CS 331 Lab #2
Timers & Signals Handlers

Spring 2003

Week #1: 2/19/2003 – 2/21/2003
Week #2: 2/26/2003 – 2/28/2003
Report due by 5:00pm: 3/5/2003 – 3/7/2003

1 Overview

In this lab you will write a program to generate square waves on the oscilloscope. The maximum voltage, minimum voltage, and frequency of the wave should be user specifiable.

2 Square Waves

Recall that the frequency of a wave measured in Hertz (Hz) is the number of complete cycles the wave makes in one second. The period of a wave is the time required for one complete cycle to occur. Mathematically, the period is the reciprocal of the frequency and vice versa.

$$\text{period} = \frac{1}{\text{frequency}} \qquad \text{frequency} = \frac{1}{\text{period}}$$

Generating one cycle of a square wave requires two transitions: one from high to low and another from low to high. So, a 100 Hz square wave has a period of $\frac{1}{100}$ seconds = 10 milliseconds. Generating such a wave requires 200 transitions per second, or a transition every $\frac{1}{200}$ seconds = 5 milliseconds.

3 Procedure

1. Make a `lab2` directory to put your code for this lab in. Copy your `iodas.c` and `Makefile` from Lab 1. Modify the first line of the `Makefile` so it is appropriate for this lab.
2. Execute ~`cs331/lab2/demo` to see an example of the program you now need to write.
3. Create a file called `lab2.cc` and use the following outline to get started. Refer to the man pages as needed for details on the functions.
   (a) Include `stdlib.h`, `iostream.h`, `stdio.h`, `time.h`, `signal.h`, and `string.h`.
   (b) Prompt for the voltages and frequency. The maximum possible square wave frequency should be computed from `clock_getres()`'s output.
   (c) Establish a SIGALRM signal handler with `memset()` and `sigaction()`. Keep unnecessary computation to a minimum in your signal handler.
   (d) Use `timer_create()` and `timer_settime()` to setup a repeating timer at the requested frequency. Make sure your program properly handles small frequencies such as 0.25 Hz.
   (e) Use `sigpause()` inside a loop to prevent the program from exiting.
4. When finished writing `lab2.cc`, compile it by running "`make`". Execute the program with "`./lab2`".
5. By hand, calculate the period in milliseconds of square waves with frequencies of 50 Hz, 40 Hz, and 25 Hz. Then use your program to generate square waves at those frequencies. How do the periods observed on the oscilloscope compare to your calculations?

4 Demonstration

Notify the TA when you are done with the assignment and ready to demonstrate your code. The TA may randomly pick one of you to do the demonstration and ask another to explain how it was done. *Make sure that everyone in your group understands how all of the code works before your demonstration.* Some lab problems will appear on the mid-term and final exams.

5 Lab Report

The Lab 2 report is due 3/5/2003 – 3/7/2003, a week when there are no labs. The deadline is 5:00pm one week after the end of your Lab 2. You may hand it in to a TA during office hours or slide it under the lab door (1102 DCL). The report should include the following items:

1. An organized header that, at the minimum, contains your names and NetIDs, as well as your lab section (day and time), workstation, and username. For example:

   CS 331 Lab Report #2

   Tim Eriksson (eriksson@uiuc.edu)
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   Section: Friday at 10:00am
   Workstation: emb8
   Username: group38

2. An overview of your program implementation.
3. A discussion of any problems you encountered while working on this assignment, and how you overcame them.
4. Responses to the following questions.
   (a) What did you observe on the oscilloscope when a 40 Hz square wave was requested? Why does this happen?
   (b) What are the 5 highest square wave frequencies that your program (running on the lab hardware) can exactly produce? How did you compute these values?
5. A printout of your commented code (`lab2.cc`).