Lab 4: Design of Digital Stop Watch (*decoder0to9*)

Objective:

* To design a Digital Stop Watch using concepts of digital system partitioning

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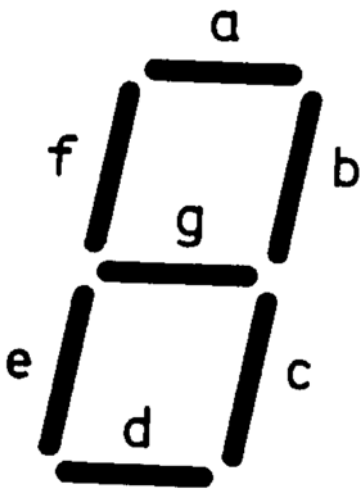
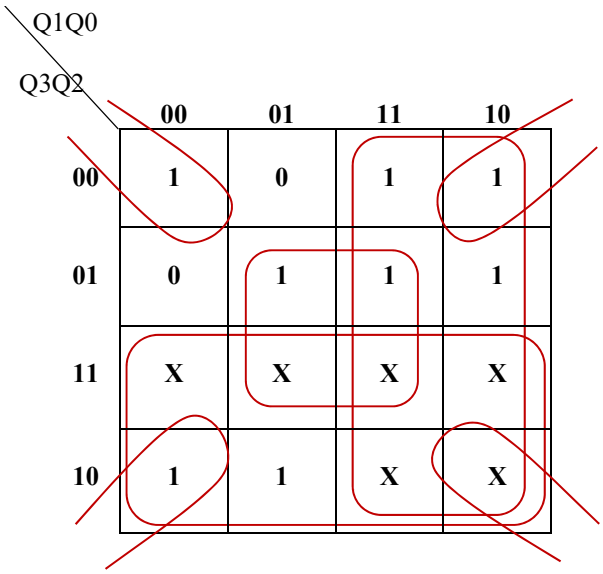
Digital design – *decoder0to9*

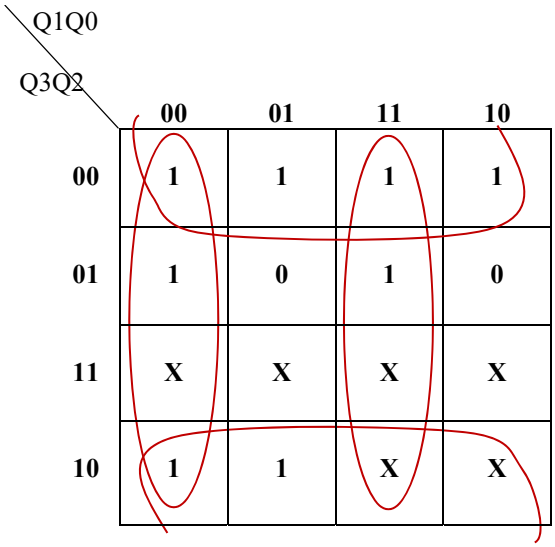
Input				**Output**						
q3	*q2*	*q1*	*q0*	*a*	*b*	*c*	*d*	*e*	*f*	*g*
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1
1	0	1	0	X	X	X	X	X	X	X
1	0	1	1	X	X	X	X	X	X	X
1	1	0	0	X	X	X	X	X	X	X
1	1	0	1	X	X	X	X	X	X	X
1	1	1	0	X	X	X	X	X	X	X
1	1	1	1	X	X	X	X	X	X	X

Table 4.1 *decoder0to9* Truth Table

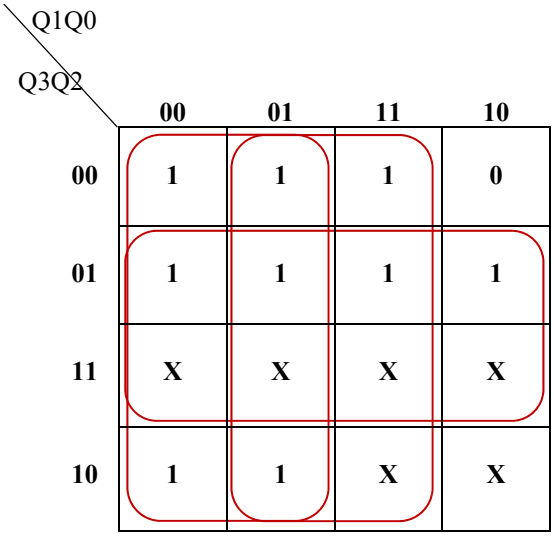




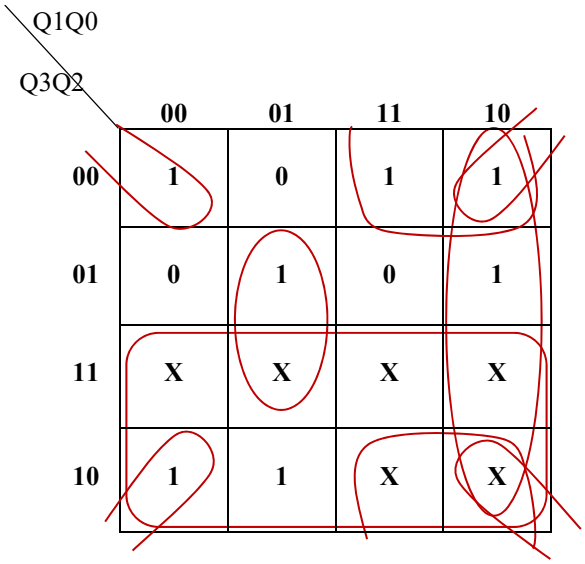
a = Q2Q0 + Q2BQ0B + Q3 + Q1



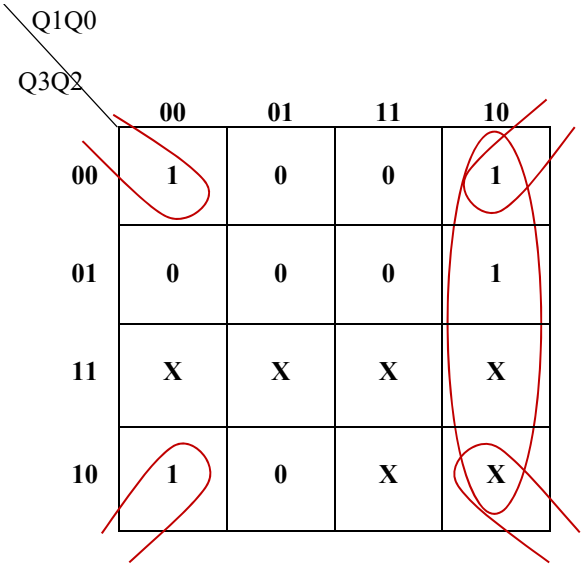
b = Q1Q0 + Q1BQ0B + Q2B



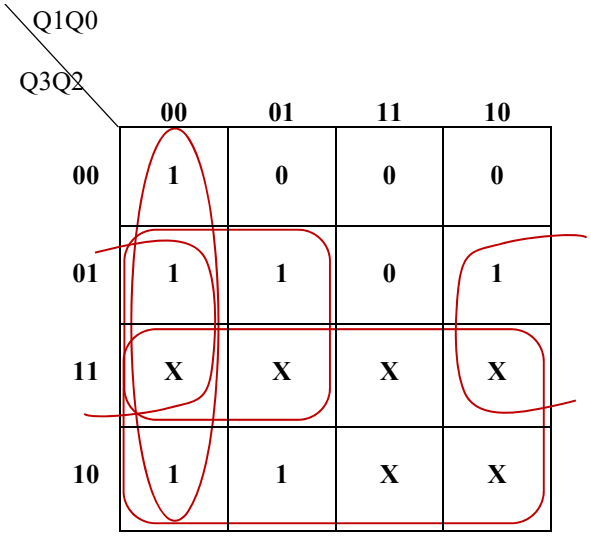
c = Q2 + Q1B + Q0



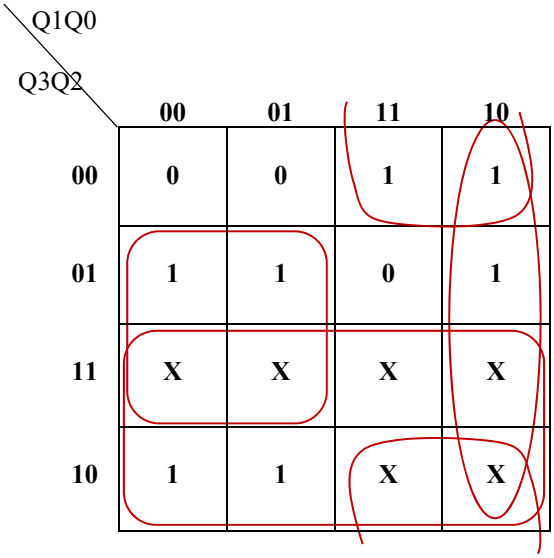
d = Q2Q1BQ0 + Q2BQ0B + Q2BQ1 + Q1Q0B + Q3



e = Q2BQ0B + Q1Q0B



f = Q2Q1B + Q2Q0B + Q1BQ0B +Q3



g = Q2BQ1 + Q2Q1B +Q1Q0B + Q3

Digital Stop Watch – *docoder0to9*

Reference Lab 3 to complete *docoder0to9*

1. Draw the ***decoder0to9*** circuit as shown in Figure 4.1.

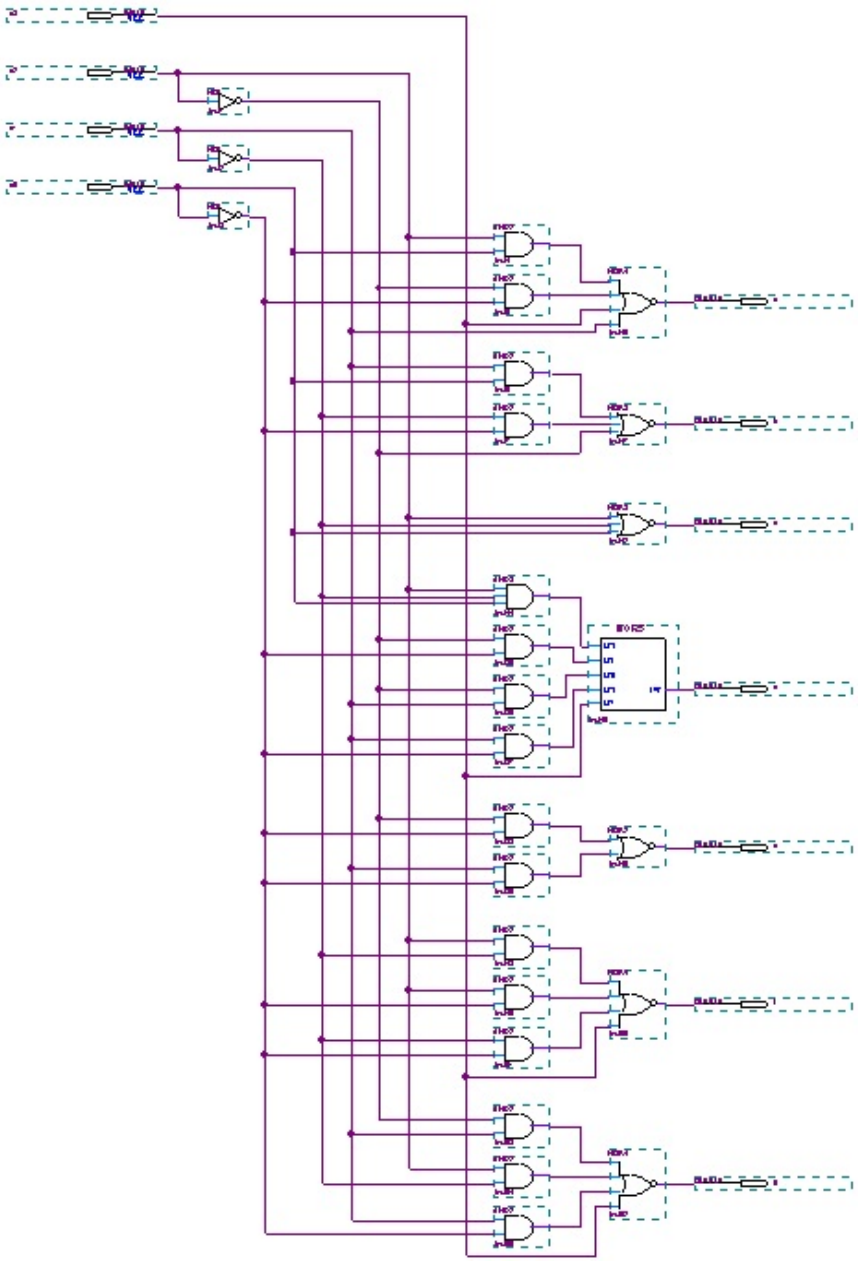


Figure 4.1 *decoder0to9* circuit

Symbols used: and2, and3, nor2, nor3, nor4, nor5 and not

Pins used: input and output

Input pins names: q3, q2, q1 and q0

Output pins names: a, b, c, d, e, f and g

2. Create symbol for the ***decoder0to9*** circuit and complete the circuit as shown in Figure 4.2 and Click ***File > Save***. Compile the circuit and ensure no error. Ignore warning/s.

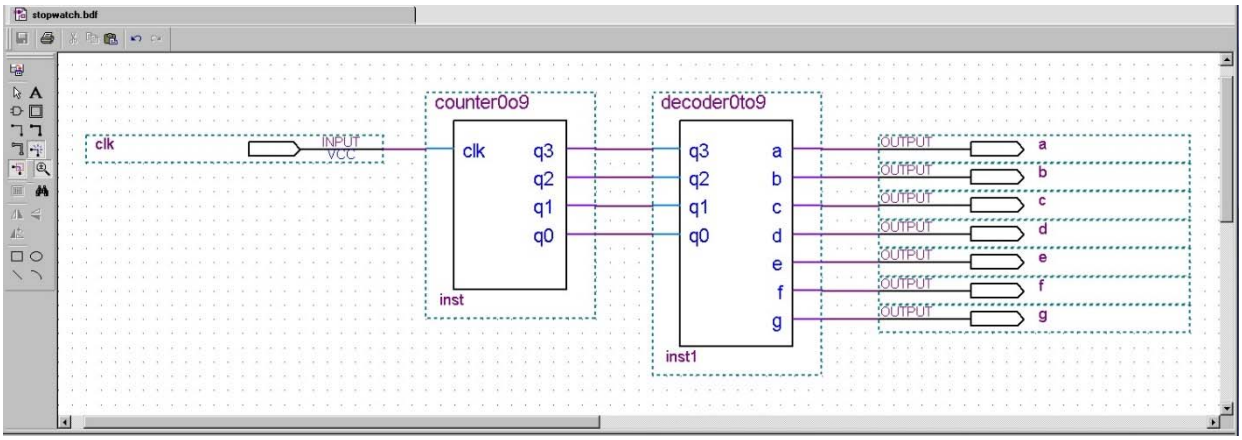


Figure 4.2 *stopwatch.bdf* with *counter0to9* and *decoder0to9* symbols connected

3. Update/edit the stopwatch Vector Waveform File – ***stopwatch.vwf*** to test the *decoder0to9* circuit as shown in Figure 4.3. (Refer to Lab 1 if you have forgotten how to create/edit Vector Waveform File).

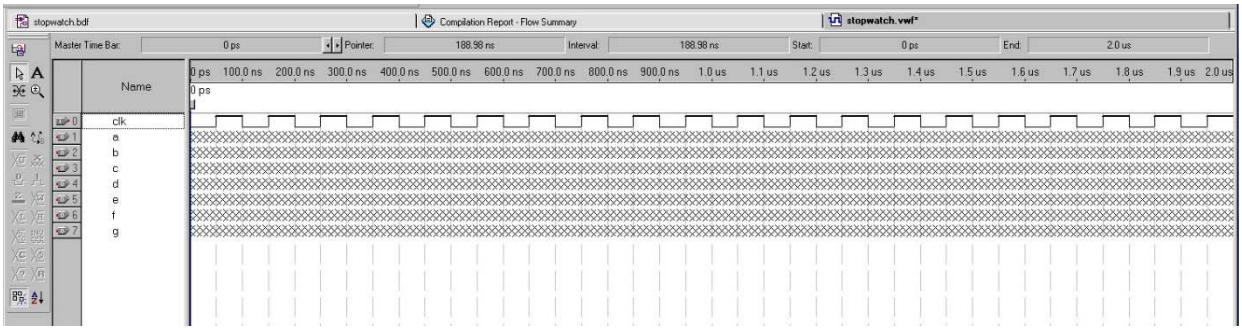


Figure 4.3 *stopwatch* Vector Waveform File to test *decoder0to9*

4. Simulate the circuit to obtain the results as shown in Figure 4.4. Verify the *decoder0to9* outputs using Table 4.2.

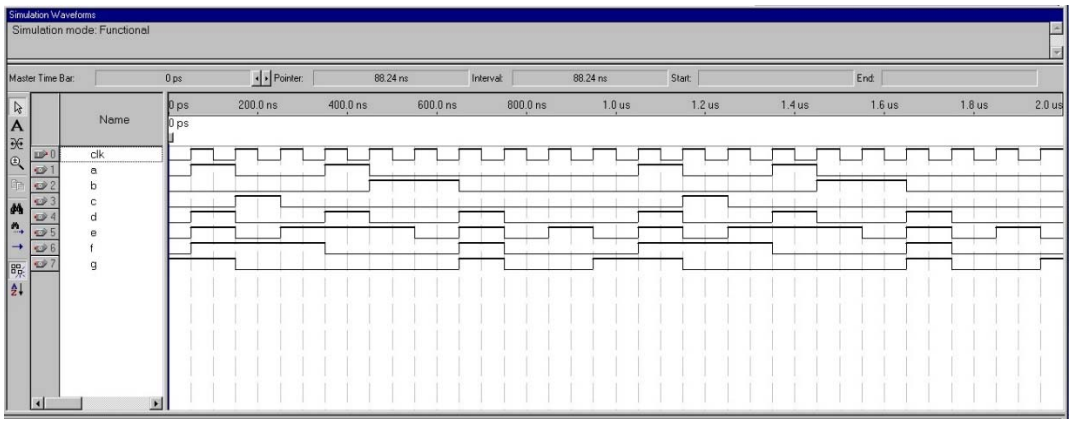


Figure 4.4 *stopwatch* (*decoder0to9*) waveform

Count	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Time	*0ns*	*100ns*	*200ns*	*300ns*	*400ns*	*500ns*	*600ns*	*700ns*	*800ns*	*900ns*
a	0	1	0	0	1	0	0	0	0	0
b	0	0	0	0	0	1	1	0	0	0
c	0	0	1	0	0	0	0	0	0	0
d	0	1	0	0	1	0	0	1	0	0
e	0	1	0	1	1	1	0	1	0	1
f	0	1	1	1	0	0	0	1	0	0
g	1	1	0	0	0	0	0	1	0	0

Table 4.2 Expected *decoder0to9* outputs