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Programmable Gas Stove

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Abstract— LPG gas leakage and its detection is a major problem in the day to day lives. At present, wastage of gas is a major issue that needs to be encountered. By the rapid advancements taking place in the field of gas automation, the risks caused by these problems can be reduced. The proposed system focuses on a timer-based control for cooking purposes. It also features gas leakage detection and notification along with the provision for gas booking. IR sensor is used for detection of vessel which turns ON the system. Continuous monitoring is achieved using sensors like MQ6 gas sensor for LPG gas detection, temperature sensor for sensing overheat, a load sensor for continuous measurement of the gas available in the cylinder. When the readings of these sensors reach above the threshold value, the system automatically shuts down the gas valve, exhaust fan turns ON and SMS notification is send to the user using GSM. The proposed system provides a safer environment for cooking activities. Safety measures are provided using sensors for the automatic closure of gas valve in order to avoid dangerous situations. An additional safety knob feature is also introduced for this purpose.It offers quick response time and accurate detection. This add-on feature in the work modifies the existing safe model installed in households.

Index *Terms—Sensors-IR, MQ6, temperature, load cell, timer-based control, GSM module, gas leakage, gas detection, Internet of Things.*

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I. INTRODUCTION

Liquefied Petroleum Gas (LPG) is currently the most commonly used fuel in the households for cooking purposes. LPG gases are highly inflammable and is very dangerous if it leaks. The number of deaths due to explosion of gas cylinders has been increasing in recent years [1]. Therefore, it should be used in safe handling manner and additional care has to be taken in order to prevent any leakage possible. LPG gases are heavier than air and do not disperse easily and can cause suffocation when inhaled. The leaked gases when ignited, can lead to explosion. Nowadays, people are having very busy schedule and hence sometimes forget or don't get enough time for booking the gas from the gas agency. Also, a major amount of gas is being wasted due to the lack of care of the consumer. The proposed system is programmable gas stove, which rectifies the above problems. It features a timer controlled cooking system to avoid wastage of gas, gas leakage detection and automatic gas booking and overheat sensing. SMS based gas leakage alert system is also provided.

II. LITERATURE SURVEY

In the year 2011, A. Mahalingam, R. T. Naayagi,1, N. E. Mastorakis, proposed a project "Design and Implementation of an Economic Gas Leakage Detector". This paper provides an audio-visual solution for LPG leakage detection in homes and commercial buildings and audibly alert the users of those premises in case of a hazardous situation and provide warning signals in case of low risk scenarios.The drawback of these techniques is that they are very much dependent on the noise of pressure or temperature measurements. T.H.Mujawar, V.D.Bachuwar, M.S. Kasbe, A.D. Shaligram and L.P. Deshmukh proposed "Development of wireless sensor network system for LPG gas leakage detection system," [1] in 2015. The designed system monitors the gas leakage detection using an Arduino microcontroller depending on the GSM network. The leakage is detected with the help of MQ-2 gas sensor.

The most important factor is that the mobile phone does not require any special application or hardware to be used in this system, and any mobile phone supporting the SMS service could be used in the system. In the year 2016, Marthy Siva Sai Krishna, MandaSuhasPriyatham, G VenkataPavan Rama SaiBharadwaj proposed "Gas level alert and automatic cut-off in a stove," [2] where an Arduino UNO module controls all the components attached to it in a network connected with the gas supply cylinder.It is also possible to detect whistles, count them and then shut the supply off. Later, Anandhakrishnan S, DeepeshNair, Rakesh K, Sampath K, Gayathri S Nair, proposed "IOT based smart gas monitoring system," [3] which provides home safety by detecting the leakage of the LPG and alerts the consumer about the leak by a notification using an android app through Internet Of Things (IOT) and the consumer can turn off the gas valve, from anywhere in the world. In the year 2016, R. NareshNaik, P. Siva Nagendra Reddy, S. Nanda Kishore, K. Tharun Kumar Reddy, proposed "Arduinobased LPG gas monitoring & automatic cylinder booking with

alert system," [7].This system continuously measures the weight of the cylinder and once it reaches minimum threshold, it will automatically send message to the authorized LPG Agent to deliver the LPG cylinder.

Review of papers on SMS Alert to the user and gas leakage was also done. In the year 2000, K. Galatsis, W. Woldarsla, Y.X. Li and K. Kalantar-zadeh proposed "A Vehicle cabin air quality monitor using gas sensors for improved safety," [4]. This paper introduces a vehicle cabin air quality monitor to control the HVAC system and alarming the passengers of carbon monoxide (CO) and oxygen (0_2) poisoning. Gas sensors measure the concentration of gases.In the year 2006, IoanLita, Ion BogdanCioc and Daniel AlexandruVisan, proposed "A New Approach of Automatic Localization System Using GPS and GSM/GPRS Transmission," [5]. This paper focuses on, a low cost automotive localization system using GPS and GSM-SMS services, which provides the position of the vehicle on the driver's or owner's mobile phone as a short message (SMS) on his request and property because of the poor emergency facilities. An integrated Cell phone GPS-GSM system is used to track vehicles using Google Earth application developed in android application. In the year 2008, Chen Peijiang and Jiang Xuehhua, "Design and implementation of Remote Monitoring System Based on GSM," [6] this paper focuses on the wireless monitoring system, based on SMS through GSM. In the year 2014, HitendraRawat, AshishKushwah, KhyatiAsthana, AkankshaShivhare, designed a system, which focused on providing security issues against thieves, leakage and fire accidents. The system sends SMS to the emergency number that is provided[7]. The proposed system Programmable Gas Stove, finds a solution to the gas leakage by alerting the user, books the cylinder at the right time and also aids the user by setting a predetermined time. A safety knob is provided to protect the user as well as to prevent any wastage of gas.

III. BACKGROUND

A gas stove is a commonly seen appliance placed in a kitchen for cooking. In the early days, the gas stove was only designed to have switches for igniting and controlling flames. It is often that a person may want to leave the kitchen temporarily to attend other matters while cookingfood, that requires longer cooking time. However, on these occasions, it is very likely for the person to forget the cooking of the food and so fail to come back in time. Consequently, the food may be burnt or even cause a serious fire in the kitchen. In order to overcome the foregoing problem, a gas stove equipped with a timer has been proposed in this paper.

The objective of the proposed system is to operate a cooking system with timer-based control, similar to that of an induction cooker. The system continuously measures 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 agent so that the user can act accordingly. This system is also designed to detect LPG gases such as propane and butane. The system detects the leakage of the LPG using gas sensor and alerts the consumer about the

gas leakage by sending SMS. The system measures the weight of cylinder by using weight sensor and display corresponding weight in LPG display. The proposed system uses the GSM Modem to alert the person about the gas leakage via SMS and status of automatic cylinder booking.

IV. SYSTEM COMPONENTS

A. IR SENSOR

An infraredsensor as shown in fig.1 is an electronic device, that emits radiations in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. When a vessel is placed on the stove, the IR sensor senses the presence of the vessel and turns on the system.The emitter of an IR sensor is an IR LED (Light Emitting Diode) and the detector of this sensor is also an IR photodiode which is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages change in proportion to the magnitude of the IR light received.

Fig.1: IR Sensor

B. GAS SENSOR

MQ-6 is a Sensor for Natural Gases Sensitive material. Gas sensor (MQ6) module is useful for gas leakage detection in home and industry.It is suitable for detecting H2, LPG, CH4, CO, alcohol, smoke or propane. It can detect gas concentrations anywhere from 200 to 10000ppm. Fig.2 shows an MQ-6 gas sensor.Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of this sensor can be adjusted by using a potentiometer.

Fig 2: MQ-6 Gas Sensor

C. LOAD CELL

Load cell is a weight measurement device necessary for electronic scales that display weights in digits. However, load cell is not restricted to weight measurement in electronic scales. Load cell as shown in fig.3 is a passive transducer or sensor which converts applied force into electrical signals. They are also referred to as "Load transducers".

Fig 3: Load Cell

The load cells commonly used work on the principle of strain gauges. The following are the main characteristics of a load cell:

- Highly precise and linear measurements.
- Small size compared with other types of load cells
- Little influence due to temperature changes

D. TEMPERATURE SENSOR

An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object anddetecting motion. Fig.4 shows MLX90614 Non contact thermometer.

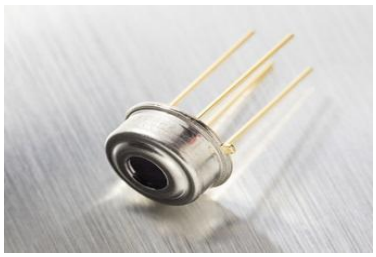

Fig 4: MLX90614

The temperature sensor used here has a range which varies from -70 to 380 degree Celsius. It has got a high accuracy of 0.5 degree Celsius. Fig.5 shows the position of the temperature sensor in the proposed system.

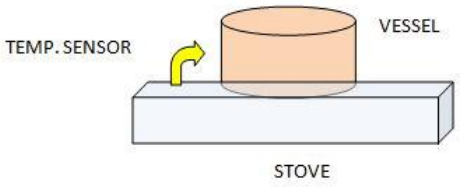

Figure.5: Temperature sensor is placed near to the vessel

E. SOLENOIDAL VALVE-UDO8E5

UD08E5 is the type of solenoidal valve used in this model. LPG liquid (or vapour) or low pressure natural gas vapour is the type of fuel used. It has an operating temperature range of -40 to 121 degree Celsius with an inlet pressure of 315 Psi (21.72 Bar) at 12V. Fig.6 shows a solenoidal valve.

Figure6: Solenoidal valve

F. GSM MODEM(SIM 900-RS 232)

GSM (Global System for Mobile) / GPRS (General Packet Radio Service) SIM 900 works for frequencies 850 MHz, 900 Hz, 800 MHz and 1900 Hz. It is compact in size and easy to plug into a GSM Modem. Fig.7 shows a GSM Modem.Themodem is designed with 3V3 and 5V DC TTL interfacing circuitry which allows the user to directly interface with 5V microcontrollers. The baud rate can be configurable from 9600-11520 bps through AT (Attention) commands. This GSM modem has internal TCP/IP stack to enable user to connect with internet through GPRS feature. It is suitable for SMS as well as data transfer application in mobile phone to mobile phone interface.

Fig 7: GSM Modem

G. ARDUINO UNO

Fig 8: Arduino Uno

Arduino UNO is used as a controller in this system. It is a well-equipped open – source prototype platform. An Arduino software will simplify the process of creating a control environment by providing the standard and flexible board that can be reusable programmed and connected to the system without any necessity of PCB design. It works on platforms like Windows, Linux and Mac. Fig.8 shows an

Aruino Uno.

V. SYSTEM DESCRIPTION

This proposed method consists of a timer control system, gas leakage detection system, weight measurement module, microcontroller, GSM module and alert system. Voltage can be built by using different components like step down transformer, rectifier, filter and regulator which are readily available as adapters these days. Supply can be either from an ac to dc adapter or battery. The board can operate on at 7-12 volts. If the voltage exceeds 12V, then the board gets damaged. The main platform used to build the project is Arduino UNO which provides the flexibility to write the code effectively in a convenient way. Arduino is cheap, has a Cross platform, simpler and clear programming environment, Open source and extensible software, and easy to understand. C programming is used here. The other main component used in our project is load cell. A load cell is a transducer that is used to convert a force into electrical signal, which is used to measure weight ofthe LPG gas cylinder. There are different load cells available in the market with different weight measurement capabilities.

The Gas Sensor is also one of the components used to detect the leakage of the LPG Gas which converts one form of the signal into other form. Methane (MQ6) Sensor is used here. The MQ6 sensor detects leakage of LPG gases like propane, CH4, Natural. It can detect natural gas concentrations from 200 to 10,000ppm. It has fast response, stable and long life. TheMLX90614 is a non contact temperature LCD (Liquid Crystal Display) is used to show the output of the results of different sensor values and various results to show of size about 32 ASCII character in 2 lines. 16x2 LCD module is used in this system. GSM Modem is used to alert the user by sending SMS (Short Message Service) about Gas Leakage and LPG Gas Completion Status. GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in different parts of the world. It helps in booking the gas when the gas in the cylinder is finished. It sends message to the user and the provider. GSM uses time division multiple access (TDMA). GSM digitizes and syncs data, then sends it to a channel with two other streams of user data, each in its own time slot. It operates at either the 800 MHz or 1800 MHz frequency band.

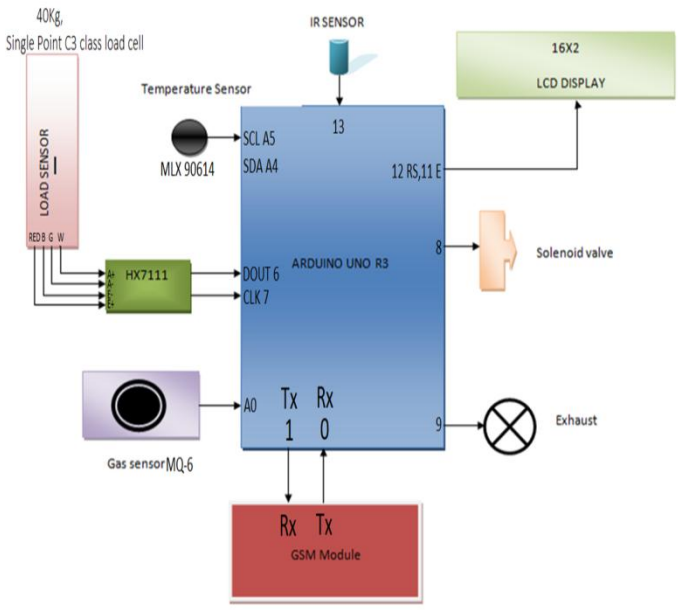

Figure9: Block diagram of the proposed system

The IR sensor is placed near the stove supported on a stand. When a vessel is kept on the stove, the IR sensor detects it and turns ON the entire circuit. The LCD display turns on and shows continuous reading of the gas concentration in the room and weight of the gas in the cylinder. The gas sensor detects the presence of the gas from the time the circuit is turned ON.This is same in the case of load sensor and temperature sensor. The user can set the time required for cooking after manually igniting the flame. When the gas value in the atmosphere increases above the

threshold value, the solenoidal valve gets closed which is normally open.

This cuts the gas flow to the stove, avoiding any further dangerous situations.The exhaust also turns ON and the LCD displays 'gas alert'. A buzzer is provided for alerting the user. Also, an alert SMS is sent to user via GSM module. Similar conditions are provided for other sensors also. When the temperature sensor senses temperature of the vessel above the threshold temperature then the solenoidal valve is closed. The gas flow to the stove is blocked and the LCD displays 'overheat' which in turn turns ON the exhaust. When the load sensor senses the weight of LPG gas cylinder below the set threshold value, then an SMS is sent to LPG providers for the booking purpose and then to the user via GSM module. The LCD displays 'Book cylinder' informing the user to book the cylinder.

VI. RESULTS AND CONCLUSION

The proposed system was experimented and the results were obtained. The IR sensor detected the presence of the vessel, which in turn turned ON the entire circuit. Fig.10 shows the working of IR sensor. When the system was turned ON, the LCD display was also turned ON. The LCD continuously displays the gas concentration in the room and also the temperature of the vessel. Fig.11 shows the working of LCD when system turns ON. The gas flow is also turned on. This is shown by green LED as in fig.12. When the vessel temperature reached above 135°c (set threshold temperature), the LCD displayed 'overheat' as in fig.13 and at the same time, the exhaust was turned ON and gas flow turned OFF. The exhaust is represented here using a blue LED. Fig.14 shows the exhaust turned ON. The gas sensor was tested using a lighter. This is shown in fig.15. The gas concentration was found to be above the threshold value and the LCD displayed 'gas alert' as shown in fig.16. Along with that, the exhaust also turned ON and gas flow turned OFF as in fig.17. It was also observed that when the weight of the cylinder reached below a threshold value, the LCD displayed 'Book cylinder' as shown in fig.18 which gave the information to the user to book the cylinder at the right time. The system was found to be quick and accurate and also provides a safer environment for cooking.

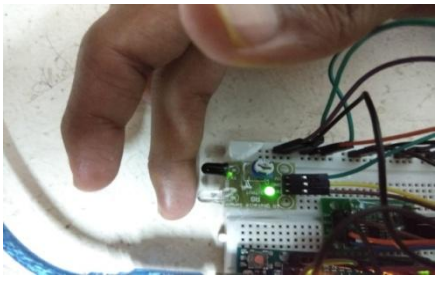

Figure10: IR sensor

Figure 11: LCD display

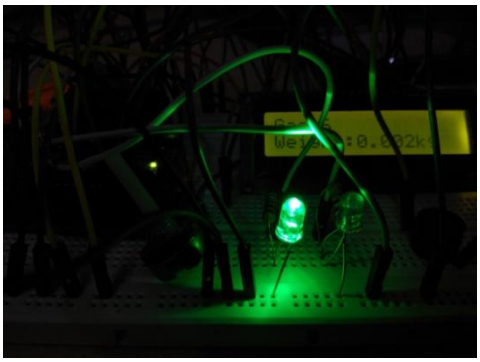

Figure12: Green LED

Figure13: LCD Display

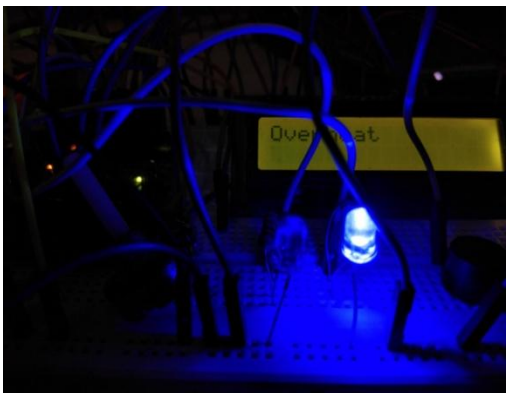

Fig 14: Blue LED

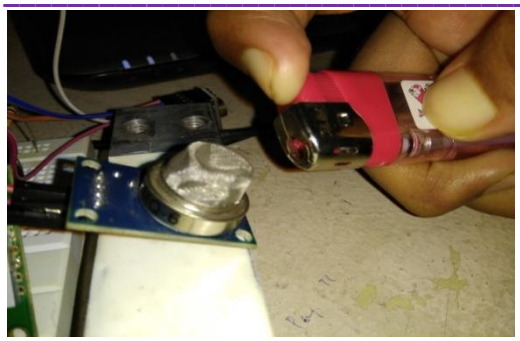

Fig 15: MQ6 gas sensor

Fig 16: LCD display

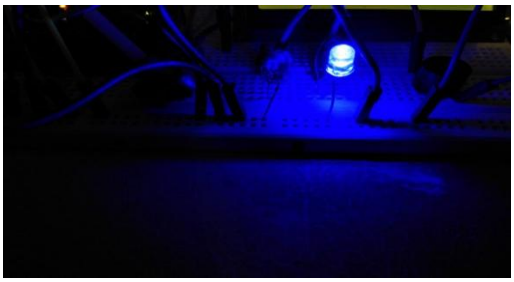

Fig 17: LED

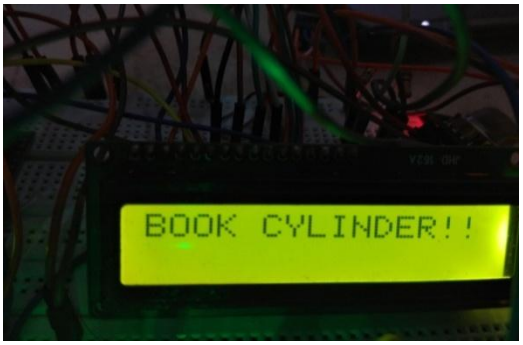

Fig 18: LCD display

This system is reasoned to help customers to upgrade their safety norms and act accordingly. The primary objective of the project is to set a timer-based control for cooking i.e., the user can set the required time for cooking. This makes the user to do multi-tasking while cooking. The system also measures the gas present in the cylinder and informs the user to book the cylinder at the right time. This system also reduces the accidents due to gas leakage and overheating.

I. FUTURE SCOPE

The system can be modified by having predetermined cooking time for different food. It can also be modified to cook food in a predetermined time by the user and adjust the flame automatically

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