Microprocessor & Interfacing Design Assignment

Digital Alarm Clock

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Group Number - 55

Question 19

25-04-2018

0. TABLE OF CONTENTS

1. PROBLEM STATEMENT

Problem 19:

System to be designed:- Digital Clock

Description:- A Digital Alarm Clock that displays Time

Basic Functionalities:-

- Time is displayed in HH:MM:SS format along with date (dd/mm/20yy). Both 24 Hr and 12 Hr formats are available and can be decided by the user.
- All of the above can be set by the user.
- Alarm can be set to a particular hour and minutes.
- The time will be displayed and updated in real time on the LCD screen provided.
- The alarm, when it rings, plays the musical octave (Sa Re Ga Ma Pa...) for the entire minute.

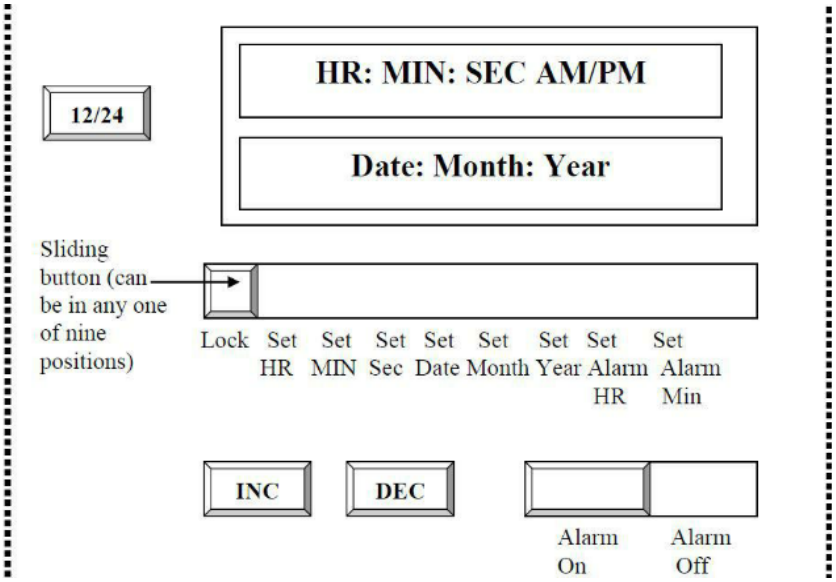
User Interface:-

- The LCD displays the current time and the date.
- Using the increment and decrement Set Switches, the user can set Seconds / Minutes / Hours / Date / Month / Year.
- Similarly, the user can set the Alarm Hour and Alarm Min using the same increment and decrement switches.
- A slider is available to decide upon the functionality that the user wishes to use. The table below lists them:

Value	Functionality	Explanation
0	LOCK	When the slider is in the LOCK position, the clock functions normally, i.e. the LCD displays the time and date. The time is updated in real time.
1	Set Hour	In the Set Hour position, the clock stops functioning. The LCD displays the current value of Hour, Minute and Second. The increment and decrement push buttons increment and decrement the Hour value respectively.
2	Set Minute	In the Set Minute position, the clock stops functioning. The LCD displays the current value of Hour, Minute and Second. The increment and decrement push buttons increment and decrement the Minute value respectively.
3	Set Second	In the Set Second position, the clock stops functioning. The LCD displays the current value of Hour, Minute and Second. The increment and decrement push buttons increment and decrement the Second value respectively.

4	Set Date	In the Set Date position, the clock stops functioning. The LCD displays the current value of Day, Month and Year. The increment and decrement push buttons increment and decrement the Day value respectively.
5	Set Month	In the Set Month position, the clock stops functioning. The LCD displays the current value of Day, Month and Year. The increment and decrement push buttons increment and decrement the Month value respectively.
6	Set Year	In the Set Year position, the clock stops functioning. The LCD displays the current value of Day, Month and Year. The increment and decrement push buttons increment and decrement the Year value respectively.
7	Set Alarm Minute	In the Set Alarm Minute position, the clock stops functioning. The LCD displays the current value of Alarm Hour and Alarm Minute. The increment and decrement push buttons increment and decrement the Alarm Minute value respectively.
8	Set Alarm Hour	In the Set Alarm Hour position, the clock stops functioning. The LCD displays the current value of Alarm Hour and Alarm Minute. The increment and decrement push buttons increment and decrement the Alarm Hour value respectively.

- The switches are available: 12/24 and Alarm On/Off, the position of which determine the display time format and turn the alarm on and off respectively.
- A diagram of the proposed user interface is given below for the sake of clarity:-



2. ASSUMPTIONS

- No. of days in a month is assumed to be 30, for the sake of simplicity. (We ignore the case of 31 days and the special case of 28 day month).
- We assume that the year is of the format 20XX. (X can be any digit).
- Alarm rings for 1 minute.
- The clock starts with the date 25-04-2018 at 06:01:50 PM. The actual time at the moment of running the simulation must be set manually.
- **NOTE: Simulation is not running in real time due to excessive CPU load.** More precisely, **All functionalities in the simulation run correctly, but the effects are delayed.** The clock fails to keep the real time in the simulation.

3. COMPONENTS USED

3.1. ICs

COMPONENT	MODEL NUMBER	NUMBER OF UNITS
Microprocessor	8086	1
Bidirectional Buffer	74LS245	2
Octal Latch	74LS373	3

3 to 8 line Decoder [DeMux]	74LS138	4
Programmable Interval Timer	8253A	2
Programmable Peripheral Interface	8255A	1
20 X 4 LCD	LM044L with hd44780	2
RAM	2732	2

3.2. OTHER COMPONENTS

COMPONENT	MODEL NUMBER	NUMBER OF UNITS
PUSH BUTTON	SW-SPDT-MOM	2
SWITCH	SWITCH	2
BCD THUMB SWITCH	THUMB SWITCH-BCD	1
BUZZER	BUZZER	8
RELAY	RELAY	8

3.3. BASIC GATES

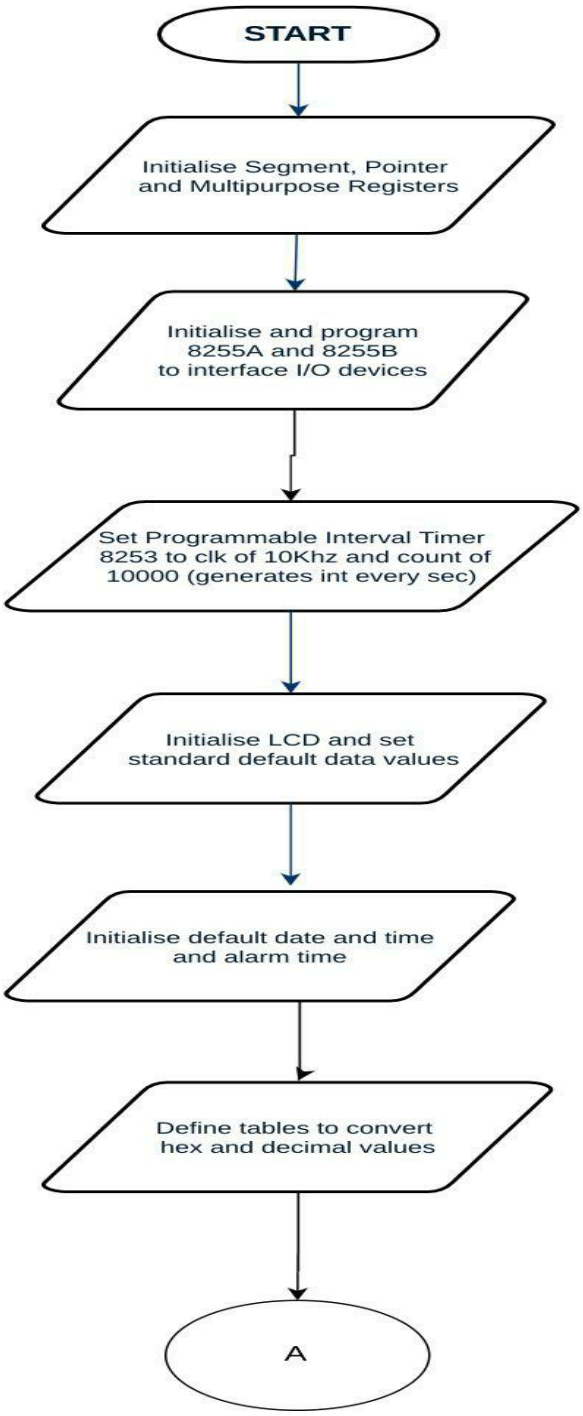
COMPONENT	MODEL NUMBER	NUMBER OF UNITS
AND	7408	1
OR	7432	6
NOT	7404	10

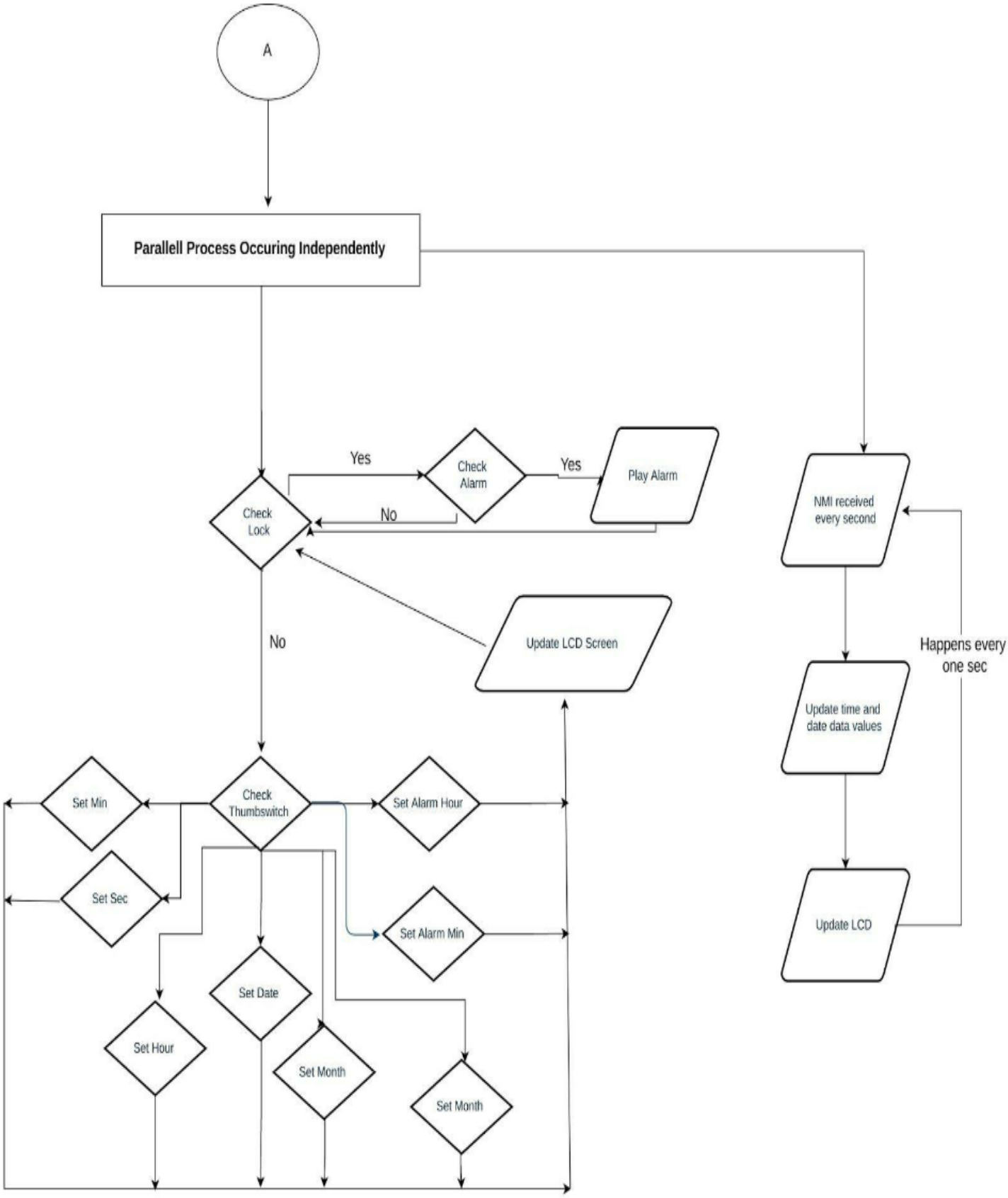
4. MEMORY ADDRESS MAP

Memory or I/O Device	Address Space
RAM - 2*2K	even chip:00000h - 007FEh odd chip: 00001h - 007FFh
Programmable Peripheral Interface A	00h - 07h

Programmable Peripheral Interface B	10h - 17h
Programmable Interval Generator	08h - 0Fh

5. FLOW CHART


START
Initialise Segment, Pointer and Multipurpose Registers
Initialise and program 8255A and 8255B to interface I/O devices
Set Programmable Interval Timer 8253 to clk of 10Khz and count of 10000 (generates int every sec)
Initialise LCD and set standard default data values
Initialise default date and time and alarm time
Define tables to convert hex and decimal values
A

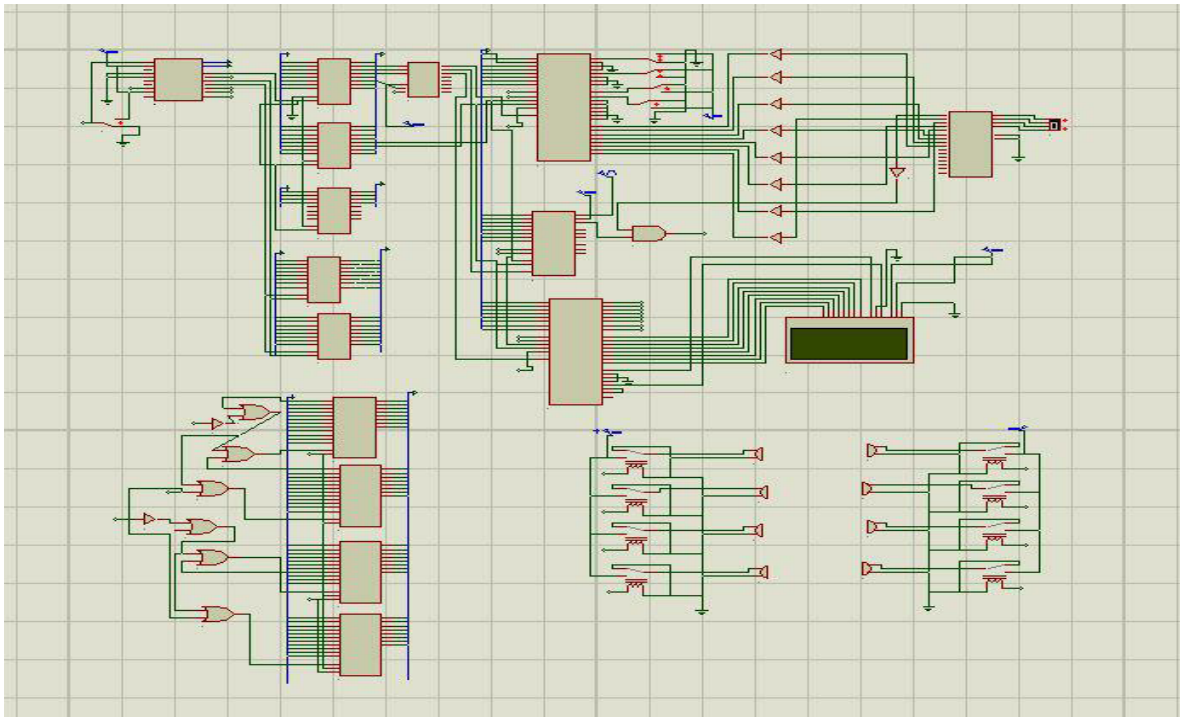

A
Parallell Process Occuring Independently
Check Lock
Yes
Check Alarm
Yes
Play Alarm
No
No
Update LCD Screen
NMI received every second
Happens every one sec
Update time and date data values
Update LCD
Check Thumbswitch
Set Min
Set Sec
Set Hour
Set Alarm Hour
Set Alarm Min
Set Date
Set Month
Set Month

6. PROTEUS SIMULATION AND ASSEMBLY CODE

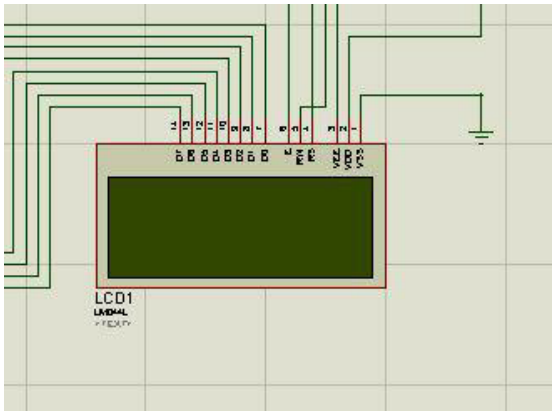
The code file (code.asm) and the proteus design file (simulation.dsm) have been mailed to the instructor at the required date. However, the same can also be found at the github repository mentioned below:

https://github.com/atalukdar/MUPI_digital_clock

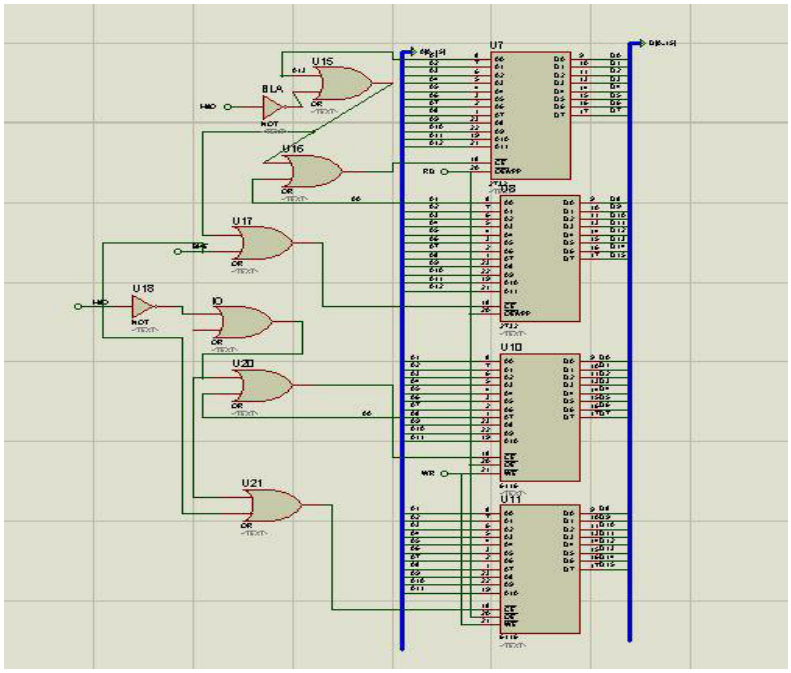
A snapshot of the final proteus design followed by individual snapshots of important components of the circuit has been given below for reference and clarity:



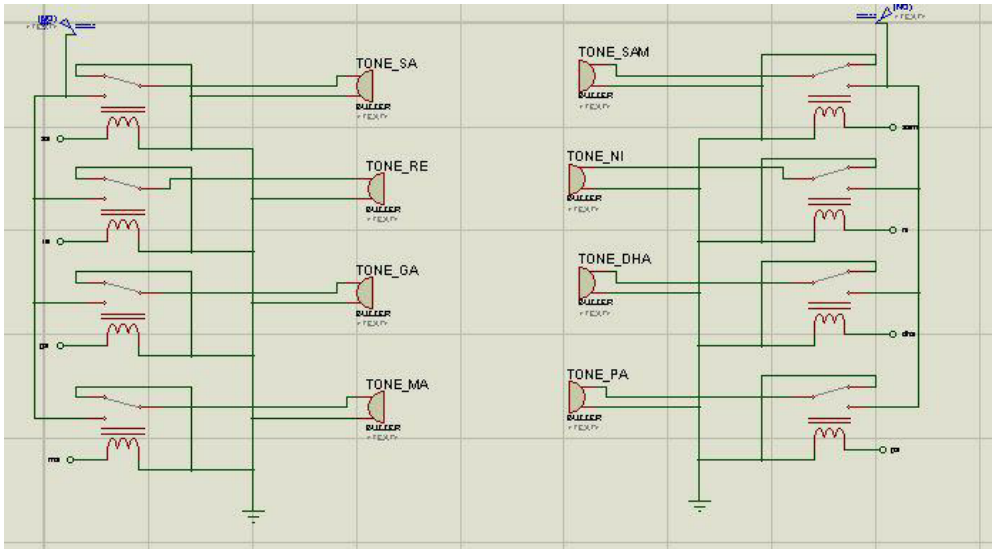
LCD (To display the time and date)



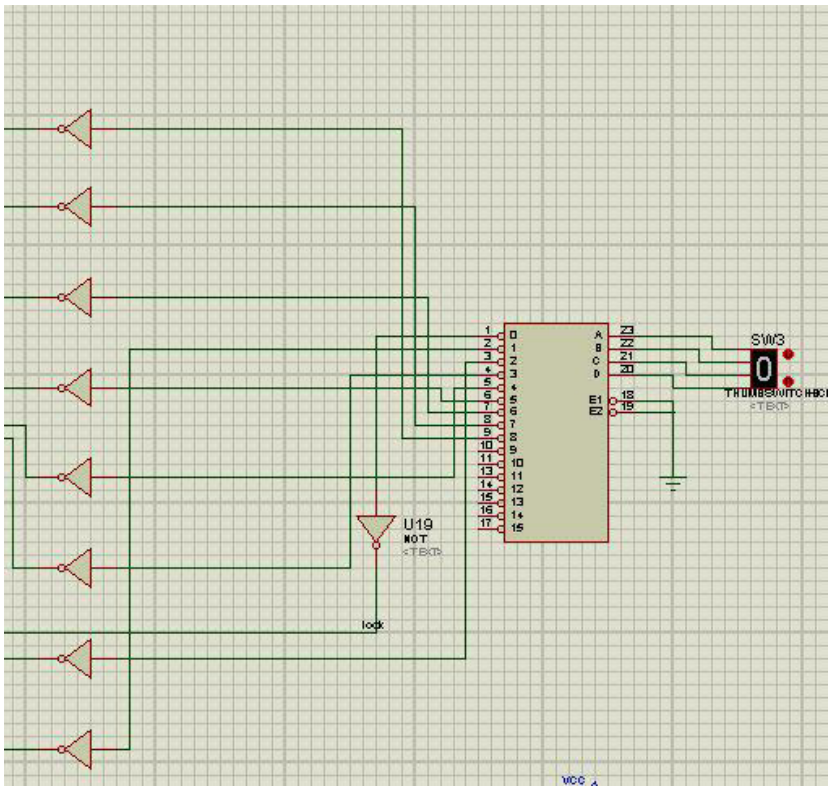
Memory (To store variables and conversion tables)



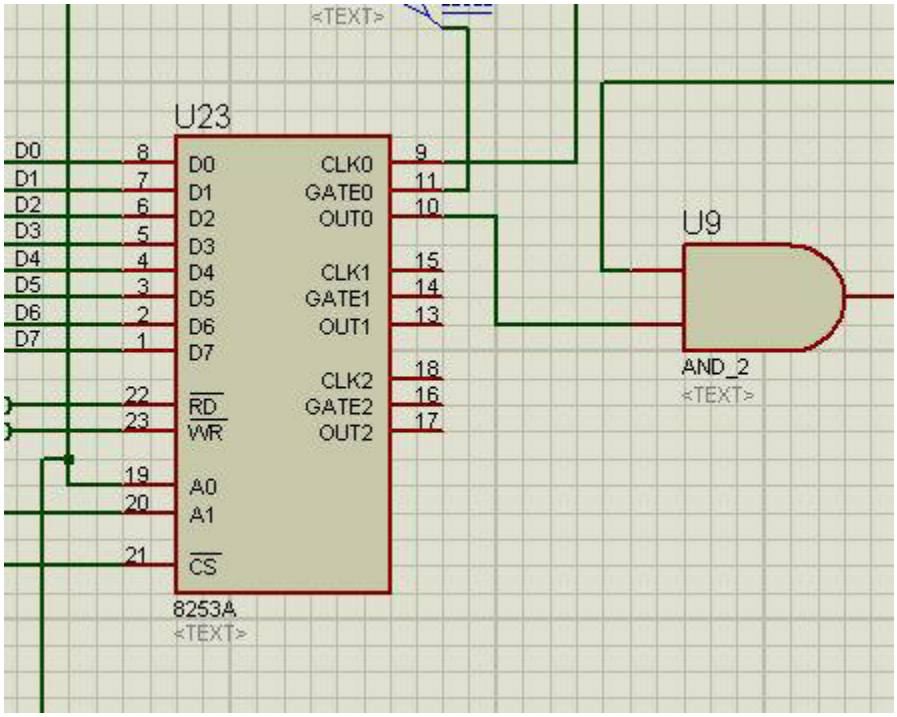
BUZZERS (To sound the alarm)



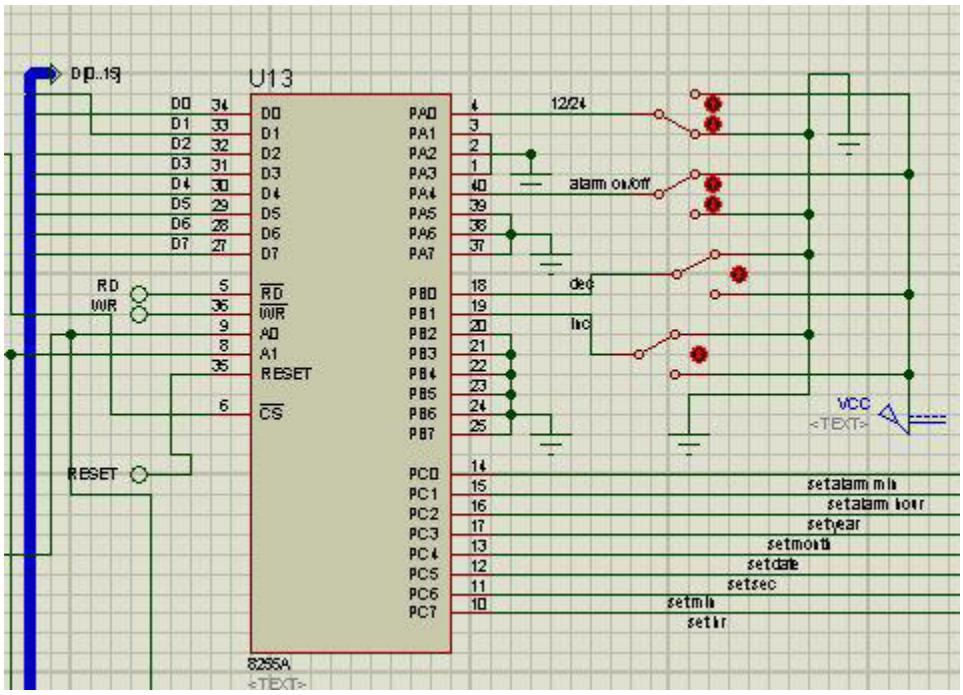
DECODER (To check status of Slider)



PROGRAMMABLE INTERVAL GENERATOR (To generate interrupts every second)



PROGRAMMABLE PERIPHERAL INTERFACE - A (For taking in inputs)



PROGRAMMABLE PERIPHERAL INTERFACE - B (For displaying outputs)