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PREVENTION OF LP GAS ACCIDENT BY USING ATMEGA16 MICROCONTROLLER

A Thirumalaikumaran[1], M Mohanraju[2], Dr K Sakthivadivel[3], S P Sundareswaran[4]

[1,2,4]Assistant Professor, Department of Mechanical Engineering, Builders Engineering College, Tamilnadu, India.
[3]Associate Professor, Department of Mechanical Engineering, Builders Engineering College, Tamilnadu, India.

Abstract - *Accidental explosions in the house are not uncommon which may be associated with gas leaks, the storage of explosive material such as propane. LPG cylinders are very commonly used in the household as a cooking gas. In spite of safety guidelines accidents occur which are fatal. Due to the release of high pressure LPG gas the blast effect becomes destructive and fatal. These accidents are mainly caused due to the carelessness of the cooker. To avoid this, a suitable technology is implemented with the stove. IR flame sensor is used to sense the leakage of gas to ATmega16 controller. The controller is operated by 6V battery which controls the servo motor which is connected to spur gear and the stove's knob. Also a timer is used to set for cooking time.*

Key Words: ATmega16 controller, IR Flame sensor, Servo motor, Spur gear, LPG (Liquefied Petroleum Gas)

1. INTRODUCTION

LPG or LP Gas is the abbreviation of Liquefied Petroleum Gas. This group of products includes saturated hydrocarbons – propane (C_3H_8) and butane (C_4H_{10}), which can be stored and transported separately or as a mixture. They exist as gases at normal room temperature and atmospheric pressure. It is called Liquefied petroleum gas because these gases liquefy under moderate pressure. They liquefy at moderate pressure readily vaporizing upon release of pressure. It is this property that permits transportation of storage of LP Gas in concentrated liquid form. LPG comes from two sources. It can be obtained from the refining of crude oil and it is generally in pressurized form. LPG is also extracted from natural gas or crude oil stream coming from underground reservoirs. 60% of LPG in the world today is produced this way whereas 40% of LPG is extracted from refining of crude oil. The commercialized product referred to as "propane" and "butane" consists very largely of these saturated hydrocarbons, but during the process of extraction certain allowable unsaturated hydrocarbons like ethylene, propylene, butylene etc., which included in the mixture along with pure propane and butane.

LPG is a flammable gas. It is the most commonly used cooking gas in every home. It is generally contained in iron gas cylinders and delivered to homes by the authorized dealers. The average weight of the cylinder is 14.2 kg. The flammable limit value of LPG is between 1.8% to 9.5% volume of gas in gas/air mixture. The flammability range for LPG is considerably lower and narrower than that for other commonly used gaseous fuels. The small percentage concentration at the lower limit, however, means that even small leaks can create explosive atmosphere. It is colour less which means that it's presence by sight cannot serve as warning signals for the impending potential fire hazards whenever there is a leakage. It is distinctively odorized to give warning in case of leakage.

The odourant contents is about 1/5th of the lower flammable limit (LFL) i.e.,(0.36%). In other words, it can be smelt long before it becomes dangerous enough to catch fire. Its vapour density is 1.8 to 2.0 at 25°C. LPG in gaseous state is nearly twice heavier than air.

The liquid density of LPG is 0.525 to 0.580 at 15°C which is lighter than water. Therefore in case of leakage LPG could be carried by flowing water. This factor should be borne in mind when using fire water hose streams for fire control purposes. The latent heat of vapourization value for LPG is 88 Kcal/kg at 20°C at 1 atm pressure. Hence, the latent heat of vaporization is very high for LPG, it takes large quantity of heat, when it vaporizes. On vaporization, LPG's requirement for latent heat gives rise to the cold burn resulting from liquid contact with naked flesh. This results in several local chilling and damage to the tissues. The LPG has high calorific value of 11000 Kcal/kg. The poor visibility of the ignitable mixture and high burning velocity that can injure instantly anyone coming into contact with it, on account of high caloric value of LPG. Most of the LPG explosion accidents are due to the vapour cloud explosion (VCE) event. It starts with the leakage of LPG either due to damage of the connecting tube or defective valve sealing the cylinder. The wind plays a significant role in its dispension. The immediate ignition of this LPG will cause fire balls followed by the delayed ignition which cases vapour cloud explosion causing severe damages. The boiling liquid expanding vapour explosion (BLEVE) occurs where there is a major container failure, which contained liquid above its boiling point. A bleve is generally followed by a fireball, which rises due to the buoyancy effect of hot gases. The burning liquid droplets fall down like rain.

Liquefied petroleum gas is a flammable gas, which has the potential to create blast accidents. Therefore it is important that the properties and safe handling of LPG are understood and applied in the domestic and commercial/industrial situations. Liquefied petroleum gas is stored under pressure.

2. SIGNIFICANCE OF THE SYSTEM

The gas may leak from any joint connection, which is not sealed properly and the gas tends to leak from the burner due to the absence of flame. Most of the accidents caused due to the carelessness of the cooker. This work's intention is to avoid LPG stove accidents due to gas leakage using ATmega16 controller and gear mechanism.

3. SCHEMATIC DIAGRAM AND STRUCTURE OF EXPERIMENT

The accident is prevented by switch off the knob by gear mechanism and stepper motor which are operated by microcontroller. The proposed schematic system embraces flame sensors, low torque DC motor, relay switches, batteries and controller.

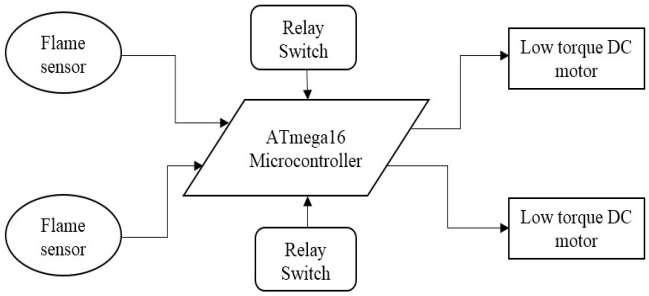

Fig -1: Block diagram of the proposed system

3.1 Battery

To satisfy the uninterrupted power supply, two 6V - 4.5amps rechargeable batteries are made builted in the system. Initial current is limited to 1.35A. Charge until battery voltage (under charge) reaches 7.20 to 7.35 volts at 68°F (20°C). Hold at 7.20 to 7.35 volts until current drops to under 45mA. Battery is fully charged under these conditions.

3.2 Microcontroller

The ATmega16 is a low-power, high-performance CMOS 8-bit microcomputer with 16 kilobytes of Flash programmable and erasable read only memory (EPROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel ATmega16 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

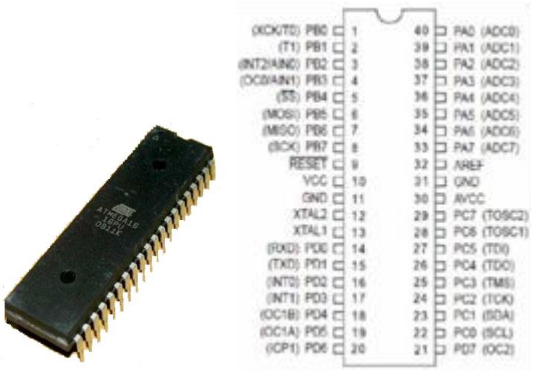

Fig -2: Microprocessor & pin out diagram

3.3 Relay switch

Relay is an electromechanical switch which used in virtually every type of electronic device to switch voltages and electronic signals. The primary purpose of the switching of the relay is to allow the primary contact to jump or switch between the circuits attached to the normally open and normally closed contacts when the relay is turn on and off. It is used to notify the microcontroller about the current knob position whether the stove knob is ON/OFF. The microcontroller takes the action according to the program input.

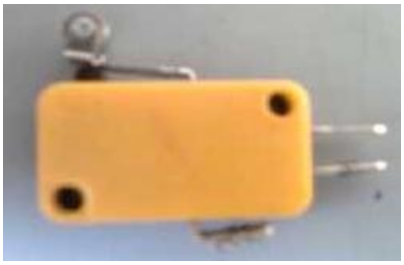

Fig - 3: Relay switch

3.4 Gear motor

A geared DC Motor has a gear assembly attached to the motor spindle. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Also, an internally threaded hole is there on the shaft to allow attachments or extensions such as wheel to be attached to the motor. In this stove the gear motors are used to satisfy the need of automatically turning the knob to off position in case of gas leakage.

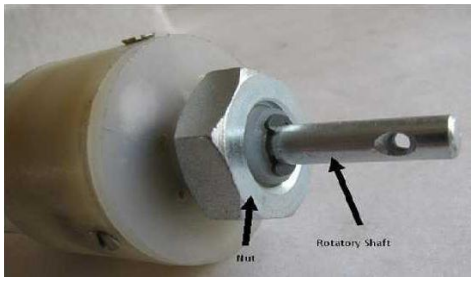

Fig – 4: Gear motor with shaft

3.5 Flame sensors

Flame and radiations are sensitively detected by the flame sensors and it can also detect ordinary light source to the range of a wavelength 760 nm -1100 nm. It senses upto a distance of 100 cm. The Flame sensor gives the output in the form of digital or analog signal. It can be used as a flame alarm or in fire fighting robots.

Fig – 5: Flame sensor

3.6 Spur gear

Spur gears are the most common type of gears. They have straight teeth and are mounted on parallel shafts. Sometimes, many spur gears are used at once to create very large gear reductions.

Fig – 6: Spur gear

4. EXPERIMENTAL PROCEDURE

4.1 Flame sensor

Flame sensor continuously monitors the flame in the burner area and it repetitively sends signals to the ATmega16 microcontroller. At the time of absence of flame in the burner, the sensor sends the signal to the microcontroller to positioning the knob.

4.2 Relay switch

Relay switch is aided to notify the microcontroller about the current state of knob whether it is on/off condition.

4.3 DC motor

Low torque DC motor rotates at 45 rpm in anticlockwise direction which switches the knob OFF with the help of spur gears once it receives the command from ATmega16 microcontroller.

4.4 Microcontroller

The ATmega16 8bit microprocessor is experimented and controls the whole system with suitable C program which already given as input in the microprocessor. The microprocessor actuates the motor as soon as it follows the suitable condition:

1. Knob is in ON position and absence of flame in burner, it immediately actuates the motor and the knob is to be turned OFF.

2. When the already given input time of the timer is overlapped, the microcontroller actuates the motor and the knob is to be turned OFF.

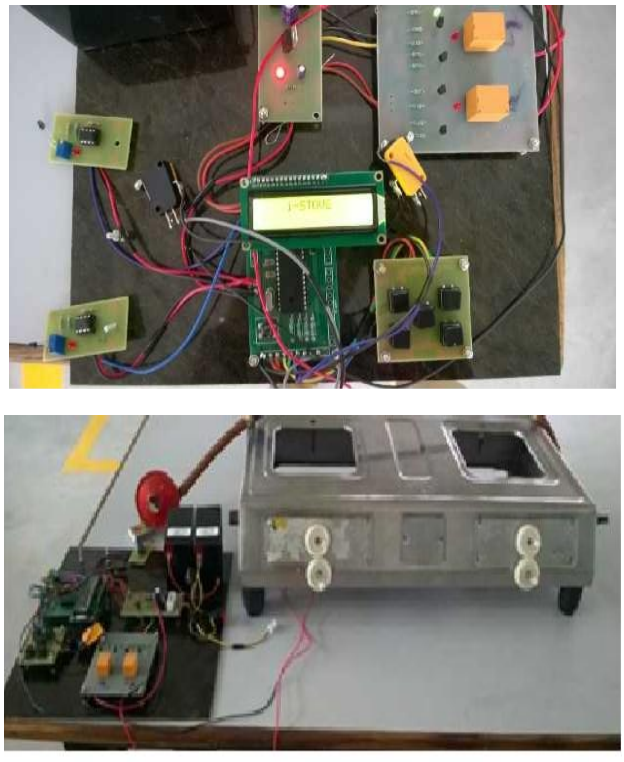

Fig – 7: Prototype of proposed experimental setup

5. CONCLUSION

This work concludes, it increases the safety of the hazardous cooking area. Any chance of accidents due to the carelessness of the cookers is nullified. And it makes the cooking much easy by providing the timer controlled automatic off feature is now smart and safe enough than the past.Replacing the conventional gas stove with accident prevention set up, this stove have wide range of advantages including safeness of the cooker and its surroundings which makes user friendly way of cooking is possible. Thus, this kind of technology will be the most welcomed in the market.

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