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Aim

- Verification of state tables of R-S and D flip-flops (with PRESET and CLEAR inputs) using NAND gates

Apparatus

- IC 7410 (3-input NAND Gate)

Theory

Sequential logic is a type of logic circuit whose output depends not only on the present value of its input signals but on the sequence of past inputs, the input history as well. This is in contrast to combinational logic, whose output is a function of only the present input. This means that sequential logic circuits are able to take into account their previous input state as well as those actually present, a sort of "before" and "after" effect is involved with sequential circuits.

In other words, the output state of a "sequential logic circuit" is a function of the following three states, the "present input", the "past input" and/or the "past output". Sequential Logic circuits remember these conditions and stay fixed in their current state until the next clock signal changes one of the states, giving sequential logic circuits "Memory".

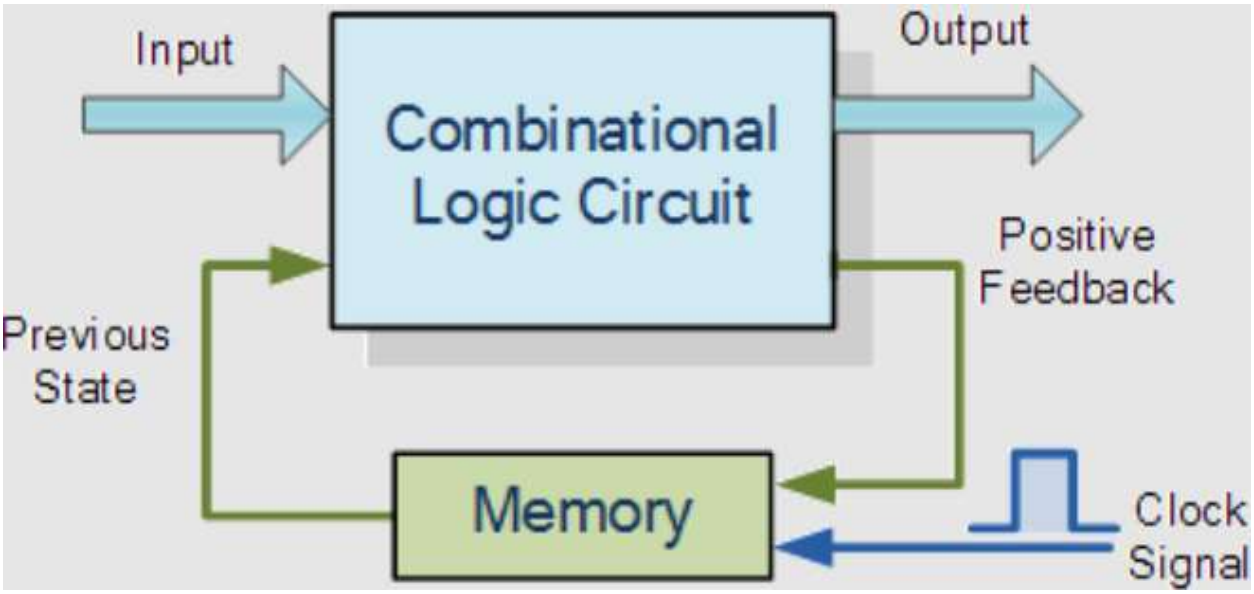

Figure 1

Flip Flop

A flip flop is an electronic circuit with two stable states that can be used to store binary data. The stored data can be changed by applying varying inputs. Flip-flops and latches are fundamental building blocks of digital electronics systems used in computers, communications, and many other types of systems. Both are used as data storage elements. It is the basic storage element in sequential logic.

R-S Latch vs R-S Flip-Flop:

The basic difference between a latch and a flip-flop is a gating or clocking mechanism.

In Simple words. Flip Flop is edge-triggered and a latch is level triggered.

Applications of Flip-Flops

These are the various types of flip-flops being used in digital electronic circuits and the applications of Flip-flops are as specified below.

- Counters
- Frequency Dividers
- Shift Registers
- Storage Registers

Logic Diagram

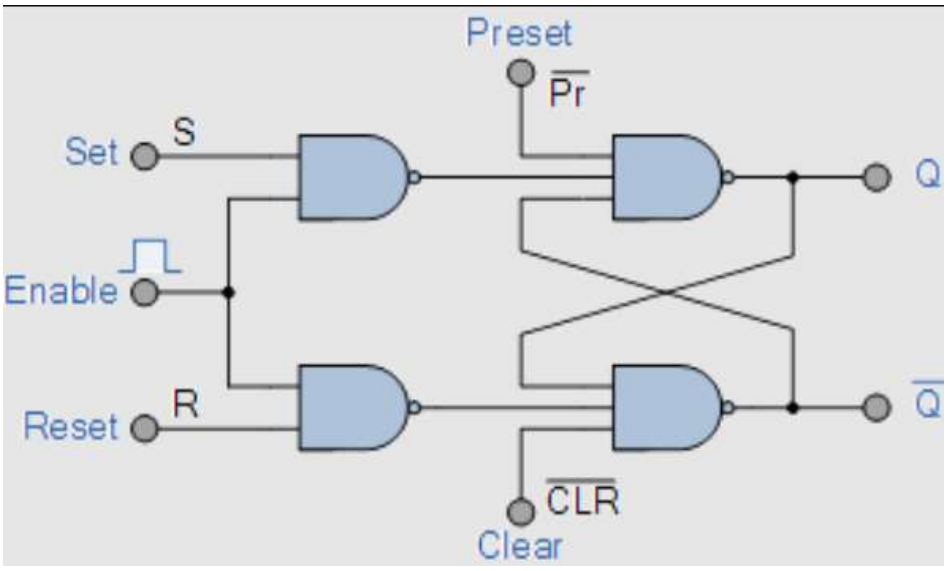

Figure 2

Truth Table

EN	SET	RESET	PRE	CLR	Q(t+1)
x	x	x	0	1	1 (SET)
x	x	x	1	0	0 (RESET)
0	x	x	1	1	Qt (NC)
1	0	0	1	1	Qt (NC)
1	0	1	1	1	0 (RESET)
1	1	0	1	1	1 (SET)
1	1	1	1	1	Indeterminate

Table : 1

D Flip Flop

D flip-flop is a better alternative that is very popular with digital electronics. They are commonly used for counters and shift-registers and input synchronization. In this, the output can be only changed at the clock edge, and if the input changes at other times, the output will be unaffected.

The change of state of the output is dependent on the rising edge of the clock. The output (Q) is same as the input and can only change at the rising edge of the clock.

Logic Diagram

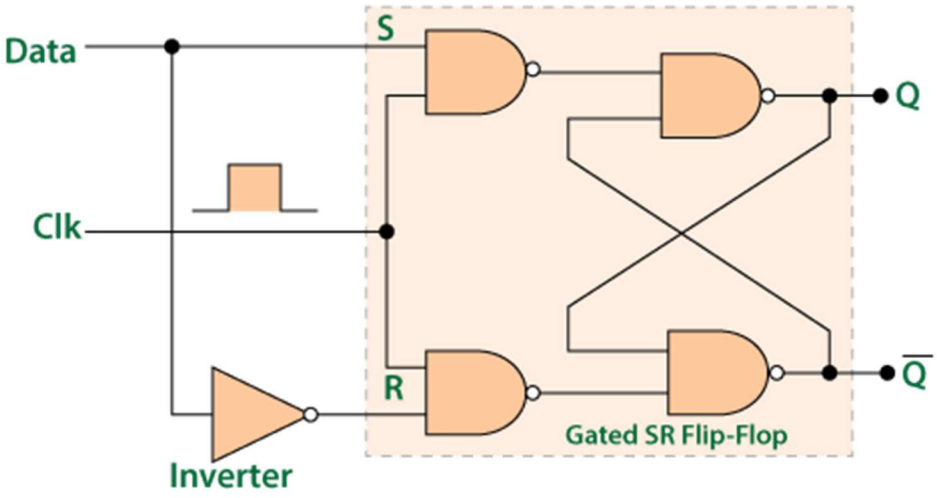

Figure 3

Truth Table

EN	D	PRE	CLR	Q(t+1)
x	x	0	1	1 (SET)
x	x	1	0	0 (RESET)
0	x	1	1	Qt (NC)
1	0	1	1	0 (RESET)
1	1	1	1	1 (SET)

Table 2

Procedure

1. Connections are made as per circuit diagram.
2. Verify truth- tables for various combinations of input.

Precaution

1. All the ICs should be checked before using the apparatus.
2. All LEDs should be checked.
3. All connections should be tight.
4. Always connect GROUND first and then VCC.
5. The circuit should be off before changing the connections.
6. After completing the experiment switch off the supply to apparatus.

Pre-Lab Questions:

1) Differentiate between combinational and sequential circuits.

Ans. A circuit whose output is dependent only on the inputs at that instant is called combinational circuit. And a circuit whose output is dependent on present and past history of the inputs is called sequential circuit.

2) What is a latch?

Ans. Storage elements that operate with signal levels are referred to as latches.

3) What is a flip-flop?

Ans. Storage elements controlled by clock transitions are called flip-flops

Lab Implementation

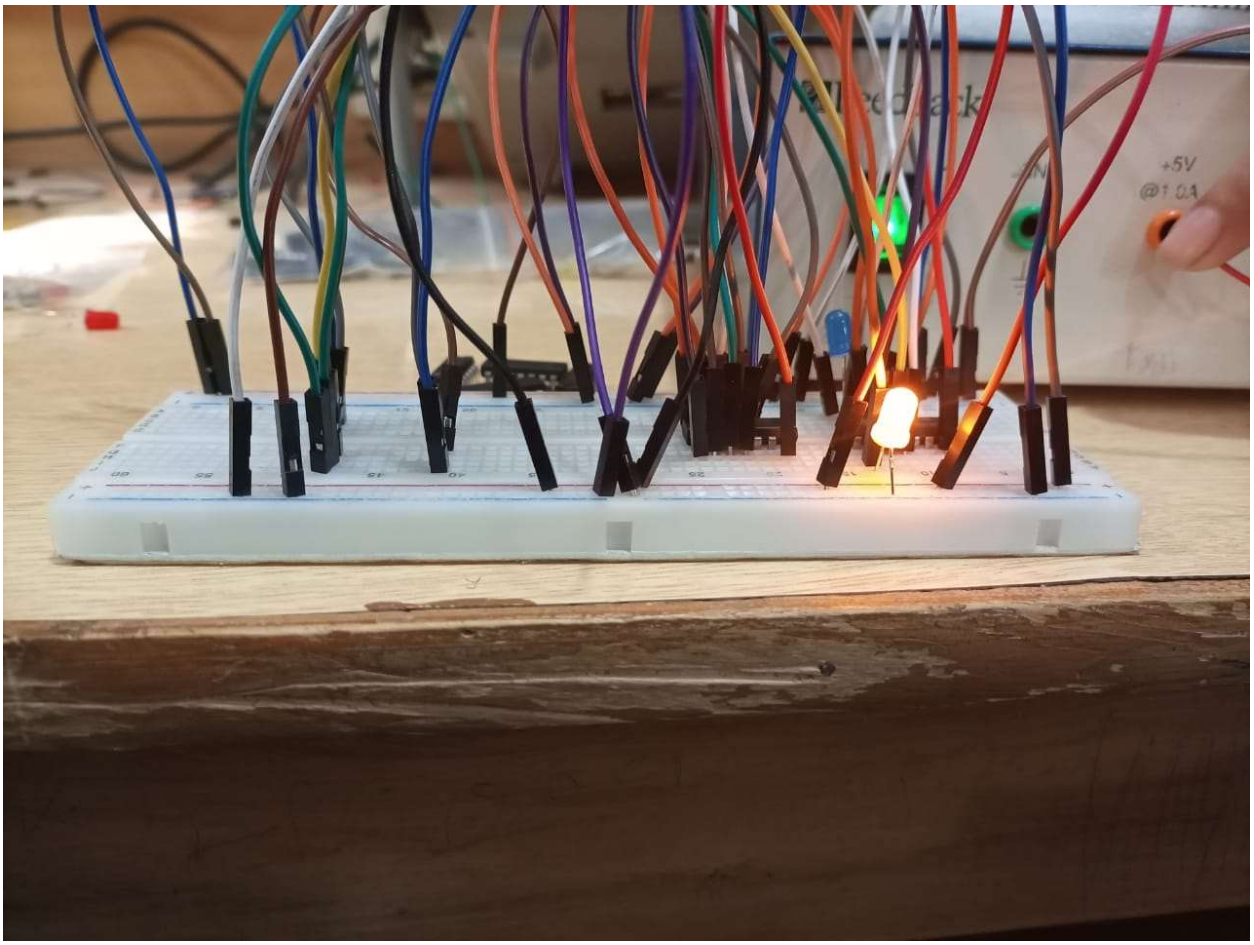

Figure 4: SR Latch

S-R:

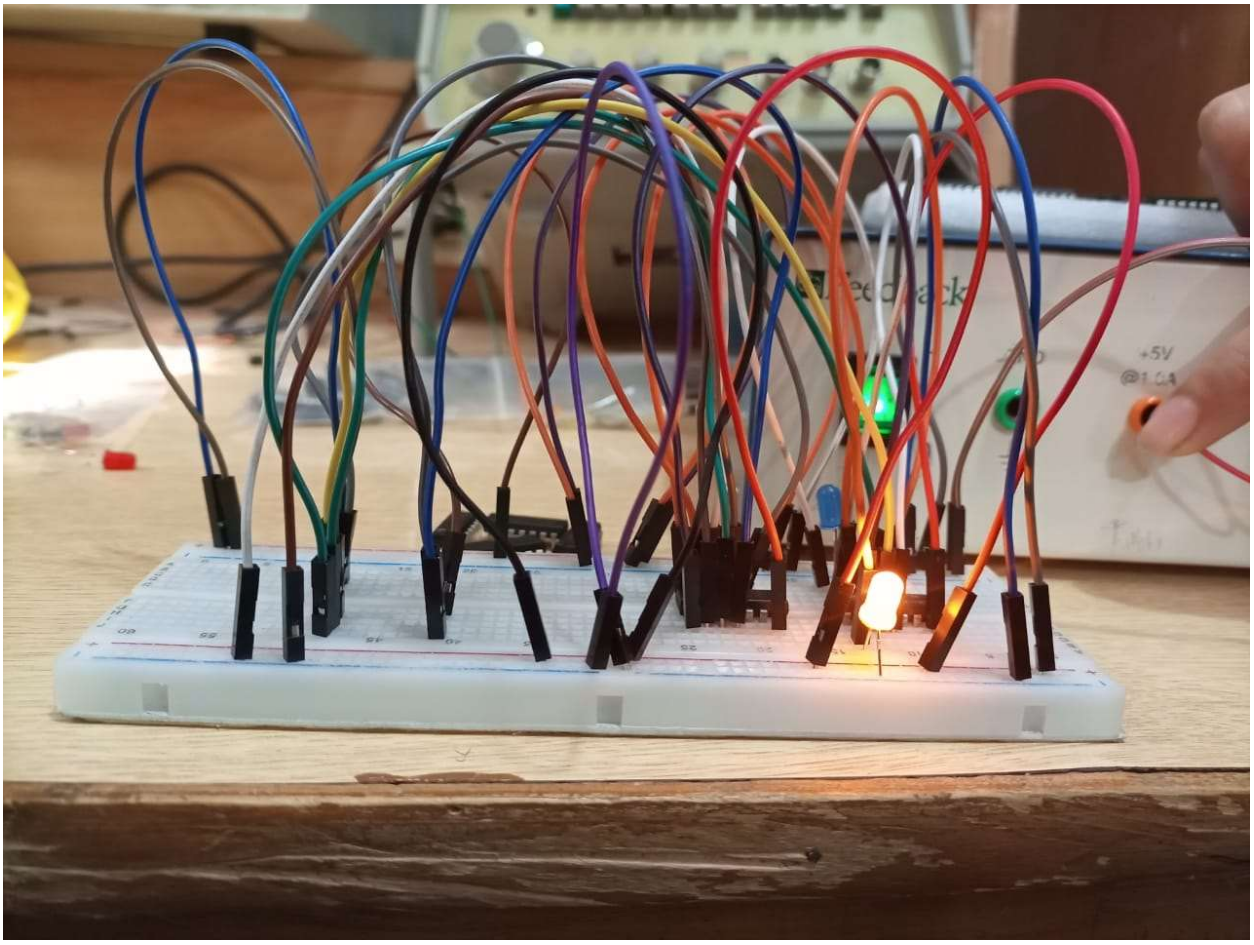

Figure 5: S-R

D Flip Flop Implementation:

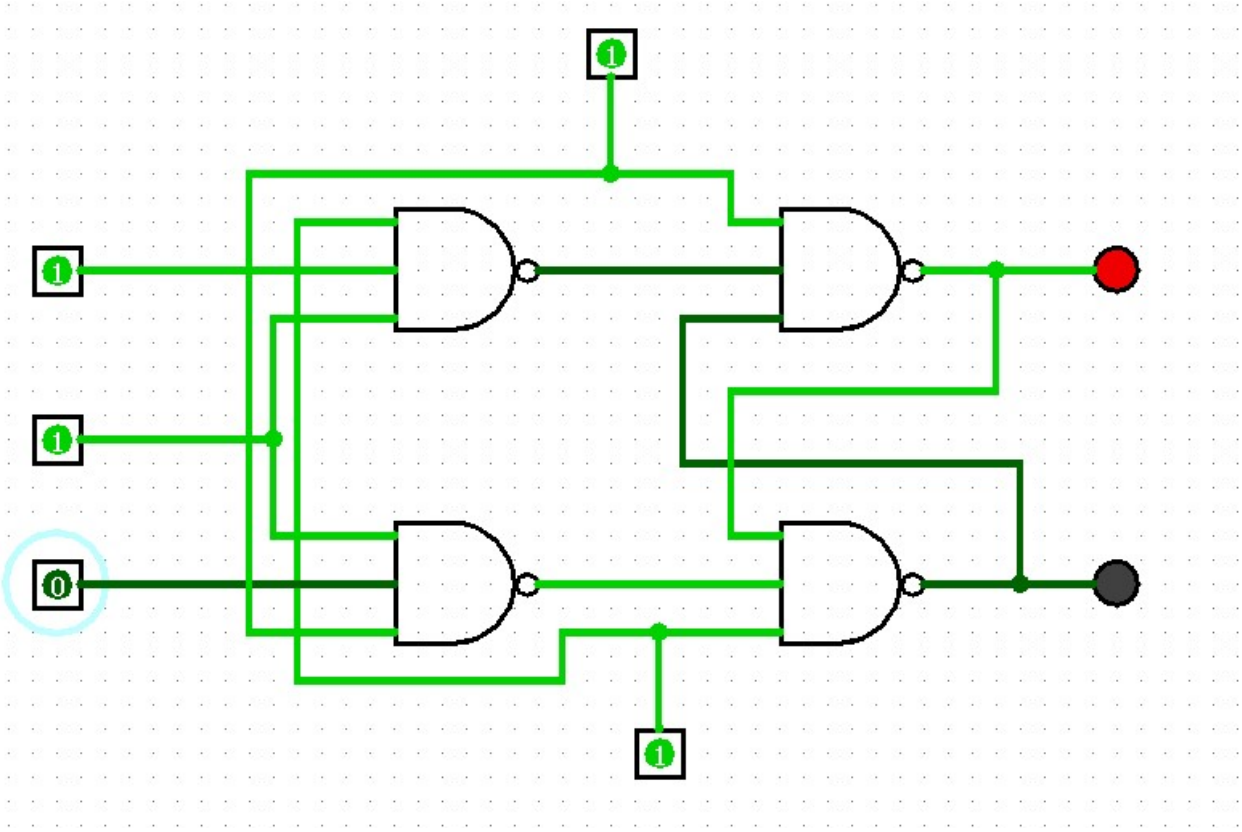

Figure 6: In SET State

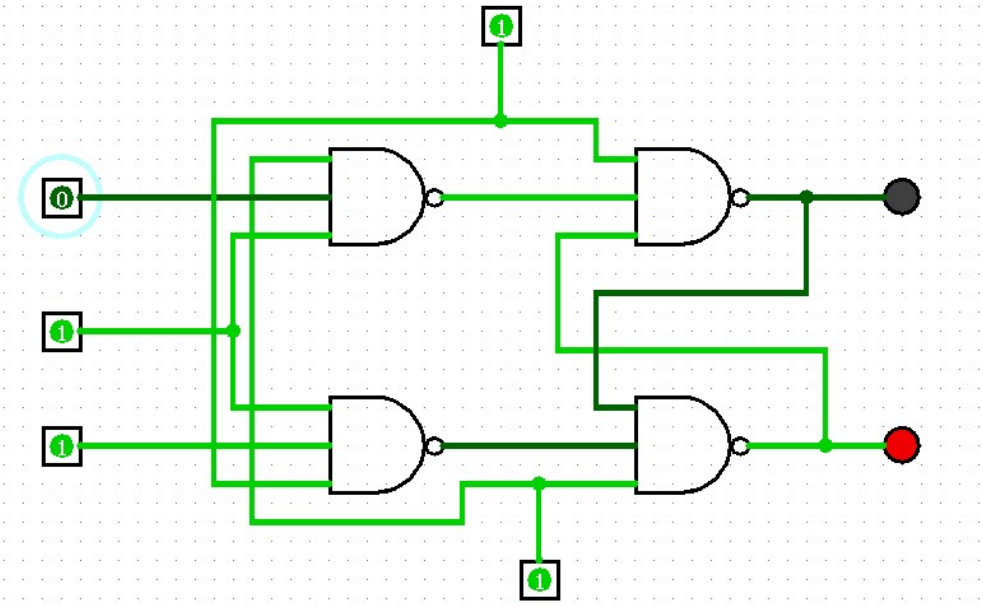

Figure 7: In RESET State