Digital clock Report

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Contents

INTRODUCTION

Digital Clock is the Clock that displays the time in the digits. With the help of various electronics devices and display, time can be display in the form of the digits/ digital form.

In this project, I have used JK Flip Flop as a counter to count the time in seconds, minutes and hours. The used flip-flop have similar clock timing and different clock timing, I have used them considering the complexity reduction of the circuits and for my easiness.

Materials Used:

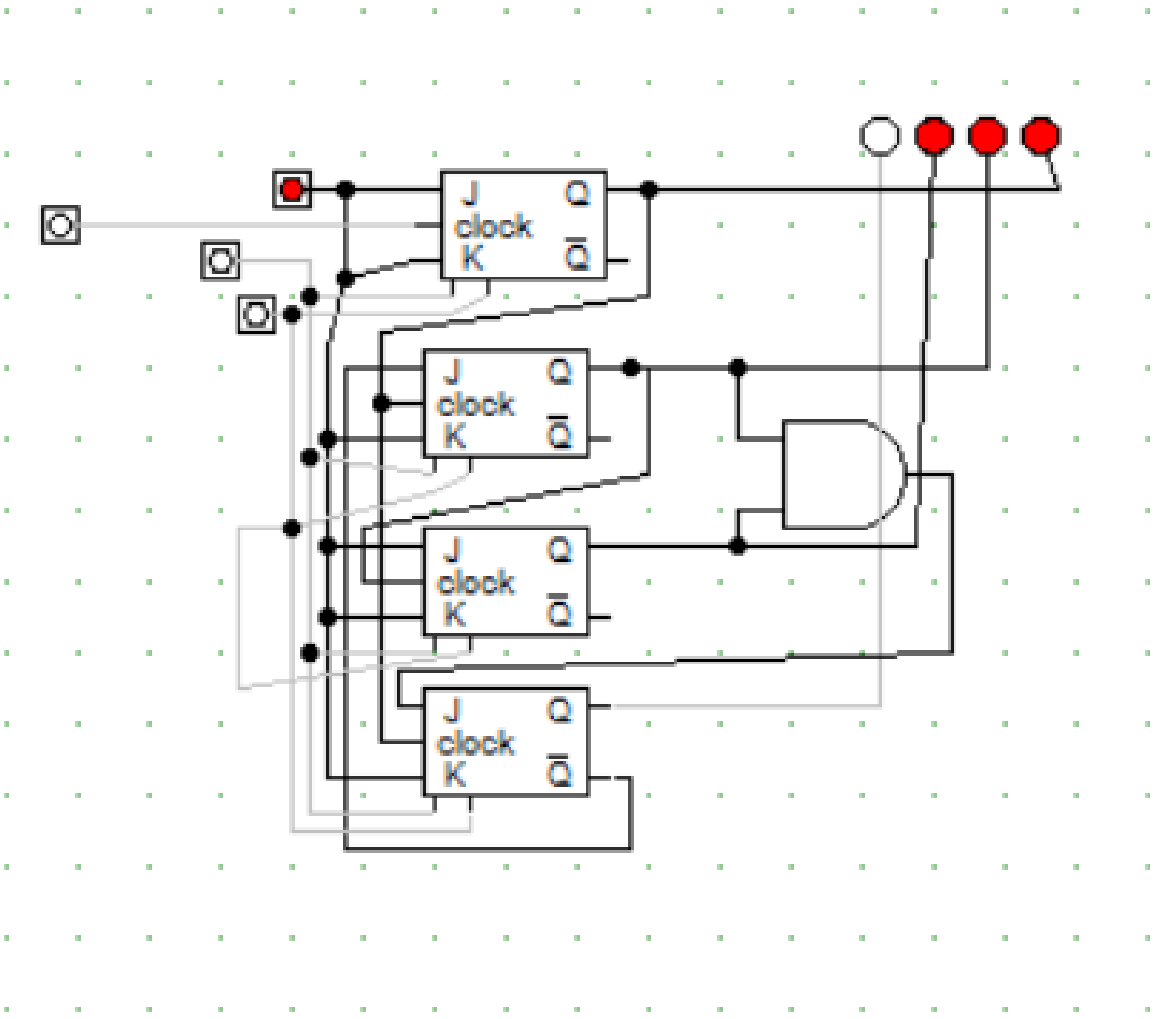
1. MOD -10 Counter/ BCD counter
2. MOD-5 Counter
3. MOD-2 Counter
4. 7 segment display
5. Digital works simulator
6. Basic logic gates
7. Clock

BCD Counter:

BCD Counter is a digital counter that counts from 0 to 9 as per the input clock pulse. It counts form the 0000 in binary to 1001 in binary and in the next trigger it resets to 0000 and it starts counting from 0000 to 1001 for

every trigger, in this way the reset and counting goes on in the BCD counter.

BCD counter using the JK flip-flop:



MOD-3

MOD-3 counter is the digital counter that counts to2. Two flip-flop is used to make this counter. It counts from 0 to 2 and then for the next clock cycle it resets and again starts counting after the next trigger.

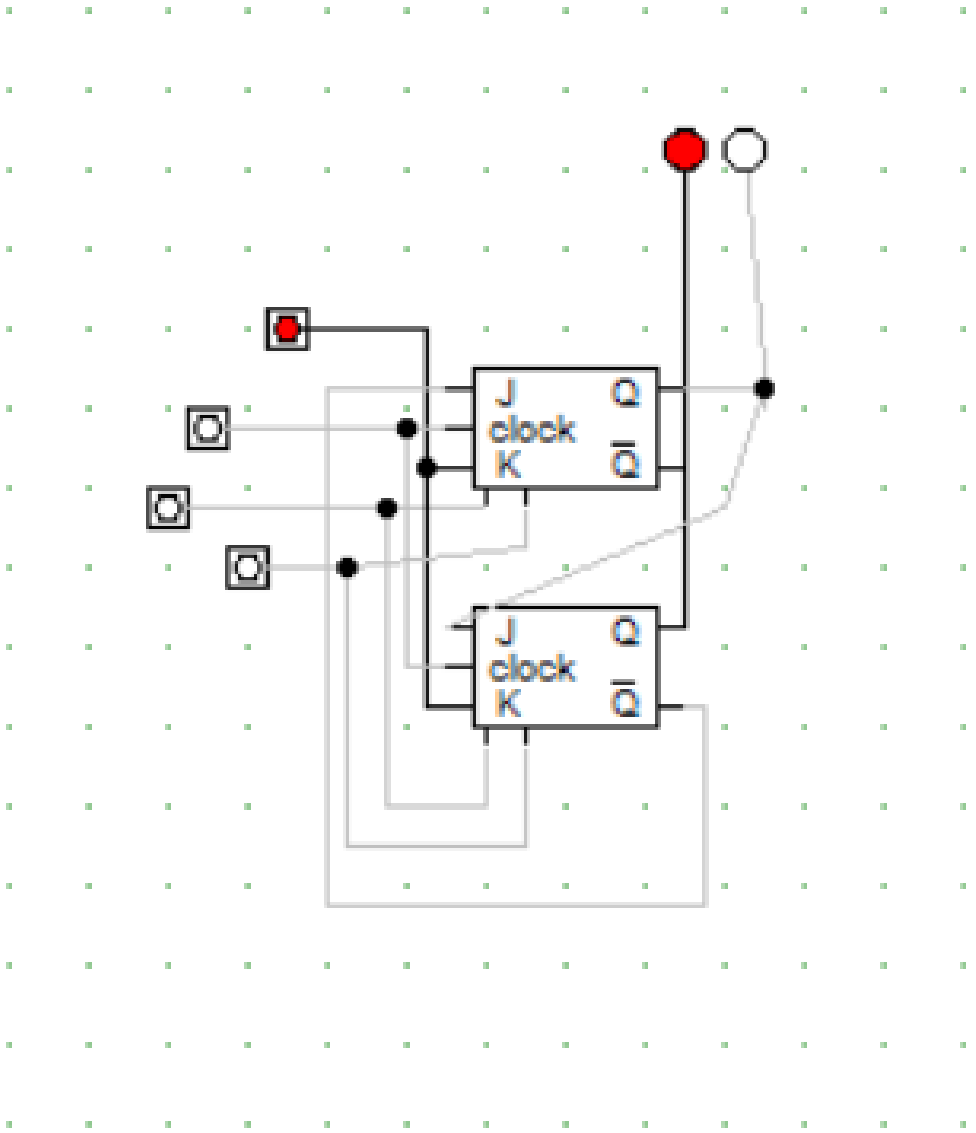


Figure: MOD-3 counter using the JK flip-flop

MOD-6 counter:

MOD-6 counter is the digital counter that counts from 0 to 5. It requires three flip-flops. Similar to mod-10 and mod-2 counter this counter counts from 0 to 5. At 5, after the next trigger it resets the flip-flop outputs to zero and starts counting after the next trigger.

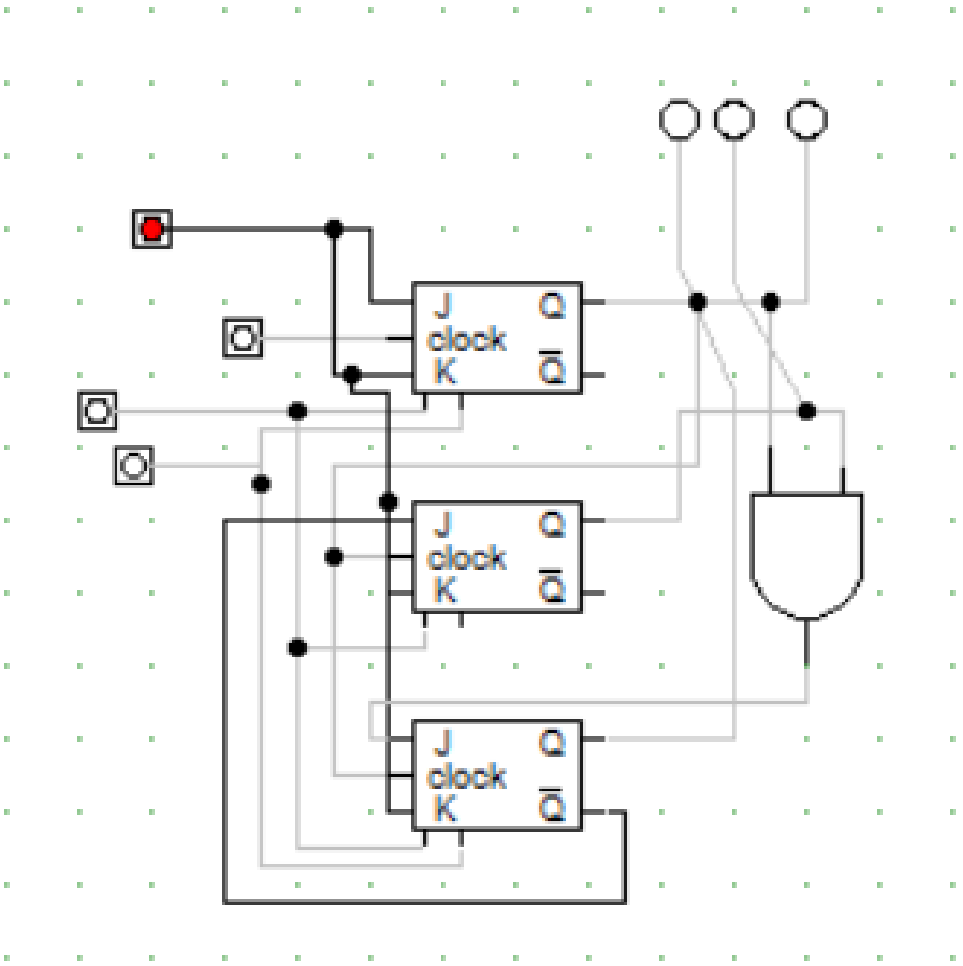
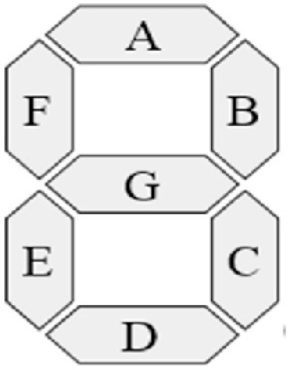


Figure: MOD-6 counter using JK flip-flop

7- Segment display:

7-Segment display is the form of the electronic display device that is used to display the decimal numbers mostly. It's also written as "seven segment display", consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown:



Decimal	Segments
0	ABCDEF
1	BC
2	ABDEG
3	ABCDG
4	BCFG
5	ACDFG
6	ACDEFG
7	ABC
8	ABCDEFG
9	ABCDFG

Truth table for the BCD counter:

Inputs				Seven Segment Displays							
Q3	Q2	Q1	Q0	A	B	C	D	E	F	G	Decimal
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	1	0	1	1	9

1	0	1	0	x	x	x	x	x	x	x	10
1	0	1	1	x	x	x	x	x	x	x	11
1	1	0	0	x	x	x	x	x	x	x	12
1	1	0	1	x	x	x	x	x	x	x	13
1	1	1	0	x	x	x	x	x	x	x	14
1	1	1	1	x	x	x	x	x	x	x	15

On solving the k-map for all the display of the seven segment displays, we get,

A = Q3 + Q1 + Q2’Q0’ + Q2 (Q1 + Q0)

B = Q1’Q0’ + Q1Q0 + Q2’

C = Q2 + Q0 + Q1’

D = Q3 + Q2’Q0’ + Q1Q0’ + Q2Q1’Q0

E = Q1Q0’ + Q2’Q0’

F = Q3 + Q2Q1’ + Q2Q0’ + Q1’Q0’

G = Q3 + Q2’Q1 + Q2Q1’ + Q1Q0’

FOR MOD-6 counter:

Similarly, Solving the truth table for the MOD-6 counter we get the Boolean expressions for the 7-segment display terminals:

A = Q2Q0 + Q1 + Q2’Q0’

B = Q2’Q0’

C = Q0 + Q1’

D = A

E = Q2’Q0’

F = Q2 + Q1’Q0’

G =Q2Q1

Boolean expression for the mod-3 counter:

ON solving the truth table for the seven-segment display for the MOD-3 counter we following expressions:

A = Q1 + Q0’

B = 1

C = Q1’

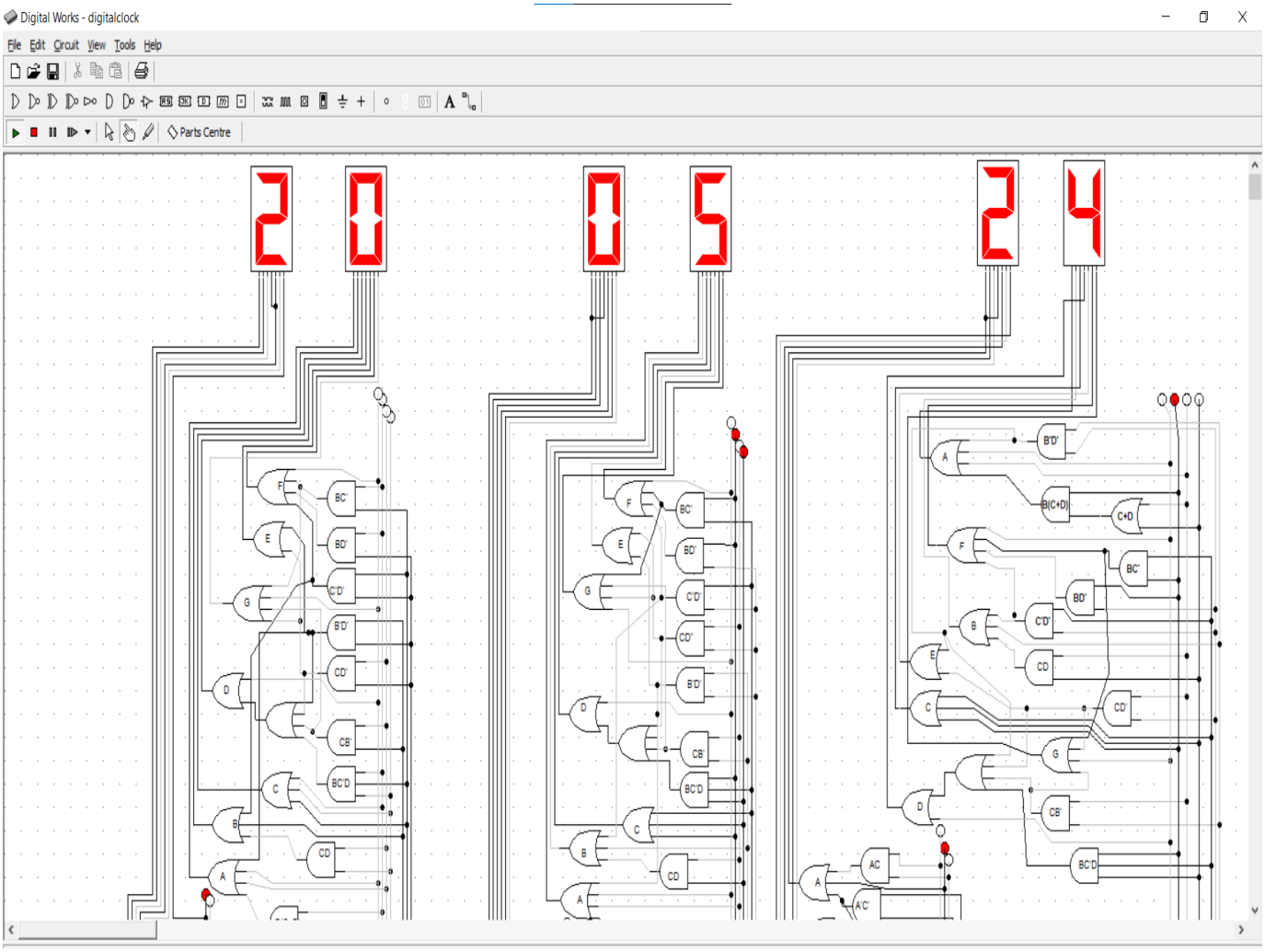
D = Q0’

E = D

F = Q1’Q0’

G = Q1

DIGITAL CLOCK



WORKING OF THE DIGITAL CLOCK:

This is the 24-hour format digital clock. There are 6 flip- flop. They are BCD Counter and MOD-6 counter for the minutes and seconds and for the hour MOD-3, counter and BCD counter is used.

The digital clock can be broken down to the four parts:

1. Seconds: The seconds counter count up to 59 and then reset in the next clock pulse and in next clock cycle, it restarts counting. For the counter two JK flip-flop is used BCD counter and MOD-6 counter. The clock of the BCD counter is connected to the Q4 of the JK flip-flop. This changes the state of the mod-6 counter. The BCD counts from 0 to 9 and in next clock when the Q4 of the BCD counter changes from 9 to 0 , the state of the mod-5 counter is changed.

2. Minutes: It is similar to the seconds counter however; the clock of the BCD counter in this counter is connected from the output of the second MOD-5 counter so that when the seconds go from the 59 to 60, it changes state of the minutes BCD counter. And the next part of this is MOD-5 counter the clock of this counter is connected from the output of the BCD counter, so that when the minutes goes from 9 to 10 it displays in 10 as BCD counter only display 0 -9.

3. Hours: Hours counter is made by using the BCD counter and the MOD-3 counter. The clock of the BCD counter is connected to the output of the minutes MOD-6 counter so that when the MOD-5 flip-flop goes from 5-6 the hours counter changes the state. And, the MOD-3 counter counter counts from 0 – 2 for 24 hour format.

4. Reset: When the Hour goes from 23 to 24, the whole clock resets to the 00: 00: 00. By connecting the Boolean expression for 2 in the MOD-3 counter and the 4 in the BCD counter to the input of the and gate and connecting them to the Clear of all the flip-flop. This resets the whole counter to zero and after next clock pulse, it starts counting again.