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CAPSTONE PROJECT

FIRE ALARM DETECTION

CHUÔNG PHÁT HIỆN BÁO CHÁY

MIDTERM CAPSTONE PROJECT REPORT

MENTOR

PhD. TRI NHUT DO

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VIETNAM NATIONAL UNIVERSITY

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UNIVERSITY OF INFORMATION TECHNOLOGY

SOCIALIST REPUBLIC OF VIETNAM

Independence – Freedom – Happiness

VIETNAMESE PROJECT NAME: Mạch báo cháy
ENGLISH PROJECT NAME: Fire Detection
Instructor PhD. Tri Nhut Do, Faculty of Computer Engineering
Implementation time: From: 25/04/2023 To: 05/05/2023
Student Perform: Lê Công Quang - 21521337 **Nguyễn Tuấn Dũng - 21520746**
Overview of the topic: The fire alarm system is a network of interconnected components that work together to detect and alert occupants to the presence of a developing fire. **The goal of the subject:** Building a fire alarm system is an essential safety measure to protect their buildings and residents from fire -related dangers. **Methods of implementation:** Using microcontroller technology that communicates with the key components like smoke,flame sensor and buzzer

Main contents of the topic: The fire alarm project report focuses on designing and installing an intelligent fire alarm system using microcontroller technology.	
Certification of Instructor (Sign and clearly state full name)	**HCM city, 2023 9 MAY** **Student** (Sign and clearly state full name)

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Chapter 1. **INTRODUCTION**

Fire detection is an essential aspect of fire safety in buildings and structures. It is crucial to have a system in place that can detect a fire early and trigger an alarm, allowing people to evacuate safely and firefighters to arrive promptly. The use of microcontrollers such as the 8051 can greatly enhance the effectiveness and reliability of fire detection systems.

Fire detection circuit are crucial components of fire safety systems in buildings and homes. They serve as the first line of defense against fires by detecting smoke, or flames and alerting occupants to evacuate the premises. In this project report, we will discuss the design, implementation, and testing of a fire alarm system. We will cover the different types of fire alarms, the components used in the system, and the programming required to make it functional. Additionally, we will explore the challenges faced during the project and the solutions developed to overcome them. Through this project report, we hope to provide an in-depth understanding of fire alarms and inspire future innovations in fire safety technology.

Fire alarms using 8051 use buzzer, smoke sensor and flame detector sensor to detect the presence of fire. Once detected, the sensor sends a signal to the 8051 microcontrollers, which triggers a loud alarm to alert people in the vicinity.The 8051 microcontroller's ability to handle multiple inputs and outputs, along with its low power consumption, make it an excellent choice for fire detection systems. The flexibility of the microcontroller also allows for customization of the system according to the specific requirements of the building.

In conclusion, the 8051 is an ideal microcontroller for use in fire detection systems. Its ability to interface with sensors, low power consumption, and compact size make it an excellent choice for this application. By using the 8051 in fire detection systems, it is possible to create a reliable and effective system that can help save lives and prevent damage to property.

Chapter 2. **OVERVIEW**

2.1 Research directions

2.1.1 Research directions in the world

The research direction of fire detection using 8051 microcontroller involves studying and developing solutions to improve and optimize the fire detection system, increasing its accuracy, reliability, and readiness:

1. Research and development of new sensors for early detection of fire, especially in hazardous or inaccessible environments. For example, gas sensors can be used to detect CO, CO2, LPG in the air, or temperature sensors can be used to detect high temperatures.
2. Optimization of the fire detection system by integrating multiple sensors and using signal analysis algorithms to reduce errors and increase the accuracy of the system.
3. Research and development of wireless network solutions to transmit signals from sensors to fire monitoring centers or controllers.
4. Integration of artificial intelligence and machine learning algorithms to enhance the accuracy and reliability of the fire detection system.
5. Research and development of new sensors and sensors fusion techniques to improve the performance of the system.
6. Investigation of advanced wireless network solutions for faster and more efficient data transmission.
7. Optimization of the power consumption of the fire detection system to reduce power usage and increase the lifespan of the batteries.
8. Development of fire detection systems that are more accessible and user-friendly for individuals with disabilities.
9. Exploration of innovative solutions to increase the response time of the fire detection system.
10. Research on integrating the fire detection system with other building automation systems such as heating, ventilation, and air conditioning (HVAC), and security systems to provide a more comprehensive solution.

2.1.2 Research directions in Viet Nam

The research direction of fire detection using 8051 microcontrollers in Vietnam is similar to the global research directions. Some specific research directions in Vietnam include :

1. Development of low-cost and efficient fire detection systems using 8051 microcontrollers to meet the demand of Vietnam's market.
2. Investigation of the optimal sensor types and configurations for fire detection in Vietnam's climate and environmental conditions.
3. Research and development of wireless network solutions that are suitable for the Vietnamese context.
4. Exploration of energy-efficient solutions to reduce the power consumption of the fire detection system.
5. Research on integrating the fire detection system with other home automation systems, such as lighting and air conditioning, to create a more comprehensive solution for Vietnamese households.
6. Investigation of the impact of Vietnamese cultural factors on the design and adoption of fire detection systems.

Overall, the research direction of fire detection using 8051 microcontrollers in Vietnam involves finding innovative solutions to address the specific needs and challenges of the Vietnamese market, such as low cost, energy efficiency, and integration with other home automation systems.

2.2 Problem

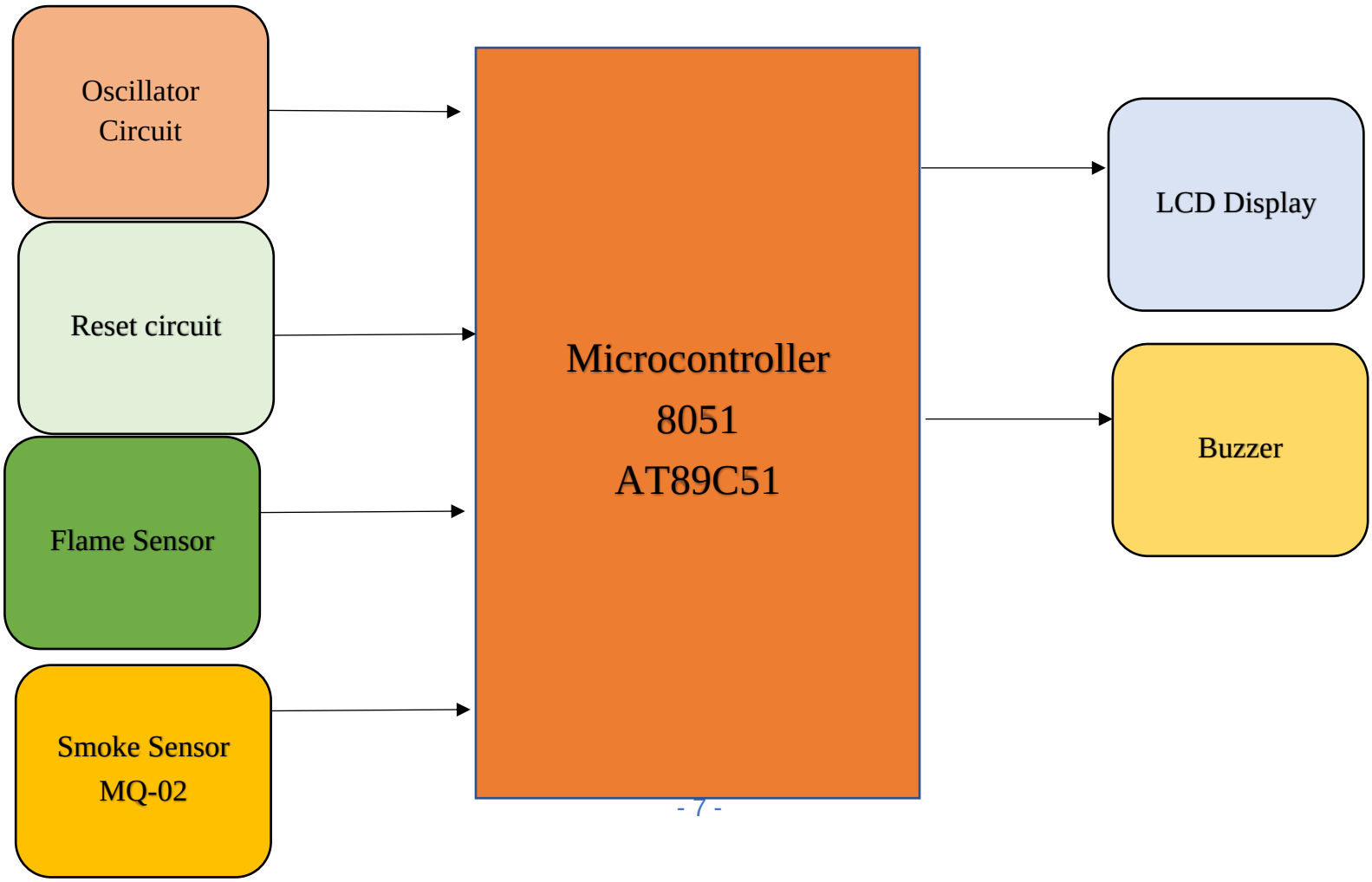
When designing a fire alarm circuit using 8051 microcontrollers, there are several challenges that one may encounter. These challenges include:

1. Sensor selection: The choice of sensors used in the circuit will have a significant impact on the accuracy and reliability of the system. The designer must select appropriate sensors that can detect fire and smoke quickly and accurately.
2. Power management: The fire alarm circuit should consume minimal power to prevent draining the battery or power source. The designer must ensure that the circuit is energy-efficient to prolong the battery life.

3. False alarms: One of the significant problems when designing fire alarm circuits is the occurrence of false alarms. The designer should consider using multiple sensors and algorithms to minimize the occurrence of false alarms.
4. Signal interference: Interference from other electronic devices can affect the operation of the fire alarm circuit, resulting in inaccurate readings. The designer should consider ways to minimize signal interference and improve the circuit's signal-to-noise ratio.
5. Design complexity: Designing a fire alarm circuit using 8051 microcontrollers can be challenging due to the complexity of the circuit. The designer should aim to simplify the circuit's design to reduce the risk of errors and improve the circuit's reliability.

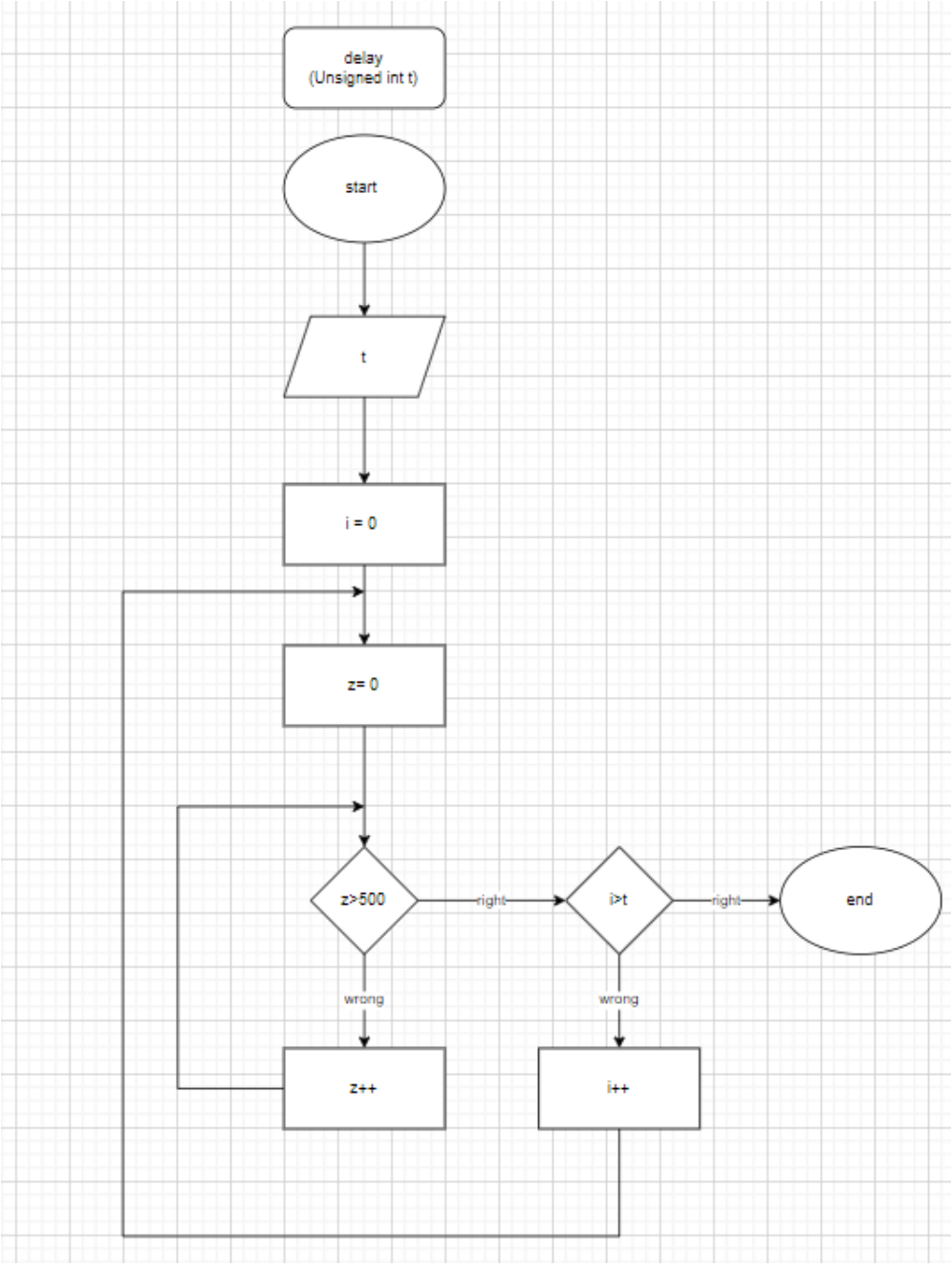
Overall, the designer must consider the above challenges and find innovative solutions to ensure the fire alarm circuit's accuracy, reliability, and energy efficiency.

2.3 Block Diagram

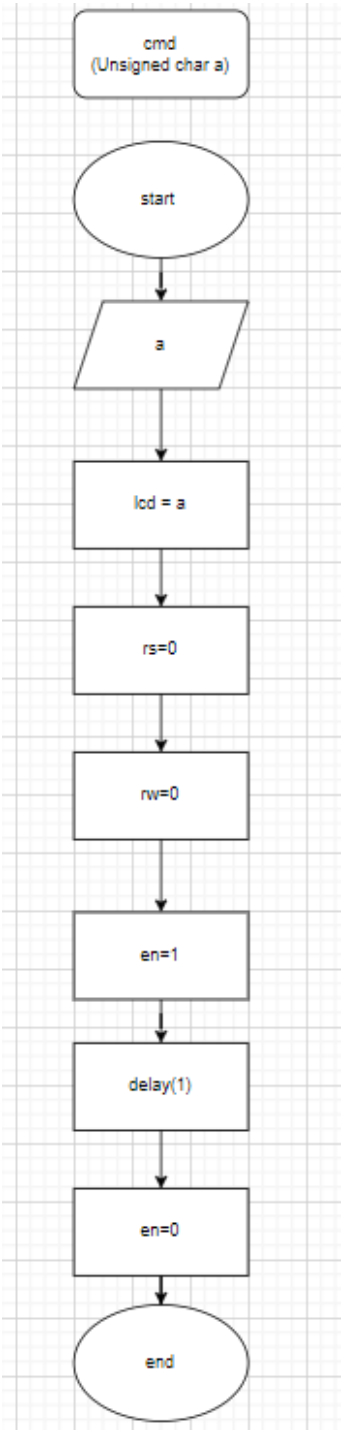


2.4 Flow Chart

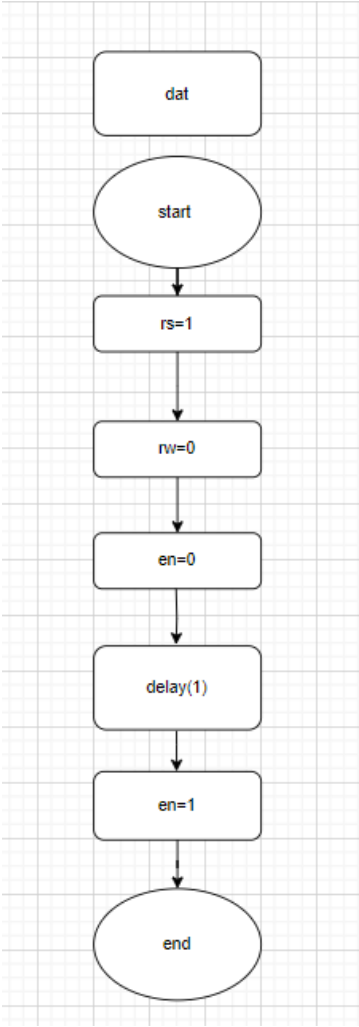
2.4.1 Delay function



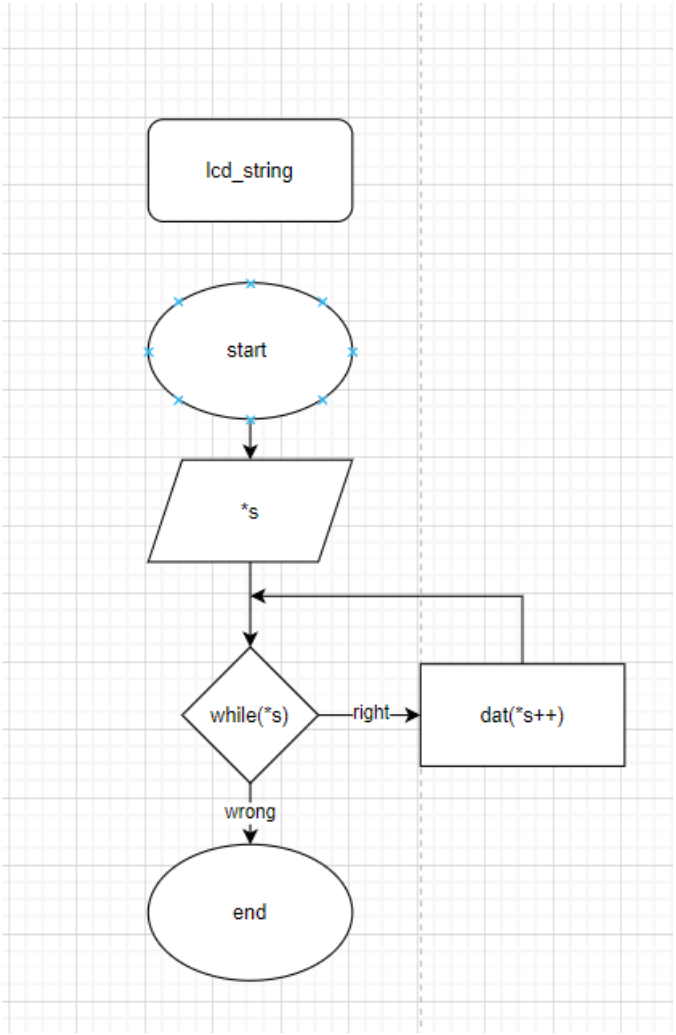
2.4.2 LCD command function



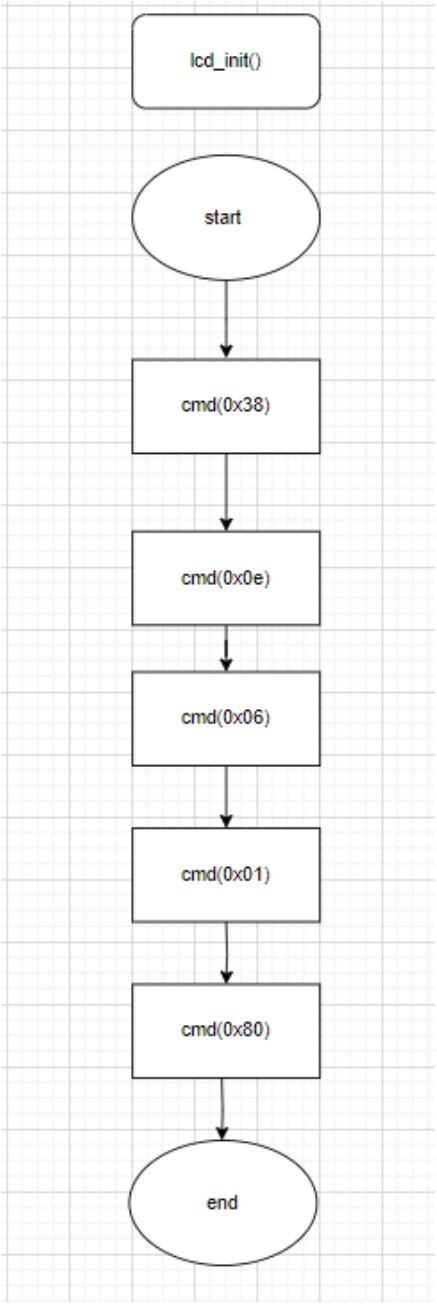
2.4.3 LCD data function



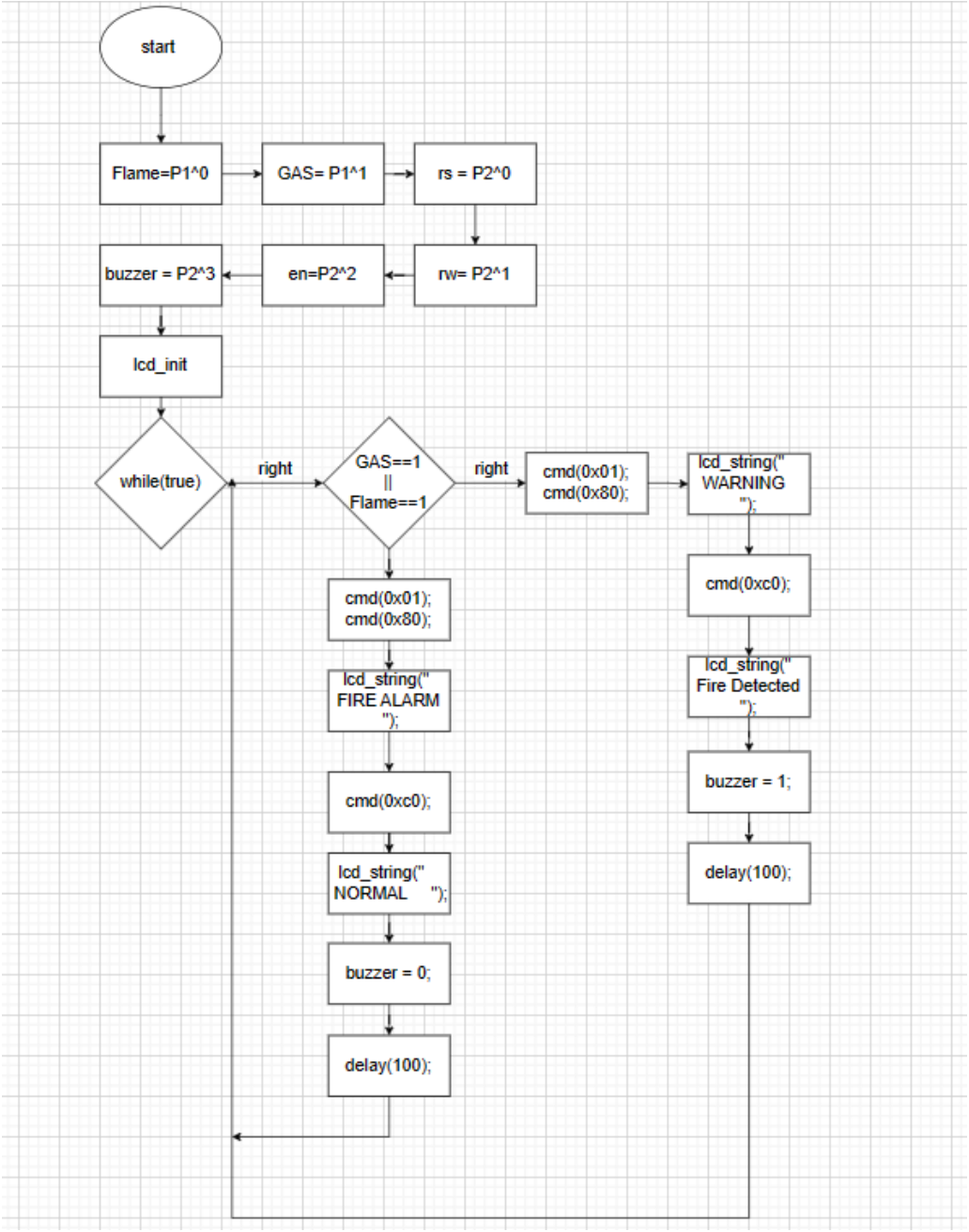
2.4.4 LCD string function



2.4.5 LCD init function



2.4.6 Main



FROM FLOW CHART ABOVE WE HAVE THE SOURCE CODE (C++)

```
#include<reg51.h>
#define lcd P3
sbit FLAME=P1^0;
sbit GAS=P1^1;
```

```
sbit rs=P2^0; //register select
sbit rw=P2^1; //RW
sbit en=P2^2; //enable
sbit buzzer = P2^3;

void lcd_init();
void cmd(unsigned char);
void dat(unsigned char);
void delay(unsigned int);
void lcd_string(char *s);

void main()
{
   lcd_init();
   while(1) {
      if(GAS == 1 || FLAME == 1) {
cmd(0x01);
cmd(0x80);
lcd_string("     WARNING    ");
          cmd(0xc0);
          lcd_string("  Fire Detected ");
buzzer = 1;
          delay(100);
       } else {
cmd(0x01);
cmd(0x80);
lcd_string("   FIRE ALARM   ");
          cmd(0xc0);
          lcd_string("     NORMAL     ");
buzzer = 0;
  delay(100);
       }
   }
}

void lcd_init()
{
```

```
   cmd(0x38);
   cmd(0x0e);
   cmd(0x06);
   cmd(0x01);
   cmd(0x80);
}

void cmd(unsigned char a)
{
   lcd=a;
   rs=0;
   rw=0;
   en=1;
   delay(1);
   en=0;
}

void dat(unsigned char b)
{
   lcd=b;
   rs=1;
   rw=0;
   en=1;
   delay(1);
   en=0;
}

void lcd_string(char *s)
{
   while(*s) {
     dat(*s++);
    }
}

void delay(unsigned int t)
{
   unsigned int i,z;
```

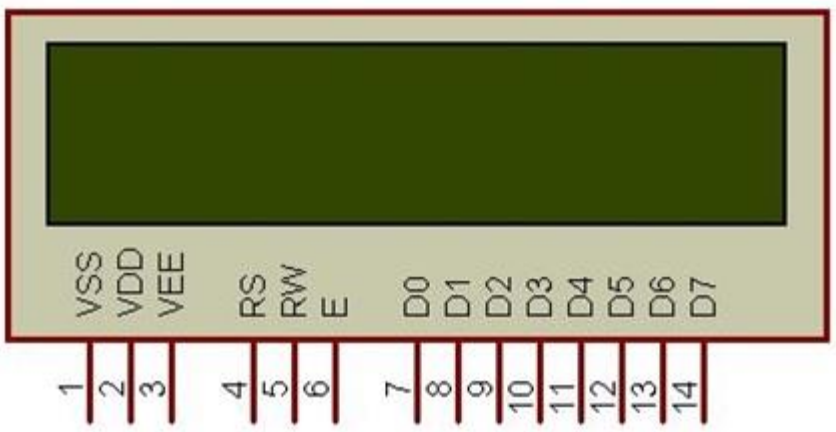
```
    for(i=0;i<t;i++)
    for (z=0; z<500; z++) ;
}
```

Chapter 3. **Implemetation**

3.1 Describe components

3.1.1 LDC LM016L

The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 charachers, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers. Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections). Pin description is shown in the table below.



Pin No.	Name	Description
Pin no. 1	VSS	Power supply (GND)
Pin no. 2	VDD	Power supply (+5V)
Pin no. 3	VEE	Contrast adjust
Pin no. 4	RS	0 = Instruction input 1 = Data input

Pin no. 5	R/W	0= Write to LCD Module 1 = Read from LCD module
Pin no. 6	EN	Enable signal
Pin no. 7	D0	Data bus line 0 (LSB)
Pin no. 8	D1	Data bus line 1
Pin no. 9	D2	Data bus line 2
Pin no. 10	D3	Data bus line 3
Pin no. 11	D4	Data bus line 4
Pin no. 12	D5	Data bus line 5
Pin no. 13	D6	Data bus line 6
Pin no. 14	D7	Data bus line 7 (MSB)

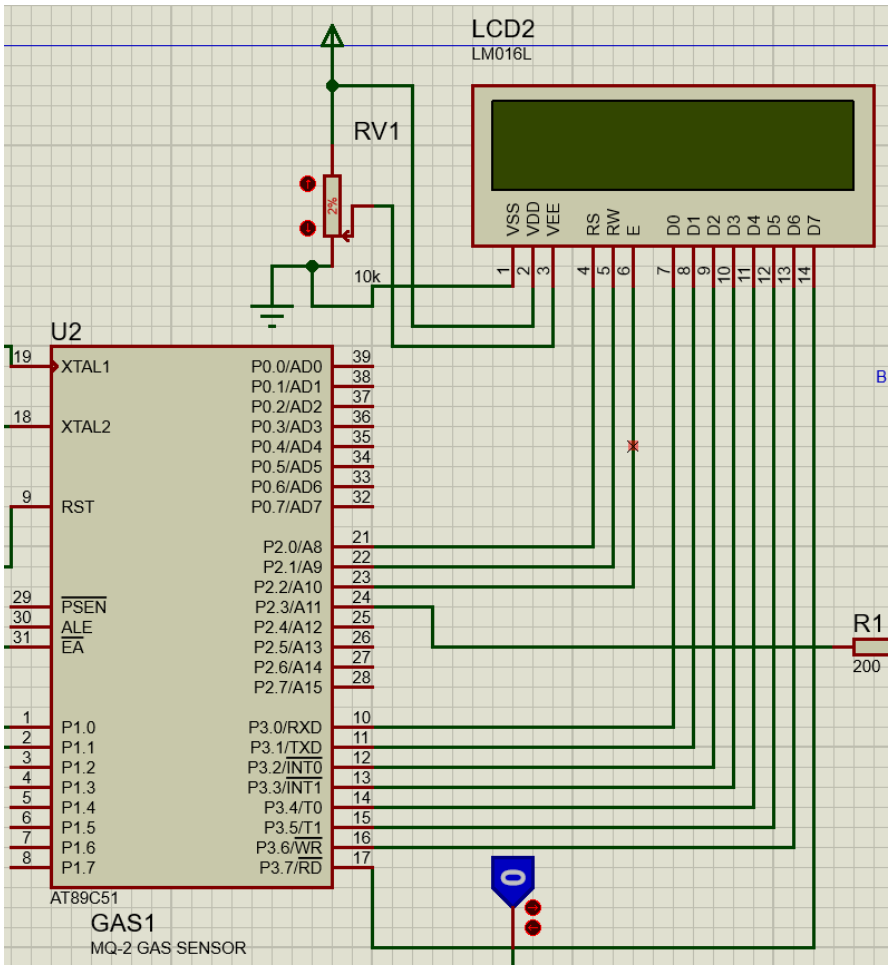
Table 3.1.1.1 Internal pin connection

The LM016L is a widely used 16x2 character LCD module with a built-in HD44780 controller, according to. It has an effective display area of 61W x 15H mm and nominal dimensions of 84W x 44H x 120 mm, with a display color of black and a single power supply of +5V. The LM016L has an extended capacity of 80 x 8 bits or 80 characters, with unused display data RAM (DDRAM) being used as general data RAM

No	HEX Value	COMMAND TO LCD
1	0x01	Clear Display Screen
2	0x30	Function Set: 8-bit, 1 Line, 5x7 Dots
3	0x38	Function Set: 8-bit, 2 Line, 5x7 Dots
4	0x20	Function Set: 4-bit, 1 Line, 5x7 Dots
5	0x28	Function Set: 4-bit, 2 Line, 5x7 Dots
6	0x06	Entry Mode
7	0x08	Display off, Cursor off
8	0x0E	Display on, Cursor on
9	0x0C	Display on, Cursor off
10	0x0F	Display on, Cursor blinking
11	0x18	Shift entire display left
12	0x1C	Shift entire display right
13	0x10	Move cursor left by one character
14	0x14	Move cursor right by one character
15	0x80	Force cursor to beginning of 1st row
16	0xC0	Force cursor to beginning of 2nd row

Table 3.1.1.2 LCD Command Codes

LCD LM016L IN CIRCUIT SIMULATION:



+ VSS connected to Power Supply (GND) (LCD Lm0161 datasheet)
+ VDD connected to Power Supply (+5V) (LCD Lm0161 datasheet)
+ VEE connected to rheostat 10K Ω to contrast adjust :

- A 10k ohm potentiometer is commonly used to adjust the contrast of the LM016L LCD module because it provides a good range of adjustment for most applications. The resistance range of the potentiometer allows for fine adjustments to be made to the contrast of the display, while still providing a wide enough range of adjustment to accommodate different lighting conditions or viewing angles.

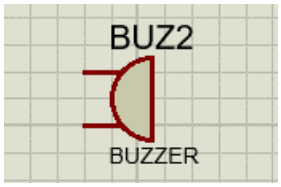
- Additionally, a 10k ohm potentiometer is a commonly available value and is widely used in electronics applications, which makes it a convenient choice for this purpose.

- It's important to note that the actual value of the potentiometer used can depend on the specific requirements of the application and the specific characteristics of the LM016L LCD module being used, so other values of potentiometers or rheostats may also be used.

Pin P2.0 connected to RS
Pin P2.1 connected to RW
Pin P2.2 connected to Enable
Port 3 (Pin P3.0 -> P3.7) connected to Pin D0 -> D7 LCD LM016L

3.1.2 Buzzer

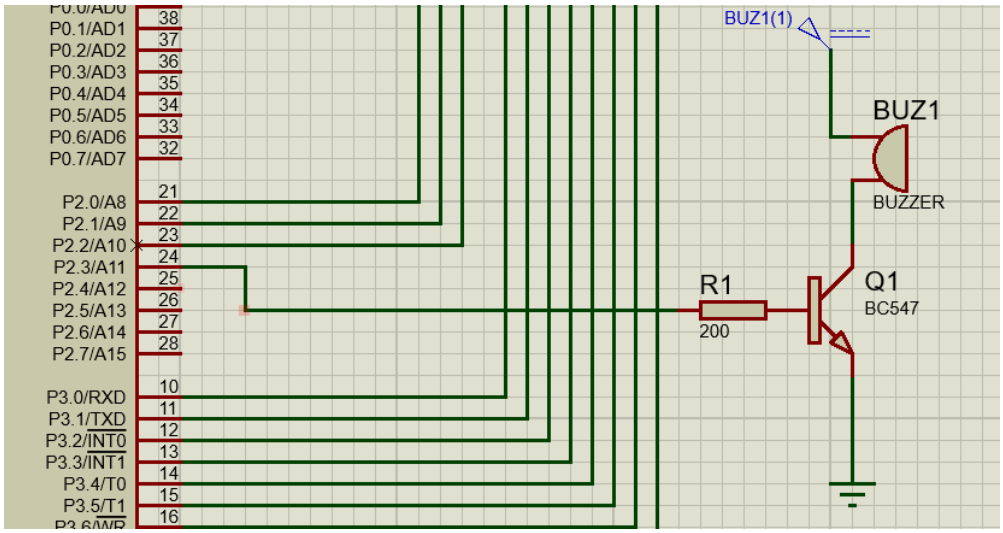
An active buzzer is a type of electronic buzzer that generates sound waves by itself when it is connected to a power source. It consists of an oscillator, a driver circuit, and a resonant device. The oscillator generates a signal that drives the resonant device, which then produces sound waves at a particular frequency. Active buzzers are easy to use and require only a power supply to operate. They can be used in a wide range of applications, including alarms, timers, and notification systems, and are commonly used in electronic projects and devices that require audio output.



Rated Voltage	5 V
Operating Voltage	4~8 V
Max Rated Current	≤32 mA
Min. Sound Output at 10cm	85 dB
Resonant Frequency	2300 ±300 Hz
Operating Temperature	-20°C to 45°C
Dimensions (Excluding Pins)	
Height	9.16 mm (0.36")
Diameter	11.78 mm (0.46")
Weight	1.6 g (0.057 oz)

Table 3.1.2 SPECIFICATIONS ACTIVE BUZZER 5V

BUZZER IN CIRCUIT SIMULATION:



+ The plus (+) pin of the buzzer is connected to the mains voltage;

+ The negative (-) pin of the buzzer is connected to the Collector (C) pin of the BC547;

+ The Emitter pin (E) of the BC547 is connected to ground;

+ The current limiting resistor connects pin C of the BC547 to the negative (-) pin of the buzzer.

+ When using BC547 as a switch, the output current will depend on the input current and the gain of the transistor. If the transistor is properly connected and used within its Saturation and Cut-off Zones, the output current will be close to the input current.

- Cutting current (Icutoff): 5 mA (BC547 datasheet)
- Saturation Current (Ihfe): 100 mA (BC547 datasheet)

Pin P2.3: We used Resistor 200 Ω and transistor BC547 and Power supply (DC 5V) for buzzer:

- The voltage level of the output pins of Port 3 of the 8051 microcontroller is dependent on the power supply voltage

(Vcc) of the microcontroller and the specific circuit being used.

- In general, the voltage level of the output pins of Port 3 will be the same as the power supply voltage of the microcontroller. For example, if the microcontroller is powered by a +5V power supply, then the output pins of Port 3 will provide a voltage level of approximately +5V when set to a logic high (1) and a voltage level close to 0V when set to a logic low (0).

- It's important to note that the actual voltage level of the output pins of Port 3 can also depend on the current drawn by the connected device and the specific load characteristics of the circuit. In some cases, additional buffering or level-shifting may be required to ensure that the output voltage level is appropriate for the connected device.

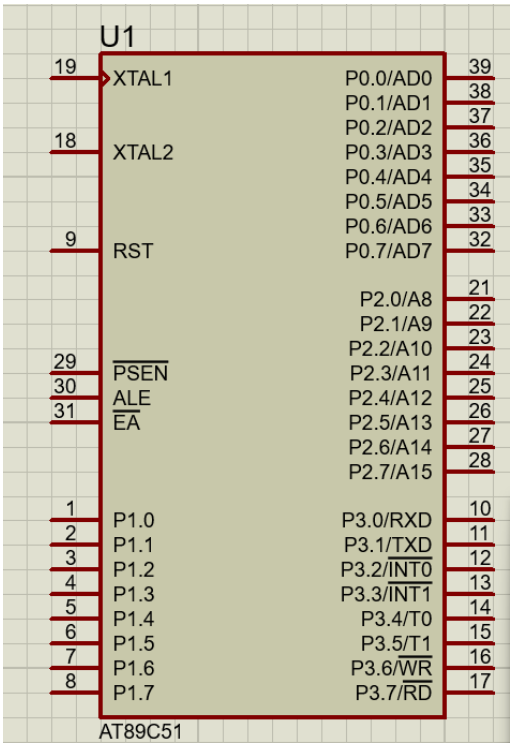
Pin P2.3 : $I_{200} = I_C = (5 - 0.7)/200 = 0.0215 = 21.5$ mA

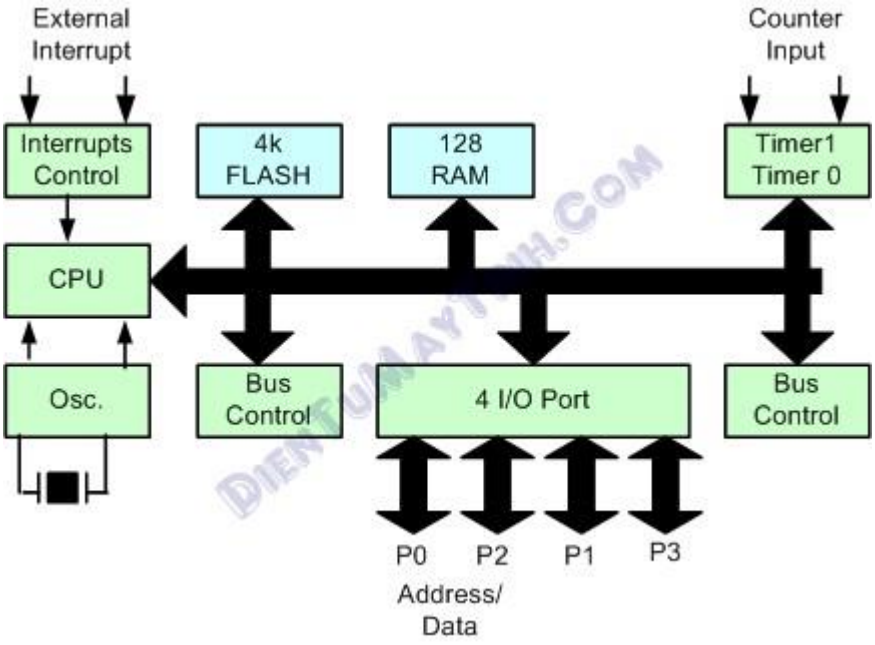
=> $20mA < I_C < 30mA$

- 21.5mA is enough for the buzzer to work, since according to the datasheet, the standard operating current of the buzzer usually ranges between 20mA and 30mA.(buzzer datasheet)

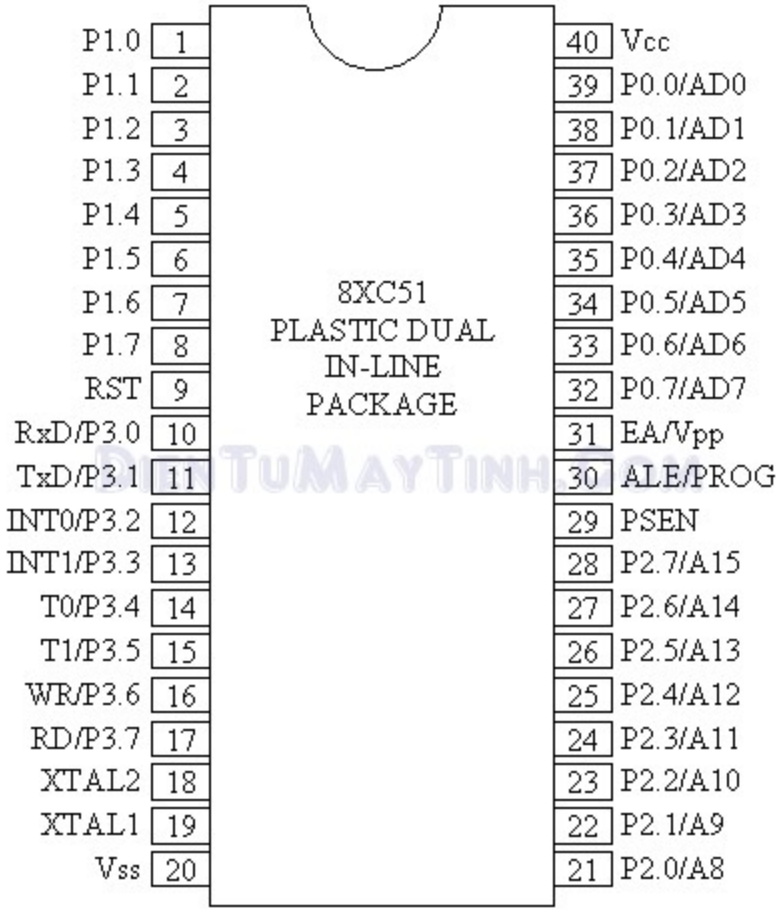
3.1.3 AT89C51

AT89C51 is an 8-bit microcontroller from the 8051 family of microcontrollers manufactured by Atmel. It has 4K bytes of Flash programmable and erasable read-only memory (PEROM), 128 bytes of Random Access Memory (RAM), 32 I/O lines, two 16-bit timer/counters, six interrupt sources, a full-duplex serial port, and on-chip oscillator and clock circuitry. The AT89C51 operates with a wide voltage range of 4.0V to 5.5V and can be programmed using a standard programmer. It is widely used in various applications such as industrial control, robotics, and home automation.





Pin Description



VCC

- Supply voltage.

GND

- Ground.

Port 0

- Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as highimpedance inputs. Port 0 may also be configured to be the multiplexed loworder address/data bus during accesses to external program and data memory. In this mode P0 has internal pullups. Port 0 also receives the code bytes during Flash programming, and

outputs the code bytes during program verification. External pullups are required during program verification.

Port 1

- Port 1 is an 8-bit bi-directional I/O port with internal pullups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pullups. Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2

- Port 2 is an 8-bit bi-directional I/O port with internal pullups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pullups.

Port 3

- Port 3 is an 8-bit bi-directional I/O port with internal pullups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pullups. Port 3 also serves the functions of various special features of the AT89C51 as listed below:

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt 0)
P3.3	INT1 (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)

P3.6	WR (external data memory write strobe)
P3.7	RD (external data memory read strobe)

Table 3.1.3 Specifications port 3

Port 3 also receives some control signals for Flash programming andverification.

PSEN

- Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory

ALE/PROG

- Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

EA/VPP

- External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming, for parts that require 12-volt VPP

RST

- Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device**.**

XTAL1

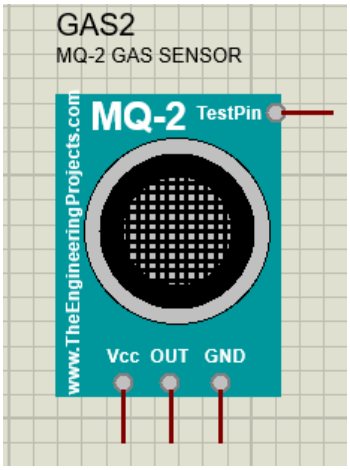
- Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2

- Output from the inverting oscillator amplifier

3.1.4 Smoke sensor MQ-2

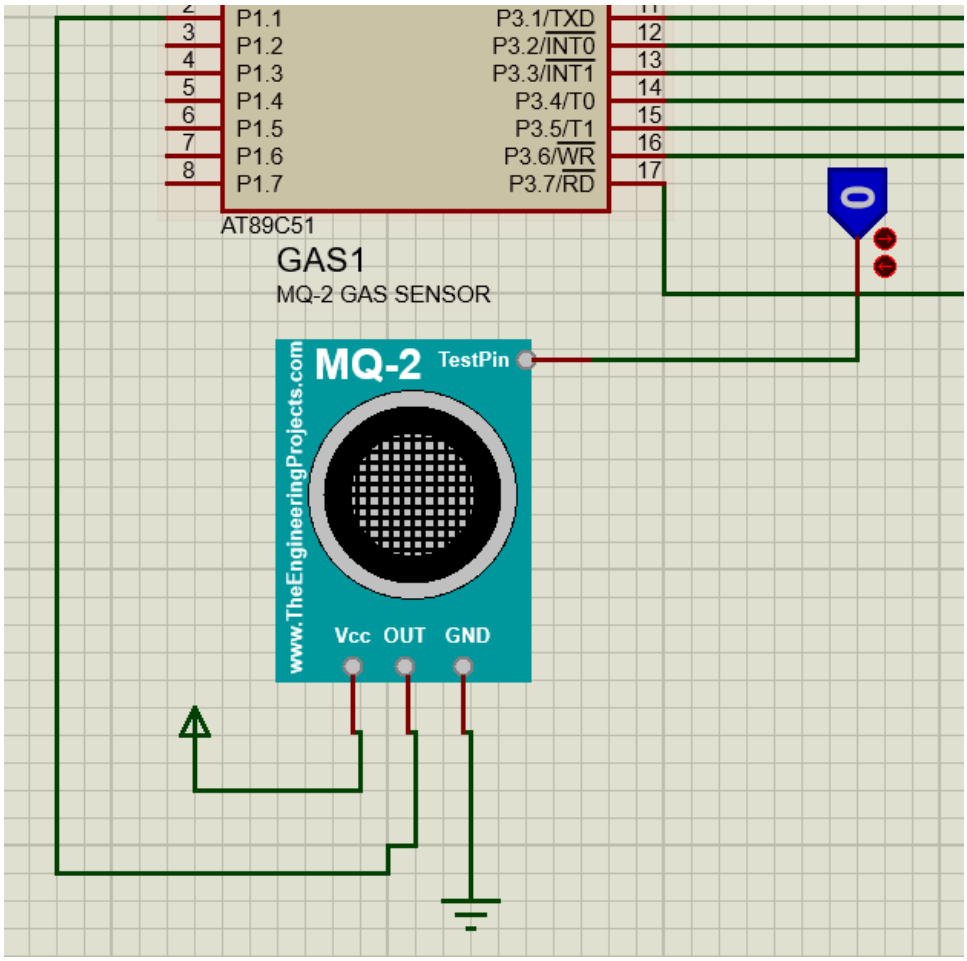
MQ-2 is a gas sensor that is used to detect smoke and combustible gases in the air. It is a small and cost-effective device that operates on the principle of the resistance of the sensing material changing when it comes in contact with a certain gas. The sensor can detect various combustible gases such as methane, butane, LPG, and smoke. MQ-2 has a detection range of 300 to 10,000 ppm and requires a voltage of 5V to operate. It has a high sensitivity and a fast response time, making it an ideal component for smoke and gas detection in various applications such as fire alarms and gas leak detectors.



Model No.			MQ-2
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			Combustible gas and smoke
Concentration			300-10000ppm (Combustible gas)
Circuit	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.2V ACorDC
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3Ω（Room Tem.）
	Heater consumption	P_H	≤900mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 2000ppm C_3H_8)
	Sensitivity	S	Rs(in air)/Rs(1000ppm isobutane)≥5
	Slope	α	≤0.6($R_{5000ppm}/R_{3000ppm}$ CH_4)
Condition	Tem. Humidity		20℃±2℃；65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V； V_H: 5.0V±0.1V
	Preheat time		Over 48 hours

Table 3.1.4 Specifications MQ-2

SMOKE SENSOR IN CIRCUIT SIMULATION:



Pin P1.1 connected to Pin OUT of MQ-2 sensor

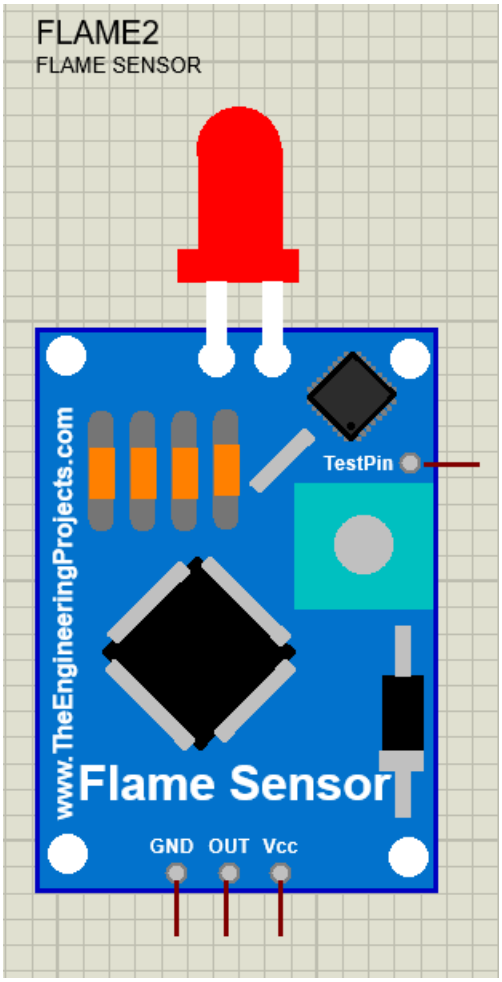
Pin VCC of MQ-2 sensor connected to Power Supply 5V DC (MQ-2 sensor datasheet)

Pin GND of MQ-2 sensor connected to Ground (MASS)

Testpin connected to LogicState (Simulation)

3.1.5 Flame Sensor

A flame sensor is an electronic device that is used to detect the presence of a flame or fire. It works by sensing the infrared radiation emitted by a flame, and generating an electrical signal in response. This signal can then be used to trigger an alarm, shut off a gas valve, or activate a fire suppression system. Flame sensors are commonly used in industrial and commercial applications, such as in gas furnaces, boilers, and ovens, as well as in fire detection and suppression systems. They are an important safety feature, helping to prevent fires and protect people and property.



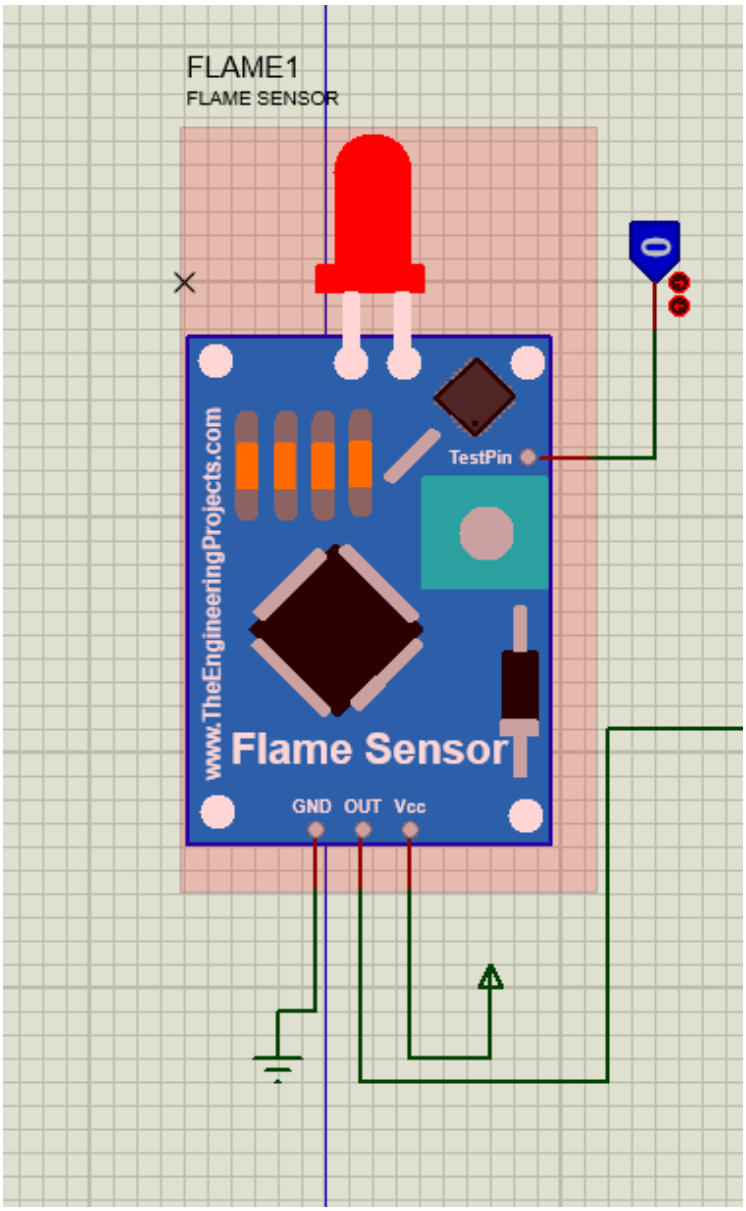
Operating Voltage	3.3V to 5V DC
Operating Current	15ma
Output Digital	- 0V to 5V, Adjustable trigger level from preset
Output Analog	- 0V to 5V based on infrared radiation from fire flame falling on the sensor
LEDs	indicating output and power
PCB Size	3.2cm x 1.4cm
Based design	LM393

Table 3.1.5 specifications flame sensor

The Flame sensor is shown in the above figure, it has four pins on it. One of them is Vcc on which you need to give +5V. Other one is GND which you need to ground. Third one is OUT pin, which will turn

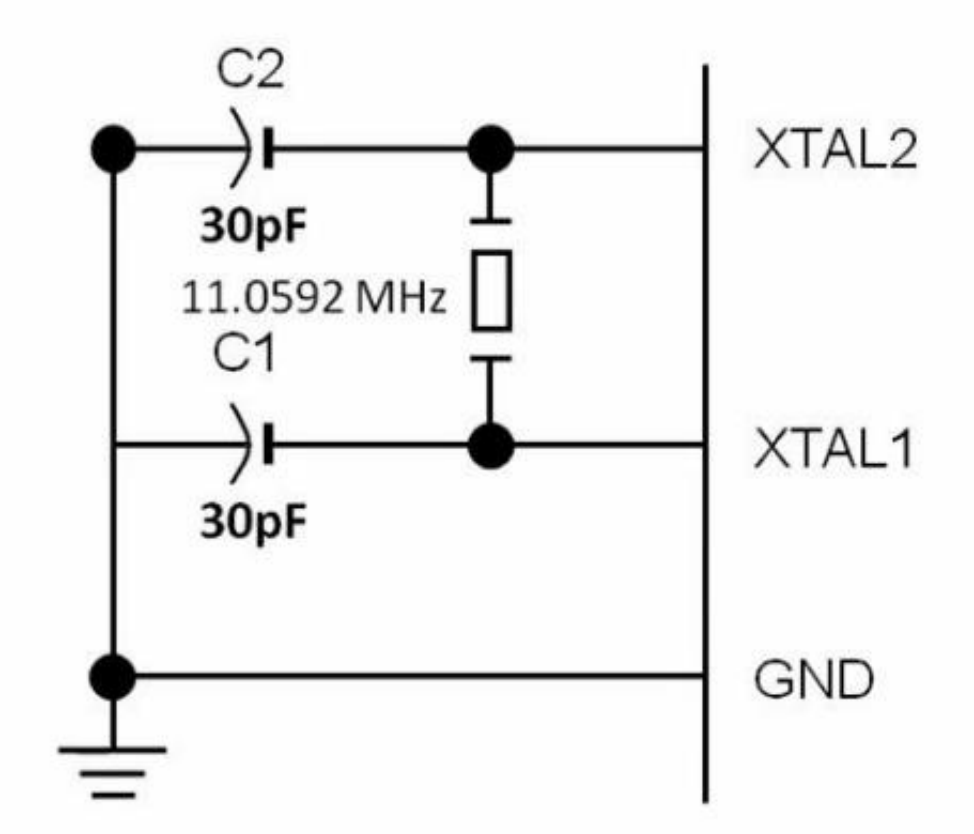
HIGH when this Flame sensor will sense flame. Fourth pin on the side is the TestPin, when it goes HIGH it means the sensor has sensed flame. Using TestPin and when you make this pin HIGH, it will be like sensor is sensing the Flame and it will give HIGH signal on your output. The Flame Sensor Module can detect flames or light sources with similar wavelengths. It uses the YG1006 infrared sensor with fast response time and high sensitivity. The IC LM393 is integrated to convert the analog signal into digital, providing two flexible output options. A potentiometer is included to adjust the sensor sensitivity. This module can be used in fire alarm systems, firefighting robots, and other applications that require flame detection. Its detection angle, power range, operating temperature, and detection range make it a versatile tool for monitoring pilot lights and experimenting with flame detection.

FLAME SENSOR IN CIRCUIT SIMULATION:



Pin P1.0 connected to Pin OUT of Flame sensor
Pin VCC of Flame sensor connected to Power Supply 5V DC (Flame sensor datasheet)
Pin GND of Flame sensor connected to Ground (MASS)
Testpin connected to LogicState (Simulation)

3.1.6 Oscillator Circuit

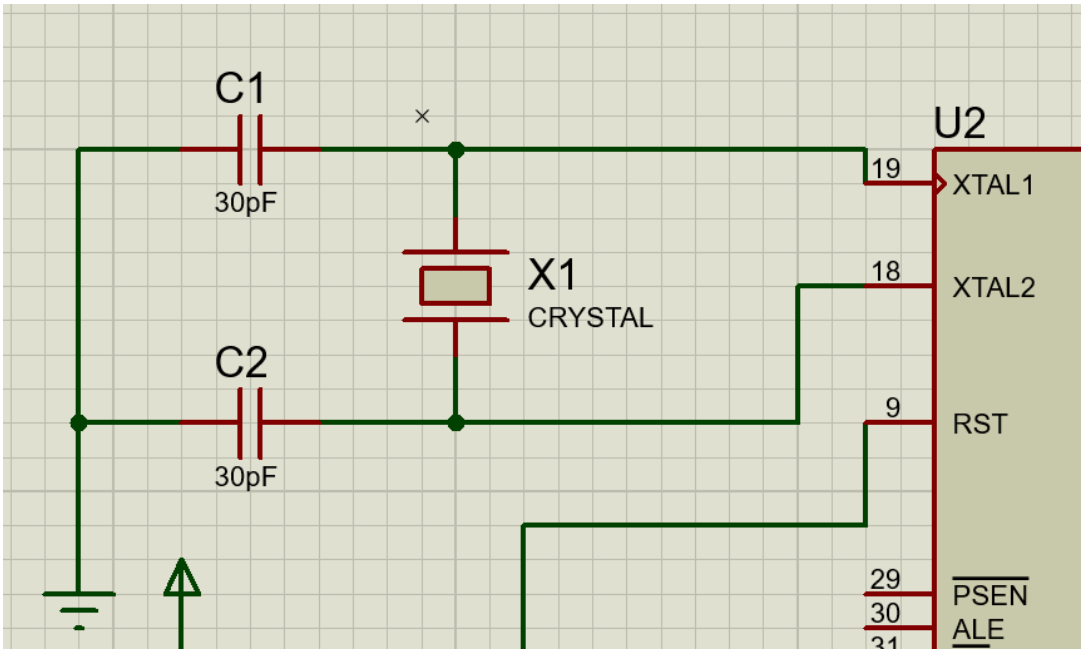


To generate operating frequency for 8051 microcontrollers we need to connect external crystal of frequency 11.0592 megahertz (datasheet) in between XTAL1 and XTAL2 pin. Oscillator formed by crystal capacitor and on-chip inverter generator pulse train at a frequency of crystal hence the crystal frequency would be the operating frequency in 8051 microcontrollers

In designing the oscillator circuit for the 8051, it is necessary to use two capacitors with a value of 30pF to generate a stable oscillation

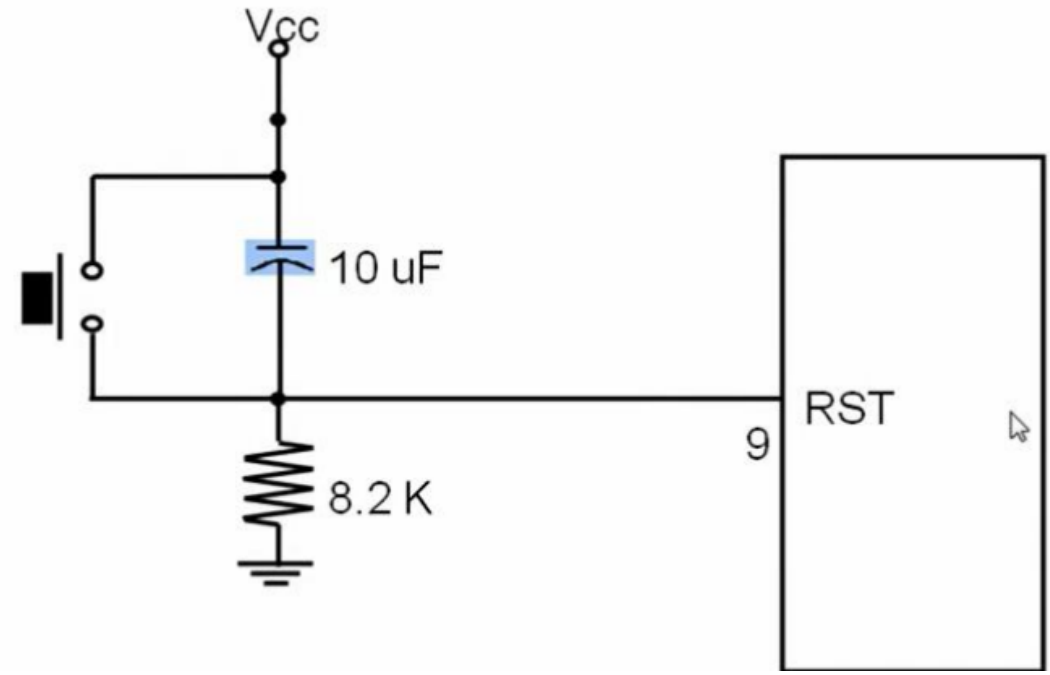
frequency. When voltage is applied to the circuit, the capacitors will be charged and retain a certain amount of charge, creating a voltage difference between them. This results in the generation of a large enough amplitude to initiate the oscillation. After the oscillation is started, the capacitors will work to keep the oscillations going, producing a stable and reliable oscillation frequency. A value of 30pF is a commonly used value to ensure that the oscilloscope will operate stably and reliably. (8051 datasheet)

OSCILLATOR IN CIRCUIT SIMULATION:



Pin XTAL1 and XTAL2 in cirtcuit above.

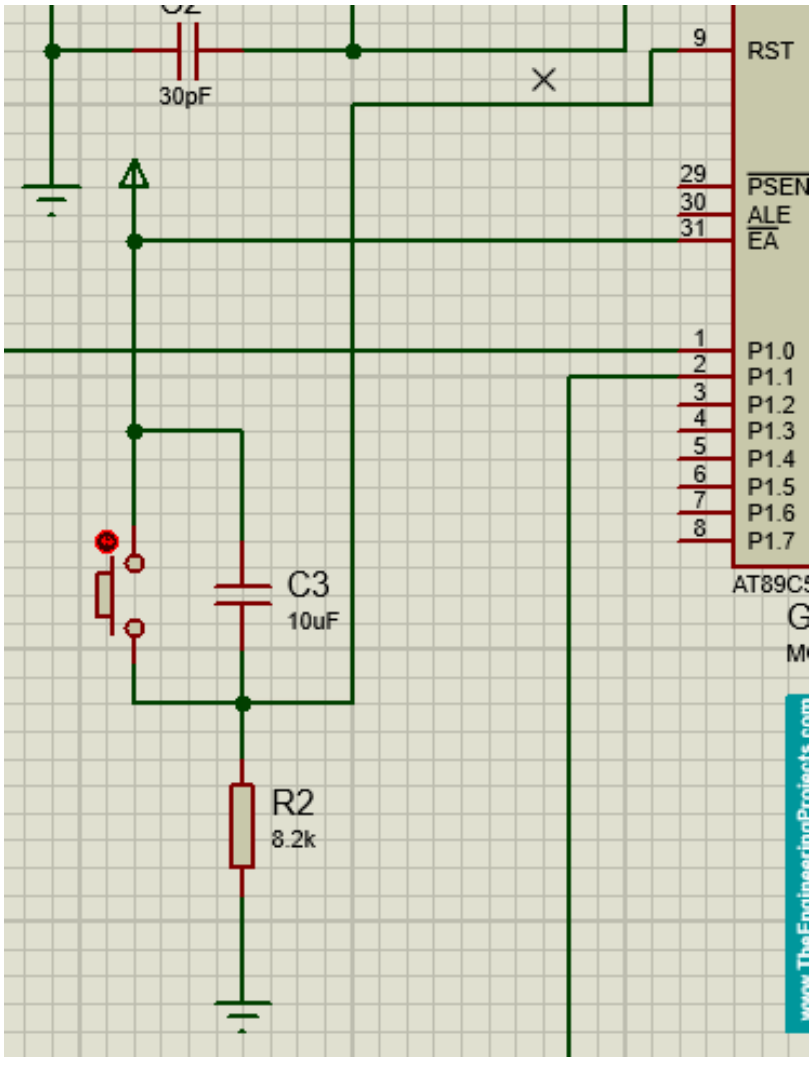
3.1.7 Reset Circuit



Pin number 9 is a reset pin, this pin is used to reset the microcontroller to its initial value. When you apply logic low to the reset pin, microcontroller work normal but when we apply the high pulse to this pin the microcontroller gets reset. For the proper operation of reset, we must apply logic high for at least two machine cycle that is 2.17 us. This requirement is fulfilled by reset circuitry. When we pressed a switch, a logic high is given to RST pin, the value of capacitor and resistor make sure that the logic high is given to the rest for at least two machine cycle.

A basic rule of thumb, therefore, is that the RC time constant should be approximately 100 ms and values of R and C chosen to meet this requirement will usually ensure effective reset operation. The standard 8.2K, 10 μF RC reset combination gives a time constant of 82 ms: this is generally adequate.

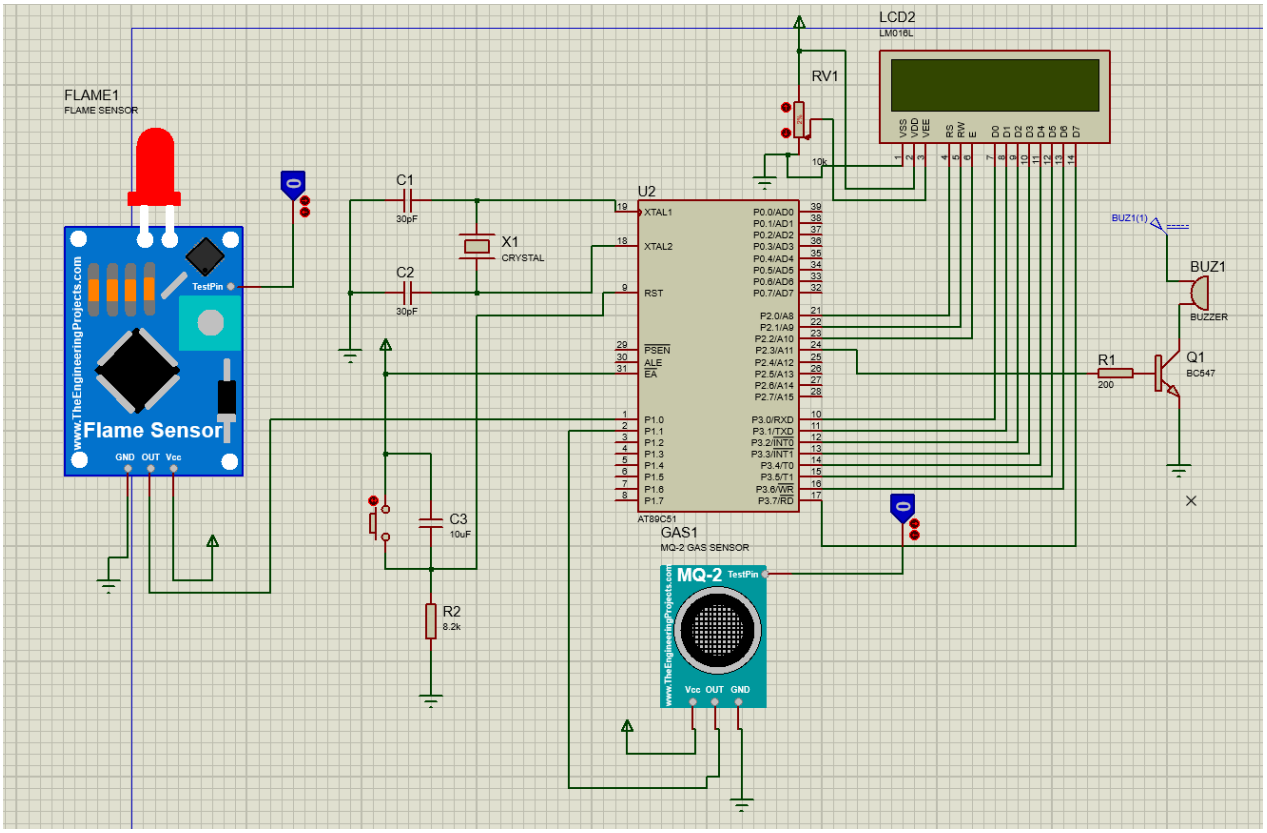
RESET CIRCUIT IN SIMULATION:



Pin RST in the circuit above. (8.2k ohms resistor and 10uF capacitor to create a more than 2 machine cycle delay when the user presses the reset button.)

PIN EA connected to VCC (We want to store program code into internal ROM memory locations hence EA pin is connected to VCC)

3.2 Circuit simulation

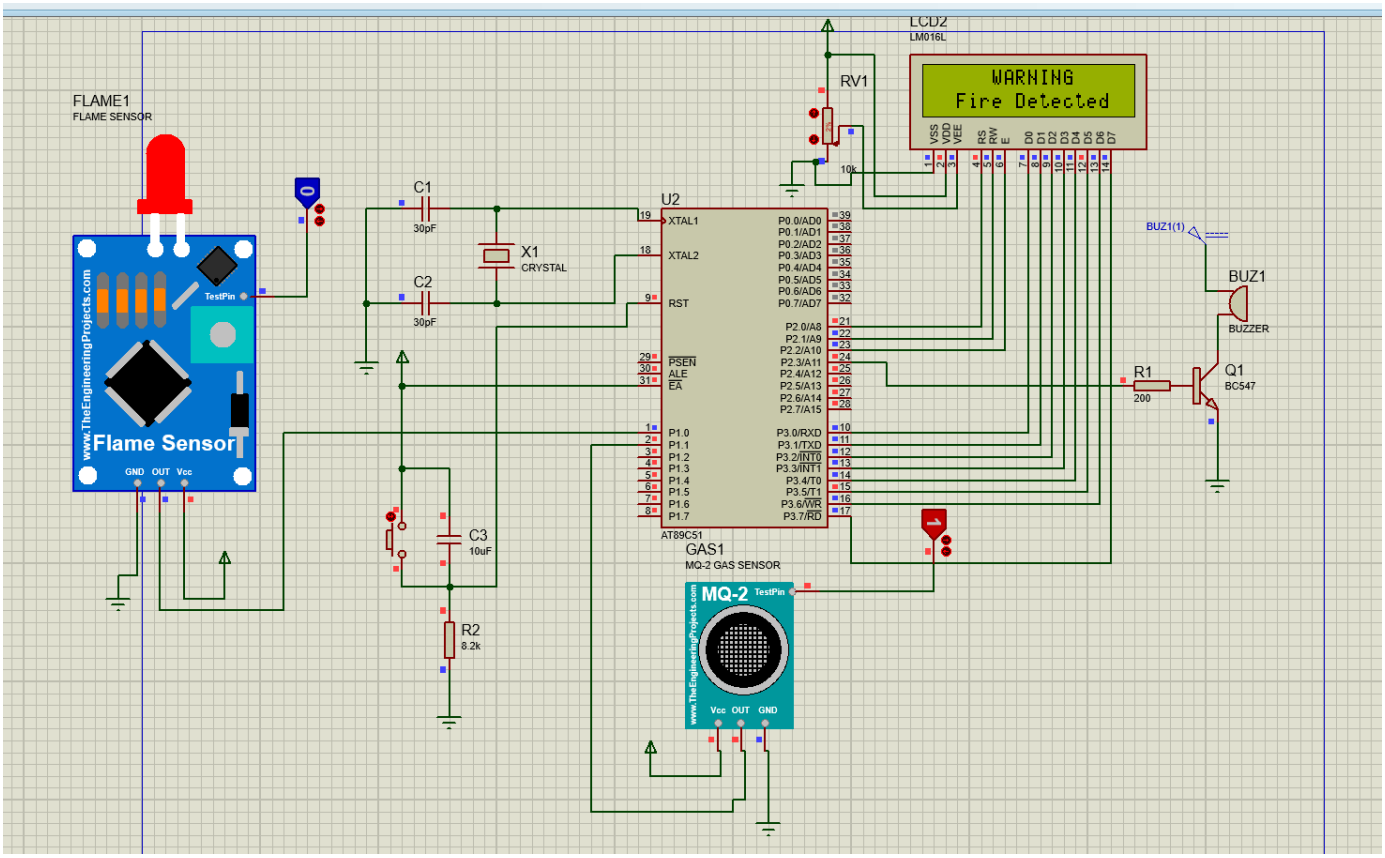


How fire alarm circuit simulation works :

- The fire alarm circuit is controlled by sensor devices when a fire occurs. When the fire alarm circuit receives the signal from the input fire alarm device, there is a fire and explosion incident. The fire alarm circuit will send a notification to the fire alarm for everyone to know and quickly handle.

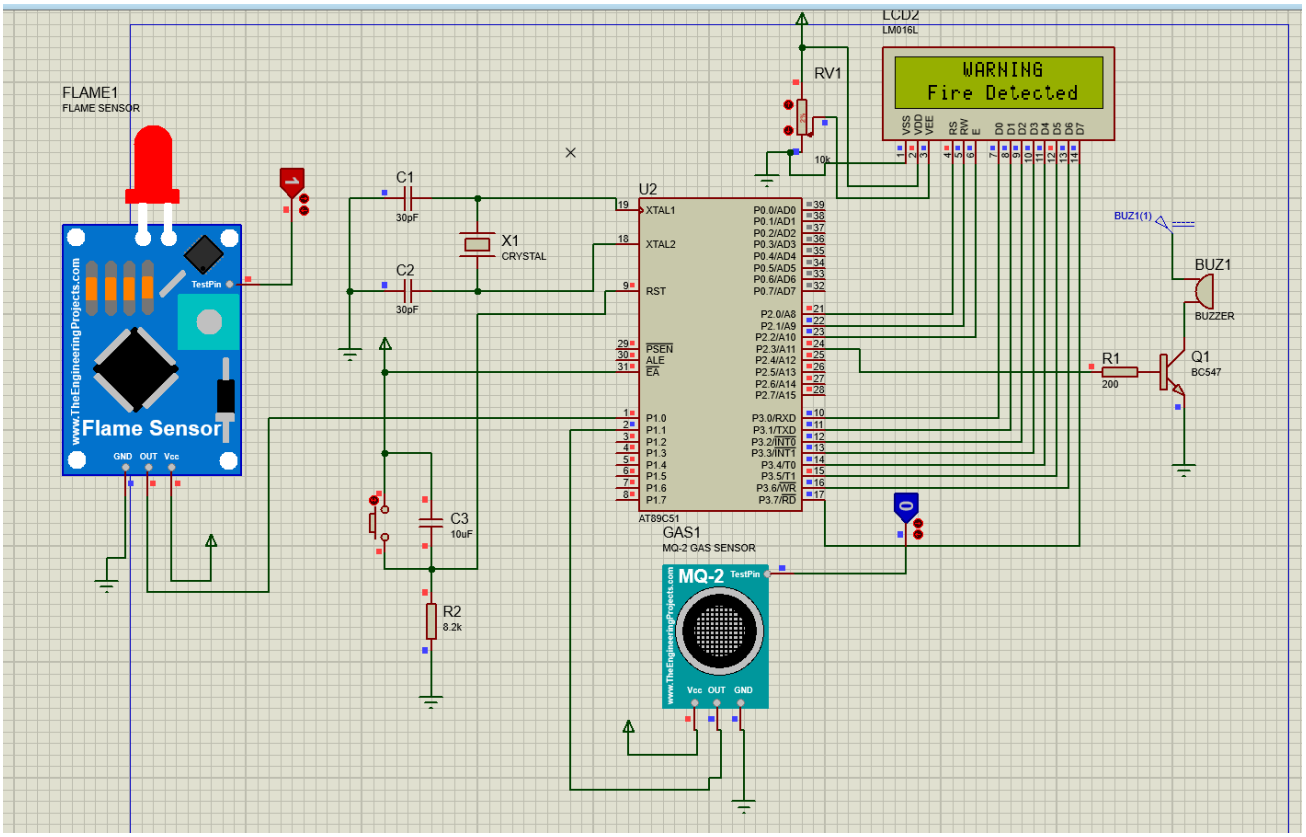
Perform the simulation of the fire alarm circuit:

- When the signal on the smoke sensor pin test is 1 (the signal to the flame sensor pin test is 0).



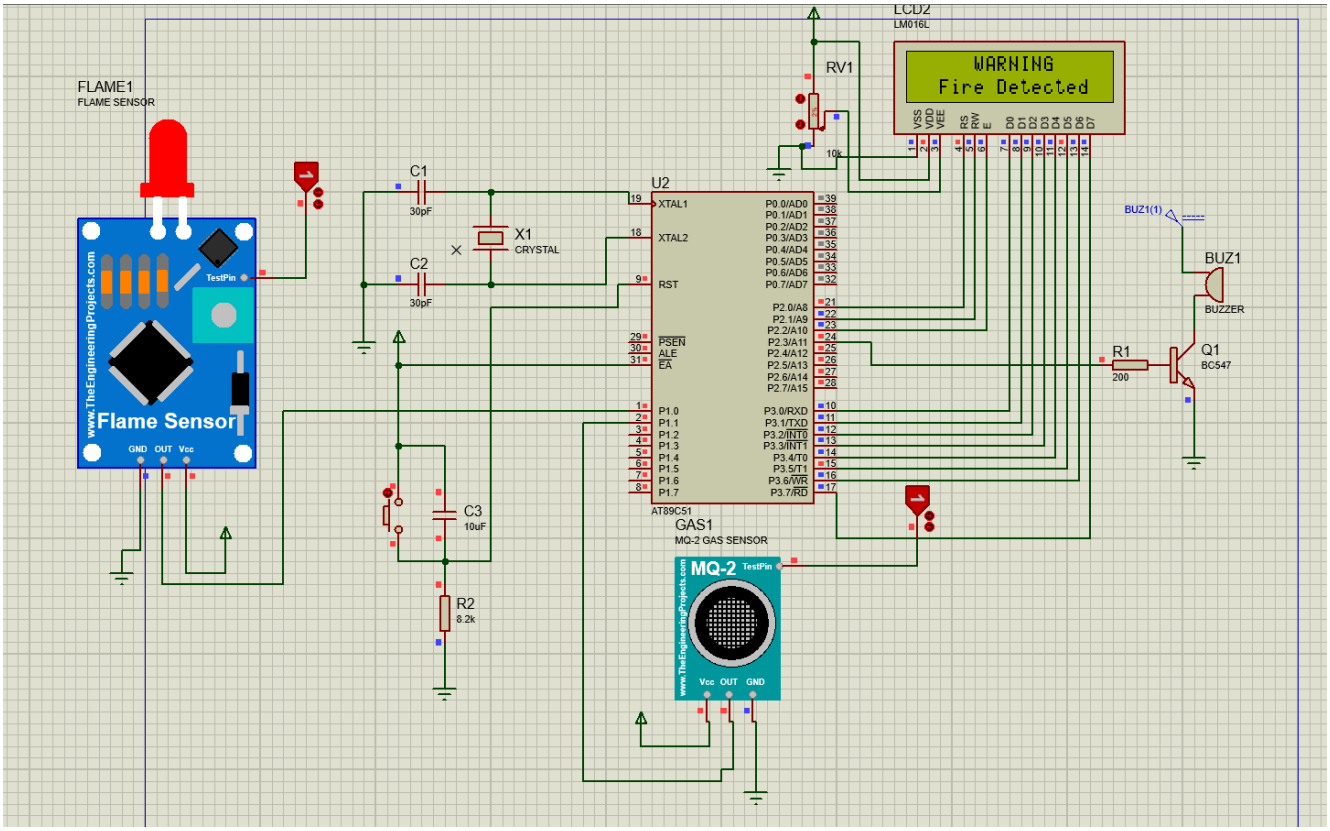
=> The LCD screen will show that the fire has been found and the buzzer will also sound to alert the fire.

- When the signal to the flame sensor pin test is 1 (the signal to the flame sensor pin test is 0).



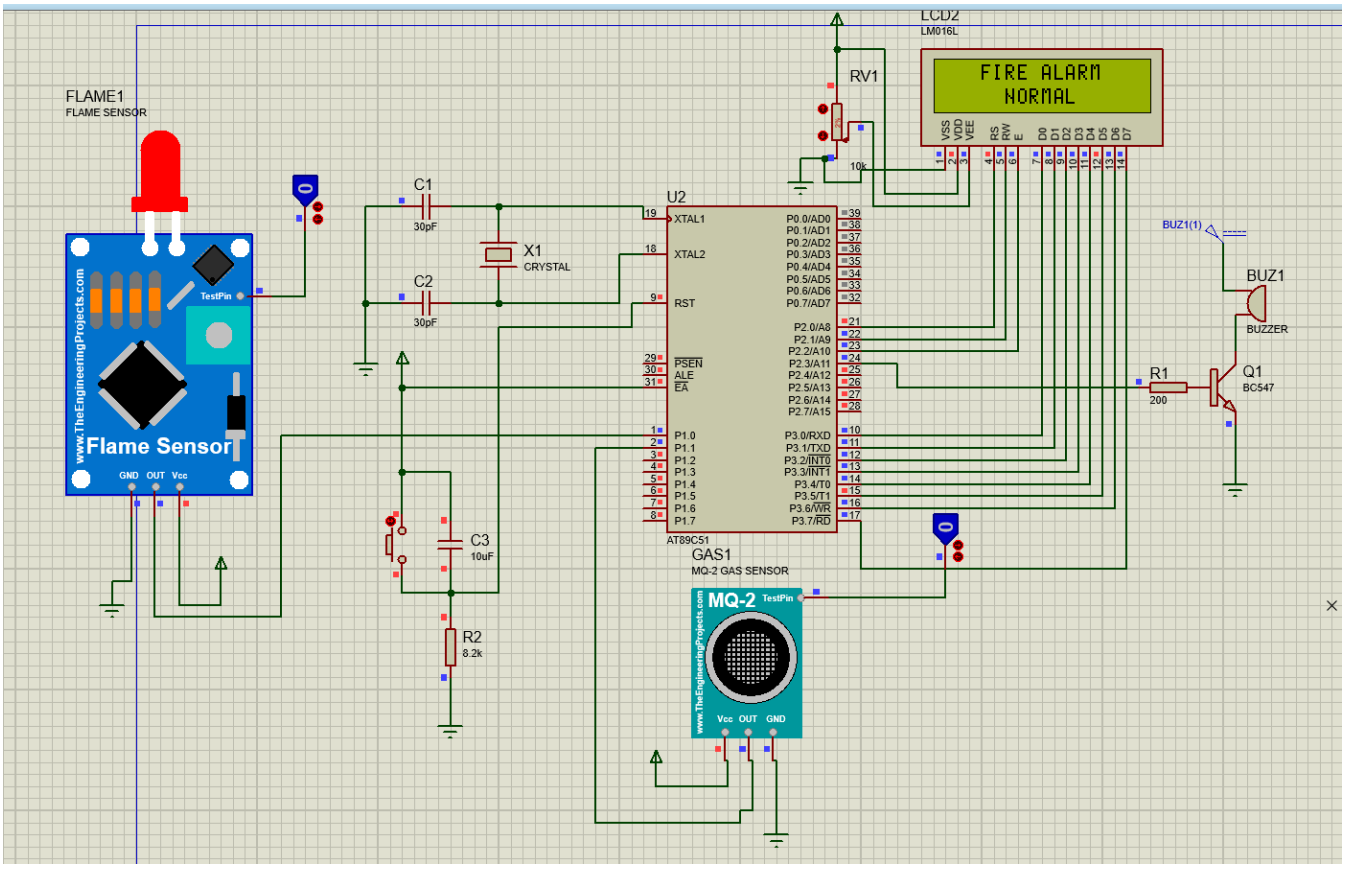
=> The LCD screen will show that the fire has been found and the buzzer will also sound to alert the fire.

- When the signal of both smoke sensor and flame sensor pins test are 1.



=> The LCD screen will show that the fire has been found and the buzzer will also sound to alert the fire.

- When the signal of both smoke sensor and flame sensor are 0.



=> LCD display no fire detected and buzzer not working.

Chapter 4 **EXPERIMENT**

4.1 Set up scenarios

According to the project report on a low-cost fire detection alarm system using an 8051 microcontroller and a smoke sensor, the system can be adapted for use in various settings such as homes, hotels, restaurants, and college canteens. Here are some scenarios of how the system could be used:

Scenario 1: A fire has broken out in a small office building, college canteens. The system can be installed in the kitchen or dining area to detect any potential fire hazards. The low-cost nature of the system makes it an ideal choice for educational institutions that may not have a large budget for fire detection systems. The fire alarm system detects the smoke and triggers an alarm. The occupants of the building immediately hear the loud alarm and begin evacuating the building through the nearest exits. The building's fire suppression system activates, extinguishing the fire and minimizing the damage.

Scenario 2: A fire has started in the kitchen of a house, where most fire incidents occur. The MQ2 gas sensor can detect smoke and carbon monoxide levels, and the buzzer and LCD display will provide clear alarms and indications to alert the occupants. The smoke from the fire triggers the smoke detector, which is connected to the home's fire alarm system. The alarm sounds throughout the house, alerting the occupants to the fire. The family quickly evacuates the house, making sure to close all doors behind them to slow the spread of the fire. They call the fire department from a safe location outside the house.

Scenario 3: A fire has started in a hotel, the system can be connected to the hotel or restaurant's central monitoring system, allowing staff to respond quickly to any fire incidents. The smoke from the fire triggers the smoke detectors, which are connected to the hotel's fire alarm system. The alarm sounds throughout the building, alerting the guests and staff to the fire. The hotel's evacuation plan is put into action, with guests and staff following designated escape routes to evacuate the building quickly and safely. The fire department is automatically notified of the fire and dispatched to the scene.

4.2 Evaluation

We have evaluation criteria based on the above 3 scenarios : The 8051 microcontroller project report provides a low-cost smoke detector and alert indication system. This system uses an MQ series gas sensor, a comparator, 8051 microcontroller, a buzzer, and an LCD display to detect smoke and carbon monoxide levels and provide clear alarms and indications. The report suggests installing this system in various places, including homes, hotels, restaurants, and college canteens. The system can be further developed to include SMS notifications and temperature sensors.

It is experimental that the fire alarm circuit has been designed to meet the criteria such as the cost of the whole circuit is very low, the power consumption is low, the fire and smoke sensors are always in working condition. The circuit is designed with a reset button to reactivate the fire alarm system in case something goes wrong with the system. Based on simulation, the circuit works smoothly, designed with the correct functions according to the original criteria.

- Performance: the response time of the circuit and the accuracy of the data collected from the sensors.
- Reliability: the risk has been minimized as much as possible.
- Expense: low cost suitable for small rooms, school canteens.

=> From the above criteria and through simulation, it is possible to evaluate the circuit operating at 100% capacity

Components	Perfection level	Status	Note
Smoke sensors	10	Active	Very sensitive
Flame sensor	10	Active	Very sensitive
Reset button	10	Active	Works well
LCD	10	Active	Clearly displayed, sometimes blurred
Buzzer	10	Active	Works well, big sounds
Beauty	9		Compact

Chapter 5 **SUMMARY, RESTRICTIONS AND DEVELOPMENT ORIENTATIONS**

5.1 Summary

The project report titled "8051 Microcontroller Based Gas and Fire Alarm System" discusses the design and implementation of a fire and gas alarm system using an 8051 microcontroller. The feature of this system is the system uses an MQ series gas sensor, comparator, buzzer, and LCD display to detect and alert people of a fire or gas leak. The report includes a circuit diagram, PCB layout, microcontroller program, hex file, and datasheets of components used in the project.

In this summary we want to emphasize that why we used 8051 microprocessor for this project ?

+ Compared with other fire detection circuits, 8051 fire detection circuits have some advantages follows:

- Low cost: The 8051 fire detection circuit has a lower cost than some other fire detection circuits, because it uses components that are common and easy to find in the market.
- High reliability: 8051 fire detection circuit built on 8051 microcontroller platform is proven for reliability and performance. Therefore, this circuit is capable of stable and reliable operation.
- Ease of use and programming: With simple fire detection applications, 8051 fire detection circuit programming can be done in C programming language or other programming languages, with micro-support libraries available for 8051 controller.

=> In this project we use 8051 microcontroller because of its advantages mentioned above. 8051 has been widely used in embedded applications for many years and has been tested to ensure reliability and stable operation.Students or students like us can study because of its low cost compared to other microcontrollers. 8051 microcontroller is easy to program, low power consumption and rich in features, helping to meet the requirements of embedded applications.

5.2 Restrictions

There are some limitations to using an 8051 microcontroller for a fire alarm system. One limitation is the limited number of input/output pins available on the microcontroller. This can restrict the number of sensors that can be connected to the system. Additionally, the processing power of the 8051 may not be sufficient for more complex fire detection algorithms, which can result in a slower response time to fire incidents. Another limitation is the lack of wireless communication capabilities, which can limit the range of the system. It is important to keep these restrictions in mind when designing and

implementing a fire alarm system using the 8051 microcontroller. Its limitations when compared with other fire alarm circuits:

- Limited fire detection: The 8051 fire detection circuit uses a highly sensitive sensor to detect smoke. However, because the sensor only detects smoke near and cannot detect smoke in distant places, the fire detection ability of this circuit is limited in some cases.
- Difficult to upgrade: The 8051 microcontroller has limited features and scalability. As the fire detection application becomes more complex, the 8051 fire detection circuit may not meet the requirements and needs to be replaced with a more complex circuit.

There are several ways to address the limitations of the 8051 fire detection circuit:

- Detection capabilities: One way to improve the fire detection ability of the 8051 circuit is to add additional sensors, such as heat sensors or gas sensors, to detect fire in other ways. This can help to overcome the limitations of smoke detection and provide more comprehensive coverage.
- Upgrading microcontroller: To the scalability and features of the circuit, upgrading the microcontroller to a more advanced model may improve be necessary. For example, the ARM Cortex-M series microcontrollers offer higher processing power, more memory, and advanced features such as real-time operating systems and connectivity options.

Overall, by combining advanced technologies and approaches, it is possible to overcome the limitations of the 8051 fire detection circuit and create more advanced and reliable fire detection systems.

5.3 Development orientations

The development of fire detection circuits using 8051 microcontrollers is likely to continue in the future, with several potential directions for improvement and innovation. Here are some possible development orientations:

- Enhanced connectivity: Future fire detection circuits could have increased connectivity to other smart devices, such as smartphones or home automation systems, allowing for real-time alerts and notifications. This could also enable remote monitoring and control of the fire detection system.
- Improved accuracy: Advancements in sensor technology could allow for more accurate and reliable detection of fires, reducing false alarms and improving response times. For example, using multi-sensor arrays or more sophisticated algorithms for data analysis could enhance the accuracy of fire detection.
- Energy efficiency: As energy efficiency becomes increasingly important, fire detection circuits could be designed to operate using low power and renewable energy sources, such as solar power or energy harvesting. This could reduce operating costs and environmental impact.
- Integration with other safety systems: Fire detection circuits could be integrated with other safety systems, such as sprinkler systems or emergency lighting, to provide a comprehensive safety solution. This could also include integration with emergency services, such as automatic notification to the fire department or ambulance services.
- Artificial intelligence: The integration of artificial intelligence (AI) could enable fire detection circuits to learn and adapt to their environment, improving their accuracy and reducing false alarms. AI

could also be used to predict potential fire hazards and provide proactive alerts and warnings.

- Miniaturization: As the trend towards miniaturization continues, fire detection circuits could become smaller and more compact, making them easier to install and less obtrusive. This could also enable the development of wearable fire detection systems or embedded sensors in furniture or appliances.

Overall, the development of fire detection circuits using 8051 microcontrollers is likely to continue to evolve and improve in the future, driven by advancements in technology and the increasing importance of safety and energy efficiency.

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