Getting Started with the Raspberry Pi

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Innovation For a Global Future

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Agenda

Overview of the Raspberry Pi

Installing the OS

Setting up VNC

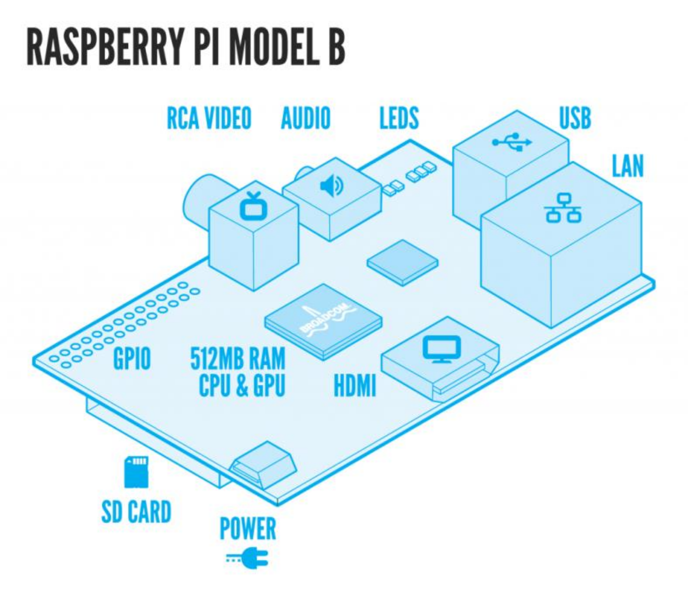
Setting up Qt locally

Serial port communications

Resources

Using a Mac

Overview of the Raspberry Pi (Model B)



Broadcom BCM2835 SOC

- 700 Mhz ARM 11 processor
- Hardware floating point
- Videocore 4 GPU (Open GL ES2.0)

512 MB RAM + SD Card for mass storage

Camera connector – camera coming soon!

JTAG connector

Low level I/O

- 12 GPIO
- UART (3.3V TTL)
- SPI, with two CS lines
- I2C

Full schematics available

Additional Hardware

To get started with the system you will need to add:

- USB Keyboard
- USB Mouse
- SD Memory Card: 4GB or larger, Class 10 or better
- Micro USB cable (Dollar stores have these cheap, and so does Amazon! http://www.amazon.com/gp/product/B003ES5ZSW/ref=oh_details_o00_s00_i01)
- 5V USB Power Plug, 700mA or better (Can also use a bench supply, etc.)
- Ethernet cable and wired network, wireless USB adapters also available
- HDMI cable and monitor
  - Can also use HDMI to DVI converter/cable (Amazon has these cheap! http://www.amazon.com/gp/product/B004S4R5CK/ref=oh_details_o00_s00_i00)

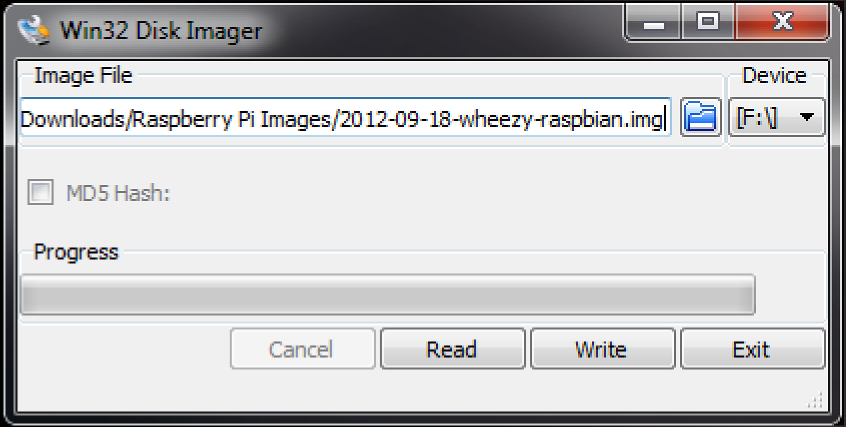
May also want:

- Multiple SD cards – really handy for experimenting
- 1/8" stereo audio cable
- 26 position IDC connectors and ribbon cable (Fry's)
- USB hub

Installing the OS

Image will be placed directly onto the SD card using a Windows PC (can also use Linux or Mac for this step with appropriate software).

1. Download and install Win32DiskImage from: https://launchpad.net/win32-image-writer/+download
2. Download the "Raspbian wheezy" image from: http://www.raspberrypi.org/downloads
   1. This is a Debian based Linux image using hardware floating point and LXDE
3. Insert the SD Card into your computer THEN run Win32DiskImage
   1. May get an error message "Incorrect Function", just ignore it
4. Select the SD Card and image to load, then press "Write" – copy will take some time!



Win32 Disk Imager

Image File: Downloads/Raspberry Pi Images/2012-09-18-wheezy-raspbian.img

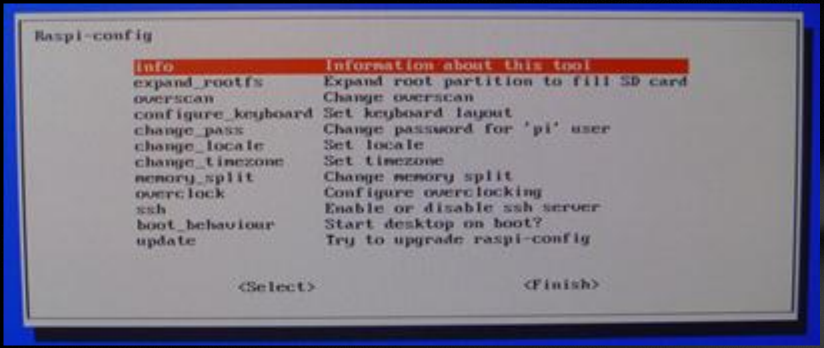
Device: [F:\]

□ MD5 Hash:

Progress

First OS Run

Install the SD card, attach USB keyboard, USB mouse, monitor into the Pi and apply power to the Pi.



```
Raspi-config

          info                Information about this tool
          expand_rootfs       Expand root partition to fill SD card
          overscan            Change overscan
          configure_keyboard  Set keyboard layout
          change_pass         Change password for 'pi' user
          change_locale       Set locale
          change_timezone     Set timezone
          memory_split        Change memory split
          overclock           Configure overclocking
          ssh                 Enable or disable ssh server
          boot_behaviour      Start desktop on boot?
          update              Try to upgrade raspi-config

                 <Select>                  <Finish>
```

First screen configuration

1. Set time zone
2. Set memory allocation between CPU and GPU, 448M/64M standard
3. Enable SSH, if desired
4. Set boot behavior – straight to desktop or not, we'll turn this on for now
5. Expand_rootfs and reboot

Use the command *sudo raspi-config* to run the configuration program at any time after the first boot.

Demo – Walk around the OS

Points of Interest

Start Menu Button

Logout Button

Multiple Desktops

File Manager

CPU Graph

LX Terminal

nano

At this point you should also update the OS!

1. Open LX Terminal
2. *sudo apt-get update*
3. *sudo apt-get upgrade*

Setup VNC – Optional Step

By setting up VNC you eliminate the need for a dedicated keyboard, mouse and monitor for the Raspberry Pi.

1. Open a command window: Accessories -> LXTerminal
2. Type: *sudo apt-get install tightvncserver*
3. Run *vncserver* and enter a password – srs_demo for the demo image
4. Edit /etc/init.d/bootmisc.sh to start vnc server on boot up
   A. *sudo nano /etc/init.d/bootmisc.sh*
   B. Scroll to end of text and add:

      su –c "vncserver :1 –geometry 1200x800 – depth 16" pi &
   C. *Ctl-o, Ctl-x* to save and exit
   D. Note: There are other more formal ways to do this – this one is simple!
5. Download and install Tight VNC Viewer for your desktop from: http://www.tightvnc.com/download.php

Setup Qt Development Environment

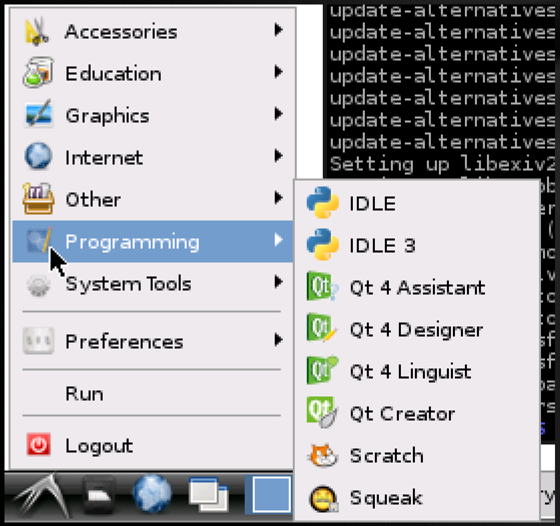
From a console window type:

sudo apt-get install g++-4.7

sudo apt-get install qt4-dev-tools

sudo apt-get install qtcreator

Qt Creator will now show up in the programming menu:

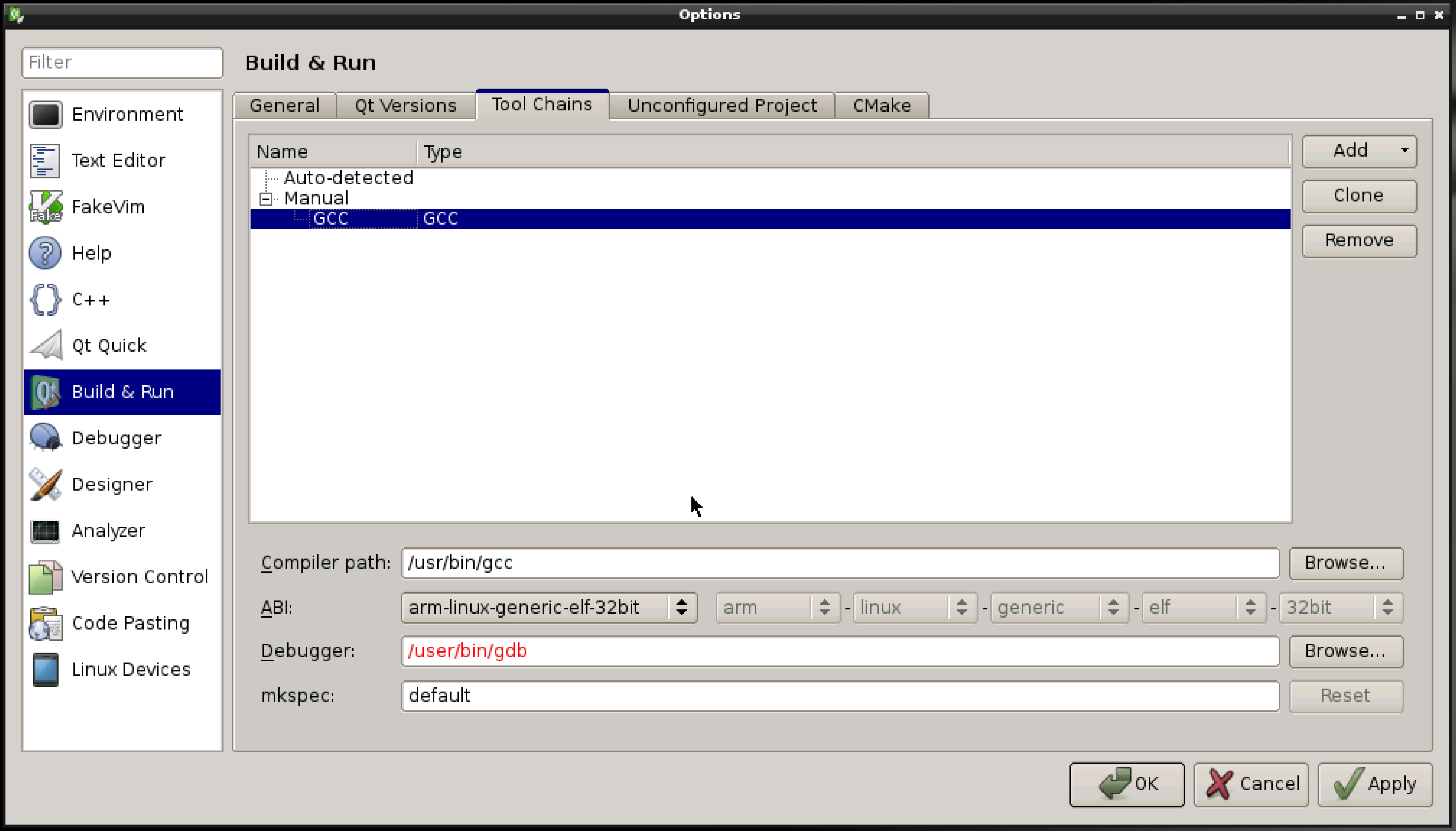


```
update-alternatives
update-alternatives
update-alternatives
update-alternatives
update-alternatives
update-alternatives
update-alternatives
Setting up libexiv2
```

Configure Your Tool Chain

Start Qt Creator and then choose Tools->Options->Build&Run->Tool Chains

Configure as shown by clicking Add->GCC:



Name	Type
Auto-detected	
Manual	
GCC	GCC

Compiler path: /usr/bin/gcc

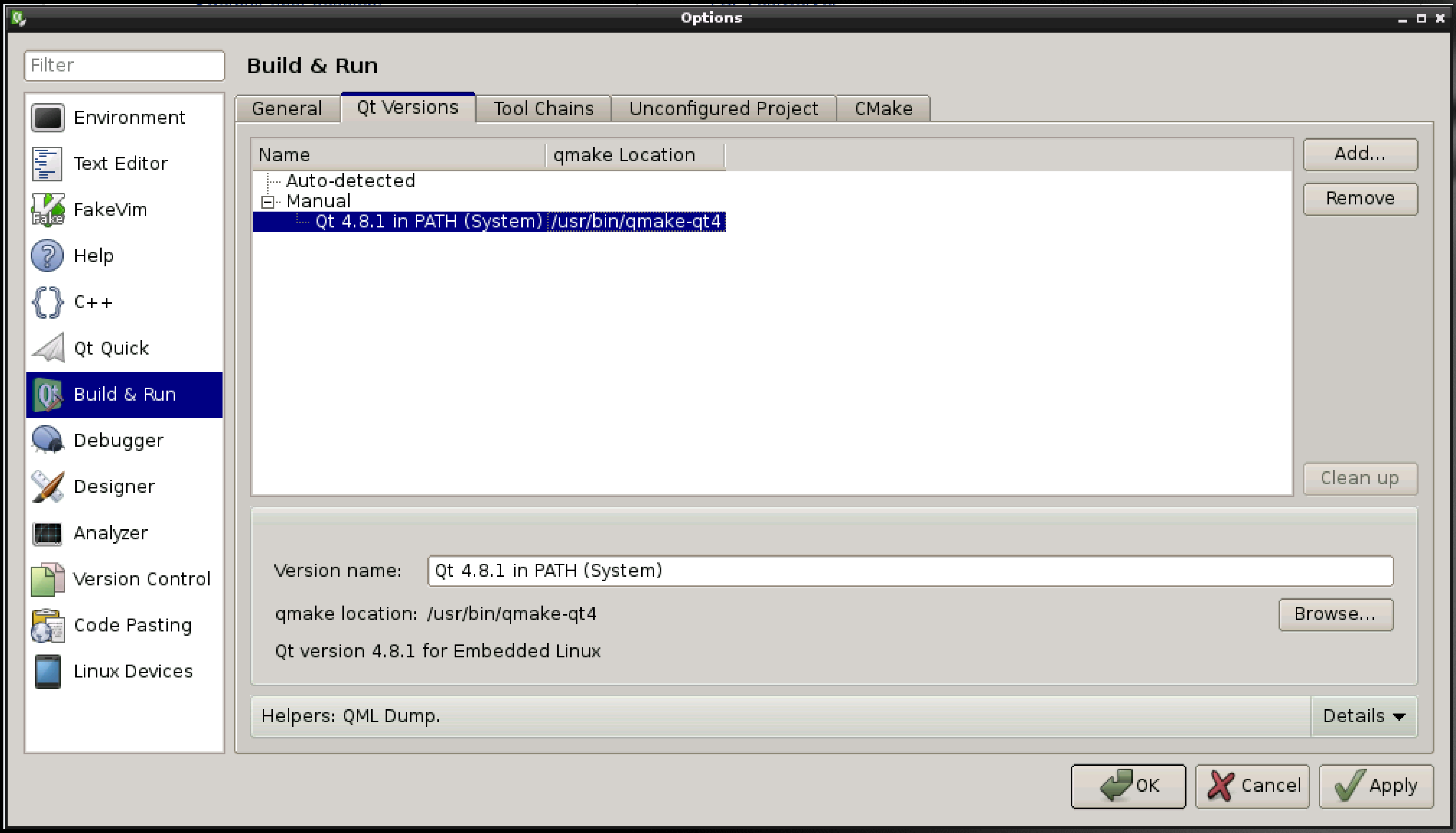
ABI: arm-linux-generic-elf-32bit   arm - linux - generic - elf - 32bit

Debugger: /user/bin/gdb

mkspec: default

Configure Qt Versions

On the same panel choose Qt Versions and configure as shown (may already be configured):



Version name: Qt 4.8.1 in PATH (System)

qmake location: /usr/bin/qmake-qt4

Qt version 4.8.1 for Embedded Linux

Helpers: QML Dump.

Name	qmake Location
Auto-detected	
Manual	
Qt 4.8.1 in PATH (System)	/usr/bin/qmake-qt4

Configuring the Serial Port

3 wire serial port located on GPIO Pins 6 (GND), 8(Tx), 10(Rx)

Device name is: /dev/ttyAMA0

Voltage levels are 3.3V, and directly connected to SOC!!!! The good news is this will directly connect to a microcontroller! Not good for a PC!

I'm using a level shifter for the demo to connect to the PC. AdaFruit has one for $10 (http://adafruit.com/products/954)

Default is to use this for an OS console port, need to disable functionality:

Configuring the Serial Port

Disable the console output in /boot/cmdline.txt

- In a console window type:

  sudo nano /boot/cmdline.txt

  Remove all references to /dev/ttyAMA0

  Ctl-o <Enter> Ctl-x (to write the file back out and exit)

  - Typical modified line will appear as:

    dwc_otg.lpm_enable=0 root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline rootwait

Disable the getty in /etc/inittab

In a console window type:

- *sudo nano /etc/inittab*
- comment last line: T0:23: respawn /sbin/getty –L ttyAMA0 115200 vt100
- *Ctl-o <Enter> Ctl-x* (to write the file back out and exit)

Restart the Raspberry Pi for this to take effect

- *sudo reboot*

The Demo Program

Can use standard GCC/Eclipse to program, however Qt provides a nice IDE and is cross platform environment (Windows, Linux, Mac, Android, Embedded Linux, Windows CE, iOS on the way)

And it is FREE! (LGPL v2.1 and commercial licenses available)

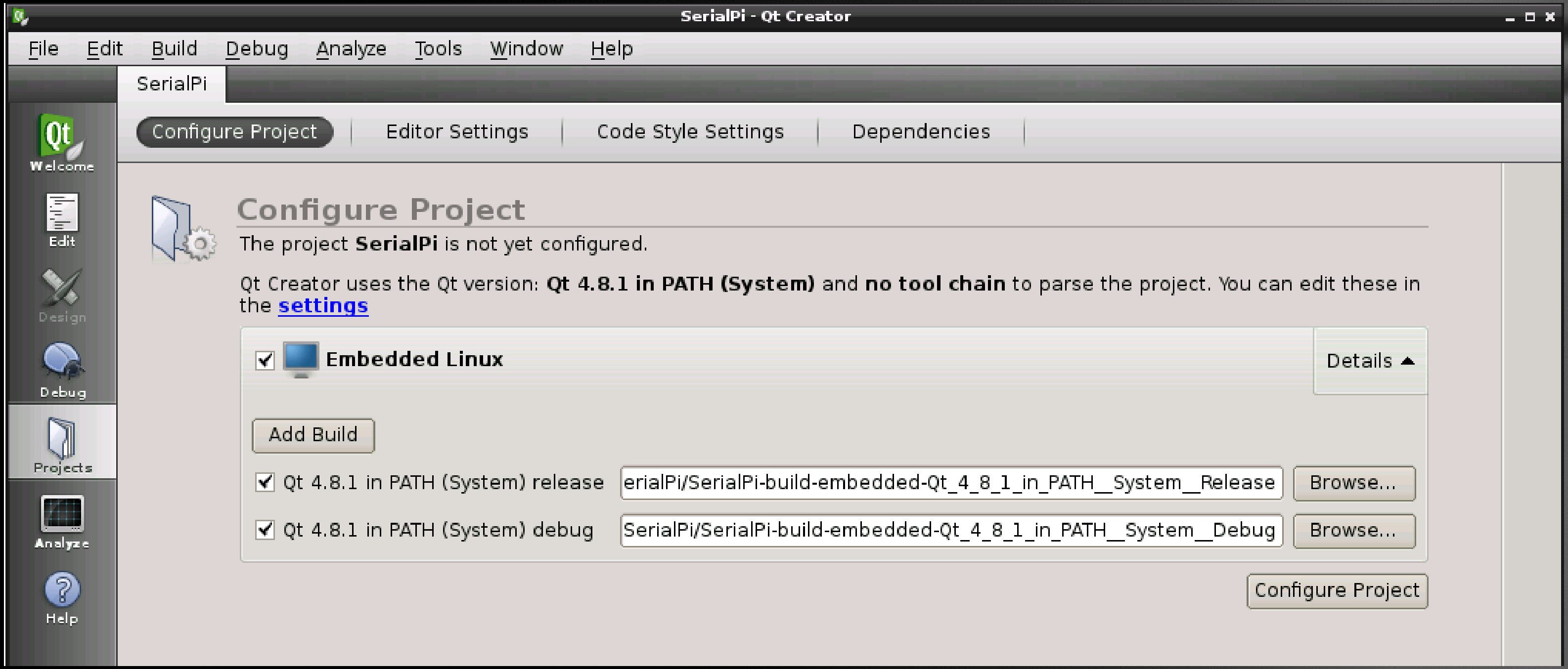
Will also be using QtExtSerialPort, a free Qt compatible serial port abstraction (MIT license)

Will simply open the serial port set 57600N81 and send out “Hello World”

Located in ~/SerialPi/SerialPi in the demo image, the project file is named SerialPi.pro

Configure SerialPi Project

The first time you open the SerialPi project you will be asked to configure it for the types of builds that you want to create. Configure the project as shown:



Configure Project

The project **SerialPi** is not yet configured.

Qt Creator uses the Qt version: **Qt 4.8.1 in PATH (System)** and **no tool chain** to parse the project. You can edit these in the **settings**

☑ **Embedded Linux**

☑ Qt 4.8.1 in PATH (System) release — erialPi/SerialPi-build-embedded-Qt_4_8_1_in_PATH__System__Release

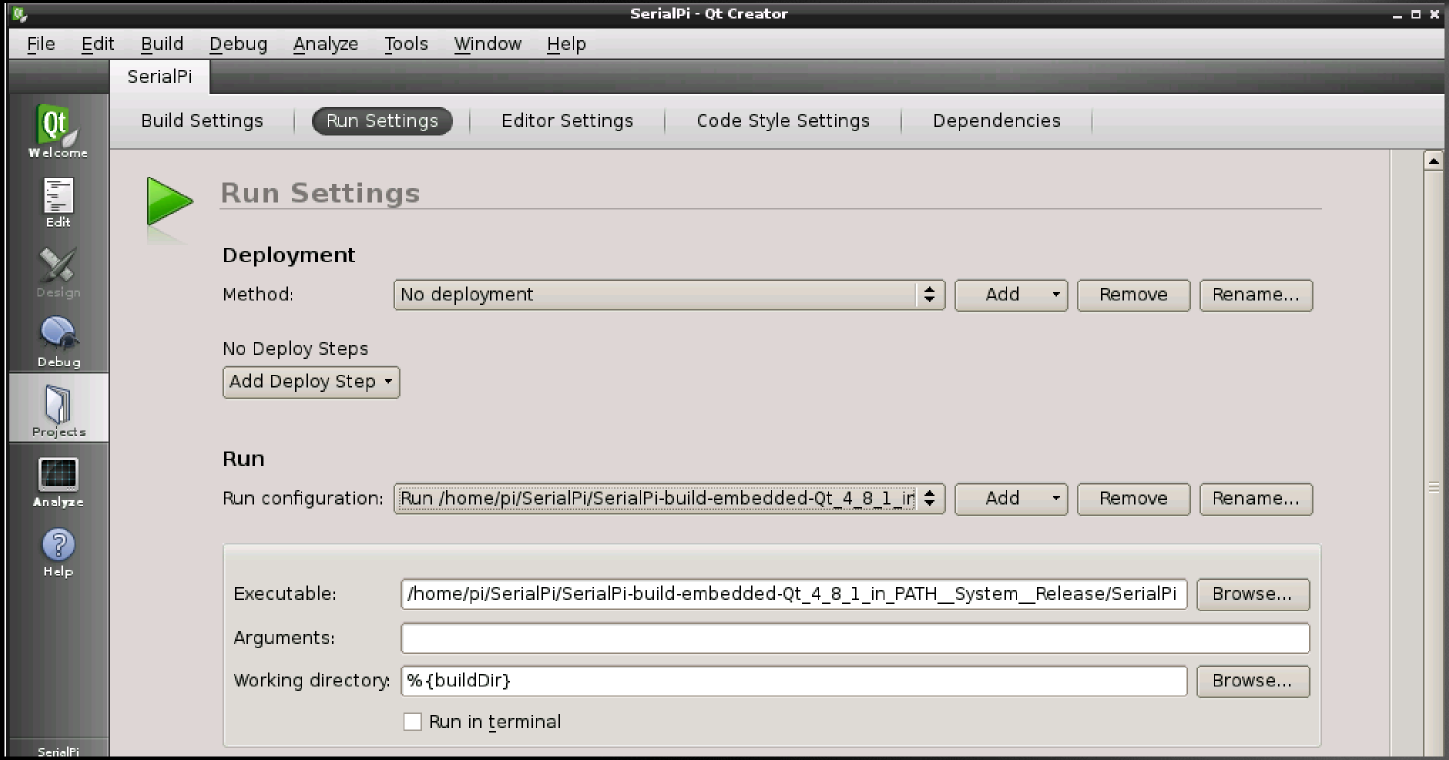
☑ Qt 4.8.1 in PATH (System) debug — SerialPi/SerialPi-build-embedded-Qt_4_8_1_in_PATH__System__Debug

Configure No Deployment Runtime

Normally for embedded development you build on a host computer and deploy to a target computer. This can be faster overall but is much more complex to set up.

To configure this project to run locally choose:

1. Deployment: Projects->Run Settings,
2. Run: Add->Deploy Configuration and set the path to the executable



Run Settings

Deployment

Method: No deployment

No Deploy Steps

Run

Run configuration: Run /home/pi/SerialPi/SerialPi-build-embedded-Qt_4_8_1_in

Executable: /home/pi/SerialPi/SerialPi-build-embedded-Qt_4_8_1_in_PATH__System__Release/SerialPi

Arguments:

Working directory: %{buildDir}

□ Run in terminal

Demo – Run Program in Qt

Few More Things

Gertboard Kit– Plugs into the IO header on the Raspberry Pi and contains:

- 12 buffered I/O lines
- 3 pushbutton switches
- 6 open collector drivers (50V 0.5A)
- 48V 4A motor controller
- 28 pin, DIP, Atmega controller
- 2 channel 12 bit ADC
- 2 channel 10 bit DAC

BCM2835 Library – Open source library containing drivers and examples for:

- SPI
- GPIO

Adapteva Project - $99 board, 16 cores, 26GFLOPS: http://arstechnica.com/information-technology/2012/09/99-raspberry-pi-sized-supercomputer-touted-in-kickstarter-project/

Using a Mac to Create the SD Card

Use Stuffit to unzip the download file (http://www.stuffit.com/mac-expander.html)

To set up the SD card:

- Insert the SD card into a card reader. I used the built-in card reader on my MacBook Air.
- The card should show up in the Finder. Run Disk Utility (from the Applications/Utilities folder), find the SD card on the left, select the volume associated with that device, and then click on the "Unmount" button. This unmounts the volume but leaves the card connected we can blast it with the disk image. Do not click on the “Eject” button as this will also disconnect the card, and we won’t be able to talk to it.
- Now we need to figure out the low-level (BSD) name to use to access the SD card. In Disk Utility, click on the item for the card reader and then click on the Info button at the top of the window. In the resulting window, you should see a line with the "disk identifier". On the MacBook Air it's "disk2", on the Mac Pro it's "disk5". Note that you want the disk identifier of the card, not the name of the volume (partition) on the card, which is generally something like “disk2s1”. If you get a volume device name, you need to click on the parent item, which is typically the name of the card reader, then choose Info.
- Run the Terminal application
- “cd” to the directory with the file decoded from the zip. If you haven't used the command line before and have no idea what I'm talking about, you can just move the SrsRaspPiDemo2.img file to your home folder, the folder the OS creates with your login name and holds all of your other folders, like Documents and Downloads.
- Finally, we're going the use the dd command to transfer the image onto the card. A note of caution: this lets you blast data directly onto a drive, INSTANTLY destroying any data already there. That's a good thing, it's what we want to do, BUT if you get the wrong BSD name or do something stupid like swap the arguments, you can COMPLETELY trash your valuable data. BE CAREFUL!!! If you've done the steps above correctly, type the command below, replacing <diskX> with the disk identifier you found in the step above. The "if" argument means "input file" and "of" means "output file" so the command above says input the disk image file and output to the card reader.

  - *dd if=SrsRaspPiDemo2.img of=/dev/<diskX>*

The transfer will take about 2 -3 hours depending on your system, this is normal and there is very little feedback – good time for having dinner!

References

Raspberry Pi Home Page: http://www.raspberrypi.org/

Tight VNC Home Page: http://www.tightvnc.com/

Qt Home Page: http://qt-project.org/

QExtSerialPort Home Page: http://code.google.com/p/qextserialport/

Gertboard: http://www.raspberrypi.org/archives/tag/gertboard

BCM2835 Drivers: http://www.open.com.au/mikem/bcm2835/index.html

BCM2835 Peripherals Datasheet: http://www.raspberrypi.org/wp-content/uploads/2012/02/BCM2835-ARM-Peripherals.pdf

MagPi Magazine: http://www.themagpi.com/

Image of today's session (8GB SD Card): http://www.CyberData-Robotics/Transfer/RaspPiImage.zip (Will be available until 2/28/2013)