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ELEC 4200 – Lab 11

11/18/21

Lab 11: Lab Final Project – Digital Alarm Clock

**Goals:**

The goal for this lab is to finish designing and present your own Lab final Project. For the final project I decided to design a digital alarm clock on the Nexys DDR4 Artic 7 FPGA board. The clock should be able to be set by the user and then proceed to keep track of that time on the board to mimic real time. The board should also be able to set the alarm at any time, then alarm at that time if the Alarm\_on switch is set on. Then when the alarm is set, pressing the reset alarm button should turn the alarm back off and wait for more instructions. The clock should continue to work until either the full\_reset button is pressed or the time is set again. Both the clock time and alarm time will be shown on the 8 separate 7segment displays.

**Design Process:**

This project can be split into a few different parts. These parts being:

1. Getting the clock and alarm input
2. Operation of the clock
3. Comparing the clock and alarm to check for turning on alarm
4. Displaying the clock and alarm
5. Displaying alarm set high and resetting when turning alarm off

In some programs it is easier to read/debug if all of those processes are in different files or maybe even separate modules. However, I found it easier to keep all of these in the same module, so that there was no confusion with calling different variables from each file/module. The code is well commented to be able to find each section easily and is very easy to read. Since there was no overall project, there is no test or chart to follow to verify the design process.

**Detailed Design:**

Since this entire project is of our own idea and design, we have no exact design to follow. This means we can split things up however we seem fit, in order to solve this overall program. With this in mind, I decided to design this process in order of the process shown above going from 1 to 5. Then after finishing each section, would go back and comment heavily throughout that section so that I could easily debug later. The code used for the overall project is shown below in Figure 1.

\*\*Note: In the creation of the clock, I have to use a decimal place on the 7 segment since the colon was not available from the Artix 7 constraint file.

\*\*Note: There are two UUT’s in this main file. These are only used by the IP Catalog and a divider file which are only used in the creation of a 1 second clock signal. Knowing this, we can assume these calls work since they are simple and only use one in and one out signal.

Text

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Graphical user interface, text, application, email

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Graphical user interface, application

Description automatically generated

Graphical user interface, text, application

Description automatically generated

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Figure 1

**Verification:**

Since this was a project of our own making, there was no testbench required in order to verify the functionality. However, I attempted to make my own testbench but since the main output I was testing had to be on a 7 segment decoder, it made this very difficult to test. This means the main way of testing this design is to upload the program to a board and visually verify all aspects of the clock. This means setting time, alarm, alarm going off (and being reset), clock functionality, correct display, and anything else that may need to be checked. After uploading and checking, I ran into just a couple problems before finally figuring it out and getting the digital alarm clock to work perfectly. I have no errors in my design.

**Conclusion:**

What I learned in this final project lab is how many ideas we have used throughout the semester can come together and create one large project that runs many of the smaller ideas, all at the same time. My biggest problem was trying to get the 7 segment controller to work correctly in order to refresh the displays correctly and fast enough to appear like the clock is running all at one time. After figuring this part out the rest of the design worked well besides a few small errors in the alarm function and running the clock. This final lab went really well since I was able to use a lot of previous ideas to get the basics working and combine that with new ideas that must be used to get the exact alarm clock that was designed.