DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING, NIRMA UNIVERSITY

2EC404- MICROPROCESSORS AND MICROCONTROLLERS

SPECIAL ASSIGNMENT REPORT

FIRE DETECTION AND CONTROL SYSTEM

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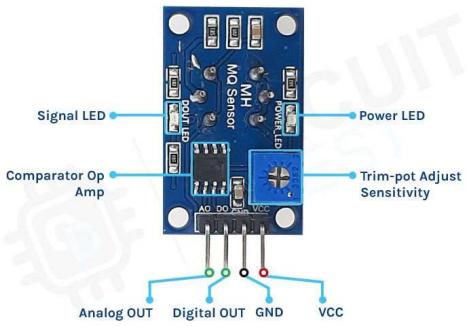
INTRODUCTION

The main aim of our project is to alert people and take safety measures during fire and gas leak emergencies. Smoke sensor is used to detect the break out of fire. LPG is most commonly used as cooking gas everywhere. Due to some defects, the gas may start leaking and it may result in big hazards. This system is meant for detecting such leakages and fire break out in an early stage and take appropriate steps and send warning messages to the consumer. For fire detection we have used a MQ2 gas sensor. The MQ2 sensor is one of the most widely used in the MQ sensor series. The MQ2 gas sensor operates on 5V DC and consumes approximately 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations ranging from 200 to 10000 ppm. When a SnO2 semiconductor layer is heated to a high temperature, oxygen is adsorbed on the surface. When the air is clean, electrons from the conduction band of tin dioxide are attracted to oxygen molecules. This creates an electron depletion layer just beneath the surface of the SnO2 particles, forming a potential barrier. As a result, the SnO2 film becomes highly resistive and prevents electric current flow. In the presence of reducing gasses, however, the surface density of adsorbed oxygen decreases as it reacts with the reducing gasses, lowering the potential barrier. As a result, electrons are released into the tin dioxide, allowing current to freely flow through the sensor. The MQ2 gas sensor is simple to use and has two different outputs. It not only provides a binary indication of the presence of combustible gasses, but also an analog representation of their concentration in air. The sensor's analog output voltage (at the A0 pin) varies in proportion to the concentration of smoke/gas. The higher the concentration, the higher the output voltage; the lower the concentration, the lower the output voltage. The animation below shows the relationship between gas concentration and output voltage. This analog signal is digitized by an LM393 High Precision Comparator and made available at the Digital Output (D0) pin. the module has two LEDs. The Power LED illuminates when the module is turned on, and the Status LED illuminates when the gas is detected. This module comes with 4-pins like VCC, GND, DO, and AO.



VCC: This pin is used for a positive voltage supply connection of 5V to power up the module.**GND (Ground):** The module is connected to the ground using this pin.
Digital Out (DO): This pin is used to generate the digital output of the module when the threshold value is set with the help of a potentiometer. It gives the digital output either High Or Low based on the presence of gas.
Analog Out(AO): This pin gives the analog output voltage in the range of 0V to 5V, which depends on the gas intensity.

This project is very useful to warn people about the fire. Fire can cause the death of many. It is also hazardous to the workstation, and home. With this low-cost fire detector mini-project, we can warn people. Fire accidents can occur at any place but it is quite difficult for everyone to install a fire alarm system in their home or shop. In such situations, our low-cost fire detector is very useful. The main advantage of this project is its cost-effectiveness

PROJECT COMPONENTS

Listed below are the components and devices along-with their specifications and functions, used for the implementation of the given project and their respective cost:

S.NO	COMPONENTS	SPECIFICATIO N	COST
1	Microcontroller	8051	99
2	Fire sensor	MQ2	140

3	Crystal oscillator	11.0592 MHZ	15
4	resistors	8.2k, 10k, 1k	5
5	capacitors	33Pf (2)	5
6	bulb	240V	40
7	Single Relay module	5V	59
8	Voltage regulator	L7805C	15
9	battery	9V dc	60
10	Connecting wires	Jumper Wires	70
11		**TOTAL**	**508**

8051 MICROCONTROLLER

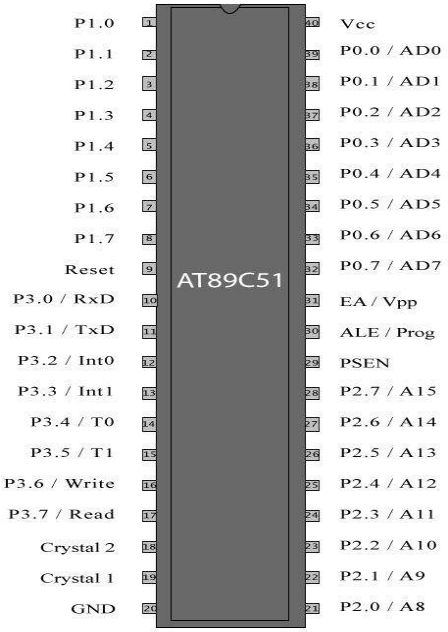
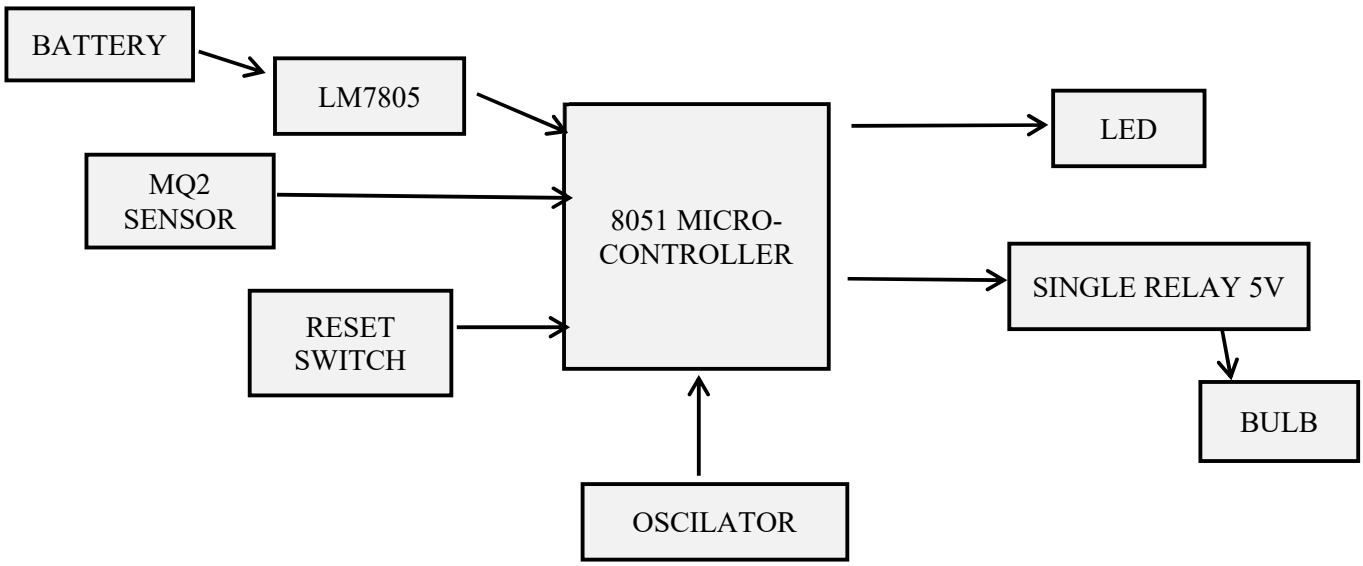


Fig. 01 : Pin Diagram of IC

AT89C51 microcontroller can be considered as the heart ofthe project here. Developed by the **Atmel** corporation, AT89C51 belongs to the Atmel AT89 series which is an **Intel 8051-compatiblefamily** of 8-bit microcontrollers. It is a high performance, low powerCMOS 8-bit general purpose microcontroller with **4K bytes** of **Flash- type EPROM**, **128-byte internal RAM** and can work with upto **64K bytes** of external memory. It is a **40-pin** monolithic IC with**32 I/O pins** (8 of each I/O Port), two **16-bit Timer/Counter Modules**, a **UART** for serial communication, **6 interrupt sources** (including Reset) and has an operating Voltage range of 2V to 5.5V.

AT89C51 requires an Integrated Development Environment(IDE) where the programming can take place. **Arduino IDE, Keil µVision** are the most commonly used platforms for the same.

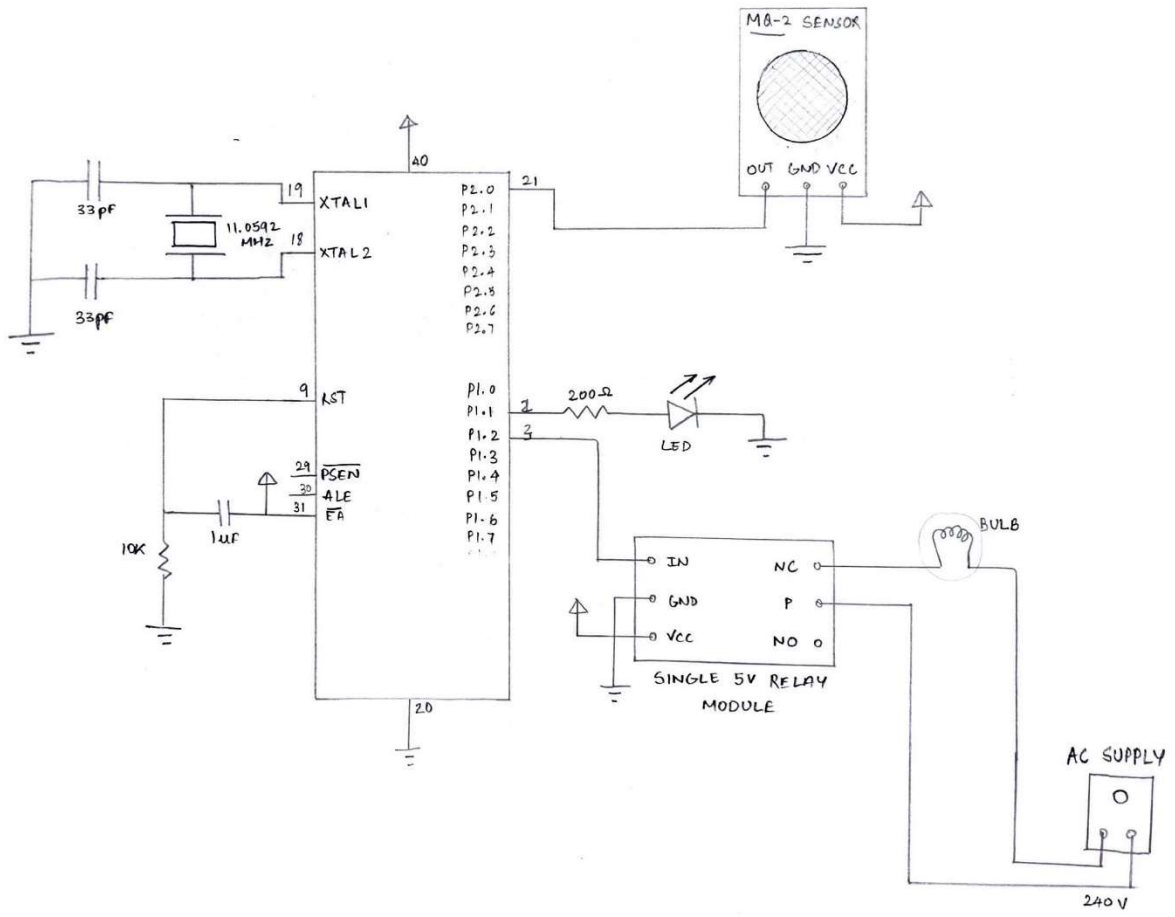
BLOCK DIAGRAM



CONSTRUCTION AND WORKING

This project consists of 8051 microcontroller interfaced with a led and a smoke sensor. The Microcontroller is given a clock of **11.0592 MHz** frequency with the help of a crystal oscillator which is connected on pins 18 and 19. The given circuit operates at 5V. Hence, a voltage regulator **IC 7805** is connected to the 12v power supply to maintain a stable supply of 5 volts to all the components. For smoke detection, we have used an MQ2 gas sensor which detects carbon monoxide and even LPG, and methane. This sensor is very useful for the detection of gas leakage. MQ2 sensor works in active-low mode. If smoke is detected then this sensor gives low digital output and this output is given to the microcontroller. Due to the fast response of the sensor, we can take immediate action on it and can stop further damage. With the help of smoke sensors, we can detect fire or smoke. The output of the sensor is given to the input port p2.0 of 8051. When smoke is detected, digital output 0 is given to the input port which in-turn gives digital output 1 to the output port p1.1. A led is connected to the output port p1.1 along with a resistor. When the output pin goes high, it turns on the led. For fire control, we have designed a prototype in which a bulb will glow when fire is detected. A 5V single relay module is connected to the output port p1.2 which is in normally closed state. This is further connected to a 240v bulb. When the output goes high, relay switches to normally open state and the bulb glows.

CIRCUIT DIAGRAM



CODE

mnmcode.a51

```
1   ORG 0
2   MOV P1, #00H  ; Initialize Port 1 as output
3   MOV P2, #0FFH  ; Initialize Port 2 as input
4
5   LOOP:
6   MOV A, P2     ; Move the contents of Port 2 to the Accumulator
7   ANL A, #01H   ; Mask all bits except for the first bit
8   CJNE A, #00H, OFF ; If the first bit is 0, jump to OFF
9   ON:
10  MOV P1, #0FFH   ; Turn on the output by setting all bits of Port 1 to 1
11  SJMP LOOP     ; Jump back to the beginning of the loop
12  OFF:
13  MOV P1, #00H   ; Turn off the output by setting all bits of Port 1 to 0
14  SJMP LOOP     ; Jump back to the beginning of the loop
15  END
16
```

The program for the give project has been written using **Keil µVision 5** using assembly language.

Explanation: It sets up the microcontroller to read input from Port 2 and control output at Port 1 based on the state of the input.

Here's a more detailed explanation of each line of code:

ORG 0: This sets the origin of the program to address 0, which is the default starting address of the 8051 microcontroller.

MOV P1, #00H: This initializes Port 1 as an output port by setting all bits of Port 1 to 0.

MOV P2, #0FFH: This initializes Port 2 as an input port by setting all bits of Port 2 to 1.

LOOP:: This is a label for a loop that will continuously read input from Port 2 and control the output at Port 1.

MOV A, P2: This moves the contents of Port 2 to the accumulator A.

ANL A, #01H: This masks all bits of the accumulator except for the first bit, which is the least significant bit of Port 2.

CJNE A, #00H, OFF: This instruction compares the contents of the accumulator to the value 00H. If the two values are not equal, it jumps to the label OFF. Otherwise, it continues to the next instruction.

ON:: This is a label that represents the state where the first bit of Port 2 is 1, indicating that the input is active.

MOV P1, #0FFH: This turns on the output by setting all bits of Port 1 to 1.

SJMP LOOP: This jumps back to the beginning of the loop to read input from Port 2 again.

OFF:: This is a label that represents the state where the first bit of Port 2 is 0, indicating that the input is inactive.

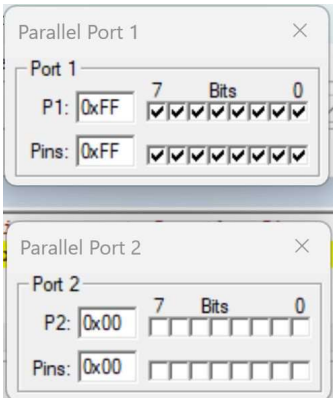
MOV P1, #00H: This turns off the output by setting all bits of Port 1 to 0.

SJMP LOOP: This jumps back to the beginning of the loop to read input from Port 2 again.

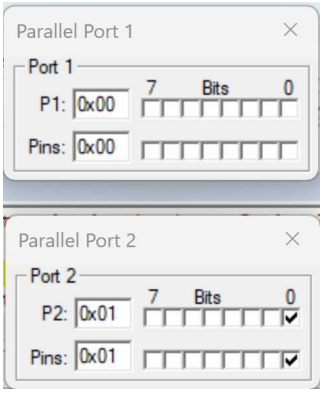
END: This indicates the end of the program.

In summary, this program continuously reads input from Port 2 and controls the output at Port 1 based on the state of the input. When the first bit of Port 2 is 1, indicating that the input is active, all bits of Port 1 are set to 1 to turn on the output. When the first bit of Port 2 is 0, indicating that the input is inactive, all bits of Port 1 are set to 0 to turn off the output.

Results:



SMOKE DETECTED



SMOKE NOT DETECTED

Applications

This project is very useful in homes, warehouses, banks, malls, and stations to alert people. This helps to avoid major accidents due to fire and smoke. This project has a domestic application since it can be used in our home kitchen. Also useful in hotels, restaurants, and college canteens. It can also be used car parks, LPG filling yard, indoor stadiums, diesel engine rooms etc.

Conclusion

We have designed a prototype for fire detection and control system. Fire detection system has the following benefits:1) Early Warning · 2) Property Protection · 3) Life Safety · 4) Legal and Insurance Requirements. 5) Cost Savings. The prototype developed here can be modified in several ways so as to ensure more effective andimproved performance from the same. With a little bit of modification, we can send this data through SMS by adding a GSM module in this project. We can also add an additional temperature sensor for accurate detection. We can connect a motor along with the bulb which turns on a water sprinkler for fire control. We can also connect a buzzer for fire indication.