LPG Gas Leakage Detection & Control System

Hitendra Rawat, Ashish Kushwah, Khyati Asthana, Akanksha Shivhare

***Abstract*— Home security has been a major issue where crime is increasing and everybody wants to take proper measures to prevent intrusion. In addition there was a need to automate home so that user can take advantage of the technological**

The project is aimed at developing the security of Home against Intruders, Gas Leak and Fire. In any of the above three cases any one met while you are out of your home than the device sends SMS to the emergency no provided to it.

The report consists of a background into the area of 8051 microcontroller and mobile communication, how they are interfaced to each other and AT commands set used in communication.

***Index Terms*— GSM, microcontroller, MODEM, software, mobile communication, bridge- rectifier, transformer, interfacing, SIM, LCD.**

I. INTRODUCTION

The objective of this project is to detect any leakage of LPG/CNG based cars, small scale factories or in home appliances also. It will detect the leakage and will close the knob of the system to stop the supply of the gas. Stepper motor is there that could be attached with the knob and will close the supply by rotating it. For assistance and LCD of 16x2 is also there. An alarm is there also the stop the alert the user as soon as leakage is found.

Gas sensors are employed in a wide range of applications in the fields of safety, health, instrumentation etc... Common examples are domestic/commercial alarms for explosive or toxic gases, or in automotive application as gas leakage detectors for LPG powered cars and exhausts detectors inside any fuel powered truck/car. Such sensors, nowadays, are found also in applications involving air quality control systems and pollution monitoring. Today's sensors, while featuring a high sensitivity to a wide gases variety, are very compact in size and have significantly reduced their power consumption to better adapt to portable solutions. Building a system with a gas sensor is not as easy as it could appear. Despite the sensor could be treated, basically, as a variable resistor (which value depends on gas concentration in air) the practical implementation in a project should be done considering some design rules, especially if the final circuit is a device to be used in a field where reliability is strongly required (e.g. safety). As an example the internal elements of a sensor (heater and gas sensitive resistors) have to be constantly kept under control to avoid failures leading to a wrong alarm indication; furthermore, if the application needs to achieve a good measurement accuracy, factors like environment temperature, sensor life etc have to be taken into account. All those features and controls require introducing in the project a certain amount of external circuitry (including components like comparators, temperature sensor, spare logic etc. This project aims to show how a microcontroller can be employed to replace a lot of external components while adding extra functionalities at a cost comparable as a simple integrated comparator. In the prototype that we are going to present, the hardware and microprocessor firmware have been optimized to implement a smart LPG gas alarm (LPG stands for Liquefied Petroleum Gas) for cars running on LPG/CNG so that it can raise alarm before any fatal incident happens.

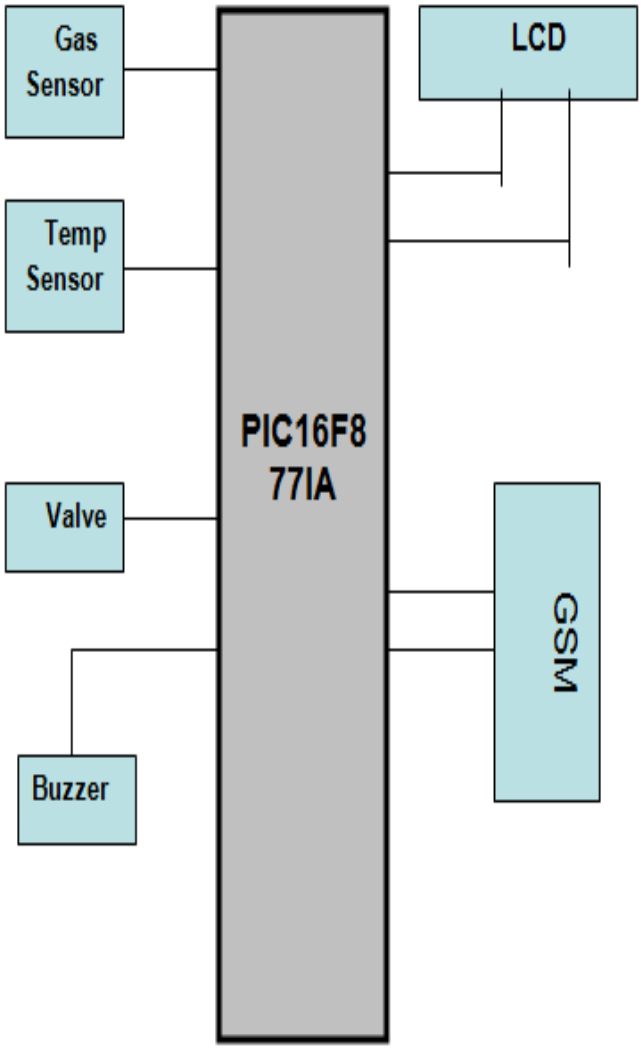

Figure 1: Block Diagram of Gas Leakage System

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II. HARDWARE IMPLEMENTATION

The block diagram of the hardware implementation of the entire system is as shown in the Figure1. In this circuit we used MQ-6 sensor for gas leakage detection. MQ-6 sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-6 has 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current. Here MQ-6 sensor works on basics 0of combustion process, and output is given in variable voltage form, so, when LPG gas is leakage voltage at the output pin of MQ-6 is increased and we use IC2 (Op-amp LM324) as a comparator for compare the LPG leakage with respect to normal condition. Output of comparator is fed to IC1 microcontroller (ATMEL 89S8253) and corresponding coding LCD is display gas leakage and give another instruction to stepper motor via ULN2803 to turn 90^o to turn off the regulator of gas tank. Temperature sensor DS18B20 is continuously communicated with Microcontroller and display temperature at LCD. If temperature is more than 50^o then fire alarm is activated and display fire on LCD.

PIC16F877A devices are available only in 40-pin packages. All devices in the PIC16F7X family share common architecture, with the following differences.

The main components of the system are-

1. PIC microcontroller
2. Gas sensor
3. GSM module
4. LCD
5. Power supply

1. PIC (MICROCONTROLLER)

The PIC (founded by Microchip) 16F877A is a CMOS-FLASH based High-performance 8-bit RISC Microcontroller. This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) microcontroller packs Microchip's powerful PIC® architecture into a 40 pin package. The PIC16F877A features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

Alternating current differ from DC in the direction of electron flow , first in one direction for a short time , then reverse direction and flow again in opposite direction for short time . The flow of electrons in one direction and then in another direction is called a cycle of AC. The number of cycles occur in one second of time is called “Cycles/Second”. In our country the standard power line frequency is 50 Hz.

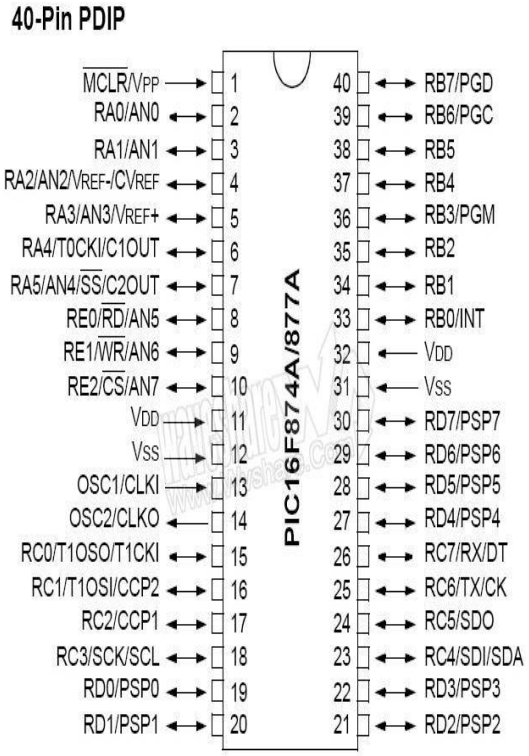

Figure 2: PIN Configuration of microcontroller

2. MQ6 Sensor

They are used in gas leakage detecting equipment in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke.

Figure3: MQ6 SENSOR

Structure and configuration of MQ-6 gas sensor is (Configuration A or B), sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-6 has 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current.

3. LCD

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly. They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in. LCDs are, however, susceptible\to image persistence. LCDs are more energy efficient and offer safer disposal than CRTs. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. The most flexible ones use an array of small pixels. The earliest discovery leading to the development of LCD technology, the discovery of liquid crystals, dates from 1888. By 2008, worldwide sales of televisions with LCD screens had surpassed the sale of CRT units. LCDs available in two models: Character LCD and Graphics LCD. The character LCD displays ASCII values and graphics LCD displays graphics. Character LCDs are available in various kinds of models. No. Of characters Lines: 8 1, 16 1, 16 2, 16 4, 20 4, 40 4,… Dots Dots: 122 32, 128 64, 240 128, 320 240… Color: Yellow, Green, Gray, Blue….Graphics LCDs are also available with different sizes and colors.

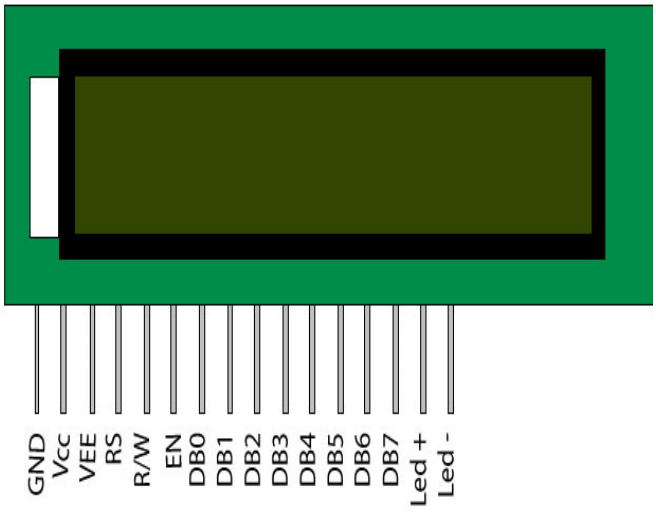

Figure 4: LCD PINOUT(16*2)

4. GSM MODEM

It is a wireless MODEM-just like dial-up MODEM works with GSM wireless network. The difference between dial-up MODEM and wireless MODEM is wireless MODEM sends and receives data through radio waves whereas dial-up MODEM send and receive data through a fixed telephone line.

Figure 4: GSM MODEM available in local market.

4. Power Supply

Power supply unit consists of the following units:

a. Step down transformer
b. Rectifier unit
c. Input filter
d. Regulator unit
e. Output filter

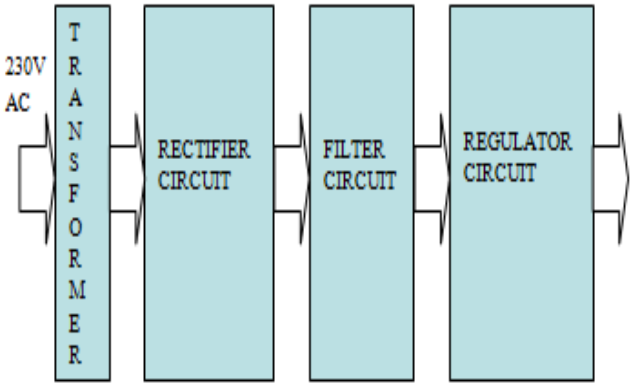

Figure 6: +5v DC power supply for microcontroller

a. *STEP DOWN TRANSFORMER:* The instrument transformer for power supply in this project is to convert AC from 230V to required low level such as 5V AC. This transformer apart from stepping down AC voltage gives isolation between power source and power supply circuitries.

b. *RECTIFIER UNIT:* In a power supply unit, rectification is normally achieved by a solid state diode. Diode contains two electrodes called the anode and the cathode. A diode has the property that will let electron flow easily in one direction. As a result when AC is applied to a diode, electrons only flow when the anode is positive and cathode is negative. Reversing the polarity of voltage applied to a diode will not permit electron flow. The various method of rectifying AC to DC or half wave, full wave and bridge rectifications. This project

employs a full wave bridge rectifier which is most commonly used in industries.

A bridge structure of four diodes is commonly used in power supply units to achieve full wave rectification. When AC voltage is applied to the primary winding of power transformer. It is stepped down to 5V AC across the secondary winding of the transformer. Normally one alteration of the input voltage will cause the polarities to reverse. Opposite end of the transformer will therefore, always be 180 degrees out of phase with each other.

For positive cycle, two diodes connected to the top winding gets positive voltage and only one diode conducts for that cycle due to forward bias. At the same time one out of the other two diodes conducts, for the negative voltage being applied from the bottom winding due to forward bias for that diode DC of frequency 100Hz.

In the next alteration the two diodes conducted from top winding and bottom winding as they are forward biased in this cycle. It is to be noted that the current flow through the load is always in one direction for each alteration of the applied AC input. This is of course, means that AC is rectified into DC. This DC output, in this case, has a ripple frequency of 100Hz, since each alternation produces a resulting output pulse, the ripple frequency or 2*50 Hz =100Hz. The output DC is not a pure DC. It is pulsating DC voltage.

c. *FILTER UNIT:* After pulsating DC has been produced by our rectifier, it must be filtered in or for it to be usable in a power supply. Filtering involves the ripple frequency. The power supply unit employed in this project used 7805 voltage regulator (for positive output voltages) and a 7905 regulator (for negative output voltages). Resistors R1 and R2 maintain line load regulation. Capacitors C2 and C4 act as high frequency suppressors. Depending on the design, it may be used to regulate one or more AC or DC voltages.
The 78xx (sometimes LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the *xx* is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). The 78xx line is positive voltage regulators: they produce a voltage that is positive relative to a common ground.

d. *REGULATOR UNIT*: Regulator regulates the o/p voltage constant depends on upon the regulator. The 78XX series of voltage regulator are intended to provide a fixed voltage for use with a variety of different circuits. They are available in a range of different voltages as shown below and, although only the positive variety is considered here, there is a complimentary range of negative regulators that are essentially identical. The voltage regulators are capable of providing currents of up to 1.5A with adequate heat-sinking and internal protection circuitry makes them almost indestructible. In other configurations and with extra components, these regulators can be employed as variable voltage sources or constant current sources crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

It is classified as follows:
a. Positive regulator
1) Input pin
2) Ground pin
3) Output pin
It regulates the positive voltage

b. Negative regulator
1) Ground pin
2) Input pin
3) Output pin
It regulate the negative voltage

e. *OUTPUT FILTER*: Capacitor acts as filter. The principle of the capacitor is charging and discharging. It charges in positive half cycle of the AC voltage an it will discharge in negative half cycle. So it allow only allows AC voltage and does not allow the DC voltage. This filterer fixed after the regulator.

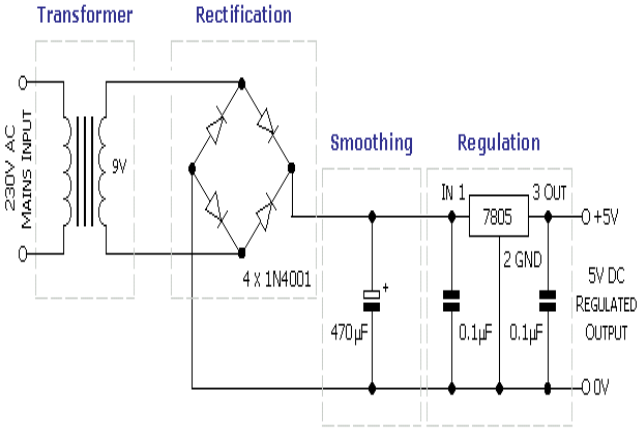

Figure 7: Power Supply Circuit

III. CIRCUIT

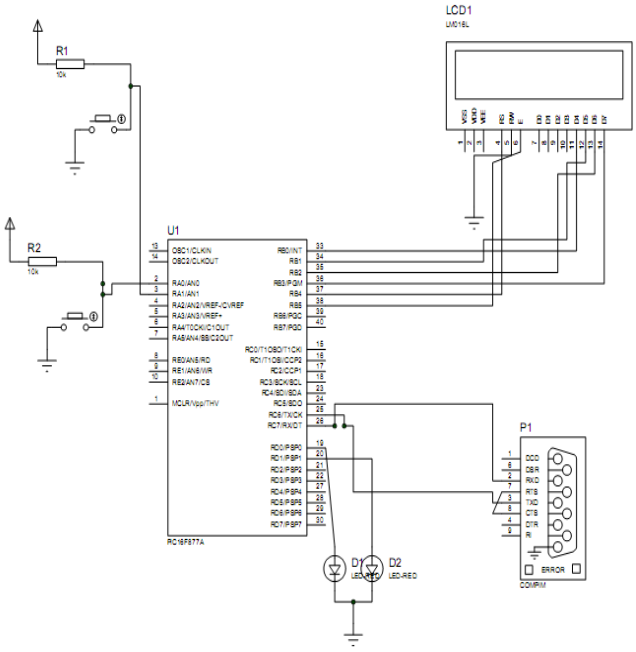

Figure8: Circuit Configuration

IV. APPLICATION

a) Protection from any gas leakage in cars
b) For safety from gas leakage in heating gas fired appliances like boilers, domestic water heaters
c) Large industries which uses gas as their production
d) For safety from gas leakage in cooking gas fired appliances like ovens, stoves etc.

V. ADVANTAGES

a) It is used in house as LPG leakage detection
b) It also detects alcohol so it is used as liquor tester.
c) The sensor has excellent sensitivity combined with a quick fast response time.
d) The system is highly reliable, tamper-proof and secure.
e) In the long run the maintenance cost is very less when Compared to the present systems.
f) It is possible to get instantaneous results and with high accuracy.

VI. FUTURE SCOPE

With recent development in technology, Temperature display during periods wherein no message buffers are empty is one such theoretical improvement that is well possible. Another very interesting and significant improvement would be to accommodate multiple receiver MODEMS at different positions in the geographical area carrying duplicate SIM cards. Multilingual display can be another added variation in the project. Audio output can be introduced to make it user Friendly.

VII. CONCLUSION

In recent households, the use of LPG is taking a big troll. From the use of cylinder up to the use of petroleum pipelines. The biggest threat in using this technology is security. And our project will prove to be boom for households and industries.

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