A REPORT

ON

FIRE ALARM SYSTEM

PREPARED FOR

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By

Group - 32

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In partial fulfillment of the requirements of
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DESIGN PROBLEM: FIRE ALARM SYSTEM

This system checks for abnormal smoke content in a room and under such conditions throws open all exit doors and windows and opens a valve that releases the gas to put-out the fire. An Alarm is also sounded; this alarm is sounded until the smoke level in the room drops to an acceptable level. The room has two doors and four windows. The smoke detection system is made up of three smoke sensors placed on the ceiling of the room. When at least two of three detectors get turned on, the alarm system is activated. If only one of them is activated a different alarm sound is produced indicating probable mal-function of alarm. The system can be activated or de-activated using a single switch.

ACKNOWLEDGEMENT

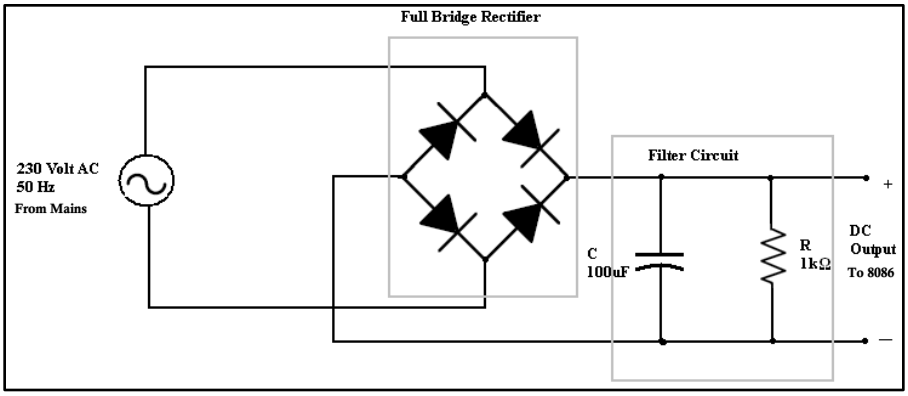
We would to express our deep gratitude to Prof. K.R. Anupama for guidance and useful critiques of our design project. The project gave us a great opportunity to enhance and apply our understanding of microprocessor concepts.

We would also like to thank Dr. Noel Prashant Ratchagar and entire teaching staff and student assistant for sharing their wisdom. This would not have been possible without guidance of all these people.

ASSUMPTIONS

1. MQ2 smoke sensor comes with a built in ADC. The sensor gives binary output through one of the pins, depending on the presence of smoke. Therefore, a separate ADC0808 is not used.
2. IR0 is raised when one or more sensors are active.
3. The opening of all doors, windows and valve is controlled by a stepper motor which operates in steps with the use of gears. It is programmed to rotate by 90 degrees.
4. The sensors are placed on the roof symmetrically so as to completely cover the entire room and completely sense any smoke.
5. We assumed that sensors are activated only by smoke and not by any other gas.
6. We assume that the room under observation, does not undergo changes in temperature or humidity conditions.
7. The whole system works only if the Power Supply is connected to the Vcc pin of 8086 is turned on. The 230 V is stepped down and rectified to give a 5 V DC Supply which powers the microprocessor that works in TTL. *

*Power Supply



SPECIFICATIONS

1. MEMORY MAPPING:

Memory Chip	Address
ROM1 [4K]	00000H-00FFFH
ROM2 [4K]	FF000H-FFFFFH
RAM1 [4K]	01000H-01FFFH

ROM must house the code segment. The Minimum amount of ROM available is 2kB (2716), we have used a total of 8kB ROM. There should be 1kB ROM at the starting to accommodate the Interrupt Vector Table (IVT). The reset address is FFFF0, therefore there should be ROM at the end. There are two ROM chips which are further divided into Even and Odd Banks of ROM.

Even Bank of ROM1: 00000H, 00002H, 00004H, …, 00FFEH.
Odd Bank of ROM1: 00001H, 00003H, 00005H, …, 00FFFH.

Even Bank of ROM2: FF000H, FF002H, FF004H, …, FFFFEH.
Odd Bank of ROM2: FF001H, FF003H, FF005H, …, FFFFFH.

RAM must house the data segment and stack segment. It's for the temporary storage of data. The Minimum amount of RAM available is 2kB (6116), so we have used 4kB RAM to accommodate the even and odd banks of Data in 8086.

Even Bank of RAM1: 01000H, 01002H, 01004H, …, 01FFEH.
Odd Bank of RAM1: 01001H, 01003H, 01005H, …, 01FFFH.

The Minimum amount of ROM available is 2kB (2716), we have used a total of 8kB ROM.

2. I/O MAPPING:

Chips	Address
8255	80H-86H
8253	88H-8EH
8259	90H-92H

8255	Address	A7	A6	A5	A4	A3	A2	A1	A0
Port A	80H	1	0	0	0	0	0	0	0
Port B	82H	1	0	0	0	0	0	1	0
Port C	84H	1	0	0	0	0	1	0	0
Control Register	86H	1	0	0	0	0	1	1	0

8253	Address	A7	A6	A5	A4	A3	A2	A1	A0
Counter 1	88H	1	0	0	0	1	0	0	0
Counter 2	8AH	1	0	0	0	1	1	1	0
Counter 3	8CH	1	0	0	0	1	1	0	0
Control Register	8EH	1	0	0	0	1	1	1	0

8259	Address	A7	A6	A5	A4	A3	A2	A1	A0
Register 1	90H	1	0	1	0	0	0	0	0
Register 2	92H	1	0	1	0	0	0	1	0

3. COMPONENTS REQUIRED:

- **8086**

  - 8-bit microprocessor
  - 40 Dual Inline Package IC
  - 20 multiplexed address lines (AD0-AD19) and 16 multiplexed data lines(D0-D15)
  - Operates in Minimum mode of Operation
  - Operates with a 5MHz clock provided by 8284

- **8255**

  - Programmable Peripheral Interface

  Port Specifications: (Used in Bit Set-Reset Mode)

  PORT A (INPUT)

  1. PA0 – MQ2 sensor 1
  2. PA1 – MQ2 sensor 2
  3. PA2 – MQ2 sensor 3

  PORT C (OUTPUT)

  1. PC0 – Malfunction Alarm
  2. PC1 – Main Fire Alarm
  3. PC2 – To Gate 0 of 8253

- **8253**

  -Programmable Interval Timer

  Used in Mode 1 – Frequency of Clock attached = 2.2 kHz; Count Value given = 3500; Duty Cycle = 30%

- **8259**

  -Programmable Interrupt Controller

  -Interrupt vector number generated for IR0 = 40h; Directs to CS and IP addresses of 00100h and 00102h when an interrupt is generated.

- **6116**
  - RAM 2K
  - 2 units used

- **2716**
  - ROM 2K
  - 4 units used

- **74LS373**
  - Octal Latch
  - 3 units used
  - for de-multiplexing address lines to A0-A19

- **72LS245**
  - Octal Bus Transmitter/Receiver
  - 2 units used
  - for de-multiplexing bi-directional data lines D0-D15

- **Alarm**
  - **Fire Alarm 1 AB1-025-RC**

    Main Fire Alarm
    Rated Current/Voltage – 6mA/12V
    Frequency – 2900Hz
    Sound Output – 88dB
  - **Fire Alarm 2 AB1-030-RC**

    Malfunction Fire Alarm
    Rated Current/Voltage – 25mA/12V
    Frequency – 400Hz
    Sound Output – 75dB

- **MQ-2**
  - Ionization Smoke sensor
  - senses LPG, Smoke, Propane, Hydrogen, Methane and Carbon Monoxide concentration

- Operating voltage – 5V
- Load Resistance – < 20KOhm
- Concentration Scope – 200 to 10000ppm
- Has a built in ADC, gives digital as well as analog output

- **74LS32**
  - quad 2-input OR gate – 8 units used
  - 3-input OR gate – 1 unit used

- **74LS04**
  - Hex-inverting gates.
  - 2 units used.

- **74LS08**
  -Quad 2-input AND gate
  - 2 units used

- **74LS138**
  - 3-line to 8-line decoder
  - 2 units used

- **Stepper Motor**
  - Voltage 4V
  - Current 1.2A
  - 30% Duty Cycle for 90-degree rotation.

- **LM297**
  - Integrates all the control circuitry, provides necessary drive signals for the power stage.
  - Along with L298, it forms a complete microprocessor-to-bipolar stepper motor interface.

- **LM298**
  - Dual bridge driver
  - Drive inductive loads such as relays, solenoids, DC and stepping motors.

- **BC547**
  - NPN transistor
  - General purpose current amplifier.
  - Used with the alarms.

- **Resistors**
  10 kΩ

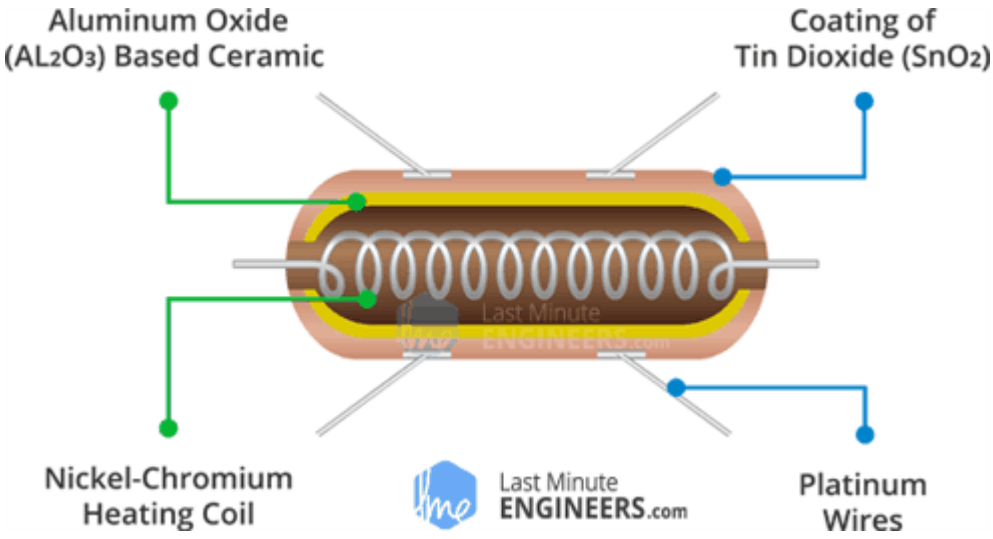
- **Electric Solenoid Valve**
  - Opens at 12 V voltage
  - Releases gas to put out fire

MQ2 SENSOR

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors. In this sensor, detection is based on change in resistance value of the semiconductor when gas comes in contact with the material.

MQ2 sensor can detect gases such as LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentration, ranging from 200 ppm-10000ppm.

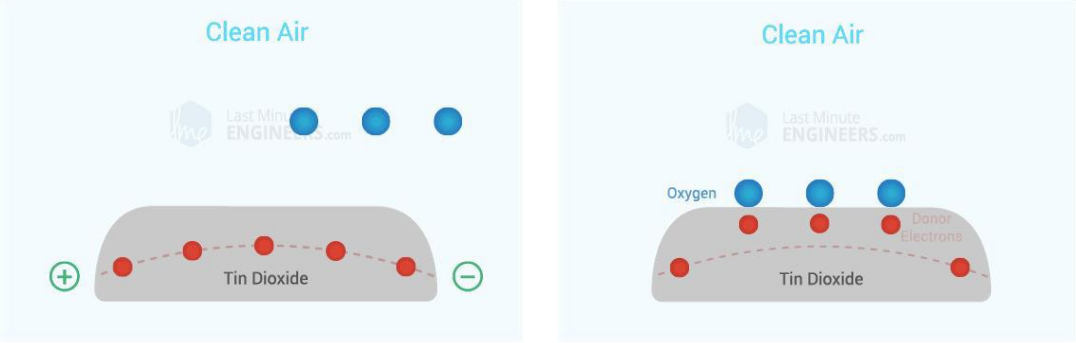
The tubular sensing element is made up of - Aluminium Oxide (Al2O3) based ceramic which increases heating efficiency, and has a coating of Tin Dioxide (SnO2). The Aluminium Oxide based ceramic is just heating system, while coating of Tin Dioxide forms the Sensing system.



WORKING

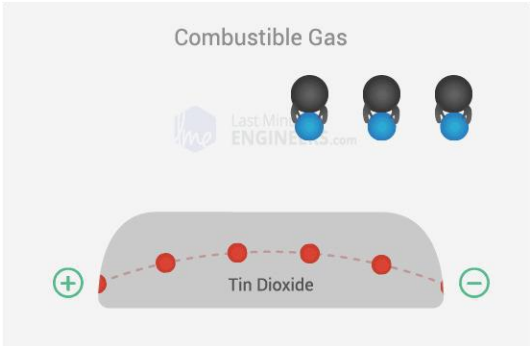
When tin dioxide is heated in air at high enough temperature, oxygen gets adsorbed on the surface. In absence of smoke and reducing gases, donor electrons in tin dioxide are attracted towards oxygen which is adsorbed on the surface of the sensing material. This reduces the conductance of tin dioxide and prevents electric current flow.

Oxygen reacts with the reducing gases in their presence. Hence surface density of adsorbed oxygen reduces in the presence of reducing gases. Electrons are then released back into tin dioxide, increasing conductance and allowing current to flow freely through the sensor.

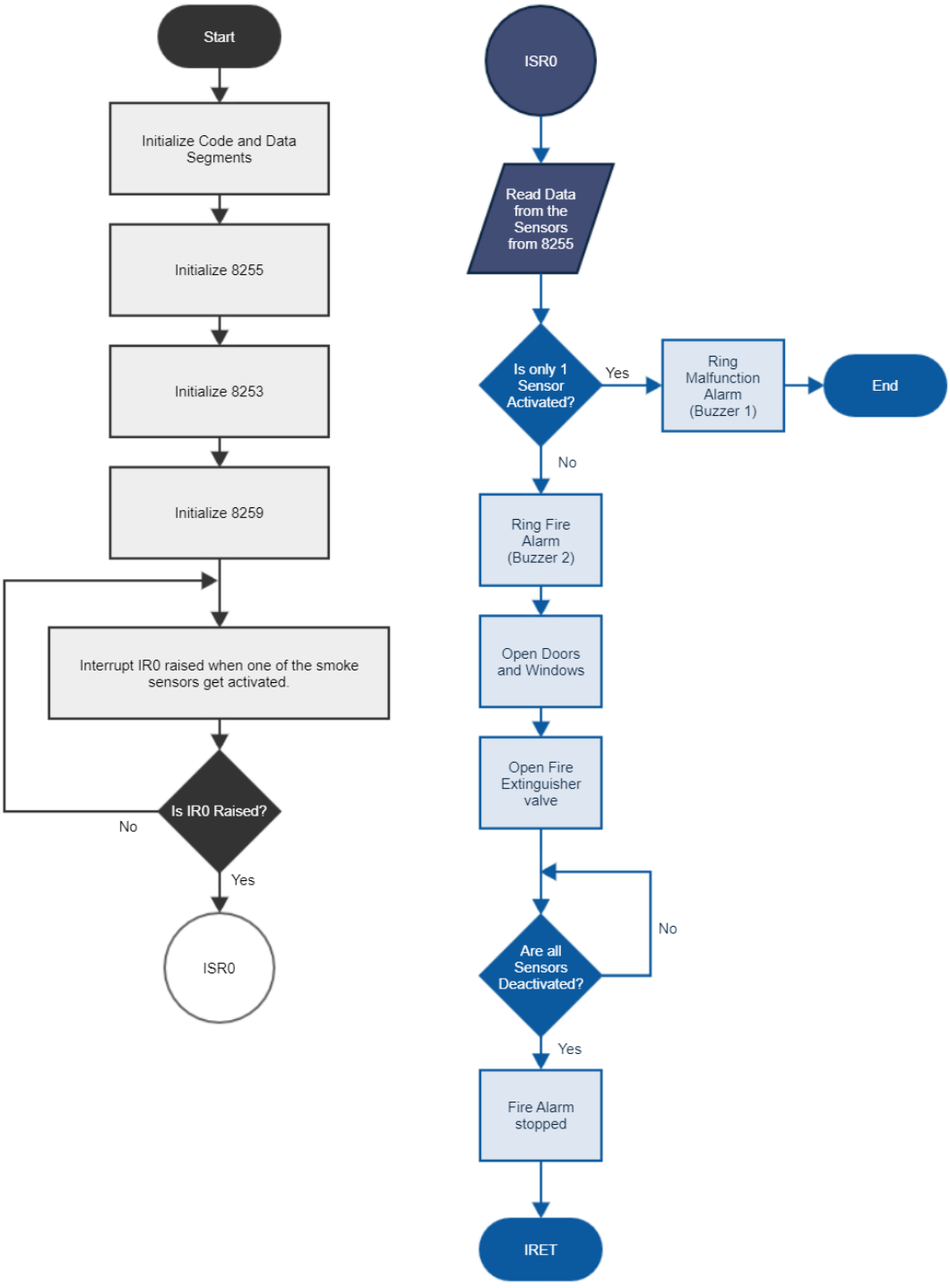


At high temperature, adsorbed oxygen attracts electron, reduces conductance.

Reducing gases decrease oxygen on surface, release electrons and conductance increase.



FLOWCHART


Start
Initialize Code and Data Segments
Initialize 8255
Initialize 8253
Initialize 8259
Interrupt IR0 raised when one of the smoke sensors get activated.
Is IR0 Raised?
No
Yes
ISR0
ISR0
Read Data from the Sensors from 8255
Is only 1 Sensor Activated?
Yes
Ring Malfunction Alarm (Buzzer 1)
End
No
Ring Fire Alarm (Buzzer 2)
Open Doors and Windows
Open Fire Extinguisher valve
Are all Sensors Deactivated?
No
Yes
Fire Alarm stopped
IRET

VARIATIONS IN PROTEUS IMPLEMENTATION

1. 8259 does not work in proteus. Therefore, not used.

2. Timer Interrupt is replaced by a software delay of 2 seconds, written as a subroutine, because of absence of 8259.

3. Using 8253 as 8254 is not available in Proteus.

4. Two 2732 ROM chip [4K] instead of four 2716 ROM 2K, as 2716 is not available on Proteus. ROM stored only in 0000 as Proteus allows to change Reset address.

5. MQ2 sensor model externally included in proteus simulation by including its library files. However, it works as a latched switch.

6. Alarm is replaced by in-built buzzer in Proteus of constant tone, with variations in frequency to differentiate between Malfunction alarm and Main Fire Alarm.

LIST OF ATTACHMENTS

1. Complete Hardware Real World Design: Design32.pdf
2. Manuals
   - 2.1 ABI-025-RC-1 Main Alarm used
   - 2.2 ABI-030-RC-1 Malfunction Alarm used
   - 2.3 BC547 Bipolar Junction Transistor
   - 2.4 MQ-2 Smoke Sensor
   - 2.5 Solenoid Valve
   - 2.6 L297 and L298 for Stepper Motor
3. Proteus Files
4. EMU 8086 Assembly File (G32.asm)
5. Binary file after assembly (G32.bin)
6. GAS SENSORS Library files for Proteus
7. ReadMe file (ReadMe.txt)
8. Image of the Circuit Design in Proteus (CircuitImage32.png)