AUTOMATIC BURNER FLAME MANAGEMENT SYSTEM USING INTERNET OF THINGS

[1]Dr.Malleti.Sreedhar, [2]Dakuri Giri babu [3] Bezawada Suneela sparsha

[1]V.N.R.Vigana Jyothi Institute of Engineering and Technology (Affiliated to :JNTUH), Bachupally, Hyderabad

[1]Professor, [2]VNRVJIET, [3]VNRVJIET.

Abstract: Burner Management System or BMS is a safety system used to assure safe- start-up, operation and shut down of burners. We have done this work to control the burner flame in kitchen burner system[2]. The outlet of the gas cylinder is connected to a burner via solenoid valve(s). This particular work is carried out for the domestic purpose This is It most effectively useful for kitchen burners of the houses, restaurants and hotels. In this we had covered safe start-up and shut down of the system. Alarming and acknowledging the user if any gas leakage and proper safe shutdown of the system in case of any gas leakage.

Key words : Detector RTD Node MCU BMS(Burner management system)

1.1 Introduction

LPG cylinder kept for more than 3 months in unused condition is like keeping a live bomb waiting to explode. Accidents due to such gas cylinder leakages are increasing day by day and the main reason are due to lack of proper attention, unaware of the guidelines to be followed. Therefore by using automatic burner flame management system we are making an attempt to avoid such accidents. Another application we are implementing in this project is to control the flame in the burner according to the boiling quantity. A burner management system is a safety measurement system which ensures that system is always monitored and controlled. BMS enables the safe start up and shut down operation, it provides the safe environment & reduces the danger of explosions which can be caused due to the leakage of gases[4].

BMS offers the simple solution to prevent any explosion and in this project we have designed a system which helps us to safe start and shut down of the cylinder using solenoid valve, stepper motor .we can get the information by the components & immediately we can shut down in case of emergency.

1.2 Semi-automated stove

In this work we designed a stove which can sense and turnoff the gas when there is a gas leakage and another application of our project is to control the flame in the burner according to the boiling quality of the food. so, by implementing these applications in the LPG gas stove we can name the stove as “SMART STOVE”

1.*3 Gas leakage detector using IOT*

Arduino and IOT based LPG leakage detection system is a project which will help in determining gas leakage in the surrounding and send data to an IOT module[5]

Internet of Things (IoT) is the networking of ‘things’ by which physical things can communicate with the help of sensors, electronics, software, and connectivity. These systems do not require any human interaction and same is the case with IOT based gas detection system, it does not require human attention.

LPG stands for Liquefied Petroleum Gas, and it is not a chemical substance but a product. It is generally a mixture of mostly propane (C_3H_8) and butane (C4H10), with smaller amounts of other hydrocarbons from C2 to C5.

LPG is an incomparable cooking fuel. It evaporates quickly and facilitates direct firing. While we understand that you operate and utilize responsibly, there might be instances of leaks from the stove or joints. So, to further enhance your cooking experience, we have designed an equally exceptional safety device[2].

The LPG Leak Detector ensures stay alert even when you can't. It detects leaks and alerts you instantaneously to avoid any harmful situations. The MQ-4 sensor and quick response time make sure you are notified much before an incident can occur.

1.4 Experimental: To achies the tasks this, we are used the RTD, stepper motor these two are the main components of this project. The RTD measures temperature of the food and the stepper motor is used to control the burner which is used to reduce the flame. This is the semi-automated project.fig.1 expains the block diagram of the system[2].

Controlling the temperature of food is extremely important in ensuring that food is safe to eat, and you must ensure that food is always cooked, cooled, chilled or reheated properly to minimise the risk of harmful levels of bacteria in the food that you sell.

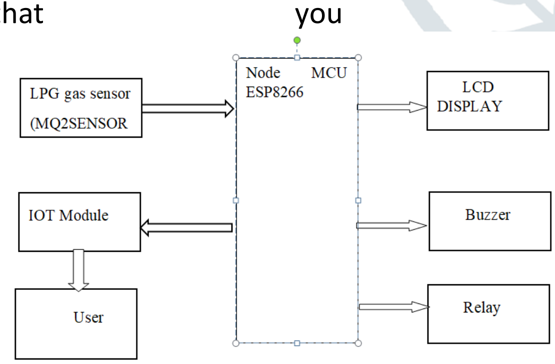


Fig 1 block diagram of gas leakage detection system

Meat products are typically regarded as high risk, but dried goods such as rice and pulses and vegetable and salads are also likely to contain bacteria that may grow if the food is subject to poor temperature control. Perishable food should always be kept out of the danger zone of 8 - 63ºC to prevent the growth of harmful bacteria[10].

1.5 Cooking at different temperatures

In raw foods, such as meat, fruit and vegetables, high levels of bacteria may be present due to contamination with soil or due to the preparation process. It is important that food is cooked thoroughly to a core temperature of at least 75ºC for at least two minutes to kill the bacteria.

One way to check whether the food has been cooked thoroughly would be to use an RTD, but you must also take care that probe do not contaminate or taint the food being probed. You can do this by cleaning and

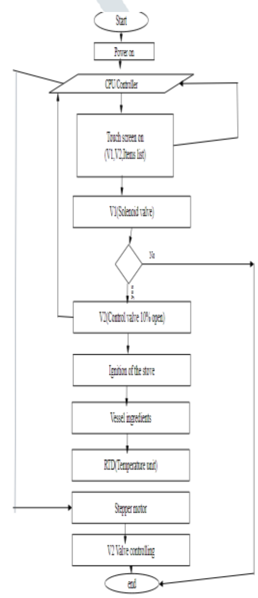


Fig 2 flow chart of the gas leakage detection system

disinfecting them before use with ready to

eat food. Where antibacterial wipes are used to do this, they must be suitable for use with food.

These are the two applications we are implementing in our project, to make sure there is enough safety and save ourselves from dangerous accidents. Thus, a normal stove with LPG cylinder can become semi-automated stove.

1.6 Operation

The gas sensor works in the combustion process i.e. when it senses the gas it burns the gas and evaluates it. It measures the energy loss in burning and generates voltage. The sensitivity of the gas sensor is set the variable resistor working as a potentiometer. In other words, it sets the range of voltage on which Op-Amp will compare and give the output. The voltage generated by the gas sensor is measured by the Op-Amp. The output generated by the Op-Amp lights up the LED light and triggers the buzzer. Our LPG Gas Detectors consists of powerful gas sensors that are capable of detecting even the smallest leak thereby giving out an audio-visual alarm.In addition to the highly sensitive gas sensors and prompt alarming system that alerts the workers within seconds of gas leakage, Ametropic gas detection system also minimizes the risk of damage by:

1.Automatically switches OFF the gas valve – In order to prevent further gas accumulation in air

2.Sending alert messages to concerned kitchen authorities – Informing them remotely about the disastrous situation even if they are not present at the site.

Main components used here are 1.Gas sensor (MQ 6 sensor),2.Load cell,3.Node MCU ESP8266,4.Buzzers,5.OLED and its Buttons,6.Analogtodigital converter (HX711 IC),7.WIFI network,,8.Gas sensor(MQ 6 sensor):

, Nitrogen, methane etc. They can also be commonly found in devices that are used to detect the leakage of the harmful gases, monitor the air quality in industries and offices etc.

A gas sensor is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated[11].

figure 3 MQ sensor

Of all the above-listed types, the most commonly used gas sensor is the Metal oxide semiconductor-based gas sensor. All Gas sensors will consist of a sensing element which comprises of the following parts:Gassensinglayer,Heater Coil,Electrode line,Tubular ceramic, Electrode

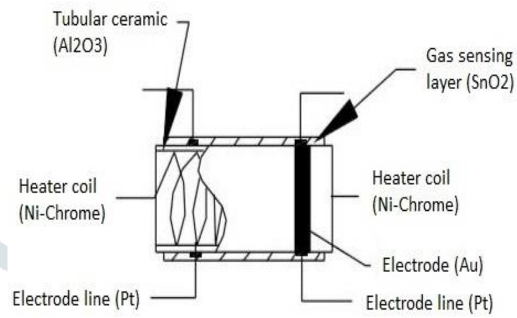


Figure 4. Metal Oxide sensor construction

The purpose of each of these elements is as below:

Gas sensing layer: It is the main component in the sensor which can be used to sense the variation in the concentration of the gases and generate the change in electrical resistance. The gas sensing layer is basically a chemi resistor which changes its resistance value based on the

The concentration of particular gas in the environment. Here the sensing element is made up of a Tin Dioxide (SnO_2) which is, in general, has excess electrons (donor element). So whenever toxic gases are being detected the resistance of the element changes and the current flown through it varies which represents the change in concentration of the gases[10].

Heater coil: The purpose of the heater coil is to burn-in the sensing element so that the sensitivity and efficiency of the sensing element increases. It is made of Nickel-Chromium which has a high melting point so that it can stay heated up without getting melted.

Electrode line: As the sensing element produces a very small current when the gas is detected it is more important to maintain the efficiency of carrying those small currents. So, Platinum wires come into play where it helps in moving the electrons efficiently.

Electrode: It is a junction where the output of the sensing layer is connected to the Electrode line. So that the output current can flow to the required terminal. An electrode here is made of Gold (Au –Aurum) which is a very good conductor.

Tubular ceramic: In between the Heater coil and Gas sensing layer, the tubular ceramic exists which is made of Aluminum oxide (Al2O3). As it has high melting point, it helps in maintaining the burn-in (preheating) of the sensing layer which gives the high sensitivity for the sensing layer to get efficient output current.

Mesh over the sensing element: In order to protect the sensing elements and the setup, a metal mesh is used over it, which is also used to avoid/hold the dust particles entering into the mesh and prevent damaging the gas sensing layer from corrosive particles.

Gas Sensor Working

The ability of a Gas sensor to detect gases depends on the chemiresistor to conduct current. The most commonly used chemiresistor is Tin Dioxide (SnO2) which is an n-type semiconductor that has free electrons (also called as donor). Normally the atmosphere will contain more oxygen than combustible gases. The oxygen particles attract the free electrons present in SnO2 which pushes them to the surface of the SnO2. As there are no free electrons available output current will be zero. The below gif shown the oxygen molecules (blue color) attracting the free electrons (black color) inside the SnO2 and preventing it from having free electrons to conduct current.

When the sensor is placed in the toxic or combustible gases environment, this reducing gas (orange color) reacts with the adsorbed oxygen particles and breaks the chemical bond between oxygen and free electrons thus releasing the free electrons. As the free electrons are back to its initial position, they can now conduct current, this conduction will be proportional the number of free electrons available in SnO2, if the gas is highly toxic more free electrons will be available.In this particular work we used MQ-6(LPG, butane gas) sensor for gas detectionitsspecificationsare:aOperating Voltage is +5V,b)Can be used to detect LPG or Butane gas,c)Analog output voltage: 0V to 5V,d)Digital Output Voltage: 0V or 5V (TTL Logic),e)Preheat duration 20 seconds,f)Can be used as a Digital or analog sensor,The Sensitivity of Digital pin can be varied using the potentiometer,load cell .

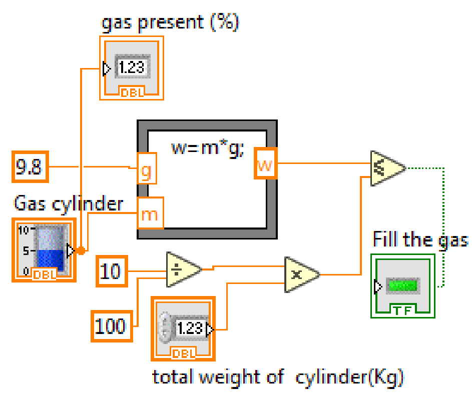


Fig 5 simulation of IOT based gas leakage detection system using Node MCU ESP 8266

1.7 Results and discussion

We have designed a prototype the "Automatic burner flame management system "in the simulation .By observing the output we can conclude that whenever there is a gas leakage the system send the signals to the user and also we also implemented the flame control management system ,whenever the boiling point increases above than the required given boiling temperature the valve of the burner controls the burner by decreasing the flame .hence ,we can avoid the food from overcooked or over burning .

Figure Temperature measurement output

CONCLUSIONS

As per, the main objectives of the project we can design the automatic burner flame management system using Iot.

We can also the safe start-up of the system manually after the intimation of the system and safe shut down of the system without any discomfort.

By using this particular system, we can avoid the accidents due to gas leakage and we can also acknowledge the user of the system by alarming setup of the system.

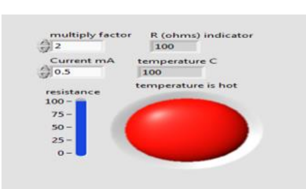
Finally, as per one of our main aims to achieve the required boiling quality by controlling the amount of gas inflow to the burner.

We can also successfully monitor the amount of the gas present in the cylinder and acknowledge the user.

Future Scope

This particular work can be further being taken in to advance stages by upgrading the system. In this particular system we could control the single burner with single control valve and could provide enough boiling quality to the single item. But further the system can be connected to multiple control valves to control the multiple burners.

This particular system can also be integrated to artificial intelligence in order to achieve the required boiling quality.



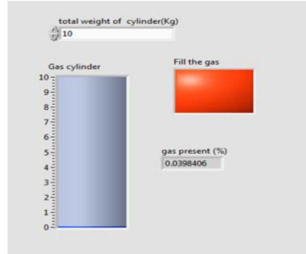


Figure6. Temperature measurement output

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About Authors :

Authour1:

Dr.M.Sreedhar is working as professor,in

VNRVJIET,Hyderabad as professor .He has published several papers in journals

Author 2

Mr Dakuri Giri babu

Author 3

Bezawada Suneela sparsha are working in the instrumentation engineering.