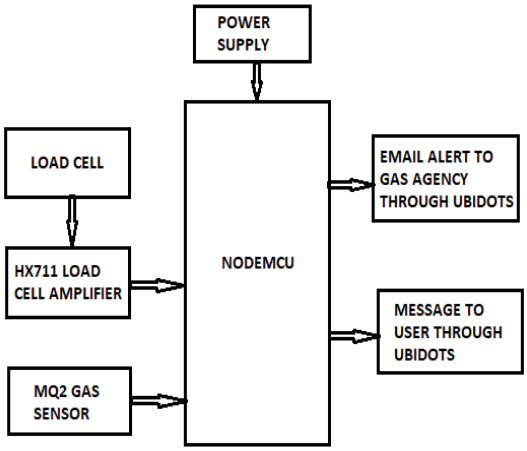

Fig. 1. Block Diagram

B. Components Required

- NodeMcu-12E
- Load cell
- HX711
- MQ2 Sensor
- wifi access
- Arduino IDE(software)
- ubidots IOT platform
- Mobile phone to receive message

C. NodeMcu-12E

NodeMcu is a microcontroller with ESP8266Wi-fi chip. So it can be connected to any network infrastructure. NodeMcu development board has an Analog pin A0 and Digital pins D0-D8 and has 3.3v internal voltage regulator and USB interface[5].Specifications:

- Power-5v power via micro USB port
- Dimensions-49*24.5*13mm
- USB-micro USB port for power (5v), programming and debugging
- Headers-2x 2.54mm 15-pin header with access to GPIOs, ADC, UART, SPI, and power pins.
- Misc-Reset and Flash buttons

The GPIOs 1, 3, 9, 10 (TX,RX,SD2,SD3) are mostly not used for GPIO purpose on development kit because they are used for other internal process. Several lines are used internally within the ESP8266 SoC, so we have about 11 GPIO pins remaining for GPIO purpose. And out of these 11 pins , only 9 general purpose pins are available (D0-D8) because 2 pins are reserved for TX and RX in order to communicate with the host pc .

D. Load Cell

Load cell is a weight sensor that is used to measure weights. It transforms pressure or force to electrical output and the electrical output is directly proportional to the force applied. Different types of load cells are available like strain gauge, hydraulic load cells.Number equations consecutively.

In this project strain guage load cell is used. It consists of four strain gauges connected in Wheatstone bridge form. It works on the principle of strain gauge. When force is applied on the gauge ,it becomes tensile or compressed resulting in change in length of the wire of the strain gauge .Since wire resistance is inversely proportional to the length, the electrical resistance of the gauge changes. This change in resistance is proportional to the force applied on gauge. The change in resistance of the gauge provides an electrical value change(in the order of mv) that is calibrated to the load placed on the load cell.

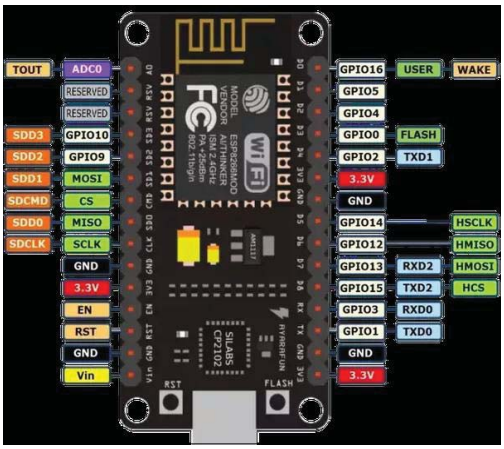

Fig. 2. NodeMcu board

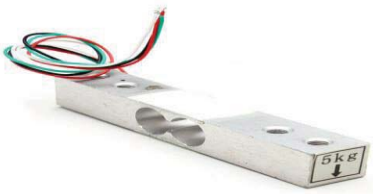

Fig. 3. Load cell

E. HX711

The electrical signal output available from the load cell is typically in the order of mv. So HX711 is used to amplify the small electrical voltage.HX711 has two analog input channels A and B. When a 5v supply is connected to AVDD of HX711, channel A can be programmed with a gain of 128 or 64 and channel B with a gain of 32. The wires coming from the load cell are connected to E+,E-,A-,A+ and the amplified output is taken from the serial data of the HX711 and given to the microcontroller.

Fig. 4. HX711

F. MQ2 Gas Sensor

MQ2 gas sensor module is used for the detection of gas leakage. It can detect gases like LPG, smoke, alcohol, hydrogen. Using analog pin of the sensor module, the concentration of the gas can be measured in ppm. Operating voltage is 5v and can be used as analog or digital sensor. Sensitivity can be adjusted by the potentiometer and has a Preheat duration of 20secs.

It has the following specifications:

- Working voltage:5V

- Heating consumption: less than 800mw
- Storage temperature: -20 _C -70 _C
- Detecting concentration scope of LPG:200-5000
- Ppm

Fig. 5 MQ2 Gas Sensor

G. *ubidots-IOT Platform*

ubidots is the IOT platform used in this project. Each ubidots user has API credentials which are to be included in the code. Then ubidots is connected to the hardware and the data measured by the hardware is sent to this IOT platform. Device is a virtual representation of data source in ubidots [1]. It takes data from the sensor and transmits to ubidots cloud through a connection protocol. Once device is created, it receives data from the hardware and is presented in a variable inside the device. This is done by using variable names in the code. After data is presented in a variable, it is added in the dashboards as widget to visualize the data. Users can visualize data in the form of a table or an indicator or a graph etc. Also alert message or email can be given to the users using events.

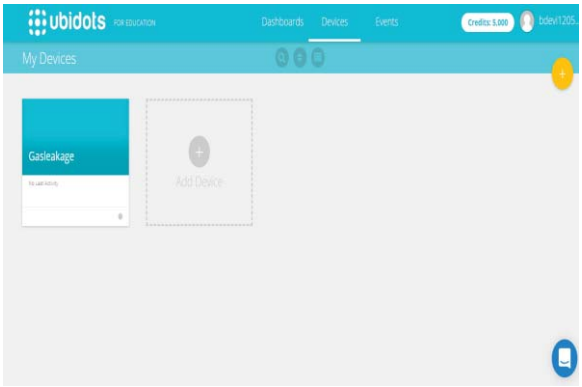

Fig. 6. ubidots-IOT platform

IV. System Setup

NodeMcu is powered by computer(5V) using an USB cable (or any external battery can also be used) and the ESP8266 is protected from the high voltage(>3.3V) by the inbuilt voltage regulator in the NodeMcu board. Cylinder weight measured by the Load cell is amplified by the HX711 Load cell amplifier and is sent to NodeMcu through the serial data pin of HX711 which is connected to the D2 digital pin of NodeMcu. The concentration of gas (in ppm) measured by MQ2 gas sensor is sent to the microcontroller through its analog pin which is connected to A0 of NodeMcu. The sensors are powered from Vin of NodeMcu.

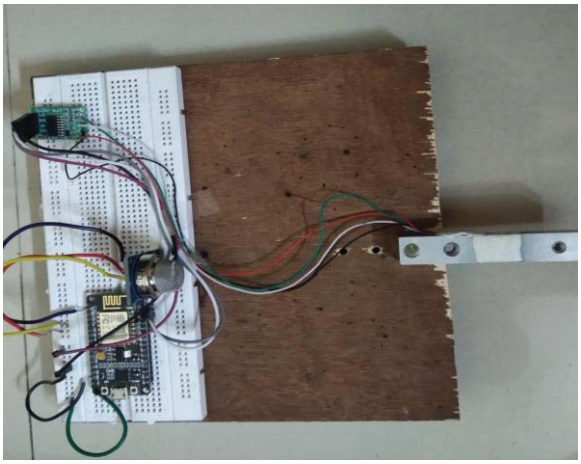

Fig. 7. System setup

Weight of the cylinder is continuously measured by the Load cell and is displayed on ubidots. When the weight is less than a specified level (410g is the level used in this project), indicator is used to indicate this by changing its colour from green to red and an email is sent directly to the gas agency asking them to book a new gas cylinder for the user. Thus the cylinder is automatically booked without the intervention of the user. Gas concentration is measured by the MQ2 sensor and is displayed on ubidots. when it is greater than a specified value (400ppm is used in this project), indicator changes from green to red and notification is sent to the user about the gas leakage asking to take necessary actions.

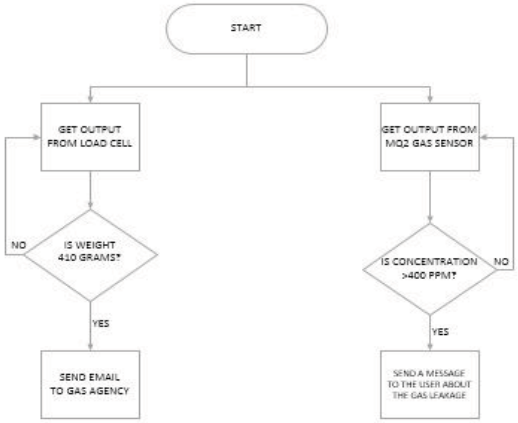

Fig. 8. Flow chart of the system

V. Results

Weight of the cylinder is displayed in the form of table on ubidots. If weight is 410g indicator colour changes to red and email is sent to the gas agency to book the cylinder.

Fig. 9. ubidots displaying weight of 170g

Fig. 10. ubidots displaying the weight of 410g and red indicator indicating less amount of gas in the cylinder

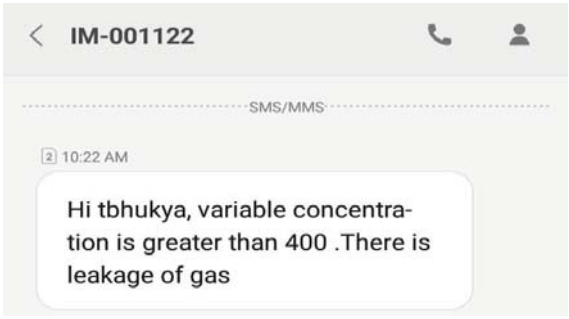

Fig. 11. notification sent to the user about gas leakage

Concentration of the gas is displayed in the form of table on ubidots. If concentration is above 400ppm indicator colour changes to red and is notified to the user.

VI. Conclusions

The proposed system is designed and successfully implemented. Load cell measures the weight of the cylinder and it sends the sensed data to NodeMcu which then sends to ubidots cloud through its Wi-Fi ESP8266.The data is displayed on ubidots and when the weight is less, indicator turns red and email is sent to the agency for gas booking. MQ2 sensor continuously measures the concentration of gas. When there is LPG gas leakage, concentration increases which is displayed on ubidots. If the concentration increases more than 400 ppm, indicator turns red and an alert message is sent to user.

VII. Further Scope

This system can be improved for automatic turn off of the gas valve. Robot can be implemented with this system to sense the gas leakages. Pressure sensor can also be used instead of load cell which measures the amount of gas in the cylinder and pressure of gas in the cylinder pipe.

References

[1] Maria Carlina Hernandez. Ubidots basics: Devices, variables, dashboards, and alerts.

[2] BD Jolhe, PA Potdukhe, and NS Gawai. Automatic lpg booking, leakage detection and real time gas measurement monitoring system. published in, 2013.

[3] MS Kasar, Rupali Dhaygude, Snehal Godse, and Sneha Gurgule. Automatic lpg gas booking and detection system. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN, pages 2278–8875, 2016.

[4] Abid Khan, Neju K Prince, Shailendra Kumar Dewangan, and Praveen Singh Rathore. Gsm based automatic lpg ordering system with leakage alert. IJRET: International Journal of Research in Engineering and Technology, 3, 2014.

[5] Fernando Koyanagi. Nodemcu esp8266: Details and pinout.

[6] Alan Macker, Anil Kumar Shukla, Sagarika Dey, and Jyoti Agarwal. sArduino based lpg gas monitoring automatic cylinder booking with alert system. In 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI), pages 1209–1212. IEEE, 2018.

[7] Digambar Surse, Swati Talekar, and Tejal Suryawanshi. Prof. mr gaikar.smart gas booking system & leakage detection. International Journal of Innovative Research in Computer and Communication Engineering

[8] Varma, Prabhakar S, and K. Jayavel. Gas leakage detection and smart alerting and prediction using iot. In 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), pages 327– 333, Feb 2017.