BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE,
PILANI

A REPORT ON

STERILIZATION UNIT USING 8086 MICROPROCESSOR

By

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PROBLEM STATEMENT

Description: This unit performs sterilization by increasing temperature to maximum value (x℃). The temperature has to be maintained at the maximum value for 2 minutes before it is brought gradually to a nominal temperature value (y℃). The time taken for bringing down the temperature can be varied between four different values as decided by the user. A slider is used to decide this value

Level 1 : 2 minutes

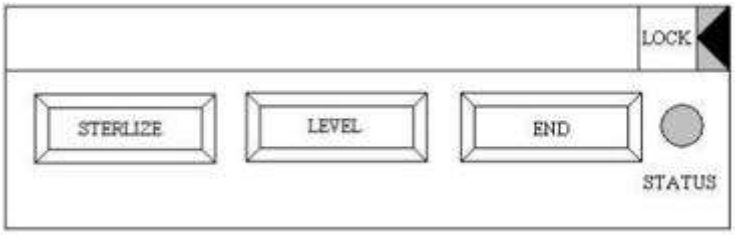
Level 2 : 4 minutes

Level 3 : 6 minutes

Level 4 : 8 minutes

While the sterilization process is taking place the door to the unit must remain locked. The Door can be opened only when user presses End.

User Interface: Status LED glows as long as the sterilization process is being done. Once 30℃ has been reached then LED goes off and the door mechanism unlocks. Once the door is closed again the temperature has to be brought back to 30℃.

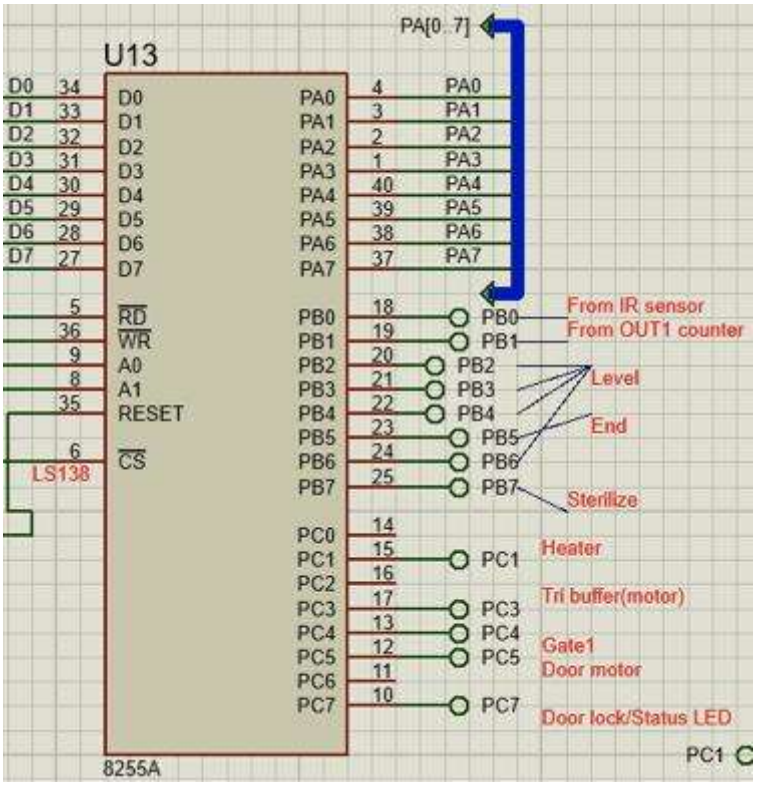


Design Specifications:

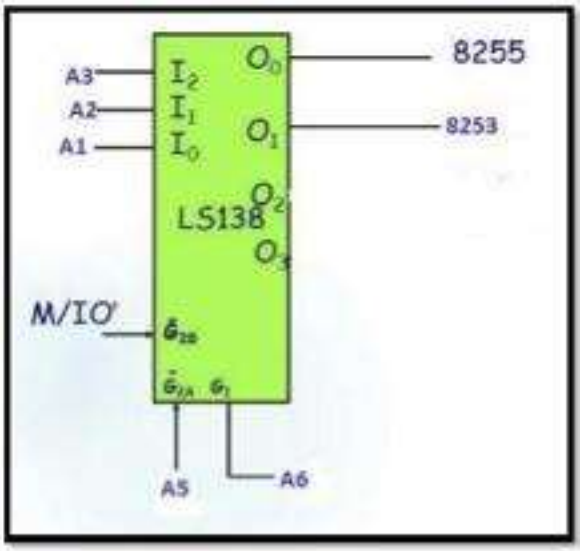
Simple DC Motor*:*
Nominal Voltage: 12 V
Coil Resistance: 12
Coil Inductance: 100mH
Zero load RPM: 2200
Max Torque%: 1
Effective mass: 0.0000001

Heater*:*
Ambient temperature: 25
Thermal Resistance to Ambient: 0.05
Oven Time Constant: 6
Heater Time Constant: 0.0001
Temperature coefficient: 1
Heating power: 2.3 kW

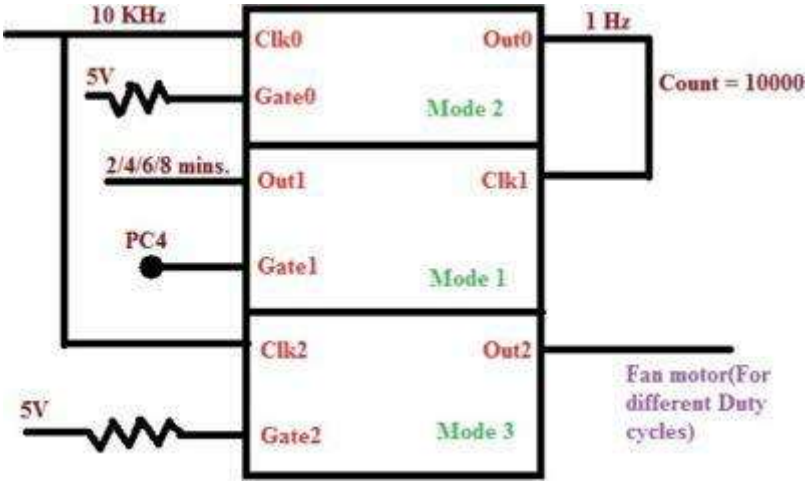
8255:

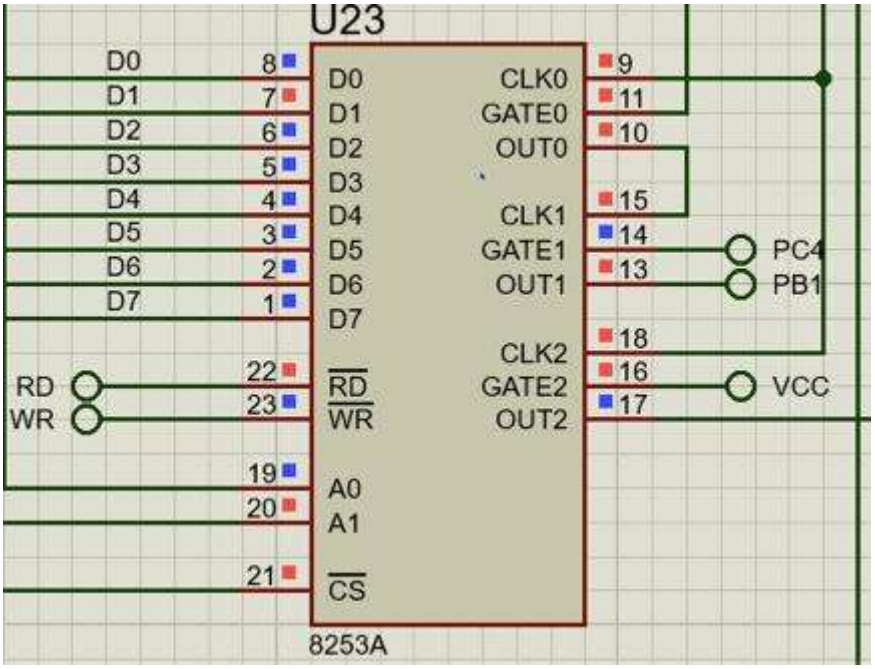


74LS138(Decoder):

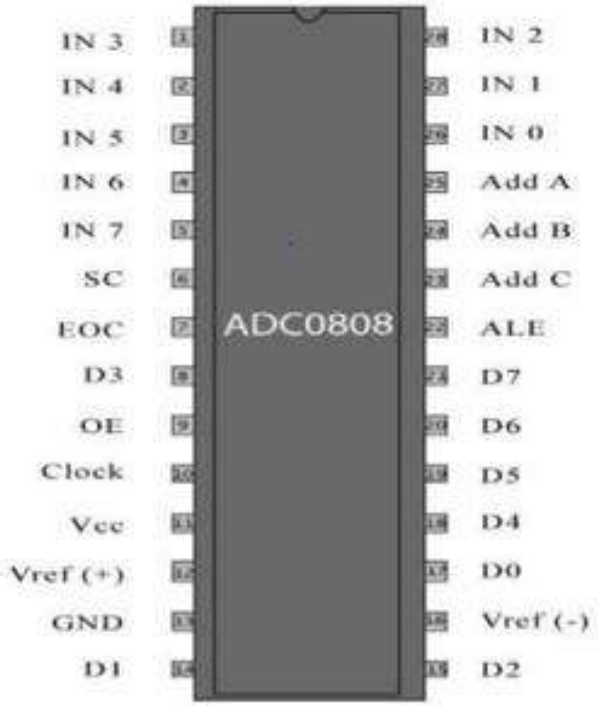


8253(Counter):





ADC 0808(AC to DC Converter)



Components Used:

1. 8086(1) - Microprocessor
2. 8255(1) - Programmable Peripheral Interface
3. 8253(1) - Programmable Interval Timer
4. 2732(2) - 4K ROM
5. 6116(2) - 2K SRAM
6. ADC0808 (1) - Analog to Digital Converter
7. 74LS373 (3) – Latch
8. 74LS245 (2) - Bidirectional Buffer
9. 74LS138 (1) - Decoder (3 : 8)
10. 2- Simple DC motors
11. L293D (1) – Motor Driver
12. 1 - Heater
13. 1 – Tri-state buffer
14. 1 – Toggle Switch
15. 6 – Button Switches
16. 3 - LEDs
17. 6 – OR Gates
18. 4 – NOT Gates

LED Status Values and meanings:

1. ‘TIMER’ LED – Used to count the time when the temperature reaches 80 deg. C. Along with this, the user chosen time is also displayed here.
    a. 1 = Counting
    b. 0 = Not Counting
2. ‘STATUS’ LED –
    a. 1 = Sterilization process going on
    b. 0 = Sterilization process stopped
3. ‘DOOR’ LED –
    a. 1 = Door is locked
    b. 0 = Door is unlocked

Input/Output port matching

1. Port A: 00h
2. Port B: 02h
3. Port C: 04h
4. Control Register: 06h
5. Counter 0: 08h
6. Counter 1: 0Ah
7. Counter 2: 0Ch
8. Counter Control Register: 0Eh

Memory Matching

1. ROM 1E(Even) => 00000H -01FFEH (4K)
2. ROM 1O(Odd) => 00001H-01FFFH (4K)
3. RAM 1E(Even) => 02000H – 02FFEH (2K)
4. RAM 2O (Odd)=> 02001H – 02FFFH (2K)

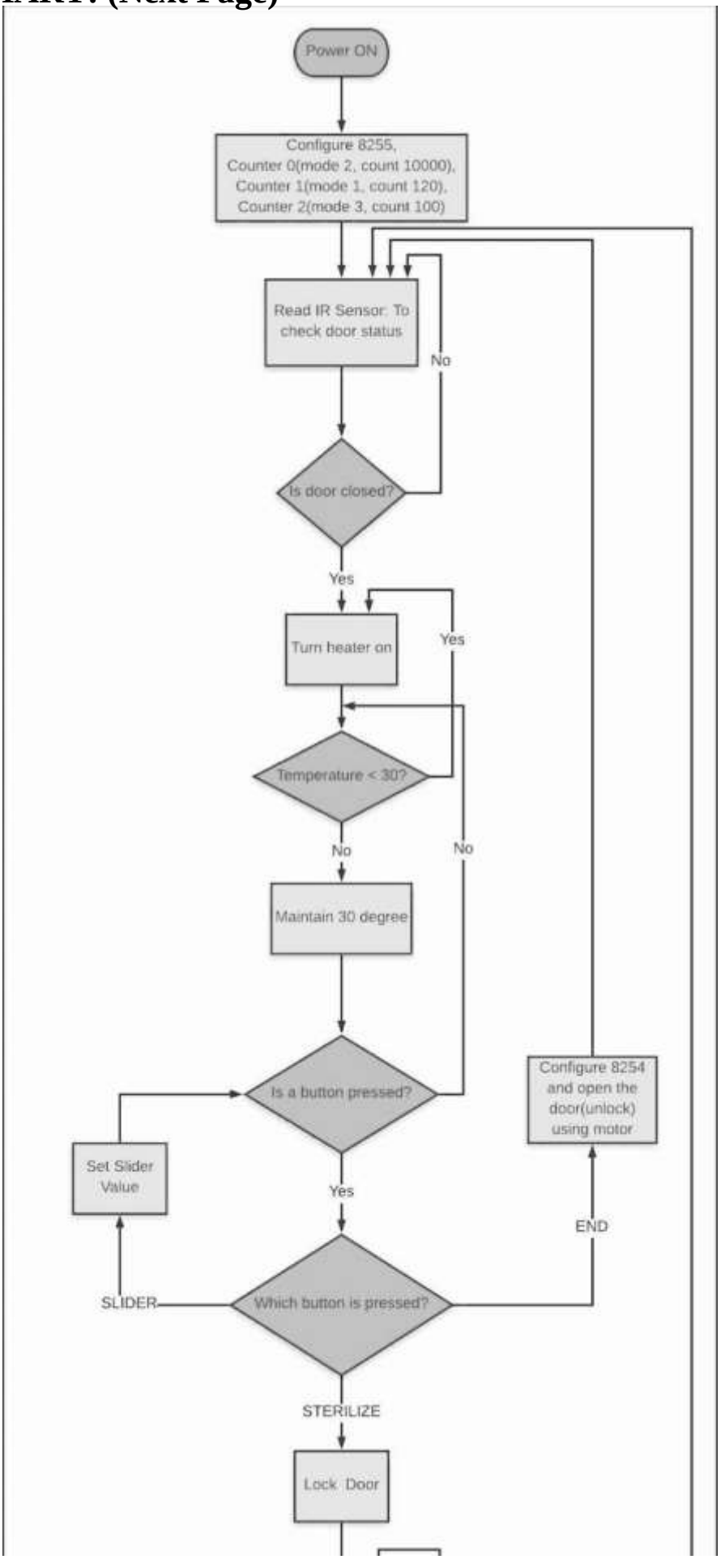
Assumptions

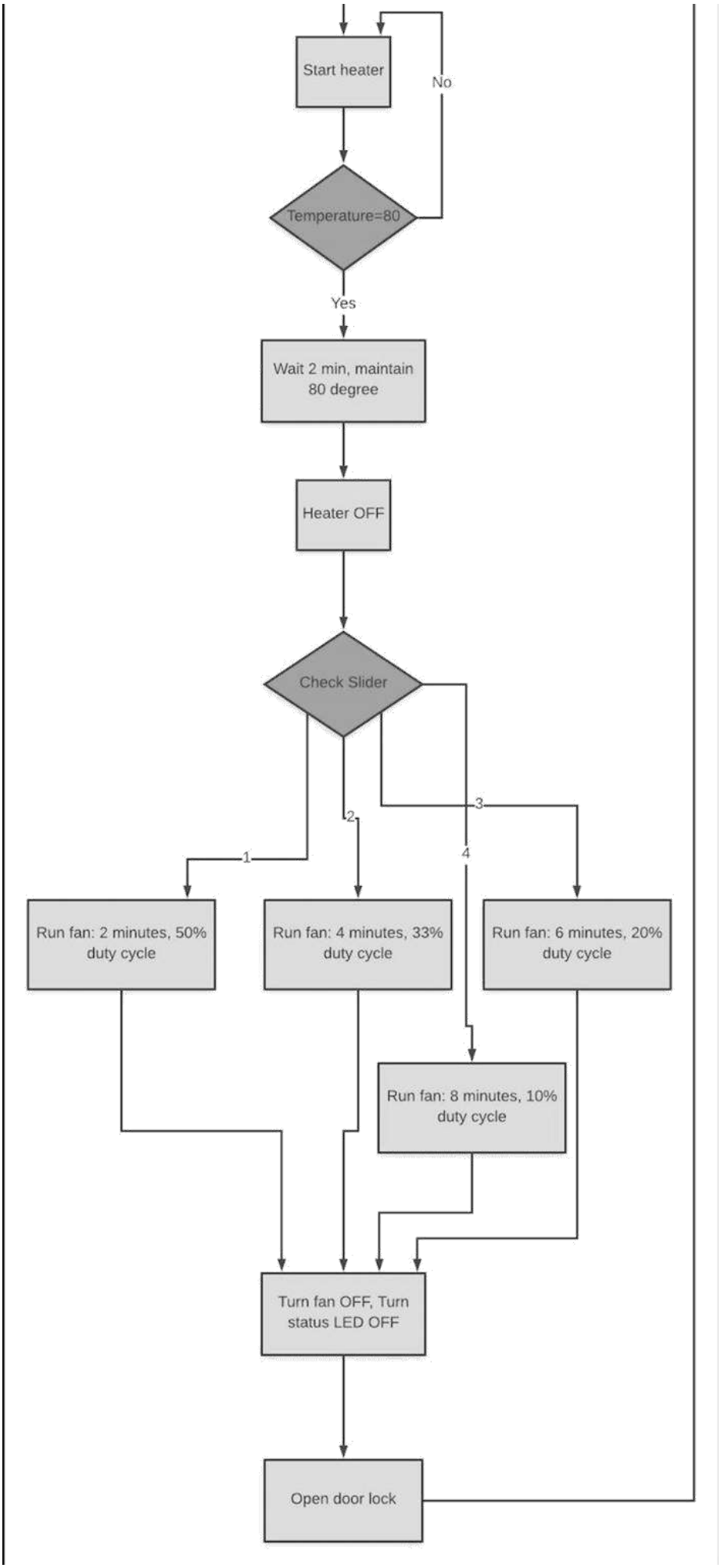
1. Assuming x=80 deg. cel.
2. Sterilization takes place at 80 deg. cel.
3. Open the door only when ‘END’ is pressed and the door opening is done using Motor. IR (toggle switch) =0 => Door closed and IR (toggle switch) =1 => Door open (Done manually)
4. Level of sterilization is selected using 4 switches over which a slider will move and as it hovers over the switches it will press the switches.
5. Since the CPU load is high for the simulation, *2 minutes in real time has been replaced by 15 seconds of simulation time due to hardware constraints. Similarly, 4 minutes is equivalent to 30 seconds of simulation time and so on.
6. The CPU load for the waiting period at 80 deg. cel is very high and hence the waiting time has been significantly reduced.

Cooling methods

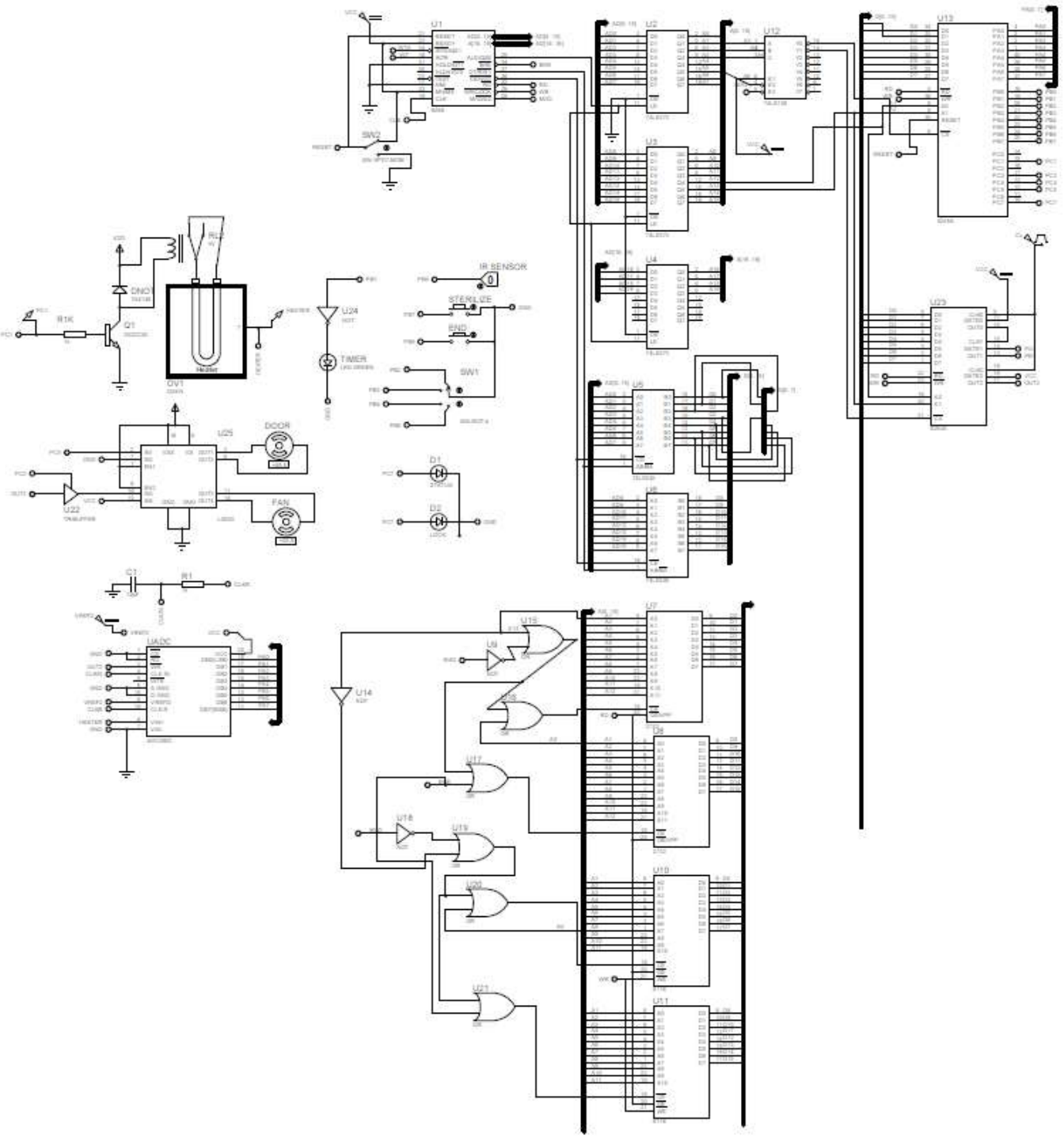
1. LEV1: Fan motor cools the sterilization unit from 80℃ to 30℃ in 2 mins* at 100% duty cycle.
2. LEV2: Fan motor cools the sterilization unit from 80℃ to 30 ℃ in 4 mins* at 50% duty cycle.
3. LEV3: Fan motor cools the sterilization unit from 80℃ to 30℃ in 6 mins* at 33% duty cycle.
4. LEV4: Fan motor cools the sterilization unit from 80℃ to 30℃ in 8 mins* at 25% duty cycle.

ASM CHART: (Next Page)




Start heater
No
Temperature=80
Yes
Wait 2 min, maintain 80 degree
Heater OFF
Check Slider
1
2
3
4
Run fan: 2 minutes, 50% duty cycle
Run fan: 4 minutes, 33% duty cycle
Run fan: 6 minutes, 20% duty cycle
Run fan: 8 minutes, 10% duty cycle
Turn fan OFF, Turn status LED OFF
Open door lock

Circuit Diagram



ASM CODE

```
.model tiny
.data

db     509 dup(0)
dw     0000
db     508 dup(0)

.code
.startup

mov al,92h
out 06h,al          ;configure 8255
mov al,00110100b            ;configure 8254 (counter 0, mode 2)
out 0eh,al
mov al,64h          ; 0064h(100)
out 08h,al
mov al,00h          ;
out 08h,al

mov al,01110010b      ;configure 8254 (counter 1, mode 1)
out 0eh,al
mov al,0ch          ;00ch (12)
out 0ah,al
mov al,00h          ;
out 0ah,al
mov al,10110110b      ;configure 8254 (counter 2, mode 3)
out 0eh,al
mov al,64h          ;0064h( to be given to soc), 064h(100)
out 0ch,al
mov al,00h
out 0ch,al


ir1:
        in al,02h           ; (ir sensor), if 0 door is closed
        and al,01h
        jnz ir1

mov cl,0
mov al,00000000b            ;( pc4- gate1 =0)
out 04h,al
mov al,00000000b            ;( pc1- heater =0)
out 04h,al



start:
        in al, 00h
        cmp al,38               ; maintaining temperature at 30 degrees
        jge x1
        mov al,00000010b     ;heater(pc 1) on
        out 04h,al
        jmp start

x1:
        mov al,00000000b    ;heater(pc 1) off
        out 04h,al

getlevel:
```

```
        in al,02h
        mov ah,al
        and ah,01000000b
        jnz lvl3
        mov cl,04h
        jmp end10

lvl3:
        mov ah,al
        and ah,00010000b
        jnz lvl2
        mov cl,03h
        jmp end10

lvl2:
        mov ah,al
        and ah,00001000b
        jnz lvl1
        mov cl,02h
        jmp end10

lvl1:
        mov ah,al
        and ah,00001000b
        mov cl,01h

end10:
        in al,02h
        mov ah,al
        and ah,80h ;80h = sterlize
        jz ster
        mov ah,al
        and ah,20h          ;20h=end
        jz end1
        jmp start

end1:           ;end pressed

call delay_20ms     ;de-bounce


in al,02h
and al,20h
jnz start

mov al,10110110b    ;configure 8254 (counter 2, mode 3) "reinitialize for adc"
out 0eh,al
mov al,64h          ;0ch( to be given to soc)
out 0ch,al
mov al,00h
out 0ch,al
mov al,01110010b    ;counter 1 mode 1
out 0eh,al
mov al,03h          ; count =3 (3 sec)
out 0ah,al
mov al,00h
out 0ah,al

mov al,00010000b    ;  pulse to gate 1 (pc4)
out 04h,al
nop
nop
```

```
mov al,00000000b    ;pulse
out 04h,al

door:
        mov al,00100000b
        out 04h,al              ;switching motor on( pc 5)
        in al,02h               ;out 1 (pb1)
        and al,02h
        jz door

mov al,00000000b      ;switching motor off( pc 5)
out 04h,al

jmp ir1

ster:                           ;sterilize pressed
        call delay_20ms         ;de-bounce
        in al,02h
        and al,80h
        jnz start
        mov al,10000000b    ;lock door( pc 7)/ status on
        out 04h,al

x5:
        mov al,10000010b    ; heater (pc 1)-on
        out 04h,al


wait1:
        in al,02h
        mov ah,al
        and ah,20h
        jz end1                                                 ;20h=end
        in al, 00h
        cmp al,102          ; waiting for 80 degree celsius
        jle wait1

mov al,01110010b            ;counter 1 mode 1
out 0eh,al
mov al,30h                          ;waiting time has been kept low as the simulation slows down during the
period
out 0ah,al
mov al,00h
out 0ah,al
mov al,10010000b            ;  pulse to gate 1 (pc4)
out 04h,al
nop
nop
mov al,10000010b            ;pulse
out 04h,al

temp100:
        in al, 00h
        cmp al,102          ; mantaining temperature=80 degrees
        jle htron
        mov al,10000000b    ;heater(pc 1) off
        out 04h,al


nop             ;nop given to calibrate heater's rate of cooling with heating
nop
nop
```

```
nop
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nop

htron:
        mov al,10000010b    ;heater(pc 1) on
        out 04h,al
        in al,02h           ;out 1 (pb1)
        and al,02h
        cmp al,0
        jz temp100

mov al,01110010b    ;counter 1 mode 1
out 0eh,al
cmp cl,1            ;count of level button
jz s1
cmp cl,2
jz s2
cmp cl,3
jz s3
cmp cl,4
jz s4


s1:
        mov al,40h          ;count =120 (2 min)
        out 0ah,al
        mov al,06h
        out 0ah,al
        mov al,10010000b     ;pulse to gate 1 (pc4)
        out 04h,al
        nop
        nop
```

```
        mov al,10000000b     ;pulse
        out 04h,al

fan1:
        mov al,10001000b     ;switching motor on (pc 3)
        out 04h,al
        in al,02h            ;out 1 (pb1)
        and al,02h
        jz fan1
        jmp out1

s2:
        mov al,10110100b      ;counter 2, mode 2
        out 0eh,al
        mov al,02h            ;given count 2 (duty cycle:50%)
        out 0ch,al
        mov al,00h
        out 0ch,al
        mov al,80h            ; count =240 (4 min)
        out 0ah,al
        mov al,0ch
        out 0ah,al
        mov al,10010000b      ; pulse to gate 1 (pc4)
        out 04h,al
        nop
        nop
        mov al,10000000b    ;pulse
        out 04h,al

fan2:
        mov al,10001000b     ;switching motor on (pc 3)
        out 04h,al
        in al,02h            ;out 1 (pb1)
        and al,02h
        cmp al,0
        jz fan2
        jmp out1

s3:
        mov al,10110100b       ;counter 2, mode 2
        out 0eh,al
        mov al,03h             ;given count 3 (duty cycle:33%)
        out 0ch,al
        mov al,00h
        out 0ch,al
        mov al,0c0h            ; count =360 (6 min)
        out 0ah,al
        mov al,12h
        out 0ah,al
        mov al,10010000b       ; pulse to gate 1 (pc4)
        out 04h,al
        nop
        nop
        mov al,10000000b    ;pulse
        out 04h,al

fan3:
        mov al,10001000b    ;switching motor on (pc 3)
        out 04h,al
        in al,02h           ;out 1 (pb1)
        and al,02h
        cmp al,0
```

```
        jz fan3
        jmp out1

s4:
        mov al,10110100b    ;counter 2, mode 2
        out 0eh,al
        mov al,04h          ;given count 4 (duty cycle:25%)
        out 0ch,al
        mov al,00h
        out 0ch,al
        mov al,00h          ; count =480 (8 min)
        out 0ah,al
        mov al,19h
        out 0ah,al
        mov al,10010000b    ; pulse to gate 1 (pc4)
        out 04h,al
        nop
        nop
        mov al,10000000b    ;pulse
        out 04h,al

fan4:
        mov al,10001000b    ;switching motor on (pc 3)
        out 04h,al
        in al,02h           ;out 1 (pb1)
        and al,02h
        cmp al,0
        jz fan4
        jmp out1

out1:
        mov al,10000000b    ;switching motor off (pc 3)
        out 04h,al
        mov al,00000000b    ;unlock door( pc 7)/ status off
        out 04h,al
        mov al,10110110b    ;configure 8254 (counter 2, mode 3)
        out 0eh,al
        mov al,0e8h         ;0ch( to be given to soc)
        out 0ch,al
        mov al,03h          ;0ch( to be given to soc)
        out 0ch,al

        in al,02h
        mov ah,al
        and ah,20h
        jz end1                                          ;20h=end

        jmp start


delay_20ms proc near    ;subroutine
        mov dx,cx
        mov cx,10
        x2:
        nop
        nop
        loop x2
        mov cx,dx
        ret
delay_20ms endp

.exit
```

end