Digital Clock

Alarm

Stop watch

In logic Design

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Introduction :A digital clock is a type of clock that displays the time digitally (i.e. in numerals or other symbols), as opposed to an analogue clock, where the time is indicated by the positions of rotating hands. Digital clocks are often associated with electronic drives, but the "digital" description refers only to the display, not to the drive mechanism. (Both analogue and digital clocks can be driven either mechanically or electronically, but "clockwork" mechanisms with digital displays are rare).

Our project :

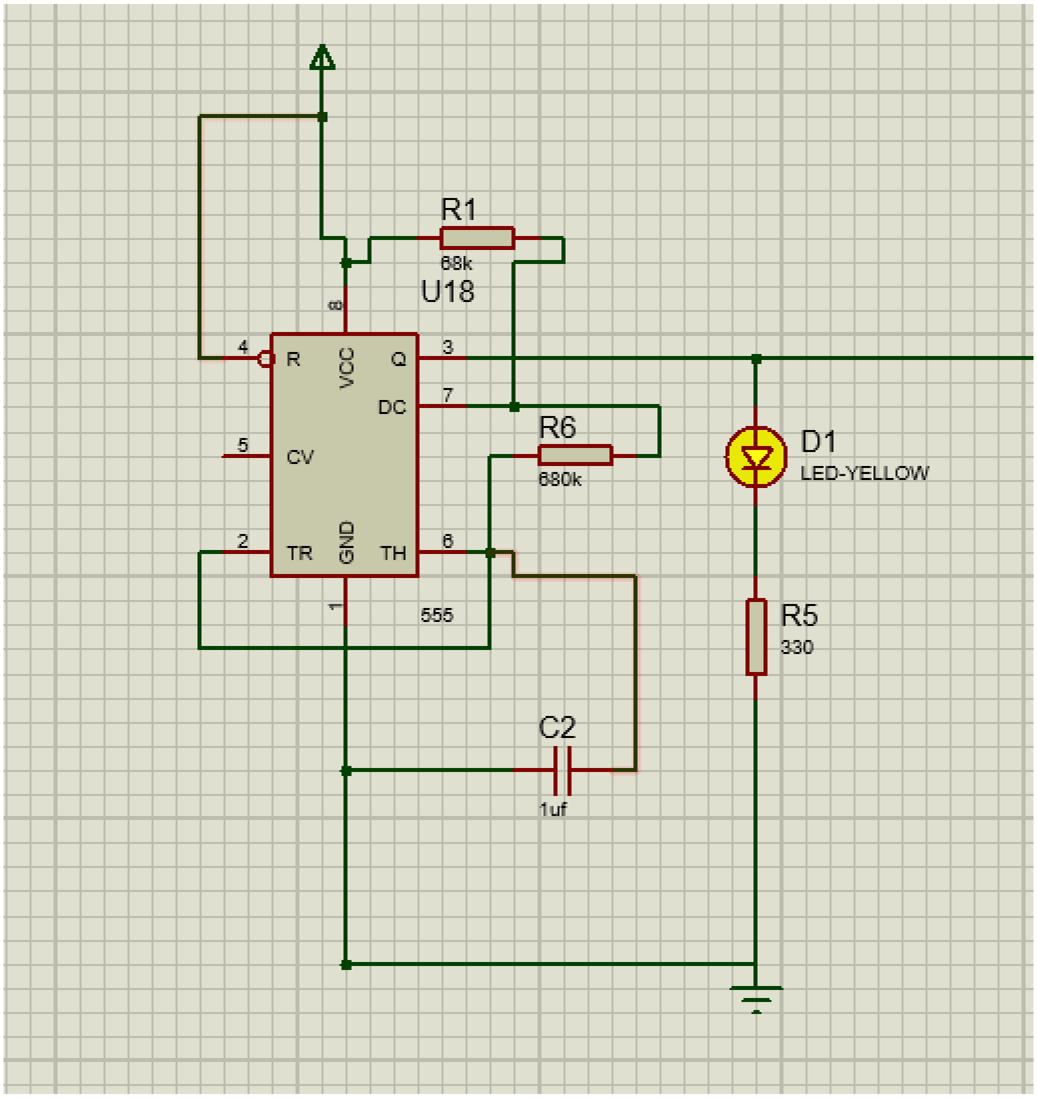
This is a 24 hour digital clock project with Alarm and Stop Watch. This project was chosen to apply what we learned in the logic design course. This digital clock will display seconds, minutes and hours. We did this by learning the course, then applying it to a simulation program (proteus)

HOW THE DIGITAL CLOCK WORKS?

An oscillator is needed for any type of clock to work. In a digital clock, this is usually provided by using a crystal which is made out of glass. As an electric charge passes through the crystal, it will change shape slightly and make a very light sound. The sound which is heard at a regular frequency is then converted into an electronic signal. By using a series of counters, the oscillations from a 60 Hertz oscillator is reduced to HOW THE DIGITAL CLOCK WORKS? An oscillator is needed for any type of clock to work. In a digital clock, this is usually provided by using a crystal which is made out of glass. As an electric charge passes through the crystal, it will change shape slightly and make a very light sound. The sound which is heard at a regular frequency is then converted into an electronic signal. By using a series of counters, the oscillations from a 60 Hertz oscillator is reduced to a 1 Hertz oscillation. The first counter will count one for each set of ten oscillations, and the other one will count ona 1 Hertz oscillation. The first counter will count one for each set of ten oscillations, and the other one will count on or each six “tens” oscillations. This sets up the 1 Hertz signal so that it can pass seconds because the actual definition of 1 Hertz is one oscillation for each second. The six counter sets up the hours, since it counts for 6 sets of 10 – or 60. Each of the counters is connected to an electronic chip that signals to the display which uses lights to display the time. This LED or LCD light display is called a “7-segment display.” This is because there are seven segments that can light up to display a number. For instance, the number 8 uses all 7 lights. But the light segments are designed to be able to light up in any array to display the numbers 0 to 9. These lights are situated on the display so that they display two sets of two digit numbers. When the digital clock reaches 12:59 and goes to 1:00 it essentially resets or starts over. The electric components in a digital clock are designed so that they have a built-in processor which basically looks for a “13” in the hours display. When it occurs, it resets the counter back to 1. Users can also reset the time using digital buttons that are installed on the clock in some accessible location. These buttons allow increased frequencies so that the numbers more much faster .

Content:

In this project, we used timer 555 in stable mode to output the frequency (pulses) that will be entered into the counter 74190, which will change its output to be an input in the decoder 74LS47, then the decoder will display the specified value on the 7 segment display.

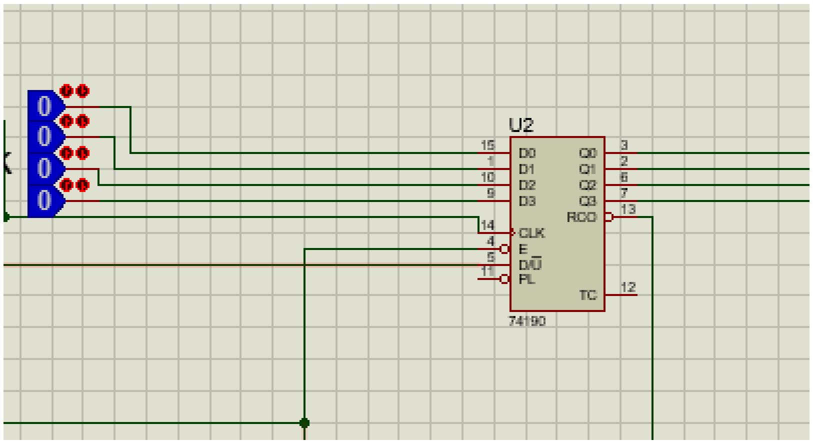


Equation

$$f = \frac{1.44}{(R_1+2R_2)C}$$

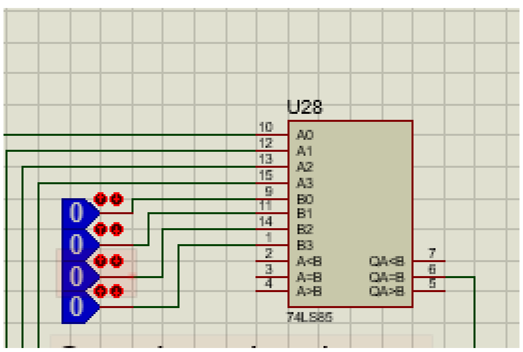
74190 counter :

To count from initial value to 9. When reach 9 RCO give 0.



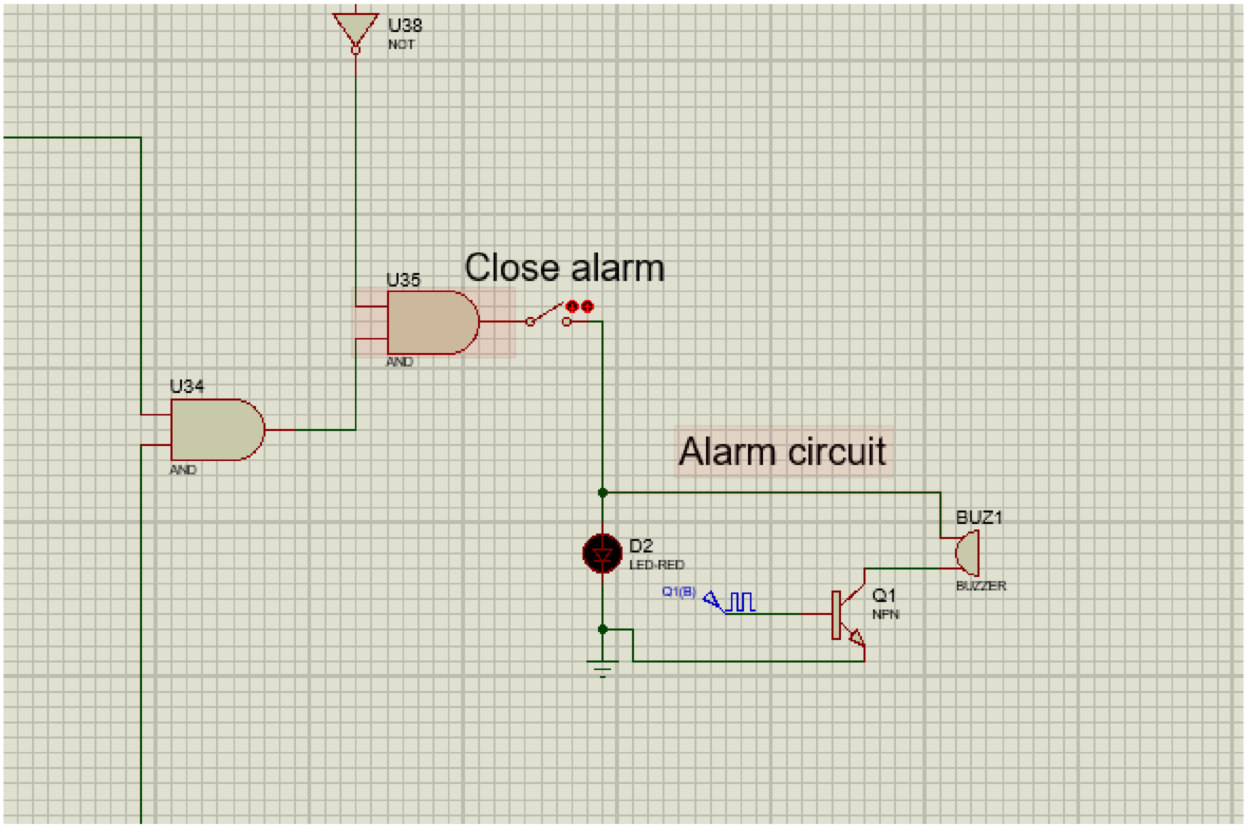
74LS85 comparator :

To compare 4 bit with another 4 bit in this application we used QA=B



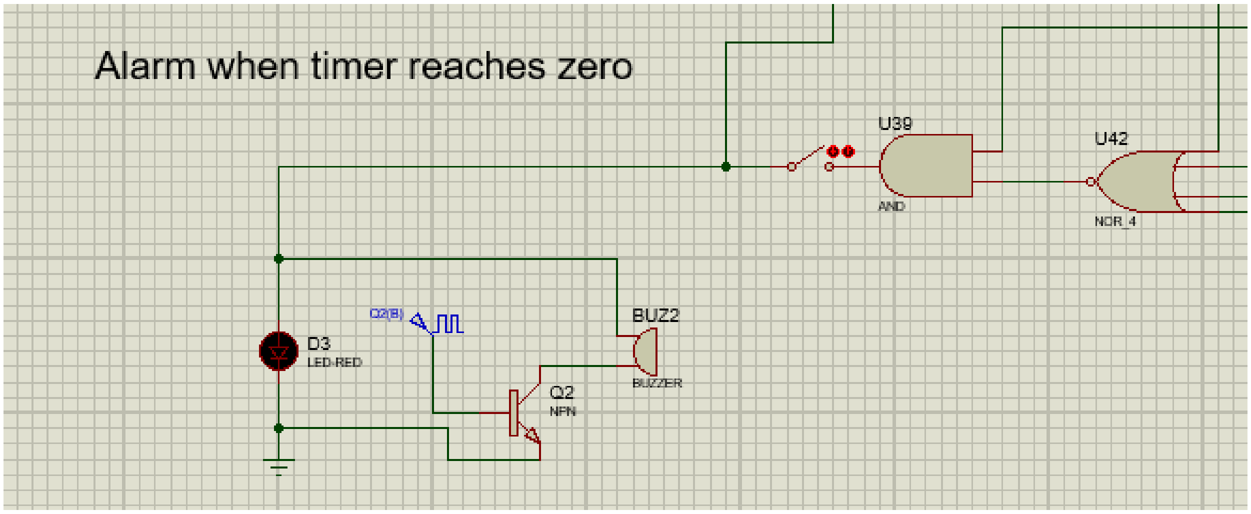
Alarm Circuit :

we set the comparator value of the hours and minutes when the 4 bit input equal 4 bit of the counter the Q out 1 this happen with all comparator and when all equal 1 the alarm circuit will start to work and npn transistor to make buzzer on and off making alarm sound.

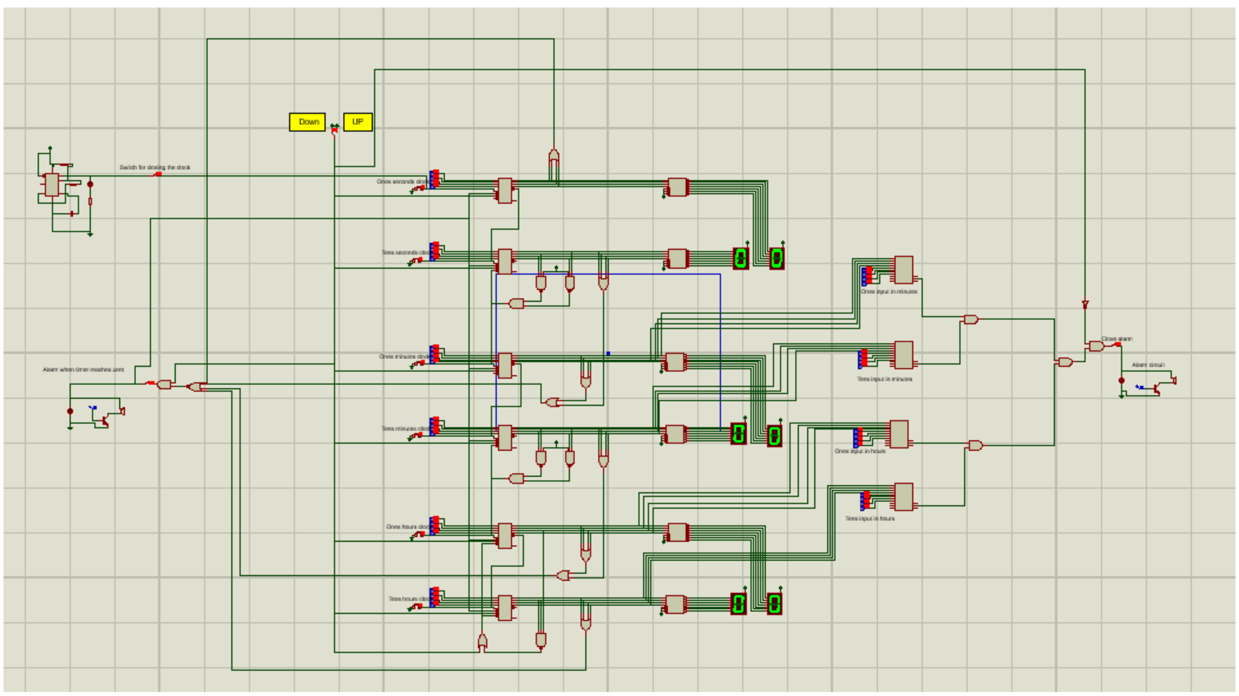


Stop Watch Circuit :

When timer reach zero the output of the will be 1 so the circuit will start the Q2 generate 0 and 1 pulses and npn transistor make the buzzer to on and off to make the alarm sound

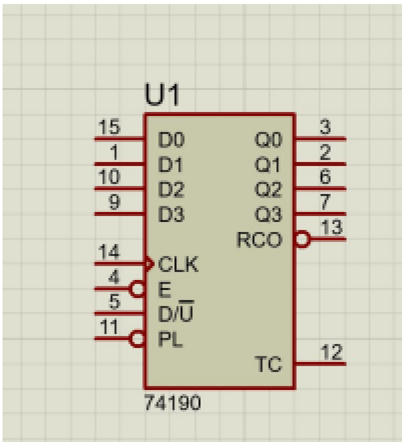


Finally we get this :

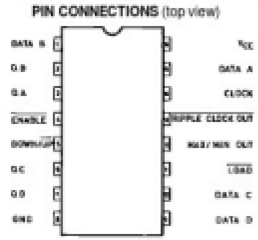


Data Sheet of components :

74190 counter :



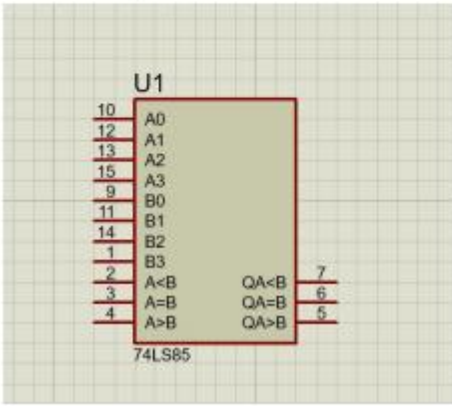
PIN CONNECTIONS (top view)



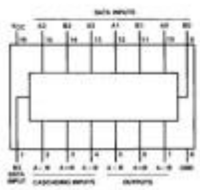
TRUTH TABLE

INPUTS				OUTPUS				FUNCTION
$\overline{LOAD}$	$\overline{ENABLE}$	D/$\overline{U}$	CLOCK	QA	QB	QC	QD	
L	X	X	X	a	b	c	d	PRESET DATA
H	L	L	↑	UP COUNT				UP COUNT
H	L	H	↑	DOWN COUNT				DOWN COUNT
H	H	X	↑	NO CHANGE				NO COUNT
H	X	X	↓	NO CHANGE				NO COUNT

74LS85 compartor :



Connection Diagram

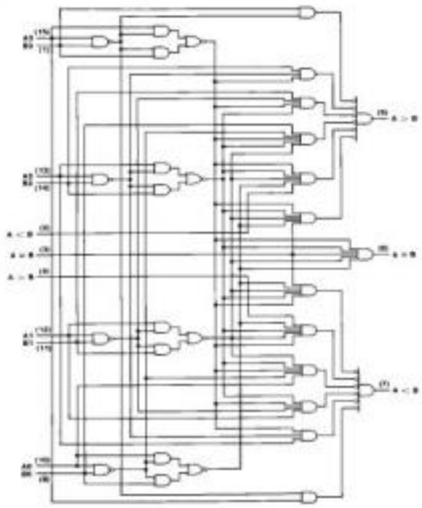


Function Table

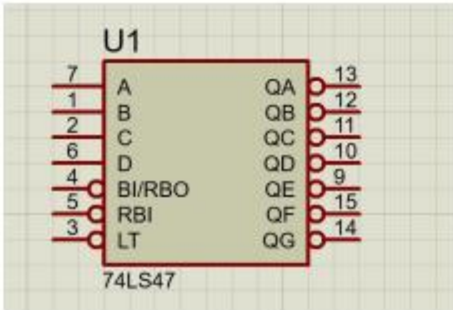
Comparing Inputs				Cascading Inputs			Outputs		
A3, B3	A2, B2	A1, B1	A0, B0	A > B	A < B	A = B	A > B	A < B	A = B
A3 > B3	X	X	X	X	X	X	H	L	L
A3 < B3	X	X	X	X	X	X	L	H	L
A3 = B3	A2 > B2	X	X	X	X	X	H	L	L
A3 = B3	A2 < B2	X	X	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 > B1	X	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 < B1	X	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 = B1	A0 > B0	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 = B1	A0 < B0	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	L	L	H	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	H	L	L	H	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	H	L	L	H
A3 = B3	A2 = B2	A1 = B1	A0 = B0	X	X	H	L	L	H
A3 = B3	A2 = B2	A1 = B1	A0 = B0	H	H	L	L	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	L	H	H	L

H = HIGH Level, L = LOW Level, X = Don't Care

Logic Diagram



74LS47 decoder :



Decoder to convert BCD to 7-segment

A:BCD input

B:BCD input

C:BCD input

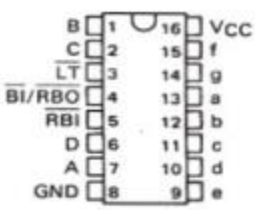
D:BCD input

BI/RBO:Blanking input/ripple blanking output

RBI: ripple blanking input

LT: lamp test input

QA to QG: 7-segment outputs



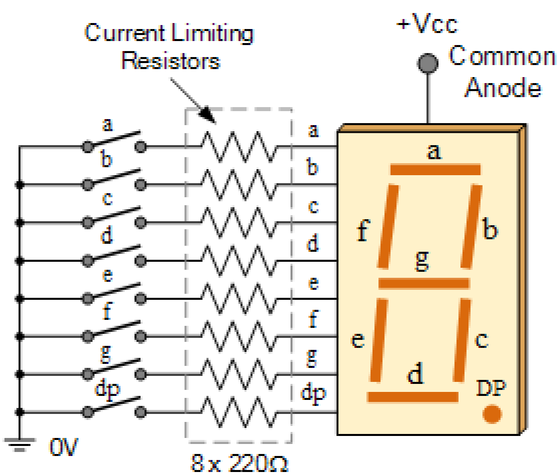
Function Table

'46A, '47A, 'LS47 FUNCTION TABLE (T1)

DECIMAL OR FUNCTION	INPUTS						$\overline{BI}/\overline{RBO}$[†]	OUTPUTS							NOTE
	$\overline{LT}$	$\overline{RBI}$	D	C	B	A		a	b	c	d	e	f	g	
0	H	H	L	L	L	L	H	ON	ON	ON	ON	ON	ON	OFF	1
1	H	X	L	L	L	H	H	OFF	ON	ON	OFF	OFF	OFF	OFF	
2	H	X	L	L	H	L	H	ON	ON	OFF	ON	ON	OFF	ON	
3	H	X	L	L	H	H	H	ON	ON	ON	ON	OFF	OFF	ON	
4	H	X	L	H	L	L	H	OFF	ON	ON	OFF	OFF	ON	ON	
5	H	X	L	H	L	H	H	ON	OFF	ON	ON	OFF	ON	ON	
6	H	X	L	H	H	L	H	OFF	OFF	ON	ON	ON	ON	ON	
7	H	X	L	H	H	H	H	ON	ON	ON	OFF	OFF	OFF	OFF	
8	H	X	H	L	L	L	H	ON	ON	ON	ON	ON	ON	ON	
9	H	X	H	L	L	H	H	ON	ON	ON	OFF	OFF	ON	ON	
10	H	X	H	L	H	L	H	OFF	OFF	OFF	ON	ON	OFF	ON	
11	H	X	H	L	H	H	H	OFF	OFF	ON	ON	OFF	OFF	ON	
12	H	X	H	H	L	L	H	OFF	ON	OFF	OFF	OFF	ON	ON	
13	H	X	H	H	L	H	H	ON	OFF	OFF	ON	OFF	ON	ON	
14	H	X	H	H	H	L	H	OFF	OFF	OFF	ON	ON	ON	ON	
15	H	X	H	H	H	H	H	OFF	OFF	OFF	OFF	OFF	OFF	OFF	
$\overline{BI}$	X	X	X	X	X	X	L	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
$\overline{RBI}$	H	L	L	L	L	L	L	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
$\overline{LT}$	L	X	X	X	X	X	H	ON	ON	ON	ON	ON	ON	ON	4

7-segment Display:

An LED or Light Emitting Diode, is a solid state optical pn-junction diode which emits light energy in the form of photons



The emission of photons from a 7-segment display occurs when the diode junction of each segment is forward biased by an external voltage allowing current to flow across its junction, and in Electronics we call this process electroluminescence.

The actual colour of the visible light emitted by an LED, ranging from blue to red to orange, is decided by the spectral wavelength of the emitted light which itself is dependent upon the mixture of the various impurities added to the semiconductor materials used to produce it.

Light emitting diodes have many advantages over traditional bulbs and lamps, with the main ones being their small size, long life, various colours, cheapness and are readily available, as well as being easy to interface with various other electronic components and digital circuits.

But the main advantage of light emitting diodes is that because of their small die size, several of them can be connected together within one small and compact package producing what is generally called a **7-segment Display**.

The *7-segment display*, also written as "seven segment display", consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed.

An additional 8th LED is sometimes used within the same package thus allowing the indication of a decimal point, (DP) when two or more 7-segment displays are connected together to display numbers greater than ten.

Each one of the seven LEDs in the display is given a positional segment with one of its connection pins being brought straight out of the rectangular plastic package. These individually LED pins are labelled from a through to g representing each individual LED. The other LED pins are connected together and wired to form a common pin.

So by forward biasing the appropriate pins of the LED segments in a particular order, some segments will be light and others will be dark allowing the desired character pattern of the number to be generated on the display. This then allows us to display each of the ten decimal digits 0 through to 9 on the same 7-segment display.

The displays common pin is generally used to identify which type of 7-segment display it is. As each LED has two connecting pins, one called the "Anode" and the other called the "Cathode", there are therefore two types of LED 7-segment display called: **Common Cathode** (CC) and **Common Anode** (CA).

The difference between the two displays, as their name suggests, is that the common cathode has all the cathodes of the 7-segments connected directly together and the common anode has all the anodes of the 7-segments connected together and is illuminated as follows.

1. The Common Cathode (CC) – In the common cathode display, all the cathode connections of the LED segments are joined together to logic "0" or ground. The individual segments are illuminated by application of a "HIGH", or logic "1" signal via a current limiting resistor to forward bias the individual Anode terminals (a-g).

7-segment Display Truth Table

Decimal Digit	Individual Segments Illuminated						
	a	b	c	d	e	f	g
0	×	×	×	×	×	×	
1		×	×				
2	×	×		×	×		×
3	×	×	×	×			×
4		×	×			×	×
5	×		×	×		×	×
6	×		×	×	×	×	×
7	×	×	×				
8	×	×	×	×	×	×	×
9	×	×	×			×	×

ADVANTAGES OF DIGITAL CLOCK:

1. Coordinated indications of all clocks at the site with a global universal time (UTC/GMT);

2. Synchronous indication of an exact zone time in the pointer and digital formats on all clocks;

3. Automatic conversion of clocks during the transition to winter/summer time;

4. Automatic setting of the clock to the exact time after restoration of power or liquidation of the accident on a line;

5. Automatic restoration of the correct indications of the clock at failures or during power interruption for a period of up to 1 week;

6. Synchronization of the computer network in accordance with the calendar date and exact time;

7. Simplicity of usage that does not require special training of the engineering personnel.

DISAVANTANGES OF THIS SYSTEM:

1. Easy to misread (sometimes an 8 looks like a 0)

2. Very limited viewing angle

3. Only run on electricity

4. Lit screens can sometimes too bright enough to make it difficult to select.

Conclusion:

This project was about making a digital clock and an alarm and Stop Watch where we used the information that we learned in the logic design course , then a simulation was made for it by proteus, then it was done practically by using logical design components of Timer 555, Counter 74190, Decoder 74LS47, 7 segment, Comparator 74LS85 , which We designed it to produce the Digital Clock in the end.

Thank You