ADDIS ABABA INSTITUTE OF TECHNOLOGY

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Digital Logic Design

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Car Alarm

In a car alarm there are two sensors, these sensors keep track of the car's doors and subtle vibrations. The alarm goes off if either one of the sensors is triggered, and shouldn't turn back off even if the sensors are turned back off. The only method of turning it back off should be through a separate remote signal transmitter switch located with the key. It should also be noted that the alarm system works only if the switch is turned on. Another important thing added to this circuit is the length of alarm duration if the alarm is triggered and not switched back off it will turn itself off after some amount of time, this time can be changed and controlled by the designer.

So our inputs should be
1. Door sensor   ------   D
2. Vibration sensor   ------   V
3. Alarm switch   ------   S

And our output is the output signal for the car alarm   ------   A

the truth table becomes

S	V	D	A
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

The k map yields

VD

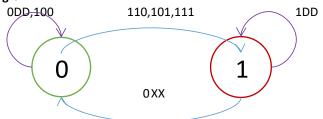| S	00	01	11	10
0	0	0	0	0
1	0	1	1	1

this k map simplifies the equation to
$$A = SD + SV$$

But this doesn't satisfy all the requirements that have already been set since the alarm turns off if the sensors are turned off (a thief opening getting inside and closing the doors) the alarm will also be tuned off. In order to fix this the circuit must also depend on its current state making the solution a sequential circuit. This is done using the JK flip flop as show in the figure.

The state diagram

0DD,100   110,101,111   1DD

0XX

The values for SVD

S	V	D	Q	Q$_{next}$
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	1
1	1	0	0	1
1	1	1	0	1
0	0	0	1	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

JK flip flop transition and implementation table

Q	Q$_{next}$	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Q	Q$_{next}$	S	V	D	J	K
0	0	0	0	0	0	1
0	0	0	0	1	0	1
0	0	0	1	0	0	1
0	0	0	1	1	0	1
0	0	1	0	0	0	1
0	1	1	0	1	1	1
0	1	1	1	0	1	1
0	1	1	1	1	1	1
1	0	0	0	0	X	1
1	0	0	0	1	X	1
1	0	0	1	0	X	1
1	0	0	1	1	X	1
1	1	1	0	0	X	1
1	1	1	0	1	X	1
1	1	1	1	0	X	1
1	1	1	1	1	X	1

K map for J   QS

VS		00	01	11	10
	00	0	0	X	X
	01	0	1	X	X
	11	0	1	X	X
	10	0	1	X	X

J = SV'D + SVD' + SVD
K = 1

The car will turn off automatically by the use of a D flip flop shown below in the image this component has a clock input and starts counting down after the alarm has been triggered after the set amount of time the flip flop shuts off in coming signals and consequently the alarm