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Lab 5 Report

Part 1: Procedure

Task: PWM LED Dimming

a: Approach for Designing Task

For Lab 5, we decided to do LED dimming for our task. Our approach to begin with was establishing what we would need to initialize to get this completed. One of the biggest factors for LED dimming was initialized the Pulse Width Modulation (PWM) so that the light's brightness could be dependent on the pulse width of the wave. Continuing, we wanted to design the task to have user functionality, meaning that the user could use the switches to interact with the program. Therefore, we decided to initialize the Switches with GPIO Port J.

To make the LEDs actually showcase the dimming effect from the PWM we needed to initialize GPIO F. We also needed to use AFSEL due to the use of the alternate function mode and PLL that we initialized. We also decided to frequency 20 for the PLL as told by the TA for the matching duty cycles with the TIVA numbers.

Our approach attempted to be well organized and the header and initialization files were organized to make it clear what we were setting up. Therefore, we used proper comments within the header files that separated different components from each other. We also made sure to reuse code that was already present in our Lab 3 to incorporate industry level standards of reusing already written pieces of code as well as to reduce redundancy.

b: Implementation Details

We decided to use various pre-sets of the light emitted, which was responsive to a user input. For the user input we used the switches to determine the duty cycle for the PWM. This is important because from what I learned in office hours. The duty cycle affects how long the light will be on for. Higher duty cycle results in the light being on more for the period and a lower duty cycle results in the being on less.

We followed the steps in the PWM section of the datasheet (page 1678) to properly initialize the values so that the PWM would be functioning properly. However, we only needed to use one generator and one comparator rather than the two suggested in the datasheet as our lab was less complex. We also decided to use our onboard LED to make it more simpler rather than linking an external led to the breadboard as TA suggested. After setting up the initialization the only thing left to do was switch between two duty cycles using the switches I implemented. As I saw in the datasheet a bigger number resulted in a lower duty cycle and a smaller number resulted in a higher duty cycle. So our system could see the flickering of the lights easily. The one that flickered more would be the lower duty cycle and vice versa.

Another thing that we implemented was the PLL, much like Lab 3. We used the PLL to power up and configure the FBCHT and EBCHT of the program. Mainly to set the frequency of the system to 20 (Suggested by TA).

c. Understanding of Peripheral

One of the strong suits of PWM dimming is that it is highly stable and has a very wide range of light emitted. In advanced PWM devices, the devices can go to an incredibly low level of light emitted because the period of the signal is so small yet the device can still recognize it and output the light. In devices that have presets, this is not possible because the thresholds are pre-defined instead of on a spectrum. The modulation of pulse width gives the

PWM the ability to have various high and low specifications that gives the variability of light emitted by LEDs, for instance, more flexibility. PWM also has the advantage of using a scaled version of the system clock which gives it more flexibility and use by programmers.

Part 2: Results

Task: PWM LED Dimming

a: Results

We were able to get the lights to dim properly and the PWM was able to be created successfully. Based on the user's choice with the switches, the duty cycle loaded into the PWM was different and the lights were dimmed. As this lab was just one task as opposed to the 4-5 tasks that other labs were, the results were fairly straightforward with not much more to add. For the PWM we implemented we saw that the lights would flicker more when the duty cycle is lower, this is because the light is on for a less period of time therefore we are able to see it happening more visibly. However, with a higher duty cycle, you will see it flicker less as it's less visible to the eye. For the purpose of the demo, I did not see the duty cycle up all the way so that we could still see it flickering, however, at a 100% duty cycle we wouldn't be able to see it flicker at all. So by switching between two switches, we swapped between a very high duty cycle and a very low duty cycle to see the clear difference

b: Proposed Changes

While we were able to get our code completed, some things that we might have improved on had we had more time is having slightly cleaner header and initialization files; although they are organized clearly and have the proper initializations, code can always be made more legible. Another potential change would be in our video having a greater difference in the duty cycle so that the dimming is more apparent. This is simply for the ease of the person grading out work and it would make it more obvious the PWM was contributing to gradual dimming. Another thing is due to the time constraint we ended up only using the onboard LED. Additionally we only used one generator and comparator. If we had more time we could have implemented the dimming with multiple external LEDs and adjusting the brightness of each LED so we could see a clear difference between the duty cycles.

c: Future Plans

If we were to incorporate any other changes into this lab, or add on different tasks (for instance, if this lab was to be curated for future EE 474 classes), then we would have more modulation. For instance, getting the light to dim and raise the brightness in a cycle, on its own, as its own task. This could be accomplished by having a while loop that counts down and up, etc. Another task we might incorporate would be to have blinking of different lights, which would help the student learn how to incorporate interrupts or polling into the design of the lab. Lastly, we might be able to send the dimming to the LCD as a response. For instance, if the light is detected as dim on the board, or if the resistance is different, have the LCD have a coordinated response for this.