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Cloud Connected Smart Gas Cylinder Platform Senses LPG Gas Leakage Using IOT Application

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Abstract

This paper explains about the most common problem experienced in our day- to- day lives that is regarding GAS container going empty. We bring this paper to create awareness about the reducing weight of the gas in the container, and to place a gas order using IOT. The gas booking/order is being done with the help IOT and that the continuous weight measurement is done using a load cell which is interfaced with a Microcontroller (to compare with an ideal value). When it comes it to security of the kit as well as gas container we have an MQ-2(gas sensor), LM 35(temperature sensor), which will detect the surrounding environment for any chance of error. Whenever any change is subjected in any of the sensors (load cell, LM35, Mq-2) a siren (60db) is triggered.

Keywords: GAS, IoT, Wi-Fi, ARM, Temperature.

I. INTRODUCTION

In the past decade, there was an increase use of liquefied petroleum gases (LPG) and natural gas (consists mainly of methane) to meet the increasing demand for energy and replace oil or coal due to their environmental disadvantages. LPG and natural gas burn cleanly and are less harmful to the environment. They have been widely used in industry, heating, home appliances, and motor fuel [1]. Although LPG and natural gas are environmental friendly, they can pose a serious threat if they leak. They are normally stored in pressurized steel cylinders in liquid form and vaporize at normal temperatures. LPG is heavier than air, therefore it flows along the floor and settle in low points which makes it difficult to disperse. If leak happens, LPG [2] and natural gas boil into air and replace oxygen which can cause suffocation. Moreover, ignition may happen and cause an explosion. Therefore, the detection of gases has gain more interest in recent years especially in fields of safety, industry, environment, and emission control. Household safety is becoming an issue due to the increase use of LPG and natural gas for heating and home appliances.

This paper is an effective & affirmative way of monitoring the gas quantity in the container, and to intimate as well as to place an refill order in the respective branch office(gas agency), via an message by means of internet through IoT module. The continuous measure is done using the load cell [3] which intern works on the principle of piezo electric sensor, i.e; when an gas container is placed on the load cell it measures the weight and sends an electric pulse to the microcontroller which will compare the pulse with an ideal value in form of digital (the electric pulse is converted in to equivalent digital value). If the compared output is high then it sends a pulse(high) to the IoT which will update it to the internet but doesn't place an order, but if the compared output is low then it send a pulse(low) to the IoT which will update it to the internet an even place an gas refill order.

II. INTERNET OF THINGS

The Internet of Things (IoT) is an important topic in technology industry, policy, and engineering circles and has become headline news in both the specialty press and the popular media. This technology is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities not previously possible. An abundance of conferences, reports, and news articles discuss and debate the prospective impact of the "IoT revolution"—from new market opportunities and business models to concerns about security, privacy, and technical interoperability.

The large-scale implementation of IoT devices promises to transform many aspects of the way we live. For consumers, new IoT products like Internet-enabled appliances, home automation components, and energy management devices are moving us toward a vision of the "smart home'', offering more security and energy efficiency. Other personal IoT devices like wearable fitness and health monitoring devices and network enabled medical devices are transforming the way healthcare services are delivered. This technology promises to be beneficial for people with disabilities and the elderly, enabling improved levels of independence and quality of life at a reasonable cost.1 IoT systems like networked vehicles, intelligent traffic systems, and sensors embedded in roads and bridges move us closer to the idea of "smart cities'', which help minimize congestion and energy consumption. IoT technology offers the possibility to transform agriculture, industry, and energy production and distribution by increasing the availability of information along the value chain of production using networked sensors. However, IoT raises many issues and challenges that need to be considered and addressed in order for potential benefits to be realized.

III. WORKING PRINCIPLE

The device connects to the internet via Wi-Fi and thus increasing the mobility of the platform within the premises of the house. The proposed system consists of three major modules: the hardware device, the cloud server and a Smartphone app. The hardware device consists of all the sensors and actuator mechanisms necessary for sensing and preventing an

abnormal situation. The Smartphone app provides the end user with a GUI to monitor the data and control the device operation from a remote place. The cloud server acts as the middle man between the hardware device and the Smartphone app managing all the data traffic between them in real-time.

The device is intended for use in household safety where appliances and heaters that use liquid petroleum gas (LPG) [4] may be a source of risk. The system can also be used for other applications in the industry or plants that depend on LPG in their operations.

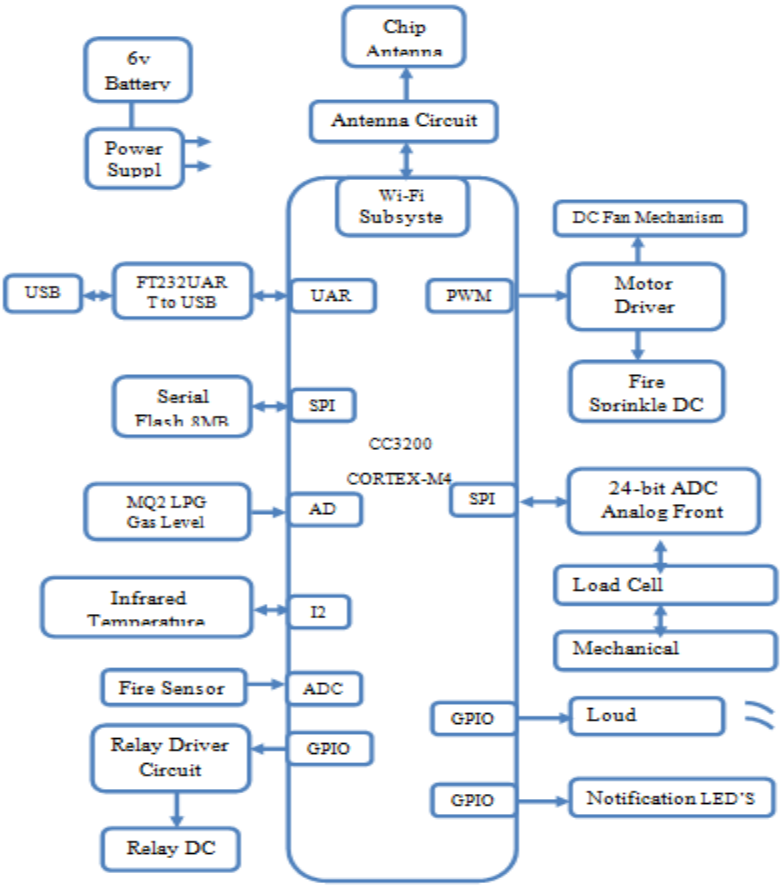

Figure 1: Gas Leakage System

A Wi-Fi capable ARM Cortex-M4 microcontroller is used to implement the system. This device offers a complete, low cost, powerful and user friendly way of real-time monitoring and remote control of gas leakages and prevention mechanisms in household and industrial areas.

Figure 1 shows that LPG gas leakage system. As soon as an LPG gas leakage or a file breakout is sensed, the device automatically takes the following precautionary measures.

1) Closes the gas valve
2) Opens the air ventilation
3) Shuts-off the home electricity, to prevent electrical sparks
4) Provides a loud local alarm to alert neighbours
5) Sends a smart phone alert to the owner
6) Sends an e-mail alert to the owner or authorities
7) Waits for the gas concentration to return to normal

Microcontroller

We are going to use CC3200, a single chip Wi-Fi microcontroller from Texas Instruments. It includes a high performance ARM Cortex-M4 processor subsystem running at 80 MHz and a Wi-Fi subsystem. The Wi-Fi subsystem consists of a dedicated ARM MCU, an 802.11b/g/n radio, baseband, and MAC with powerful crypto engine for fast, secure Internet connection. CC3200 chip supports Station, Access Point and Wi-Fi Direct modes. It also supports WPA2 personal and enterprise security and WPS 2.0. Multiple provisioning methods are supported including Smartconfig, AP mode and WPS. It includes embedded TCP/IP stack and multiple Internet protocols for easy web access. It consumes very low power and can run for more than a year from a single coin-cell battery.

Sensors

A weighing scale platform is constructed using a load cell sensor, a 24-bit analog front end and its associated electronics. Gas weight will be sensed using this mechanism. The platform is capable of measuring up to 40 Kg.

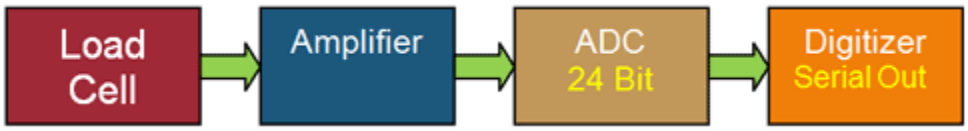

Figure 2: Sensor Configuration

Figure 2 shows that the sensor configuration. A LPG gas level sensor, an Infrared temperature sensor and a fire sensor are used to sense the environmental parameters of the area.

Actuators

A servo motor is used to control the gas valve position, whereas DC fan motor mechanism acts like a ventilation/exhaust fan. Another DC electrical motor will do the work of a fire sprinkler motor. All these motors are controlled using appropriate PWM signal generation. An AC relay circuitry is used cut-off the mains electrical supply.

Live-Monitoring and Control

The smart phone app can show the amount of LPG gas remaining, present room temperature other device status. These data are updated every few seconds providing real-time live monitoring. In addition to this, the actuators connected on the device can be controlled from the smart phone app giving additional benefits for the user.

On-Demand Automatic Reordering Facility

If the device is configured in automatic reordering mode, whenever the gas level comes below a certain threshold, the device automatically sends a gas cylinder requesting e-mail to the gas vendor or gas distributor. The user must save the e-mail address of the gas distributor before enabling this feature.

Low Weight Alert

Every time when a new gas cylinder is delivered, the user must press a button on the device which starts the process of measuring the weight of the cylinder and if it detects low weight cylinder, which means a low fuel content, it will immediately alert the user Smartphone app about this as well as send an e-mail alert to the gas agency company to register this case. This is a useful application in finding and avoiding a low weight gas cylinder at the time of delivery.

Local Audio Alarm

A loud beep alarm sound is generated intermittently to alert the neighbouring people.

Device User Interface

Notification LED's are used to indicate Wi-Fi provisioning and cloud server connection status.

IV. IOT CLOUD-BLYNK

The cloud is responsible for

1) Authorizes the hardware device and the Smartphone app
2) Enables the communication between the Smartphone app and the hardware device
3) Handles all the data translation and data management between them.

There are many cloud platforms available. In our case, we are going to use Blynk cloud server and Blynk Smartphone app for its ease of use and simplicity. The connection to the internet is based on Wi-Fi. The project hardware has to be registered with the Blynk server. An authentication token is issued by the server while creating the project. This token will be used as a unique identifier that allows connecting the hardware to the Smartphone app. The cloud is

capable of managing all forms of communication, between device to device, device to server and server to web application over internet. The Blynk server will be running a custom protocol for this communication and the Blynk library provided handles that.

Smartphone App - Blynk

The Smartphone app allows the user to monitor and control the device from a remote place. The Smartphone GUI is created using Blynk app that is readily available for download for both Android and iOS. Blynk is a Smartphone app that allows the developer to create a custom UI according to the application requirements. It leverages the resources of a Smartphone and provides a set of widgets that helps to create the custom user interface.

Wi-Fi

The device uses Wi-Fi communication to connect to the internet. Wi-Fi is a local area wireless computer technology that allows devices to connect to the network using 2.4 GHz radio band. It connects to the internet through a wireless network access point. Typically we need a wireless router to act as the wireless access point.

V. RESULTS AND DISCUSSION

Figure 3 shows that the hardware implementation of gas leakage system. If the device is configured in automatic reordering mode, whenever the gas level comes below a certain threshold, the device automatically sends a gas cylinder requesting e-mail to the gas vendor or gas distributor. The user must save the e-mail address of the gas distributor before enabling this feature. Every time when a new gas cylinder is delivered, the user must press a button on the device which starts the process of measuring the weight of the cylinder and if it detects low weight cylinder, which means a low fuel content, it will immediately alert the user Smartphone app about this as well as send an e-mail alert to the gas agency company to register this case.

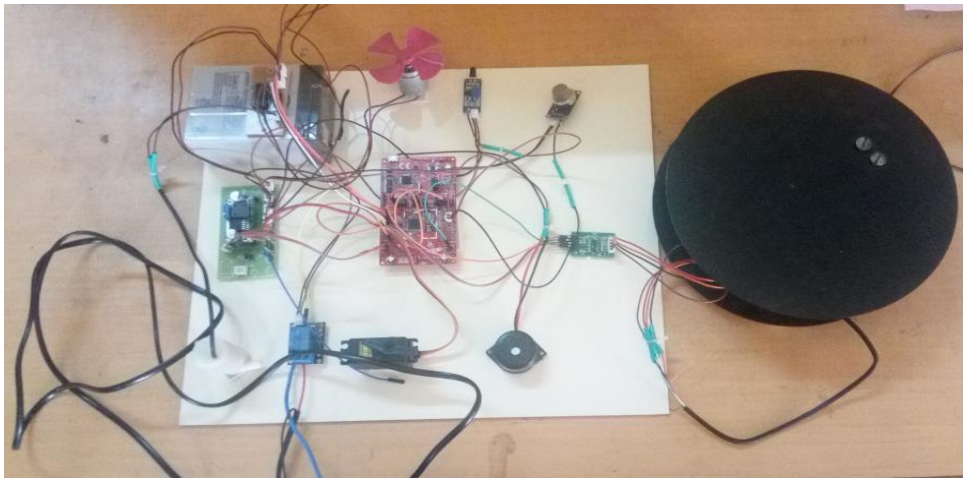

Figure 3: Hardware Implementation

This is a useful application in finding and avoiding a low weight gas cylinder at the time of delivery. The smart phone app can show the amount of LPG gas remaining, present room temperature other device status. These data are updated every few seconds providing real-time live monitoring. In addition to this, the actuators connected on the device can be controlled from the smart phone app giving additional benefits for the user.

VI. CONCLUSION

This works represents a prototype for wireless gas leakage systems that can be used mainly in household safety and many other applications in the industry and environment. For example it can be used in facilities where gas cylinders are stored. Any leakage can be recognized through the receiver module. The use of a sensor that is sensitive to small changes of concentration provides an excellent tool to detect a gas leak as it can detect small concentrations down to 100 ppm. The proposed system can be supplied with a switching circuit along with an electromechanical solenoid valve that can disable the flow of gas from the source in case of detected gas leakage. Further improvement can be introduced to the system by including a temperature measurement system to be used for temperature compensation, which can be done through the microcontroller.

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