PSoC Labs: Instructor Introduction

Purpose

This document introduces what is required for running the labs and final project.

Requirements

It is suggested that these labs are worked on individually since it is difficult to split up the work in a way that allows the students to learn all aspects of working with the PSoC. In order to run these labs, the following is required for each student:

- A computer with a complete installation PSoC Creator 3.0 or newer and a method for storing development files (approximately 15-25 MB per lab)
  - These labs were tested with version 3.0. Newer versions will probably be compatible with the labs. Download for free here: http://www.cypress.com/psoccreator/
  - The computer must have Windows 7, 8, or 8.1 as the operating system, as of version 3.0.
  - Lab 4 requires a certain driver to be installed on the computers. See the instructor's guide for Lab 4 for more details.
- A CY8CKIT-050 PSoC 5LP Development Kit
  - Including mini-USB cable, LCD display, and bag of jumper wires. All of these come in the development kit's box.
  - These can be purchased for $99 here: http://www.cypress.com/?rID=51577
  - These may also be obtained for free for educational use by professors here: http://www.cypress.com/cua
  - With these two options, the kits could either be purchased by the students or offered for borrowing from a professor. Since the kits could be damaged if mishandled, it may be better to have the students purchase their own kits so they are more careful with handling them (for example, have the university purchase some to resell, like how EE/CE digital systems courses provide the required electronics).
- Lab 5 requires the following temperature sensor: http://www.adafruit.com/product/1782
  - It is suggested that these are purchased by the instructor as soldering is required to mount the headers. The students can then borrow these sensors for use during this lab session.
  - A different I^2C device may be substituted for this one, but that would require rewriting portions of Lab 5.
  - If obtaining an I^2C device for this lab is not possible, this lab can be skipped.
  - See Lab 5 for more details.

Each lab can take up to two hours to complete, so lab sessions should last for two hours. The final project requires independent work, so it is suggested to use a lab room that may be used outside of lab sessions, especially for students who may not have a computer with Windows on it.

There are some suggested materials to have for the final project. See the Final Project section for more details.

Labs

Structure

Each lab has three sections: objective, background, and procedure.

The objective summarizes the purpose of each lab.

The background provides the information required to complete the lab. It is split up into subsections for each topic being covered. Most questions that a student might ask about how something works within the context of the lab should be answered in this section.

The procedure describes what the student will be creating for the lab. There may be multiple procedures in these labs. Within each procedure, there are subsections for each of the three primary steps of developing on the PSoC: designing the system, programming the firmware, and running the project.

All labs also come with an Instructor's Guide for lab-specific information for running the lab and the solutions to the labs. There is also a zip file that contains a workspace with solutions for all of the labs and the implementation of the final project example.

Content

- Lab 0 – Introduction to PSoC and PSoC Creator
- Lab 1 – Basic Analog and Digital I/O
- Lab 2 – Clocks and Timers
  - Includes basic synchronous circuitry. It would be good to teach synchronous circuitry in more detail in a lecture.
- Lab 3 – Interrupts and Debouncers
  - Labs 0-3 are required, as they introduce concepts that will be used in later labs. Future labs are not necessarily required, but they do introduce useful concepts.
- Lab 4 – PWM and USBUART
  - Requires the special driver for the USBUART. See the instructor's guide for more details.
- Lab 5 – I^2C
  - Requires the specified I^2C temperature sensor. See the instructor's guide.

There are two additional labs, 6 and 7, but those are incomplete. Those labs contain content removed from labs 3 and 4, which would have been too long otherwise. Labs 6 and 7 do not have instructor's guides since they are incomplete.

Suggestions

- You should complete all of the labs yourself so you can understand how each lab works.
- When grading the labs, primarily make sure the result works as described in the "Running the Project" section of the procedure. You may check for this during the lab session or afterwards.
  - In labs that have multiple part procedures, you should ask students to allow you to check their results between parts to make sure they are on the right track.
- You may also want to add some post-lab content like short questions or require a lab report to be submitted later; whatever your preference.

Final Project

There are two documents provided for the final project: the criteria and suggestions for the project and an example implementation. The criteria should be provided to the students and the implementation should be demonstrated in some way.

The criteria provide rules for what a project should include such that a project isn't too small or too trivial. Additionally, the criteria encourage the students to discover new components not covered in the labs.

The project should be assigned to the students so they have at least three weeks to work on it. At least five weeks would be ideal so students can figure out what they want to work on.

It would probably be best to make the projects individual for the same reason that the labs should be an individual effort. However, if a group of two students want to work on a large project that uses a lot of hardware, such as a robot, there would probably be enough work both inside and outside the PSoC to split it up.

The example project should be replicated so the students can see an example of a large project that they could do. The report describing the example project states how to replicate it and the PSoC Creator project is included with the lab solutions in PSoC Course Project.zip. An SD/microSD card and SPI breakout for it is required along with a headphone jack breakout. See the report for more information, including specifically where they can be purchased.

Note that some of the suggestions for the final project require peripheral hardware, like the temperature sensor from Lab 5. It may be wise to have some peripherals available for students to use, such as accelerometers. Browse Sparkfun and Adafruit for devices that are mounted on breakout boards, which allow them to be easily used in the prototyping area (breadboard) on the development kit.

You may also want to have some tools and miscellaneous supporting hardware available, such as soldering stations and jumper wire kits. It would be a good idea if only the instructor did soldering for safety reasons.