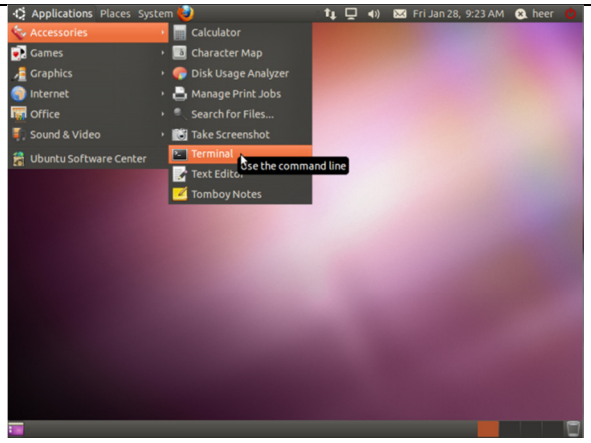
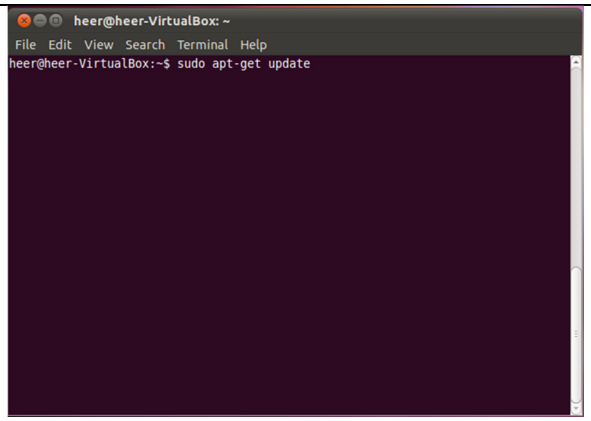
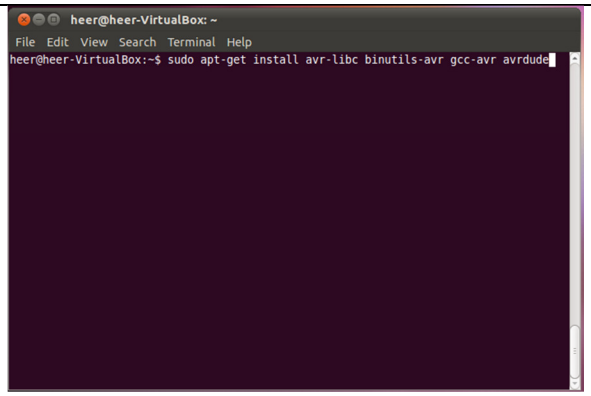
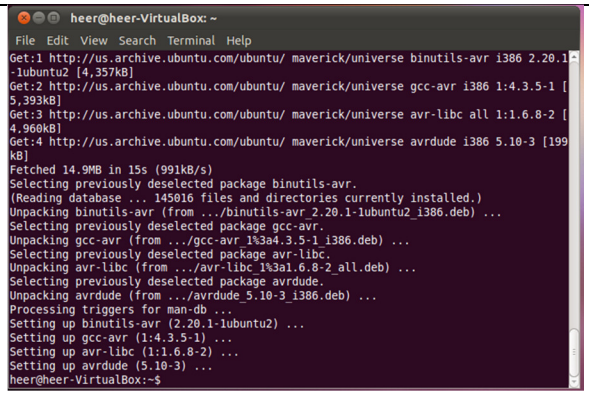
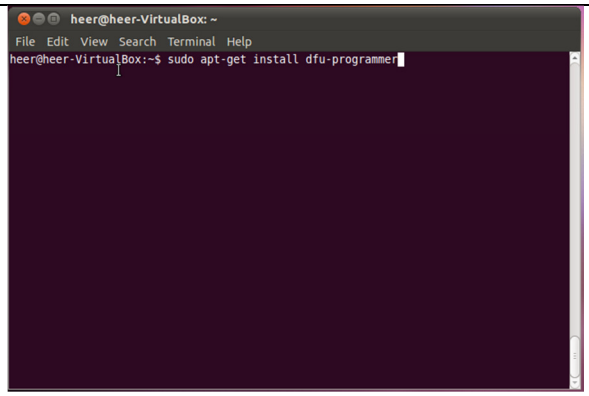
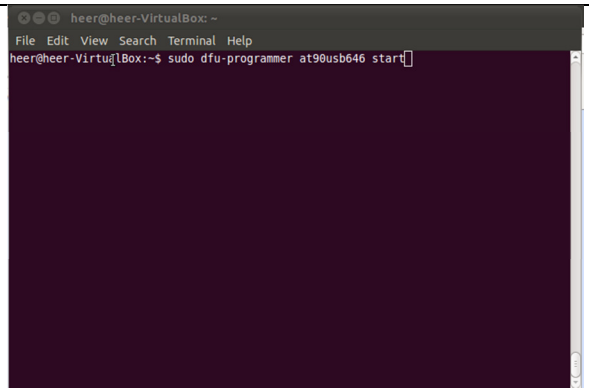
Appendix

Installing avr-gcc and Programming the Wunderboard in Linux

Installation of the tools in Ubuntu is very simple for newer versions of Ubuntu. It is recommended you upgrade to the newest version before starting.

1. First, open a Terminal window.	
2. Make sure Ubuntu has a current copy of what can be installed by entering the command **sudo apt-get update** in the command window. You will need to enter your password when asked.	
3. Install the compiler by running the command: **sudo apt-get install avr-libc binutils-avr gcc-avr avrdude**	

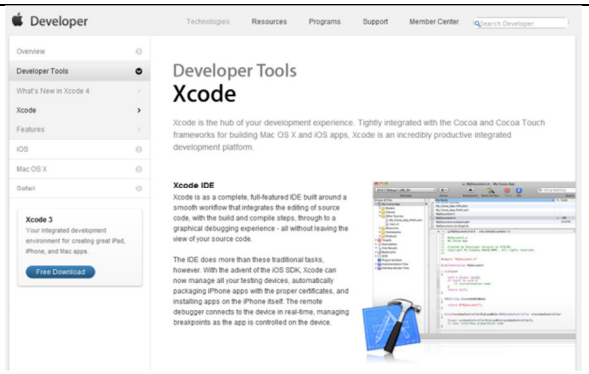
4. If everything works, the last 4 lines seen in the terminal will be **Setting up binutils-avr (version stuff)** **Setting up gcc-avr (version stuff)** **Setting up avr-libc (version stuff)** **Setting up avrdude (version stuff)**	
5. Last, install the dfu programmer to be able to download code to the Wunderboard. **sudo apt-get install dfu-programmer**	
6. After the installation, ensure the system works by connecting the Wunderboard as described in lab 6 and preparing it to be programmed. Next run the command **sudo dfu-programmer at90usb646 erase** If there are no errors reported, you are all set.	

Installing avr-gcc on a Mac

Installation of the tools on Mac is very similar to installing on Linux. It does take some time however as the installation of Xcode is a massive download. If Xcode is already installed, the process is relatively quick.

1. First, if not already installed, install Xcode. Xcode is supplied by Apple and is free. You will need to sign-up for a development account to get access to download it.
   The web address to get Xcode is:

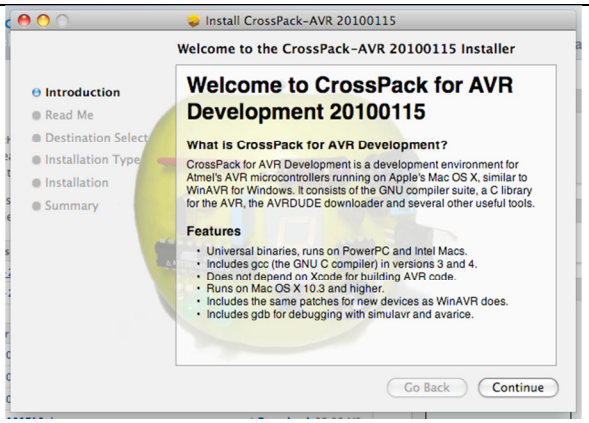
   http://developer.apple.com/technologies/tools/xcode.html



2. After installing Xcode, download and install the Mac CrossPack for AVR. This manual installs version 20100115, but new versions should work as well.

   You can find the CrossPack installer at:

   http://www.obdev.at/products/crosspack/download.html



3. The next tool to install is 'MacPorts.' MacPorts allows for various Linux programs to be easily installed onto a Mac. This manual assumes you are installing MacPorts-1.9.2, but any newer version should also work.

   You can find the MacPorts installers at:

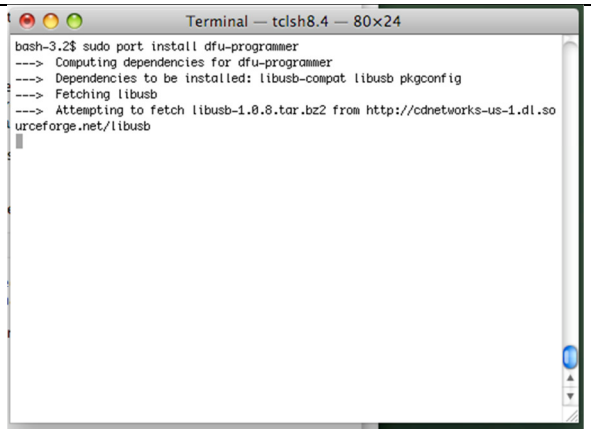
   http://www.macports.org/install.php

4. To download files to the Wunderboard, you need to use MacPorts to install the 'dfu-programmer.' To do this, open a terminal window and run the command:

   sudo port install dfu-programmer

   If you have a firewall installed (e.g. PeerGurdian), you may get errors. If so, temporarily disable your firewall and run the command below before running the dfu-programmer install.

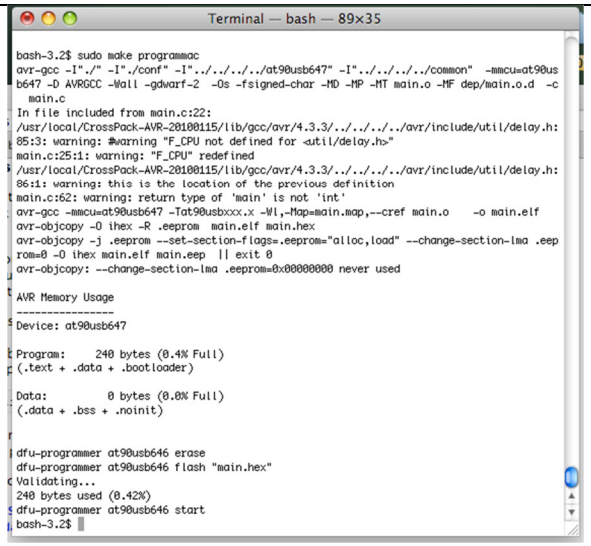
   sudo port selfupdate



5. To verify your installation, download the lab 6 sample code and un-archive it your hard drive. Open a terminal window and navigate to the directory where you unarchived the files. Make sure you are in the directory where the main.c file is located. Now type:

   sudo make programmac

   If there are no errors reported, you are all set. Your output may look something like the figure.



The Wunderboard Peripherals

The Wunderboard was design to be a system that had several different types of inputs and outputs built in to allow for embedded coding without significant wiring and electrical knowledge. However, most IO ports are available for use. To best utilize the functionality of the board, please read the sections below detailing the peripherals that are wired to the microcontroller on the Wunderboard.

Switches and Buttons

The switches and buttons on the Wunderboard are all connected to Port A. Care should be taken that these pins not be setup as output pins. The push buttons (Port A0 to A3) are active high. Pressing a button will produce a '1' in the corresponding PINA bit position. The slide switches (Port A4 to A7) flip between either state as needed. There is no hardware debouncing on any pin, so the user should take software precautions to avoid multiple triggerings. As a reminder, debouncing is needed since many buttons will 'activate' many times very quickly when the switch is depressed. Figure 26 shows the arrangement of the switches.

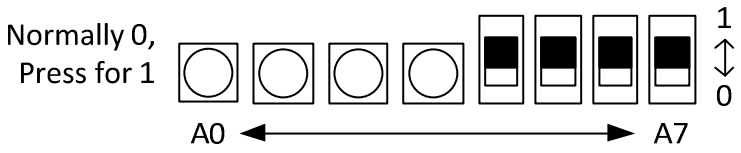


Figure 26: Switch Arrangement

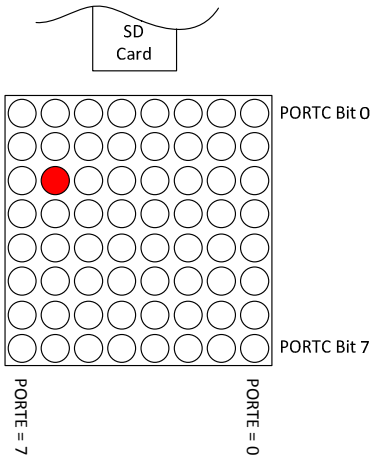
Serial Port

The serial system on the Wunderboard is connected to UART1 of the AT90USB microcontroller. This interface uses an FTDI USB to Serial integrated circuit to allow communication with modern PCs. The drivers for the FTDI chip can be found online at the Wunderboard hardware reference webpage. In the event that the user would like to connect this serial port to a device other that the FTDI chip, remove the jumper labeled 'FTDI EN' from the board. This will put the FTDI chip into sleep mode and allow the user to access the port D2 and D3 pins.

The FTDI chip is compatible with Windows, Linux, and Mac computers. The baud rate is auto selecting based on what is set by software on the microcontroller. In order to be able to read and write to the port, the computer will need to have a 'terminal' program installed.

LED Array

The LED array on the Wunderboard is a bicolor display capable of displaying red, green, and amber (red and green together). It was designed to be easily accessed as an array. Each row of the display contains 8 LEDs, each one controlled by one bit of Port C. The columns of the display are indexed by the lowest 3 bits of Port E. The intention is that the user can create an array of 8bit values (unsigned char) of 8 elements in size. By outputting the value of each element to PORTC and the index to PORTE, the entire array can be displayed quickly. Figure 27, show the LED array and how the bits of the ports are aligned. The SD card slot is shown for reference.



Example:
PORTB = 0b01000000;
PORTC = 0b00000100;
PORTE = 6;

Figure 27: LED Array

If the user would like to disable the LED array, removing the 'LED EN' jumper will do this. With the display disabled, Port C and Port E0 - E2 can be used as inputs or outputs as needed.

Audio

Acceleration

The on board accelerometer is accessed using PORT F5-F7. Based on the version of Wunderboard, there is either a 2 or 3 axis accelerometer installed. Each accelerometer axis produces an analog voltage based how much acceleration there is in that axis. An acceleration of 0 gravities would return a value of approximately 0x7F. Figure 28 shows the direction to tip the Wunderboard for the X and Y acceleration values. The LED array is shown only for reference.

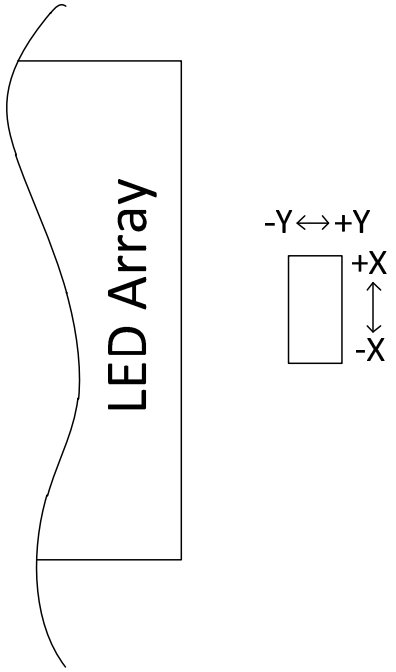


Figure 28: Accelerometer

Helper functions have been written to read from the accelerometers. These functions are located in the **adc.c** and **adc.h** source files on the Wunderboard hardware resources webpage. The X-axis is connected to ADC channel 5 and the Y-axis is channel 6.

Mechanical Relay

The mechanical relay on the Wunderboard can be used to control both DC and AC systems. The relay is a double pole double throw switch. Writing a '1' to the relay control (port E6) pin will activate the relay. The user can wire the relay so that it is normally closed when deactivated or normally open. The relay is capable of controlling 120VAC loads of up to 1 amp and 120VDC loads 500mA.

MicroSD Card

The microSD slot allows for the user to read and write to microSD cards. Caution should be used since the cards are accessed in raw' mode. This means that without proper firmware, the data written to the card cannot be read by a PC and may wipe existing data. Additionally without proper firmware, files written to a microSD card cannot be read by the Wunderboard either.

Source code for interfacing to FAT32 formatted microSD cards is available for download from the TekBots Hardware resources webpage.