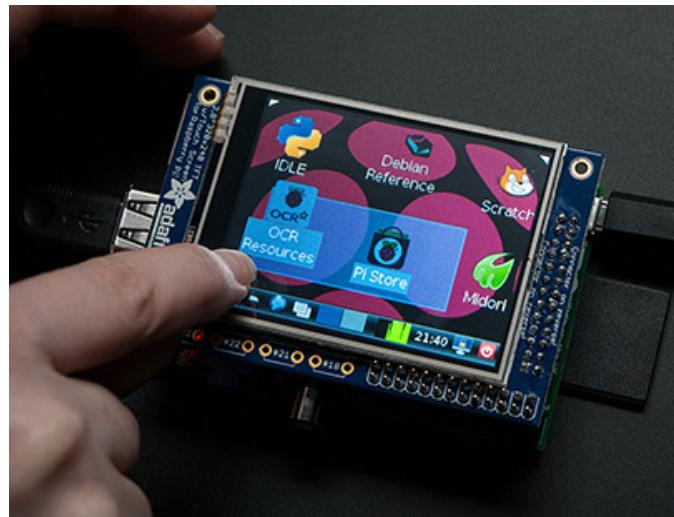




Adafruit PiTFT - 2.8" Touchscreen Display for Raspberry Pi

Created by lady ada



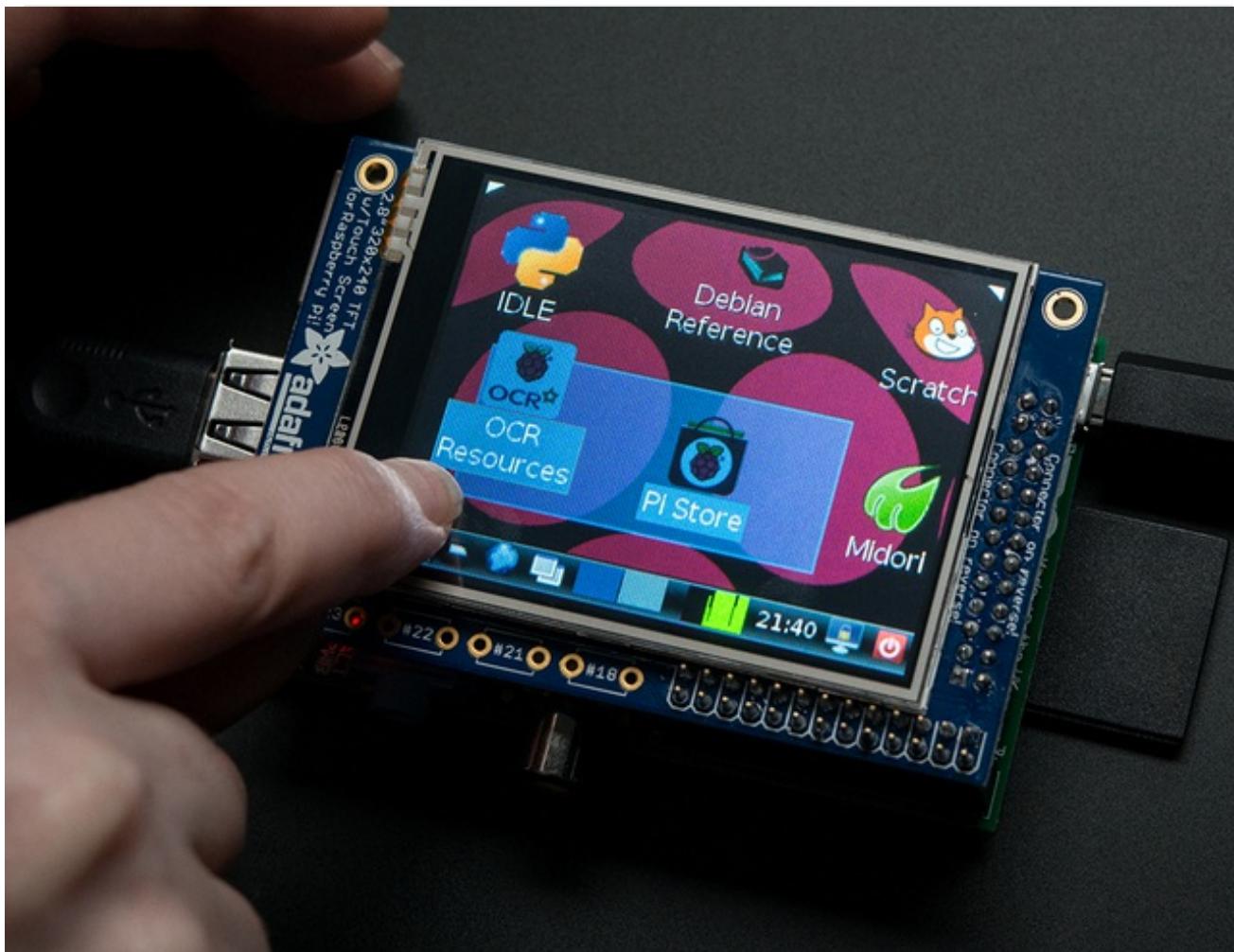
Last updated on 2014-12-11 09:45:11 AM EST

Guide Contents

Guide Contents	2
Overview	4
Assembly	8
Easy Install	15
Ready to go image	15
DIY Installer script	15
Detailed Installation	21
Before you start	22
Download & Install	22
Module Auto-loading	26
Touchscreen Install & Calibrate	31
Setting up the Touchscreen	31
AutoMagic Calibration Script	34
Manual Calibration	36
X Calibration	37
Using the Console	41
Turn off Console Blanking	44
Playing Videos	45
How To Play Videos	45
Converting/Resizing Videos	47
Displaying Images	51
Extras!	53
Controlling the backlight	53
Tactile switch as power button	54
Making it easier to click icons in X	55
Boot to X Windows on PiTFT	56

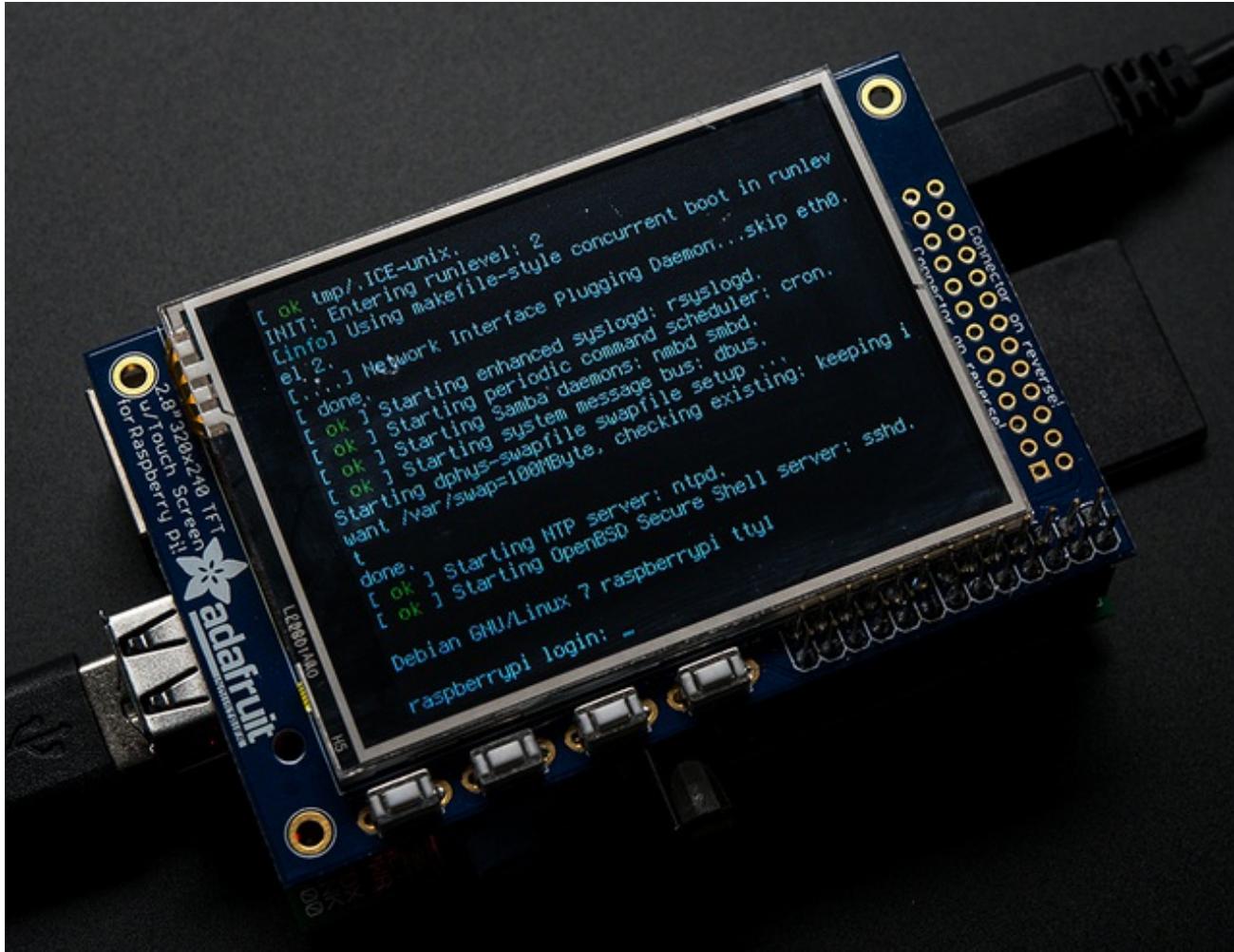
Gesture Input	58
Installation	58
Usage	58
FAQ	62
Downloads	65
Schematic & Layout	65

Overview



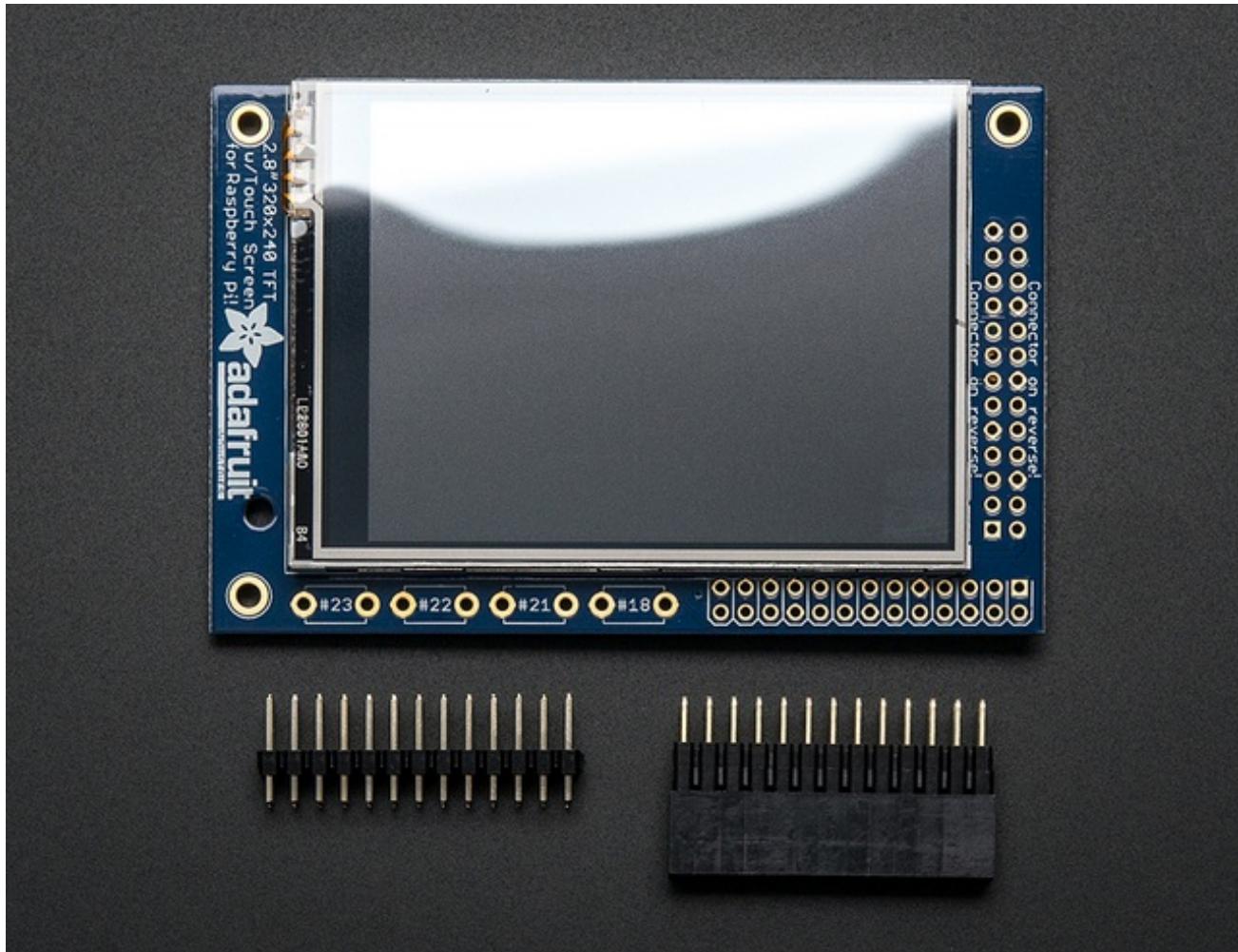
Is this not the cutest little display for the Raspberry Pi? It features a 2.8" display with 320x240 16-bit color pixels and a resistive touch overlay. The plate uses the high speed SPI interface on the Pi and can use the mini display as a console, X window port, displaying images or video etc. Best of all it plugs right in on top!

It's designed to fit nicely onto the Pi Model A or B but also works perfectly fine with the Model B+ as long as you don't mind the PCB overhangs the USB ports by 5mm

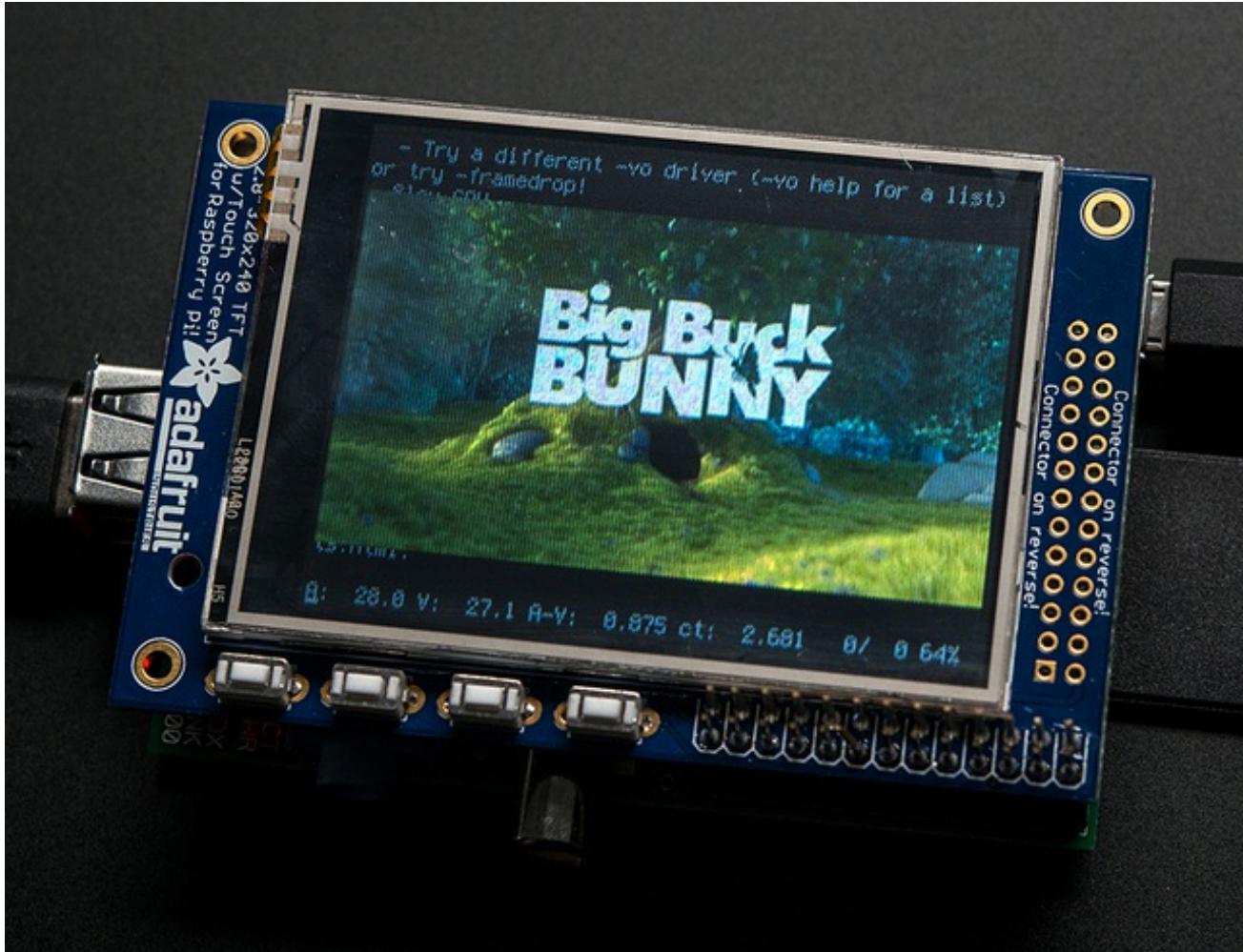


This design uses the hardware SPI pins (SCK, MOSI, MISO, CE0, CE1) as well as GPIO #25 and #24. All other GPIO are unused. Since we had a tiny bit of space, there's 4 spots for optional slim tactile switches wired to four GPIOs, that you can use if you want to make a basic user interface. For example, you can use one as a power on/off button.

We bring out GPIO #23, #22, #21, and #18 to the four switch locations!



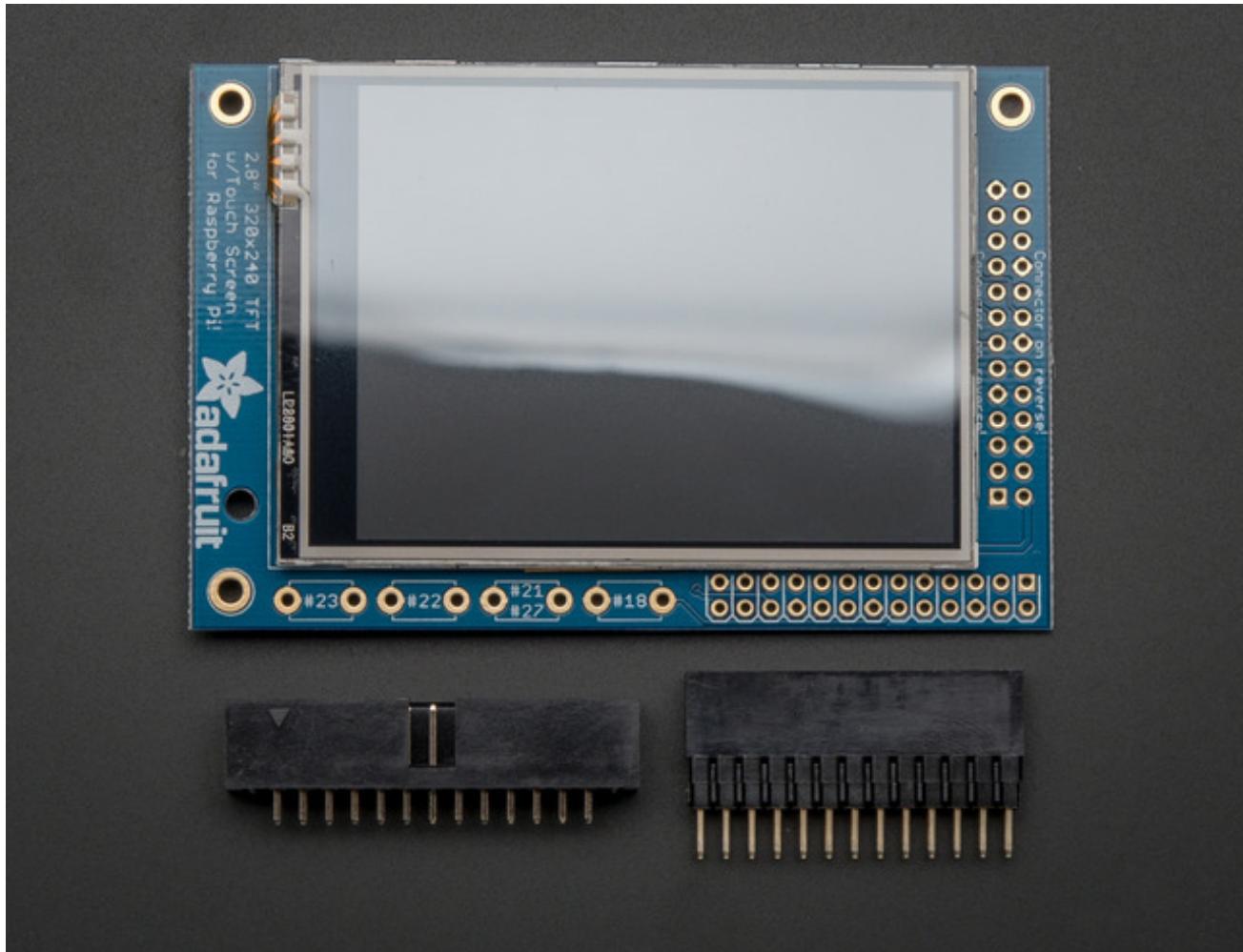
To make it super easy for use: we've created a custom kernel package based off Notro's awesome framebuffer work, so you can install it over your existing Raspbian (or derivative) images in just a few commands.



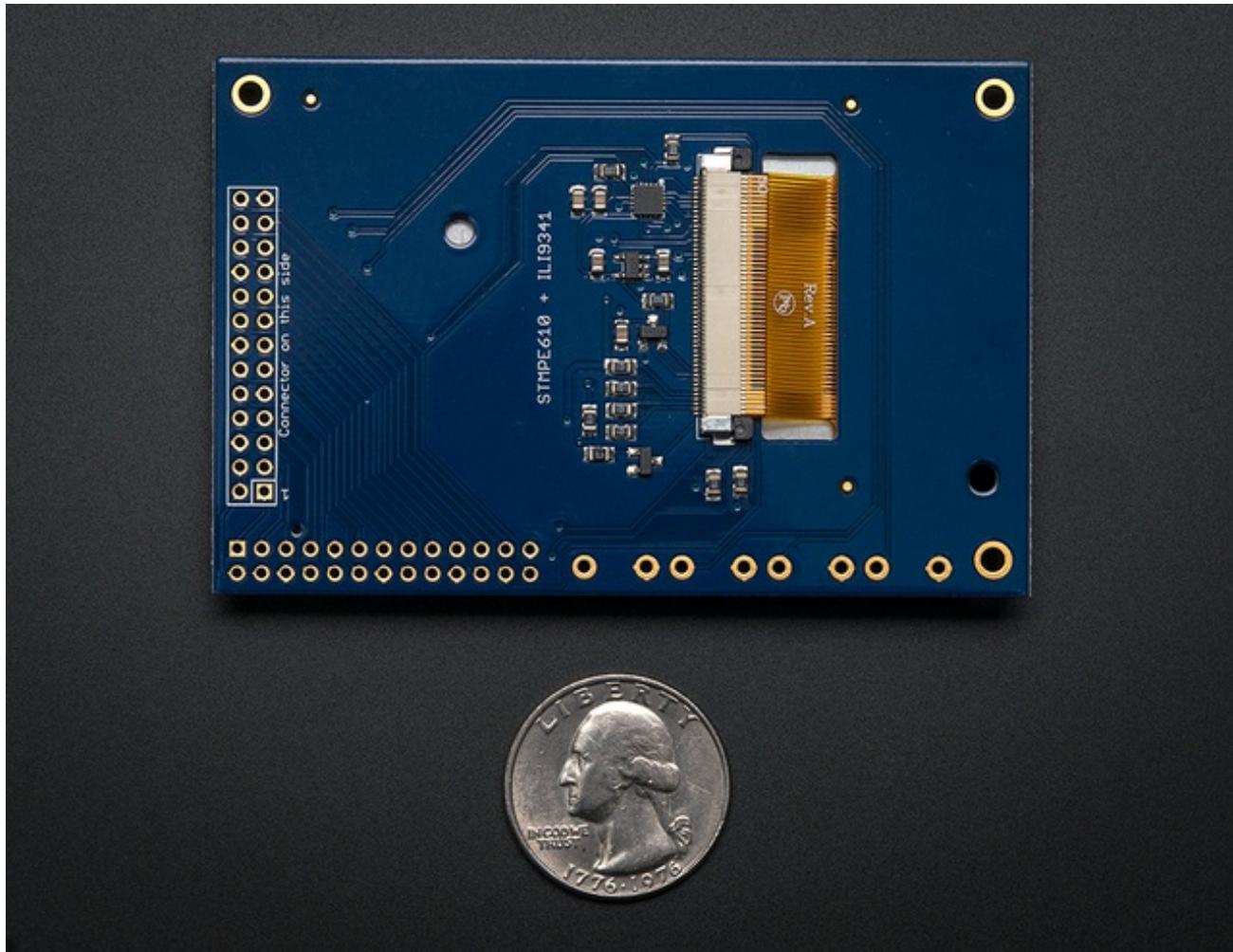
This tutorial series shows you how to install the software, as well as calibrate the touchscreen, play videos, display images such as from your PiCam and more!

Assembly

This tutorial page is for PiTFT that came as a kit. If your PiTFT is already assembled, skip this step!



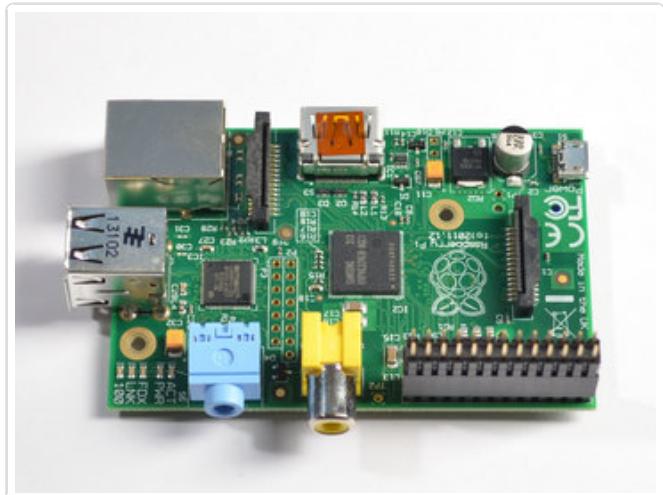
Before you start check that you have the parts you need: an assembled PiTFT plate with the 2.8" screen, extra tall female header and the 2x13 IDC socket. Note that it is normal for the screen to be 'loose' - this is so its easier for you to solder the connector on!



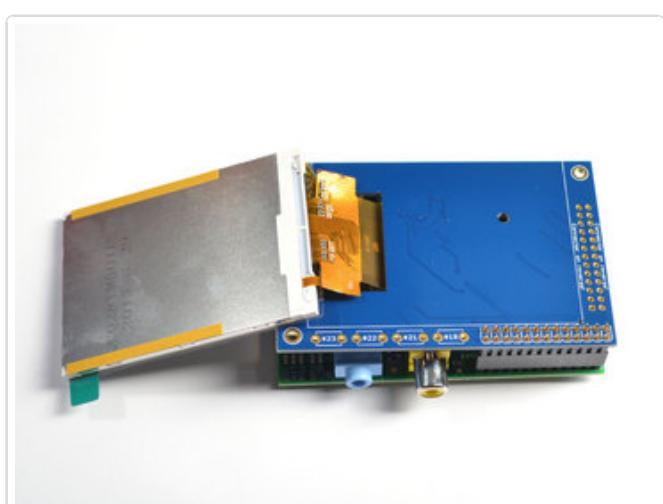
Check also on the back that the TFT is attached and that the flex connector is seated into the onboard FPC socket.



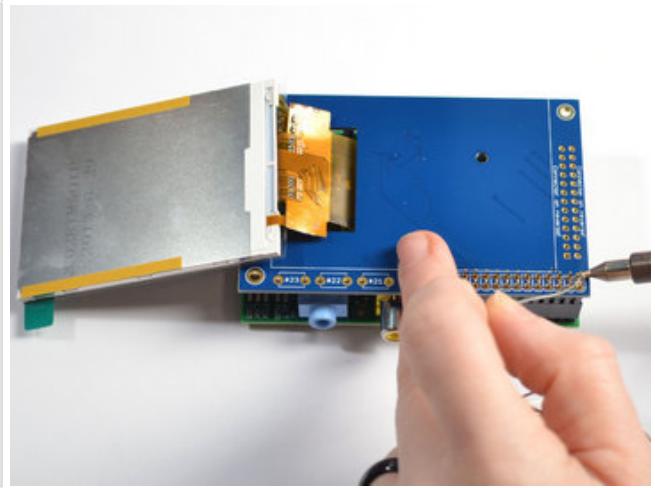
The easiest way to attach the header is if you have a Raspberry Pi as a 'stand' - make sure its powered off & unplugged!



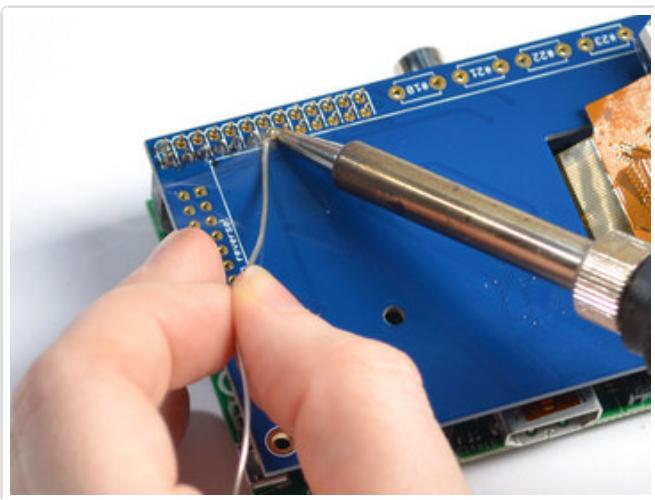
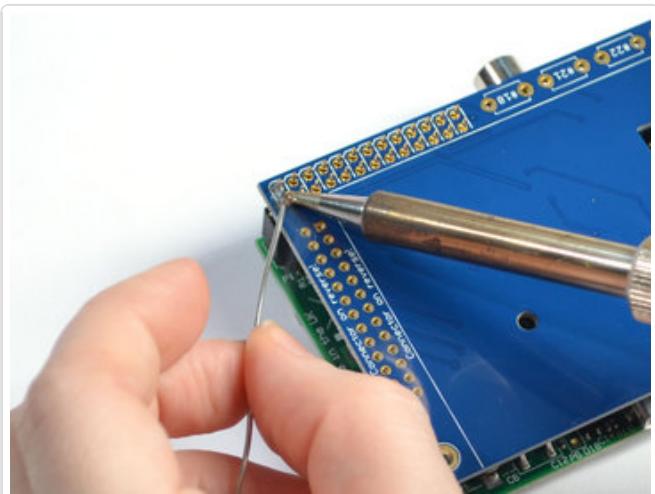
Plug the extra tall female header into the GPIO port on the Pi as shown. Make sure its seated nice and flat

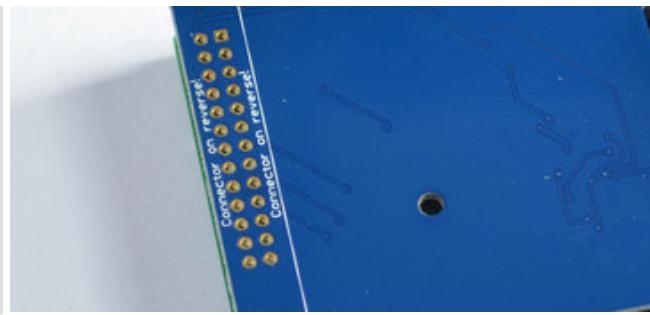


Place the PiTFT shield on top so all the pins stick through the connector on the side. Gently flip the TFT so its off to the side and wont be in your way while you solder

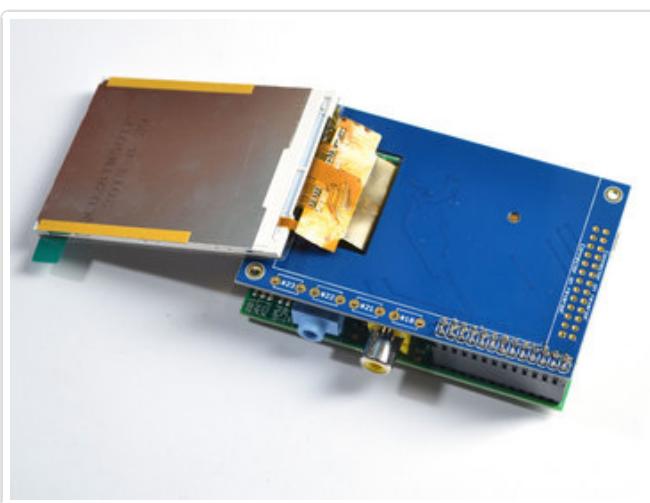


Heat up your soldering iron, and grab some solder. Start by tack-soldering one of the corners while pressing on the plate to make it sit flat. Once you have one or two pins done you can continue to solder each of the pins.

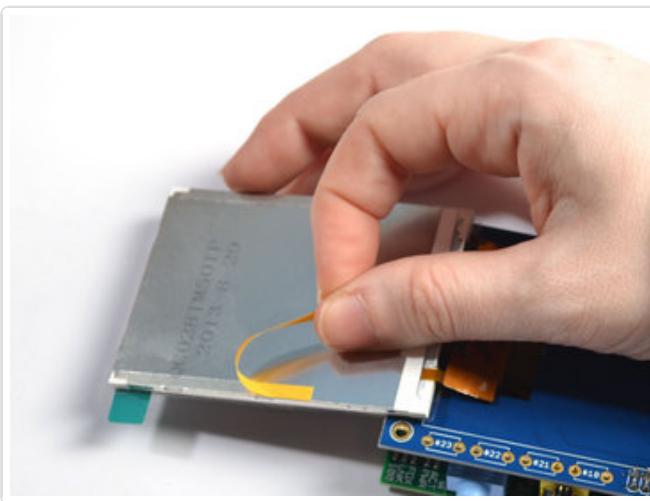




Before attaching the display, check that all the pins are soldered nicely and there's no bridging, cold solder, shorts, or unsoldered pins.

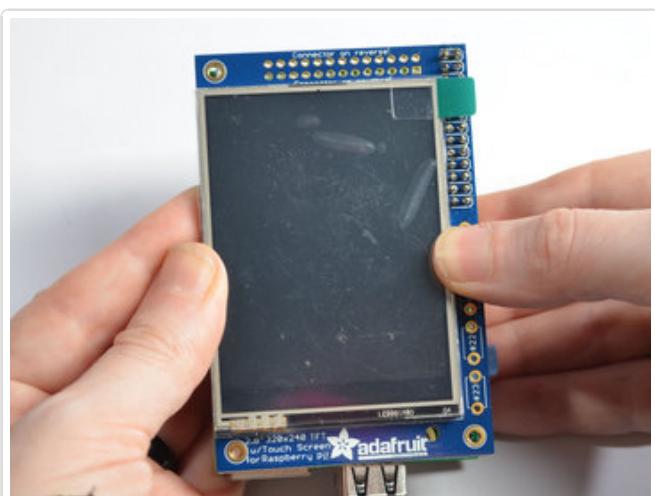


Now we can attach the screen. Remove the two thin tape cover strips.

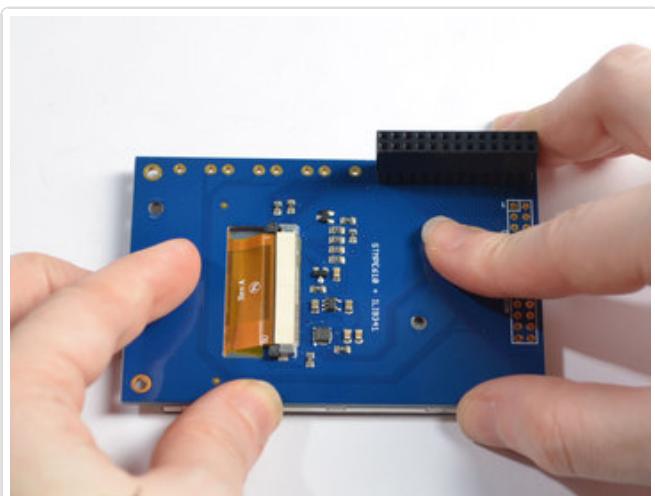




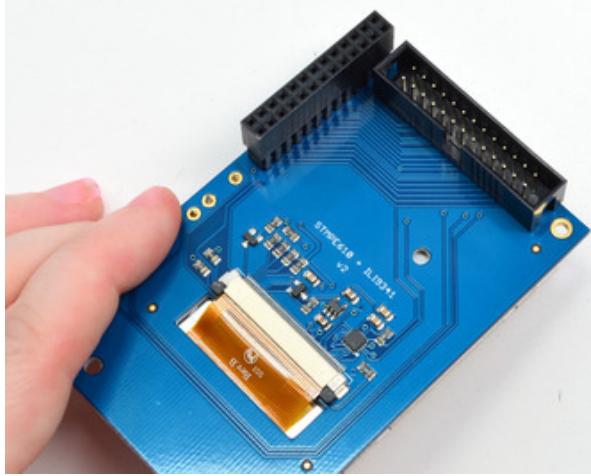
Line up the screen on the white outline, make sure there's some space from the header you just soldered in and the metal sides of the screen. As long as you don't really press down on the screen you can reposition it once or twice.



Once you have the screen so it is definitely not touching the header, you can gently press on the sides to secure the tape.

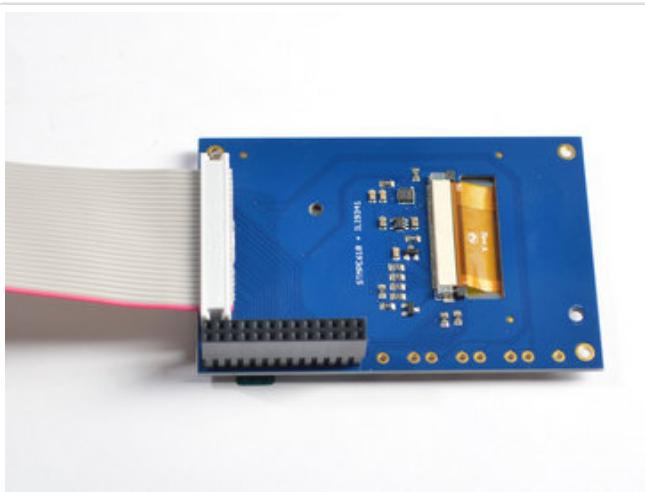


If the protective plastic cover is still on the screen you can press it against a clean table from above. That way you will really securely attach it!



If you want to attach an Adafruit Cobbler or similar, you can solder in the optional 2x13 IDC on the **bottom** of the screen as shown here. This will keep the top side clean and flat. Solder in all 26 pins

The picture shows a 2x13 male header. We've since updated this product to include an IDC socket so it's easier to add a cobbler. Both will work, though!



You can attach a 26-pin IDC cable just make sure the pin 1 indicator is on the right as indicated in this photo - there's also a #1 marking on the PCB!

Easy Install

The PiTFT requires kernel support and a couple other things to make it a nice stand-alone display. We have a detailed step-by-step setup for hackers who want to tweak, customize or understand the PiTFT setup. If you just want to get going, check out the following for easy-install instructions!

Ready to go image

If you want to start with a fresh image, we have one for Raspbian - click here to download it and install into a new SD card. [Unzip and follow the classic SD card burning tutorials \(http://adafru.it/aMW\)](http://adafru.it/aMW)

Download PiTFT 2.8" Resistive Image (9/18/2014)

<http://adafru.it/e12>

This image is customized for the RESISTIVE touch 2.8" TFT, also known as PID #1601! Not for PID #1983

Previous images:

- [Raspbian 2014/06/20-based image \(http://adafru.it/dSM\)](http://adafru.it/dSM)

We also have a couple older images we used to suggest. We are keeping the links here in case you need them. Thank you to Notro for putting these together!

- [An image built on Raspbian January 7, 2014. This is not B+ compatible! \(http://adafru.it/dxa\)](http://adafru.it/dxa)
- [An image built on Raspbian June 20, 2014. B+ compatible \(http://adafru.it/dMo\)](http://adafru.it/dMo)

DIY Installer script

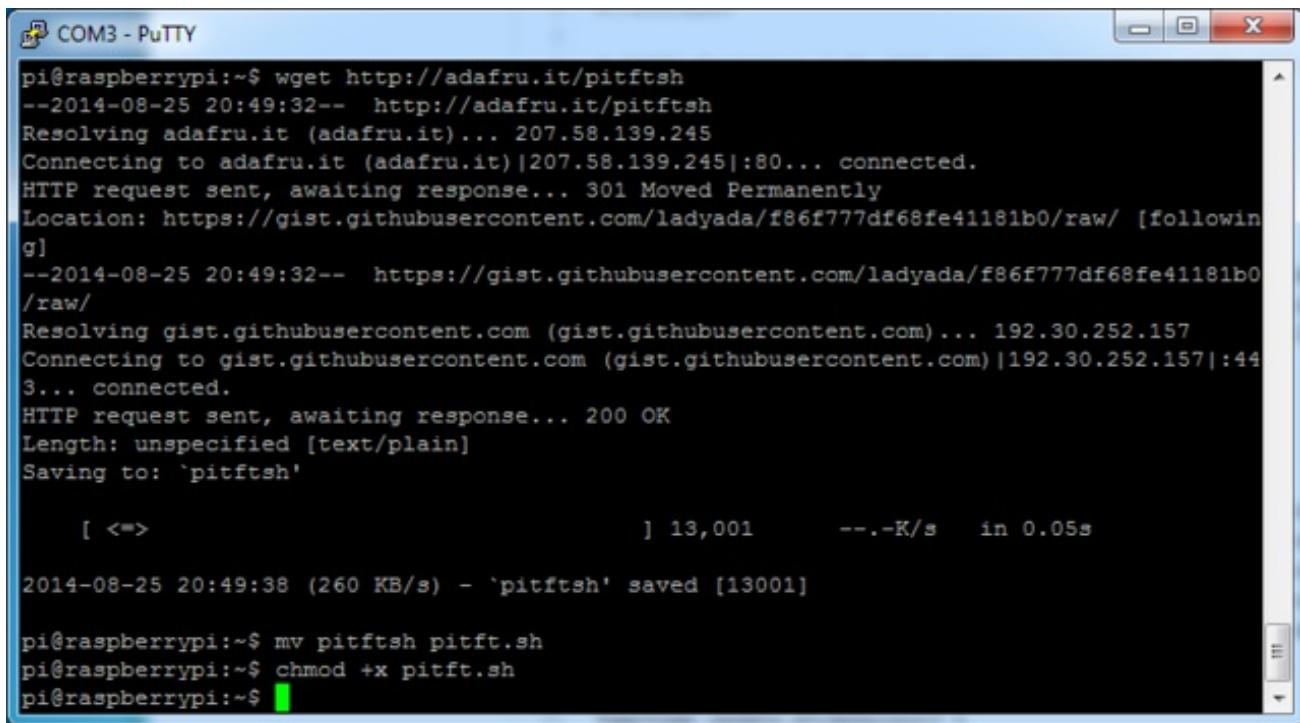
If you don't want to download an image, you can run this script from inside your existing Raspbian install. It will download the kernel add-ons, and configure your Pi for PiTFT joy

[The script is available for perusal here \(http://adafru.it/dSN\)](http://adafru.it/dSN)

you can download it with:

```
wget http://adafru.it/pitftsh  
mv pitftsh pitft.sh
```

```
chmod +x pitft.sh
```



A screenshot of a PuTTY terminal window titled "COM3 - PuTTY". The window shows the command line interface of a Raspberry Pi. The user has run the command "chmod +x pitft.sh" to make the script executable. Then, they used "wget" to download a file from Adafruit's website. The download progress bar indicates a speed of 260 KB/s and a total size of 13,001 bytes. After the download completes, the user runs "mv pitftsh pitft.sh" to move the downloaded file to the current directory, and then "chmod +x pitft.sh" again to make it executable.

```
pi@raspberrypi:~$ wget http://adafru.it/pitftsh
--2014-08-25 20:49:32--  http://adafru.it/pitftsh
Resolving adafru.it (adafru.it)... 207.58.139.245
Connecting to adafru.it (adafru.it)|207.58.139.245|:80... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://gist.githubusercontent.com/ladyada/f86f777df68fe41181b0/raw/ [following]
--2014-08-25 20:49:32--  https://gist.githubusercontent.com/ladyada/f86f777df68fe41181b0/raw/
Resolving gist.githubusercontent.com (gist.githubusercontent.com)... 192.30.252.157
Connecting to gist.githubusercontent.com (gist.githubusercontent.com)|192.30.252.157|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [text/plain]
Saving to: 'pitftsh'

[ <=>                               ] 13,001      --.-K/s   in 0.05s

2014-08-25 20:49:38 (260 KB/s) - 'pitftsh' saved [13001]

pi@raspberrypi:~$ mv pitftsh pitft.sh
pi@raspberrypi:~$ chmod +x pitft.sh
pi@raspberrypi:~$
```

Then run it with:

```
sudo ./pitft.sh -t 28r -r
```

This will install the "2.8 Resistive" type of PiTFT into the current install.

COM3 - PuTTY

```
Connecting to adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com) |17
6.32.102.57|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 184818 (180K) [application/octet-stream]
Saving to: `libraspberrypi-bin-adafruit.deb'

100%[=====] 184,818      306K/s  in 0.6s

2014-08-25 20:52:12 (306 KB/s) - `libraspberrypi-bin-adafruit.deb' saved [184818/184818]

--2014-08-25 20:52:12-- http://adafruit-download.s3.amazonaws.com/libraspberrypi-dev-ad
afruit.deb
Resolving adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com)... 176
.32.102.57
Connecting to adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com) |17
6.32.102.57|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 672150 (656K) [application/octet-stream]
Saving to: `libraspberrypi-dev-adafruit.deb'

100%[=====] 672,150      684K/s  in 1.0s

2014-08-25 20:52:13 (684 KB/s) - `libraspberrypi-dev-adafruit.deb' saved [672150/672150]

--2014-08-25 20:52:13-- http://adafruit-download.s3.amazonaws.com/libraspberrypi-doc-ad
afruit.deb
Resolving adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com)... 176
.32.102.57
Connecting to adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com) |17
6.32.102.57|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 31480442 (30M) [application/octet-stream]
Saving to: `libraspberrypi-doc-adafruit.deb'

3% [>                                              ] 1,033,977      674K/s
```

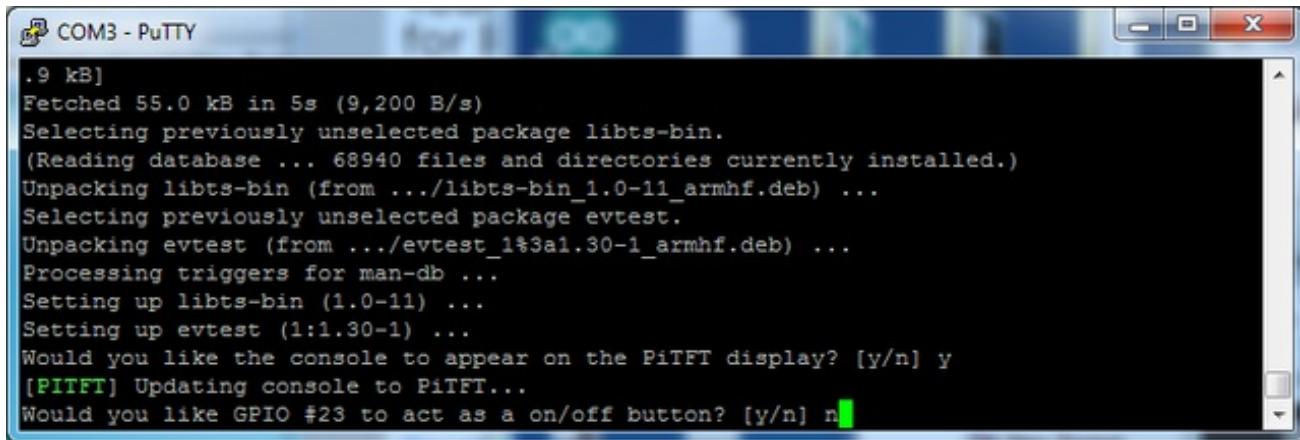
```
COM3 - PuTTY
Ign http://raspberrypi.collabora.com wheezy/rpi Translation-en
Ign http://archive.raspberrypi.org wheezy/main Translation-en
Hit http://mirrordirector.raspbian.org wheezy/contrib armhf Packages
Get:10 http://mirrordirector.raspbian.org wheezy/non-free armhf Packages [49.3 kB]
Hit http://mirrordirector.raspbian.org wheezy/rpi armhf Packages
Ign http://mirrordirector.raspbian.org wheezy/contrib Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/contrib Translation-en
Ign http://mirrordirector.raspbian.org wheezy/main Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/main Translation-en
Ign http://mirrordirector.raspbian.org wheezy/non-free Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/non-free Translation-en
Ign http://mirrordirector.raspbian.org wheezy/rpi Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/rpi Translation-en
Fetched 6,992 kB in 48s (143 kB/s)
Reading package lists... Done
[PITFT] Installing Adafruit kernel...
total 54408
-rw-r--r-- 1 root root 444188 Aug 25 20:57 libraspberrypi0-adafruit.deb
-rw-r--r-- 1 root root 184818 Aug 25 20:57 libraspberrypi-bin-adafruit.deb
-rw-r--r-- 1 root root 672150 Aug 25 20:57 libraspberrypi-dev-adafruit.deb
-rw-r--r-- 1 root root 31480442 Aug 25 20:57 libraspberrypi-doc-adafruit.deb
-rw-r--r-- 1 root root 22918510 Aug 25 20:57 raspberrypi-bootloader-adafruit-20140724-1.deb
Selecting previously unselected package libraspberrypi-bin-adafruit.
dpkg: considering removing libraspberrypi-bin in favour of libraspberrypi-bin-adafruit .
..
dpkg: yes, will remove libraspberrypi-bin in favour of libraspberrypi-bin-adafruit
(Reading database ... 69052 files and directories currently installed.)
Unpacking libraspberrypi-bin-adafruit (from .../libraspberrypi-bin-adafruit.deb) ...
Selecting previously unselected package libraspberrypi-dev-adafruit.
dpkg: considering removing libraspberrypi-dev in favour of libraspberrypi-dev-adafruit .
..
dpkg: yes, will remove libraspberrypi-dev in favour of libraspberrypi-dev-adafruit
Unpacking libraspberrypi-dev-adafruit (from .../libraspberrypi-dev-adafruit.deb) ...
```

```
ikernelhack'
Removing 'diversion of /boot/start_x.elf to /usr/share/rpikernelhack/start_x.elf by rpikernelhack'
Setting up libraspberrypi0-adafruit (1.20130902-1) ...
Setting up libraspberrypi-bin-adafruit (1.20130902-1) ...
Setting up libraspberrypi-dev-adafruit (1.20130902-1) ...
Setting up libraspberrypi-doc-adafruit (1.20130902-1) ...
[PITFT] Updating /etc/modules...
Adding spi-bcm2708
Adding fbft_device
[PITFT] Updating /etc/modprobe.d/adafruit.conf...
[PITFT] Updating X11 default calibration...
[PITFT] Updating X11 setup tweaks...
Moving 99-fbturbo.conf to /home/pi
Adding 'export FRAMEBUFFER=/dev/fb1'
[PITFT] Updating TSLib default calibration...
[PITFT] Updating SysFS rules for Touchscreen...
[PITFT] Installing evtest tslib libts-bin...
Reading package lists... Done
Building dependency tree
Reading state information... Done
Note, selecting 'libts-0.0-0' instead of 'tslib'
libts-0.0-0 is already the newest version.
libts-0.0-0 set to manually installed.
The following NEW packages will be installed:
  evtest libts-bin
0 upgraded, 2 newly installed, 0 to remove and 48 not upgraded.
Need to get 55.0 kB of archives.
After this operation, 219 kB of additional disk space will be used.
Get:1 http://mirrordirector.raspbian.org/raspbian/ wheezy/main libts-bin armhf 1.0-11 [3
3.1 kB]
Get:2 http://mirrordirector.raspbian.org/raspbian/ wheezy/main evtest armhf 1:1.30-1 [21
.9 kB]
Fetched 55.0 kB in 5s (9,200 B/s)
```

At the end you will be prompted on whether you want the text console to appear on the PiTFT. Answer Y or N depending on your personal desires!

```
3.1 kB]
Get:2 http://mirrordirector.raspbian.org/raspbian/ wheezy/main evtest armhf 1:1.30-1 [21
.9 kB]
Fetched 55.0 kB in 5s (9,200 B/s)
Selecting previously unselected package libts-bin.
(Reading database ... 68940 files and directories currently installed.)
Unpacking libts-bin (from .../libts-bin_1.0-11_armhf.deb) ...
Selecting previously unselected package evtest.
Unpacking evtest (from .../evtest_1%3a1.30-1_armhf.deb) ...
Processing triggers for man-db ...
Setting up libts-bin (1.0-11) ...
Setting up evtest (1:1.30-1) ...
Would you like the console to appear on the PiTFT display? [y/n] y
```

You will also be prompted on whether you want one of the tactile buttons to act as an 'on off' switch. Answer Y or N depending on your personal desires!



A screenshot of a PuTTY terminal window titled "COM3 - PuTTY". The window displays a series of command-line instructions for setting up a PiTFT display. The text includes package fetching, unpacking, selecting, and processing steps for libts-bin and evtest packages. It also asks if the console should appear on the PiTFT display and if GPIO #23 should act as an on/off button, with responses "y" and "n" respectively.

```
.9 kB]
Fetched 55.0 kB in 5s (9,200 B/s)
Selecting previously unselected package libts-bin.
(Reading database ... 68940 files and directories currently installed.)
Unpacking libts-bin (from .../libts-bin_1.0-11_armhf.deb) ...
Selecting previously unselected package evtest.
Unpacking evtest (from .../evtest_1%3a1.30-1_armhf.deb) ...
Processing triggers for man-db ...
Setting up libts-bin (1.0-11) ...
Setting up evtest (1:1.30-1) ...
Would you like the console to appear on the PiTFT display? [y/n] y
[PITFT] Updating console to PiTFT...
Would you like GPIO #23 to act as a on/off button? [y/n] n
```

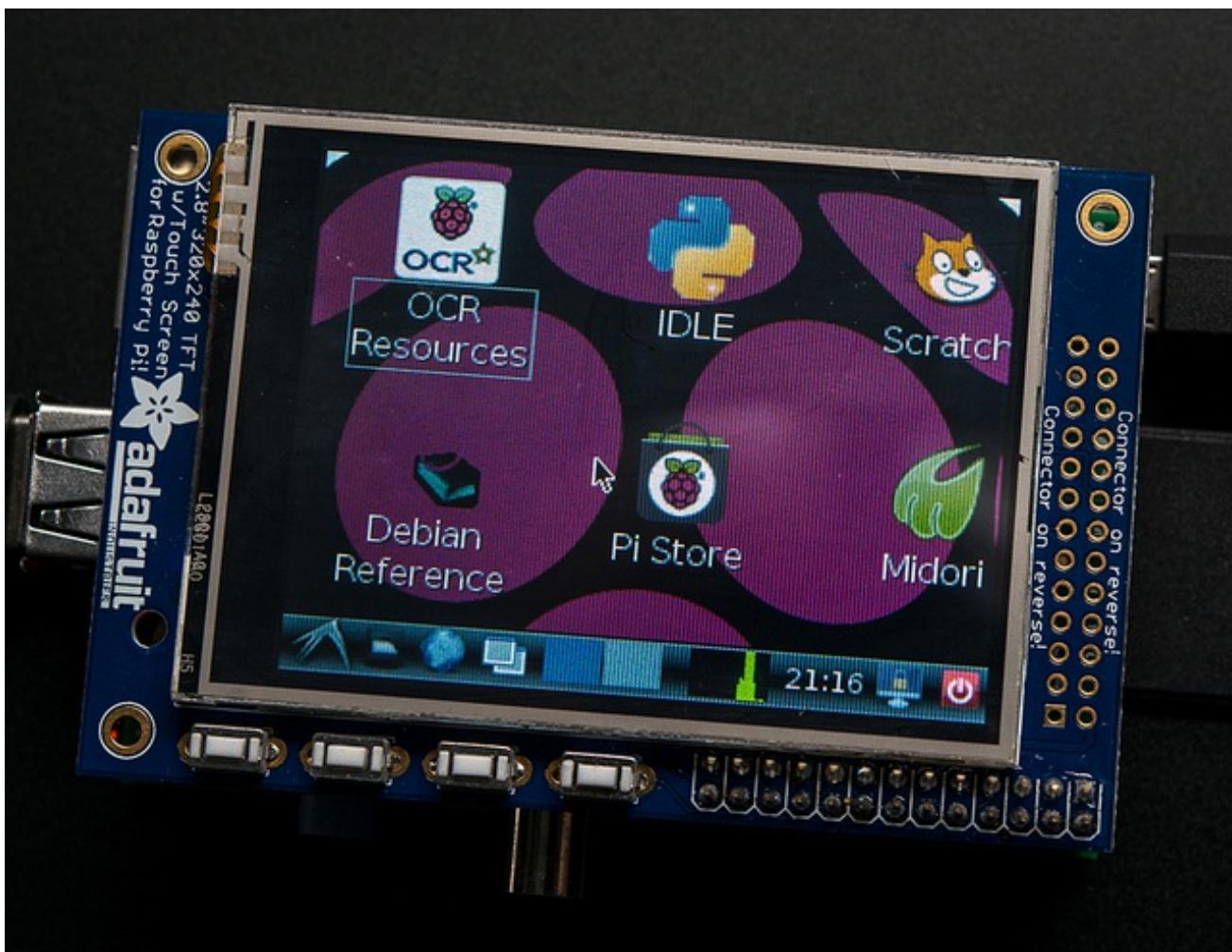
Thats it!

Run **sudo reboot** to try out your fancy new PiTFT :)

Detailed Installation

If you've grabbed our Easy Install image, or use the script, this step is not required, it's already done! This is just for advanced users who are curious on how to configure and customize the kernel install

In the next few steps we'll cover the **detailed** installation procedure. Chances are, you should grab the Easy Install image or script. If you have some interest in the details of how we install the PiTFT setup, read on!



In order to add support for the 2.8" TFT and touchscreen, we'll need to install a new Linux Kernel. Lucky for you, we created a kernel package that you can simply install over your current Raspbian (or Raspbian-derived) install instead of needing a whole new image. This makes it easier to keep your install up-to-date.

To use our kernel .deb files you must be using Raspbian or derivative. This won't work with Arch or other Linux flavors. As Raspbian is the official OS for the Pi, that's the only Linux we will support! [Others can recompile their own kernel using our patchfile \(http://adafru.it/cY2\)](http://adafru.it/cY2),

but we have no tutorial or support or plans for such.

Before you start

You'll need a working install of Raspbian with network access. [If you need help getting that far, check out our collection of Pi tutorials](http://adafru.it/aWq) (<http://adafru.it/aWq>).

We'll be doing this from a console cable connection, but you can just as easily do it from the direct HDMI/TV console or by SSH'ing in. Whatever gets you to a shell will work!

Also, run **sudo apt-get update** !

To run these all the setup and config commands you'll need to be logged into a proper Terminal - use ssh, a console cable, or the main text console (on a TV). The WebIDE console may not work.

Download & Install

Download the multiple files you'll need by running the following commands

```
cd ~  
wget http://adafruit-download.s3.amazonaws.com/libraspberrypi-bin-adafruit.deb  
wget http://adafruit-download.s3.amazonaws.com/libraspberrypi-dev-adafruit.deb  
wget http://adafruit-download.s3.amazonaws.com/libraspberrypi-doc-adafruit.deb  
wget http://adafruit-download.s3.amazonaws.com/libraspberrypi0-adafruit.deb  
wget http://adafruit-download.s3.amazonaws.com/raspberrypi-bootloader-adafruit-20140917-1.deb
```

Connecting to adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com)|176.32.100.72|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 672150 (656K) [application/octet-stream]
Saving to: `libraspberrypi-dev-adafruit.deb'

100%[=====>] 672,150 811K/s in 0.8s

2013-11-27 01:37:11 (811 KB/s) - `libraspberrypi-dev-adafruit.deb' saved [672150 /672150]

pi@raspberrypi:~\$ wget http://adafruit-download.s3.amazonaws.com/libraspberrypi-doc-adafruit.deb
--2013-11-27 01:37:11-- http://adafruit-download.s3.amazonaws.com/libraspberrypi-doc-adafruit.deb
Resolving adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com)... 176.32.100.72
Connecting to adafruit-download.s3.amazonaws.com (adafruit-download.s3.amazonaws.com)|176.32.100.72|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 31480442 (30M) [application/octet-stream]
Saving to: `libraspberrypi-doc-adafruit.deb'

19% [=====>] 6,026,697 2.01M/s

Next install the new kernel with

```
sudo dpkg -i -B *.deb
```

This will take a few minutes so go make a sandwich or coffee

```
pi@raspberrypi:~$ sudo dpkg -i -B *.deb
Selecting previously unselected package libraspberrypi0-adafruit.
dpkg: considering removing libraspberrypi0 in favour of libraspberrypi0-adafruit
...
dpkg: yes, will remove libraspberrypi0 in favour of libraspberrypi0-adafruit
(Reading database ... 62260 files and directories currently installed.)
Unpacking libraspberrypi0-adafruit (from libraspberrypi0-adafruit.deb) ...
De-configuring libraspberrypi-doc, to allow removal of libraspberrypi0 ...
De-configuring libraspberrypi-dev, to allow removal of libraspberrypi0 ...
De-configuring libraspberrypi-bin, to allow removal of libraspberrypi0 ...
Selecting previously unselected package libraspberrypi-bin-adafruit.
dpkg: considering removing libraspberrypi-bin in favour of libraspberrypi-bin-ad
afruit ...
dpkg: libraspberrypi-bin is not properly installed; ignoring any dependencies on
it
dpkg: yes, will remove libraspberrypi-bin in favour of libraspberrypi-bin-adafru
it
Unpacking libraspberrypi-bin-adafruit (from libraspberrypi-bin-adafruit.deb) ...
Selecting previously unselected package libraspberrypi-dev-adafruit.
dpkg: considering removing libraspberrypi-dev in favour of libraspberrypi-dev-ad
afruit ...
dpkg: libraspberrypi-dev is not properly installed; ignoring any dependencies on
it
```

```
in by rpikernelhack'
Removing 'diversion of /boot/fixup.dat to /usr/share/rpikernelhack/fixup.dat by
rpikernelhack'
Removing 'diversion of /boot/fixup_cd.dat to /usr/share/rpikernelhack/fixup_cd.d
at by rpikernelhack'
Removing 'diversion of /boot/fixup_x.dat to /usr/share/rpikernelhack/fixup_x.dat
by rpikernelhack'
Removing 'diversion of /boot/kernel.img to /usr/share/rpikernelhack/kernel.img b
y rpikernelhack'
Removing 'diversion of /boot/kernel_cutdown.img to /usr/share/rpikernelhack/kern
el_cutdown.img by rpikernelhack'
Removing 'diversion of /boot/kernel_emergency.img to /usr/share/rpikernelhack/ke
rnel_emergency.img by rpikernelhack'
Removing 'diversion of /boot/start.elf to /usr/share/rpikernelhack/start.elf by
rpikernelhack'
Removing 'diversion of /boot/start_cd.elf to /usr/share/rpikernelhack/start_cd.e
lf by rpikernelhack'
Removing 'diversion of /boot/start_x.elf to /usr/share/rpikernelhack/start_x.elf
by rpikernelhack'
Setting up libraspberrypi0-adafruit (1.20130902-1) ...
Setting up libraspberrypi-bin-adafruit (1.20130902-1) ...
Setting up libraspberrypi-dev-adafruit (1.20130902-1) ...
Setting up libraspberrypi-doc-adafruit (1.20130902-1) ...
pi@raspberrypi:~$
```

If you have a version of Raspbian more recent than Sept. 2013, you'll need to turn off

the accelerated X framebuffer here, run "sudo mv /usr/share/X11/xorg.conf.d/99-fbturbo.conf ~" to remove the accelerated X buffer and save it in your home directory

Now we'll just reboot to let it all sink in.

sudo shutdown -h now (if you don't have the TFT installed, shutdown, place the TFT on the Pi and re-power)

or

sudo reboot (if you have the TFT plate installed already)

Now that you're rebooted, log back in on the console/TV/SSH. There's no screen yet, we'll do a test to make sure everything is perfect first!

Run the following commands to install the screen driver. Note that the screen will go from white to black indicating the commands succeeded.

```
sudo modprobe spi-bcm2708
sudo modprobe fbtft_device name=adafruitts rotate=90
export FRAMEBUFFER=/dev/fb1
startx
```

```
pi@raspberrypi:~$ sudo modprobe spi-bcm2708
pi@raspberrypi:~$ sudo modprobe fbtft_device name=adafruitts rotate=90
pi@raspberrypi:~$ export FRAMEBUFFER=/dev/fb1
pi@raspberrypi:~$ startx
xauth:  file /home/pi/.Xauthority does not exist

X.Org X Server 1.12.4
Release Date: 2012-08-27
X Protocol Version 11, Revision 0
Build Operating System: Linux 3.2.0-2-mx5 armv7l Debian
Current Operating System: Linux raspberrypi 3.6.11+ #26 PREEMPT Tue Nov 26 18:19
:51 SGT 2013 armv6l
Kernel command line: dma.dmachans=0x7f35 bcm2708_fb.fbwidth=1440 bcm2708_fb.fbheight=900 bcm2708.boardrev=0x2 bcm2708.serial=0x7f0168 smsc95xx.macaddr=B8:27:EB:7F:01:68 sdhci-bcm2708.emmc_clock_freq=100000000 vc_mem.mem_base=0xec00000 vc_mem.mem_size=0x10000000 dwc_otg.lpm_enable=0 console=ttyAMA0,115200 kgdboc=ttyAMA0,115200 console=tty1 root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline rootwait
Build Date: 20 April 2013 05:19:09AM
xorg-server 2:1.12.4-6 (Julien Cristau <jcristau@debian.org>)
Current version of pixman: 0.29.3
Before reporting problems, check http://wiki.x.org
to make sure that you have the latest version.
```

You should see the Pi desktop show up on the TFT! Congrats, you've completed the first test perfectly. Now we'll make the TFT kernel modules automatically install on boot.

Hit Control-C in the console to quit the X server so we can continue configuration

Module Auto-loading

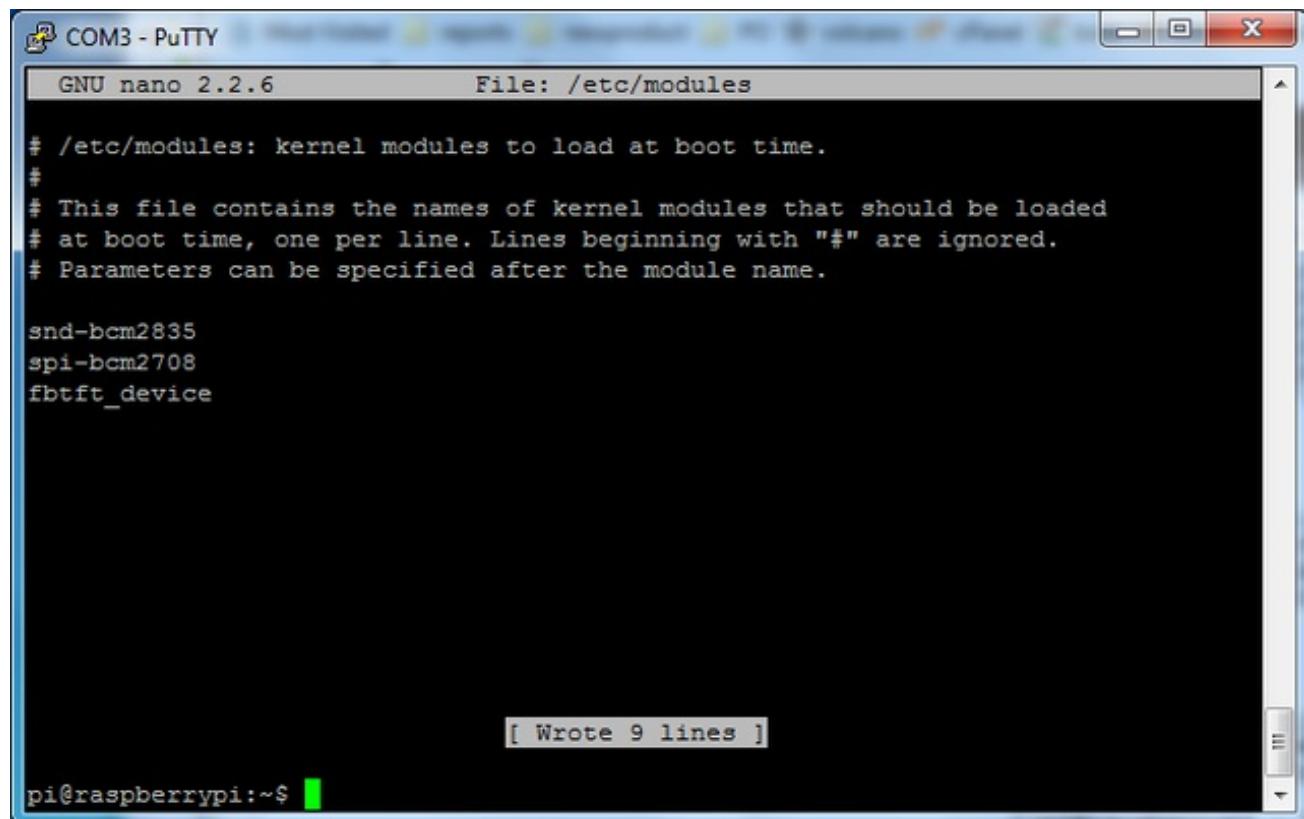
We'll now make the modules auto-load. Lets edit the /etc/modules list with

```
sudo nano /etc/modules
```

add two lines

```
spi-bcm2708
fbtft_device
```

Then **Control-X Y [return]** to save



```
GNU nano 2.2.6          File: /etc/modules

# /etc/modules: kernel modules to load at boot time.
#
# This file contains the names of kernel modules that should be loaded
# at boot time, one per line. Lines beginning with "#" are ignored.
# Parameters can be specified after the module name.

snd-bcm2835
spi-bcm2708
fbtft_device

[ Wrote 9 lines ]
```

pi@raspberrypi:~\$

You're not done yet! Now we have to add the configuration details in a new modprobe file:

```
sudo nano /etc/modprobe.d/adafruit.conf
```

add the following line

```
options fbtft_device name=adafruitrt28 rotate=90 frequency=32000000
```

and save like you did before.

The **rotate**= variable tells the driver to rotate the screen **0 90 180** or **270** degrees.

0 is portrait, with the bottom near the "Adafruit Logo"

90 is landscape, with the bottom of the screen near the buttons.

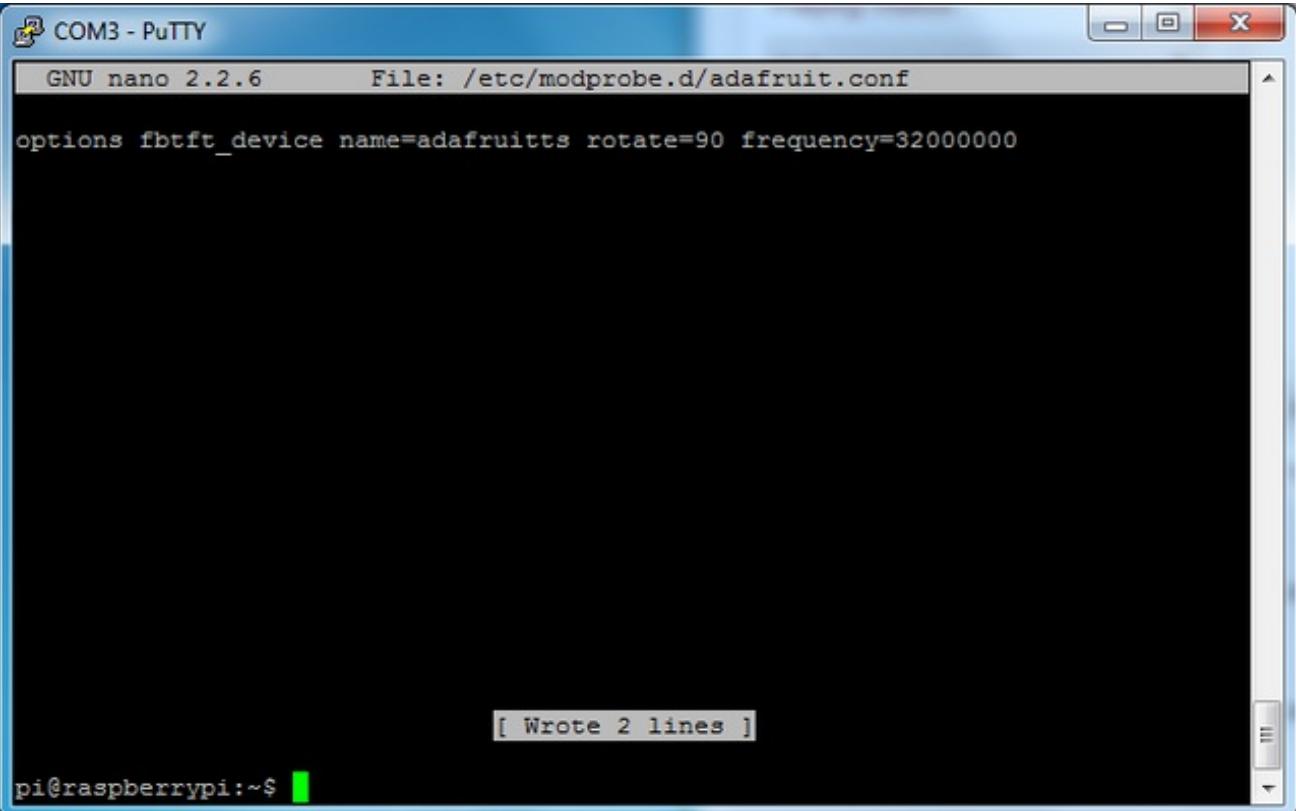
180 is portrait, with the top near the "Adafruit Logo"

270 is landscape, with the top of the screen near the buttons.

You can change this file with **nano** and reboot to make the change stick.

The frequency= variable tells the driver how fast to drive the display. 32MHz
(32000000) is a pretty nice 20 FPS rate but if your screen is acting funny, try taking it down to 16MHz (**16000000**)

The screenshot below shows "name=adafruiitts" but its better to use "name=adafruitrt28" since we now have multiple types of touchscreens, so its good to be super clear we're using the Adafruit Resistive Touch 2.8" (adafruitrt28) driver



GNU nano 2.2.6 File: /etc/modprobe.d/adafruit.conf

```
options fbtft_device name=adafruiitts rotate=90 frequency=32000000
```

[Wrote 2 lines]

pi@raspberrypi:~\$

sudo reboot and look at the console output (or run **dmesg** in the console window after logging in) you will see the modules install. Look in particular for the STMPE610 detection and the ILI9340 screen frequency as highlighted here

```
th irq 16
[ 12.377691] bcm2708_spi bcm2708_spi.0: DMA channel 4 at address 0xf2007400 wi
th irq 20
[ 12.401498] spi_master spi0: will run message pump with realtime priority
[ 12.429977] bcm2708_spi bcm2708_spi.0: SPI Controller at 0x20204000 (irq 80)
[ 12.450193] bcm2708_spi bcm2708_spi.0: SPI Controller running in polling mode
[ 12.618455] fbtft_device: SPI devices registered:
[ 12.637464] fbtft_device:     spidev spi0.0 500kHz 8 bits mode=0x00
[ 12.652365] fbtft_device:     spidev spi0.1 500kHz 8 bits mode=0x00
[ 12.663233] fbtft_device: 'fb' Platform devices registered:
[ 12.673221] fbtft_device:     bcm2708_fb id=-1 pdata? no
[ 12.683062] fbtft_device: Deleting spi0.1 (spi0.1)
[ 12.695163] fbtft_device: Looking at item 0
[ 12.705831] fbtft_device: Setting pin 24 to 2
[ 12.800476] stmpe-spi spi0.1: stmpe610 detected, chip id: 0x811
[ 12.818094] fbtft_device: Deleting spiu.u (spiu.u)
[ 12.840693] fbtft_device: GPIOs used by 'adafruitts':
[ 12.860192] fbtft_device:     'dc' = GPIO25
[ 12.868574] fbtft_device: SPI devices registered:
[ 12.897923] fbtft_device:     stmpe610 spi0.1 500kHz 8 bits mode=0x00
[ 12.915964] fbtft_device:     fb ili9340 spi0.0 32000kHz 8 bits mode=0x00
[ 12.959334] input: stmpe-ts as /devices/virtual/input/input3
[ 13.488121] graphics fb1: fb ili9340 frame buffer, 320x240, 150 KiB video mem
ory, 16 KiB buffer memory, fps=20, spi0.0 at 32 MHz
```

We can set up the touchscreen for **rotate=90** configuration by doing the following (for more delicate calibration or for other rotate=XX values, see the next section)
Create the directory and new calibration configuration file:

```
sudo mkdir /etc/X11/xorg.conf.d
sudo nano /etc/X11/xorg.conf.d/99-calibration.conf
```

and enter in the following lines, then save.

```
Section "InputClass"
    Identifier      "calibration"
    MatchProduct   "stmpe-ts"
    Option         "Calibration" "3800 200 200 3800"
    Option         "SwapAxes"    "1"
EndSection
```

```
GNU nano 2.2.6      File: /etc/X11/xorg.conf.d/99-calibration.conf  Modified

Section "InputClass"
    Identifier      "calibration"
    MatchProduct    "stmpe-ts"
    Option   "Calibration"    "3800 200 200 3800"
    Option   "SwapAxes"      "1"
EndSection

File Name to Write: /etc/X11/xorg.conf.d/99-calibration.conf
^G Get Help      M-D DOS Format     M-A Append      M-B Backup File
^C Cancel       M-M Mac Format     M-P Prepend
```

You can now try to run X again with

FRAMEBUFFER=/dev/fb1 startx

Type Control-C to quit X

If you don't ever want to have to type FRAMEBUFFER=/dev/fb1 before startx, you can make it a default state by editing your profile file: **sudo nano ~/.profile** and adding

export FRAMEBUFFER=/dev/fb1

near the top and saving the file. Then reboot to reload the profile file. It will now always assume you want to use /dev/fb1

COM3 - PuTTY

GNU nano 2.2.6 File: /home/pi/.profile

```
# ~/.profile: executed by the command interpreter for login shells.
# This file is not read by bash(1), if ~/.bash_profile or ~/.bash_login
# exists.
# see /usr/share/doc/bash/examples/startup-files for examples.
# the files are located in the bash-doc package.

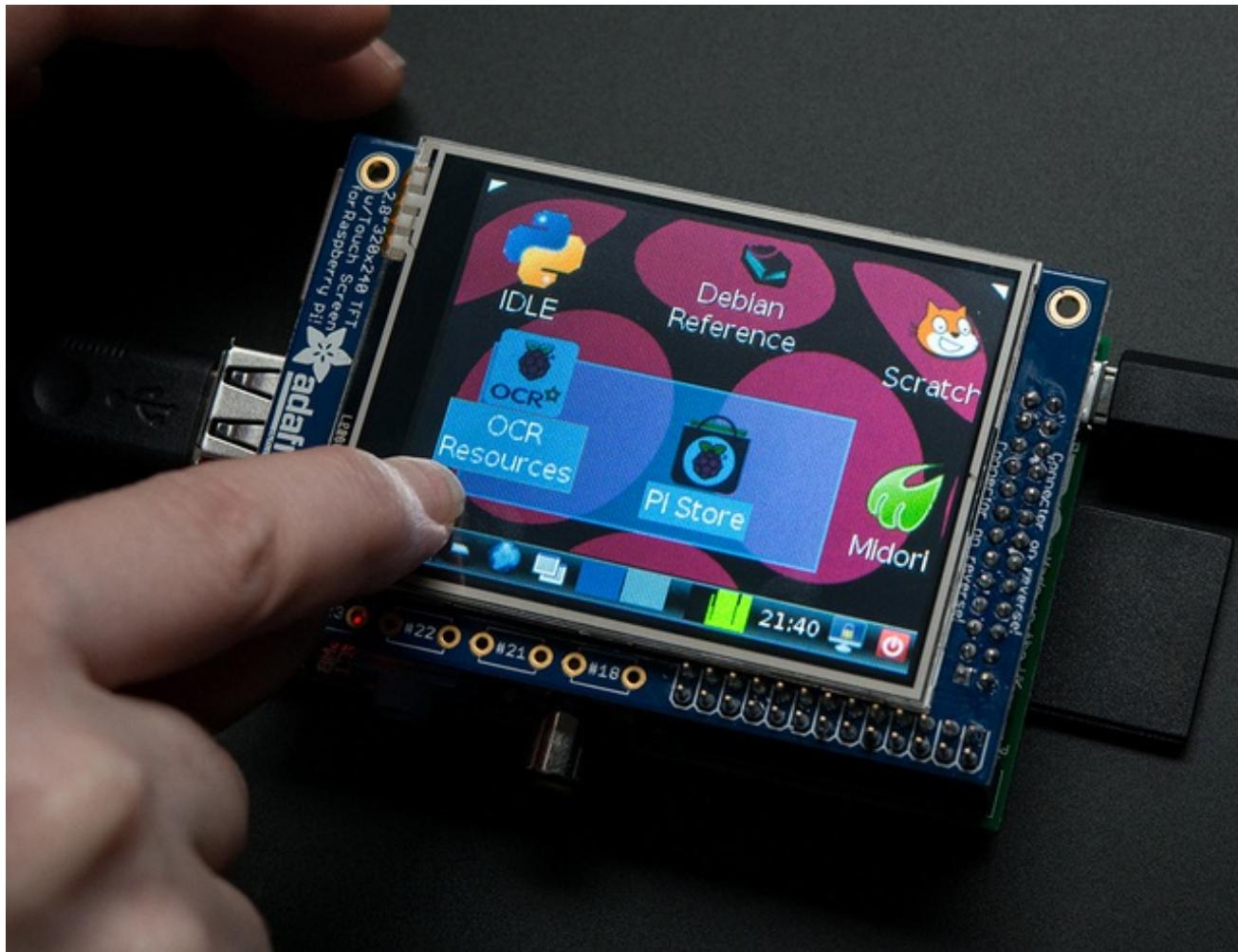
# the default umask is set in /etc/profile; for setting the umask
# for ssh logins, install and configure the libpam-umask package.
#umask 022

export FRAMEBUFFER=/dev/fb1 [Read 24 lines]

# if running bash
if [ -n "$BASH_VERSION" ]; then
    # include .bashrc if it exists
    if [ -f "$HOME/.bashrc" ]; then
        . "$HOME/.bashrc"
    fi
fi
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is  ^V Next Page ^U UnCut Text^T To Spell
```

Touchscreen Install & Calibrate

If you've grabbed our Easy Install image, or use the script, this step is not required, it's already done! This is just for advanced users who are curious on how to configure and customize the touchscreen



Setting up the Touchscreen

Now that the screen is working nicely, we'll take care of the touchscreen. There's just a bit of calibration to do, but it isn't hard at all.

Before we start, we'll make a **udev** rule for the touchscreen. That's because the **eventX** name of the device will change a lot and its annoying to figure out what its called depending on whether you have a keyboard or other mouse installed.

Run

```
sudo nano /etc/udev/rules.d/95-stmpe.rules
```

to create a new **udev** file and copy & paste the following line in:

```
SUBSYSTEM=="input", ATTRS{name}=="stmpe-ts",
ENV{DEVNAME}=="*event*", SYMLINK+="input/touchscreen"
```

```
SUBSYSTEM=="input", ATTRS{name}=="stmpe-ts", ENV{DEVNAME}=="*event*", SYMLINK+=
```

Remove and re-install the touchscreen with

```
sudo rmmod stmpe_ts; sudo modprobe stmpe_ts
```

Then type **ls -l /dev/input/touchscreen**

It should point to **eventX** where X is some number, that number will be different on different setups since other keyboards/mice/USB devices will take up an event slot

```
pi@raspberrypi:~$ sudo rmmod stmpe_ts; sudo modprobe stmpe_ts
pi@raspberrypi:~$ ls -l /dev/input/touchscreen
lrwxrwxrwx 1 root root 6 Nov 27 15:04 /dev/input/touchscreen -> event2
pi@raspberrypi:~$
```

There are some tools we can use to calibrate & debug the touchscreen. Install the "event test" and "touchscreen library" packages with

```
sudo apt-get install evtest tslib libts-bin
```

```
pi@raspberrypi:~$ sudo apt-get install evtest tslib libts-bin
Reading package lists... Done
Building dependency tree
Reading state information... Done
Note, selecting 'libts-0.0-0' instead of 'tslib'
libts-0.0-0 is already the newest version.
The following NEW packages will be installed:
  evtest tslib-bin
0 upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 0 B/55.0 kB of archives.
After this operation, 219 kB of additional disk space will be used.
Do you want to continue [Y/n]? Y
Selecting previously unselected package tslib-bin.
(Reading database ... 62285 files and directories currently installed.)
Unpacking tslib-bin (from .../libts-bin_1.0-11_armhf.deb) ...
Selecting previously unselected package evtest.
Unpacking evtest (from .../evtest_1%3a1.30-1_armhf.deb) ...
Processing triggers for man-db ...
Setting up tslib-bin (1.0-11) ...
Setting up evtest (1:1.30-1) ...
pi@raspberrypi:~$
```

Now you can use some tools such as **sudo evtest /dev/input/touchscreen** which will let you see touchscreen events in real time, press on the touchscreen to see the reports.

```
pi@raspberrypi:~$ sudo evtest /dev/input/touchscreen
Input driver version is 1.0.1
Input device ID: bus 0x18 vendor 0x0 product 0x0 version 0x0
Input device name: "stmpe-ts"
Supported events:
  Event type 0 (EV_SYN)
  Event type 1 (EV_KEY)
    Event code 330 (BTN_TOUCH)
  Event type 3 (EV_ABS)
    Event code 0 (ABS_X)
      Value        0
      Min         0
      Max       4095
    Event code 1 (ABS_Y)
      Value        0
      Min         0
      Max       4095
    Event code 24 (ABS_PRESSURE)
      Value        0
      Min         0
      Max       255
Properties:
Testing ... (interrupt to exit)
```

```
Event: time 1385565357.639692, type 3 (EV_ABS), code 24 (ABS_PRESSURE), value 149
Event: time 1385565357.639699, ----- SYN_REPORT -----
Event: time 1385565357.645965, type 3 (EV_ABS), code 0 (ABS_X), value 1580
Event: time 1385565357.645973, type 3 (EV_ABS), code 1 (ABS_Y), value 1846
Event: time 1385565357.645980, ----- SYN_REPORT -----
Event: time 1385565357.652293, type 3 (EV_ABS), code 0 (ABS_X), value 1634
Event: time 1385565357.652301, type 3 (EV_ABS), code 1 (ABS_Y), value 1864
Event: time 1385565357.652305, type 3 (EV_ABS), code 24 (ABS_PRESSURE), value 143
Event: time 1385565357.652310, ----- SYN_REPORT -----
Event: time 1385565357.658614, type 3 (EV_ABS), code 0 (ABS_X), value 1658
Event: time 1385565357.658622, type 3 (EV_ABS), code 1 (ABS_Y), value 1877
Event: time 1385565357.658626, type 3 (EV_ABS), code 24 (ABS_PRESSURE), value 139
Event: time 1385565357.658631, ----- SYN_REPORT -----
Event: time 1385565357.664919, type 3 (EV_ABS), code 0 (ABS_X), value 1748
Event: time 1385565357.664928, type 3 (EV_ABS), code 1 (ABS_Y), value 1888
Event: time 1385565357.664935, ----- SYN_REPORT -----
Event: time 1385565357.671199, type 3 (EV_ABS), code 0 (ABS_X), value 1778
Event: time 1385565357.671207, type 3 (EV_ABS), code 1 (ABS_Y), value 1895
Event: time 1385565357.671211, type 3 (EV_ABS), code 24 (ABS_PRESSURE), value 134
Event: time 1385565357.671216, ----- SYN_REPORT -----
Event: time 1385565357.698600, type 3 (EV_ABS), code 24 (ABS_PRESSURE), value 0
Event: time 1385565357.698607, type 1 (EV_KEY), code 330 (BTN_TOUCH), value 0
Event: time 1385565357.698610, ----- SYN_REPORT -----
```

AutoMagic Calibration Script

If you rotate the display you need to recalibrate the touchscreen to work with the new screen orientation. You can manually run the calibration processes in the next section, or you can run a small Python script which will automatically set a default touchscreen calibration based on the screen orientation.

To run this script, first download it by executing in a terminal on the Pi:

```
wget https://github.com/adafruit/PiTFT_Extras/raw/master/pitft_touch_cal.py
```

Then make the script executable and run it as root with sudo by executing:

```
sudo mkdir /etc/X11/xorg.conf.d/
chmod +x pitft_touch_cal.py
sudo ./pitft_touch_cal.py
```

By default the script will attempt to read the screen orientation by examining the PiTFT module configuration with modprobe. If the script can read the orientation it will print out the current orientation, the current touchscreen calibration values, and the new touchscreen calibration values based on the current orientation. Before updating the calibration the script will ask you to confirm that you'd like to make the change. Press y and enter to confirm.

For example when I update my display rotation to 180 degrees and run the script, I see the following output:

```
pi@raspberrypi ~ $ sudo ./pitft_touch_cal.py
-----
USING ROTATION: 180

-----
CURRENT CONFIGURATION

Current /etc/pointercal configuration:
-30 -5902 22077792 4360 -105 -1038814 65536

Current /etc/X11/xorg.conf.d/99-calibration.conf configuration:
Section "InputClass"
Identifier "calibration"
MatchProduct "stmpe-ts"
Option "Calibration" "3807 174 244 3872"
Option "SwapAxes" "1"
EndSection

-----
NEW CONFIGURATION

New /etc/pointercal configuration:
-4228 73 16353030 -60 -5888 22004262 65536

New /etc/X11/xorg.conf.d/99-calibration.conf configuration:
Section "InputClass"
Identifier "calibration"
MatchProduct "stmpe-ts"
Option "Calibration" "3868 264 3789 237"
Option "SwapAxes" "0"
EndSection

Update current configuration to new configuration? [y/N]: y

Updated /etc/pointercal
Updated /etc/X11/xorg.conf.d/99-calibration.conf
```

Try using this default calibration script to easily calibrate your touchscreen display. Note that the calibration values might not be exactly right for your display, but they should be close enough for most needs. If you need the most accurate touchscreen calibration, follow the steps in the next section to manually calibrate the touchscreen.

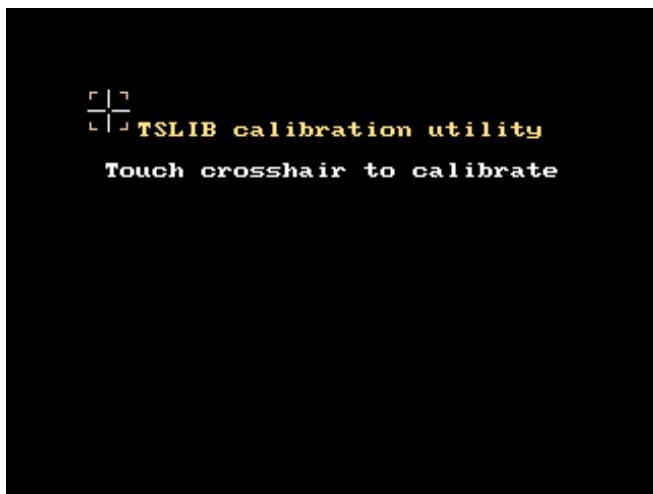
Manual Calibration

If the "automagic" calibration technique isn't working for you, or you have some other setup where you need to carefully calibrate you can do it 'manually'

You will want to calibrate the screen once but shouldn't have to do it more than that. We'll begin by calibrating on the command line by running

```
sudo TSLIB_FBDEVICE=/dev/fb1  
TSLIB_TSDEVICE=/dev/input/touchscreen ts_calibrate
```

follow the directions on the screen, touching each point. Using a stylus is suggested so you get a precise touch. Don't use something metal, plastic only!



You should see five crosshair targets. If you see less than that, the touchscreen probably generated multiple signals for a single touch, and you should try calibrating again.

```
pi@raspberrypi:~$ sudo TSLIB_FBDEVICE=/dev/fb1 TSLIB_TSDEVICE=/dev/input/touchscreen ts_calibrate
xres = 320, yres = 240
Took 43 samples...
Top left : X = 989 Y = 3192
Took 56 samples...
Top right : X = 1049 Y = 674
Took 56 samples...
Bot right : X = 3191 Y = 695
Took 37 samples...
Bot left : X = 3167 Y = 3168
Took 41 samples...
Center : X = 2095 Y = 1913
330.127167 -0.000068 -0.088149
-18.096893 0.064811 0.001094
Calibration constants: 21635214 -4 -5776 -1185998 4247 71 65536
pi@raspberrypi:~$
```

Next you can run **sudo TSLIB_FBDEVICE=/dev/fb1 TSLIB_TSDEVICE=/dev/input/touchscreen ts_test** which will let you draw-test the touch screen. Go back and re-calibrate if you feel the screen isn't precise enough!



X Calibration

You can also calibrate the X input system but you have to use a different program called **xinput_calibrator**

You can do this if the calibration on the screen isn't to your liking or any time you change the **rotate=XX** module settings for the screen. Since the screen and touch driver are completely separated, the touchscreen doesn't auto-rotate

Normally you'd have to compile it but we have a ready to go package for you so run:

```
wget http://adafruit-download.s3.amazonaws.com/xinput-calibrator_0.7.5-1_armhf.deb  
sudo dpkg -i -B xinput-calibrator_0.7.5-1_armhf.deb
```

Before you start the xinput_calibrator you will need to delete the old calibration data so run

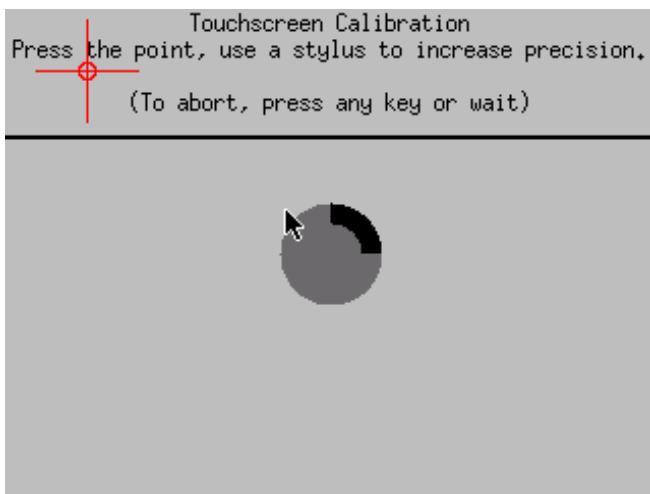
```
sudo rm /etc/X11/xorg.conf.d/99-calibration.conf
```

Before running **startx** and the calibrator - otherwise it gets really confused!

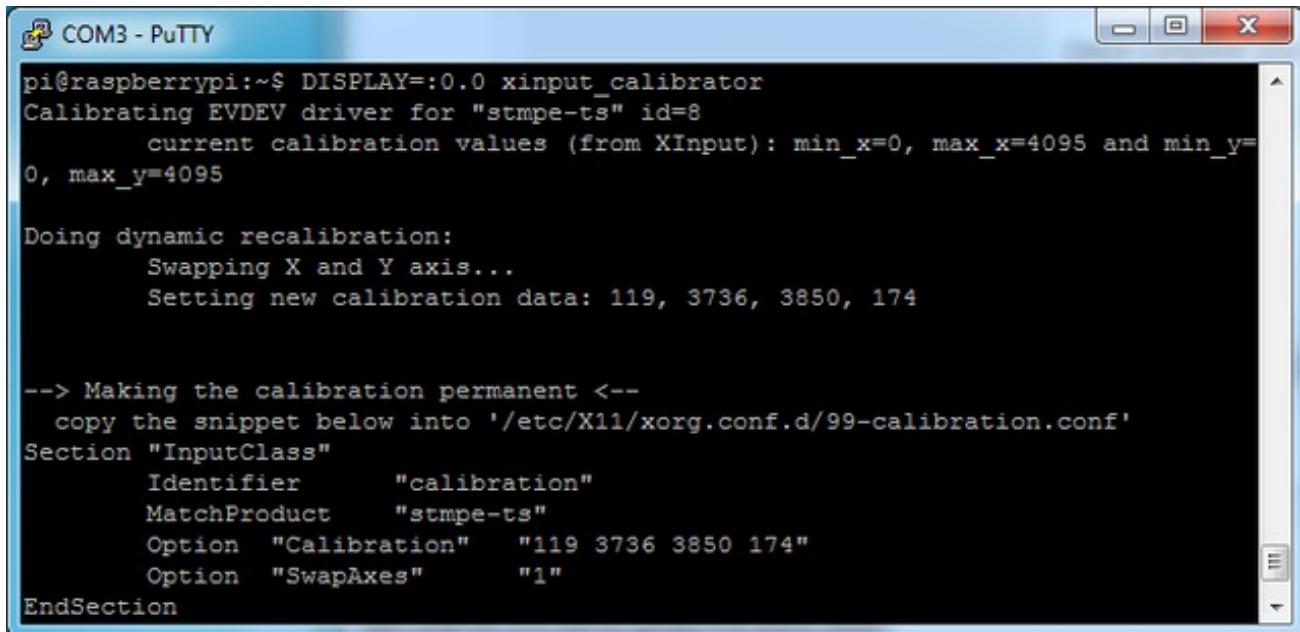
Now you'll have to run the xcalibrator while also running X. You can do this by **startx** and then opening up the terminal program and running the **xinput_calibrator** command (which is challenging to do on such a small screen) OR you can do what we do which is run startx in a SSH/Terminal shell and then run the xinput_calibrator from the same shell, which requires the following command order:

```
FRAMEBUFFER=/dev/fb1 startx &  
DISPLAY=:0.0 xinput_calibrator
```

Follow the directions on screen



Once complete you'll get something like:



pi@raspberrypi:~\$ DISPLAY=:0.0 xinput_calibrator
Calibrating EVDEV driver for "stmpe-ts" id=8
current calibration values (from XInput): min_x=0, max_x=4095 and min_y=0, max_y=4095

Doing dynamic recalibration:
Swapping X and Y axis...
Setting new calibration data: 119, 3736, 3850, 174

--> Making the calibration permanent <--
copy the snippet below into '/etc/X11/xorg.conf.d/99-calibration.conf'
Section "InputClass"
Identifier "calibration"
MatchProduct "stmpe-ts"
Option "Calibration" "119 3736 3850 174"
Option "SwapAxes" "1"
EndSection

Run **sudo nano /etc/X11/xorg.conf.d/99-calibration.conf** and copy the

```
Section "InputClass"  
Identifier "calibration"  
MatchProduct "stmpe-ts"  
Option "Calibration" "119 3736 3850 174"  
# Option "SwapAxes" "1"  
EndSection
```

or whatever you got, into there. You can quit X if you want by typing **fg** to bring that command into the foreground, and then Control-C to quit.

Depending on the 'rotation' of the screen, when you do this calibration, you may need to comment out the SwapAxes part with a # and/or swap the numbers around so looks like:

1. **Option "Calibration" "119 3736 3850 174"**

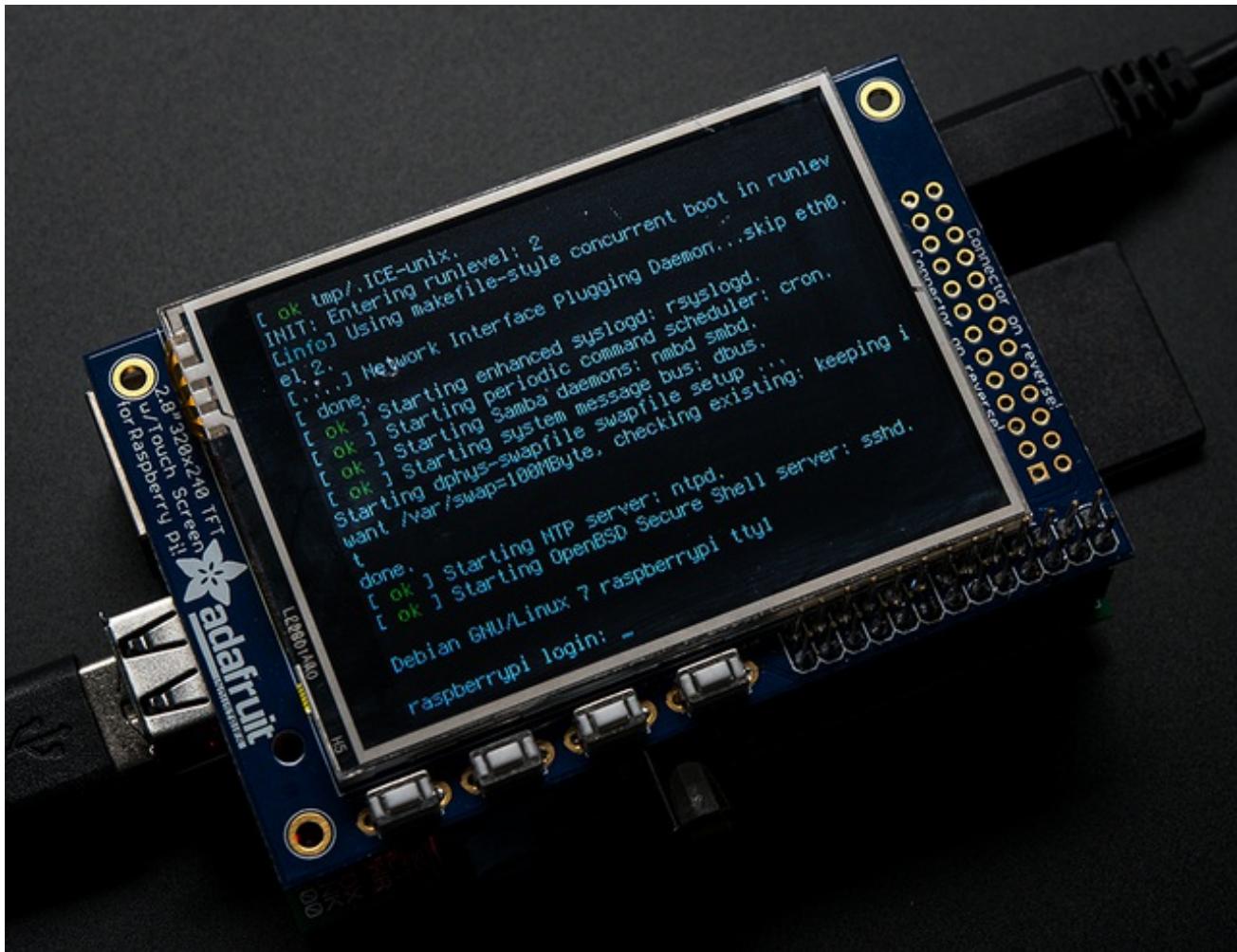
to

1. **Option "Calibration" "3736 119 174 3850"**
2.

Your touchscreen is now super calibrated, hurrah!

Using the Console

If you've grabbed our Easy Install image, or use the script, this step is not required, it's already done! This is just for advanced users who are curious on how to configure and customize the console



At the end of the line, find the text that says **rootwait** and right after that, enter in: **fbcon=map:10 fbcon=font:VGA8x8** then save the file.

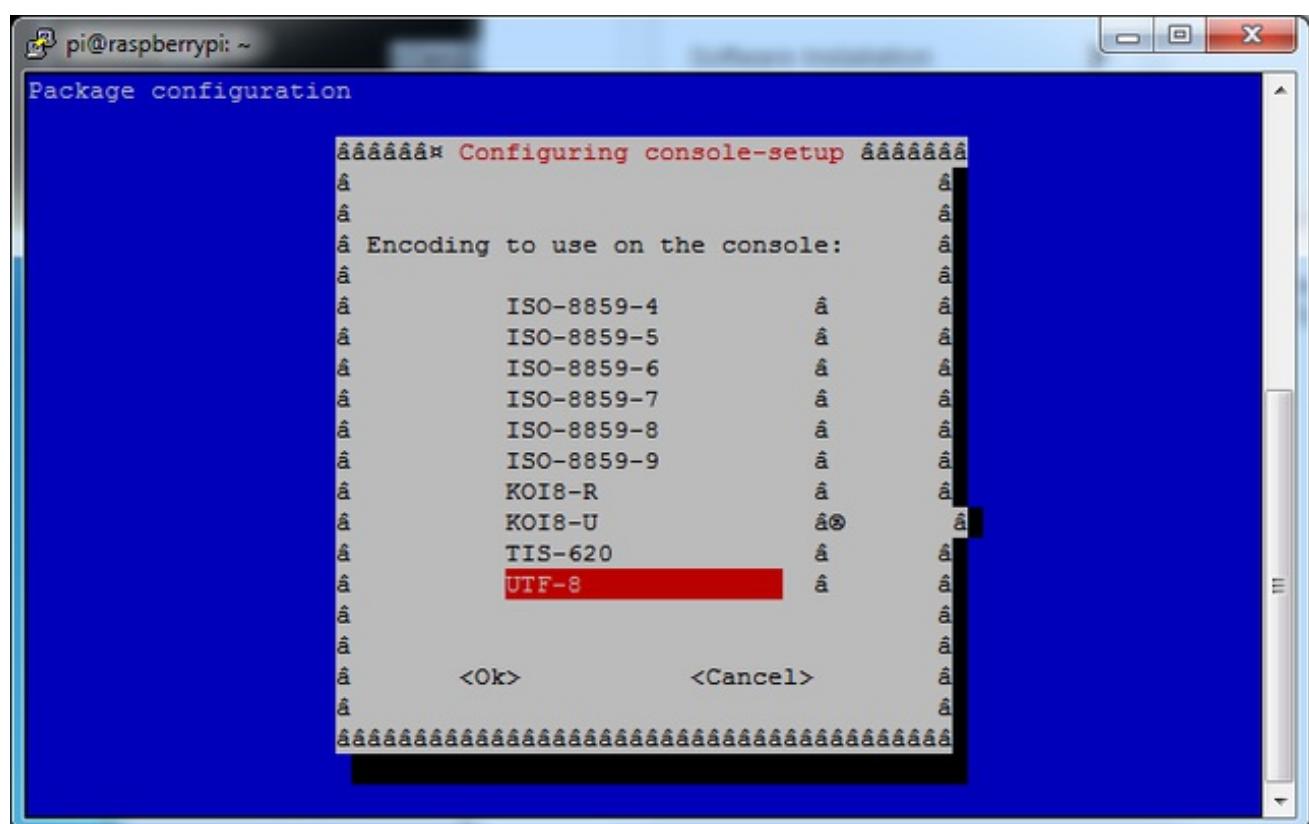
On the next boot, it will bring up the console.

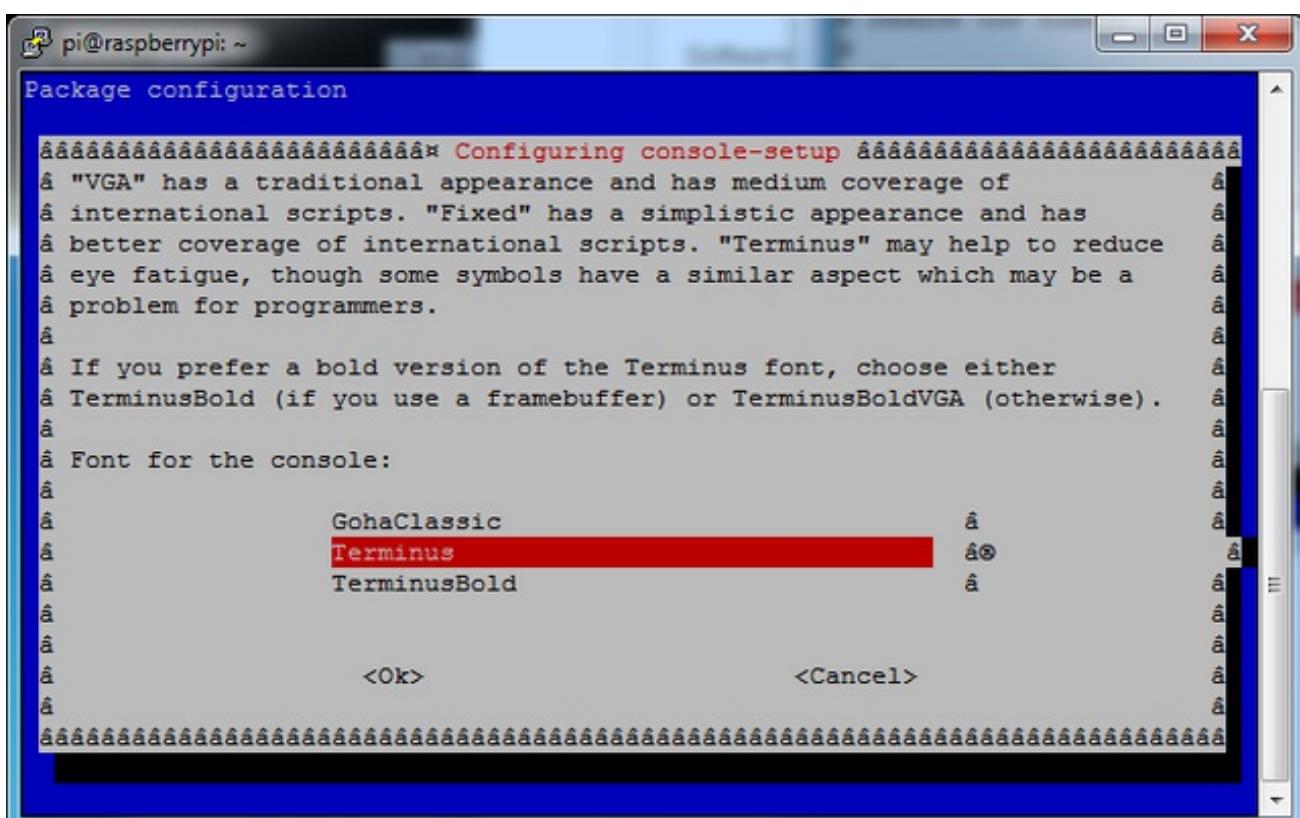
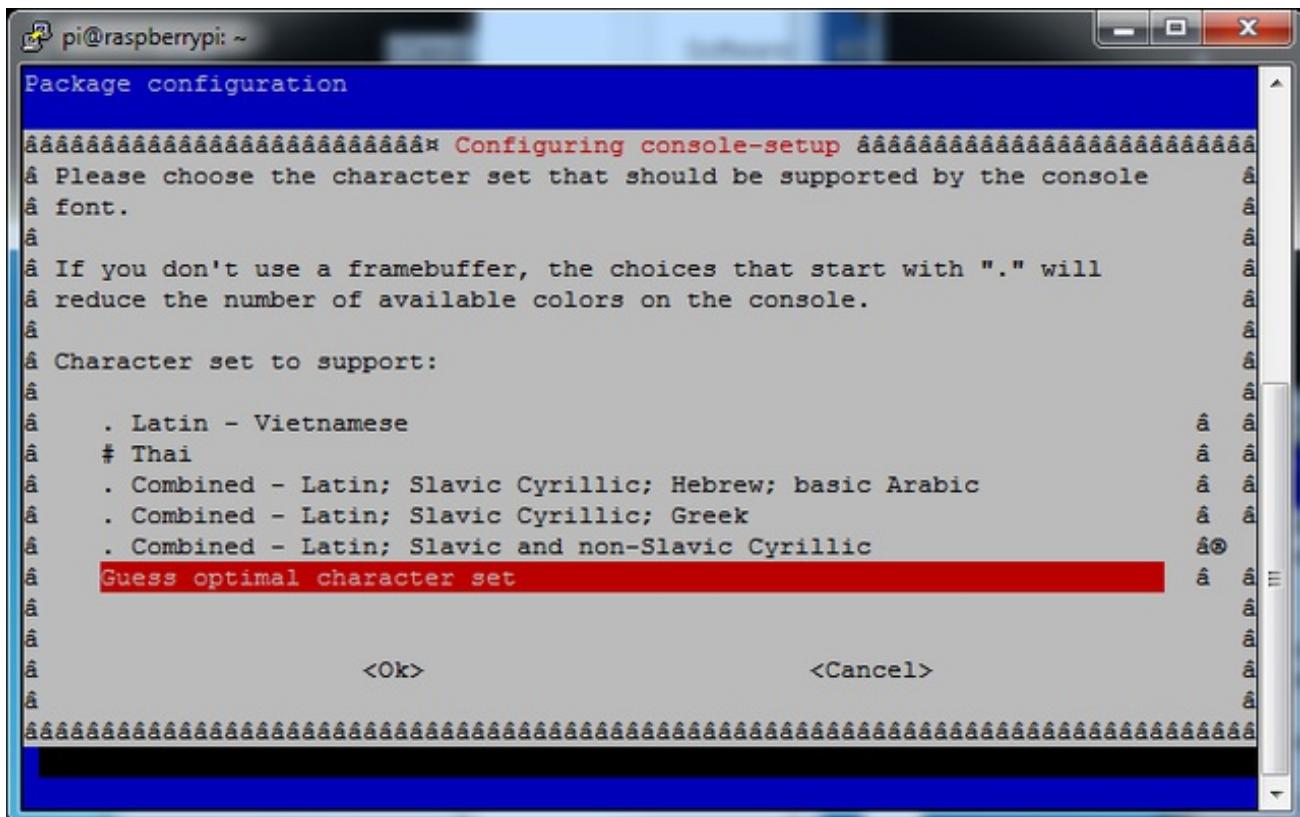
Note that the kernel has to load up the display driver module before it can display anything on it so you won't get the rainbow screen, a NooBs prompt, or a big chunk of the kernel details since the module is loaded fairly late in the boot process.

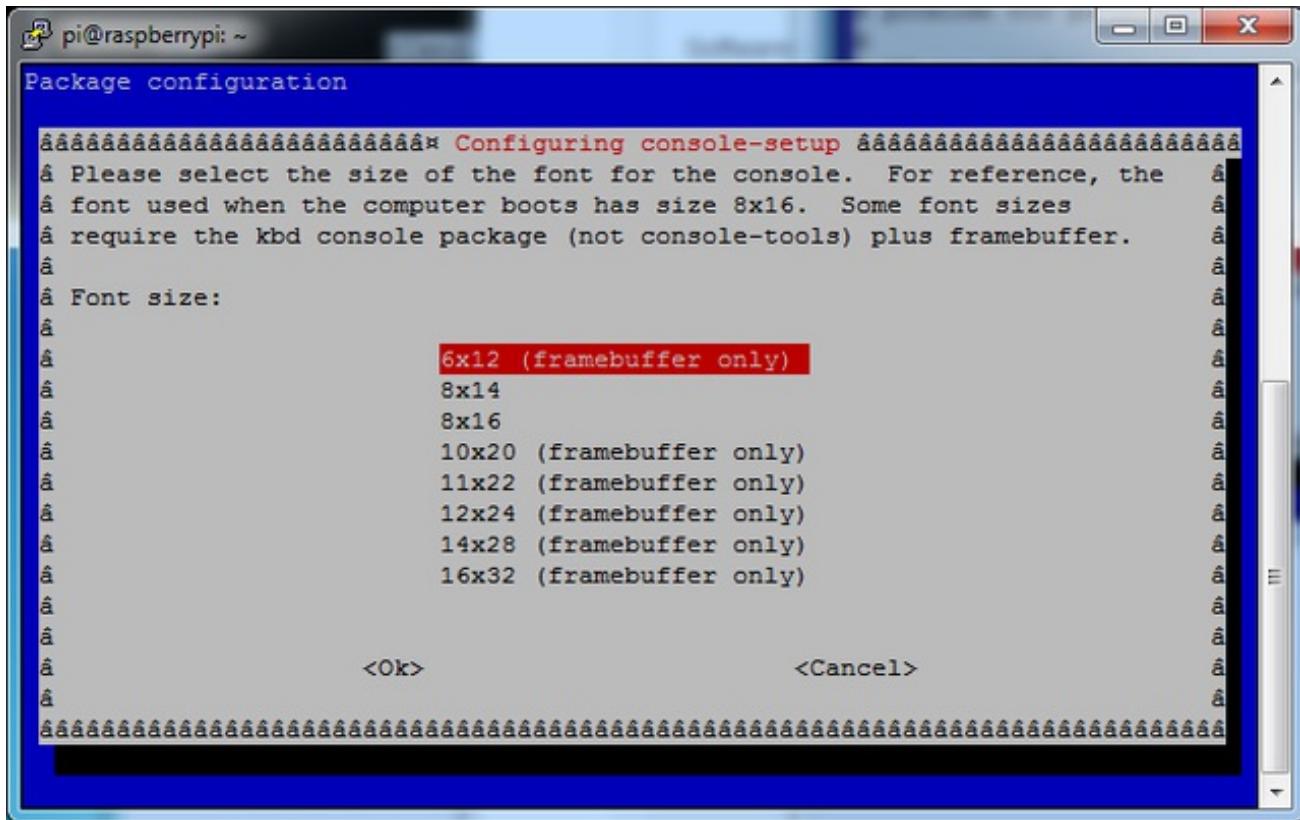
```
pi@raspberrypi:~$ cat /boot/cmdline.txt
dwc_otg.lpm_enable=0 console=ttyAMA0,115200 kgdboc=ttyAMA0,115200 console=tty1
root=/dev/mmcblk0p2 rootfstype=ext4 elevator=deadline rootwait fbcon=map:10 f
bcon=font:VGA8x8

pi@raspberrypi:~$
```

I think the VGA8x8 font is a bit chunky, you probably want 12x6 which is what is shown in the photo above. To change the font, run **sudo dpkg-reconfigure console-setup** and go thru to select Terminus 6x12.





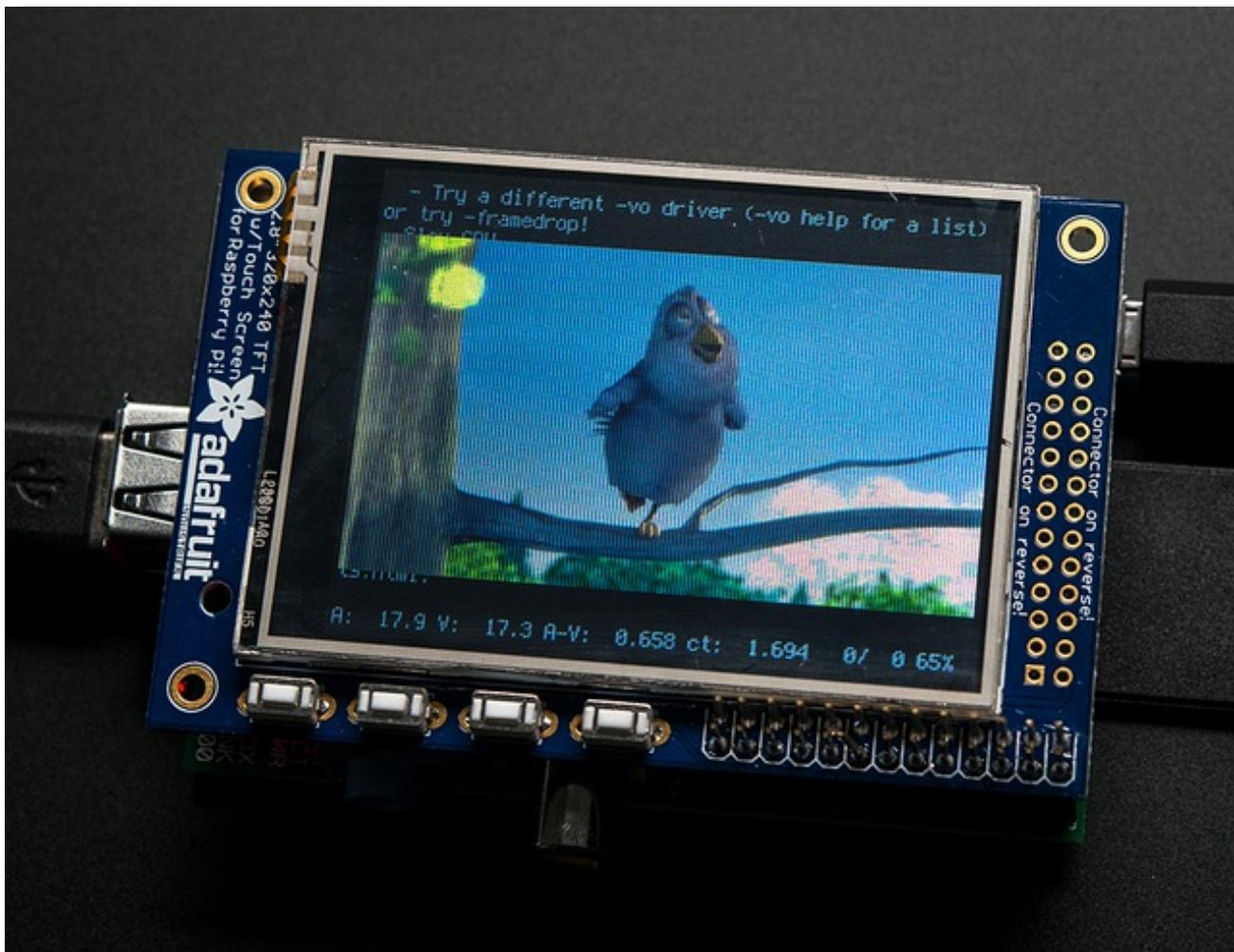


Turn off Console Blanking

You may notice the console goes black after 30 minutes, this is a sort of 'power saving' or 'screensaver' feature. You can disable this by editing **/etc/kbd/config** and setting the blank time to 0 (which turns it off)

```
BLANK_TIME=30
```

Playing Videos



How To Play Videos

You can play many types of videos on the screen, using mplayer you don't even need to run X and you can script the movies to play using Python. We'll show you how to just play one video for now.

To demo, we'll use an mp4 of Big Buck Bunny for 320 pixel wide screens. Below we show you how to create/resize videos, but to make it easy, just download our version with:

```
wget http://adafruit-download.s3.amazonaws.com/bigbuckbunny320p.mp4 (http://adafru.it/cXR)
```

The video is 30MB which is a lot if you haven't expanded your SD card yet. Before you do this, run sudo raspi-config to expand the SD card so you don't run out of space!

If you don't have **mplayer** yet, run

sudo apt-get update

sudo apt-get install mplayer

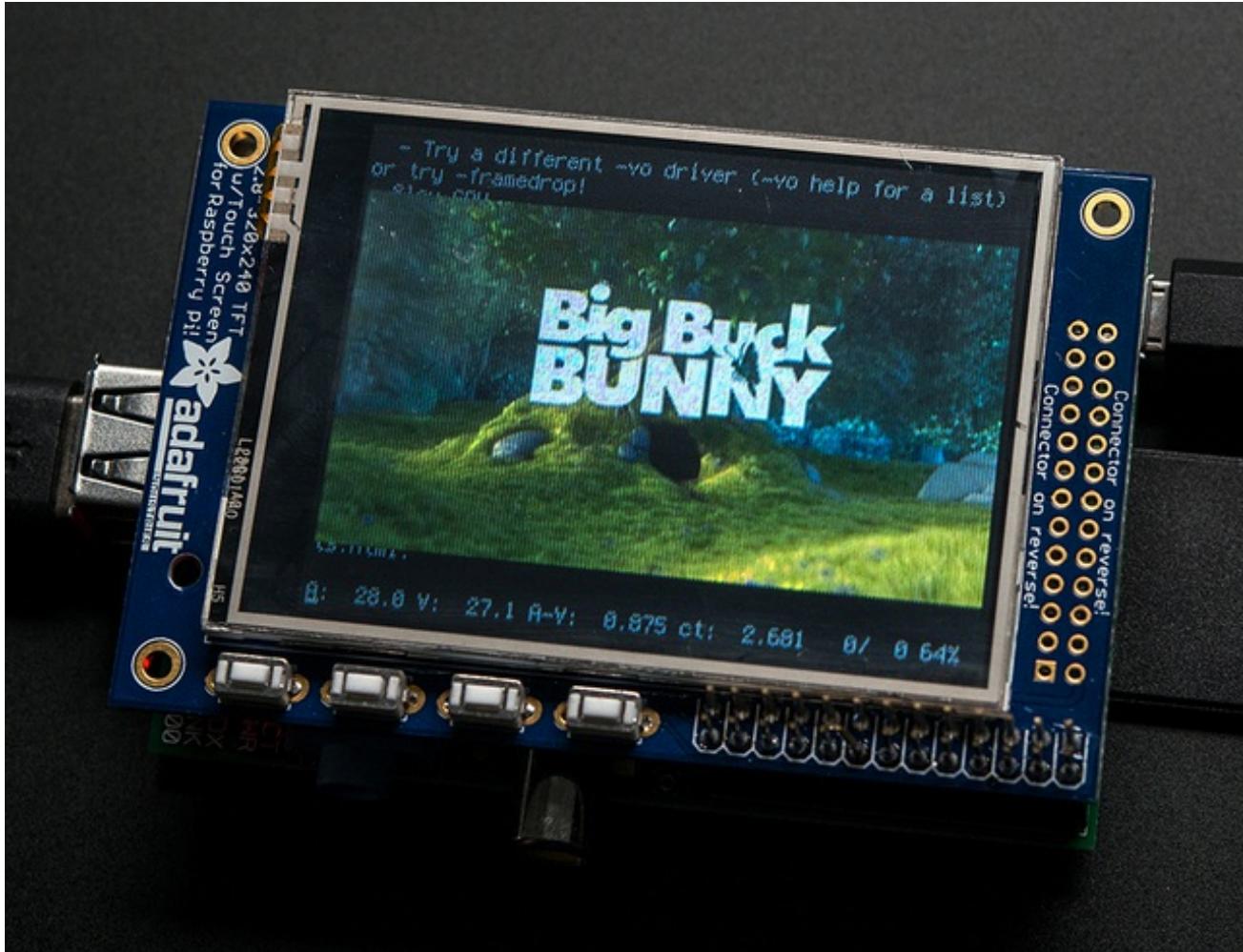
to install it. It may take a few minutes to complete

```
pi@raspberrypi ~ $ sudo apt-get install mplayer
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  esound-common libaa1 libaudiofile1 libavcodec53 libavformat53 libavutil51
  libcdparanoia0 libdca0 libdirac-encoder0 libdvdnav4 libdvdread4 libenca0
  libesd0 libfaad2 libfribidi0 libgpm2 libgsm1 libjack-jackd2-0 liblircclient0
  liblzo2-2 libmp3lame0 libmpeg2-4 libopenal-data libopenal1 libpostproc52
  libschoedinger-1.0-0 libspeex1 libswscale2 libtheora0 libvai libvp1
  libx264-123 libxvidcore4 libxvmc1
Suggested packages:
  libdvdcss2 pulseaudio-esound-compat gpm jackd2 lirc libportaudio2
  libroar-compat2 speex mplayer-doc netselect fping
The following NEW packages will be installed:
  esound-common libaa1 libaudiofile1 libavcodec53 libavformat53 libavutil51
  libcdparanoia0 libdca0 libdirac-encoder0 libdvdnav4 libdvdread4 libenca0
  libesd0 libfaad2 libfribidi0 libgpm2 libgsm1 libjack-jackd2-0 liblircclient0
  liblzo2-2 libmp3lame0 libmpeg2-4 libopenal-data libopenal1 libpostproc52
  libschoedinger-1.0-0 libspeex1 libswscale2 libtheora0 libvai libvp1
  libx264-123 libxvidcore4 libxvmc1 mplayer
0 upgraded, 35 newly installed, 0 to remove and 52 not upgraded.
Need to get 9,296 kB of archives.
After this operation, 20.6 MB of additional disk space will be used.
Do you want to continue [Y/n]? 
```

OK now you just have to run

**mplayer -vo fbdev2:/dev/fb1 -x 240 -y 320 -framedrop
bigbuckbunny320p.mp4**

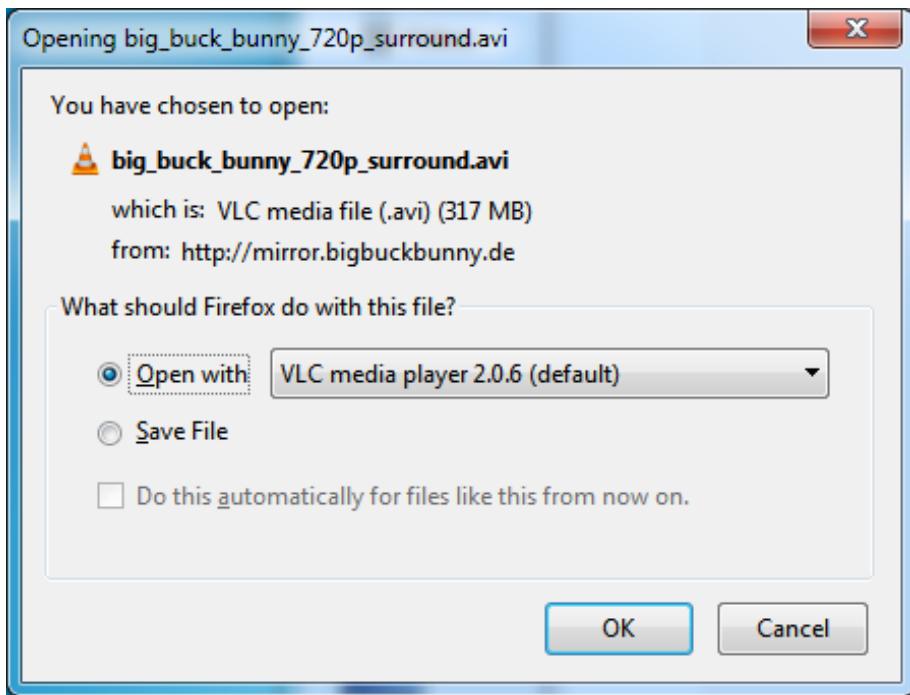
if your video is not sized for 320 wide, you may need to add a -zoom after -framedrop so that it will resize - note that this is quite taxing for the Pi, so it may result in a choppy or mis-synced video!



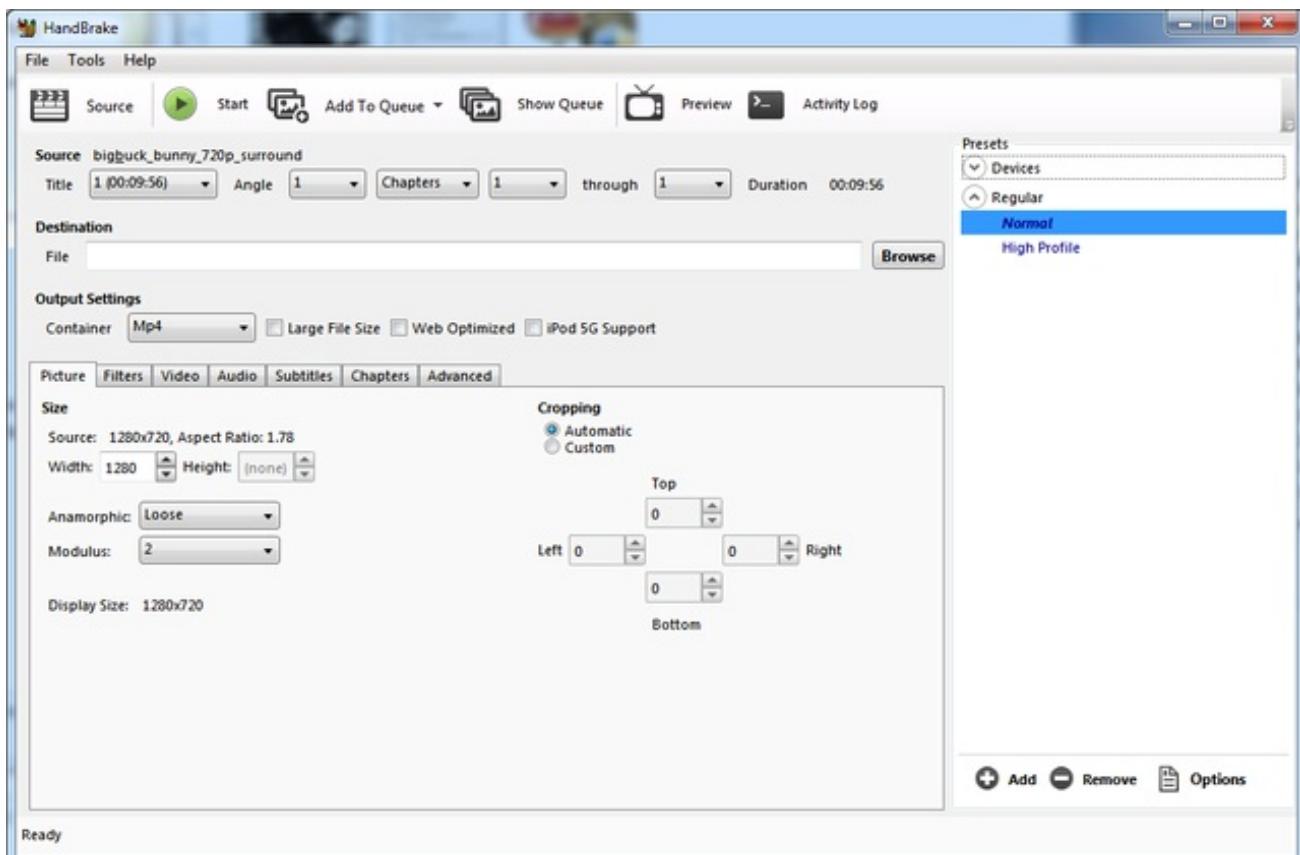
Converting/Resizing Videos

It's possible to play full length videos on the TFT plate, but since the screen is small and the Pi can't use hardware acceleration to play the videos it's best to scale them down to 320x240 pixels. This will be easier for the Pi to play and also save you tons of storage space. For this demo, we'll be using the famous [Big Buck Bunny](http://adafru.it/cXS) (<http://adafru.it/cXS>) video, which is creative commons and also very funny!

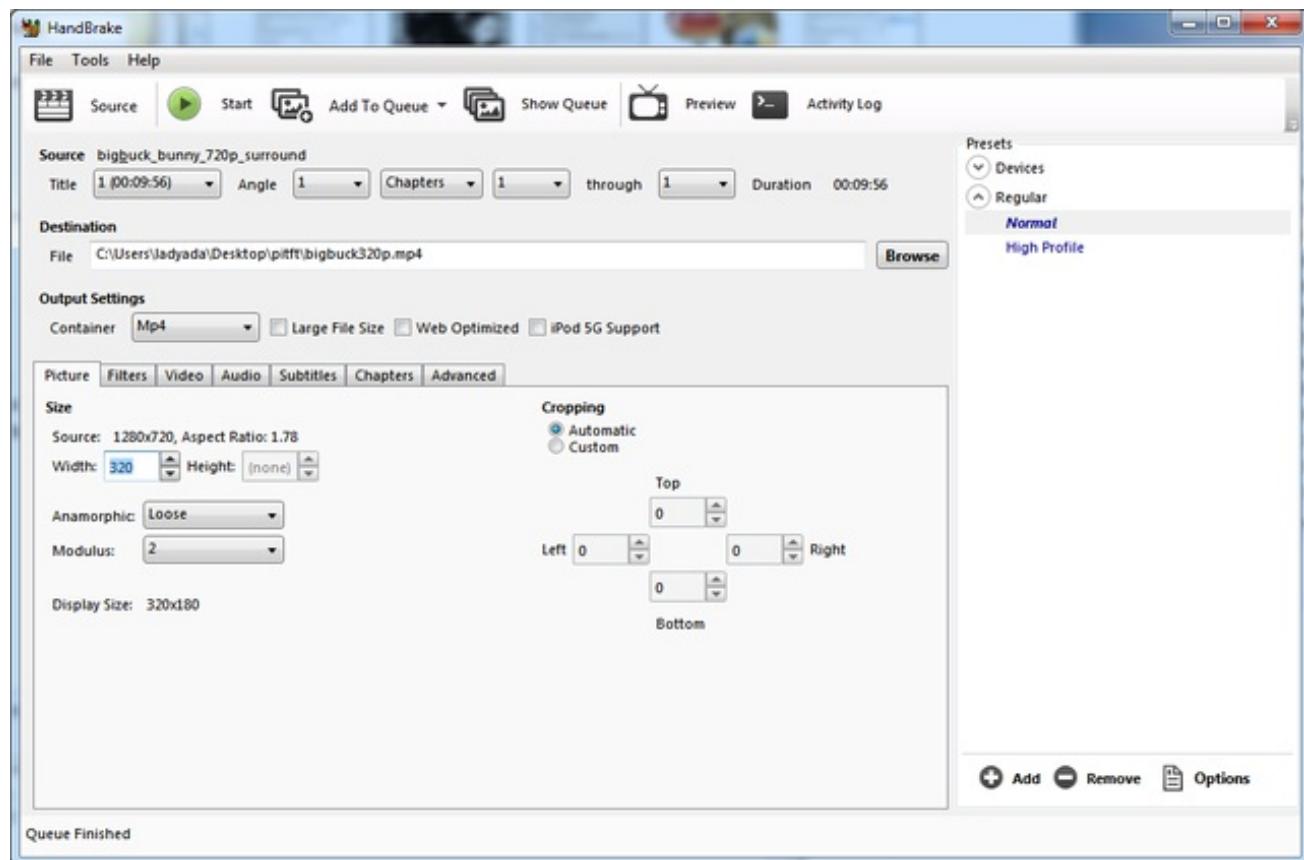
You can download it from the link above, we'll be using the 720p AVI version.



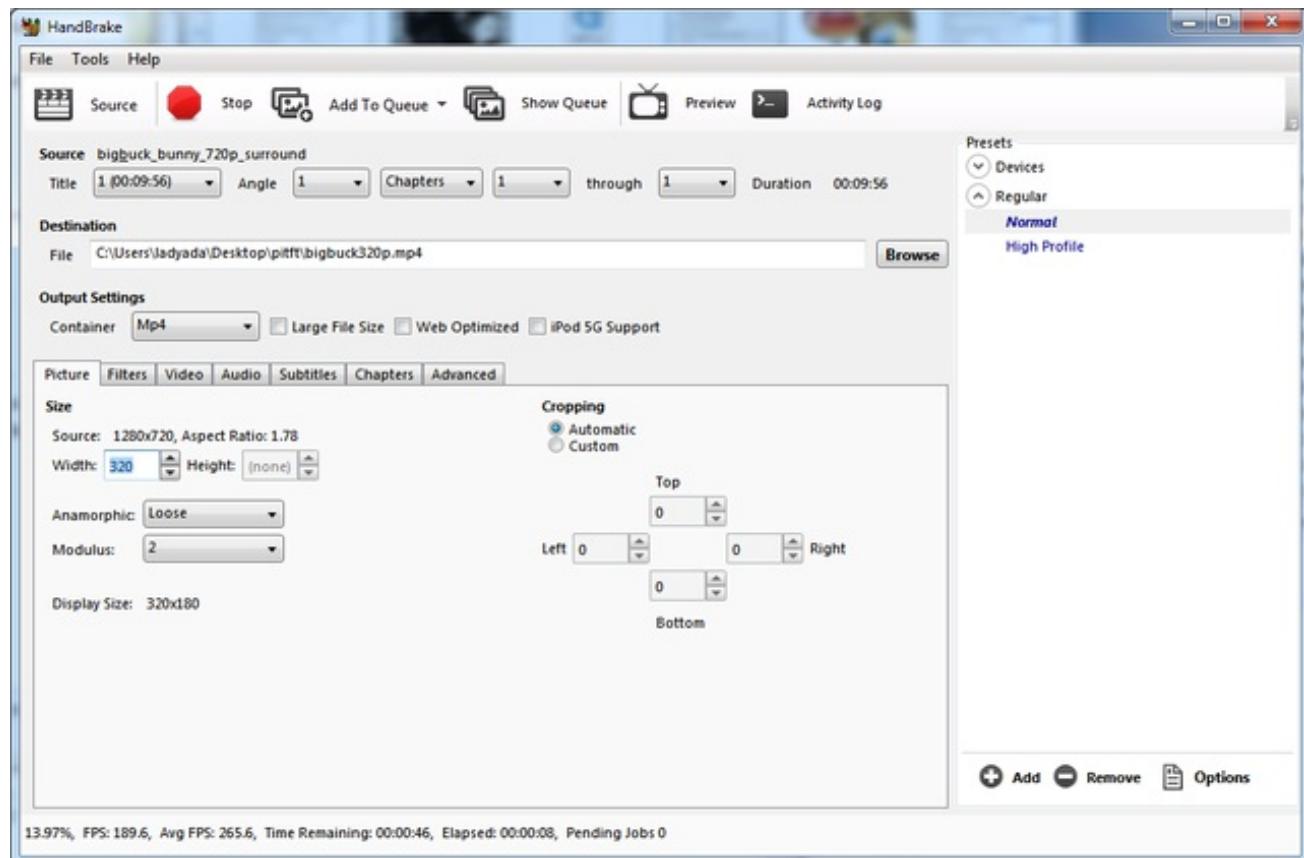
To do the conversion itself, we suggest [HandBrake](http://adafru.it/cXT) (<http://adafru.it/cXT>) which works great and is open source so it runs on all operating systems! Download and install from the link. Then run the installed application and open up the AVI file from before. The app will pre-fill a bunch of information about it.



Under **Destination** click **Browse...** to select a new MP4 file to save. Then under **Picture** change the **Width** to 320 (the height will be auto-calculated)



Click **START** to begin the conversion, it will take a minute or two.

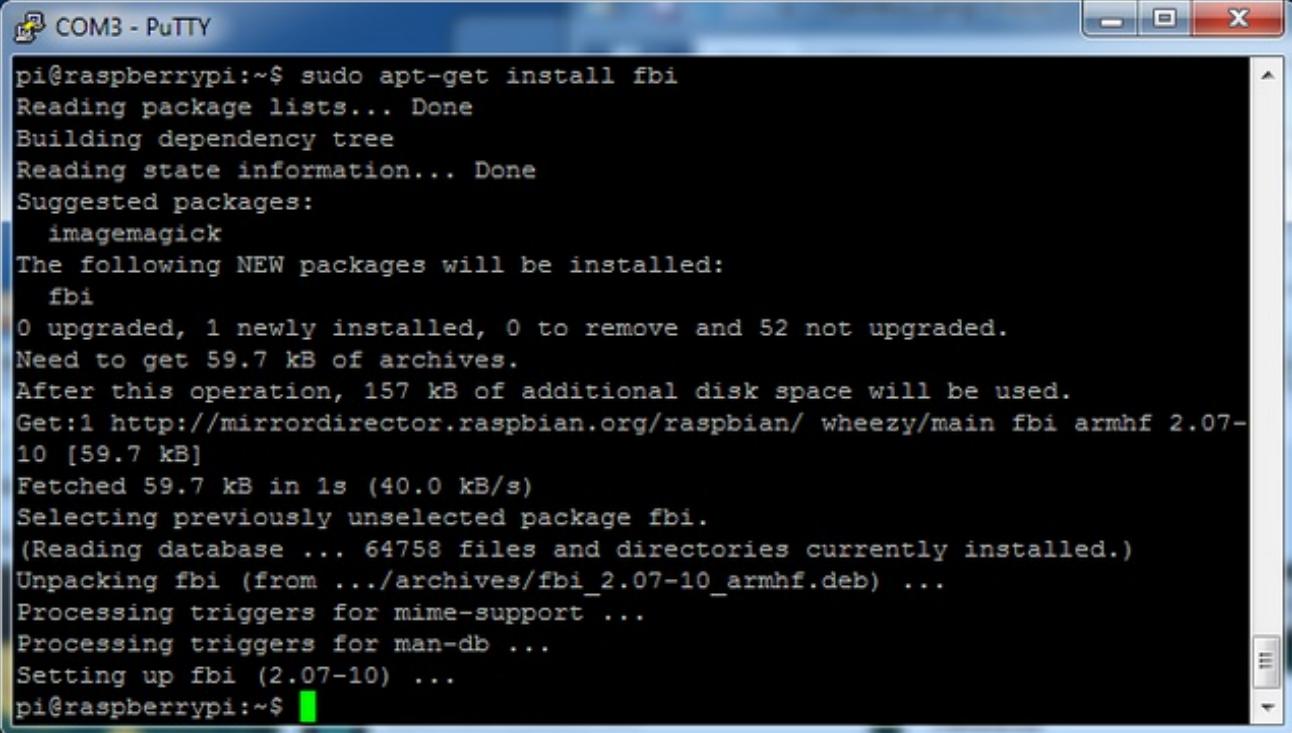


That's it! You now have a smaller file. Don't forget to play it on your computer to make sure it plays right before copying it to your Pi

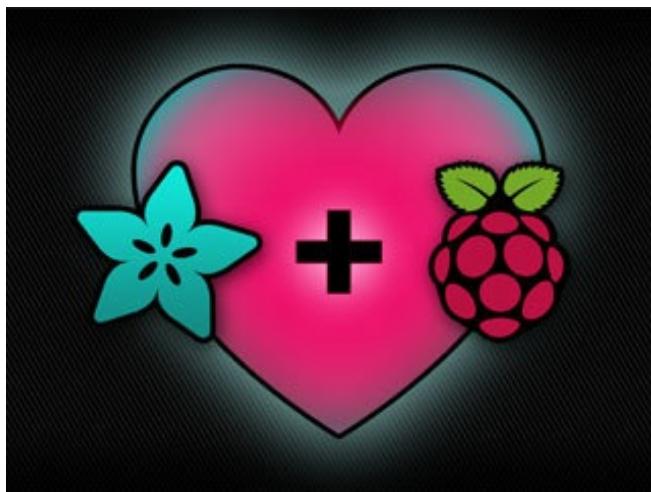
Displaying Images

You can display every day images such as GIFs, JPGs, BMPs, etc on the screen. To do this we'll install **fbi** which is the **frame buffer image** viewer (not to be confused with the FBI agency!)

sudo apt-get install fbi will install it



```
pi@raspberrypi:~$ sudo apt-get install fbi
Reading package lists... Done
Building dependency tree
Reading state information... Done
Suggested packages:
  imagemagick
The following NEW packages will be installed:
  fbi
0 upgraded, 1 newly installed, 0 to remove and 52 not upgraded.
Need to get 59.7 kB of archives.
After this operation, 157 kB of additional disk space will be used.
Get:1 http://mirrordirector.raspbian.org/raspbian/ wheezy/main fbi armhf 2.07-10 [59.7 kB]
Fetched 59.7 kB in 1s (40.0 kB/s)
Selecting previously unselected package fbi.
(Reading database ... 64758 files and directories currently installed.)
Unpacking fbi (from .../archives/fbi_2.07-10_armhf.deb) ...
Processing triggers for mime-support ...
Processing triggers for man-db ...
Setting up fbi (2.07-10) ...
pi@raspberrypi:~$
```



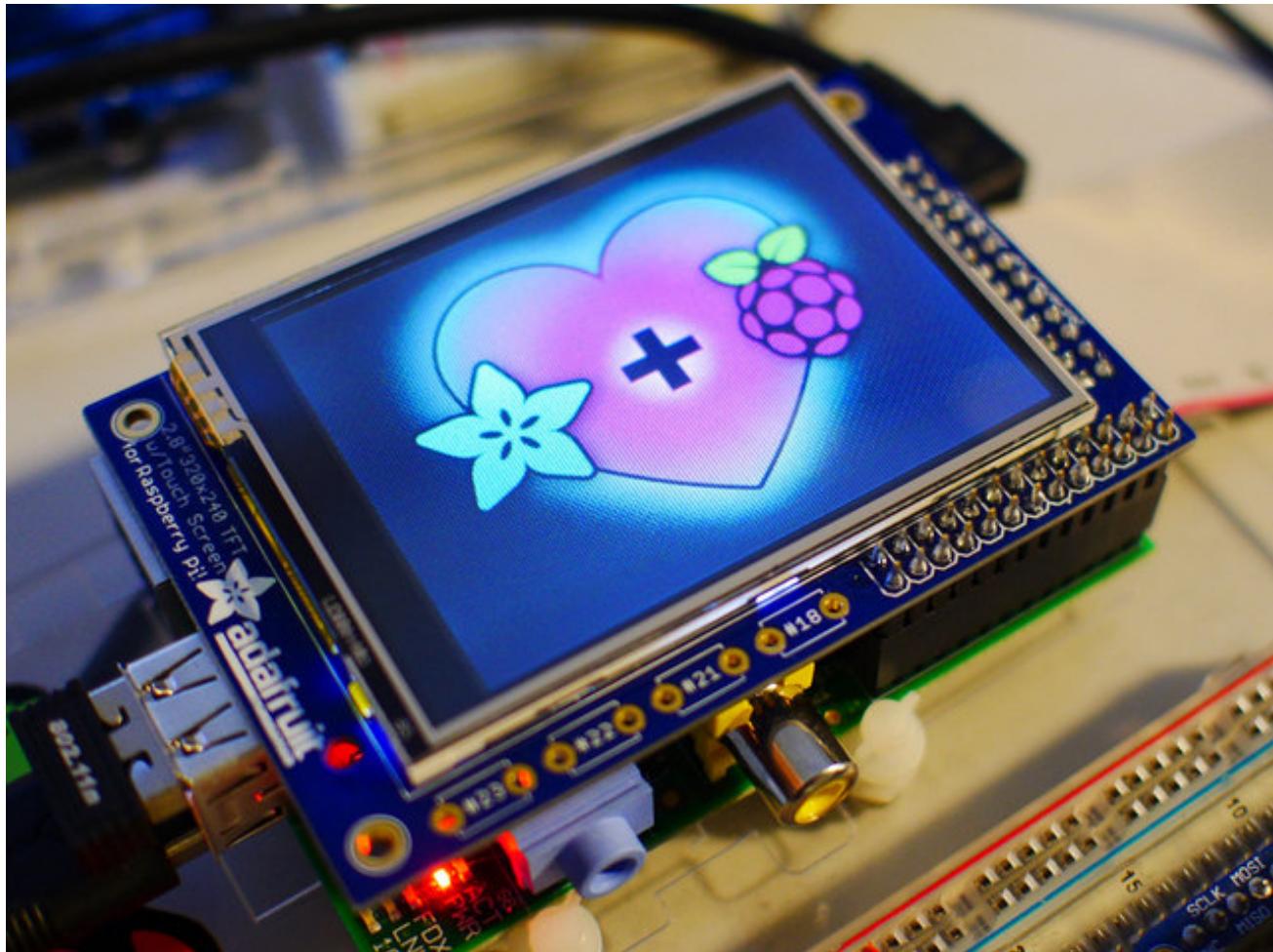
Grab our lovely wallpaper with

```
wget http://adafruit-
download.s3.amazonaws.com/adapiluv320x240.jpg (http://adafru.it/cXU)
```

and view it with

```
sudo fbi -T 2 -d /dev/fb1 -noverbose -a adapiluv320x240.jpg
```

That's it!



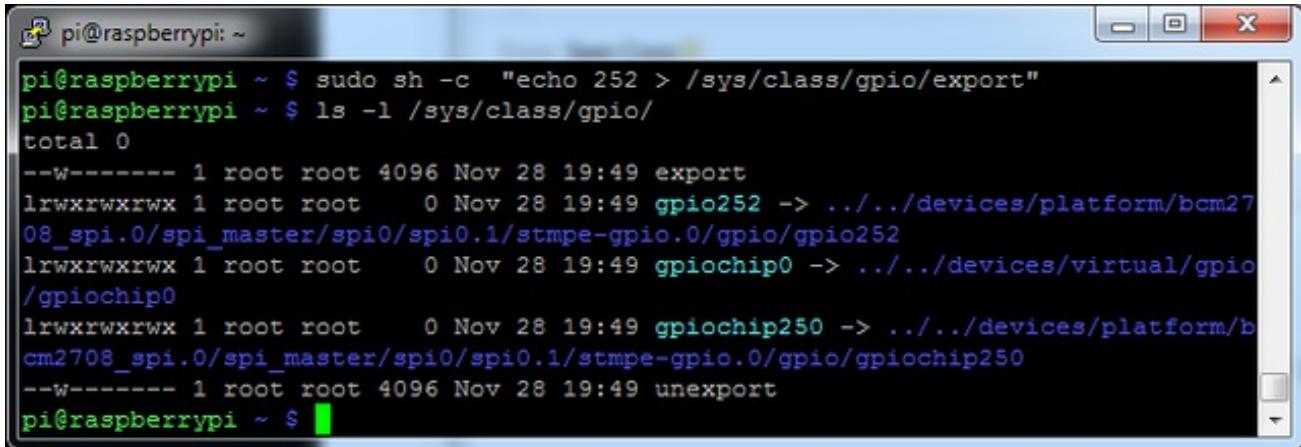
Extras!

Controlling the backlight

There's a 4-LED backlight on the TFT and it draws ~75mA at all times. There might be times you'd like to save some power and turn off the backlight. The screen and touchplate will still work, you just can't see anything. We designed the board with the STMPE610 touchscreen controller which has 2 extra GPIO and tied one of them to the transistor that controls the backlight. You can use the command line to control the backlight.

Start by getting access to the GPIO by making a device link

```
sudo sh -c "echo 252 > /sys/class/gpio/export"
ls -l /sys/class/gpio
```



```
pi@raspberrypi: ~
pi@raspberrypi ~ $ sudo sh -c "echo 252 > /sys/class/gpio/export"
pi@raspberrypi ~ $ ls -l /sys/class/gpio/
total 0
--w---- 1 root root 4096 Nov 28 19:49 export
lrwxrwxrwx 1 root root      0 Nov 28 19:49 gpio252 -> ../../devices/platform/bcm2708_spi.0/spi_master/spi0/spi0.1/stmpe-gpio.0/gpio/gpio252
lrwxrwxrwx 1 root root      0 Nov 28 19:49 gpiochip0 -> ../../devices/virtual/gpio/gpiochip0
lrwxrwxrwx 1 root root      0 Nov 28 19:49 gpiochip250 -> ../../devices/platform/bcm2708_spi.0/spi_master/spi0/spi0.1/stmpe-gpio.0/gpio/gpiochip250
--w---- 1 root root 4096 Nov 28 19:49 unexport
pi@raspberrypi ~ $
```

Once you verify that you see GPIO #252, then you can set it to an output, this will turn off the display since it will output 0 by default

```
sudo sh -c "echo 'out' > /sys/class/gpio/gpio252/direction"
```

Then turn the display back on with

```
sudo sh -c "echo '1' > /sys/class/gpio/gpio252/value"
```

or back off

```
sudo sh -c "echo '0' > /sys/class/gpio/gpio252/value"
```

```
pi@raspberrypi ~ $ sudo sh -c "echo 'out' > /sys/class/gpio/gpio252/direction"
pi@raspberrypi ~ $ sudo sh -c "echo '1' > /sys/class/gpio/gpio252/value"
pi@raspberrypi ~ $ sudo sh -c "echo '0' > /sys/class/gpio/gpio252/value"
pi@raspberrypi ~ $ sudo sh -c "echo '1' > /sys/class/gpio/gpio252/value"
pi@raspberrypi ~ $
```

Tactile switch as power button

Its a good idea to safely turn off your Pi with a good **sudo shutdown -h now** but that often means pulling out a keyboard or connecting to the console. With our kernel we added a cool module that will let you turn any GPIO into a power button. Since there's a couple of tactile switches right there on the front, lets turn one into a power button. Press once to properly turn off the pi, press again to start it up. Isn't that nice?

We'll be using GPIO #23, the left-most button. You can use any of them or other GPIO but #23's our favorite number anyways.

You will have to grab a pack of slim tactile switches (<http://adafruit.it/1489>) or otherwise solder in a button

Add **rpi_power_switch** to **/etc/modules** and save

```
pi@raspberrypi ~ $ 
GNU nano 2.2.6          File: /etc/modules          Modified
# /etc/modules: kernel modules to load at boot time.
#
# This file contains the names of kernel modules that should be loaded
# at boot time, one per line. Lines beginning with "#" are ignored.
# Parameters can be specified after the module name.

snd-bcm2835
spi-bcm2708
fbftf_device
rpi_power_switch
```

Now create a new conf file or edit our existing one with

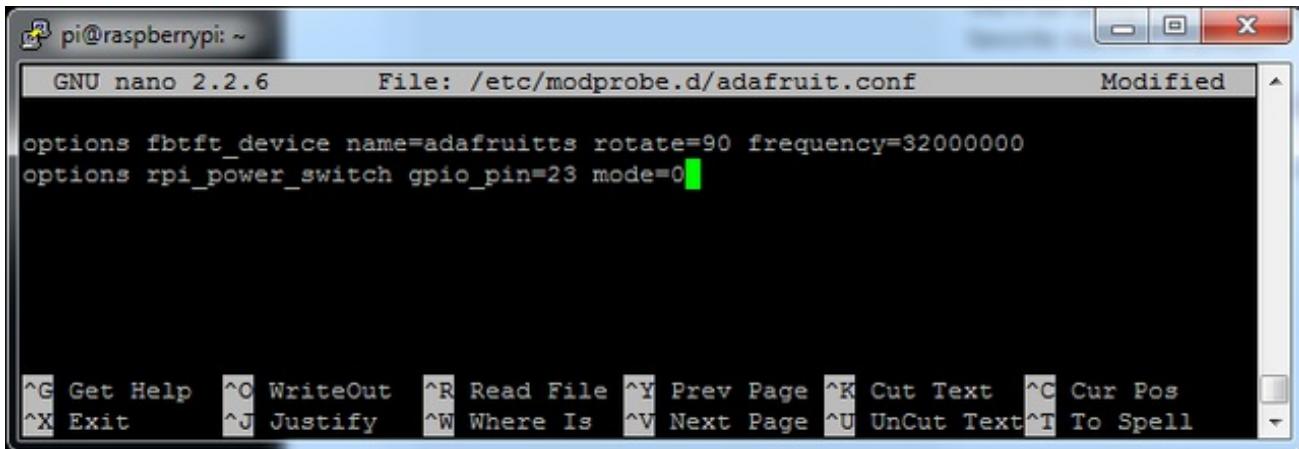
sudo nano /etc/modprobe.d/adafruit.conf

and enter in the line

options rpi_power_switch gpio_pin=23 mode=0

Of course, change the **gpio_pin** setting to some other # if you wish. **mode=0** means its a

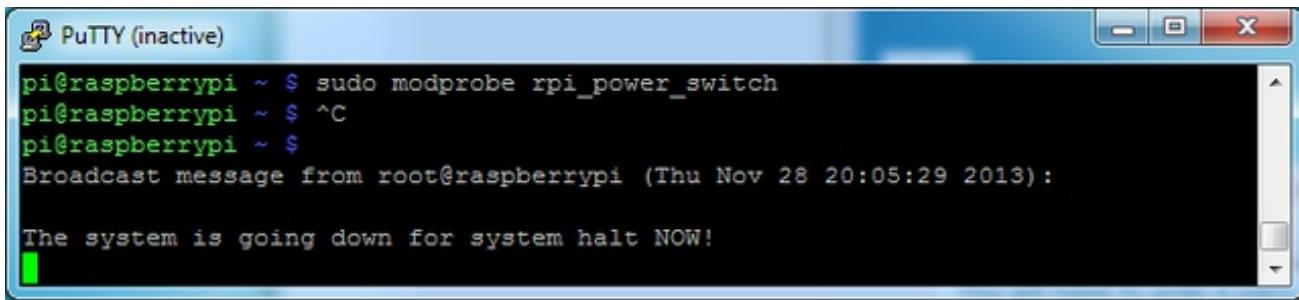
pushbutton *not* a switch. If you happen to install an on/off switch, use **mode=1**



```
pi@raspberrypi: ~
GNU nano 2.2.6      File: /etc/modprobe.d/adafruit.conf      Modified
options fbftf_device name=adafruitts rotate=90 frequency=32000000
options rpi_power_switch gpio_pin=23 mode=0

^G Get Help  ^C WriteOut  ^R Read File  ^Y Prev Page  ^K Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is   ^V Next Page  ^U UnCut Text ^T To Spell
```

To make it active immediately run **sudo modprobe rpi_power_switch**



```
pi@raspberrypi ~ $ sudo modprobe rpi_power_switch
pi@raspberrypi ~ $ ^C
pi@raspberrypi ~ $ 
Broadcast message from root@raspberrypi (Thu Nov 28 20:05:29 2013):
The system is going down for system halt NOW!
```

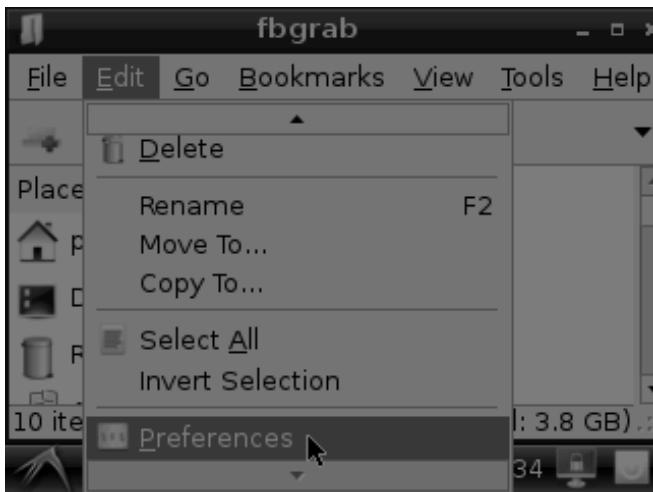
Making it easier to click icons in X

If you want to double-click on icons to launch something in X you may find it annoying to get it to work right. In LXDE you can simply set it up so that you only need to single click instead of double.

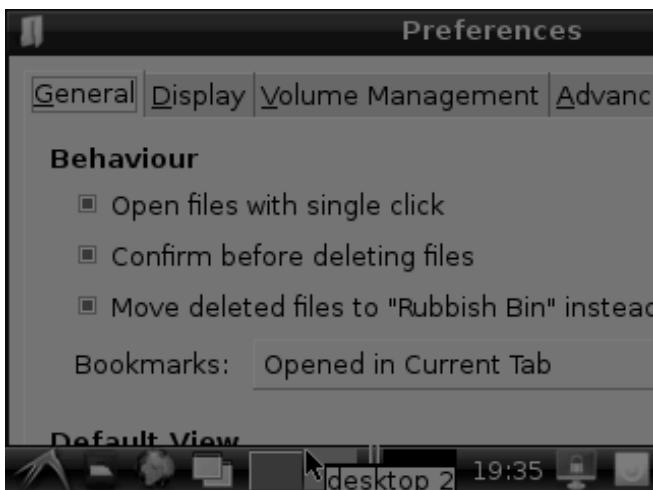
From LXDE launch the file manager (sorry these pix are grayscale, still figuring out how to screenshot the framebuffer!)



Then under the **Edit** menu, select **Preferences**



Then select **Open files with single click** and close the window (you'll need to drag it over to get to the X button)



Boot to X Windows on PiTFT

To enable booting straight to X windows on the PiTFT follow the steps below. First make sure a display configuration which would conflict is **not** present by executing in a terminal on the Pi:

```
sudo mv /usr/share/X11/xorg.conf.d/99-fbturbo.conf ~
```

Don't worry if the command fails with an error that the file doesn't exist. This failure is normal and should happen on a good PiTFT install. You can ignore it and move on.

Next run the command below to open the nano text editor as root and create the file **/usr/share/X11/xorg.conf.d/99-pitft.conf**:

```
sudo nano /usr/share/X11/xorg.conf.d/99-pitft.conf
```

When the editor loads to a blank file, copy in the text below:

```
Section "Device"
Identifier "Adafruit PiTFT"
Driver "fbdev"
Option "fbdev" "/dev/fb1"
EndSection
```

Then save the file by pressing **Ctrl-O** and then **enter**, and finally exit by pressing **Ctrl-X**.

The step above will create a configuration file which tells X windows that it should use the PiTFT framebuffer (located at /dev/fb1) by default when it runs.

At this point you can use the raspi-config tool to enable booting to desktop just like normal on the Pi. Run the following command:

```
sudo raspi-config
```

Then pick the **Enable Boot to Desktop/Scratch** option and choose if you want to boot to the console, desktop, or scratch environment. After exiting the tool and rebooting you should see the Pi load X windows on the PiTFT after (be patient it can take around 30 seconds to load).

If you want to disable booting to X, just use the raspi-config command again to choose the console boot option.

Gesture Input

With the PiTFT touchscreen and [xstroke \(<http://adafru.it/dD0>\)](http://adafru.it/dD0) you can enter text in applications by drawing simple character gestures on the screen! Check out the video below for a short demonstration and overview of gesture input with xstroke:

Installation

Unfortunately xstroke hasn't been actively maintained for a few years so there isn't a binary package you can directly install. However compiling the tool is straightforward and easy with the steps below. Credit for these installation steps goes to [mwilliams03 at ozzmaker.com \(<http://mwilliams03.ozzmaker.com>\)](http://mwilliams03.ozzmaker.com) (<http://adafru.it/dD1>).

First install a few dependencies by opening a command window on the Pi and executing:

```
sudo apt-get -y install build-essential libxft-dev libxpm-dev libxtst-dev
```

Now download, compile, and install xstroke by executing:

```
cd ~  
wget http://mirror.egtvedt.no/avr32linux.org/twiki/pub/Main/XStroke/xstroke-0.6.tar.gz  
tar xfv xstroke-0.6.tar.gz  
cd xstroke-0.6  
.configure  
make  
sudo make install
```

If the commands above execute successfully xstroke should be installed. If you see an error message, carefully check the dependencies above were installed and try again.

Once xstroke is installed you will want to add a couple menu shortcuts to start and stop xstroke. Execute the following commands to install these shortcuts:

```
wget https://github.com/adafruit/PiTFT_Extras/raw/master/xstroke.desktop  
wget https://github.com/adafruit/PiTFT_Extras/raw/master/xstrokekill.desktop  
sudo cp xstroke*.desktop /usr/share/applications/
```

Usage

To use xstroke I highly recommend using a plastic stylus instead of your finger. Also [calibrate the touchscreen for X-Windows \(<http://adafru.it/dD2>\)](http://adafru.it/dD2) so you have the best control over the cursor possible.

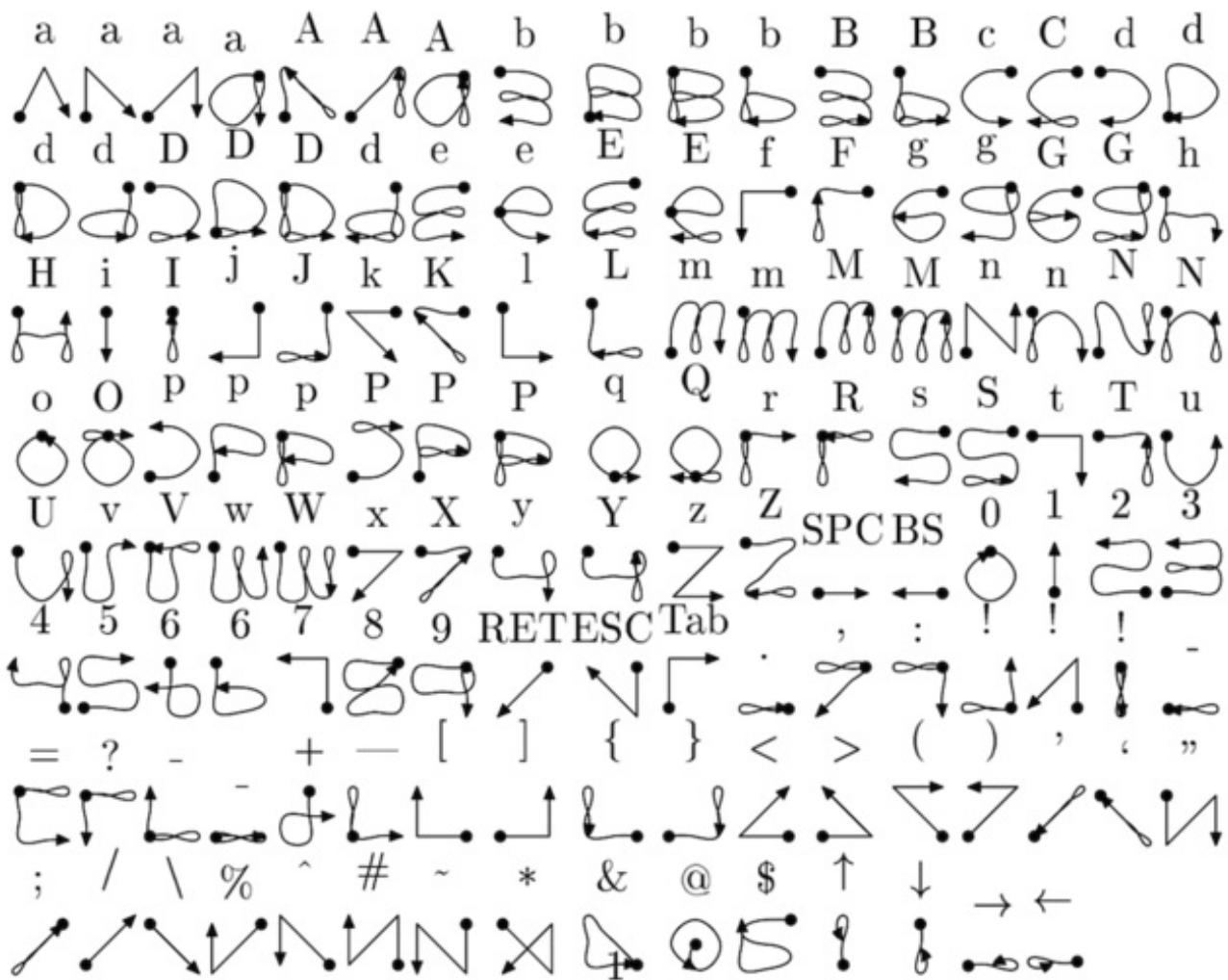
Don't use a ballpoint pen or sharp metal stylus as it could scratch or damage the touchscreen!

Start X-Windows on the PiTFT and open the LXDE menu by clicking the icon in the lower left corner. Scroll up to the **Accessories** menu at the top and notice the new **XStroke** and **XStroke Kill** commands.

Click the **XStroke** menu option to start xstroke. You should see a small pencil icon appear on the bottom right side of the screen. The pencil icon means xstroke is running, however by default it's not yet looking for gesture input.

Open an application that takes text input, such as LXTerminal. To enable gesture input click the xstroke pencil icon. You should see the pencil turn green and the text 'abc' written over top of the icon. You might need to click the icon a few times to get the click to register in the right spot.

When xstroke is looking for gesture input you can drag the mouse cursor in a gesture anywhere on the screen to send specific key strokes. Here's a picture of the possible gestures you can send:



(credit to Carl Worth for the image above)

To draw a gesture from the above image, press anywhere on the screen, start from the circle in the gesture, and follow the gesture pattern towards the arrow. As you draw a gesture you should see a blue line displayed that shows what you've drawn. Lift up the stylus when you get to the end of the gesture at the arrow. If xstroke recognizes the gesture it will send the appropriate key press to the active window. Try drawing a few characters from the image above to get the hang of writing gestures.

A few very useful gestures are backspace (which deletes a character), return/enter, and space. To draw a backspace gesture just draw a line going from the right side of the screen to the left side. The gesture for return/enter is a diagonal line from the top right to bottom left. Finally a space is a straight line from the left to the right.

Note that when xstroke is looking for gestures you might not be able to click or control the cursor as you normally would expect. To stop xstroke's gesture recognition carefully press the xstroke pencil icon again until the 'abc' text disappears. I've found this process can be a little finicky as the icon is very small and any movement will be interpreted as a gesture. Use

a light touch and try a few times to click the icon.

If you get stuck completely and can't disable xstroke by clicking the icon, connect to the Raspberry Pi in a terminal/SSH connection and run 'killall xstroke' (without quotes) to force xstroke to quit. The normal way to stop xstroke is to navigate to the **Accessories -> XStroke Kill** command, but you might not be able to do that if xstroke is listening for gesture input.

Have fun using xstroke to control your Pi by writing gestures on the PiTFT screen!

FAQ

How can I bring up X on the HDMI/TV monitor?

Use the **fb0** framebuffer when you want to display stuff on the HDMI/TV display, for example:

FRAMEBUFFER=/dev/fb0 startx

will use the HDMI/TV framebuffer for X windows instead of the PiTFT

That doesn't work! I can't get X on HDMI!

If both

FRAMEBUFFER=/dev/fb0 startx &

and

FRAMEBUFFER=/dev/fb1 startx &

wind up showing the GUI on your PiTFT, enter the following instruction from the command line:

```
sudo mv /usr/share/X11/xorg.conf.d/99-fbturbo.conf ~
```

I'm trying to run startx and I get FATAL: Module g2d_23 not found.

don't forget you have to remove the turbo file!

sudo mv /usr/share/X11/xorg.conf.d/99-fbturbo.conf ~

Why doesn't the tactile button on GPIO #21 work?

On some older PiTFTs we had one of the buttons labeled #21 - that's the original RasPi name for that pin. If you're using a V2 (chance is, you are!) that is now called #27.

All the PiTFT's we ship now have the button labeled #21 and #27

I want better performance and faster updates!

You can change the SPI frequency (overclock the display) by editing **/etc/modprobe.d/adafruit.conf** and changing the options line to:

```
options fbtft_device name=adafruitrt28 rotate=90
frequency=62000000 fps=60
```

here's the thing, the Pi only supports a *fixed number* of SPI frequencies. So tweaking the number a little won't do anything. The kernel will round the number to the closest value. You will always get frequencies that are 250MHz divided by an even number. Here's the only SPI frequencies this kernel supports

- 15,625,000 (a.k.a 16000000 = 16 MHz)
- 17,857,142 (a.k.a. 18000000 = 18 MHz)
- 20,833,333 (a.k.a 21000000 = 21 MHz)
- 25,000,000 (= 25 MHz)
- 31,250,000 (a.k.a 32000000 = 32MHz)

- 41,666,666 (a.k.a 42000000 = 42MHz)
- 62,500,000 (a.k.a 62000000 = 62MHz)

So if you put in 48000000 for the speed, you won't actually get 48MHz, you'll actually only get about 42MHz because it gets rounded down. We tested this display nicely with 32MHz and we suggest that. But you can put in 42MHz or even try 62MHz and it will update faster

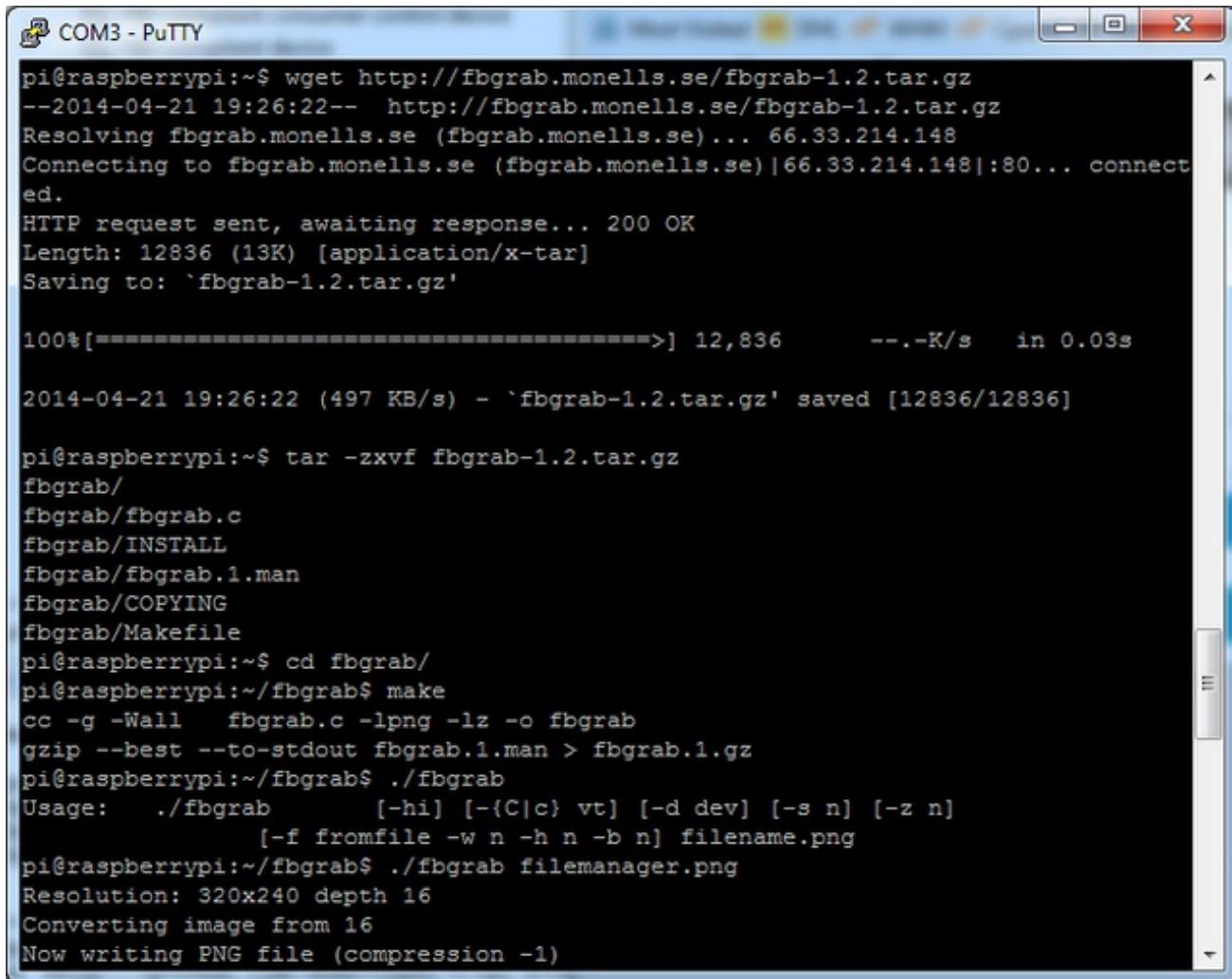
You can tweak fps (frames per second) from 20 to 60 and frequency up to 62MHz for tradeoffs in performance and speed. Reboot after each edit to make sure the settings are loaded properly. There's a trade off that if you ask for higher FPS you're going to load the kernel more because it's trying to keep the display updated.

How can I take screenshots of the little screen?

We took the screenshots for this tutorial with

(<http://adafruit.it/diV>)**fbgra** (<http://adafruit.it/diV>)**b** (<http://adafruit.it/diV>)

```
wget http://fbgrab.monells.se/fbgrab-1.2.tar.gz (http://adafruit.it/diW)
tar -zvxf fbgrab*.gz
cd fbgrab/
make
./fbgrab screenshot.png
```



pi@raspberrypi:~\$ wget http://fbgrab.monells.se/fbgrab-1.2.tar.gz
--2014-04-21 19:26:22-- http://fbgrab.monells.se/fbgrab-1.2.tar.gz
Resolving fbgrab.monells.se (fbgrab.monells.se)... 66.33.214.148
Connecting to fbgrab.monells.se (fbgrab.monells.se)|66.33.214.148|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 12836 (13K) [application/x-tar]
Saving to: 'fbgrab-1.2.tar.gz'

100%[=====] 12,836 --.-K/s in 0.03s

2014-04-21 19:26:22 (497 KB/s) - `fbgrab-1.2.tar.gz' saved [12836/12836]

pi@raspberrypi:~\$ tar -zxvf fbgrab-1.2.tar.gz
fbgrab/
fbgrab/fbgrab.c
fbgrab/INSTALL
fbgrab/fbgrab.1.man
fbgrab/COPYING
fbgrab/Makefile
pi@raspberrypi:~\$ cd fbgrab/
pi@raspberrypi:~/fbgrab\$ make
cc -g -Wall fbgrab.c -lpng -lz -o fbgrab
gzip --best --to-stdout fbgrab.1.man > fbgrab.1.gz
pi@raspberrypi:~/fbgrab\$./fbgrab
Usage: ./fbgrab [-hi] [-{C|c} vt] [-d dev] [-s n] [-z n]
[-f fromfile -w n -h n -b n] filename.png
pi@raspberrypi:~/fbgrab\$./fbgrab filemanager.png
Resolution: 320x240 depth 16
Converting image from 16
Now writing PNG file (compression -1)

How do I automatically boot to X windows on the PiTFT?

Once you have a PiTFT installation setup you can add a custom X windows configuration to use the PiTFT by default. Then you can use the normal raspi-config boot to console/desktop options to control if the Pi boots to a console or desktop. [See the detailed instructions on this page of the guide \(http://adafru.it/e1s\)](http://adafru.it/e1s) for more information.

Downloads

- The latest kernel fork that adds all the TFT, touchscreen, and other addons is here on github (<http://adafru.it/dcA>)
- Datasheet for the 'raw' 2.8" TFT display (<http://adafru.it/d4m>)

Schematic & Layout

