

Massachusetts Institute of Technology  
Department of Electrical Engineering and Computer Science  
6.111 – Introductory Digital Systems Laboratory

Problem Set 4

Issued: March 4, 2002

**Due: March 13, 2002**

**Part 1**

Well, you've slaved through another week of problem sets and labs, and you and your pals decide it's time to party. Except like the good student you are, you've spent all your time cracking the books instead of planning the celebration. All the rooms are already booked, and you didn't save up enough money for even a bad DJ. You scratch your head and think, what do they use that 6.111 lab for over the weekend, anyway? You run over to Star and grab some sodas and chips (to be consumed only in the hallway, of course) and ponder about where you're going to find some musical entertainment. As you pace past the stockroom, you notice someone has brought in a 32-disc CD player. But you don't want to sit there pressing buttons while everyone else is having fun -- you want to enjoy yourself too. Then it hits you. Of course! A digital DJ is what you need. You tear off the cover of the CD player, and discover that behind the control panel there are some controls for the changer:

- A change input, that selects one of the CDs from the caddy in a direction depending on the level of an up/down input
- a change commit input, that actually rotates the caddy to the next selected position
- a play input, which plays the current track of the current CD if high and stops if low
- a CD reset input, which when asserted is equivalent to power-cycling the CD player
- a 5-bit-wide output which gives the current track number

After trying out the CD player, you notice that whenever it is turned on it automatically loads the first CD and sets itself to track 1. When play is pressed, the CD player plays each track on the CD sequentially, and plays the CDs sequentially as well. After figuring all this out, you borrow CDs from all your friends, and have a nice collection to choose from.

Keeping in mind the musical preferences of the guest, you sort the CDs into four categories: Pop, Country, Techno and Alternative. You have 16 pop CD's, 4 Country, 8 Techno, and 4 alternative, loaded in contiguous groups, in that order.

Design a system to allow you to press one button and play any group of CDs (from start to finish) that you want. You want to play each CD in the group sequentially, and only once. There should be a reset button to power cycle the CD player, and one button for each type of music. (see Figure 1) Include a state diagram and (well-documented) VHDL code. Compile your code to a 374I CPLD and include the pinout section of the report file.

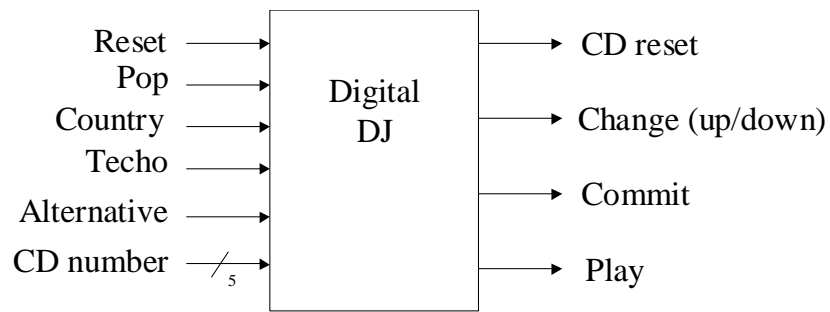


Figure 1. Block diagram of Digital DJ

## Part 2

Modify your DJ to be able to enter "shuffle" mode. This means that after resetting your system, with the touch of a button the player will start playing a random CD. In one "shuffle cycle," no one CD should be played more than once. You don't need to write VHDL code for this part, but please provide a state diagram.

Also, draw a block diagram showing the basic layout of your circuit, including a detailed section for the random input generator. Please also provide a word description of the random generator.

{Hint} You will need to keep track of which CDs have been played -- a RAM would suit this purpose quite well. You will need to implement outputs of your state machine to select an address based on the number of CD, from 0-31, that you are up to.

Also, think about how you can obtain random input to select a random CD using the basic components distributed in your kits. If you can't come up with a solution for this part of the problem, you can still solve the rest by just assuming that you have a random input to your state machine.