BATCH NUMBER: 38 PROJECT NUMBER: 20

MICROPROCESSORS AND INTERFACING

-DESIGN ASSIGNMENT.

“FIRE ALARM ”

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Thank you!

PROBLEM STATEMENT

This system checks for abnormal smoke content in a room every 2 seconds. Under abnormal conditions, it throws open 2 doors and 2 windows and opens a valve that releases the gas to put out fire. An alarm is also sounded, this alarm is sounded until smoke level in room drops to an acceptable level. The smoke detection system is made up of 2 smoke sensors placed on the ceiling of the roof. When the smoke level comes back below the danger level, the doors, windows and valves are closed.

ASSUMPTIONS

To reduce the design effort as well as to get the simplest design possible using the minimum amount of hardware while meeting all the restrictions specified by our problem statement, we have made the following assumptions:

1.) The smoke sensors that are used in this design come with a built in ADC. Such sensors are actually available in market (MQ-2 smoke sensor) which make this design viable. It gives high output (1) in case smoke is present near it and gives low output (0) when smoke is not present.

2.) Abnormal conditions are considered when both the smoke sensors give high output i.e. 1.

3.) To simulate the 2 Doors,2 Windows,1 Valve and the Alarm,6 LEDS have been used.

DESIGN PROCESS

(A) Components Used:

Chip Number	Quantity	Chip	Purpose
8086	1	Microprocessor	Central Processing Unit
8253A	1	Programmable Interval Timer	Used to generate timing signals
8255A	1	Programmable Peripheral Interface	Used to interface ports as input and output for smoke sensors, opening and closing of doors, valves and windows and the sounding of alarm
2732	2	EPROM	Read only Erasable Programmable memory to house code segment
6116	2	RAM	Read Write Memory to house the segment
-	33	2 input OR Gate	Used for Decoding Logic
-	5	NOT Gate	Used for Decoding Logic
-	6	LED (equivalent to mechanical switches relay and alarms in chart)	Simulate doors, windows and valves
74LS373	3	8 bit buffer bidirectional buffers	Buffering address bus
74LS245	2	8 bit buffer bidirectional	Buffering data bus

		buffers	
74LS244	2	Octal Buffers	Creation of Vector number (40h)

(B) Memory Organization:

Total RAM used by system = 4KB

Total ROM used by system = 8KB

RAM chip used = 6116.

So, size of each RAM chip = 16/8 = 2KB.

Hence, number of 6116 RAM chips required = 4KB/2KB = 2.

EPROM chip used = 2732

So, size of each ROM chip = 32/8 = 4KB.

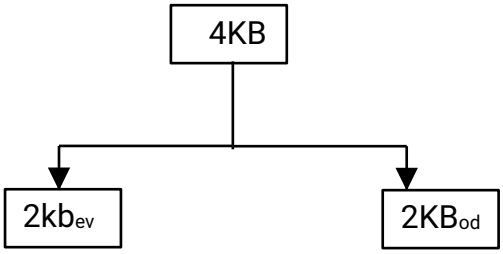
Hence, number of 2732 EPROM chips required = 8KB/4KB = 2.

Let us consider RAM first.

- ✓ **RAM must house the data segment and stack segment.**

Starting address of RAM = 00000_H

System has 4KB RAM. So, Ending address of RAM = $00FFF_H$.



Even Bank of RAM = 00000_H,00002_H,00004_H,00006_H,. . . . . , $00FFE_H$.

Odd Bank of RAM = 00001_H,00003_H,00005_H,00007_H,. . . . . , $00FFF_H$.

	A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
Start Address	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End Address	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1

Data Segment starts at address location 00000_H and is of size 1KB.

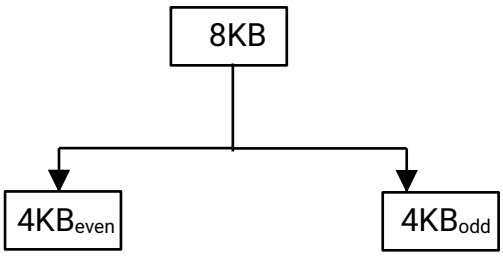
Stack segment starts at address 00800_H and is also of size 1KB.

Now, let us consider ROM.

- ✓ **ROM must house the code segment.**

Starting address of ROM = $FE000_H$

System has 8KB ROM. So, Ending address of ROM = $FFFFF_H$.



Even Bank of ROM = $FE000_H$,$FE002_H$,$FE004_H$,$FE006_H$,. . . . . , $FEFFE_H$.

Odd Bank of ROM = $FE001_H$,$FE003_H$,$FE005_H$,$FE007_H$,. . . . . , $FEFFF_H$.

	A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
Start	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Address																				
End Address	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1

The code begins at the address $FF000_H$.

The first address the processor sends out when it is switched on is $FFFF0_H$.

At this location, there is a jump instruction which takes the program control to the beginning of the code.

(C) IO BASED MEMORY MAPPING:

1.) 8253 Programmable Interval Timer

According to our problem statement, we need to check values from sensors every 2 seconds. For this we need a timer and hence we are using 8253. It is organized in the following way:

	Address	A7	A6	A5	A4	A3	A2	A1	A0
Port A	30_H	0	1	0	1	0	0	0	0
Port B	32_H	0	1	0	1	0	0	1	0
Port C	34_H	0	1	0	1	0	1	0	0
Control Reg.	36_H	0	1	0	1	0	1	1	0

2.) 8255 Programmable Peripheral Interface

One 8255(Programmable Peripheral Interface) are used to communicate with other input and output devices. It is organized in the following manner.

	Address	A7	A6	A5	A4	A3	A2	A1	A0
Port A	00_H	0	0	0	0	0	0	0	0
Port B	02_H	0	0	0	0	0	0	1	0
Port C	04_H	0	0	0	0	0	1	0	0
Control Reg.	06_H	0	0	0	0	0	1	1	0

(D) SENSOR:

MQ-2 Smoke Sensor circuit with built in Analog to digital convertor (with logic 1 as output in case of presence of smoke else logic 0 is the output)

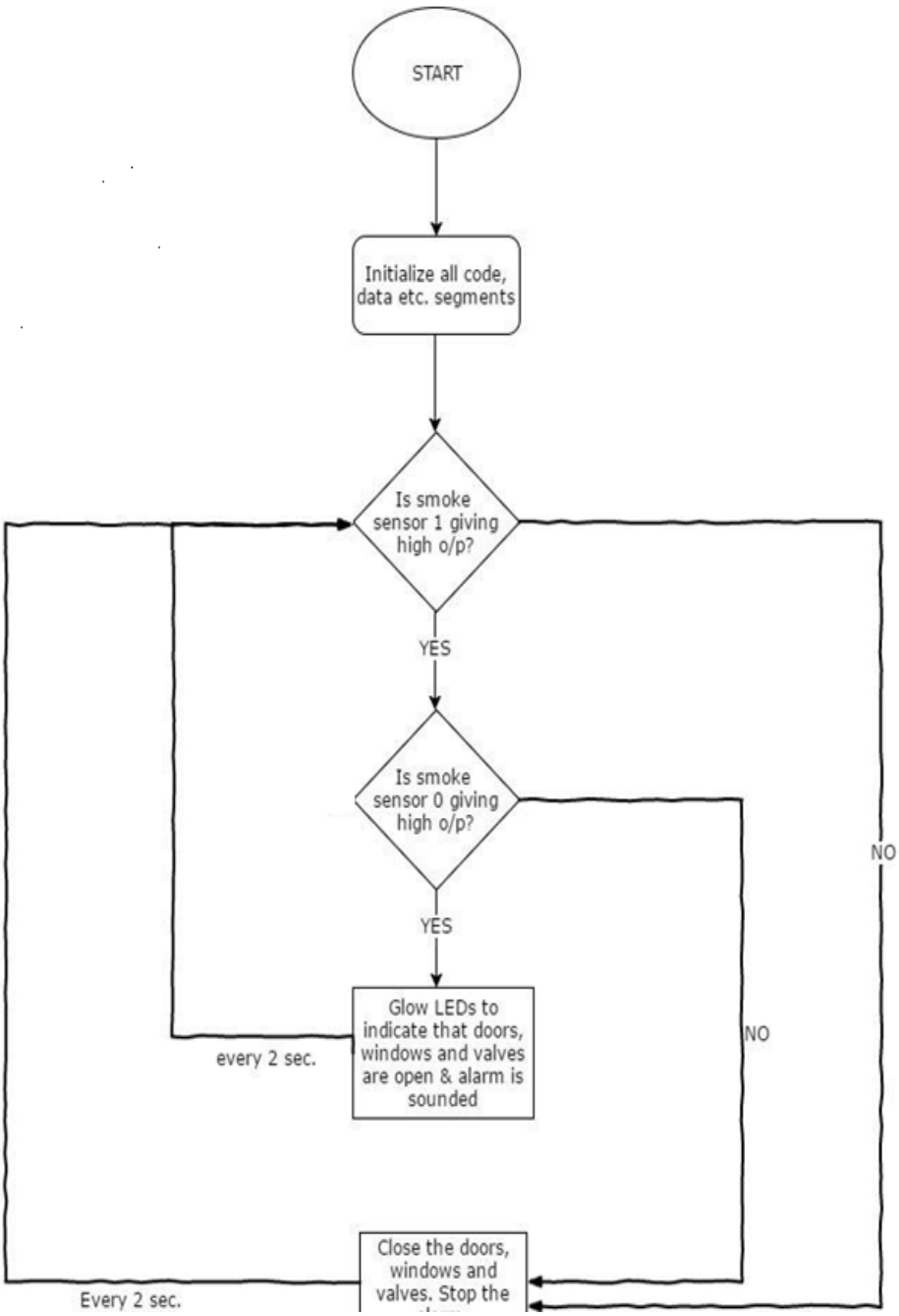
1 = Output
2 = Vcc (positive voltage)
3 = Gnd

The 8253 is used in Mode 2 as a rate counter where an interrupt is given to the 8086 microprocessor every 2 seconds. On the interrupt the 8086 checks for the values at the smoke detectors, that is if it is logic 1 or logic 0. On the basis of the following truth table the actions are taken

SENSOR 1	SENSOR 2	ACTION TAKEN
0	0	Close door, valves and

		windows
0	1	Close door, valves and windows
1	0	Close door, valves and windows
1	1	Open door, valves and windows

FLOWCHART


START
Initialize all code, data etc. segments
Is smoke sensor 1 giving high o/p?
YES
Is smoke sensor 0 giving high o/p?
YES
NO
Glow LEDs to indicate that doors, windows and valves are open & alarm is sounded
every 2 sec.
NO
Close the doors, windows and valves. Stop the
Every 2 sec.

CODE

; The code begins at the address $FF000_H$.

```
#make_bin#

#LOAD_SEGMENT=FFFFh#
#LOAD_OFFSET=0000h#

#CS=0000h#
#IP=0000h#

#DS=0000h#
#ES=0000h#

#SS=0000h#
#SP=0800sh#

#AX=0000h#
#BX=0000h#
#CX=0000h#
#DX=0000h#
#SI=0000h#
#DI=0000h#
#BP=0000h#
```

;At this location i.e. FF000h , there is a jump instruction which takes the program

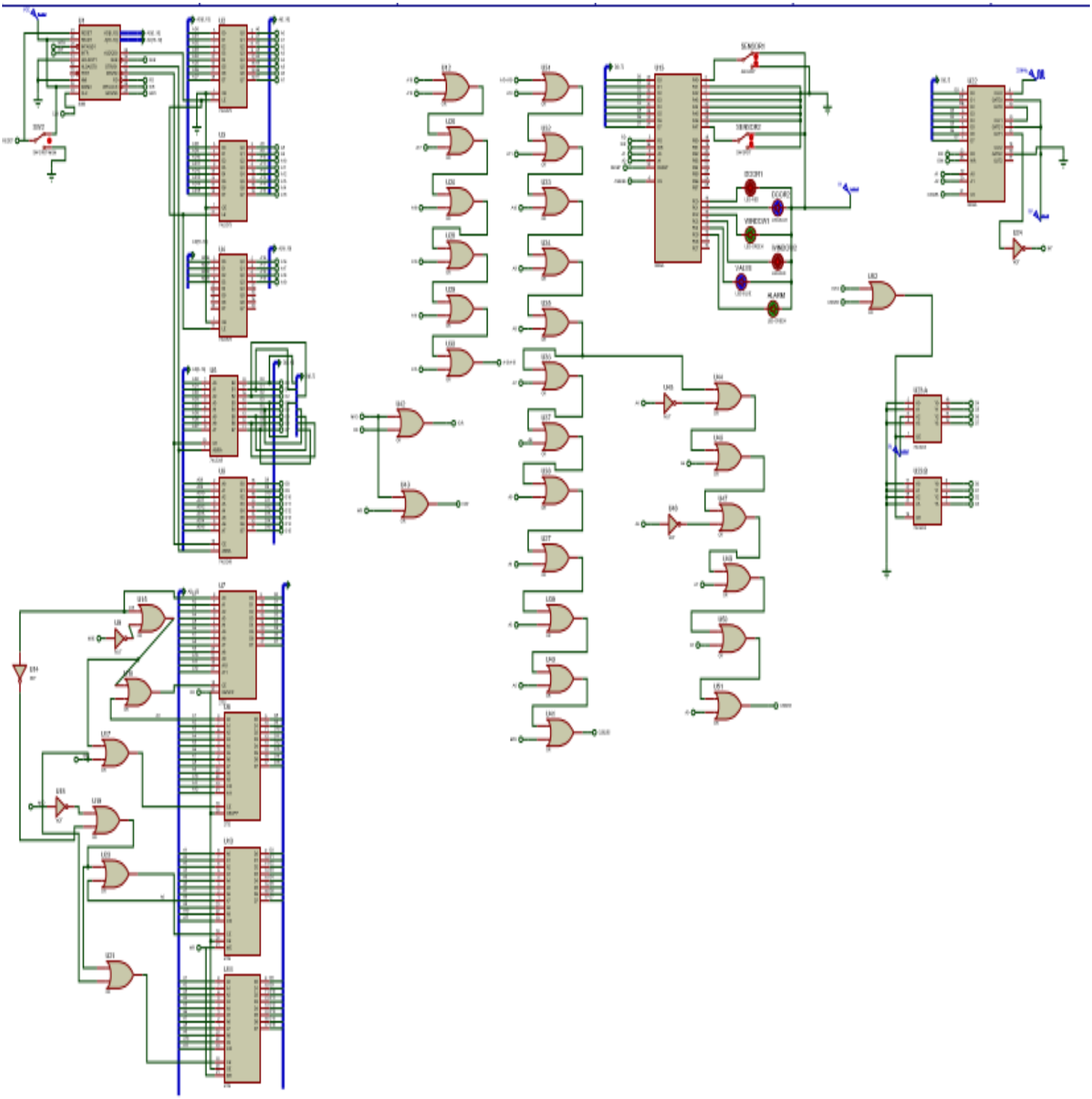
control to the beginning of the main program

```
jmp     st1
db      1024 dup(0)

;main program starts from here
st1:
;clear interrupt flags in order to block any other interrupts
cli
; intializing ds, es,ss to the address 0000h i.e. start of RAM
mov     ax,0000h
mov ds,ax
mov es,ax
mov ss,ax
mov     sp,0800H

;interfacing 8255A i.e.  Programmable Peripheral Interface
;initializing Port A and Port B as Inputs and Port C as output
mov     al,92h ;10010010b
out     06h,al

;for regular time intervals the ideal mode in 8253 is Counter mode 2
;initialise counter mode 2 in 8253
;countreqd = 5*10^6
;Cascading the counters Count 0 and Count 1
;count0 stores 2500 and Count 1 stores 2000
;30h = address of count0 i.e. starting address for 8253
mov     al,34h
out     36h,al
mov     al,0C4h
out     30h,al
```

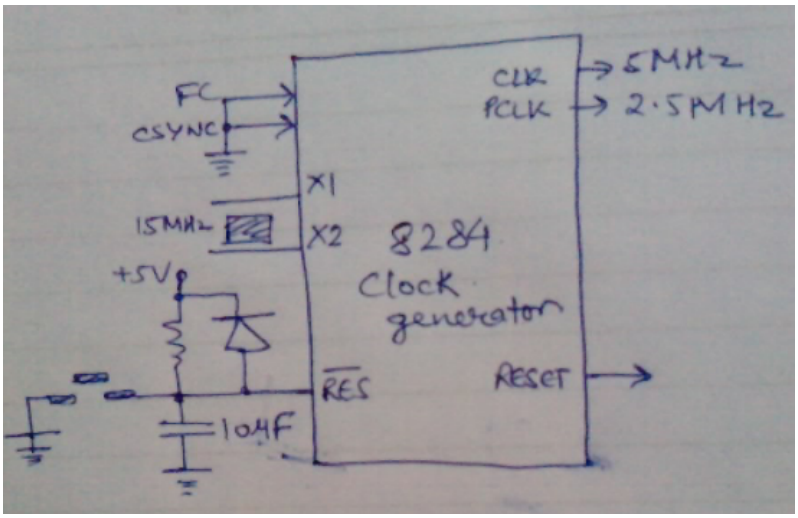
```
mov     al,09h
out     30h,al

;count1 stores 2000
;32h =address of Count 1
mov     al,74h
out     36h,al
mov     al,0D0h
out     32h,al
mov     al,07h
out     32h,al

;taking  input from smoke sensors that are connected to Port A A0 and A7 pins
;Address of port A i.e. starting address of 8255 is 00h
next:
  in      al,00h
mov bl,al
;checking  if both are on or not
cmp     bl,81h
jnz     off

; opening valves, doors and windows and sound alarm on the sign of abnormal conditions by giving output to Port C to which LEDs are connected (Active Low)
;address of port c is 04H
glow:
mov     al,0C0h
out     04h,al
jmp     over
```

```
   ;close valves, doors and windows in the normal conditions by giving Output  to Port C
off:
   mov       al,0FFh
   out       04h,al
jmp     over
over:

;interupt  generation after every 2 seconds with the help of 8253
Lea si,read
mov     ds:[256],si
;Vector number 40h is generated using octal buffers i.e. 74LS244
 ;vector number = 40h = 64d, so location in IVT = 64*4 = 256
;Saving cs and ip
Mov  cx,cs
mov    ds:[258],cx

;set the interrupt flags
sti

;infinite loop, will stop only power s switched off
jmp     next

read proc near:
iret
readendp
```

CIRCUIT DIAGRAM



In the above circuit 8284 was used to generate the required clock at frequencies 5MHz and 2.5 MHz and in 8253 the counts count0 and count 1 are cascaded in order to get the count required 5x10^6.Count 0 X Count1 = 2500 x 2000 = 5x10^6



REFERENCES TO MANUALS USED

- 8085/86
- x86 processors (Intel processors book by BareyBrey)
- 2716_EPROM
- 6116
- 8255
- adc0808-n (for understanding the concept of ADC, not used in project though)
- SN74LS245
- SN74LS373

All the above manuals were either searched on Internet or available on Edx for student's reference.

For the smoke sensors, the below sites were referred

- http://www.learningaboutelectronics.com/Articles/MQ-2-smoke-sensor-circuit-with-arduino.php
- http://store.fut-electronics.com/products/smoke-sensor-module-mq2-digital-analog
- http://www.nrdcentre.com/MQ2-Smoke-Sensor-Module
  http://www.hw-group.com/products/sensors/index_en.html