GTU Department of Computer Engineering
CSE 433 – Spring 2023
Homework #1 Report

Hasan Mutlu
1801042673

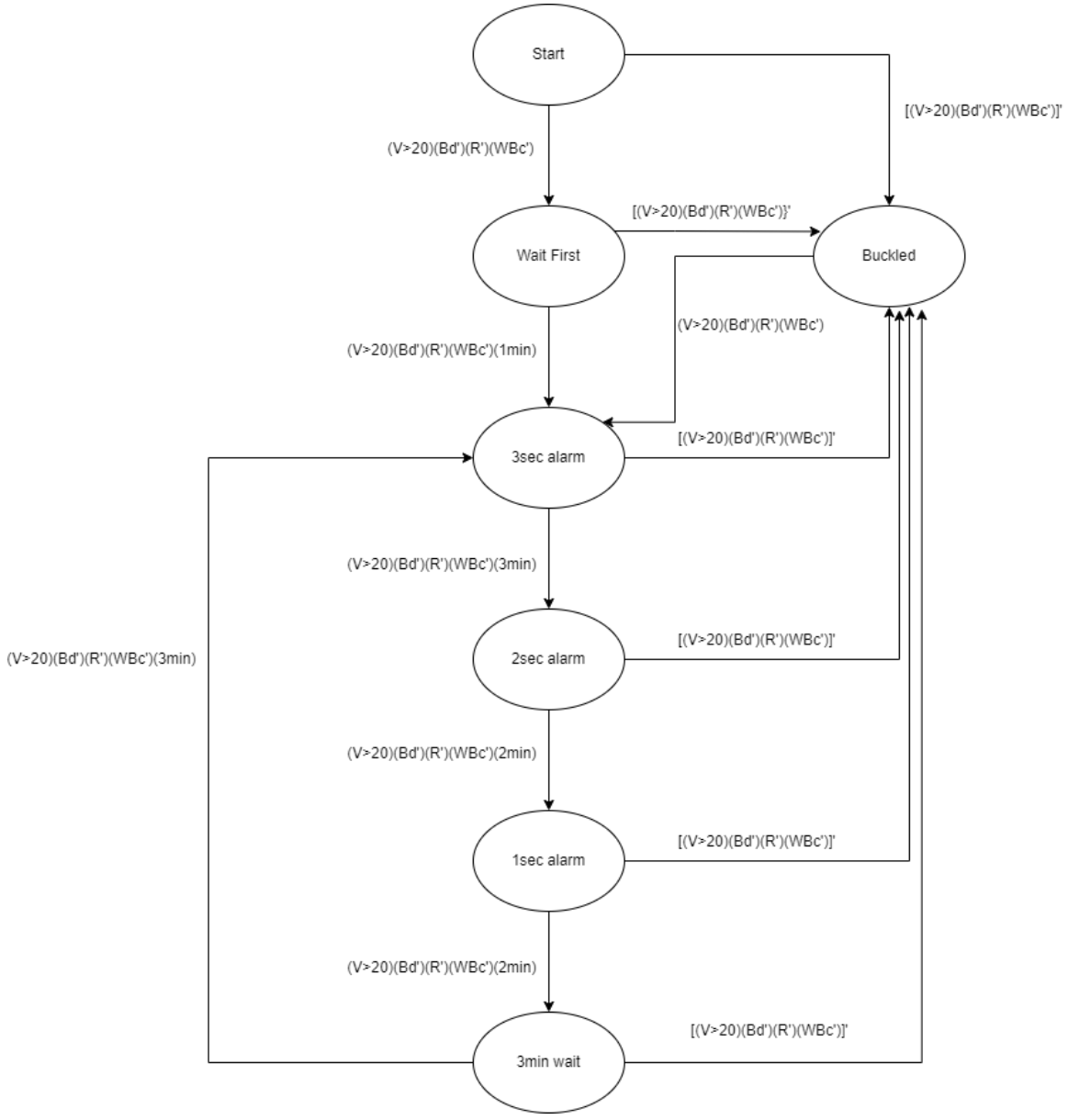
Solution

In this problem, there are 4 conditions and when these conditions are true, there is a dangerous situation and alarms should sound. So, this danger situation is defined as combination of these conditions and represented as: ((V>20)(Bd')(R')(WBc')). This combination is shortly called Danger(dang) and state transitions happen according to this Danger value.

It is assumed that there are 3 more sensors, called 1min, 2min and 3min. These sensors are triggered after x minutes has passed.

There are 3 outputs called 1sec, 2sec and 3sec. It is assumed that the alarm sounds in x seconds when either one of these values is 1.

Finite State Machine



States and Their Defintions

State	Registers	Definition
Start	3'b000	Start of the process
Wait First	3'b001	There is danger but alarm is not on yet, waits for 1 min.
Buckled	3'b010	There is no danger.
3sec Alarm	3'b011	Alarm is sounding in 3 seconds.
2sec Alarm	3'b100	Alarm is sounding in 2 seconds.
1sec Alarm	3'b101	Alarm is sounding in 1 seconds.
3min Wait	3'b110	Alarm is dismissed, silent for 3 mins.

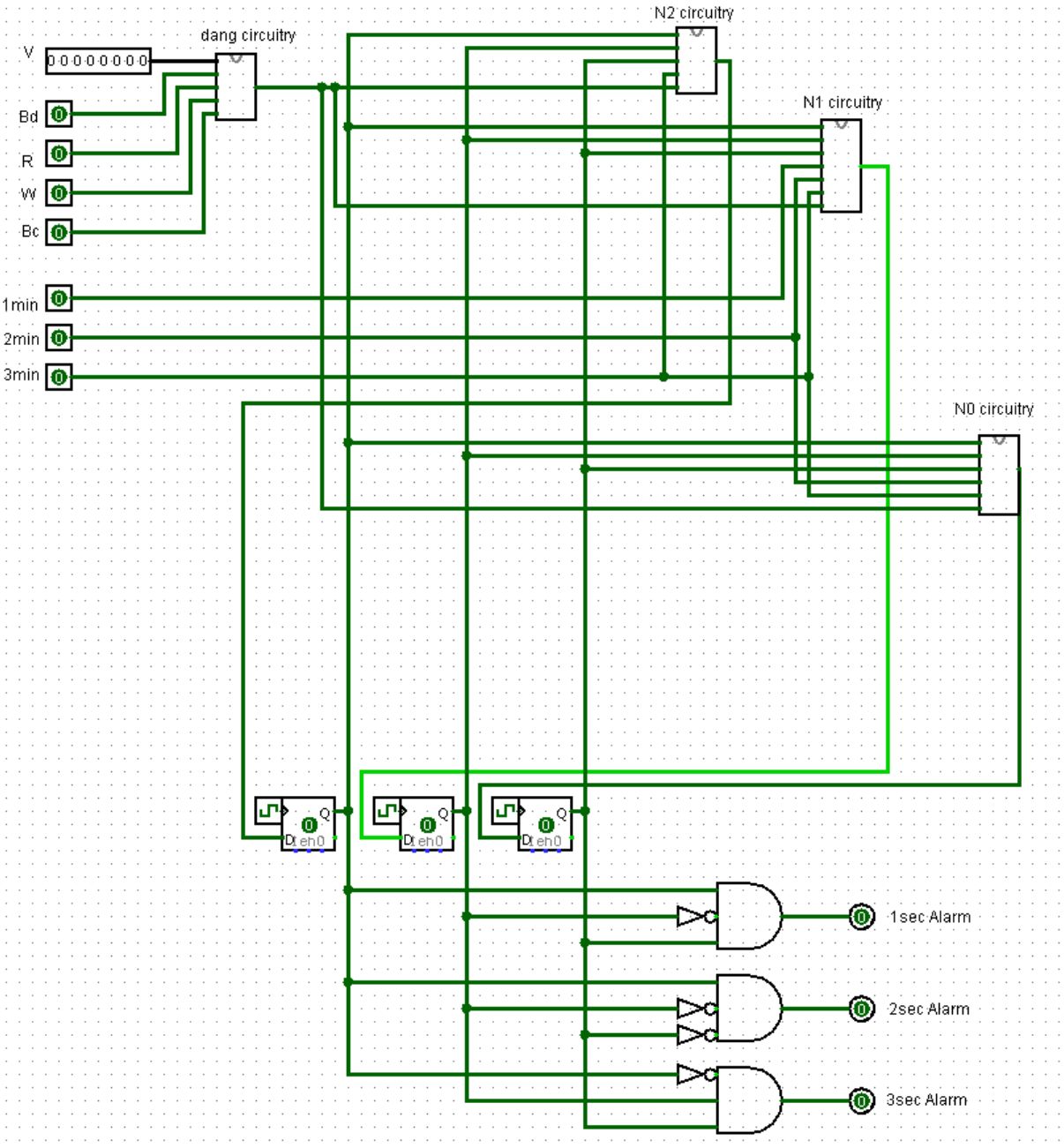
Truth Table

	Inputs							Outputs					
State	R2	R1	R0	1min	2min	3min	Danger ((V>20)(Bd')(R')(WBc'))	1sec	2sec	3sec	N2	N1	N0
Start	0	0	0	x	x	x	0	0	0	0	0	1	0
	0	0	0	x	x	x	1	0	0	0	0	0	1
Wait First	0	0	1	x	x	x	0	0	0	0	0	1	0
	0	0	1	0	x	x	1	0	0	0	0	0	1
	0	0	1	1	x	x	1	0	0	0	0	1	1
Buckled	0	1	0	x	x	x	0	0	0	0	0	1	0
	0	1	0	x	x	x	1	0	0	0	0	1	1
3sec Alarm	0	1	1	x	x	x	0	0	0	1	0	1	0
	0	1	1	x	x	0	1	0	0	1	0	1	1
	0	1	1	x	x	1	1	0	0	1	1	0	0
2sec Alarm	1	0	0	x	x	x	0	0	1	0	0	1	0
	1	0	0	x	0	x	1	0	1	0	1	0	0
	1	0	0	x	1	x	1	0	1	0	1	0	1
1sec Alarm	1	0	1	x	x	x	0	1	0	0	0	1	0
	1	0	1	x	0	x	1	1	0	0	1	0	1
	1	0	1	x	1	x	1	1	0	0	1	1	0
3min Wait	1	1	0	x	x	x	0	0	0	0	0	1	0
	1	1	0	x	x	0	1	0	0	0	1	1	0
	1	1	0	x	x	1	1	0	0	0	0	1	1

Boolean expressions of outputs:

1sec = R2.R1'.R0
2sec = R2.R1'.R0'
3sec = R2'.R1.R0
N2 = R2'.R1.R0.3min.Dang + R2.R1'.R0'.Dang + R2.R1'.R0.Dang + R2.R1.R0'.3min'.Dang
N1 = R2.R1'.R0.2min + R2'.R1.3min' + R2'.R1'.R0.1min + R2'.Dang' + R1.R0' + R1'.Dang'
N0 = R2'.R1'.Dang + R2'.3min'.Dang + R1.R0'.3min.Dang + R1'.R0'.2min.Dang + R1'.R0.2min'.Dang

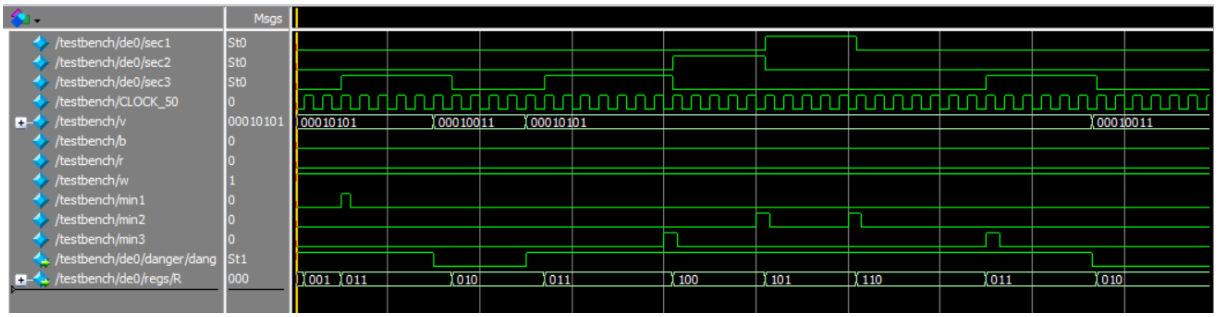
Logisim Implementation



It is tested and works correctly.

Verilog Implementation

In Verilog, the alert system is implemented for the DE0-CV board. It is tested both in ModelSim and on the physical board. ModelSim testbench output is as follows:



- ➔ Firstly, the system starts with danger situation. It goes to the wait first state directly.
- ➔ After 1 min sensor is triggered, it goes to 3 sec alarm state and sec3 is 1.
- ➔ Before 3 min passes, the car slows down and there is no danger anymore. It goes to buckled state and alarm is off.
- ➔ After some time, car accelerates and there is danger. It goes to 3 sec alarm state and sec3 is 1.
- ➔ After 3 min, it goes to 2 sec alarm state and sec2 is 1.
- ➔ After 2 min, it goes to 1 sec alarm state and sec1 is 1.
- ➔ After 2 min, it goes to 3 min wait state and alarm is off.
- ➔ After 3 min, it goes back to 3 sec alarm state and sec3 is 1.
- ➔ Before 3 min passes, the car slows down and there is no danger anymore. It goes to buckled state and alarm is off.

It worked as expected in the physical board as well.