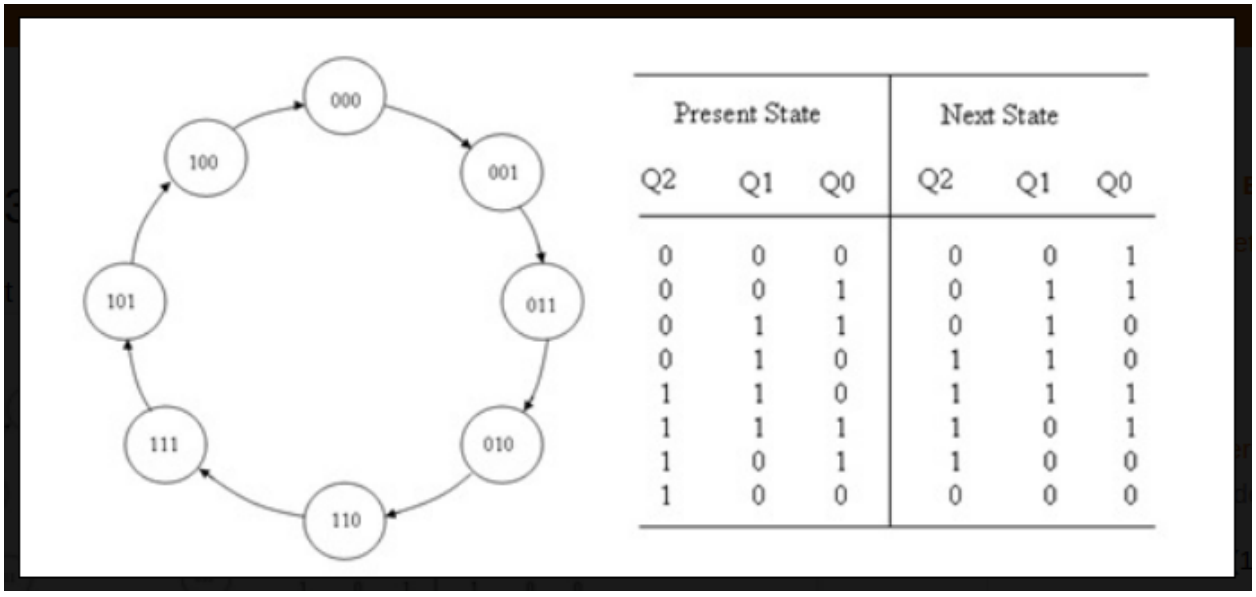
3-Bit Gray Code Counter

Gray code is a kind of binary number system where only one bit will change at a time. A Gray Code encodes integers as sequences of bits with the property that the representations of adjacent integers differ in exactly one binary position. The 3-bit gray code counter takes one input(pulse) and has one output. The output is high (1) when the state changes from S7 to S0 i.e after 8 input pulse.

The states are represented as:
S0 = 000
S1 = 001
S2 = 011
S3 = 010
S4 = 110
S5 = 111
S6 = 101
S7 = 100

State Diagram :



Present State			Next State		
Q2	Q1	Q0	Q2	Q1	Q0
0	0	0	0	0	1
0	0	1	0	1	1
0	1	1	0	1	0
0	1	0	1	1	0
1	1	0	1	1	1
1	1	1	1	0	1
1	0	1	1	0	0
1	0	0	0	0	0

Truth Table for Gray Counter:

Gray Code	Counter	Current State (Q2 Q1 Q0) (at time t)	Next State (Q2 Q1 Q0) (at time t+1)	Output (at time t)
000	0	S0	S1	0
001	1	S1	S2	0
011	2	S2	S3	0
010	3	S3	S4	0
110	4	S4	S5	0
111	5	S5	S6	0
101	6	S6	S7	0
100	7	S7	S0	1

In the above truth table, it is assumed that Gray Code changes on posedge of the input pulse. So that means state changes on every posedge of the input pulse, and the value of the counter is incremented by one till it reaches 7 after which it is reset to zero.

Excitation Table:

PRESENT STATE			NEXT STATE			Excitation Inputs					
Q_2	Q_1	Q_0	Q_2	Q_1	Q_0	J_2	K_2	J_1	K_1	J_0	K_0
0	0	0	0	0	1	0	X	0	X	1	X
0	0	1	0	1	1	0	X	1	X	X	0
0	1	1	0	1	0	0	X	X	0	X	1
0	1	0	1	1	0	1	X	X	0	0	X
1	1	0	1	1	1	X	0	X	0	1	X
1	1	1	1	0	1	X	0	X	1	X	0
1	0	1	1	0	0	X	0	0	X	X	1
1	0	0	0	0	0	X	1	0	X	0	X

Transition Table:

Input	Q2 - Q1- Q0							
	000	001	011	010	110	111	101	100
0	000	001	011	010	110	111	101	100
1	001	011	010	110	111	101	100	000

Output Table:

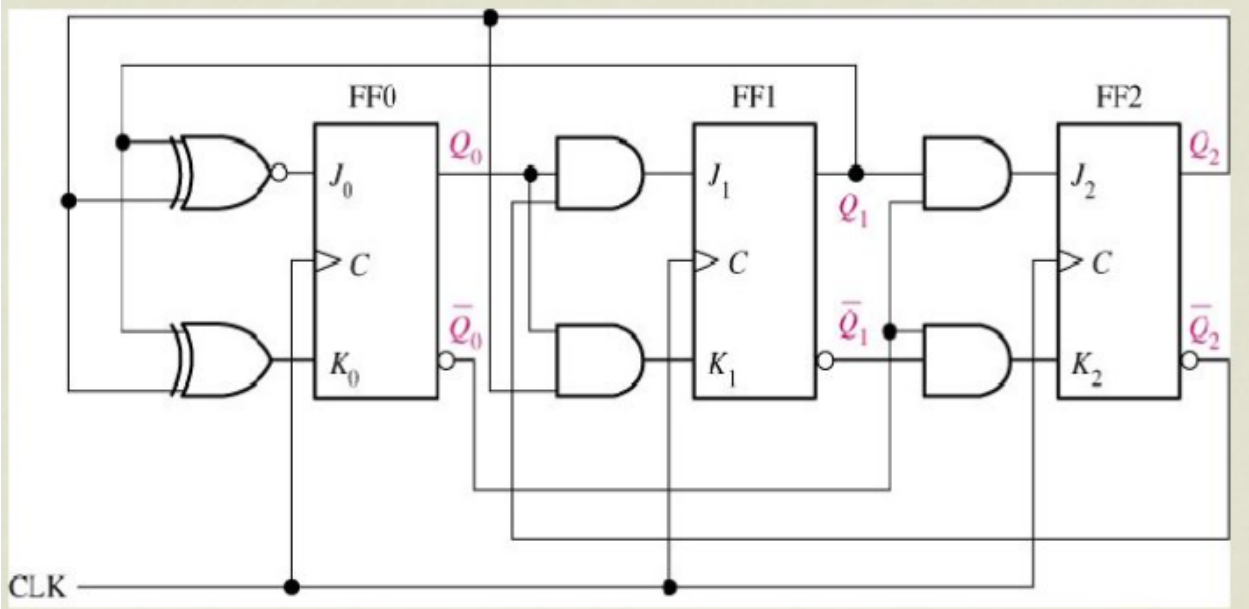
Input	Q2 - Q1- Q0							
	000	001	011	010	110	111	101	100
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1

K-Map for output bit of 3-Bit Gray Code Counter:

Input	Q2 - Q1- Q0							
	000	001	011	010	110	111	101	100
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1

$$Output = (\overline{Input} \,.\, \overline{Q2} \,.\, \overline{Q1} \,.\, \overline{Q0}) + (Input \,.\, Q2 \,.\, \overline{Q1} \,.\, \overline{Q0})$$

Circuit Diagram:



Timing Diagram: