AMRITA VISHWA VIDYAPEETHAM

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AMRITA SCHOOL OF ENGINEERING, BENGALURU

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

B. TECH. III SEMESTER(ECE) 2023-2024

23ECE281 DIGITAL ELECTRONICS LAB

DIGITAL CLOCK

Submitted by

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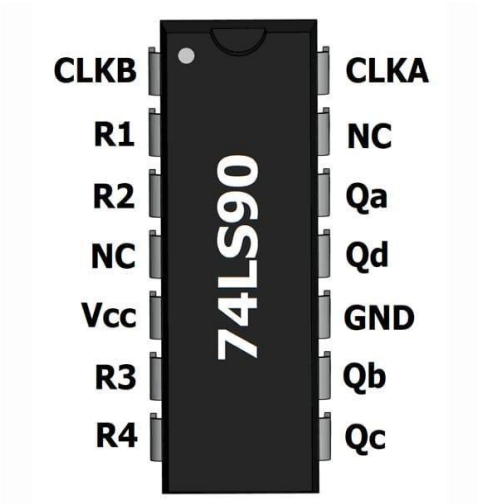
AIM: To construct and set up a digital clock using a common cathode 7-segment display that accurately shows the time.

COMPONENTS REQUIRED ALONG WITH THEIR SPECIFICATIONS:

Sl. No	Name of the Component	Specification	Quantity
1.	IC 7490	Binary decade counter	6
2.	IC 7446	BCD-7segment display driver	6
3.	IC 7408	2I/P And gate	1
4.	IC 555	Timer IC for pulse generator	1
5.	7-Segment Display		6
6.	PCB	12*18cm	1
7.	Battery	9V	1
8.	Connecting wires		

BLOCK DIAGRAM CONSISTING OF ALL THE REQUIRED FUNCTIONS



The 7490 IC is a versatile decade counter, commonly used in digital circuits for counting applications. It has 14 pins, each serving a specific function.

Pin Functions:

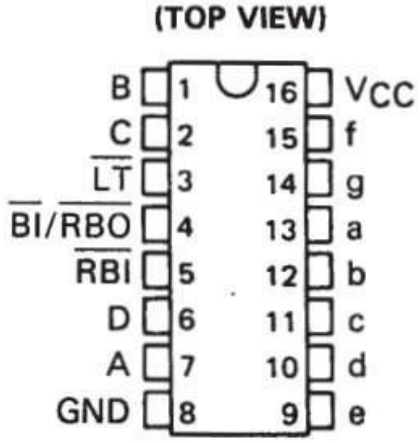
1. **R0 (Reset 0):** When this pin is low, the counter is reset to 0.
2. **R1 (Reset 1):** Another reset pin, similar to R0.
3. **R2 (Reset 2):** Yet another reset pin, also used for resetting the counter.
4. **R3 (Reset 3):** The fourth reset pin, providing flexibility in resetting the counter.
5. **Vcc:** The positive power supply pin, typically connected to a 5V DC supply.
6. **R4 (Reset 4):** The fifth and final reset pin, allowing for various reset configurations.
7. **QA:** The least significant bit (LSB) output of the counter.
8. **QB:** The second least significant bit output.
9. **QC:** The third least significant bit output.
10. **QD:** The most significant bit (MSB) output.
11. **RCO (Ripple Carry Output):** This output goes high when the counter reaches its maximum count (9) and then resets to 0. It can be used to cascade multiple 7490 ICs for higher count values.

12. **NC (No Connection):** This pin is not connected to any internal circuitry and can be left floating.

13. **GND:** The ground pin, connected to the ground potential.

14. **CLK B (Clock Input B):** This is one of the two clock input pins. The counter increments on the negative edge of the clock pulse at this input.

PIN CONFIGURATION OF IC 7446:



The 7446 IC is a popular integrated circuit that converts binary-coded decimal (BCD) inputs into signals to drive a 7-segment display. This allows for the display of numerical digits from 0 to 9

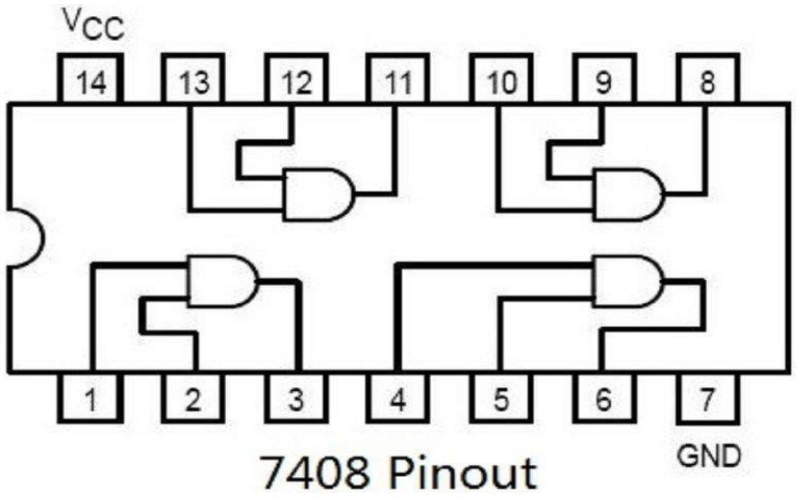
PIN FUNCTIONS:

1. **1,2,6,7 (A, B, C, D):** BCD input lines. These four lines accept a 4-bit binary code representing a decimal digit.
2. **5 (RBI):** Ripple Blank Input. This input is used to blank leading zeros on a multi-digit display.
3. **3 (LT):** Lamp Test Input. When this input is high, all segments of the display are turned on for testing purposes.
4. **4 (RBO):** Ripple Blank Output. This output can be connected to the RBI input of another 7447 IC to cascade multiple displays.
5. **8 (GND):** Ground.

6. **9-15 (a-g):** Outputs corresponding to the segments of a 7-segment display. These outputs drive the individual segments to form the desired digit.

7. **16 (VCC):** Power supply voltage, typically 5V.

PIN CONFIGURATION OF IC 7408:



The 7408 IC is a quad 2-input AND gate, which means it contains four independent 2-input AND gates in a single package. Each gate has two inputs and one output.

PIN FUNCTIONS:

Pin 1: First input of the first AND gate.

Pin 2: Second input of the first AND gate.

Pin 3: Output of the first AND gate. This output is the AND result of inputs 1A and 1B.

Pin 4: First input of the second AND gate.

Pin 5: Second input of the second AND gate.

Pin 6: Output of the second AND gate. This output is the AND result of inputs 2A and 2B.

Pin 7: Ground pin. Connects to the ground of the power supply.

Pin 8: Output of the third AND gate. This output is the AND result of inputs 3A and 3B.

Pin 9: First input of the third AND gate.

Pin 10: Second input of the third AND gate.

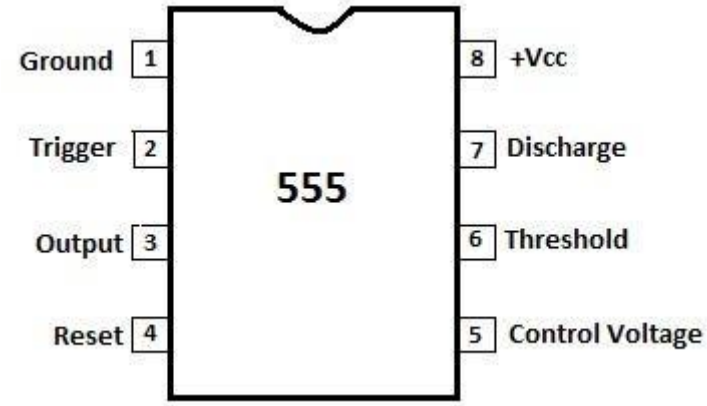
Pin 11: Output of the fourth AND gate. This output is the AND result of inputs 4A and 4B.

Pin 12: First input of the fourth AND gate.

Pin 13: Second input of the fourth AND gate.

Pin 14: Positive power supply pin. Connects to the positive terminal of the power source.

PIN CONFIGURATION OF IC 555:

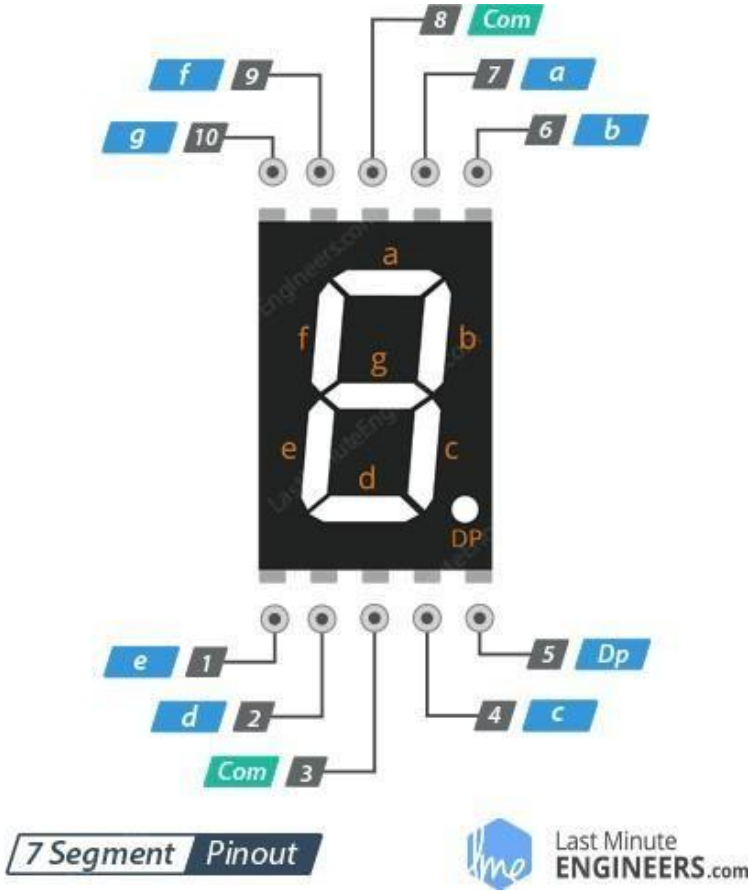


The **IC 555** is a versatile timing integrated circuit widely used for generating precise time delays, pulse waveforms, and oscillations. Here is its 8-pin configuration with each pin's function:

- **Pin 1 (GND)**: Ground. Connects to the negative terminal of the power supply.
- **Pin 2 (Trigger)**: Trigger pin to start the timing cycle. When the voltage on this pin drops below 1/3 of the supply voltage, it initiates the output and changes the internal flip-flop, setting the output high in monostable mode.
- **Pin 3 (Output)**: Provides the output signal. This pin can source or sink current, typically driving LEDs, relays, or other components directly.
- **Pin 4 (Reset)**: Resets the timer when connected to ground. A low signal (0V) on this pin will reset the IC and immediately stop the output, overriding other inputs

- **Pin 5 (Control Voltage)**: Allows control over the threshold voltage (and thus the timing interval) by connecting an external voltage. It is typically connected to ground through a capacitor to stabilize the operation if unused.
- **Pin 6 (Threshold)**: Monitors the voltage across the timing capacitor. When the voltage reaches 2/3 of the supply voltage, it ends the timing cycle and changes the output state in both monostable and a stable modes.
- **Pin 7 (Discharge)**: Connected internally to an open-collector transistor, which discharges the timing capacitor to ground when the output is low in a stable mode.
- **Pin 8 (Vcc)**: Positive power supply. Connects to the positive terminal of the power supply (typically 4.5V to 15V).

7-SEGMENT DISPLAY PIN CONFIGURATION:



Common Anode 7-segment display, all the anodes of the LEDs are connected together and are typically tied to a positive voltage source (like +5V or +3.3V). The individual segments are controlled by applying a LOW voltage (0V) to their corresponding cathodes, which turns the segment ON. To turn a segment OFF, a HIGH voltage (Vcc) is applied to its corresponding cathode.

PIN NUMBER	SEGMENT	DESCRIPTION
1	E	Bottom-left vertical segment
2	D	Bottom horizontal segment
3	Dp	Decimal point
4	C	Bottom-right vertical segment
5	G	Middle horizontal segment
6	B	Top-right vertical segment
7	A	Top horizontal segment
8	Common anode	Tied to positive voltage (Vcc)
9	Common anode	Tied to positive voltage (Vcc)
10	Common anode	Tied to positive voltage (Vcc)

THEORY:

A digital clock is an electronic device that displays time using digital components. This system level design uses integrated circuits (ICs) 7490, 7446 and 7408, 7- segment display, capacitors and resistors to create a functional digital clock.

IC 7490: This IC is used as a decade counter to generate the timing signals for seconds, minutes, and hours.

IC 7446: This IC is a decoder that converts binary inputs into 7-segment display outputs.

IC 7408: This IC is a quad AND gate used for various logic operations within the circuit.

7- Segment Display: This component displays the numerical output. Each digit is controlled by a 7446 IC, converting the binary count to a human-readable number format on the display.

CIRCUIT OPERATION:

1. Timing Generation:

- The 74LS90 ICs generate the timing signals for seconds, minutes, and hours.
- The clock input to the first 74LS90 IC (for seconds) is likely provided by a crystal oscillator or an external clock source.
- The output of each 74LS90 IC is connected to the input of the next 74LS90 IC to create a cascading counter.

2. Display Control:

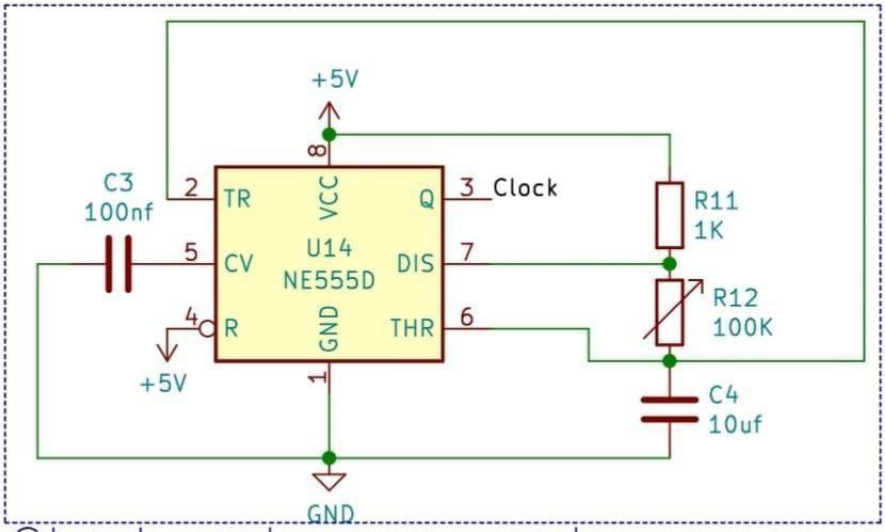
- The outputs of the 74LS90 ICs are connected to the inputs of the 74LS46 ICs.
- The 74LS46 ICs decode the binary inputs and activate the appropriate segments of the 7-segment displays to display the current time.

3. Logic Gates:

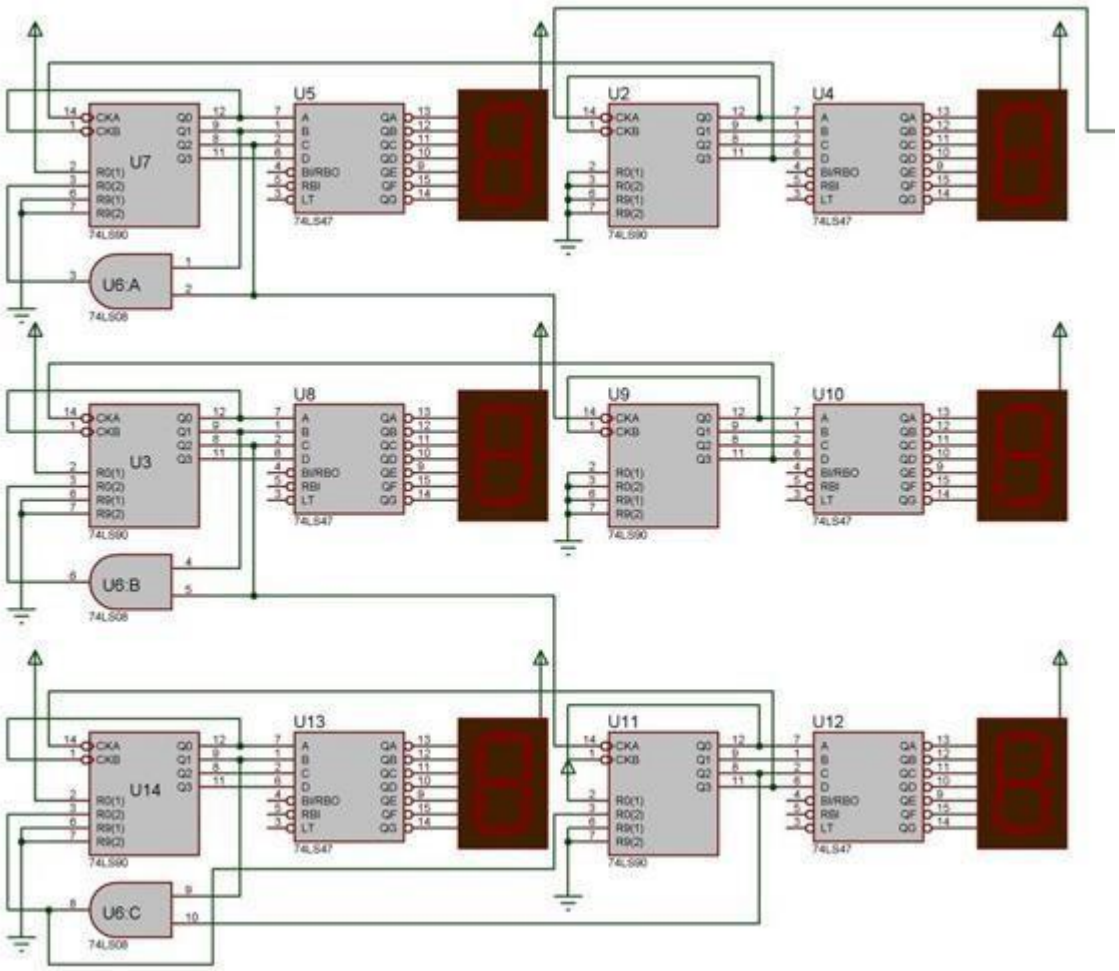
- The 74LS08 ICs are used for various logic operations, such as generating the carry signals for the decade counters and controlling the display segments.

LOGIC CIRCUIT:

CLOCK PULSE GENERATOR

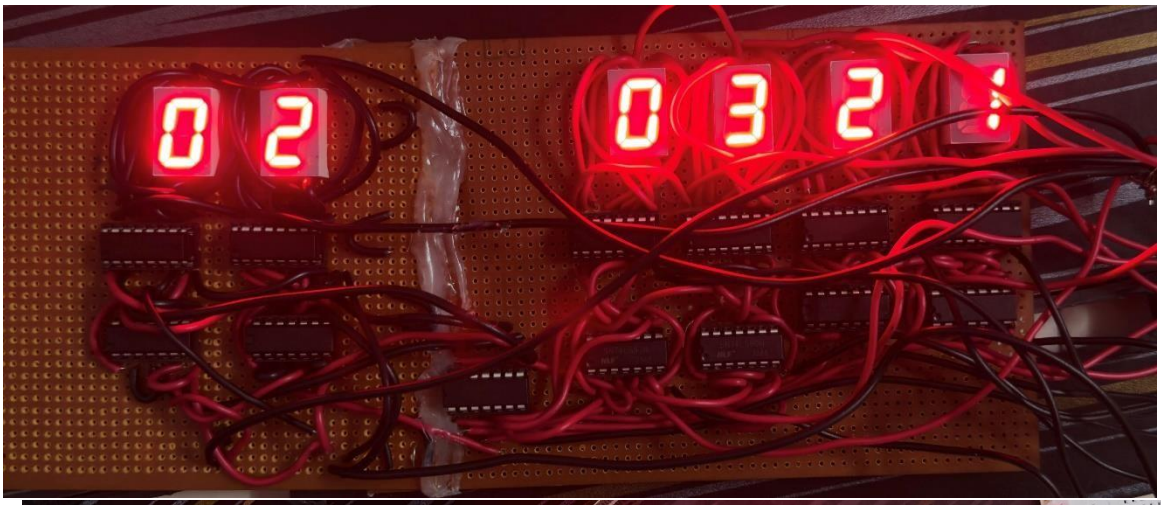


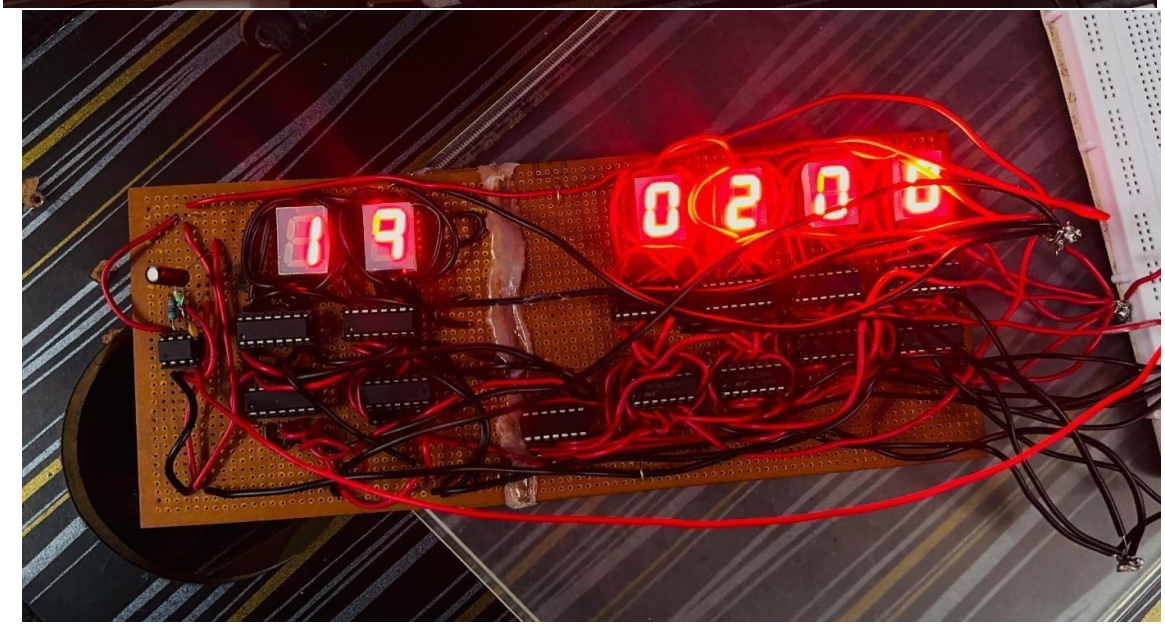
Clock pulse generator



SCREENSHOT OF THE WORKING HARDWARE FOR ALL THE REQUIRED FUNCTIONS:

OUTPUT OBTAINED:





RESULT:

The digital clock successfully displayed time in MM: SS format on the common cathode 7segment display. The IC 7490 generated the timing signal for seconds and minutes, while IC 7446 converted the binary inputs into 7 segment display output. The 555IC ensured accurate timing with a steady 1Hz pulse.

Accuracy: The clock maintained precise time with a steady 1Hz pulse from the 555IC.

Display: The time was clear, with proper illumination.

CONCLUSION:

This experiment successfully demonstrated the construction of digital clock using IC 7490 and IC 7446, along with a common cathode display. The clock displayed time in MM: SS format accurately, with stable timing provided by the 555 IC. The use of PCB made the design compact and durable, ensuring reliable performance.

ACTUAL COST REQUIRED:

SI.NO	Name of the component	Cost	Quantity	Total
1	IC Holder	3.65	14	51.1
2	IC NE555P Timer IC	7	1	7
3	wire	7.85	10m	78.5
4	Capacitor's (0.1uF,10uF)	5.51,5.51	(0.1uF) =1 (10uF) =1	11.02
5	Resistor's(100Kohm,1kohm)	5	(100kohm) =1	89
6	Lead wire	75	1	75
Total = 311.62				

PROBLEMS FACED DURING THE IMPLEMENTATION

- Formation of solder bridges (short circuit) and cold joints.
- Pads lifting from PCB.

PROBLEMS RESOLVED USING SOLUTIONS

- Ensure the soldering iron temperature is appropriate and the solder is applied correctly.
- Employ high-precision placement equipment and accurate component placement techniques.
- Proper placement prevents excessive stress on the pads.

REFERENCES

Circuit diagram:

- Observed from digital electronics lab notice board.