2022

In-Car Carbon Monoxide Level Detector and Fire Alarm

SLTC

GROUP 13

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Introduction

We have to create an in-car carbon monoxide level detector with a display to show the ppm value of carbon monoxide present in the car. We have set up an alarm system for this detector when the oxygen level gets lower or carbon monoxide gets higher and the reason for this alarm system is because there are more accidents occur in these days.

The important causes of using this detector in the car because of much death that occur in the car due to suffocation problems from an air conditioner or by smoking inside the car and in absence of parents, some small kids are playing inside the car. When they accidentally locked themselves inside the car and the window got closed. They are unable to open the door or window and they struggle to breathe inside the car after an hour, this may turn to unconscious and cause death. Many people are sleeping inside the car with fully closed windows and with an air conditioner sometimes this may cause unconscious death. Because Experts say that in less than an hour one can die of carbon monoxide from the air conditioner. When carbon fuel burned in an open location with enough air, these energy sources are not harmful. However, carbon monoxide is dangerous in tight spaces. It is produced as a byproduct of the combustion of carbon fuels such as natural gas in your stove and gasoline in your vehicle.

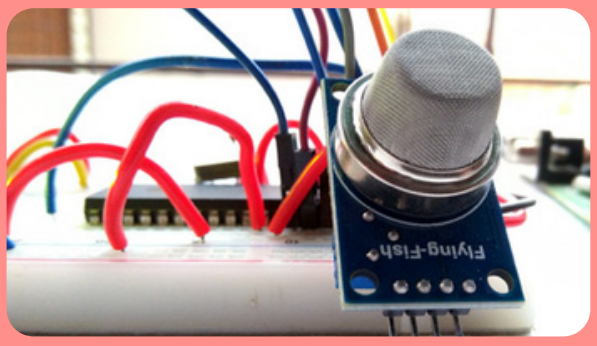
As an additional advantage, we can notice any kind of flammable gas present inside the vehicle with the help of the sensor we have used. We can use this circuit not only inside the car to detect any kind of flammable gas but also inside residential places.

Approach

The MQ-2 sensor and the PIC16F877A are the two primary components of this project.

PIC16F877A MICROCONTROLLER

The PIC microcontroller PIC16f877a is one of the most well-known in the industry. This microcontroller is quite easy to use, and coding or programming it is also very simple. Because it employs FLASH memory technology, one of its key advantages is that it can be write-erased as many times as possible. It contains a total of 40 pins, 33 of which are for input and output. Many pic microcontroller applications make use of the PIC16F877A and also widely used in digital electronics circuits. Major reason for using pic is low power consumption. PIC is the best replacement for arduino.



MQ-2 SENSOR

The MQ2 gas sensor is an electronic sensor that detects the concentration of gases in the air, including LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide. MQ2 gas sensor is sometimes referred to as chemiresistor. It has a sensor substance inside that alters resistance as it comes into touch with the gas. This variation in resistance value is useful for gas detection.

This sensor's sensitivity material is SnO2. As there is no gas present in the air, it has a poor conductivity. If a flammable gas is present in the air, the MQ-2 gas sensor has a high conductivity. The conductivity of the air is determined by the quantity of gas present.

Hardware Components

The following are the hardware components that we used to design this project. We spent around 6000lkr to buy these components. The major problems related to components are the shortage of components and not enough experience to handle and work with these components. We struggled a bit but anyway we managed to complete the circuit.

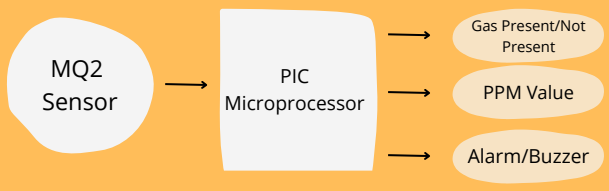
Component	Quantity
MQ 2 Sensor	1
1K Resistor	5
0.47nF Capacitor	1
47nF Capacitor	1
1N5817 Diode	1
2N3904	1
16 X 2 LCD	1
PIC16F877A	1
10K Potentiometer	1
LED	1
Jumper Wires, Circuit Board, Soldering Essentials	1

Methodology

The MQ-2 sensor and the PIC16F877A are the project's two primary components. The sensor's resistance lowers when it comes into touch with explosive gas. This sensor is installed on a stripboard with a comparator circuit, so when the detection level exceeds a certain threshold, a signal is generated that can be read directly by a PIC (the output pin of the sensor is either 1 or 0). The sensor module, on the other hand, provides an analog output that allows us to take measurements. As a result, the MQ-2 sensor is linked to one of the PIC16F877A's port A pins: RA0. The digital signal that indicates the PIC that the gas levels are dangerous is handled by RA0.

The firmware that runs on the PIC is...

- Takes analog readings from the sensor
- Displays analog values on a 16X2 LCD
- Probes RA0 for danger levels
- Fires alarms and sounds buzzers

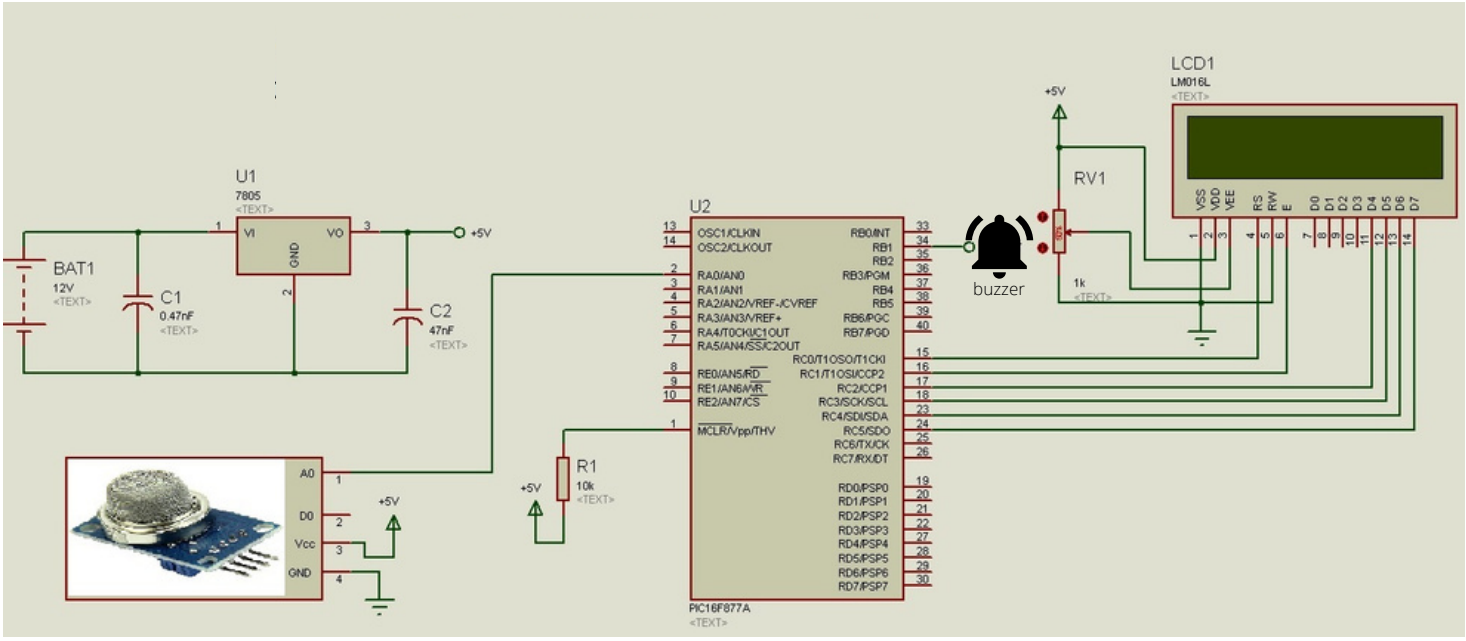


The PIC executes its configuration when it boots up, which configures the IO ports, ADC module, internal oscillator, and LCD. When the system is properly configured and functioning, the PIC begins its infinite loop. This entails obtaining measurements from the sensor, showing the findings, and then evaluating the MQ-2 sensor's danger level digital output. Measurements are taken by setting the GO bit in the ADC module and waiting for the conversion to complete. This number is subsequently translated into a character and transmitted to the LCD module.

If the PIC senses that the gas level has become unsafe (via the MQ-2's digital output), it enters an alert routine, which activates the buzzer. There is no reset button or any other way to exit the alarm loop on this circuit (resetting the alarm involves disconnecting the power and re-enabling it). This is done to decrease the chance of the alarm going off in the case of an explosive gas detection. Unlike fire and smoke, gas accumulation can cause an explosion at any time, therefore leaving as soon as possible is critical.

Circuit Diagram

The circuit schematic for connecting a MQ-2 gas sensor to the pic microcontroller is shown below.

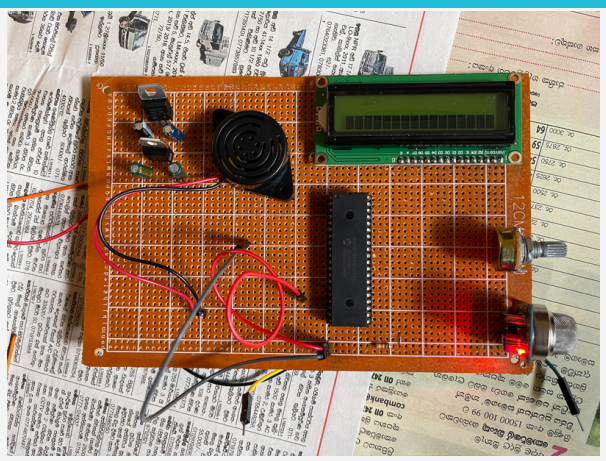


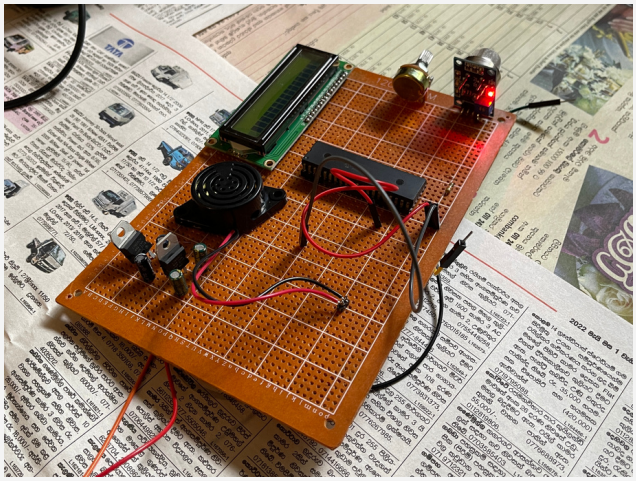
Code for MQ-2 gas sensor interfacing with pic microcontroller

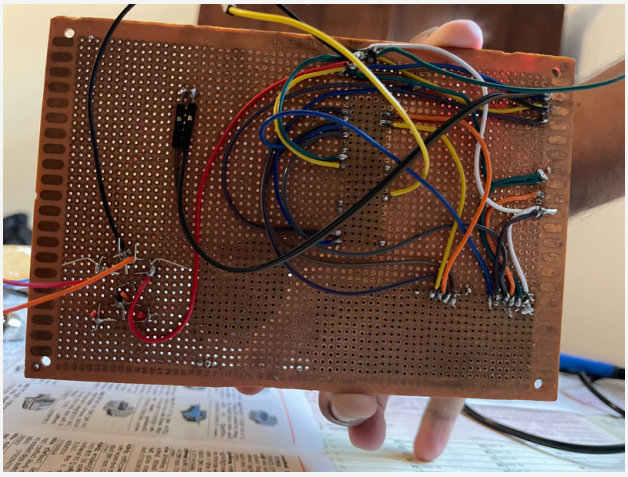
```
// LCD module connections
sbit LCD_RS at RD2_bit;
sbit LCD_EN at RD3_bit;
sbit LCD_D4 at RD4_bit;
sbit LCD_D5 at RD5_bit;
sbit LCD_D6 at RD6_bit;
sbit LCD_D7 at RD7_bit;

sbit LCD_RS_Direction at TRISD2_bit;
sbit LCD_EN_Direction at TRISD3_bit;
sbit LCD_D4_Direction at TRISD4_bit;
sbit LCD_D5_Direction at TRISD5_bit;
sbit LCD_D6_Direction at TRISD6_bit;
sbit LCD_D7_Direction at TRISD7_bit;

// MQ-2 gas sensor interfacing with pic //

int gas_value;
char text[10];
void main(void)
{
ADC_Init();
// it will initialize the adc module of pic16f877a
Lcd_Init(); // Initialize LCD
Lcd_Cmd(_LCD_CLEAR); // Clear display
Lcd_Cmd(_LCD_CURSOR_OFF); // Cursor off
Lcd_Out(1,1,"CO Level Detector" ); // Write text in first
delay_ms(2000);
Lcd_Cmd(_LCD_CLEAR); // Clear display

while(1)
{ // Endless loop

gas_value = ADC_Read(0);
// It will read the gas value of sensor
if( gas_value > 400 )
Lcd_Out(1,1, "Gas detected" );
else
Lcd_Out(1,4, "No Gas " );
intToStr(gas_value, Ltrim(text));
Lcd_Out(2,1, text );
delay_ms(1000);

}
}
```

Results

The following are the photos of the working circuit



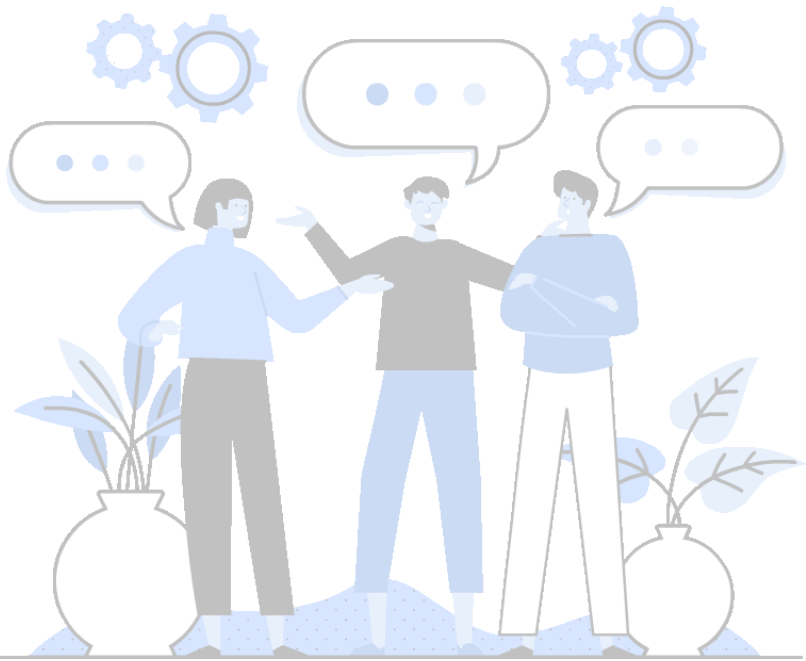




Discussion

Since we didn't have much experience working with PIC coding and implementation, we had to face many errors and some faults due to a lack of knowledge.

- First, the problem was the basic PIC setup. There are two VCC and VDD pins that we didn't notice at first. They both needed to be powered up.
- There are 40 pins and installing the PIC into the stripboard needs to be taken good care of. We broke one PIC during the project.
- During burning there we too many problems which we solved later on. The burning process needs power for the burner to find the PIC we couldn't do that at first but solved it by using the power option in the MPLab IPE Advanced Option.
- The components are not accurate. So at first, we were not seeing our desired outputs and we used DMM to find if there was enough power to the system for it to work and we found that one wire was faulty.
- We used the MikroC LCD library for operating the LCD. But we had to include that library in our code by selecting it from another option, which took a lot of time for us to find.
- The Lcd Brightness was an issue. The letters were clear enough to visualize. We used a POT to control the contrast of the LCD screen.
- There is not much help on the internet regarding PIC and its coding. So we had to go through some hard times solving our problems.



Future Work

Overall, the system's software and hardware have been built and tested by introducing a little amount of Carbon Monoxide and LPG near the gas sensor module. We hope to develop this device for an industry-based solution. Also, one of the notable upcoming functions of this system is the addition of a subsystem where gas waste and usage can be monitored. The system is adaptable since a bigger number of sensors and relays may be added depending on the overall LPG or CO supply arrangement within the environment.

In addition, we hope to include more software-based intelligent functions into this system. This is a gas detection, control, and alarm system that operates automatically. In the future, this technology will be able to inform emergency services if any incidents occur. Also, there will be a smartphone app and a web-based app for real-time monitoring. Many smart features will be introduced to the user app for this system. Overall, the enhancements will make the system safer for users. The system will be tuned for usage in a variety of places, including the vehicle, the house, industries, and many more.

This is a low-cost, low-power, lightweight, portable, safe, user-friendly, efficient, multi-featured, and basic gas detection system gadget. Gas leak detection will not only help us in the health sector, but it will also help our economy, since when gas leaks, it not only contaminates the atmosphere but also wastes gas, which hurts our economy. More advanced functions will be integrated with this system in the future, providing customers with more safety and comfort.