**Lab 8: Up/Down Counters**

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CS 2204

***Objective:***

In this lab, our objective is to write three Verilog codes that implant a up/down counter for binary, grey code, and one hot using finite state machines. In addition, will be using the FPGA board to test our counters.

***Introduction:***

**Binary Counter:** The Binary counter will be using in this lab will a 3-bit counter that goes from “000” to “111” which is 0 to 7.

**Gary code:** Gray Code is a binary encoding system that groups a sequence of bits so that just one bit in each group differs from the number before and after it. Will be using a 3-bit grey code counter in this lab so that we start “000” until we get “100”.

**One-Hot:** A one-hot is a set of bits in which the only permissible value combinations are those with a single high (1) bit and all others low (0). We will be using a 8-bit one hot counter that will start “00000001” to “10000000”.

**Finite state machine:**

**State Diagram:**

**Table

Description automatically generated with medium confidenceShape

Description automatically generated with medium confidence**

***ModelSim:***

**Binary:**

**Graphical user interface, application

Description automatically generated**

As shown in the waveform we have the binary “000” to “111” (0 to 7) and then back to zero.

**Gray Code:**

**Graphical user interface, application

Description automatically generated**

As shown in the waveform we have gray code that for each present bit we get a district bit from the number before and after it.

**One Hot:**

**Graphical user interface, application

Description automatically generated**

As shown in the waveform we have implemented a one hot counter that’s starting at “00000001” to “10000000”.

**FPGA Board:**

The FPGA board is running three counters at the same time, with the first eight LED lights indicating the one-hot counter. Then there is a one-LED break, and the next three LEDs indicate the gery code. Again, we have a one-LED gap, and the following LED represents the binary counter. Furthermore, when direction is 0, the 7-sigment display counts from 7 to 0, and when direction is 1 count from 0 to 7 and cycles back.

Click on the link:<https://youtu.be/TfW35ZmhvgY>