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NDSU Embedded Systems II
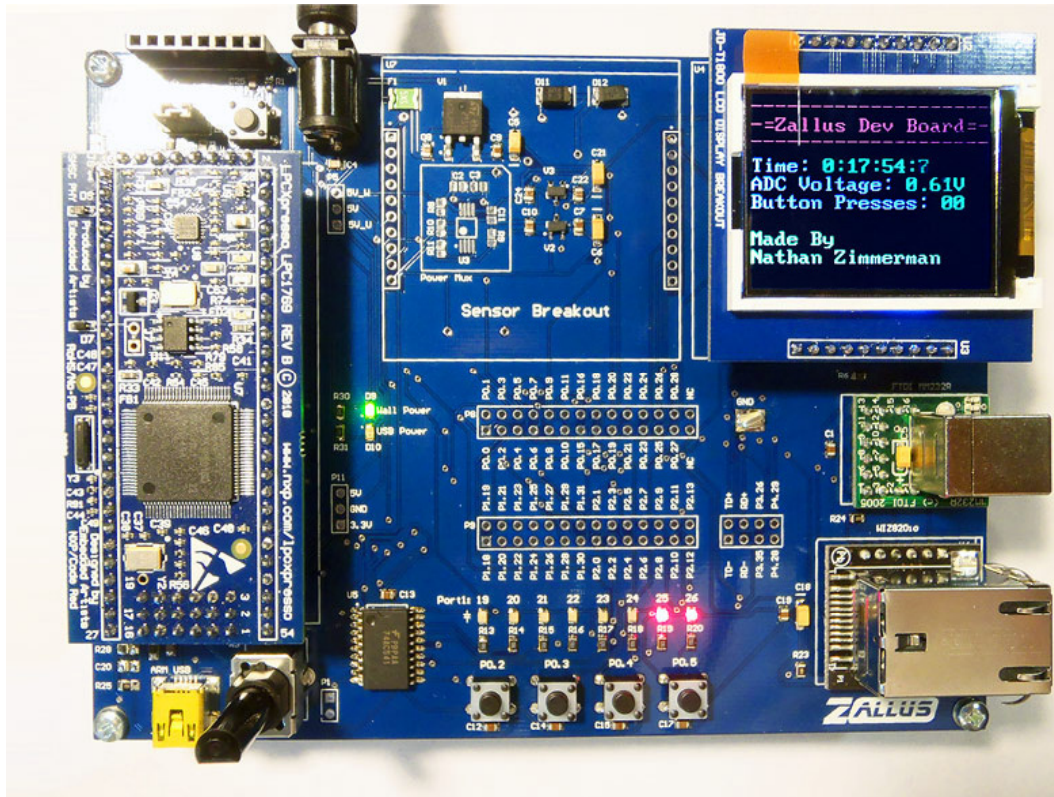
ECE471 Dev Board Construction

Objectives:
 • Construct the ECE471 Development Board

Also to obtain/review familiarity with the following:

• PCB Assembly Construction / SMT Components
• Hand Soldering
• SMT Reflowing

By
Nathan Zimmerman

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ECE471 Development Board

Primary Features:

1: LPCXPRESSO 1769
2: 1.8" SPI LCD Display
3: UART -> USB FT232R
4: W5200 Ethernet

Secondary Features:

1. 8 Red LEDs
2. 4 Tactile Push Buttons
3. 10k POT
4. LPC1769 GPIO Breakouts
5. USB Slave via LPC1769 MCU

Useful Resources:

Schematic: This will be useful in order to obtain the LPC1768 port pins required in order to operate the various peripherals on the ECE471 embedded development board
Link:

LPC1769 Datasheet: Standard microcontrollers will generally come with two important resource documents for specifications. One of these documents is the datasheet which will generally contain the electrical hardware specifications of the device. The other primary resource document is the user manual which will generally contain extensive microprocessor register descriptions.
Link: http://www.nxp.com/documents/user_manual/UM10360.pdf

LPC1769 User Manual: See above for description.
Link: http://www.nxp.com/documents/user_manual/UM10360.pdf

LPC Xpresso IDE:

The Xpresso IDE (Integrated Development Environment) is a "free" eclipse based GNU-C compiler for NXP microcontrollers. The extreme advantage of this complier is that it is free and can be downloaded to your own personal PC which I would highly recommend. Currently our school computers are imprisoned by CEA tech and are rendered virtually useless for any type of practical development. The disadvantage of the Xpresso IDE is that it is code size limited to 128kB and that its licensing restrict its use for commercial development. However, 128kB should be more than enough coding space for the these labs.

Download URL: http://lpcxpresso.code-red-tech.com/LPCXpresso/

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Why a custom dev board?

The ECE 471 Development board was a board specifically designed for NDSU embedded systems development. The reason for using a custom development board as opposed to a commercial prebuilt board is twofold. One, with our own development board we have the ability to choose the specifically peripherals that are populated on it. Secondly, having our own development board and its creation helps give students a glimpse as well as some experience with an electronic assembly process. Depending upon the size of the company that you work for, such experience can be incredibly useful. In addition, such experience helps improves your overall capacity for design projects such as your senior design.
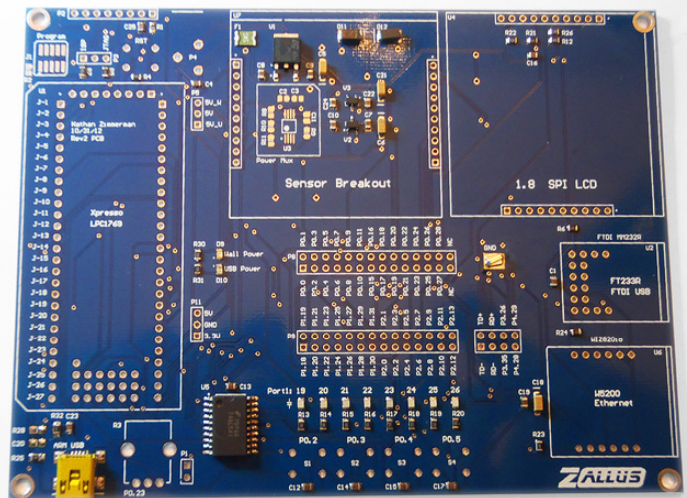
Steps for Construction

1. Obtain kit from bookstore. Cost will be roughly 100 USD.
2. Apply solder paste to PCB surface mount pads. Do not apply solder paste to any holes / through-hole component pads!
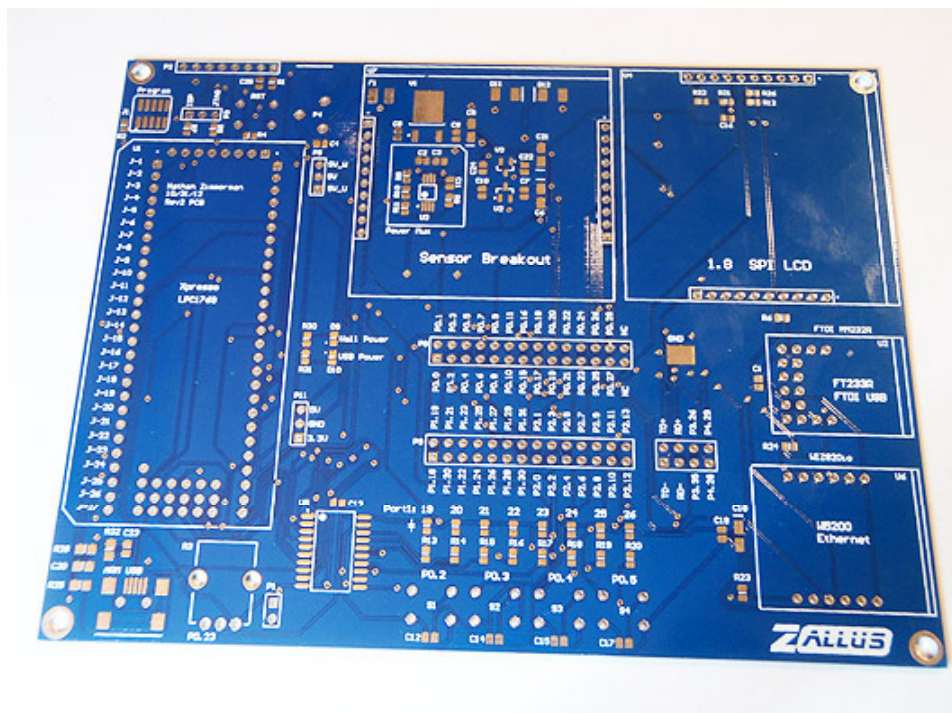
Steps for Construction

3. Populate PCB while referencing the schematic. Match component reference designators in schematic versus PCB. Place SMT only components on top of pads with solder paste already applied. Wait until the next step before populating any through-hole components.

4. Reflow SMT components in a reflow oven.

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Steps for Construction

5.   Hand solder in remaining through-hole components .

Note: Apply the following order for soldering the LPCXpresso Board.
Cut LPCXpresso board in half if not done so already. (reference picture)
Solder in male headers to LPCXpresso board. Ensure they are straight!
Apply male-female headers to soldered in male headers. Insert male end of male-female headers into ECE471 development board. Solder in male end. This ensures that everything will fit properly.

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Flashing Demo Program

Now that your ECE471 development board is mostly completed, the next step is to flash a sample program to the LPC1769 ARM Cortex M3 MCU that demonstrates the functionality of the board. This can be done using the "LPC LINK" side of the LPCXpresso development board. This link contains a NXP LPC3154 MCU which acts as a JTAG Emulator / Debugger.

What is JTAG? Read here: http://en.wikipedia.org/wiki/Joint_Test_Action_Group
What is a debugger? Read here: http://en.wikipedia.org/wiki/Debugger

Using CodeRed IDE: As mentioned previously, we will be using the Code Red integrated development environment in this class. If you have not already downloaded it, download it here:
http://lpcxpresso.code-red-tech.com/LPCXpresso/
After install go to File → Import. Select Existing Project Into Workspace. Once selected, hit next. Hit "Select root directory" and then hit Browse.
Now go into the ECE471 code folder and select the project called "CMSISv2p00_LPC17xx".
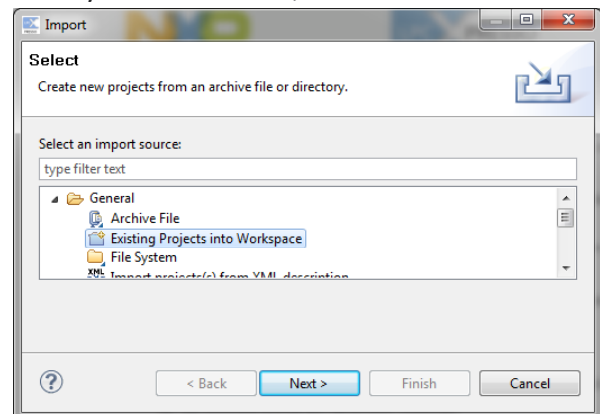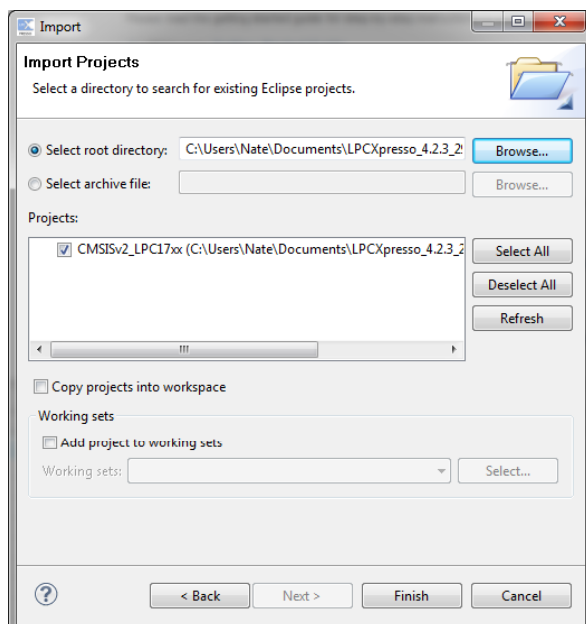
At this point hit finish and the project should be imported into your workspace on the left. Next do the exact same thing for the "demo_project" folder. This project should show up as well in your workspace. Next it is time to flash the .axf file in that project to your micro. Select the "demo_project" folder in your work space and then hit the flash button on the xpresso toolbar. A "program flash" window should pop up. Under the select file option, hit "browse" and upload "SimpleDemo.axf" to your ECE471 dev board. Next hit okay and the ECE471 should be flashed with the new code. Upon completion, the dev board should run a sample program which blinks some LEDs and demonstrates the functionality of the dev board.

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Lab Credit

In order to receive credit for this lab, display your ECE471 dev board with flashed demo code to the TA before the assigned due date.