Lab no 08: Counter and Timer

The Purpose of this Lab is to: learn about 555-Timer, BCD Decade Counter, decoder, seven-segment display, and Proteus Simulator.

In this lab, we will simulate a circuit that counts and displays numbers on the seven-segment display. Then your task is to implement the circuit and test it on the breadboard.

Required Components

- Breadboard.
- 5V battery.
- Jumper wires.
- 330-ohm Resistor.
- 50k-ohm Resistor.
- 44k-ohm Resistor.
- 10nF (nano-farad) Capacitor
- 10uF (micro-farad) Capacitor.
- Led.
- 555 Timer.
- BCD Decade Counter IC 74LS90.
- Digital 7 segments display anode.
- Digital 7 segments decoder IC 7447.

Parts:

1. Introduction to 555 Timer, Counter, decoder, and seven-segment display.
2. Simulate the counter circuit using 555 Timer, Counter, decoder, and seven-segment display on Proteus.

Part 1: Introduction to 555 Timer, Counter, decoder, and seven-segment display.

- **555 Timer** IC is an integrated circuit used in a variety of timer, Time delay generation, Sequential timing, pulse generation, and oscillator applications. The 555 Timer may be used as a clock generator.
  The 555 Timer has two operating modes:

  - **Monostable or one-shot Timer**

    Monostable is a mode with only one stable state. When triggered, it goes to its unstable state for a predetermined time period, then returns to its stable state. Where the pulse width is determined by R1 and C1. Approximately tw = 1.1 * R1*C1 as shown in Figure 1.

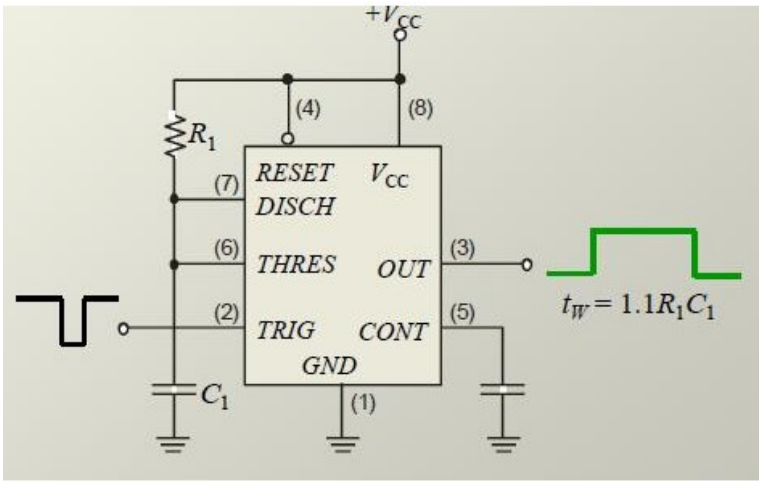
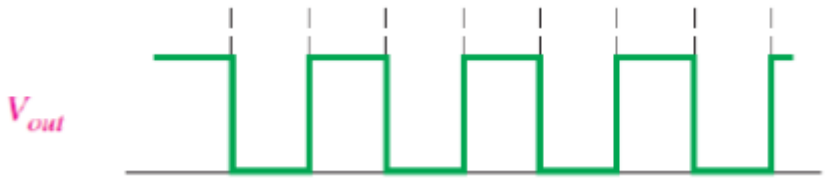
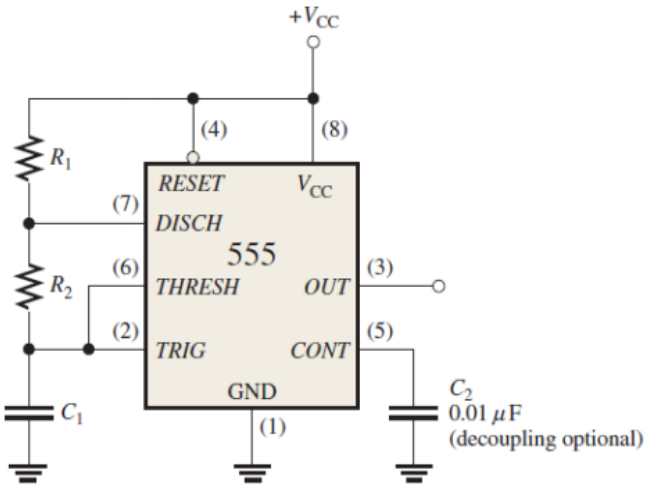


Figure 1: Monostable or one-shot Timer.

  - **Astable Timer**

    An astable is a device that has no stable states. The resulting output is typically a square wave that is used as a clock signal in many types of sequential logic circuits as shown in Figure 2.





$$f = \frac{1.44}{(R_1 + 2R_2)C_1}$$

Figure 2: A stable Timer.

- **BCD Decade Counter** A binary coded decimal (BCD) is a serial digital counter that counts in a sequence of ten digits (from 0: 9) and then returns back to zero after the count of nine. When the Decade counter is at REST, the count is equal to 0000. A decade Obviously to count up to a binary value of nine, the counter must have at least four flip-flops within its chain to represent each decimal digit as shown in Figure 3.

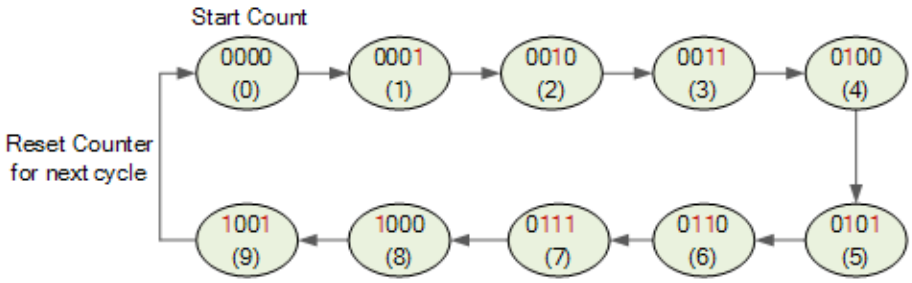


Figure 3: BCD Decade Counter FSM.

Note: Refer to Lab 7 to revise the BCD & Seven-Segment Display.

Part 2:- Simulate the counter circuit using 555 Timer, Counter, decoder, and seven-segment display on Proteus.

- **Timer 555** NE555 is a Timer that can be found in many electronic devices. It is a highly stable integrated circuit that can produce accurate time delays and oscillations as shown in Figure 4. The pinout and its functions are discussed below.

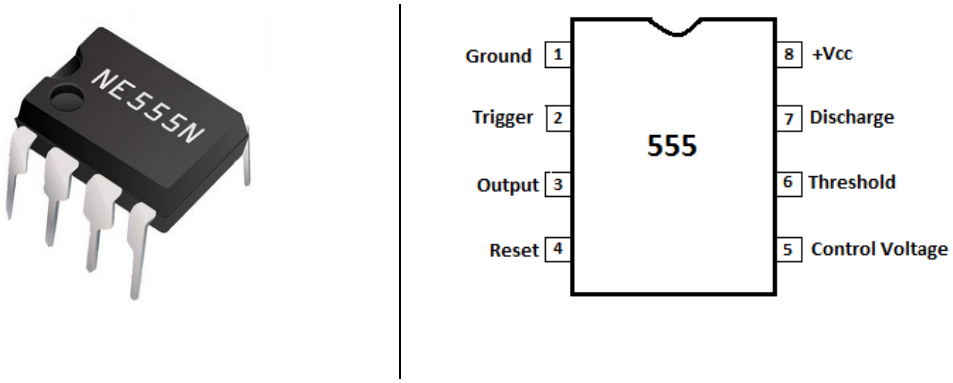


Figure 4: NE555N IC & Pin Configuration.

- **BCD Decade Counter 74LS90** is a MOD-10-decade counter that generates a BCD output code as shown in figure 5. The pinout and its functions are discussed below.

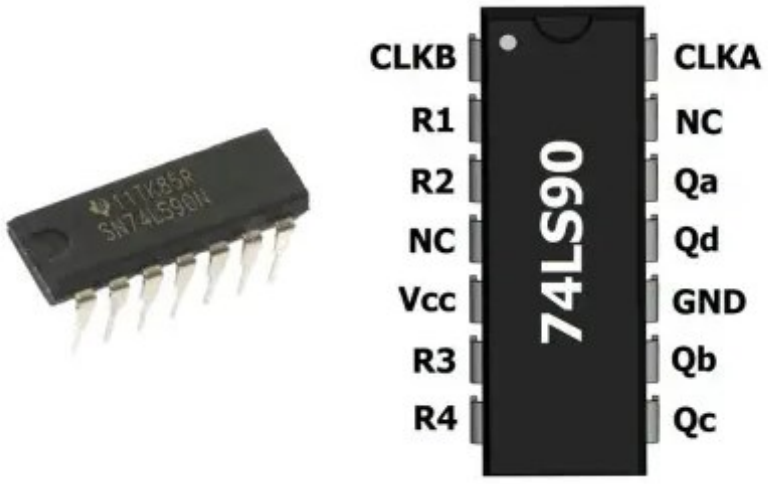


Figure 5:- 74LS90 IC & Pin Configuration.

Schematic for Decade Counter and the Seven-Segments Decoder.

Figure 6 shows the schematic of Counter 74LS90, where QA, QB, QC, and QD are the outputs as shown in the truthtable. Once a clock is trigged, it counts up.

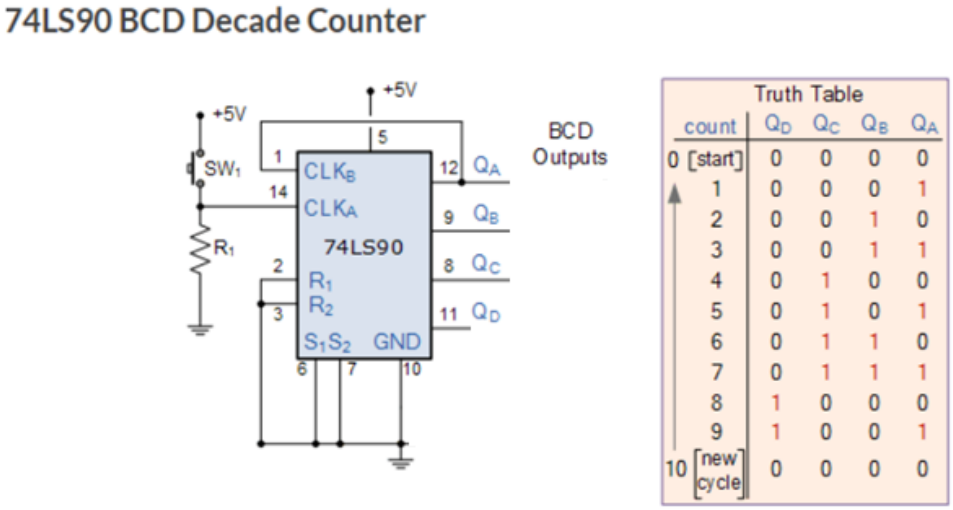


Figure 6: Schematic of 74LS90 BCD Counter and Truth Table.

Figure 7 shows the schematic of the seven-segment decoder and seven-segments display, where A, B, C, and D are the inputs. Once the binary inputs (A, B, C, D) are set, the display shows the equivalent decimal number of the binary code.

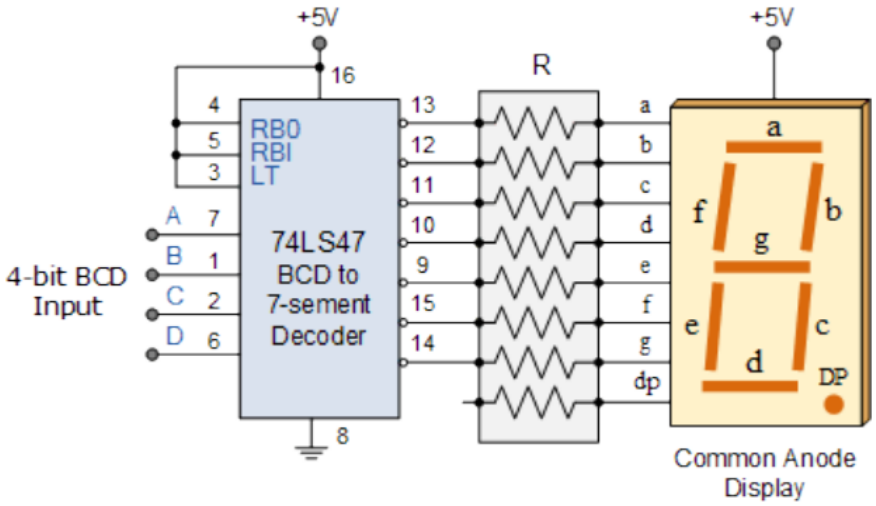


Figure 7: Schematic of 74LS47 BCD to 7-segment Decoder.

Figure 8 shows the schematic of the integration of the Counter 74LS90 and the seven-segment decoder and seven-segment display, where the counter outputs (QA, QB, QC, QD) are connected to the decoder inputs A, B, C, and D.

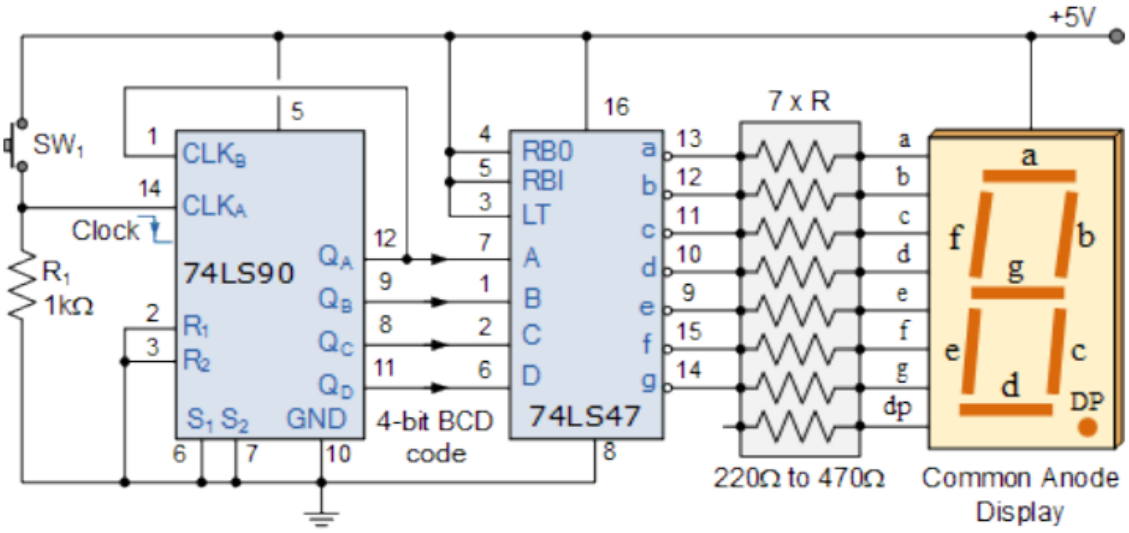
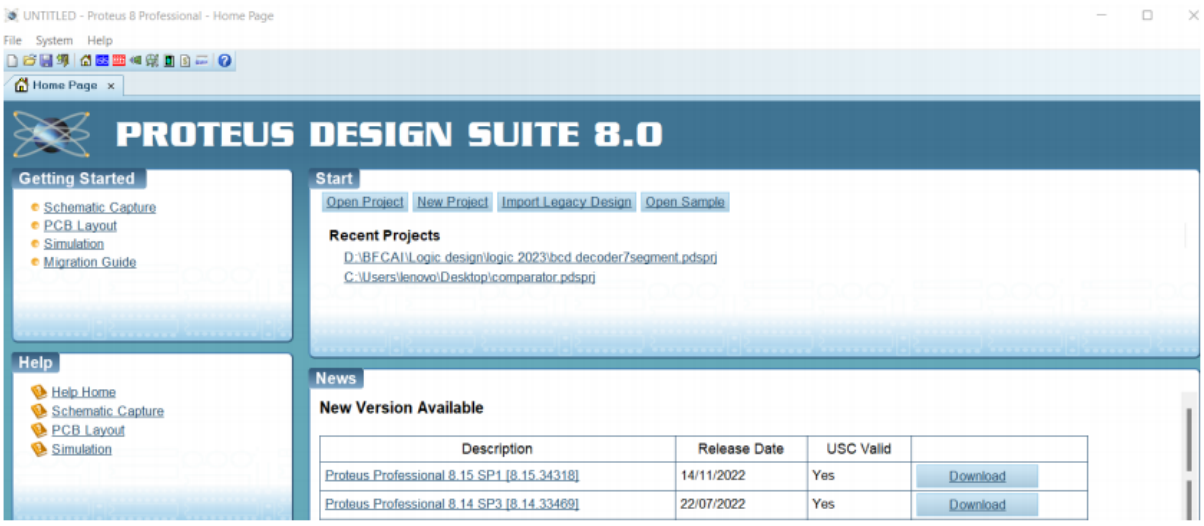


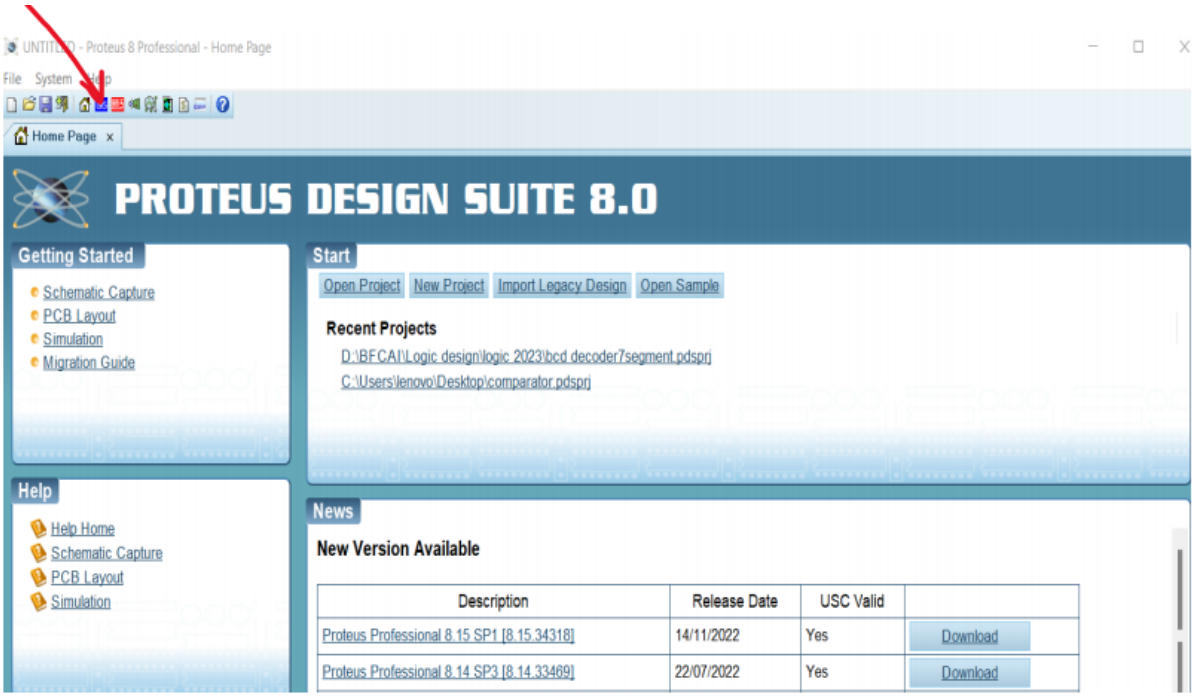
Figure 8: Schematic of 74LS90 BCD Counter to 7-segment.

Steps to simulate the counter circuit In Proteus.

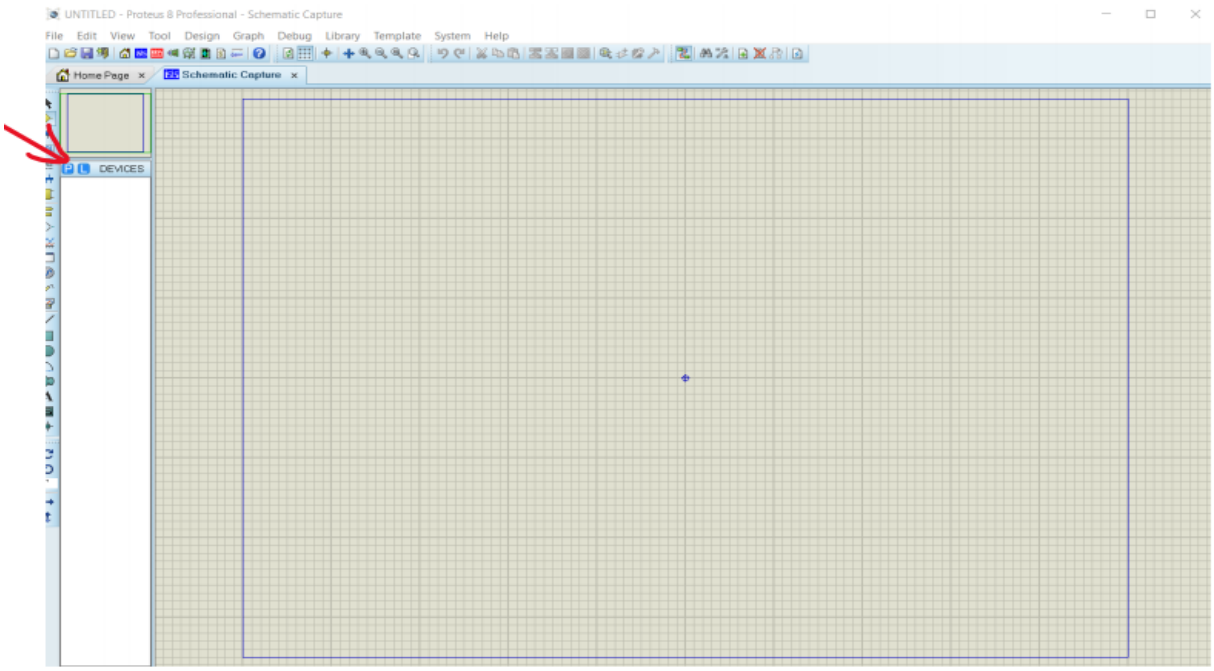
- **Open** Proteus Software.



- **Open** schematic capture

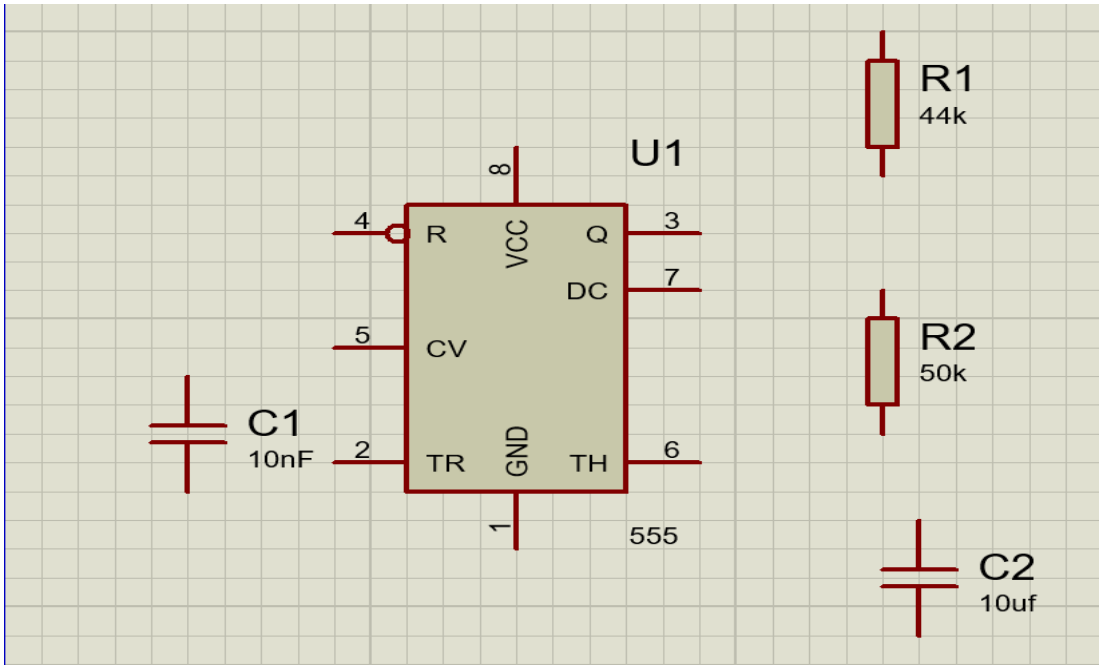


- **Open** pick devices from devices

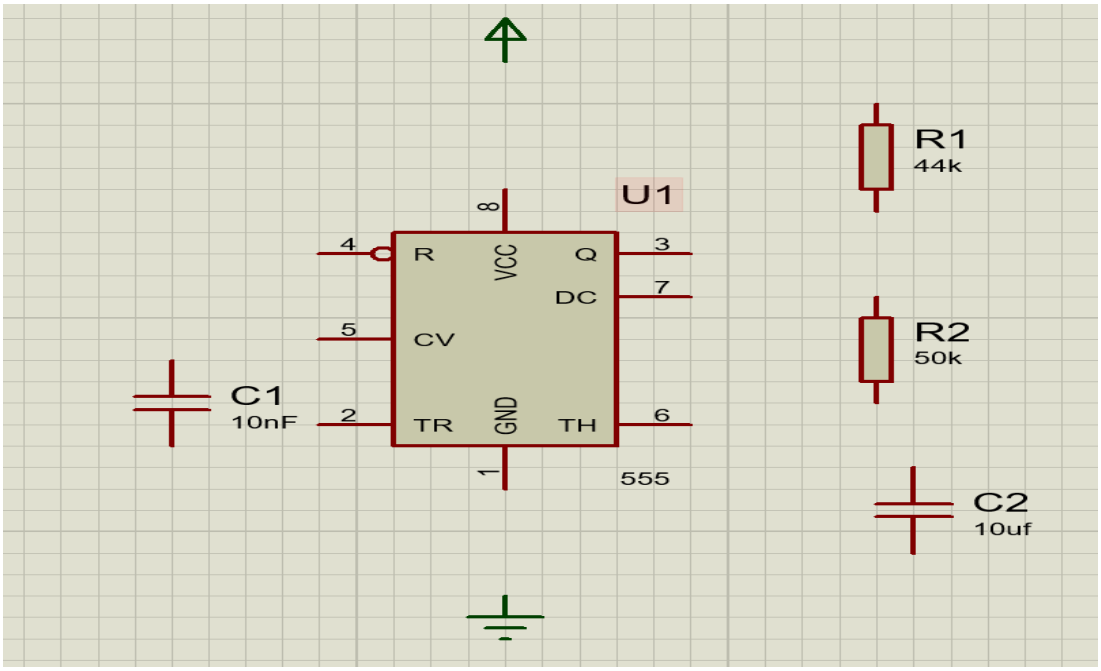


First: Generate the clock using the Timer-555 Circuit.

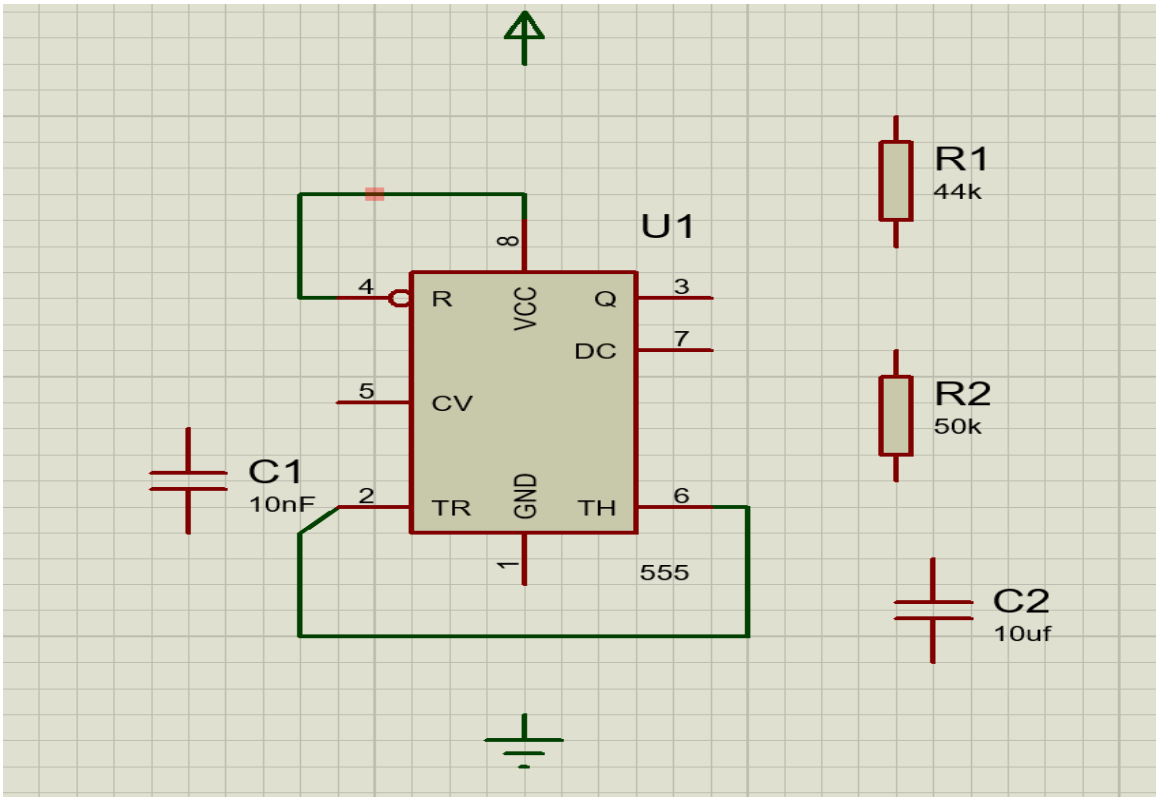
- **Search** for IC 555 Timer and **Add** to the schematic.
- **Add** from pick device resistors (44 k and 50 k (kilo ohm)), capacitor 10 nf (nano-farad) and 10 uf (microfarad)



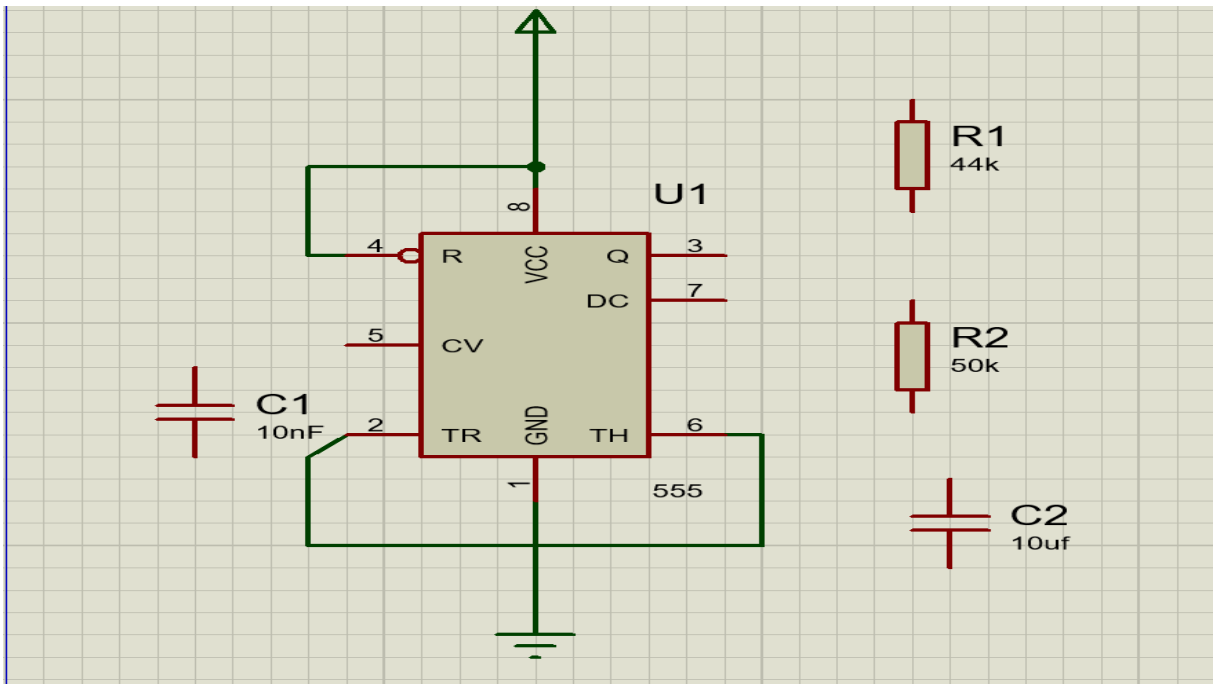
- **Add** power and ground from terminal mode



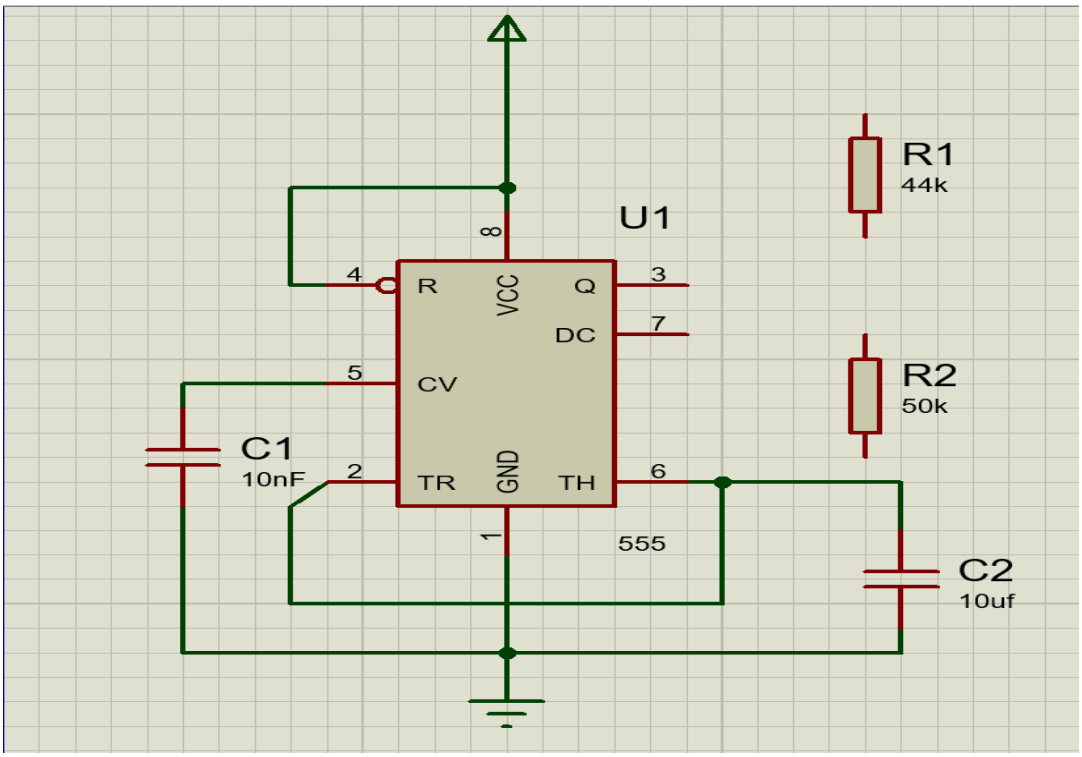
- **Connect** (Pin 2) to (Pin 6) and **Connect** (Pin 4) to (Pin 8)



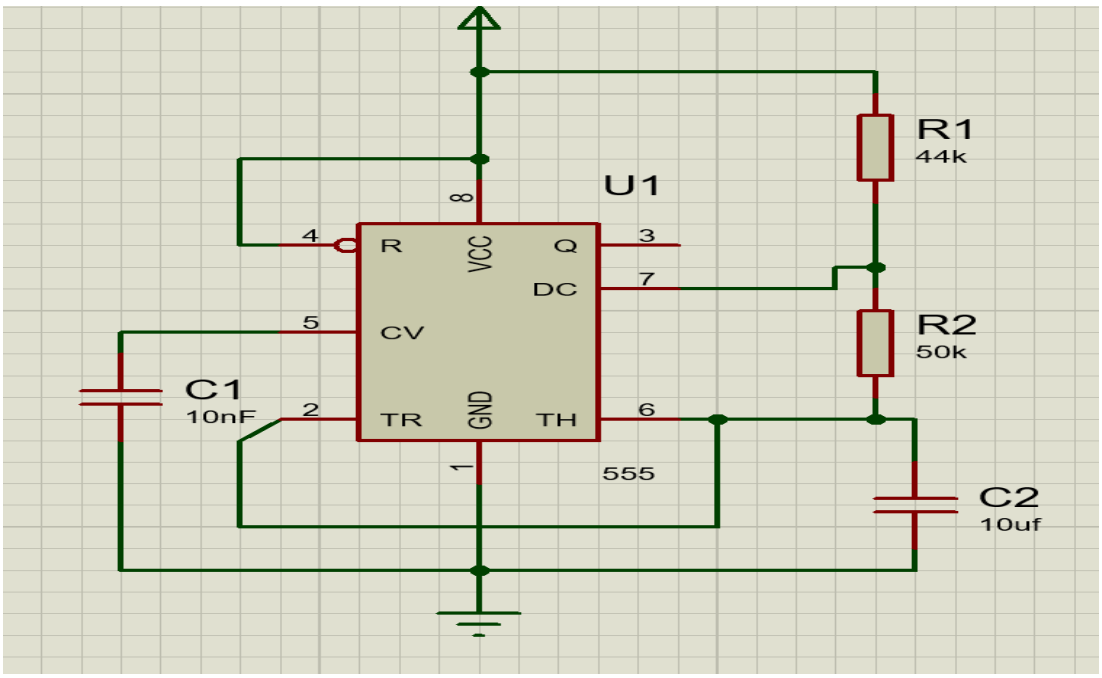
- **Connect** (Pin 1) to (Ground (-)) and **Connect** (Pin 8) to (power (+))



- **Connect** capacitor c1 10 nf to pin (5) and ground
  Connect capacitor c2 10 uf to pin (6) and ground

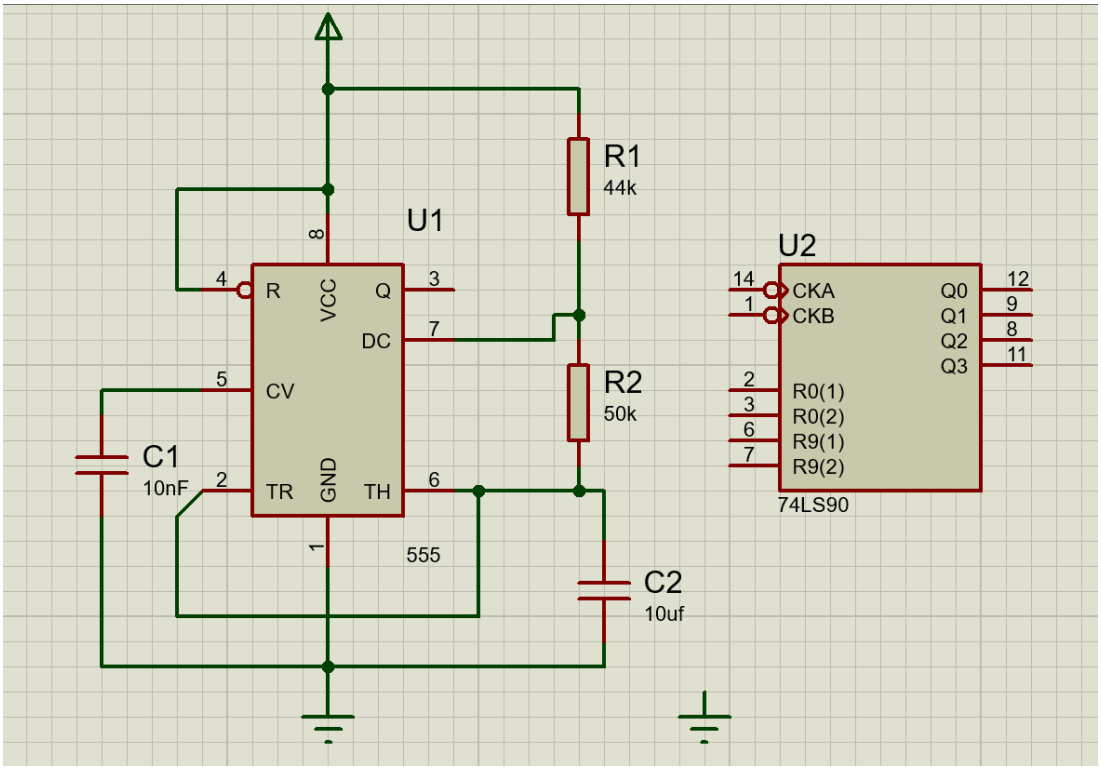


- **Connect** resistor R1 44 k to pin (7) and power
  Connect resistor R2 50 k to pin (6) and pin (7)

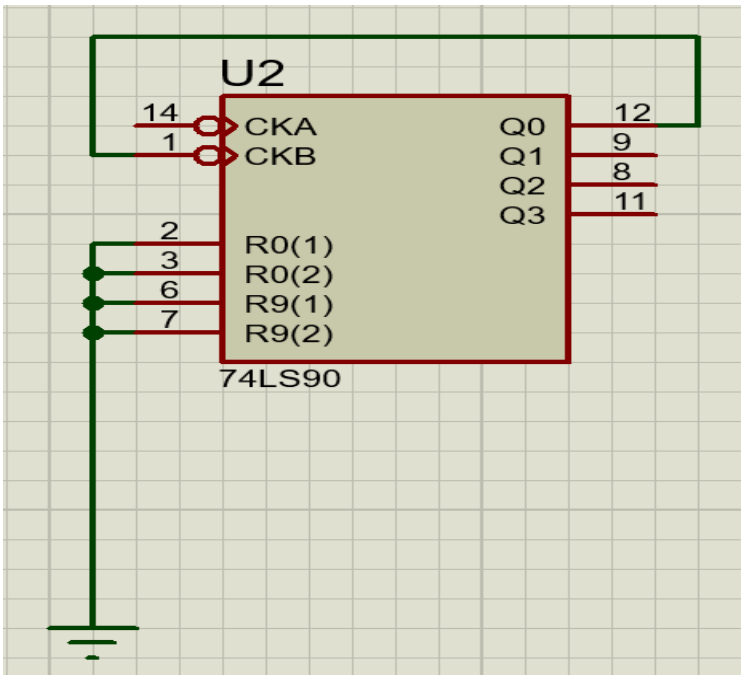


Second: Connect the Decade Counter.

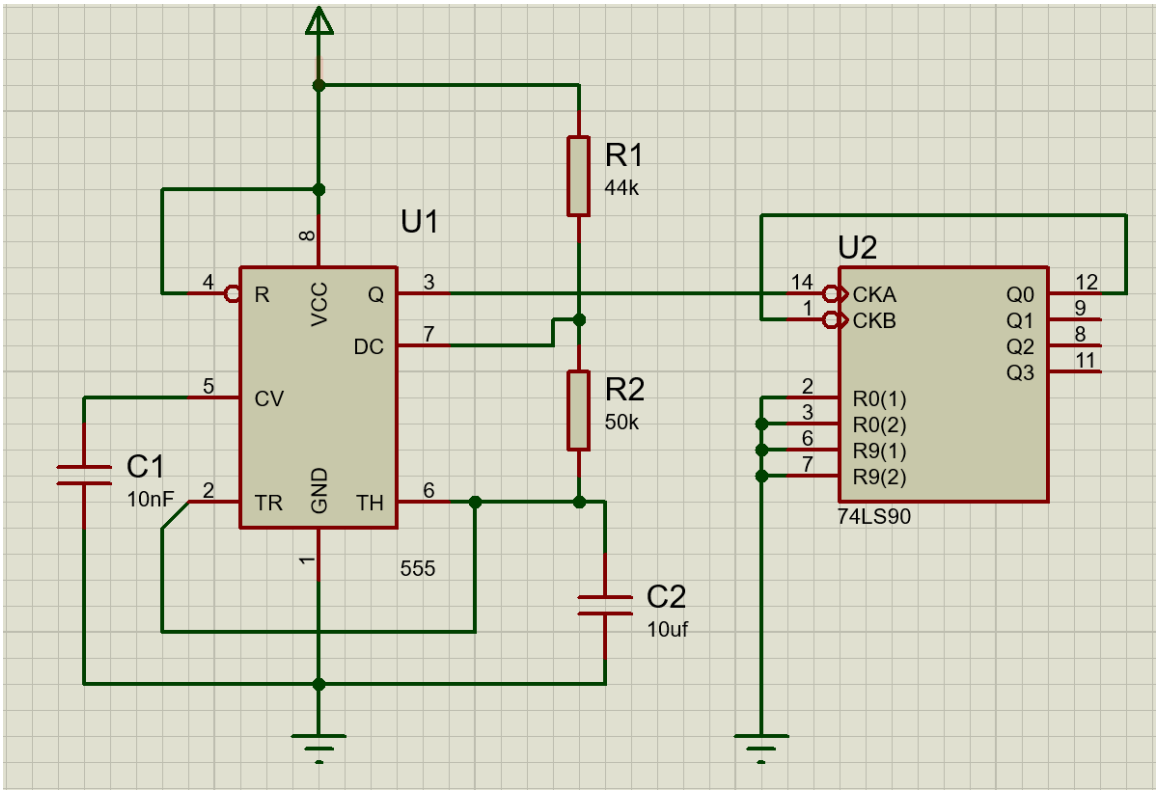
- **Add** from pick device ic 74LS90 and ground from terminal mode



- **Connect** (Pin 1) to (Pin 12)
  Connect (Pin 2) , (Pin 3) , (Pin 6) and (Pin 7) to ground

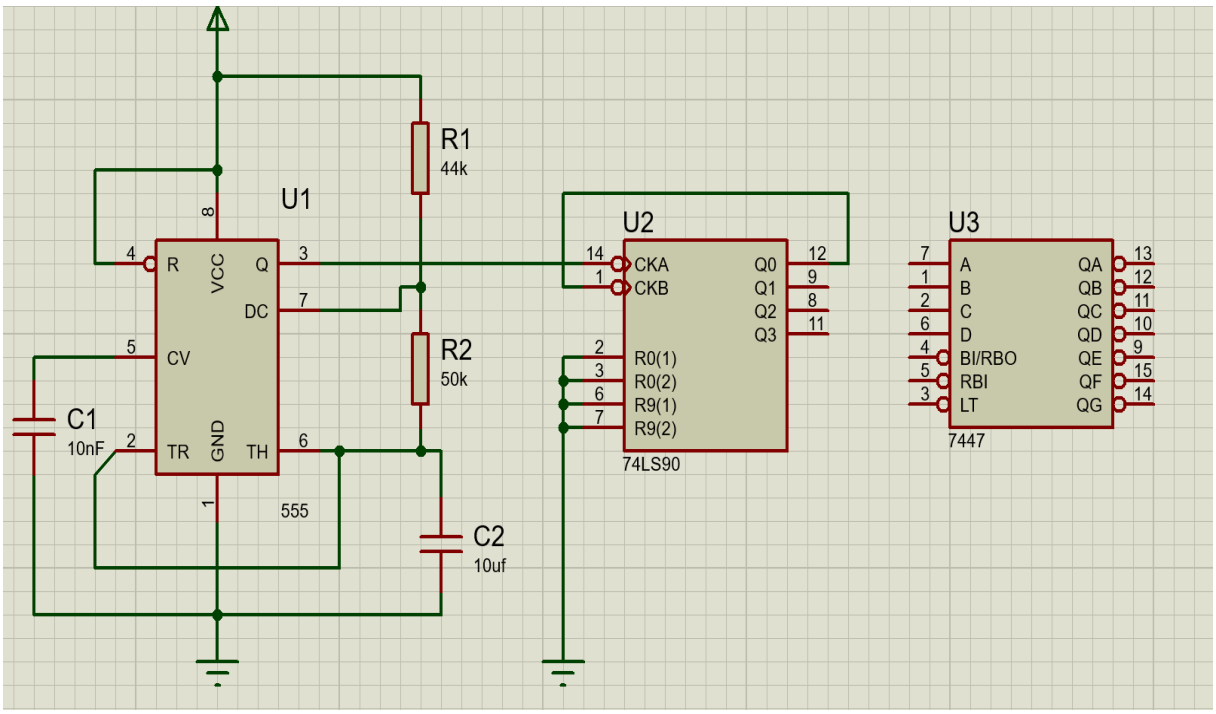


- **Connect** (Pin 3) in Timer 555 to Pin (14) in counter (The Clock)

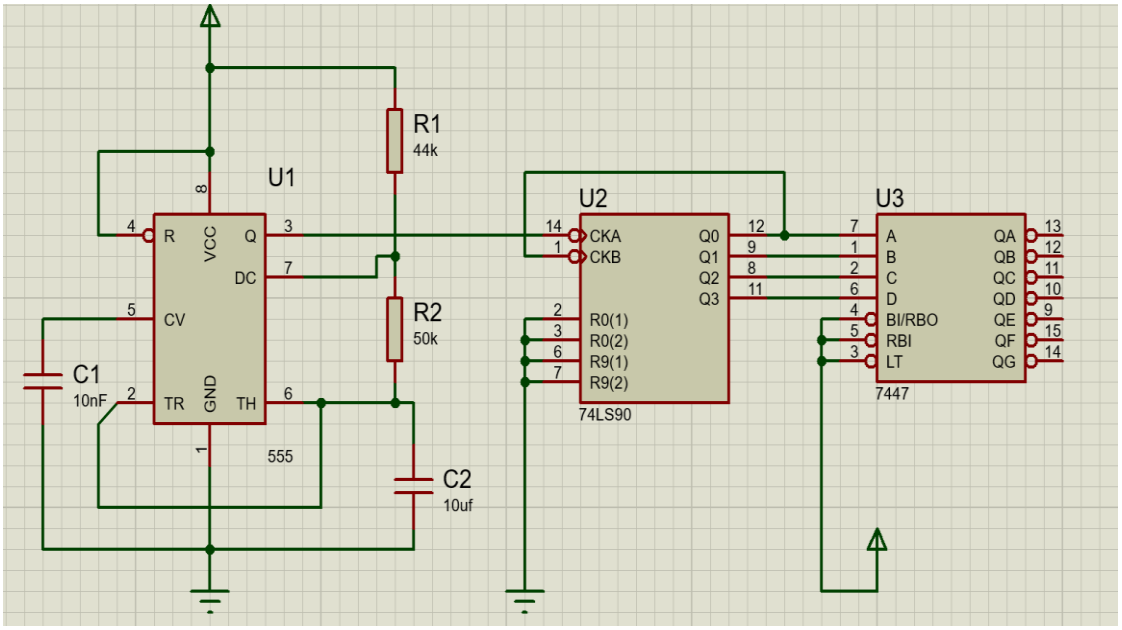


Third: Connect the Seven-Segment Decoder and Display

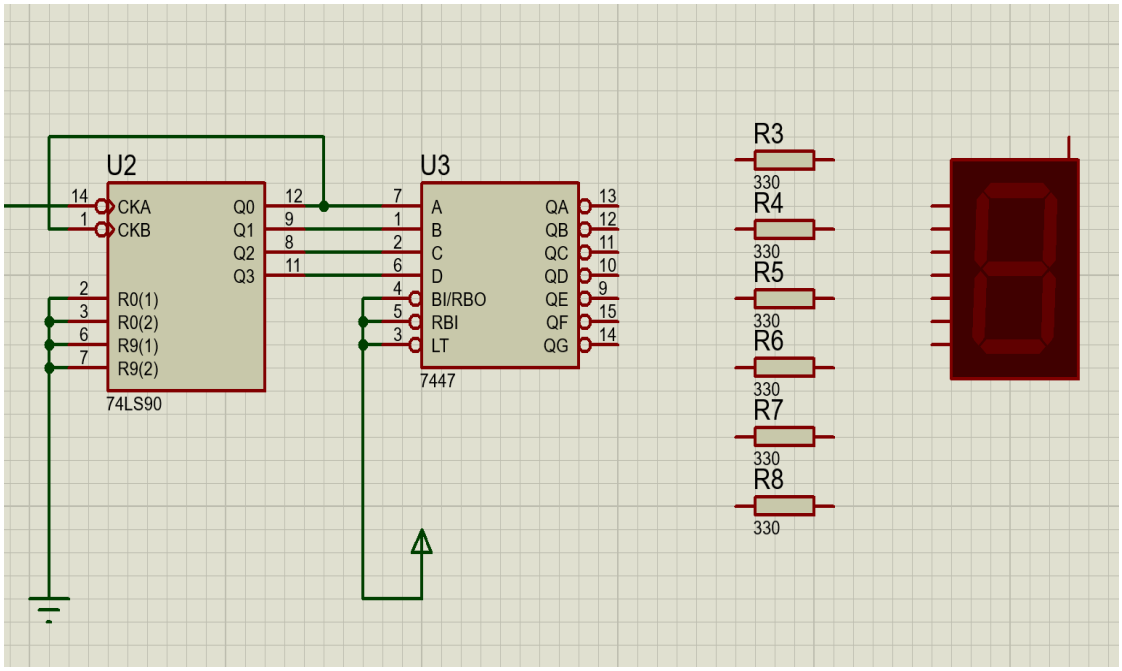
- **Add** from pick device IC 7447



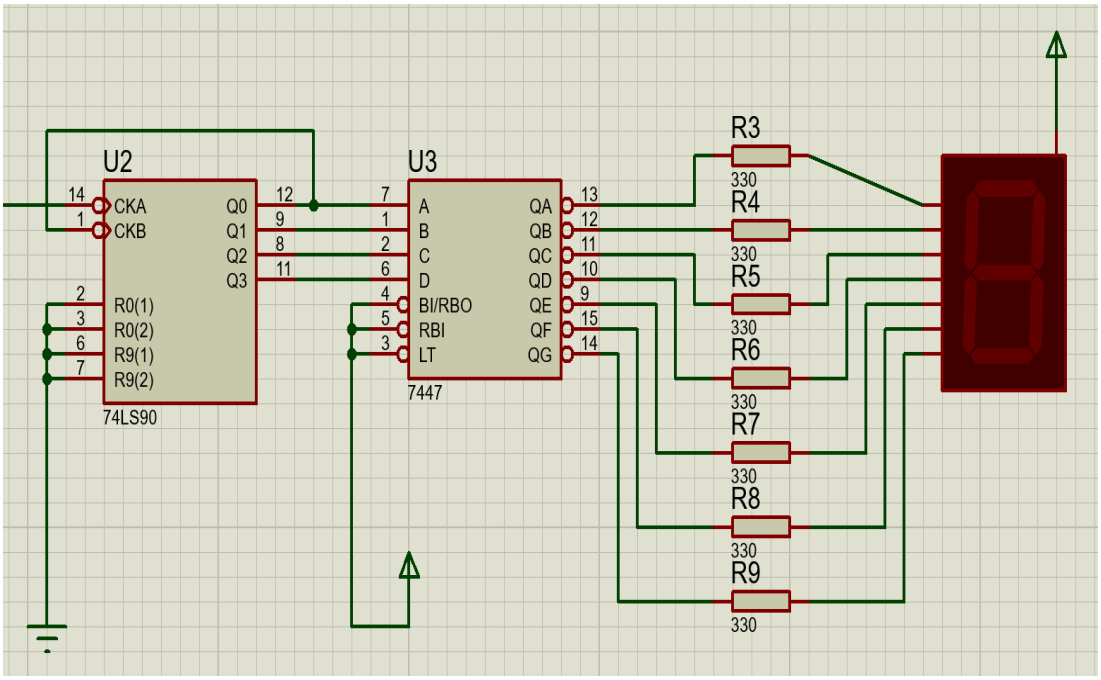
- **Connect** Pin 12 in counter to Pin 7 in Decoder
- **Connect** Pin 9 in counter to Pin 1 in Decoder
- **Connect** Pin 8 in counter to Pin 2 in Decoder
- **Connect** Pin 11 in counter to Pin 6 in Decoder
- **Connect** LT (Pin 3) and BI/RBO (Pin 4) and RBI (Pin 5) to the 5V power



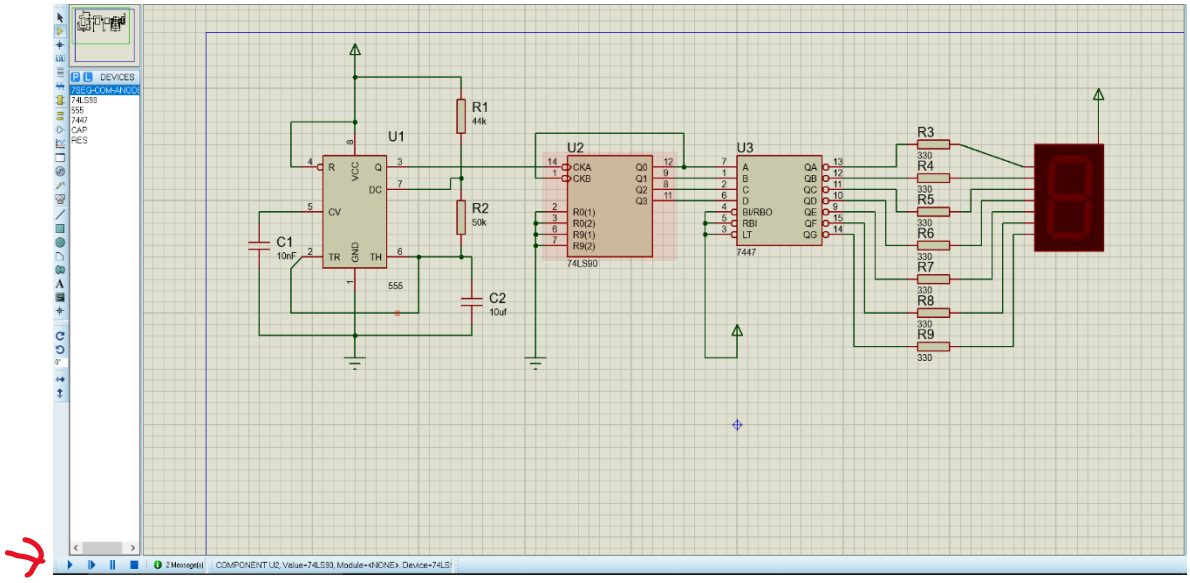
- **Add** from pick devise resistors 330 ohms and anode 7-segment



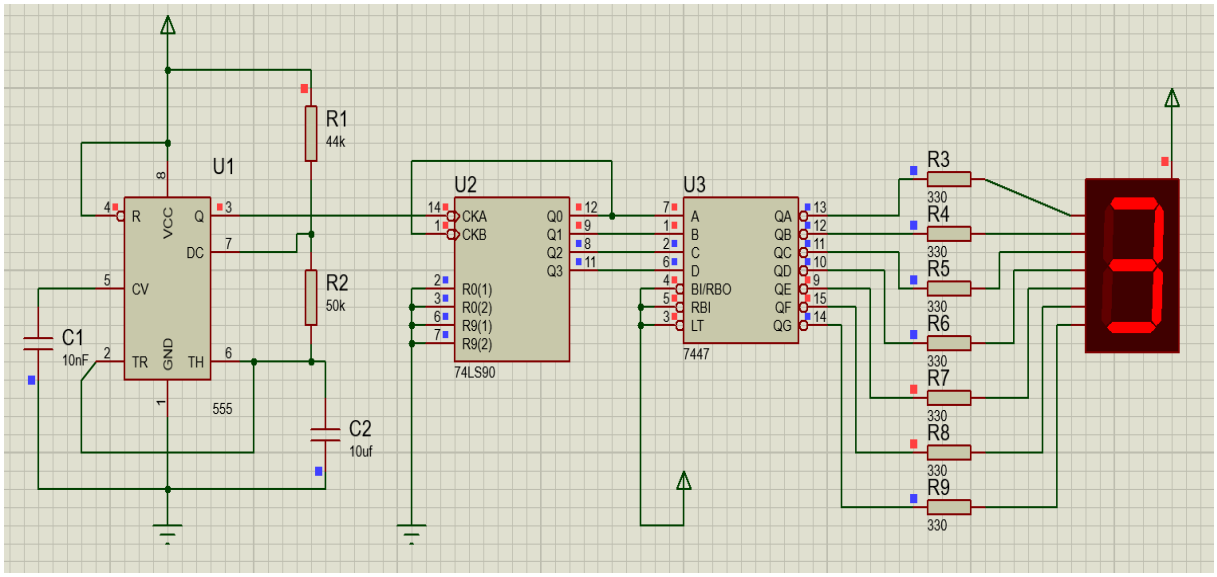
- **Connect** Outputs ‘QA’ to ‘QG’ from 74ls47 to the resistors R3 to R9.
- **Connect** resistors (R3 to R9) to (‘a’ to ‘g’) in the 7-segment display
- **Connect** the common pin in the digital 7 segments to the power pin.



- **Click** on run simulation



Finally: you can notice the counting up on the seven-segment display every second



Task: Hardware Connections.

Now, it is your turn. On the breadboard, **Connect** the above circuit. **Review** the schematic in Figure.8. Then **Test** **the function of 7490 IC.**

Note

- **Proteus Source. Link**
- **Install Proteus Steps Link**
- **Timer and Counter in Proteus video Lab Link**