A REPORT
ON
DOOR SECURITY CONTROL

Submitted in partial fulfillment of the course
INSTR F241 Microprocessors and Interfacing

Submitted by Group No. 106

Shirisha Singh	**2016A8PS0415P**
Aayush Attri	**2016A8PS0421P**
Saksham Consul	**2016A8PS0424P**
Prithviraj Shivraj Patil	**2016A8PS0427P**

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE
PILANI, RAJASTHAN-333031
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Contents

PROBLEM STATEMENT

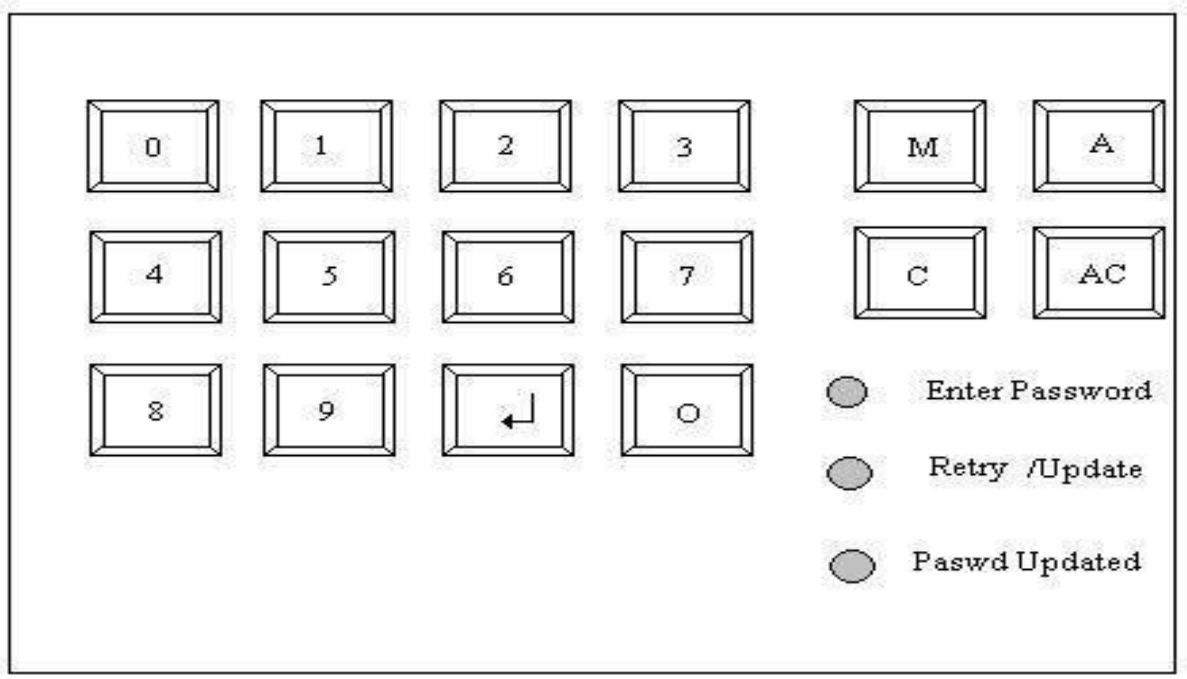
DESCRIPTION: This system controls the opening and closing of a door based on password entry. If the password is correct the person can enter. Each person is given two chances to enter the correct password. On failure an alarm is sounded. Inside the room a button is available when the button is pressed the door opens for 1 Min, so that the person can leave the room.

USER INTERFACE: There are three sets of passwords:

(1) User

(2) Master

(3) Alarm off



- The Master password is used by the security Personnel for updating Password of the day. Pressing the M button activates this mode. The system glows Enter Password LED asking the personnel to enter the password. The master password is a 16-digit value. The master is given only a single chance to enter the password. If authenticated, the retry/Update LED glows. If there is a failure in authentication the alarm is sounded. When the retry/ Update LED glows the user has to enter password of the day. This is 12-digit value. Once this value has been accepted by the system the Password Updated LED glows.

- User has to press the O key when he wants to enter the room. The Enter Password LED prompts the user to enter the password. The user is given C/AC option as well. If the first attempt fails, the RETRY LED glows. The user is allowed to re-enter password, on authentication door opens for a period of 1 Min. On Failure an ALARM is sounded.
- To Turn-off the Alarm the A button has to be pressed. Enter Password LED glows prompting user to enter the 14-digit password for turning of alarm, no retries are allowed. If authentication is successful then the alarm is turned off.
- To leave the room a button is available inside the room, when the button is pressed the door opens for 1 Minute so that the person can leave the room.
- LCD show the entry as asterisk when the password characters are entered.

ASSUMPTIONS

- All operations are sequential and so, no two operations can be carried out at the same time.

- User cannot access the door lock system at the 24 hour mark. First, a user password needs to be set using the master mode and only then can the door lock be accessed.

- Once you have entered a mode, it is necessary to complete the entire procedure. Pressing any other mode buttons like M, O or A will not override the mode.

- In case of mistake in typing the password to turn down the alarm, the system will get locked in it’s last state and to use it again, it is necessary to shutdown and restart the system.

- The 24 hour clock starts running as soon as we turn on the system.

- The Master Password and the Alarm Password have been hard coded in the system.

  Master Password: 9999999999999999

  Alarm Password: 99999999999999

LIST OF COMPONENTS USED

Sr. No.	Hardware Device	Description	Quantity
1.	8086	16 bit Microprocessor	1
2.	74LS373	Octal Latch	3
3.	74LS245	Transceiver	2
4.	7432	OR gate	6
5.	NOT	NOT gate	6
6.	2732	ROM	2
7.	6116	RAM	2
8.	74LS138	3-to-8 Decoder	1
9.	8255A	Programmable Peripheral Interface	2
10.	8253A	Programmable Interval Timer	2
11.	KEYPAD-PROJECT	Hex-keypad	1
12.	BUTTON	Button	1
13.	LM016L	16x2 LCD display	1
14.	BUZZER	Alarm	1
15.	LED-RED	Red LED	3
16.	MOTOR-STEPPER	Stepper Motor	1

17.	OMIH-SH-105D	Relay	1
18.	SW-SPDT-MOM	SPDT Switch	1
19.	ULN2003A	Darlington Transistor	1
20.	74LS241	Tri-state Buffer	1

Memory Mapping

Size of 2732 (ROM) : 4k

ROM(even) : 00000h - 01FFEh (A0 = 0)
ROM (odd) : 00001h - 01FFFh (A0 = 1)

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
0	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X

Size of 6116 (RAM) : 2k

RAM(even) : FF000h - FFFFEh (A0 = 0)
RAM(odd) : FF001h - FFFFFh (A0 = 1)

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
1	1	1	1	X	X	X	X	X	X	X	X	X	X	X	X

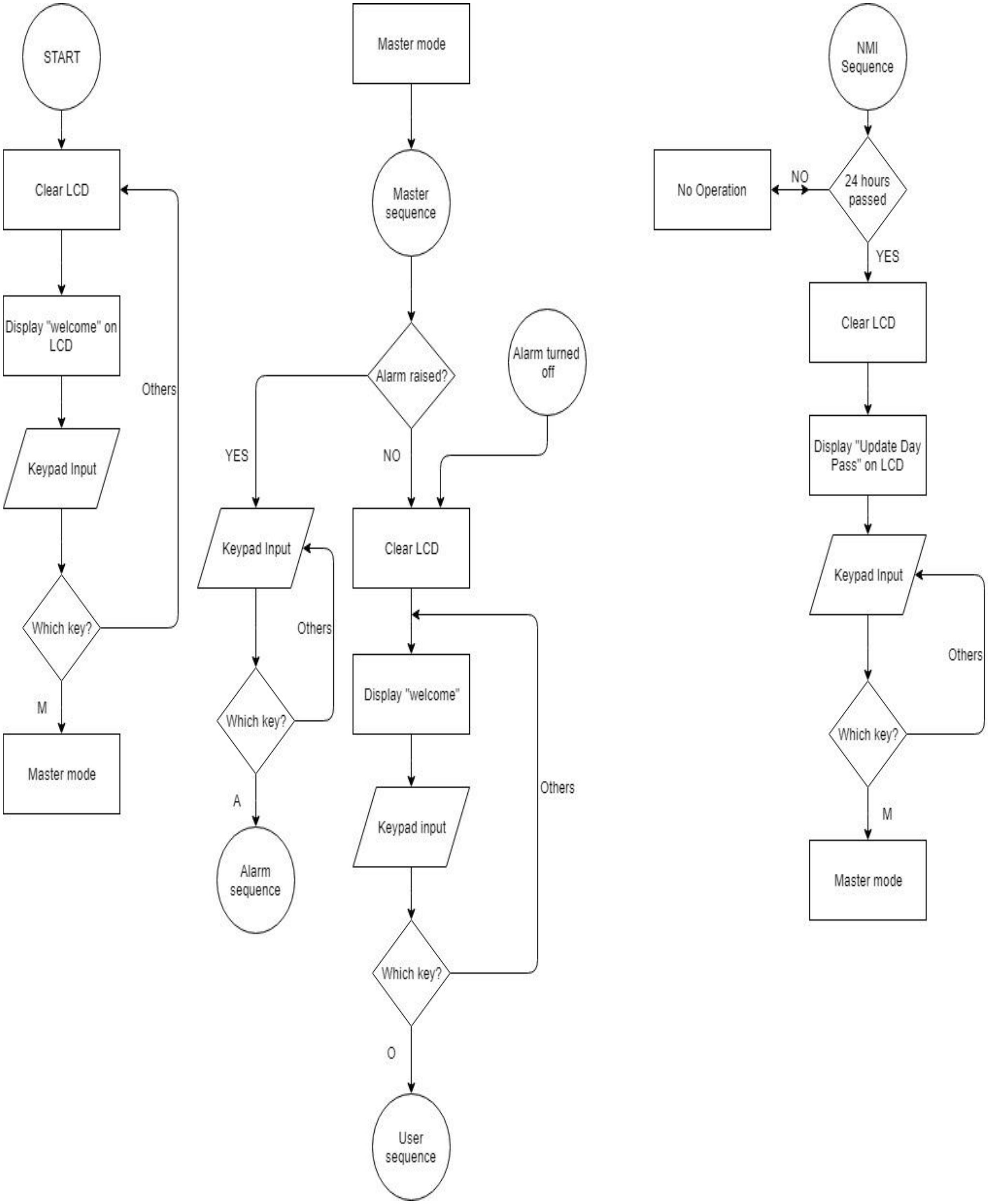
I/O Mapping

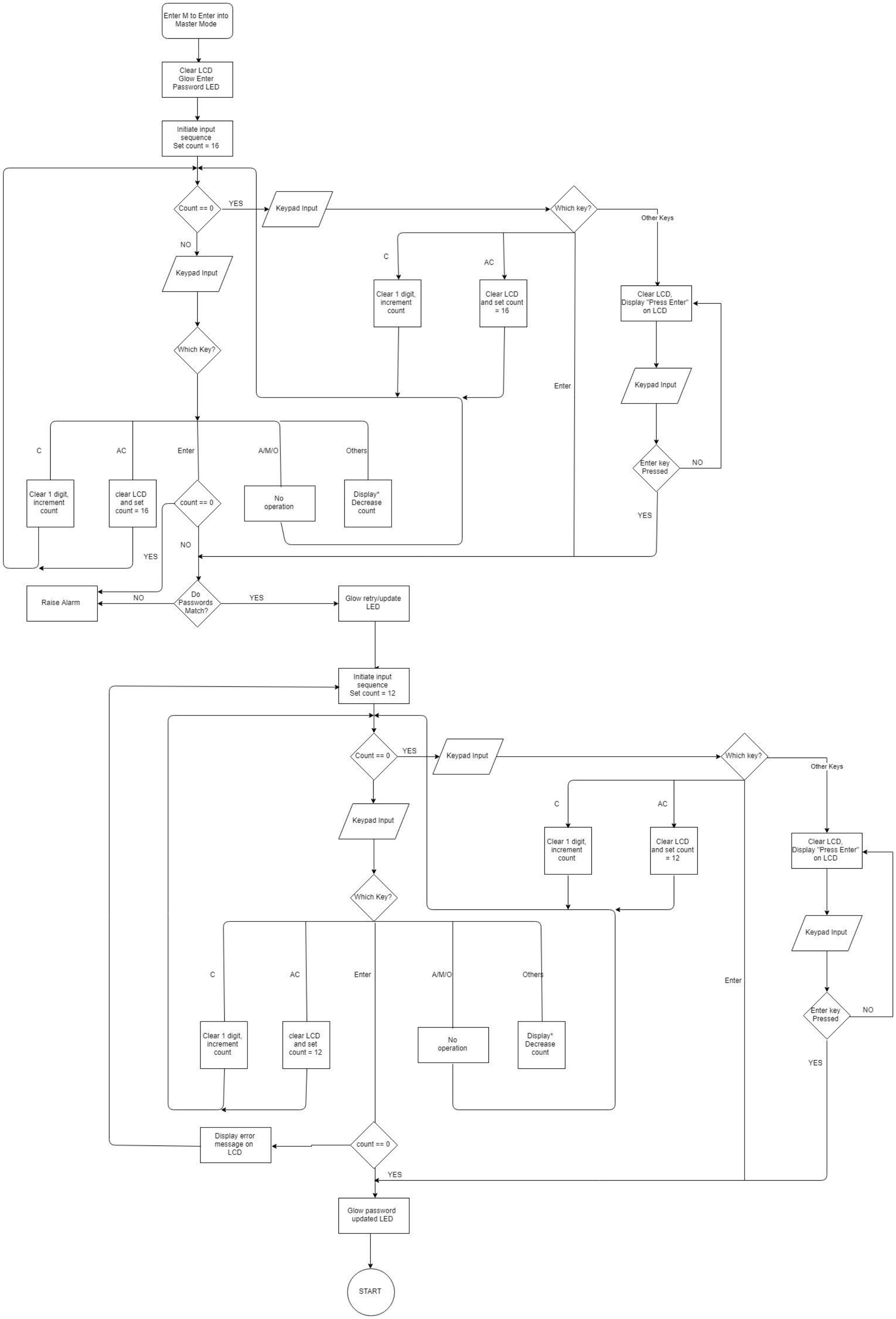
Address of 8255-1 port-A	: 00h
Address of 8255-1 port-B	: 02h
Address of 8255-1 port-C	: 04h
Address of 8255-1 control register	: 06h
Control word of 8255-1	: 88h
Address of 8255-2 port-A	: 08h
Address of 8255-2 port-B	: 0Ah
Address of 8255-2 port-C	: 0Ch
Address of 8255-2 control register	: 0Eh
Control word of 8255-2	: 89h
Address of 8253-1 count0	: 10h
Address of 8253-1 count1	: 12h
Address of 8253-1 count2	: 14h
Address of 8253-1 control register	: 16h
Control word of 8253-1 count0	: 36h
Control word of 8253-1 count1	: 56h
Control word of 8253-1 count2	: 92h
Address of 8253-2 count0	: 18h
Address of 8253-2 count1	: 1Ah
Address of 8253-2 count2	: 1Ch
Address of 8253-2 control register	: 1Eh
Control word of 8253-2 count0	: 34h
Control word of 8253-2 count1	: 5Ah
Control word of 8253-2 count2	: 94h

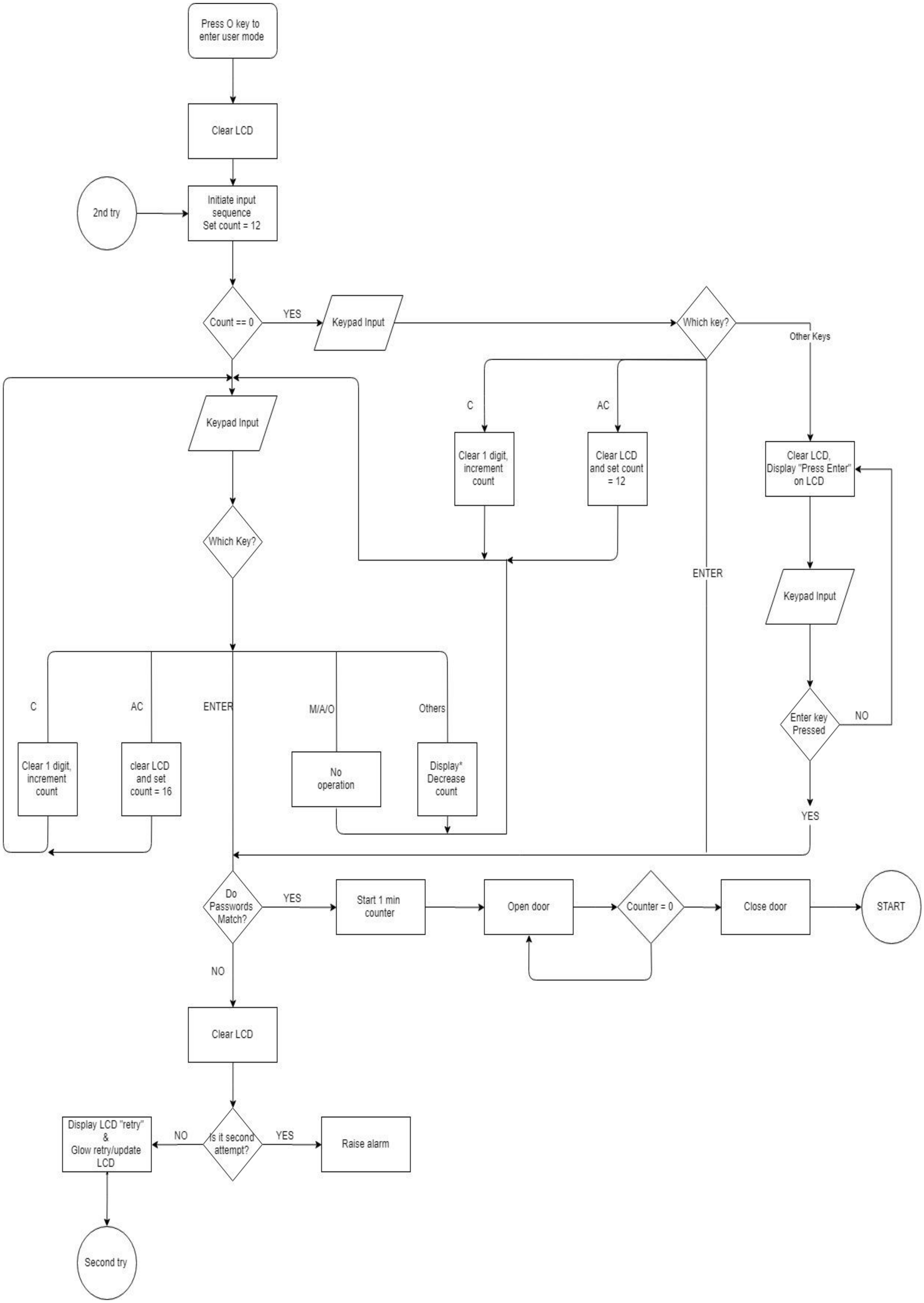
IVT

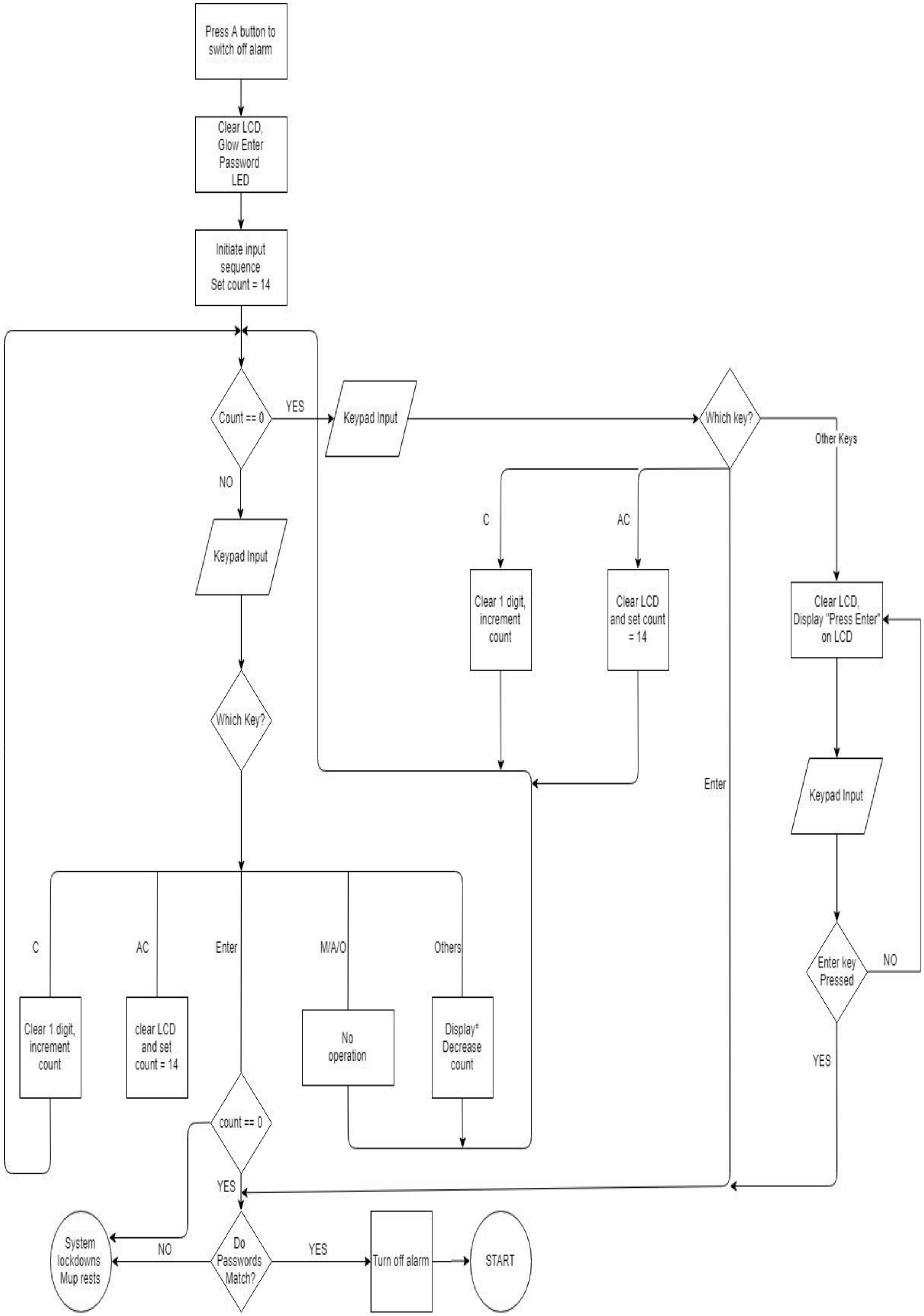
Interrupt Vector No.	Physical Address	Contains
INT 02h	00008h 0000Ah	IP2 CS2
INT 80h	00200h 00202h	IP128 CS128

Flow-Chart of the System




Enter M to Enter into Master Mode
Clear LCD Glow Enter Password LED
Initiate input sequence Set count = 16
Count == 0
YES
NO
Keypad Input
Which key?
Other Keys
C
AC
Clear 1 digit, increment count
Clear LCD and set count = 16
Enter
Clear LCD, Display "Press Enter" on LCD
Keypad Input
Enter key Pressed
NO
YES
Keypad Input
Which Key?
C
AC
Enter
A/M/O
Others
Clear 1 digit, increment count
clear LCD and set count = 16
count == 0
No operation
Display* Decrease count
NO
YES
Raise Alarm
NO
Do Passwords Match?
YES
Glow retry/update LED
Initiate input sequence Set count = 12
Count == 0
YES
Keypad Input
Which key?
Other Keys
C
AC
Clear 1 digit, increment count
Clear LCD and set count = 12
Clear LCD, Display "Press Enter" on LCD
Keypad Input
Enter key Pressed
NO
YES
Enter
Keypad Input
Which Key?
C
AC
Enter
A/M/O
Others
Clear 1 digit, increment count
clear LCD and set count = 12
No operation
Display* Decrease count
Display error message on LCD
count == 0
YES
Glow password updated LED
START


Press O key to enter user mode
Clear LCD
2nd try
Initiate input sequence Set count = 12
Count == 0
YES
Keypad Input
Which key?
Other Keys
C
AC
Clear 1 digit, increment count
Clear LCD and set count = 12
ENTER
Clear LCD, Display "Press Enter" on LCD
Keypad Input
Enter key Pressed
NO
YES
Keypad Input
Which Key?
C
AC
ENTER
M/A/O
Others
Clear 1 digit, increment count
clear LCD and set count = 16
No operation
Display* Decrease count
Do Passwords Match?
YES
Start 1 min counter
Open door
Counter = 0
Close door
START
NO
Clear LCD
Display LCD "retry" & Glow retry/update LCD
NO
Is it second attempt?
YES
Raise alarm
Second try


Press A button to switch off alarm
Clear LCD, Glow Enter Password LED
Initiate input sequence Set count = 14
Count == 0
YES
NO
Keypad Input
Which key?
Other Keys
C
AC
Enter
Clear 1 digit, increment count
Clear LCD and set count = 14
Clear LCD, Display "Press Enter" on LCD
Keypad Input
Enter key Pressed
NO
YES
Keypad Input
Which Key?
C
AC
Enter
M/A/O
Others
Clear 1 digit, increment count
clear LCD and set count = 14
No operation
Display* Decrease count
count == 0
YES
Do Passwords Match?
NO
YES
System lockdowns Mup rests
Turn off alarm
START

ALP Code

```
#make_bin#

#LOAD_SEGMENT=FFFFh#
#LOAD_OFFSET=0000h#

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

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

#SS=0000h#
#SP=FFFEh#

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



    jmp    st1
    db    5 dup(0)

    ;IVT entry for NMI (INT 02h)
    dw    Nmi_24hrtimer
    dw    0000
    db    500 dup(0)

      ;IVT entry for 80H
       dw    Switch_intR
```

```
   dw    0000
     db    508 dup(0)
    st1:     cli ;Clear IF, now initiliaze RAM

    ;intialize ds, es,ss to start of RAM
   mov      ax,0200h
   mov      ds,ax
   mov      es,ax
   mov      ss,ax
   mov      sp,0FFFEH
    ; INITIALIZATION OF 8255,8253 BEGINS HERE

    port_a1 equ 00h
    port_b1 equ 02h
    port_c1 equ 04h
    creg1 equ 06h

    port_a2 equ 08H
    port_b2 equ 0Ah
    port_c2 equ 0Ch
    creg2 equ 0Eh

    cnt0_1 equ 10h
    cnt1_1 equ 12h
    cnt2_1 equ 14h
    creg3 equ 16h

    cnt0_2 equ 18h
    cnt1_2 equ 1Ah
    cnt2_2 equ 1Ch
    creg4 equ 1Eh

    sti
    mov al,89h   ; control word for 8255-2 I/O Mode, Port A - Mode 0,
o/p, PCU - i/p Port B - Mode 0, o/p, PCL - i/p
    out creg2,al
```

```
        mov al,88h   ; control word for 8255-1 I/O Mode, Port A - Mode 0,
o/p, PCU - i/p Port B - Mode 0, o/p, PCL - o/p
        out creg1,al

        mov al,36h   ;control word for 8253-1 counter 0     16bit count, Mode
3, Bin
        out creg3,al

        mov al,56h   ;control word for 8253-1 counter 1 8bit LSB count, Mode
3, Bin
        out creg3,al

        mov al,92h   ;control word for 8253-1 counter 2, 8bit LSB count,
Mode 1, Bin
        out creg3,al

        mov al,34h   ;control word for 8253-2 counter 0 16bit count, Mode 2,
Bin
        out creg4,al

        mov al,5ah   ;control word for 8253-2 counter 1 8bit LSB count, Mode
5, Bin
        out creg4,al

        mov al,94h   ;control word for 8253-2 counter 2 8bit LSB count Mode
2, Bin
        out creg4,al

        mov al,50h   ;load count lsb for 8253-1 counter 0 | Count value =
50000(dec)
        out cnt0_1, al

        mov al,0C3h          ;load count msb for 8253-1 counter 0
        out cnt0_1, al

        mov al,64h   ;load count for 8253-1 counter 1 | Count value =
100(dec)
```

```
    out cnt1_1, al

    mov al,1eh   ;load count lsb for 8253-1 counter 2 (1 minute Timer) |
Count value = 30(dec)
    out cnt2_1, al


    mov al,0A0h;load count for 8253-2  LSB counter 0 (24 hour counter)
| Count value = 64(dec)
    out cnt0_2, al

    mov al,-5h    ;load count for 8253-2  MSB counter 0 (24 hour counter)
    out cnt0_2, al

    mov al,3       ;load count for 8253-2 counter 1 (Switch trigger counter)
| Count value = 3(dec)
    out cnt1_2, al

    mov al,2       ;load count for 8253-2 counter 2 | Count value = 2(dec)
    out cnt2_2, al
    ;INITIALIZATION OF 8255,8253 ENDS HERE


    mov al,00h   ;default low output from 8255-2 upper port C
    out port_c2, al

    call DELAY_20ms ;LCD INITIALIZATION BEGINS
    mov al,04h ;E=1 RW=0 RS=0 -> control write
    out port_b1,al
    call DELAY_20ms
    mov al,00h ;E=0 RW=0 RS=0 -> control write H-L transition
    out port_b1,al

    mov al,38h ;Initialization
    out port_a1,al

    mov al,04h ;E=1 RW=0 RS=0 -> control write
```

```
        out port_b1,al
        call DELAY_20ms
        mov al,00h ;E=0 RW=0 RS=0 -> control write H-L transition
        out port_b1,al
        call DELAY_20ms
        mov al,0Ch ;LCD ON, cursor ON, curson blinking OFF
        out port_a1,al
        mov al,04h ;E=1 RW=0 RS=0 -> control write
        out port_b1,al
        call DELAY_20ms
        mov al,00h ;E=0 RW=0 RS=0 -> control write H-L transition
        out port_b1,al

        mov al,06h ;move cursor right
        out port_a1,al
        call DELAY_20ms
        mov al,04h ;E=1 RW=0 RS=0 -> control write
        out port_b1,al
        call DELAY_20ms
        mov al,00h ;E=0 RW=0 RS=0 -> control write H-L transition
        out port_b1,al
        mov al,4ch
        out port_a1,al
        call DELAY_20ms  ;LCD INITIALIZATION ENDS

   mov ax,0200h ; Initialize DS
        mov ds,ax

        mov si,0000h
        mov al,0bdh ;hard coding pass-word ; 9999999999999999 (BD ->
Keyboard value)
        mov [si],al

        mov al,0bdh
        mov [si+1],al

        mov al,0bdh
        mov [si+2],al

        mov al,0bdh
        mov [si+3],al

        mov al,0bdh
        mov [si+4],al

        mov al,0bdh
        mov [si+5],al

        mov al,0bdh
        mov [si+6],al

        mov al,0bdh
        mov [si+7],al

        mov al,0bdh
        mov [si+8],al

        mov al,0bdh
        mov [si+9],al

        mov al,0bdh
        mov [si+0ah],al

        mov al,0bdh
        mov [si+0bh],al

        mov al,0bdh
        mov [si+0ch],al

        mov al,0bdh
        mov [si+0dh],al

        mov al,0bdh
        mov [si+0eh],al
        mov al,0bdh
        mov [si+0fh],al

        add si,000fh
        inc si ; Update si to store future entry


        mov al,0bdh ;hard coding alarm pass-word ; 99999999999999
        mov [si],al

        mov al,0bdh
        mov [si+1],al

        mov al,0bdh
        mov [si+2],al

        mov al,0bdh
        mov [si+3],al

        mov al,0bdh
        mov [si+4],al

        mov al,0bdh
        mov [si+5],al

        mov al,0bdh
        mov [si+6],al

        mov al,0bdh
        mov [si+7],al

        mov al,0bdh
        mov [si+8],al

        mov al,0bdh
        mov [si+9],al
```

```
          mov al,0bdh
          mov [si+0ah],al

          mov al,0bdh
          mov [si+0bh],al

          mov al,0bdh
          mov [si+0ch],al

          mov al,0bdh
          mov [si+0dh],al

          add si,000dh
   inc si ;Update si to store future values

          mov al,0ffh ; Switch off all LEDs
          out port_a2,al

          start:  call clear_LCD
                  call welcome_msg

                  mov bp,00h
                  call keypad_input
                  cmp al,0bbh
                  jz master_Mode
                  jmp start

x6:      call clear_LCD
       call welcome_msg
       call keypad_input
          cmp al,0b7h
          jz User_Mode
          jmp x6 ;press valid key

master_Mode:
  call intm
  mov bp,0abcdh
  cmp ax,0abcdh
  jnz x6
x8:     call keypad_input
        cmp al,7Dh
        jz Alarm_Mode
        jnz x8

Alarm_Mode:
  call inta
  cmp dh,6h
  jz start
  cmp dh,1h
  jz x6
  jmp x70

User_Mode:
  call intu
  cmp ax,0abcdh
  jz x8
  jnz x6

x70:
stop: jmp stop

DELAY_20ms proc

        MOV             CH,5
        X4:     NOP
                NOP
                DEC     CH
                JNZ     X4
        RET
DELAY_20ms endp
DELAY_0.04s proc

        MOV     cx,4fffh
        X17:    NOP
                NOP
                DEC     cx
                JNZ     X17
        RET
DELAY_0.04s endp
DELAY_max proc

        MOV     cx,0ffffh
        X16:    NOP
                NOP
                DEC     cx
                JNZ     X16
        RET
DELAY_max endp

enter_LCD proc
        mov al,0A0h
        out port_a1,al
        call DELAY_20ms
        mov al,05h ;E=1 RW=0 RS=1 -> data write
        out port_b1,al
        call DELAY_20ms
        mov al,01h ;E=1 RW=0 RS=1 -> data write H-L transition
        out port_b1,al  ;prints Space

        mov al,0A0h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints Space

        mov al,50h
        out port_a1,al
```

```
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints P

mov al,52h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints R

mov al,45h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,53h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints S

mov al,53h
out port_a1,al
call DELAY_20ms
```

```
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints S

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,45h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,4Eh
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints N

mov al,54h
out port_a1,al
call DELAY_20ms
mov al,05h
```

```
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints T

        mov al,45h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints E

        mov al,52h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints R
RET
enter_LCD endp


intm proc

                call clear_LCD
                mov al,0feh
                out port_a2,al              ;turns on enter password LED
                mov cx,16

enter_16bit:
                call keypad_input
                cmp al,7eh ;  Check if pressed 'C'
                jz pressc
                cmp al,7bh ; Check if pressed 'AC'
                jz pressac
                cmp al,77h ; Check if pressed 'ENTER'
                jz press_enter
                cmp al,0bbh ;Check if pressed 'M'
                jz nop_master
                cmp al,0b7h ; Check if pressed 'U'
                jz nop_master
                cmp al,7dh ; Check if pressed 'A'
                jz nop_master
                mov [si],al
                CALL asterisk
                inc si
                dec cx
                jnz enter_16bit
disp_entermaster:
                call keypad_input
                cmp al,7eh
                jz pressc
                cmp al,7bh
                jz pressac
                cmp al,77h
                jz press_enter
asd:    CALL clear_LCD
                CALL enter_LCD
                call keypad_input
                cmp al,77h
                jz press_enter
                jnz asd

nop_master:             nop
                jmp enter_16bit
pressc:         call clear_1digit_LCD
                dec si
                inc cx
                jmp enter_16bit
pressac:
                CALL clear_LCD
                mov cx,16
                mov si,1eh          ;start of pass segment
                jmp enter_16bit
press_enter:
                CALL clear_LCD
                mov al,0ffh ; All LED off
                out port_a2,al
                cmp cx,0
                jz cmp_pass
                jmp raise_alarm


day_pass:
                mov si,002Eh
                mov al,0fdh ; Retry/Update is on
                out port_a2,al
                call DELAY_max
                call DELAY_max
                call DELAY_max
                call clear_LCD
                mov cx,12
enter_12bit:
                call keypad_input
                cmp al,7eh ;Check for 'C'
                jz presscday
                cmp al,0bbh ;Check for 'M'
                jz nop_day
                cmp al,0b7h ;Check for U
                jz nop_day
                cmp al,7dh ;Check for A
                jz nop_day
                cmp al,7bh ;Check for AC
                jz pressacday
                cmp al,77h ;Check for ENTER
                jz press_enterday
                mov [si],al
```

```
                CALL asterisk
                inc si
                dec cx
                jnz enter_12bit
disp_enter:
                call keypad_input
                cmp al,7eh
                jz presscday
                cmp al,7bh
                jz pressacday
                cmp al,77h
                jz press_enterday
asd1:                   CALL clear_LCD
                        CALL enter_LCD
                        call keypad_input
                        cmp al,77h ;Check for ENTER
                        jz press_enterday
                        jnz asd1
nop_day:        nop
                jmp enter_12bit

presscday:
                call clear_1digit_LCD
                dec si
                inc cx
                jmp enter_12bit
pressacday:
                CALL clear_LCD
                jmp day_pass
press_enterday:
                CALL clear_LCD
                mov al,0ffh
                out port_a2,al
                cmp cx,0
                jnz err_msg
                mov al,0fbh
                out port_a2,al
                call DELAY_max
                call DELAY_max


                mov al,0ffh
                out port_a2,al
                jz end_69h
err_msg:
                call error_msg
                jmp day_pass
cmp_pass:
                cld
                mov si,0000h
                mov di,001Eh
                mov cx,17
x5:             mov al,[si]
                mov bl,[di]
                dec cx
                jz day_pass
                cmp al,bl
                jnz raise_alarm
                inc si
                inc di
                jmp x5


raise_alarm:
                mov dh,5h
                mov al,0fh
                out port_a2,al
                mov ax,0abcdh
end_69h:
ret
intm endp

asterisk proc
```

```
                mov al,2Ah
                out port_a1,al
                call DELAY_20ms
                mov al,05h
                out port_b1,al
                call DELAY_20ms
                mov al,01h
                out port_b1,al  ;prints *
ret
asterisk endp

clear_LCD proc
        mov al,00h
        out port_b1,al
        call DELAY_20ms
        mov al,01h                      ;Clear Display
        out port_a1,al
        call DELAY_20ms
        mov al,04h
        out port_b1,al
        call DELAY_20ms
        mov al,00h
        out port_b1,al
RET
clear_LCD endp

keypad_input proc                               ;SubR for keypad entry,al has unique
key input value.
x0:             mov al,00h
                out port_c1,al
x1:             in al, port_c1
                and al,0f0h
                cmp al,0f0h
                jnz x1
                CALL DELAY_20ms

                mov al,00h                              ; Check for key press
                out 04,al
x2:
                in al, port_c1
                and al,0F0h
                cmp al,0F0h
                jz x2
                CALL DELAY_20ms

                mov al,00h                      ; Check for key press
                out 04,al
                in al, port_c1
                and al,0F0h
                cmp al,0F0h
                jz x2

                mov al,0Eh                      ;Check for key press column 1
                mov bl,al
                out port_c1,al
                in al, port_c1
                and al,0f0h
                cmp al,0f0h
                jnz x3

                mov al,0Dh                      ;Check for key press column 2
                mov bl,al
                out port_c1,al
                in al, port_c1
                and al,0f0h
                cmp al,0f0h
                jnz x3

                mov al,0Bh                      ;Check for key press column 3
                mov bl,al
                out port_c1,al
                in al, port_c1
                and al,0f0h
                cmp al,0f0h
                jnz x3

                mov al,07h                              ;Check for key press column 4
                mov bl,al
                out port_c1,al
                in al,port_c1
                and al,0f0h
                cmp al,0f0h
                jz x2

x3:             or al,bl
ret
keypad_input endp

inta proc
        mov al,00eh
        out port_a2,al



        mov cx,14
        mov si,3ah                                      ;store the 16-bit entered pass
after the hard coded pass word
enter_14bit:
                call keypad_input
                cmp al,7eh
                jz pressc_alarm
                cmp al,0bbh
                jz nop_alarm
                cmp al,0b7h
                jz nop_alarm
                cmp al,7dh
                jz nop_alarm
                cmp al,7bh
                jz pressac_alarm
                cmp al,77h
                jz press_enter_alarm
```

```
            mov [si],al
            CALL asterisk
            inc si
            dec cx
            jnz enter_14bit
disp_enteralarm:
            call keypad_input
            cmp al,7eh
            jz pressc_alarm
            cmp al,7bh
            jz pressac_alarm
            cmp al,77h
            jz press_enter_alarm
asd2:       CALL clear_LCD
            CALL enter_LCD
            call keypad_input
            cmp al,77h
            jz press_enter_alarm
            jnz asd2
nop_alarm: nop
       jmp enter_14bit
pressc_alarm:
            call clear_1digit_LCD
            dec si
            inc cx
            jmp enter_14bit
pressac_alarm:
            call clear_LCD
            mov cx,14
            mov si,3ah                           ;start of pass segment
            jmp enter_14bit
press_enter_alarm:
            CALL clear_LCD
            mov al,0fh
            out port_a2,al
            cmp cx,0
            jz cmp_pass_alarm
```

```
                jnz x56
cmp_pass_alarm:
                cld
                mov si,10h
                mov di,3ah
                mov cx,14
                repe cmpsb
                cmp cx,00h
                jnz x56
                mov al,0ffh
                out port_a2,al
                add dh,1h
x56:
ret
inta endp



intu proc
                call clear_LCD
                mov dl,1                        ;flag for checking two inputs

                mov al,0feh
                out port_a2,al
                mov cx,12
                mov si,48h                      ;store the 12-bit entered pass
after the hard coded pass word
enter_12bitu:
                call keypad_input
                cmp al,7eh
                jz pressc_user
                cmp al,7bh
                jz pressac_user
                cmp al,0bbh
                jz nop_user
                cmp al,0b7h
                jz nop_user
                cmp al,7dh
                jz nop_user
                cmp al,77h
                jz press_enter_user
                mov [si],al
                CALL asterisk
                inc si
                dec cx
                jnz enter_12bitu
disp_enter_user:
                call keypad_input
                cmp al,7eh
                jz pressc_user
                cmp al,7bh
                jz pressac_user
                cmp al,77h
                jz press_enter_user
asd3:           CALL clear_LCD
                CALL enter_LCD
                call keypad_input
                cmp al,77h
                jz press_enter_user
                jnz asd3
nop_user:
                        nop
                        jmp enter_12bitu
pressc_user:
                call clear_1digit_LCD
                dec si
                inc cx
                jmp enter_12bitu
pressac_user:
                call clear_LCD
                mov cx,12
                mov si,48h                              ;start of pass segment
                jmp enter_12bitu
press_enter_user:
```

```
                mov al,0ffh
                out port_a2,al
                cmp cx,0
                jz cmp_pass_user
                jnz wrong_pass

cmp_pass_user:
                cld
                mov si,2eh
                mov di,48h
                mov cx,12
                repe cmpsb
                cmp cx,00h
                jnz wrong_pass
                jz open_door_user

wrong_pass :
                call clear_LCD
                mov si,48h
                mov cx,12
                cmp dl,0
                jz raise_alarm_user
                mov al,0fdh
                out port_a2,al
                call retry_msg
                call DELAY_max
                call DELAY_max
                call clear_LCD
                mov cx,12
                dec dl
                jmp enter_12bitu
raise_alarm_user:
                mov dh,0
                mov al,0fh
                out port_a2,al
                mov ax,0abcdh
                jmp end_70h
```

```
open_door_user:
                call open_door
end_70h:
ret
intu endp

ints proc

                call open_door

                ; CALL DELAY_0.04s
                ; mov al,00h
                ; out port_c2, al
ret
ints endp

open_door proc
        call clear_LCD
        mov al,8ah
        out port_b2,al

        call DELAY_20ms

        mov al,0ah
        out port_b2,al

x31:            in al, port_c2
                cmp al,0ffh
                jnz x31
                call DELAY_20ms
                call close_door
ret
open_door endp

close_door proc
        mov al,03h
        out port_b2,al
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max
        call DELAY_max


ret
close_door endp


welcome_msg proc
        mov al,0A0h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints Space

        mov al,0A0h
```

```
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,57h
out port_a1,al
```

```
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints W

mov al,45h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,4Ch
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints L

mov al,43h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints C

mov al,4Fh
out port_a1,al
call DELAY_20ms
```

```
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints O

        mov al,4dh
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints M

        mov al,45h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints E

ret
welcome_msg endp

update_msg proc
        mov al,55h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints U
```

```
mov al,50h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints P

mov al,44h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints D

mov al,41h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints A

mov al,54h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints T

mov al,45h
```

```
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,50h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints P

mov al,41h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints A

mov al,53h
out port_a1,al
```

```
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints S

mov al,53h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints S

mov al,57h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints W

mov al,4Fh
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints O

mov al,52h
out port_a1,al
call DELAY_20ms
```

```
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints R

        mov al,44h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints D

ret
update_msg endp

clear_1digit_LCD proc
        mov al,00h
        out port_b1,al
        call DELAY_20ms
        mov al,10h                      ;shift left by 1
        out port_a1,al
        call DELAY_20ms
        mov al,04h
        out port_b1,al
        call DELAY_20ms
        mov al,00h
        out port_b1,al

        mov al,0A0h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al                          ;prints Space

        call DELAY_20ms
        mov al,10h                      ;shift left by 1
        out port_a1,al
        call DELAY_20ms
        mov al,04h
        out port_b1,al
        call DELAY_20ms
        mov al,00h
        out port_b1,al

RET
clear_1digit_LCD endp

error_msg proc
        mov al,0A0h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints Space

        mov al,45h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints E

        mov al,4Eh
        out port_a1,al
```

```
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints N

mov al,54h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints T

mov al,45h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,52h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints R

mov al,0A0h
out port_a1,al
call DELAY_20ms
```

```
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,31h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints 1

mov al,32h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints 2

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,44h
out port_a1,al
call DELAY_20ms
mov al,05h
```

```
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints D

mov al,49h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints I

mov al,47h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints G

mov al,49h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints I

mov al,54h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
```

```
    call DELAY_20ms
    mov al,01h
    out port_b1,al  ;prints T

    mov al,53h
    out port_a1,al
    call DELAY_20ms
    mov al,05h
    out port_b1,al
    call DELAY_20ms
    mov al,01h
    out port_b1,al  ;prints S
RET
error_msg endp

retry_msg proc
    mov al,0A0h
    out port_a1,al
    call DELAY_20ms
    mov al,05h
    out port_b1,al
    call DELAY_20ms
    mov al,01h
    out port_b1,al  ;prints Space

    mov al,0A0h
    out port_a1,al
    call DELAY_20ms
    mov al,05h
    out port_b1,al
    call DELAY_20ms
    mov al,01h
    out port_b1,al  ;prints Space

    mov al,0A0h
    out port_a1,al
    call DELAY_20ms
```

```
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,0A0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,52h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints R

mov al,45h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,54h
out port_a1,al
call DELAY_20ms
mov al,05h
```

```
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints T

        mov al,52h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints R

        mov al,59h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints Y

ret
retry_msg endp


updateday_msg proc
        mov al,55h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints U
```

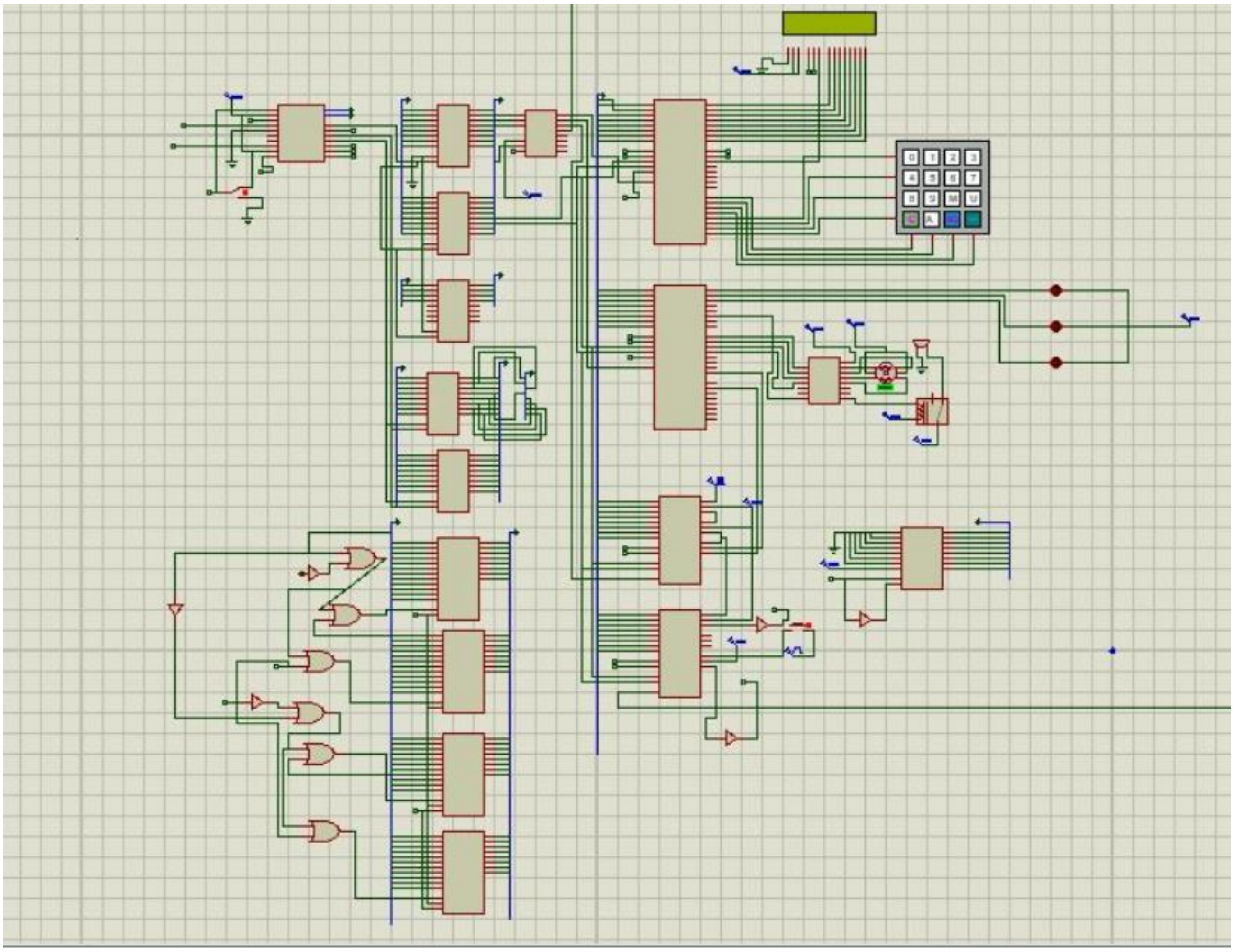
```
mov al,50h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints P

mov al,44h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints D

mov al,41h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints A

mov al,54h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints T

mov al,45h
```

```
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints E

mov al,0a0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,44h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints D

mov al,41h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints A

mov al,59h
out port_a1,al
```

```
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Y

mov al,0a0h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints Space

mov al,50h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al ;prints P

mov al,41h
out port_a1,al
call DELAY_20ms
mov al,05h
out port_b1,al
call DELAY_20ms
mov al,01h
out port_b1,al  ;prints A

mov al,53h
out port_a1,al
call DELAY_20ms
```

```
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints S

        mov al,53h
        out port_a1,al
        call DELAY_20ms
        mov al,05h
        out port_b1,al
        call DELAY_20ms
        mov al,01h
        out port_b1,al  ;prints S
ret
updateday_msg endp

Nmi_24hrtimer:
                                call clear_LCD
                                call clear_1digit_LCD
                                call updateday_msg
startnmi:

                call keypad_input
                cmp al,0bbh; Check for 'M'
                jz master_Mode
                jmp startnmi

 iret
 Switch_intR:
        call open_door
        sti
        cmp bp,0abcdh
        jz x6
        jnz start
```

Complete Circuit Diagram



References

- A 16x2 LCD display has been used. Following links were referred to understand its working:

  http://www.alldatasheet.com/view.jsp?Searchword=LMO16L
  http://www.sakshieducation.com/Engineering/Story.aspx?cid=12&nid=96054

- A 4x4 hex keypad has also been used.

  http://www.futurlec.com/Keypad4x4.shtml

- A stepper motor and a Darlington transistor has been used.

  https://www.youtube.com/watch?v=8aLkXsh1O44
  https://www.engineersgarage.com/electronic-components/ul n2003-datasheet