# Fan Speed Sensing and Control

Hardware Design and Assembly Level Program

TEAM MEMBERS

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## PROBLEM STATEMENT:

This system senses the speed at which the fan is rotating and adjusts the speed, based on the user input. The user can select three different speeds of the fan. The current speed should be sensed and the control mechanism should gradually increase the speed to the desired speed.
User Interface:
1. Fan starts when user presses 'Start' button.
2. User can then set the required speed by using a keypad interface. This speed value should be displayed on the display.
3. After setting speed initially, user should be able to change the fan speed setting by an up and down switch. Each press on this arrow button increases/ decreases the speed by 1 unit. Min speed value is 1, whereas maximum speed value is 5 Units. Pressing 'UP' button after reaching to value 5, should not change the display value or setting of fan speed. Same is true for lower bound.
4. Fan can be stopped by pressing 'Stop' button.
5. User can also set the mode of fan as 'Auto' mode besides a 'Regular mode' setting.
In Auto mode, user should be able to enter the value of time in terms of hours after which the fan has to be switched off automatically. (For example, if value entered is 2, then the fan should switch off after 2 hours from the time this setting is applied.

## ASSUMPTIONS:

1) CLK pin of the micro-processor is connected to a reliable clock generator to produce waveform of suitable frequency.
2) User can start the fan only by pressing the start button. No other key will function until the fan has been started.
3) The fan starts at speed 1 on press of the start button.
4) Pressing the start button after the fan has started results in no change of the system state.
5) Auto mode allows users to enter numbers from 0 to 3. (Can be extended)
6) After time in auto mode has lapsed, user can move to regular mode by pressing the auto button again or by pressing stop followed by start.
7) Stop time (in hours) has to be set before the auto key has been pressed.
8) Fan speed can be set only once using keys numbered 1-5 after the fan has been switched on.

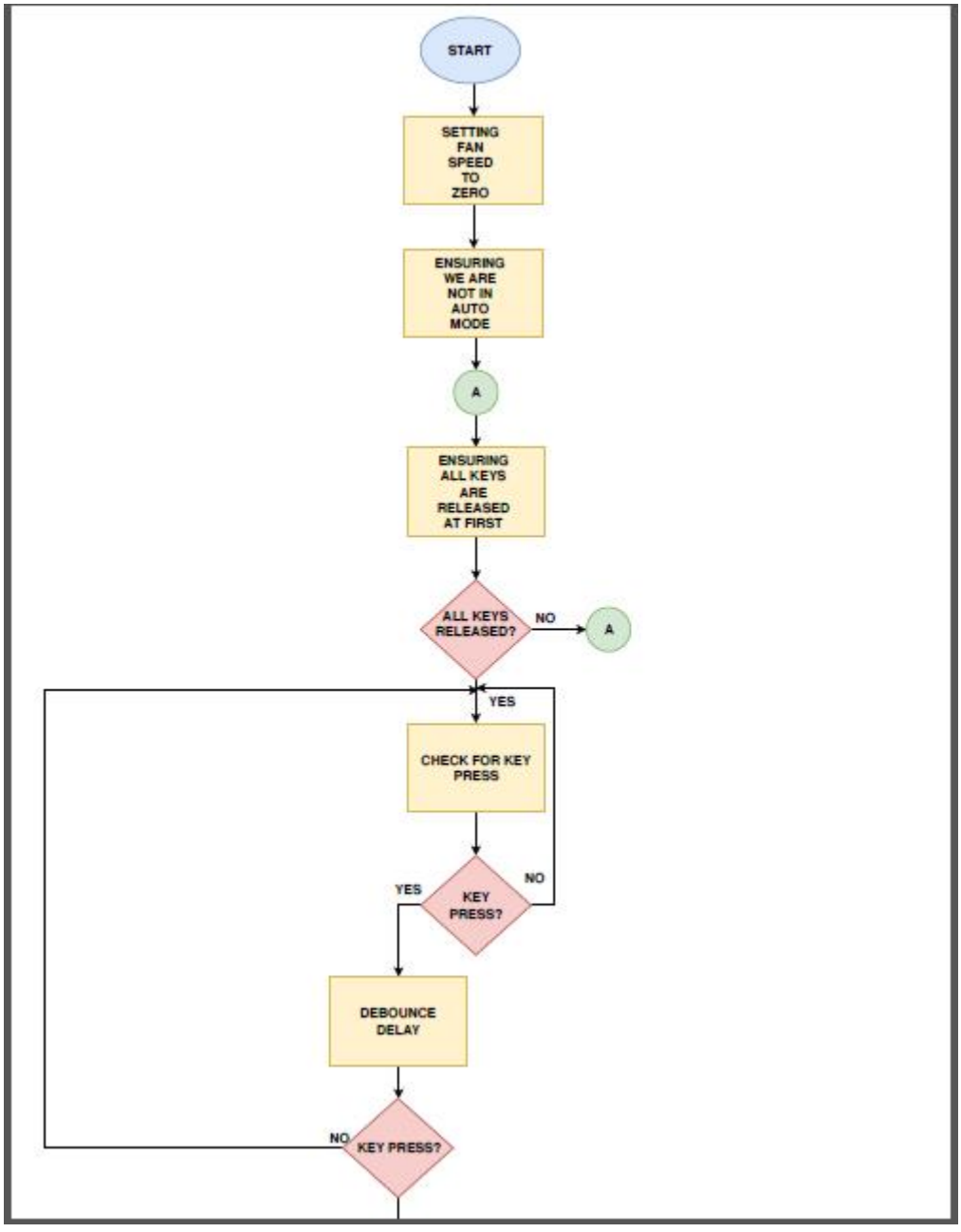
## List of components used:

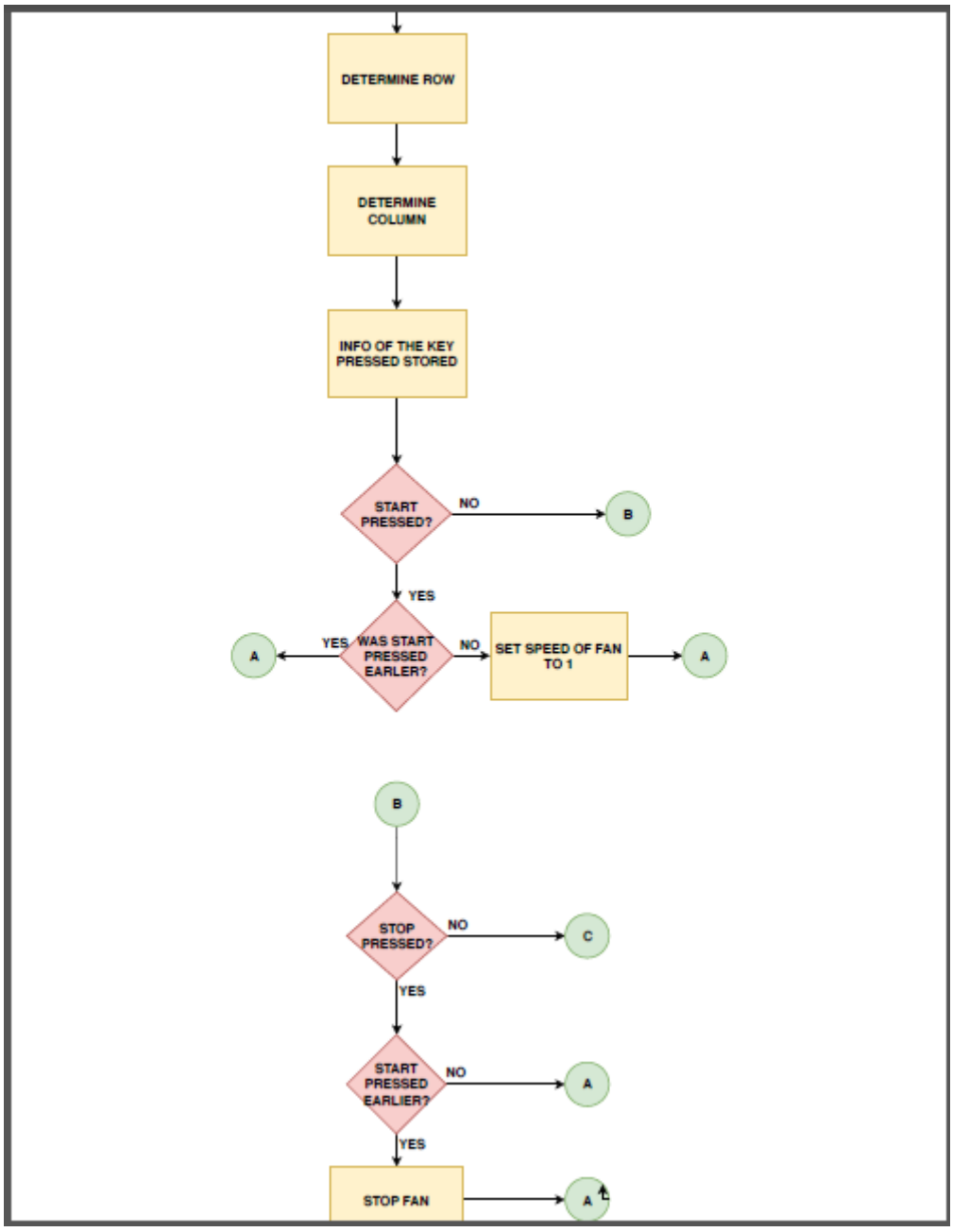
1) 8086 Micro-Processor = 1
2) 74LS373 Octal Latches = 3
3) 8255A Programmable Peripheral Interfacing Device = 2
4) 74LS107 J-K flip flops = 3
5) 7SEG-BCD Display = 2
6) DAC_8 Digital to Analog Converter = 1
7) DC Fan = 1
8) Push Button Switches = 11
9) 74LS245 Bi-Directional Buffer = 2
10) 74LS244 Unidirectional Buffer=1
11) 2732 ROM Chips (4KB each) = 2
12) 6116 RAM Chips (2KB each) = 2
13) OR Gates = 12
14) NOT Gates = 4
15) NAND Gates = 1
16) AND Gates = 9
17) 8253A Clock generator
18) Ground Terminal = as required
19) DC Voltage Sources = as required
20) Buses = as required

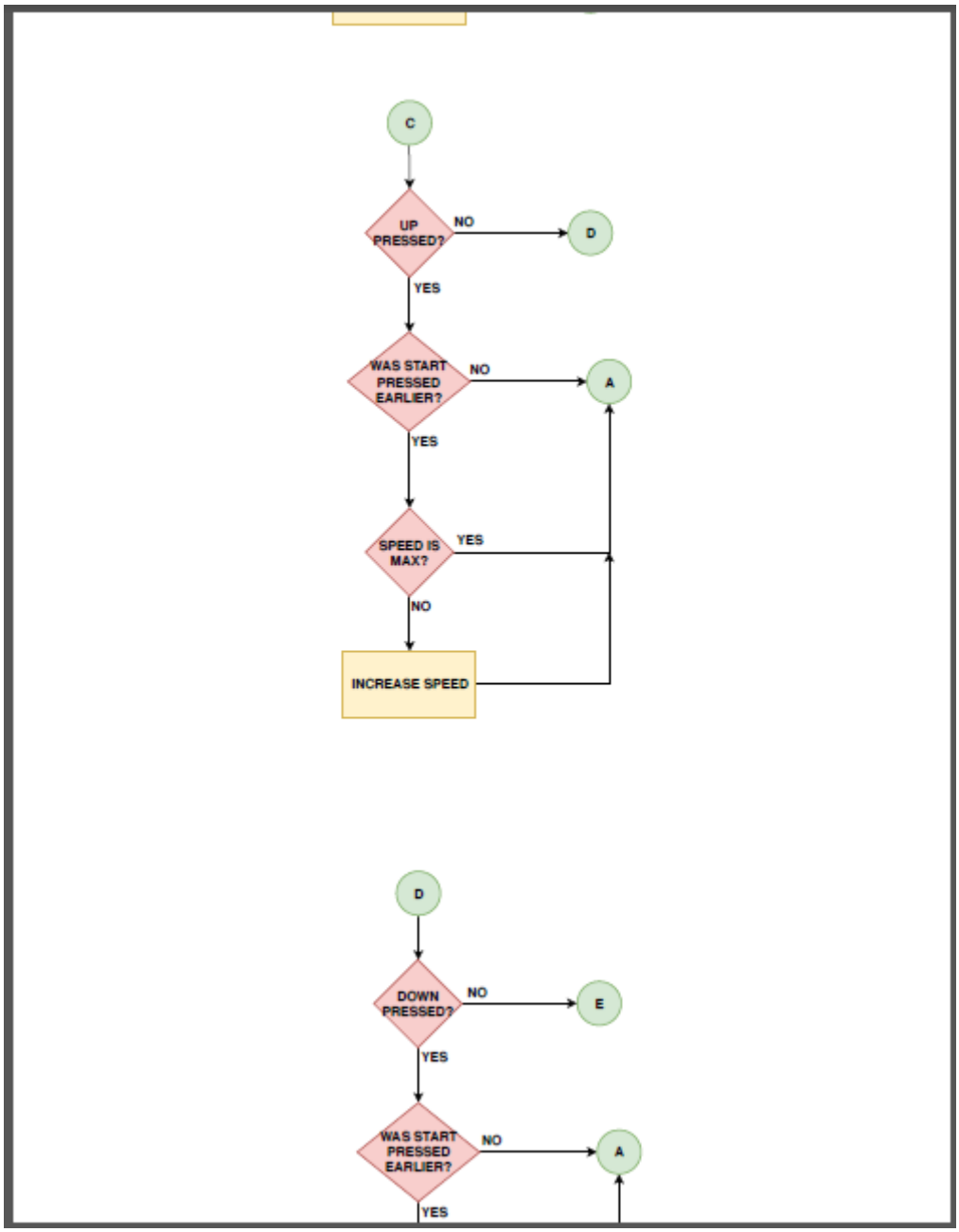
## Complete address mapping of memory and I/O devices:

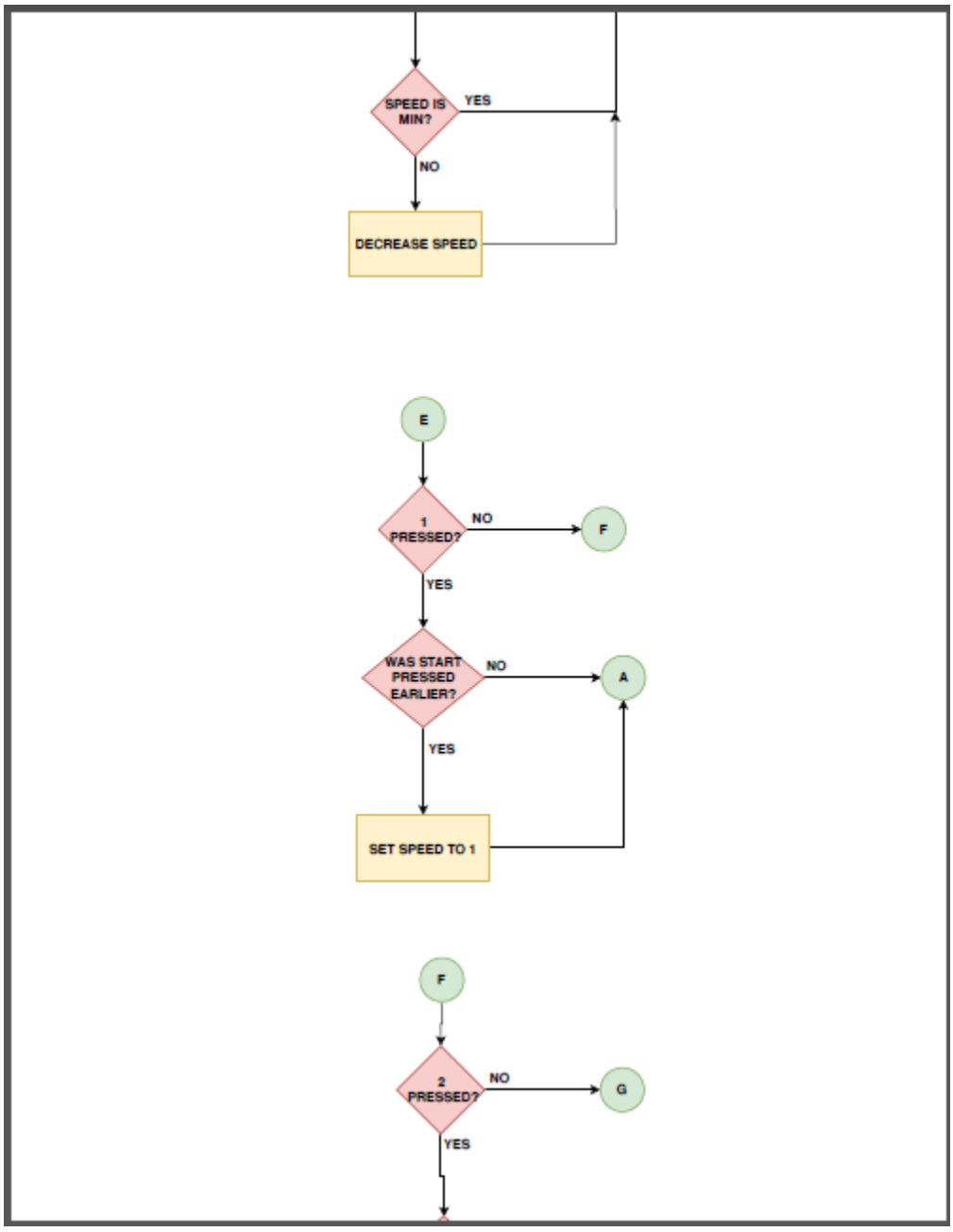
| Component | Address Mapping | Details |
|---|---|---|
| ROM | 00000H-01FFFH | 8KB ROM USING TWO 4KB CHIPS (EVEN AND ODD BANK) |
| RAM | 02000H-02FFFH | 4KB RAM USING TWO 2KB CHIPS(EVEN AND ODD BANK) |
| PORT A (8255-(1)) | 00H | OUTPUT(DC FAN) |
| PORT B (8255-(1)) | 02H | CONTROL SIGNALS(clock, reset) |
| PORT C (8255-(1)) | 04H | KEYPAD |
| CONTROL REGISTER (8255-(1)) | 06H | FOR LOADING CONTROL WORD |
| COUNTER 0 (8253) | 08H | USED FOR COUNTER 0 |
| CONTROL REGISTER(8253) | 0EH | FOR LOADING CONTROL WORD |
| PORT A (8255-(2)) | 10H | TIME INPUT |
| PORT B (8255-(2)) | 12H | UNUSED |
| PORT C (8255-(2)) | 14H | UNUSED |
| CONTROL REGISTER (8255-(2)) | 16H | FOR LOADING CONTROL WORD |

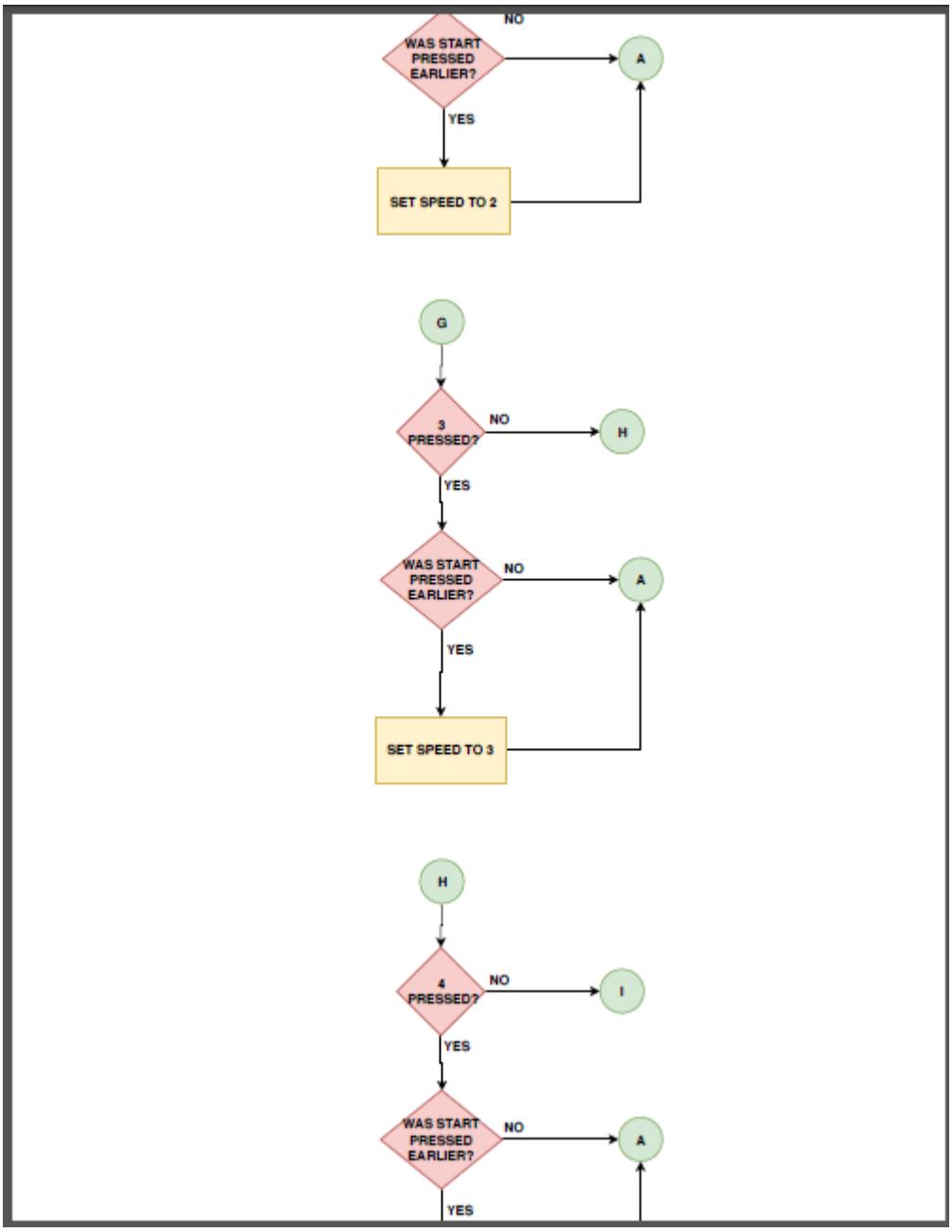
# FLOWCHART

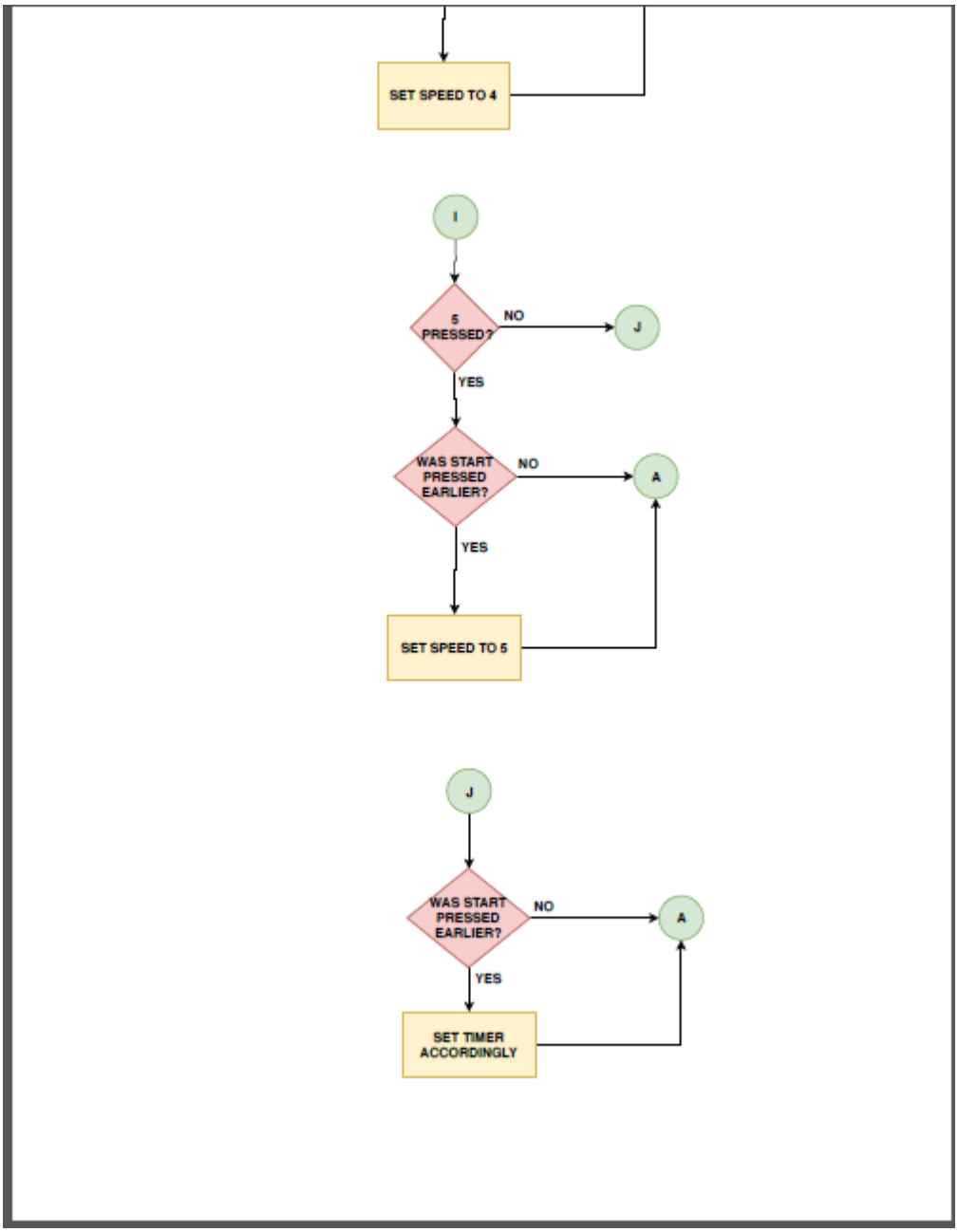

START
SETTING FAN SPEED TO ZERO
ENSURING WE ARE NOT IN AUTO MODE
A
ENSURING ALL KEYS ARE RELEASED AT FIRST
ALL KEYS RELEASED?
NO
A
YES
CHECK FOR KEY PRESS
KEY PRESS?
YES
NO
DEBOUNCE DELAY
KEY PRESS?
NO


DETERMINE ROW
DETERMINE COLUMN
INFO OF THE KEY PRESSED STORED
START PRESSED?
NO
B
YES
A
YES
WAS START PRESSED EARLER?
NO
SET SPEED OF FAN TO 1
A
B
STOP PRESSED?
NO
C
YES
START PRESSED EARLIER?
NO
A
YES
STOP FAN
A


C
UP PRESSED?
NO
D
YES
WAS START PRESSED EARLIER?
NO
A
YES
SPEED IS MAX?
YES
NO
INCREASE SPEED
D
DOWN PRESSED?
NO
E
YES
WAS START PRESSED EARLIER?
NO
A
YES


SPEED IS MIN?
YES
NO
DECREASE SPEED
E
1 PRESSED?
NO
F
YES
WAS START PRESSED EARLIER?
NO
A
YES
SET SPEED TO 1
F
2 PRESSED?
NO
G
YES


NO
WAS START PRESSED EARLIER?
A
YES
SET SPEED TO 2
G
3 PRESSED?
NO
H
YES
WAS START PRESSED EARLIER?
NO
A
YES
SET SPEED TO 3
H
4 PRESSED?
NO
I
YES
WAS START PRESSED EARLIER?
NO
A
YES


SET SPEED TO 4
I
5 PRESSED?
NO
J
YES
WAS START PRESSED EARLIER?
NO
A
YES
SET SPEED TO 5
J
WAS START PRESSED EARLIER?
NO
A
YES
SET TIMER ACCORDINGLY

## CODE:

```
.MODEL TINY
.8086
.DATA
        PORT_FAN EQU 00H
        PORT_B EQU 02H
        PORT_KEYPAD EQU 04H
        PORT_CREG1 EQU 06H
        PORT_TIMER EQU 08H
        PORT_CREG2 EQU 0EH
        PORT_TIME EQU 10H
        PORT_CREG3 EQU 16H
        SPEED0 EQU 00H
        SPEED1 EQU 3FH
        SPEED2 EQU 5FH
        SPEED3 EQU 7FH
        SPEED4 EQU 9FH
        SPEED5 EQU 0BFH
        DAT DB 'A' , 'B' , 'C' , 'D' , 'E' , 'F' , 'G' , 'H' , 'I' , 'J'
.CODE
.STARTUP
```

```
MOV AL , 81H                    ;INITIALISING 8255(1)
OUT PORT_CREG1 , AL

MOV AL , SPEED0                 ;SETTING FAN SPEED 0 ON
OUT PORT_FAN , AL

MOV AL , 0FDH                   ;ENSURING WE ARE NOT IN AUTO
                                                    MODE
OUT PORT_B , AL

MOV AL , 0FFH
OUT PORT_B , AL

MOV AL , 30H                    ;INITIALISING 8253
OUT PORT_CREG2 , AL

MOV AL , 9BH                    ;INITIALISING 8255(2)
OUT PORT_CREG3 , AL

    MOV BL , 00H                ;BL CONTAINS INFORMATION
                                                ABOUT FAN SPEED.
                                ;SETTING CURRENT SPEED OF 0
```

```
        MOV DL , 00H                ;DL CONTAINS INFORMATION IF
                                    START HAS BEEN PRESSED YET.
                                    DL = 0 IMPLIES START HAS NOT
                                    YET BEEN PRESSED.

L0:                                 ;KEYPAD INPUT
    X1: MOV AL , 00H                ;CHECKING ALL KEYS ARE
                                    RELEASED
        OUT PORT_KEYPAD , AL
        IN AL , PORT_KEYPAD
        AND AL , 0FH
        CMP AL , 0FH
        JNZ X1
X2:     MOV AL , 00H                ;READING KEYPAD
        OUT PORT_KEYPAD , AL
        IN AL , PORT_KEYPAD
        AND AL , 0FH
        CMP AL , 0FH
        JZ X2
        MOV CX , 1100               ;DEBOUNCE DELAY
        A9: LOOP A9
        MOV AL , 00H
        OUT PORT_KEYPAD , AL
```

```
        IN AL , PORT_KEYPAD
        AND AL , 0FH
        CMP AL , 0FH
        JZ X2
      MOV SI , OFFSET DAT          ;GIVEN THE KEY PRESS FIGURING
                                    OUT THE EXACT KEY
        CMP AL , 0DH
        JNZ X3
        ADD SI , 4
        JMP X5
X3: CMP AL , 0EH
        JNZ X5
        ADD SI , 8
X5:     MOV AL , 7FH
        OUT PORT_KEYPAD , AL
        IN AL , PORT_KEYPAD
        AND AL , 0FH
        CMP AL , 0FH
        JZ X6
        MOV AL , [SI]
        JMP L1
X6:     MOV AL , 0BFH
        OUT PORT_KEYPAD , AL
```

```
        IN AL , PORT_KEYPAD
        AND AL , 0FH
        CMP AL , 0FH
        JZ X7
        MOV AL , [SI+1]
        JMP L1
X7:     MOV AL , 0DFH
        OUT PORT_KEYPAD , AL
        IN AL , PORT_KEYPAD
        AND AL , 0FH
        CMP AL , 0FH
        JZ X8
        MOV AL , [SI+2]
        JMP L1
X8: MOV AL , [SI+3]

L1:     CMP AL , 'A'                    ;IF START IS PRESSED
        JNZ L2
        CMP DL , 0
        JNZ L0
        MOV BL , SPEED1
        MOV AL , BL
        OUT PORT_FAN , AL
```

```
        MOV DL , 1                          ;TELLING START HAS BEEN
                                                PRESSED

        MOV AL , 0FDH
        OUT PORT_B , AL
        MOV CX , 1100
        A8: LOOP A8
        MOV AL , 0FFH
        OUT PORT_B , AL
        JMP L0

L2: CMP AL , 'B'                    ;IF STOP HAS BEEN PRESSED
        JNZ L3
        CMP DL , 0
        JZ L0
        MOV BL , SPEED0
        MOV AL , BL
        OUT PORT_FAN , AL
          MOV DL , 0                        ;TELLING STOP HAS BEEN
                                                PRESSED

        MOV AL , 0FDH
        OUT PORT_B , AL
        MOV CX , 1100
        A7: LOOP A7
```

```
        MOV AL , 0FFH
        OUT PORT_B , AL
        JMP L0

L3:     CMP AL , 'C'                    ;IF UP IS PRESSED
        JNZ L4
        CMP DL , 0
        JZ L0
        CMP BL , SPEED5                 ;CHECKING IF SPEED
                                                IS ALREADY 5
        JZ L0
        ADD BL , 20H
        MOV AL , BL
        OUT PORT_FAN , AL
        JMP L0

L4:     CMP AL , 'D'                    ;IF DOWN IS PRESSED
        JNZ L5
        CMP DL , 0
        JZ L0
        CMP BL , SPEED1                 ;CHECKING IF SPEED
                                                IS ALREADY 1
        JZ L0
```

```
        SUB BL , 20H
        MOV AL , BL
        OUT PORT_FAN , AL
        JMP L0

L5:     CMP AL , 'E'                    ;IF 1 IS PRESSED
        JNZ L6
        CMP DL , 0
        JZ L0
        MOV BL , SPEED1
        MOV AL , BL
        OUT PORT_FAN , AL
        JMP L0

L6:     CMP AL , 'F'                    ;IF 2 IS PRESSED
        JNZ L7
        CMP DL , 0
        JZ L0
        MOV BL , SPEED2
        MOV AL , BL
        OUT PORT_FAN , AL
        JMP L0
```

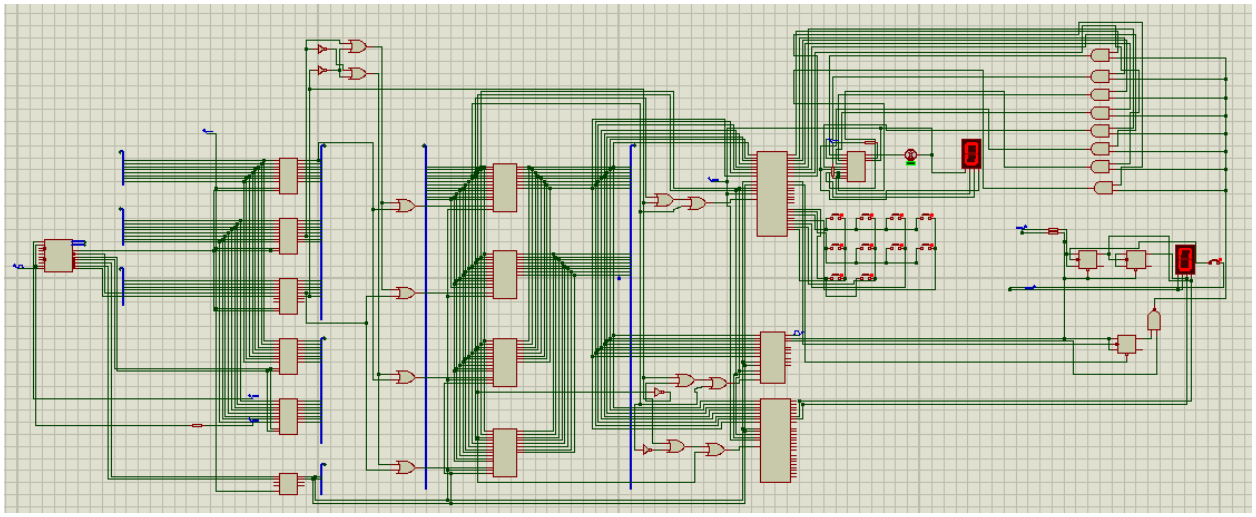
```
L7:   CMP AL , 'G'                    ;IF 3 IS PRESSED
      JNZ L8
      CMP DL , 0
      JZ L0
      MOV BL , SPEED3
      MOV AL , BL
      OUT PORT_FAN , AL
      JMP L0

L8:   CMP AL , 'H'                    ;IF 4 IS PRESSED
      JNZ L9
      CMP DL , 0
      JZ L0
      MOV BL , SPEED4
      MOV AL , BL
      OUT PORT_FAN , AL
      JMP L0

L9:   CMP AL , 'I'                    ;IF 5 IS PRESSED
      JNZ L10
      CMP DL , 0
      JZ L0
      MOV BL , SPEED5
```

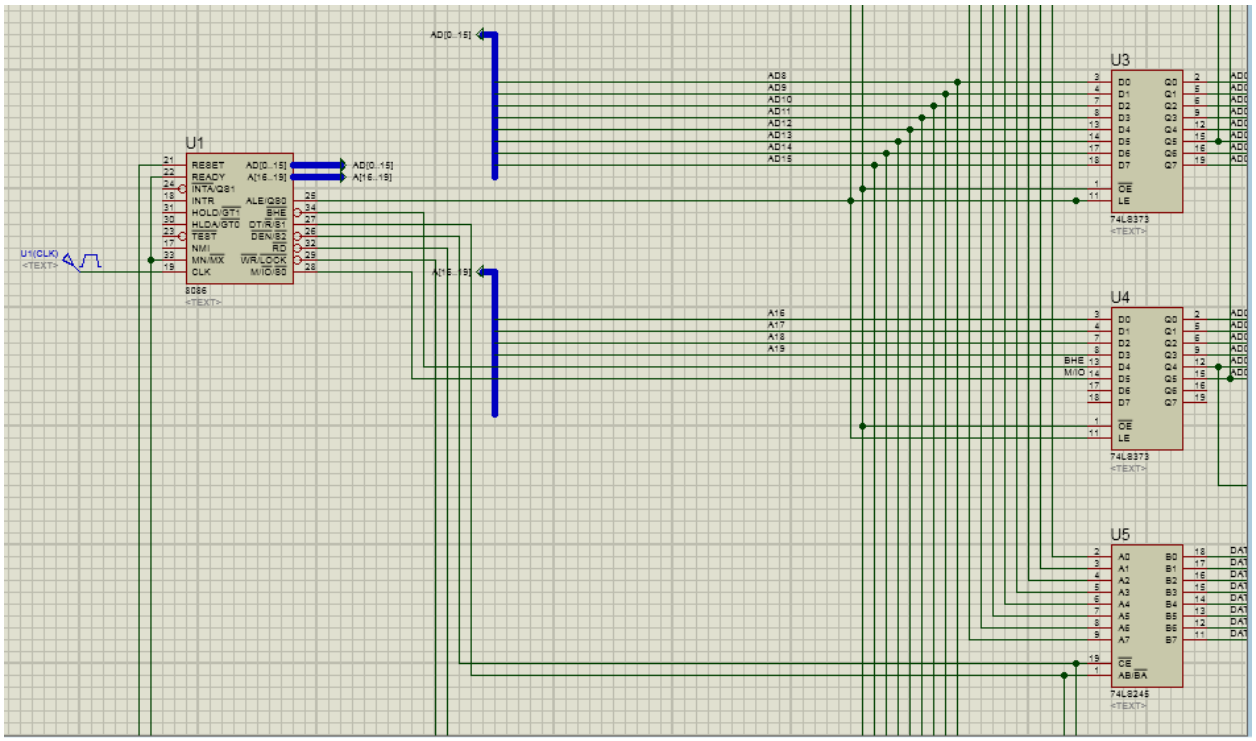
```
        MOV AL , BL
        OUT PORT_FAN , AL
        JMP L0

L10:CMP DL , 00H                    ;IF AUTO IS PRESSED
        JZ L0
        IN AL , PORT_TIME
        AND AL , 60H
        CMP AL , 00H
        JNZ L11
        MOV AX , 0001H
        OUT PORT_TIMER , AL
        MOV AL , AH
        OUT PORT_TIMER , AL
        MOV AL , 0FEH
        OUT PORT_B , AL
        MOV CX , 1100
        A6: LOOP A6
        MOV AL , 0FFH
        OUT PORT_B , AL
        JMP L0
L11:CMP AL , 20H
        JNZ L12
```

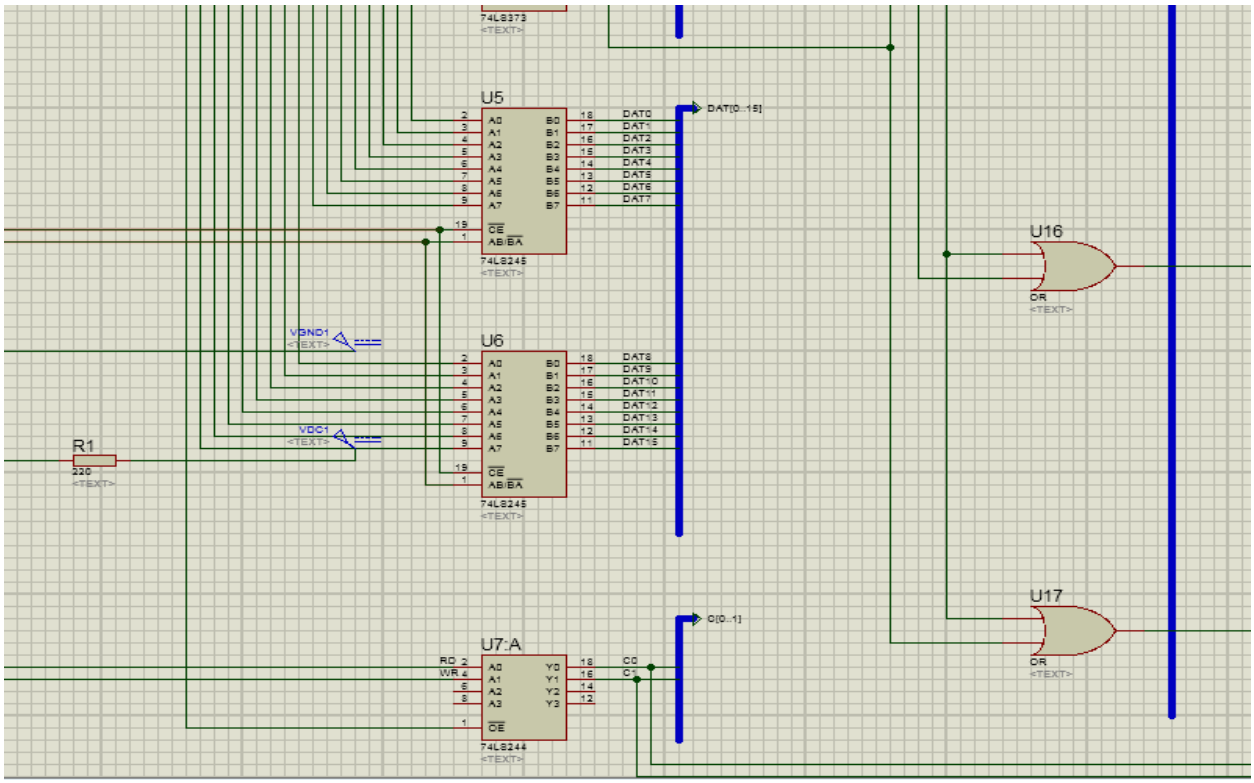
```
        MOV AX , 3600
        OUT PORT_TIMER , AL
        MOV AL , AH
        OUT PORT_TIMER , AL
        MOV AL , 0FEH
        OUT PORT_B , AL
        MOV CX , 1100
        A5: LOOP A5
        MOV AL , 0FFH
        OUT PORT_B , AL
        JMP L0
L12:CMP AL , 40H
        JNZ L13
        MOV AX , 7200
        OUT PORT_TIMER , AL
        MOV AL , AH
        OUT PORT_TIMER , AL
        MOV AL , 0FEH
        OUT PORT_B , AL
        MOV CX , 1100
        A4: LOOP A4
        MOV AL , 0FFH
        OUT PORT_B , AL
```

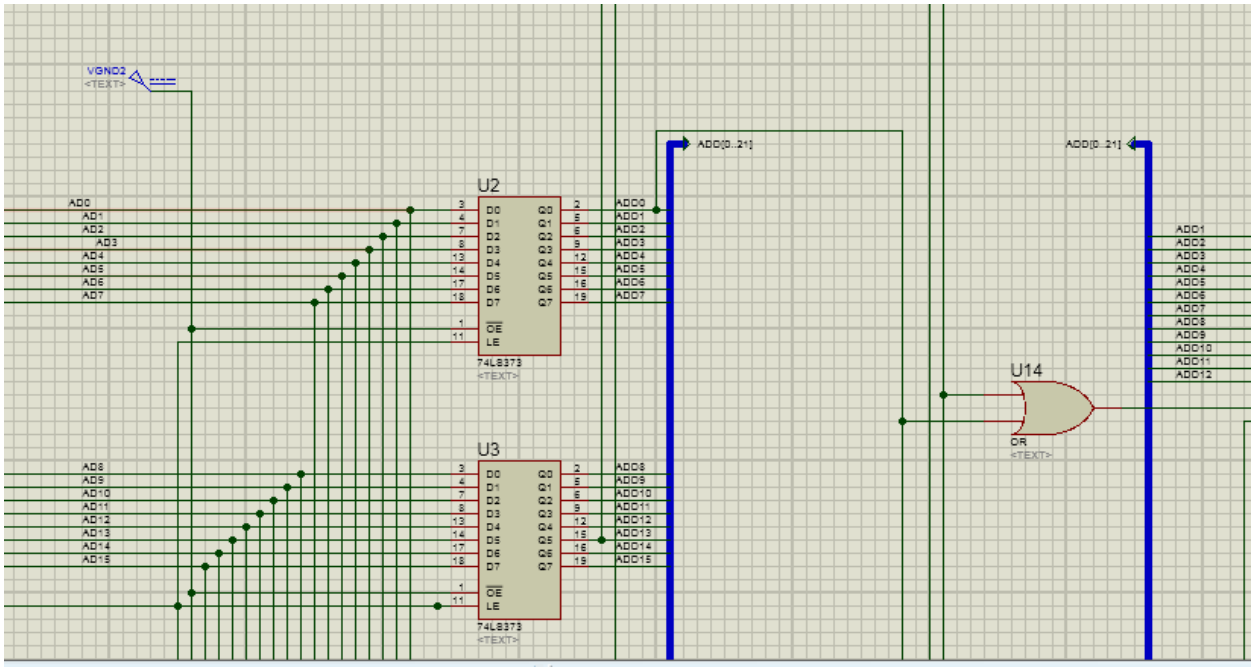
```
        JMP L0
L13:MOV AX , 10800
        OUT PORT_TIMER , AL
        MOV AL , AH
        OUT PORT_TIMER , AL
        MOV AL , 0FEH
        OUT PORT_B , AL
        MOV CX , 1100
        A3: LOOP A3
        MOV AL , 0FFH
        OUT PORT_B , AL
        JMP L0


.EXIT
END
```

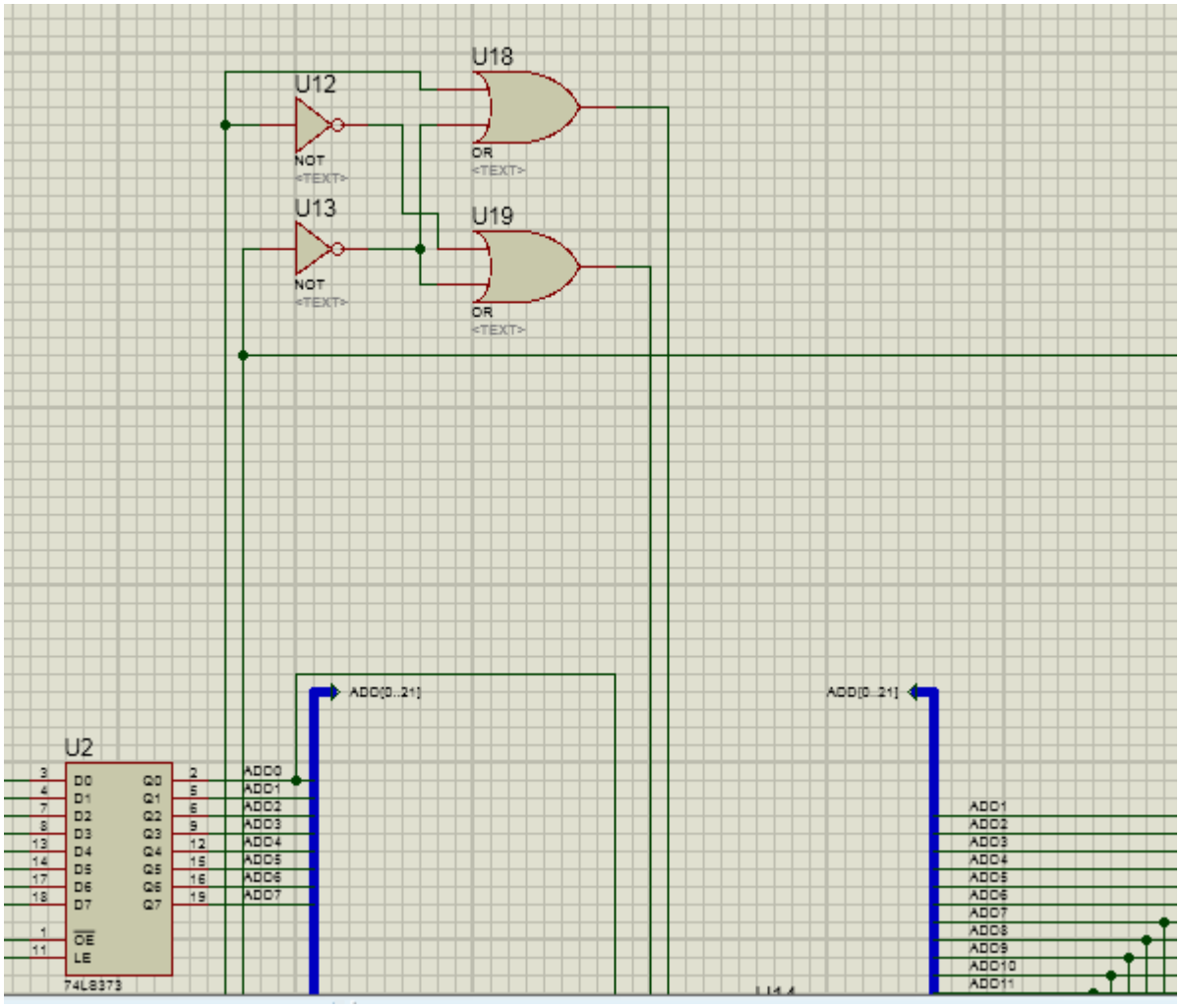
# SCREENSHOTS OF CIRCUIT:

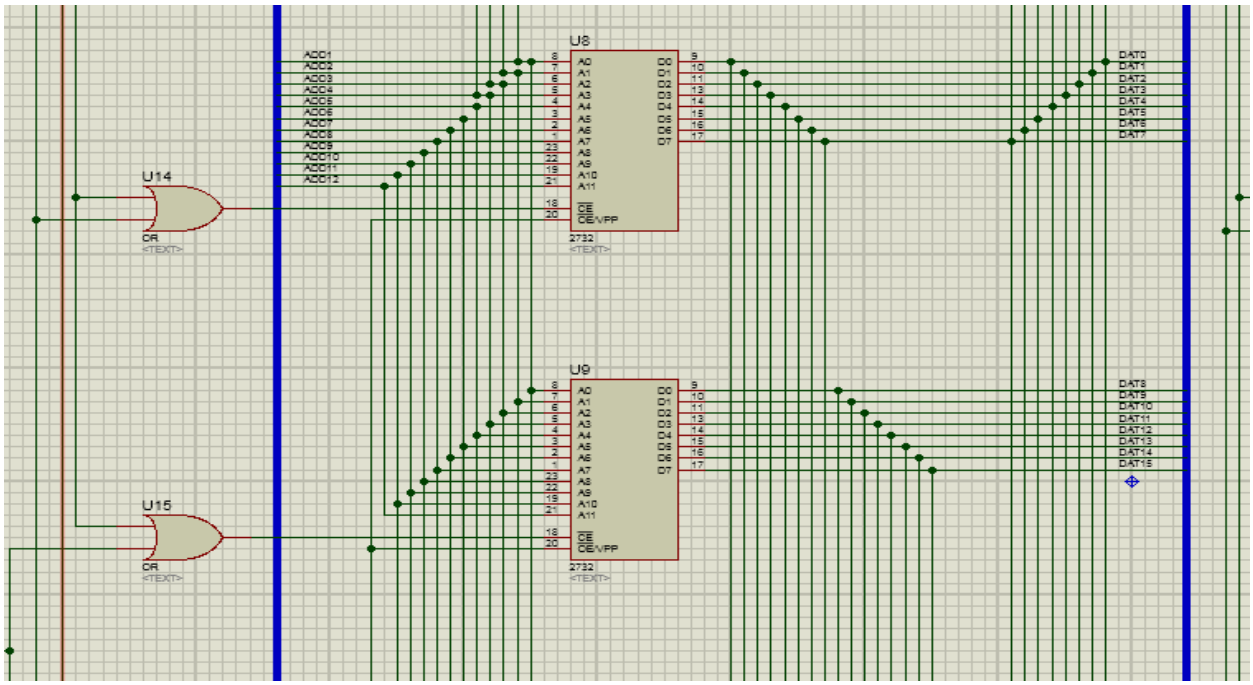


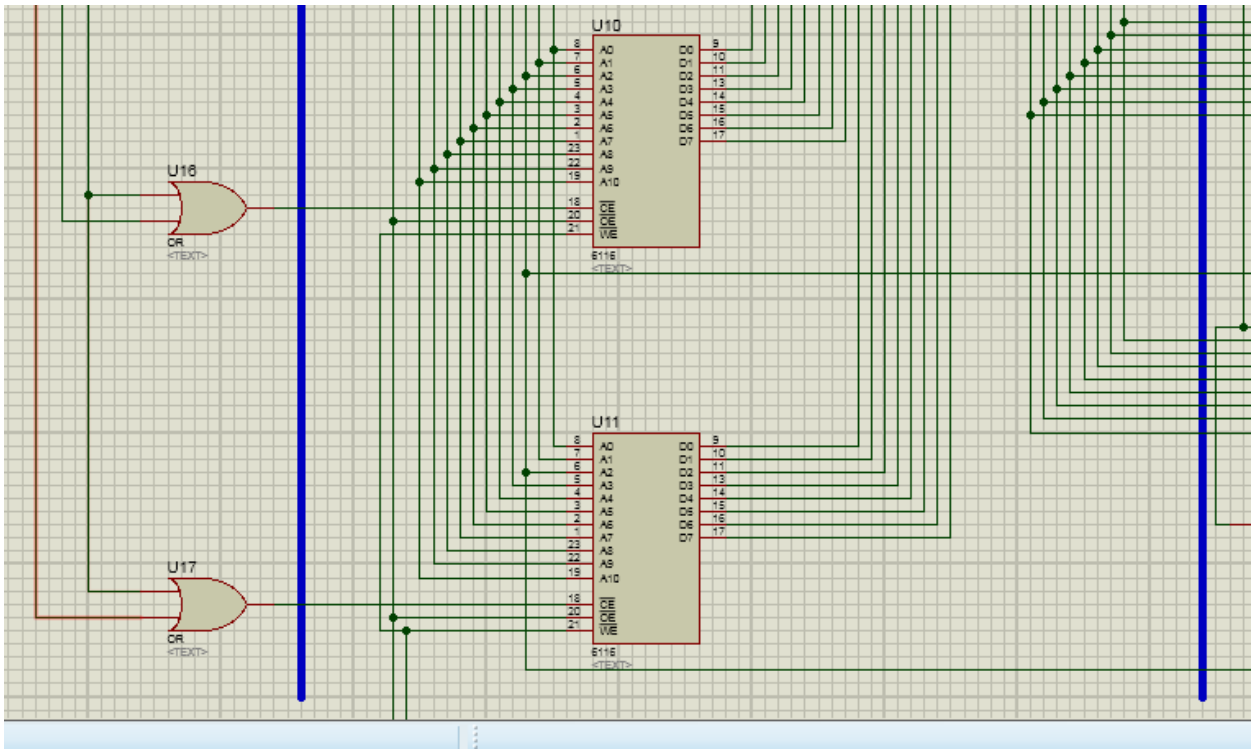


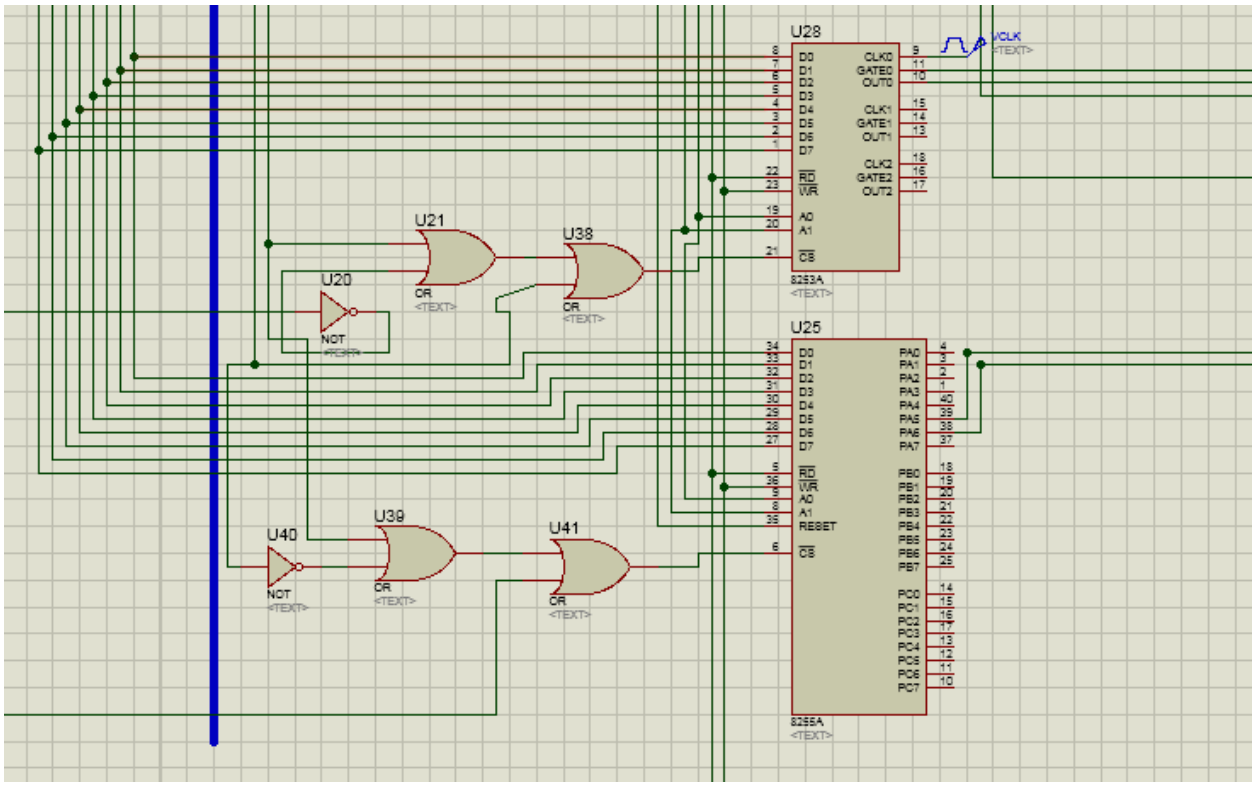

74LS373
U5
DAT[0..15]
DAT0
DAT1
DAT2
DAT3
DAT4
DAT5
DAT6
DAT7
74LS245
U16
OR
VGND1
U6
DAT8
DAT9
DAT10
DAT11
DAT12
DAT13
DAT14
DAT15
VDC1
R1
220
U17
O[0..1]
U7:A
RD
WR
CO
74LS244

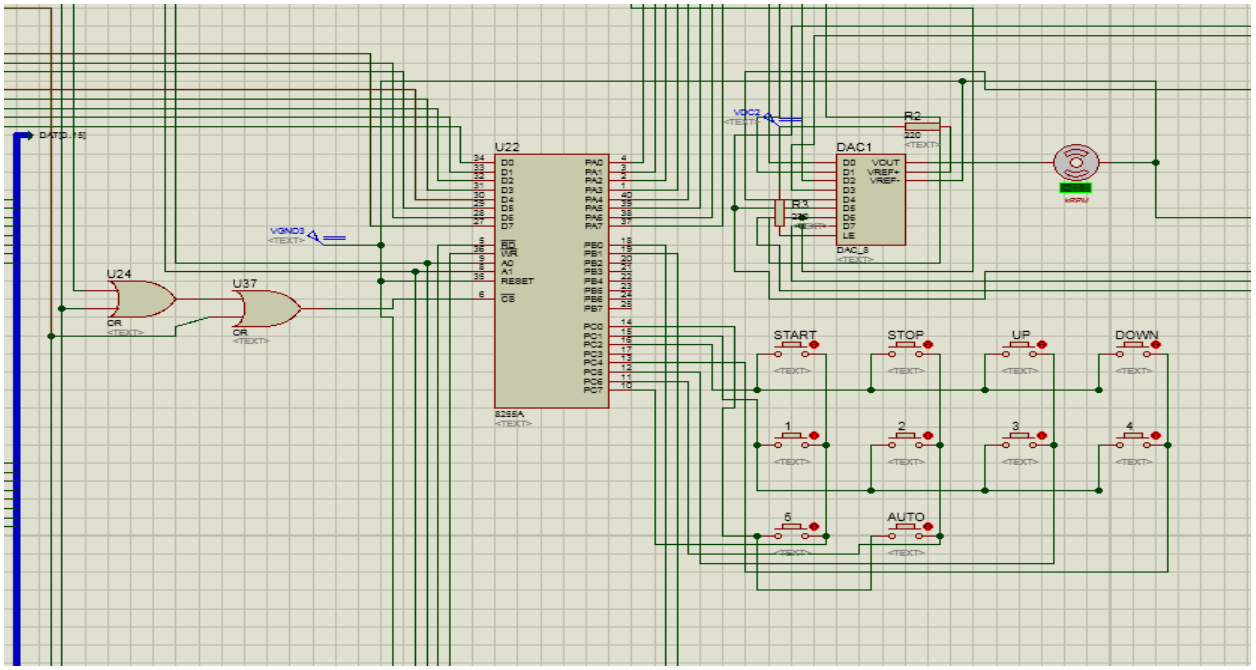

VGND2
ADD[0..21]
U2
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
74LS373
U14
OR
U3
AD8
AD9
AD10
AD11
AD12
AD13
AD14
AD15

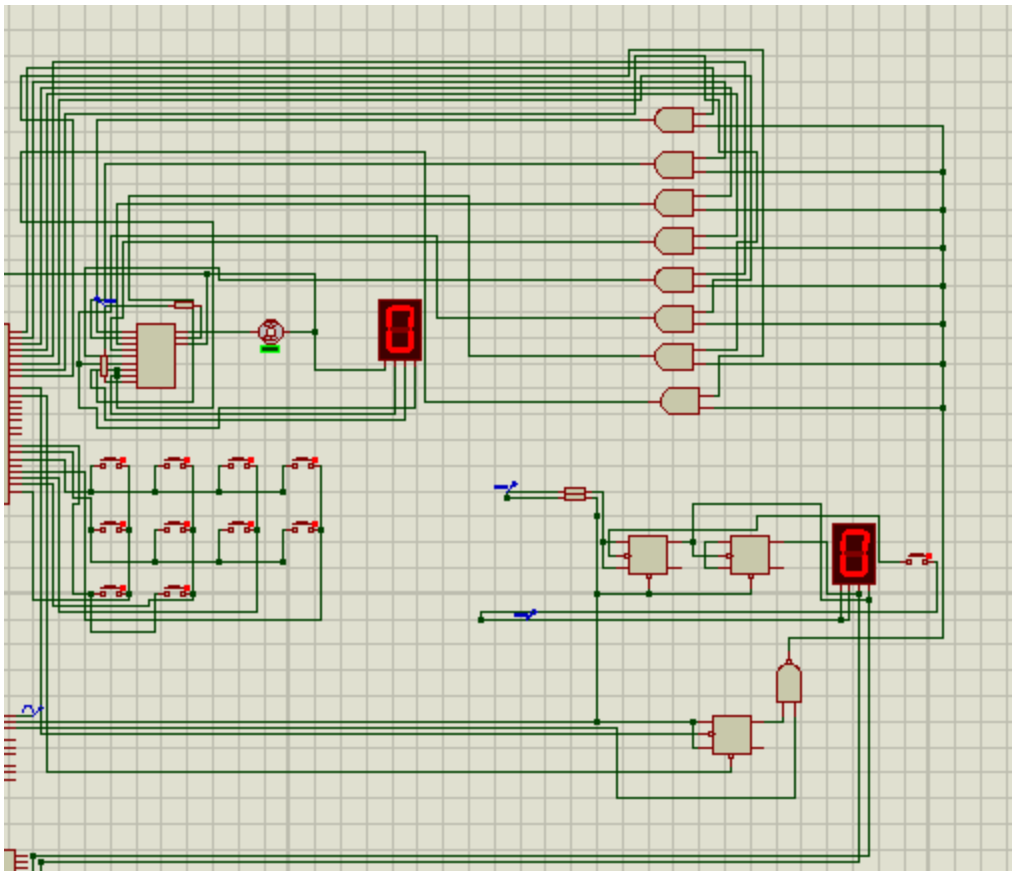

U18
U12
NOT
<TEXT>
OR
<TEXT>
U13
U19
NOT
<TEXT>
OR
<TEXT>
ADD[0..21]
ADD[0..21]
U2
D0
D1
D2
D3
D4
D5
D6
D7
OE
LE
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
ADD0
ADD1
ADD2
ADD3
ADD4
ADD5
ADD6
ADD7
74LS373
ADD1
ADD2
ADD3
ADD4
ADD5
ADD6
ADD7
ADD8
ADD9
ADD10
ADD11

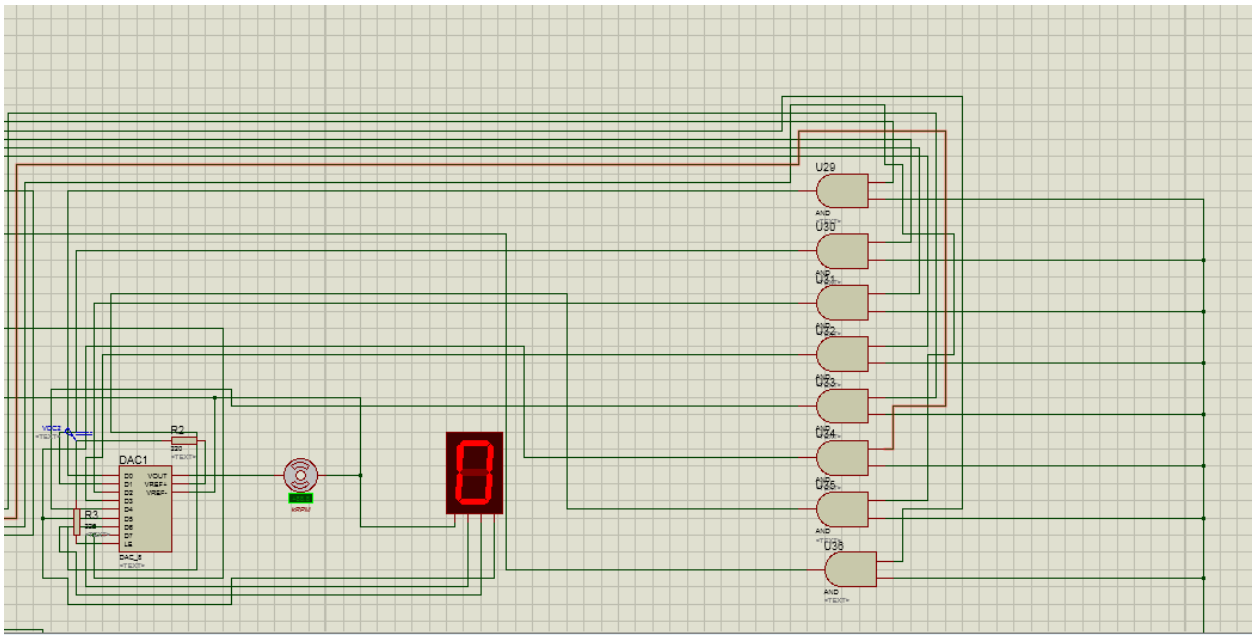

U8
U9
U14
U15
2732
OR


U10
U11
U16
U17
5116
OR

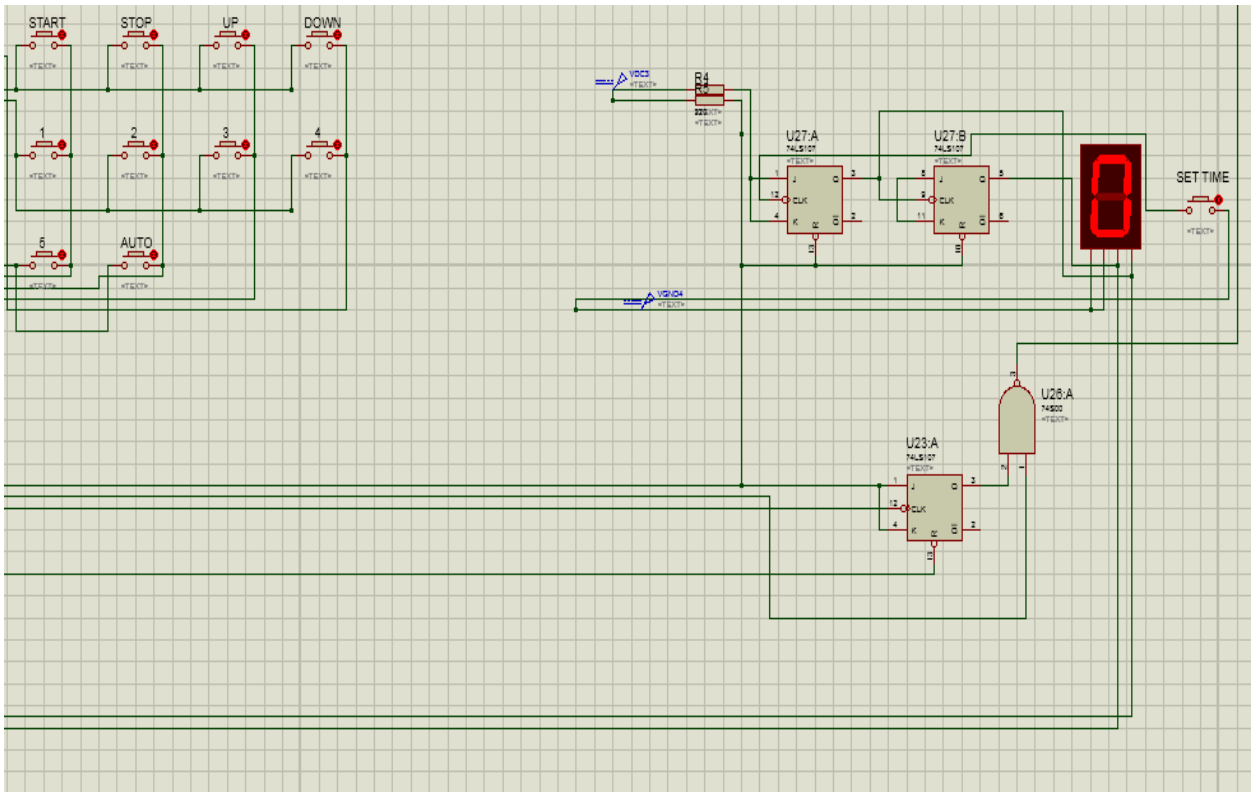

U28
8253A
U25
8255A
U21
U38
U20
U40
U39
U41
NOT
OR
VCLK


U22
8255A
U24
U37
DAC1
DAC_8
R2
R3
START
STOP
UP
DOWN
AUTO
1
2
3
4
5
6




U29
U30
U31
U32
U33
U34
U35
U36
DAC1
R2
R3

\


START
STOP
UP
DOWN
1
2
3
4
5
AUTO
R4
U27:A
74LS107
U27:B
74LS107
SET TIME
U26:A
74S00
U23:A
74LS107

# THANK YOU