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Forbiddance of LPG Based Catastrophic Accidents through Gas Sensor Technology

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Abstract—*Stoves running on LPG or natural gas are a necessity in every household. Being highly flammable, these stoves are responsible for several unfortunate accidents across the nation. To reduce such mishappenings, odorants are added to these odourless gases to make them easily detectable in case of leakage. However, this detection relies on the human senses, which makes it necessary for someone to be attentive during any leakage. In the absence of people, gas leakage from the stove can result in catastrophic events. Metal oxide gas sensors can be used to curb the occurrences of such events.*

1. Introduction

DC motor actuated by a gas sensor through an electrical circuit can be used to detect and turn the gas nozzle valves off in case of any leakage or the extinguishing of the flame even with the gas knob turned on. There are several methods for detection of combustible gas with varying gas sensitivity and affinity towards specific gases. Out of these, metal-oxide semiconductor based gas sensors are widely available and used for applications requiring detection of LPG or CNG gases.

2. Literature review

There are three types of gas sensors which can be employed:

1. Metal oxide semiconductor type
2. Catalytic type
3. Electrochemical type

2.1 Catalytic Type

These types of sensors consist of two elements - detector element and a compensator element. In a non-combustible gas environment, the resistance of both elements is equal and constant, creating a balanced wheatstone bridge. [4]
When combustible gases are present, it burns only on the detector element, increasing its temperature and resistance. This change in resistance causes an unbalance in the wheatstone bridge.

2.2 Electrochemical Type

These sensors have two electrodes (sensing and counter electrode) with an ion conductor between them. When toxic gas comes in contact with the detector electrode, a chemical reaction occurs resulting in expulsion of electrons, short circuiting the electrodes and causing a surge in current. The current flowing through is directly proportional to the amount of gas in the environment. [5]

2.3 MOS Type

These sensors commonly use a Tin dioxide (SnO2) connected to a heating coil to provide the appropriate working temperature for the sensor.
In clean, oxygen rich air, O2 molecules get adsorbed on the sensor, thus increasing its resistance and producing a ‘low’ signal. [1]
In an environment having high concentration of combustible gases, the amount of oxygen molecules getting adsorbed is reduced. This allows some current to pass through the sensor, thus producing a ‘high’ output signal.

The sensitivity of the sensor can be adjusted by varying the resistance across the sensing element.

3. Working

- An MQ6 type gas sensor has been used in this application.
- The gas sensor is fixed slightly below the gas nozzle so as to keep it within rage and avoid any unnecessary heating.
- Electric components including the logic gate ICs are fixed below the stove and out of sight.
- The gas knob is replaced with a spur gear which is meshed with another gear of larger diameter further connected to a DC motor.
- The DC motor gets actuated when the sensor produces a 'high' signal during gas leakage.
- The complete circuit gets switched ON only when the gas valve is rotated away from its 'zero' position.

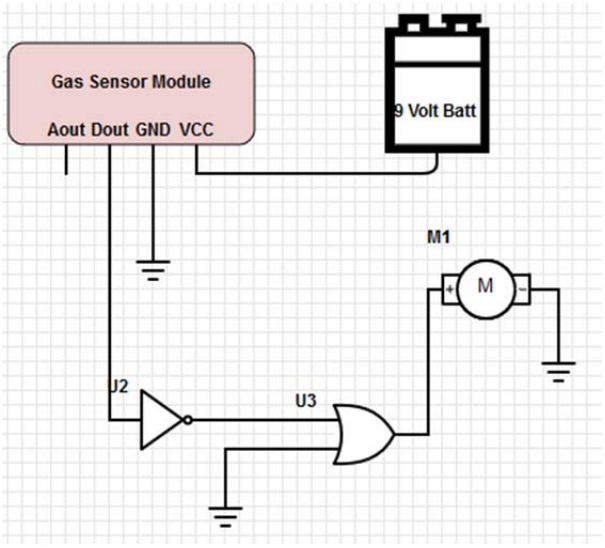

Figure 1. Circuit Diagram

4. MQ6 Gas Sensor Module

There are several gas sensors available from the "MQ" series of gas sensors, out of which the MQ6 sensor exhibits the highest sensitivity towards LPG. The sensitivity of the gas sensor is determined by many factors such as the humidity, temperature, resistance of reference gas (air) and the resistance of target gas (LPG). [2]

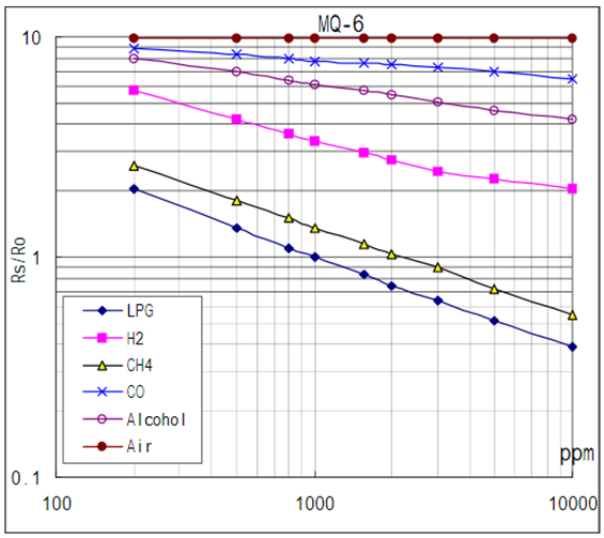

Figure 2. Sensitivity characteristics of MQ6 gas sensor

5. Results and Conclusion

The electrical setup was completed on a gas stove with the knob being shut off during gas leakage.

5.1 Benefits and applications

This setup plays a crucial role in the safety of people working in the kitchen as well as other equipment.
Being a simple electromechanical circuit, this device can be used even on older stove models and is not model or design specific.

5.2 Future Scope

This technology can also be utilized in large industries/factories which may have high pressure gas pipelines as a safety feature for detection of gas leakage.

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