

# An Introduction to Raspberry Pi

## January 10, 2013

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Splat Space

<http://splatspace.org>

Presented by:

Pete Soper

Alan Dipert

Clinton Dreisbach

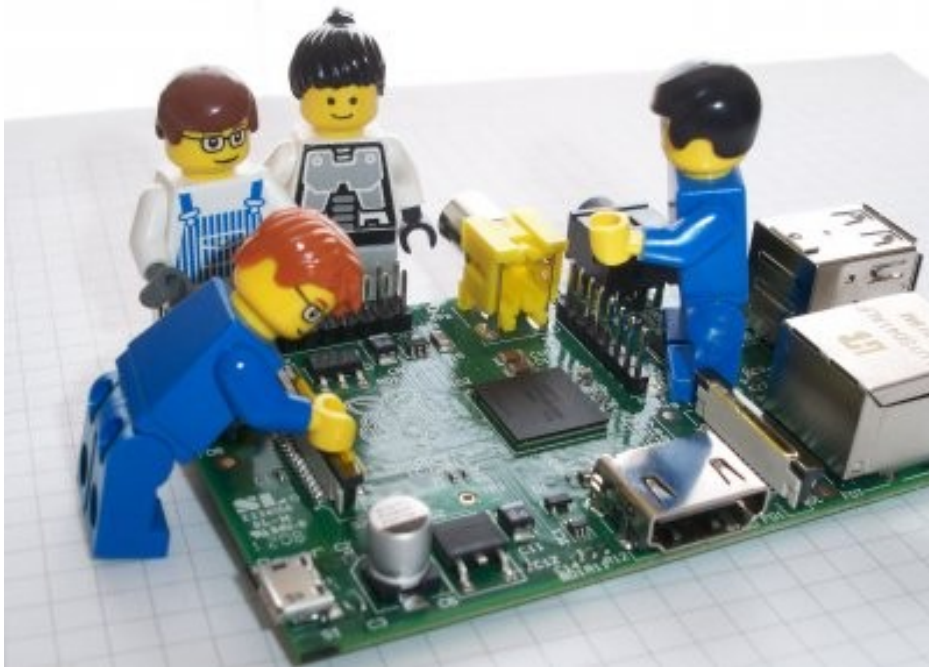
Peter Reintjes



# Outline

- What is a Raspberry Pi?
  - History and charter
  - Description
- Resources
- The Raspberry Pi Workstation
- Open Computer Vision and Stepper Motors
- Q&A

# Tonight vs Saturday



- Tonight:
  - Presentations/demos
- Saturday (Splat Space):
  - Installfest
  - Show and Tells
  - Educator discussion led by Elliot Hauser [eah13@mac.com](mailto:eah13@mac.com)
  - Troubleshooting, customization

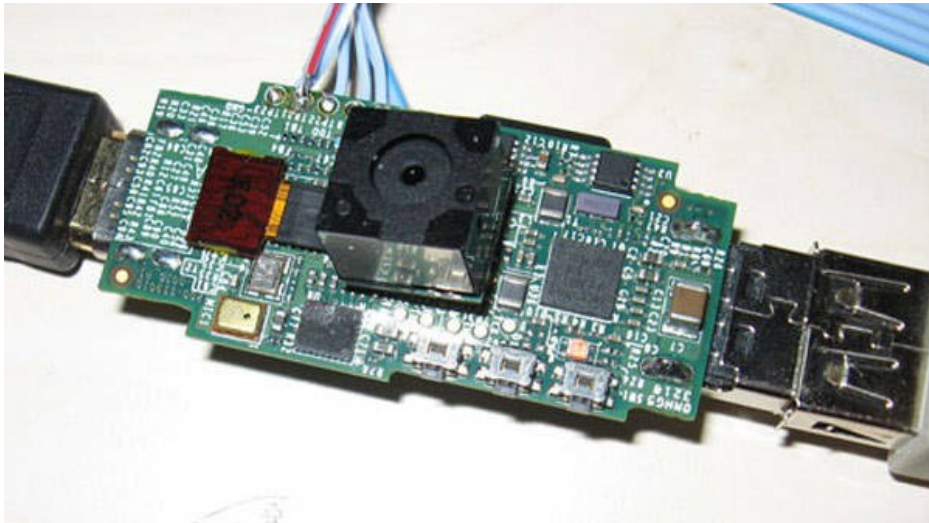
# What is Raspberry Pi?

- A single board, very flexible, four watt computer in \$35 (model B) and \$25 (model A) flavors designed and made in the UK
- A mostly-open educational platform. (Some chip firmware not open)
- A standalone Linux, BSD, RISC OS, or Plan 9 system with a lot of I/O
- A powerful programming environment

# The Short History

- Around 2005 Eben Upton was Director of Studies in Computer Science at Cambridge.
- Incoming students had relatively few programming and/or hardware skills vs “the old days”, creating vision of “something like the BBC Computer, but running a modern language like Python.” The name “Raspberry Pi” is a combination of “a fruit name” and a play on “Python”.
- Between 2006-2011 the vision turned into a highly capable single board computer design.

# Raspberry Pi Proto



- Getting past the idea that “Python is enough”

# History (2)

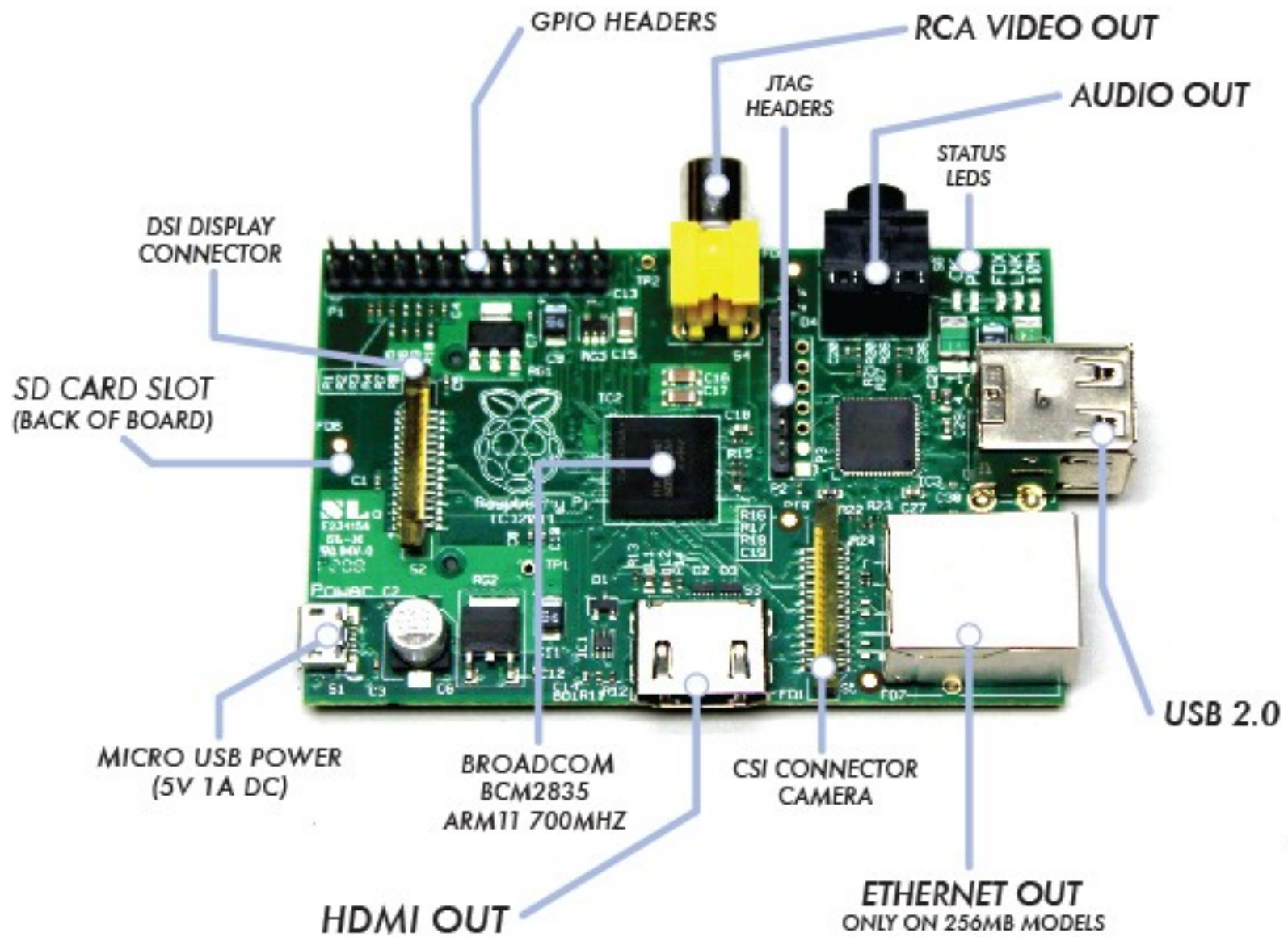
- Interest in RPi exploded as production plans became more and more enthusiastic, reaching the initial run of 10k boards by a partnership with Element14 and RS Components in the UK.
- The day sales began 100k orders were chasing the first 10k boards.
- Support hardware and software development have been proportionate to the estimated 1M boards shipped.
- But this is all really just STEP ONE.

# Why was Raspberry Pi Made?



- Education!
- Original measure of success: more CS students
- But education-related efforts are rapidly spreading downward, aiming toward young children.





# Two Models, Two HW Versions

- Model B, version 1
  - Original \$35 board (almost everybody's is this one)
  - 1/4gb RAM, all peripheral support
- Model B, version 2 (starting late last year)
  - 1/2gb RAM, other tweaks mentioned later
- Model A (started shipping late last year)
  - \$25
  - No ethernet jack: networking via USB add-on
  - 1/4gb RAM

# Processor and Memory

- Broadcom 2835 System On Chip
  - 32 bit ARM RISC CPU core (not x86 compatible)
  - Videocore IV GPU
  - Gadzooks of additional I/O
- Arm11 hardware, Arm6 architecture (-1 from current “hot” cellphone chips)
- Default clock speed is 700mhz
- Second and third chips for  $\frac{1}{2}$  (model B) or  $\frac{1}{4}$  (model A) gb RAM and ethernet/USB

# The RPi Mass Storage: SD Card



- Any SD card, but if you don't have a very recent RPi , check class 10 list at [elinux.org/RPi\\_Hub](http://elinux.org/RPi_Hub)
- Kernel boots from SD card, period.
- Easy to have root FS on other device

# Video



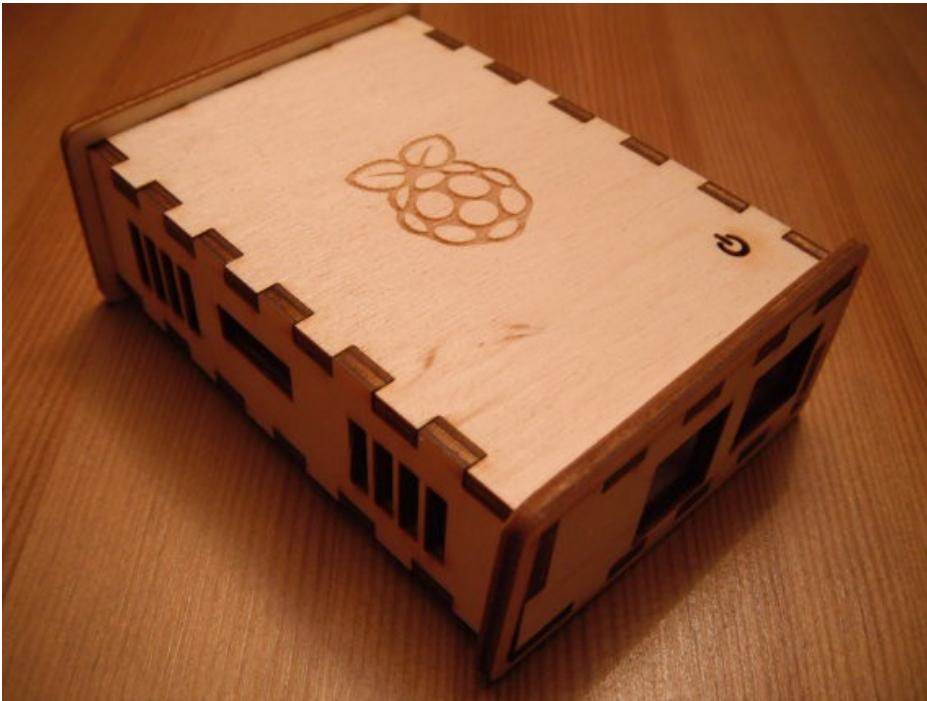
- HDMI or (digital) DVI via cheap adaptor/cable
- Composite NTSC/PAL via RCA
- Wide range of resolutions
- NO VGA without an add-on, nontrivial converter (Adafruit)

# Audio



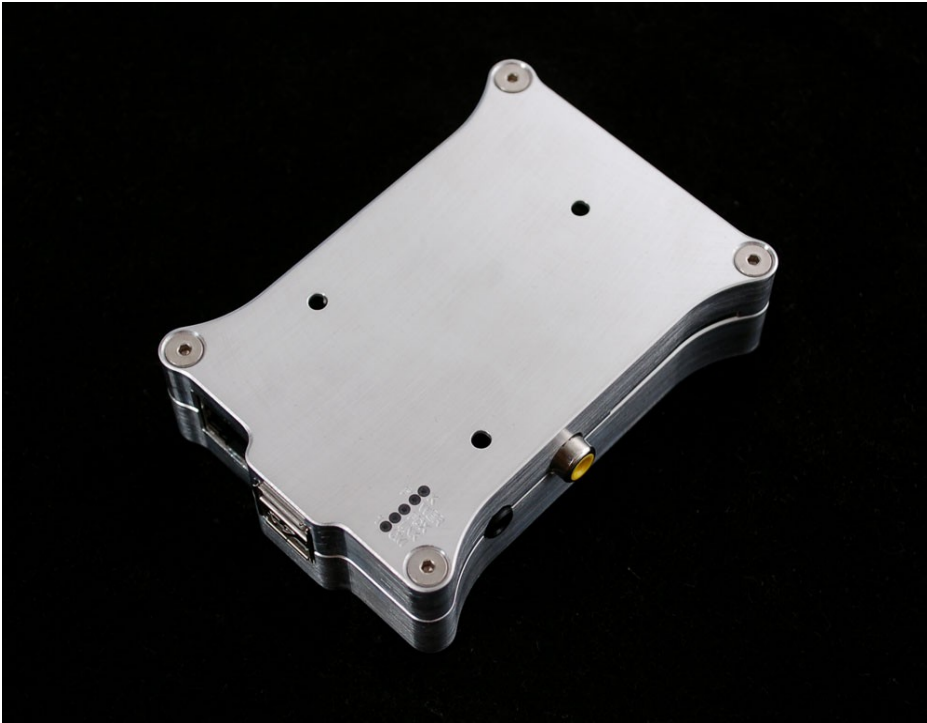
- Via HDMI **or** from stereo jack
- Output only
- Support maturity appears to be lagging

# Networking



- 10/100mbps via RJ45 on model B
- Wireless via USB add-on supported

# USB



- Dual USB sockets on RPi model B, single on model A
- Expandable via regular or powered hubs



# Speaking of Power



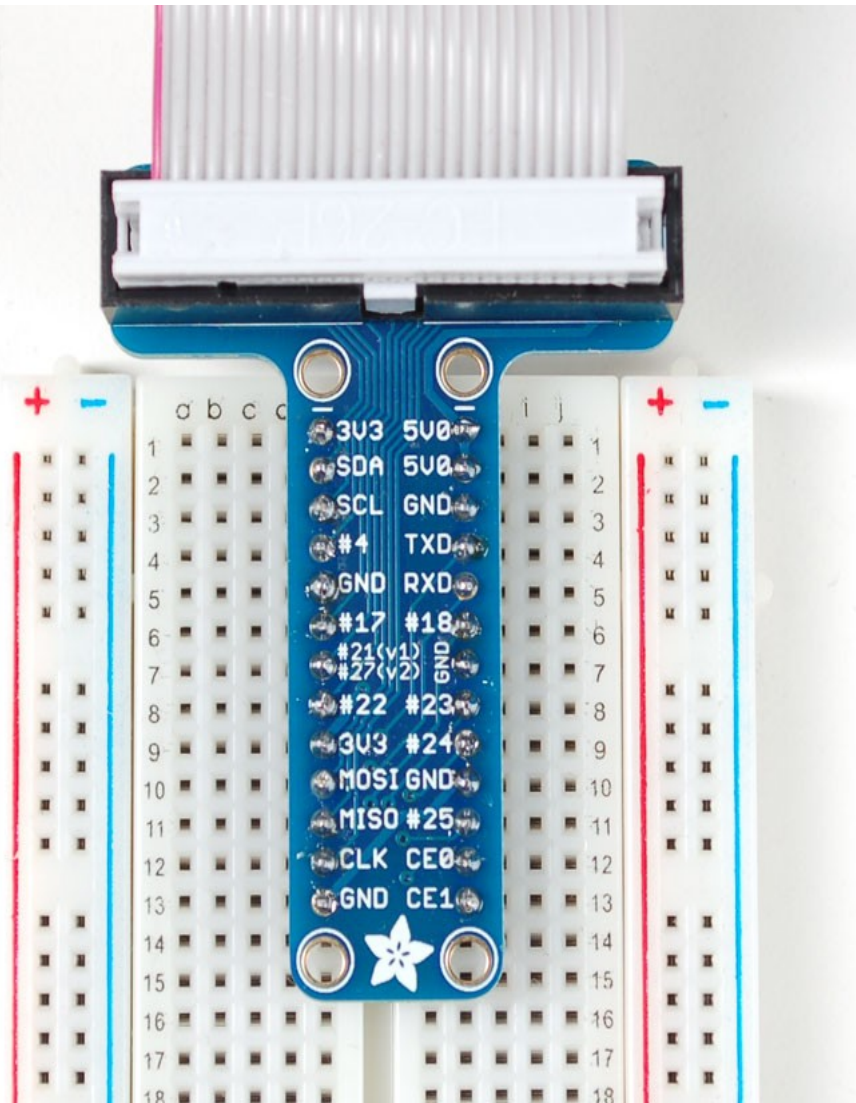
- Primary power via microUSB plug: a one amp cell charger works well, but you'll need two amps with a USB hard drive
- Model A about a quarter amp less
- PC USB port does **not** work

# More on Power



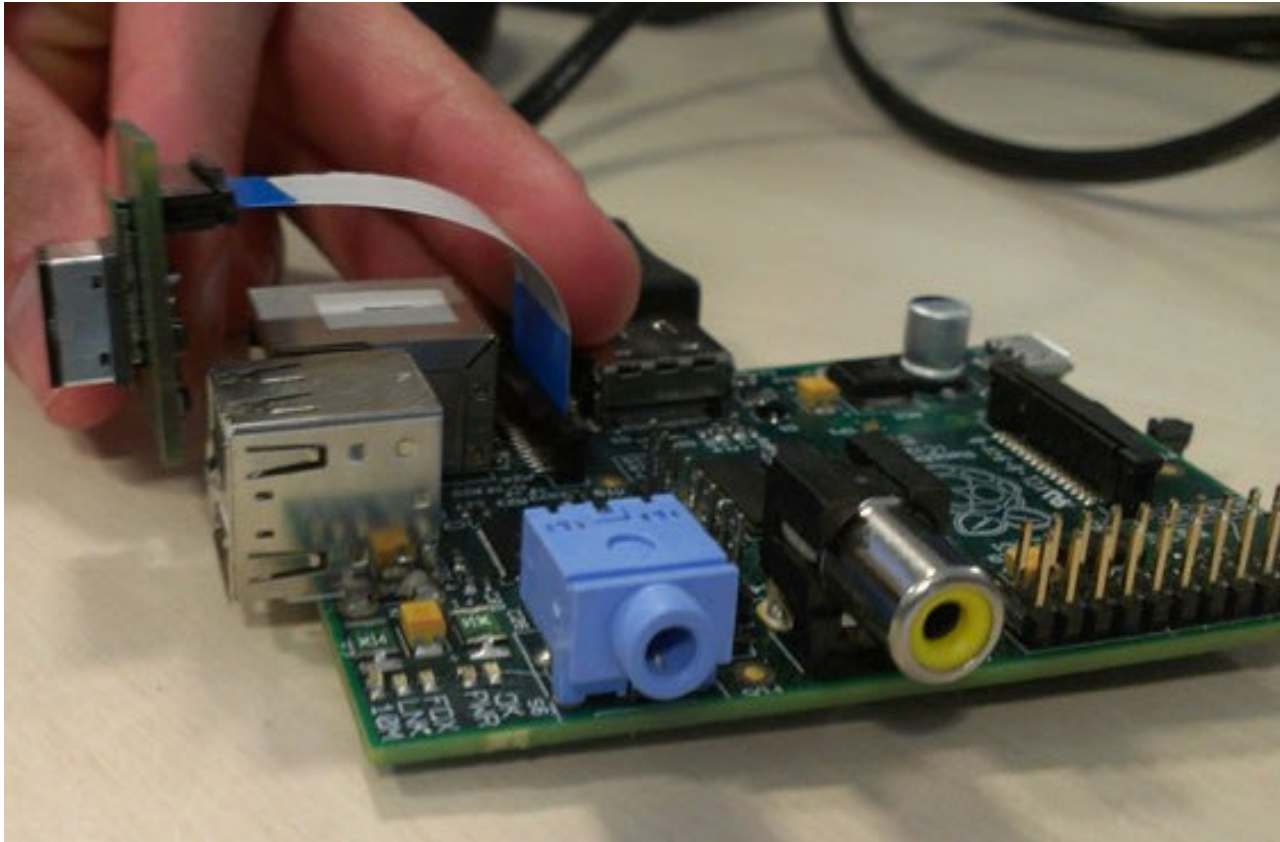
- Most existing Rpi boards have a current limiting fuse in the USB socket path
- This means high-power peripherals like hard drives **MUST** use a powered USB hub
- Fixed in rev 2 boards

# General Purpose I/O



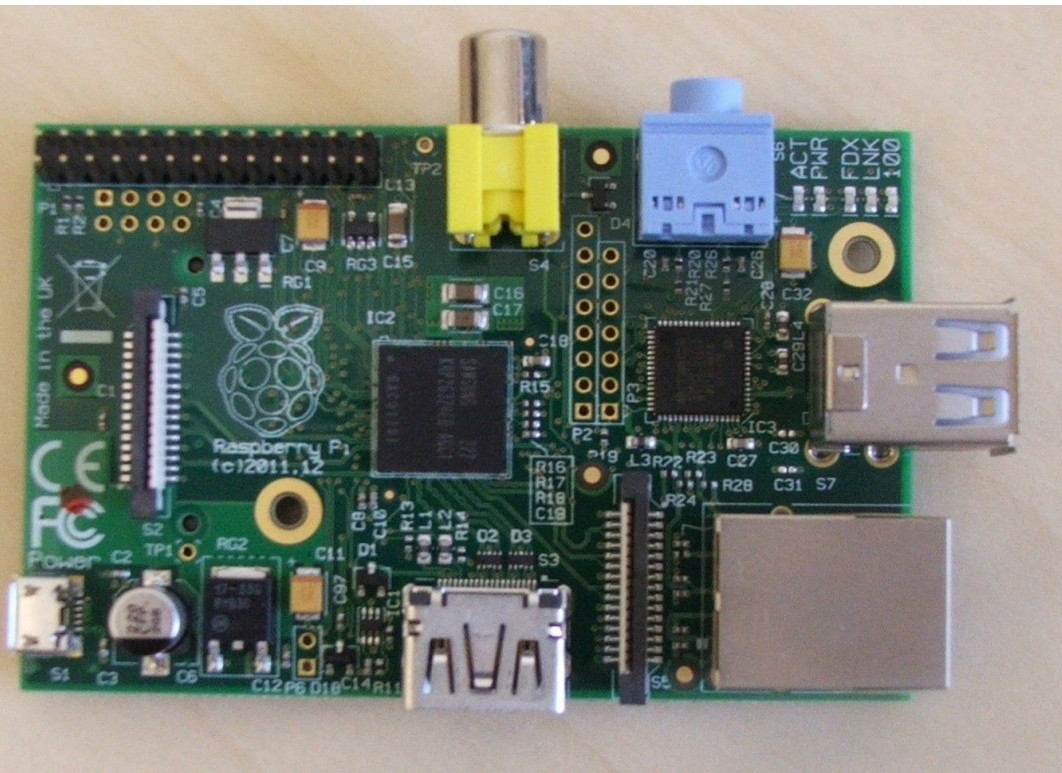
- 3.3 volt logic via 26 pin header (**NOT** 5 volt or short tolerant)
- Parallel I/O pins
- UART (Linux console support)
- I2C, SPI for peripherals

# Even more I/O



- DSI LCD panel support
- CSI camera support
- JTAG
- Additional GPIO via other headers

# More Version 2 Hardware Details



- Doubled RAM
- Removed current limiting fuse from USB socket path
- Rearranged, added GPIO, including reset
- Added two mounting holes

# Software

- Many OS ports in progress
- Debian Linux best supported with two flavors of Wheezy (rev 7):
  - Current (mid-December), hardware FP
  - Earlier, software FP rev required by Oracle Java
- Initial install by pre-installed SD card or copied disk image
- Beginner's starting point:  
<http://raspberrypi.org/downloads>

# Resources: Web sites

- <http://raspberrypi.org>
  - Foundation web site
  - Most folks should start here, but plan on going to:
- [http://elinux.org/RPi\\_Hub](http://elinux.org/RPi_Hub)
  - Primary reference repository. Your first 99 questions are answered here.
  - Where to buy list is [http://elinux.org/Buying\\_RPi](http://elinux.org/Buying_RPi)

# Resources: Pubs and Communities

- Magpi magazine

<http://www.themagpi.com/>

- Raspberry Pi Educational Manual

- <http://tinyurl.com/RPi-edu>

- This manual is being updated: revisit periodically

- Communities and Forums

- Via [http://elinux.org/RPi\\_Hub#Community](http://elinux.org/RPi_Hub#Community)

- Via <http://raspberrypi.org>



# Resources: Books

- **Raspberry Pi: A Quick Start Guide** by Schmidt
- **Raspberry Pi User Guide**, Upton and Halfacre
- Search Amazon, Barnes and Noble: bags of bunches of RPi books

## 2b Connect display

If *not* using HDMI,  
plug in your analogue  
TV or display

## 3 Connect input

Plug in a USB keyboard  
and mouse

## 4 Connect network

Connect to your wired  
network [optional]

## Insert SD card

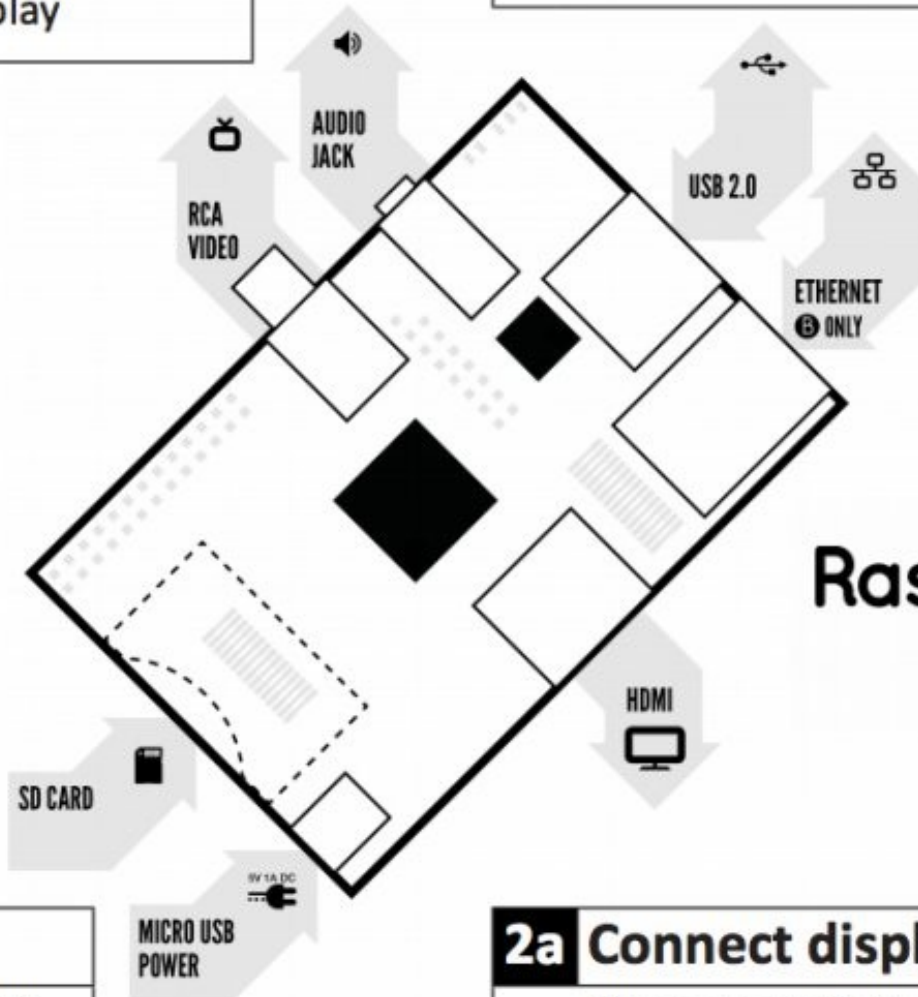
See page 3 for how to  
prepare the SD card

## 5 Power up

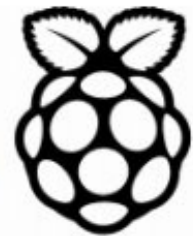
Plug in the micro USB  
power supply

## 2a Connect display

Plug in your digital TV  
or monitor



Raspberry Pi  
Quick start



Alan Dipert, Splat Space Board President

Clinton Dreisbach, Web Developer

# The Raspberry Pi Workstation

- Scratch <http://scratch.mit.edu>
- Clojure <http://clojure.org>
- Berrycam  
<https://github.com/alandipert/berrycam>
- Clinton's software stack  
<http://prompt.sh/articles/raspberry-pi-fun/>

# Open Computer Vision (CV) and Stepper Motors

Peter Reintjes, Museum of Life and Science

- Can Raspberry Pi perform significant image processing and do something useful with some motors?

# The other chip you need



ULN2001A-ULN2002A  
ULN2003A-ULN2004A

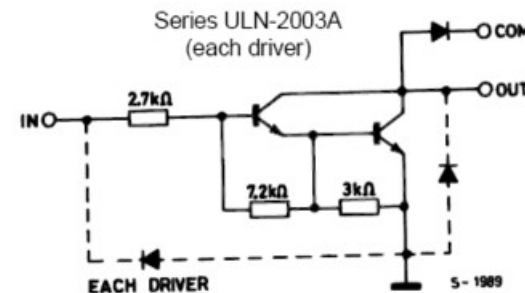
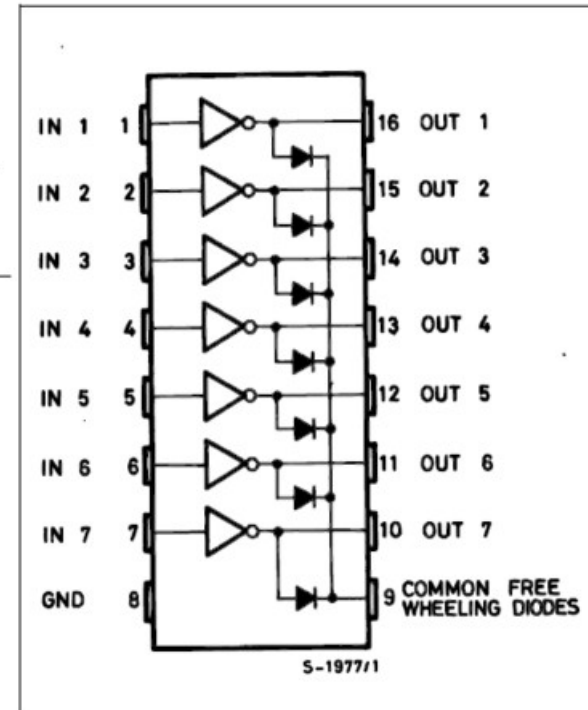
## SEVEN DARLINGTON ARRAYS

- SEVEN DARLINGTONS PER PACKAGE
- OUTPUT CURRENT 500mA PER DRIVER (600mA PEAK)
- OUTPUT VOLTAGE 50V
- INTEGRATED SUPPRESSION DIODES FOR INDUCTIVE LOADS
- OUTPUTS CAN BE PARALLELED FOR HIGHER CURRENT
- TTL/CMOS/PMOS/DTL COMPATIBLE INPUTS
- INPUTS PINNED OPPOSITE OUTPUTS TO SIMPLIFY LAYOUT

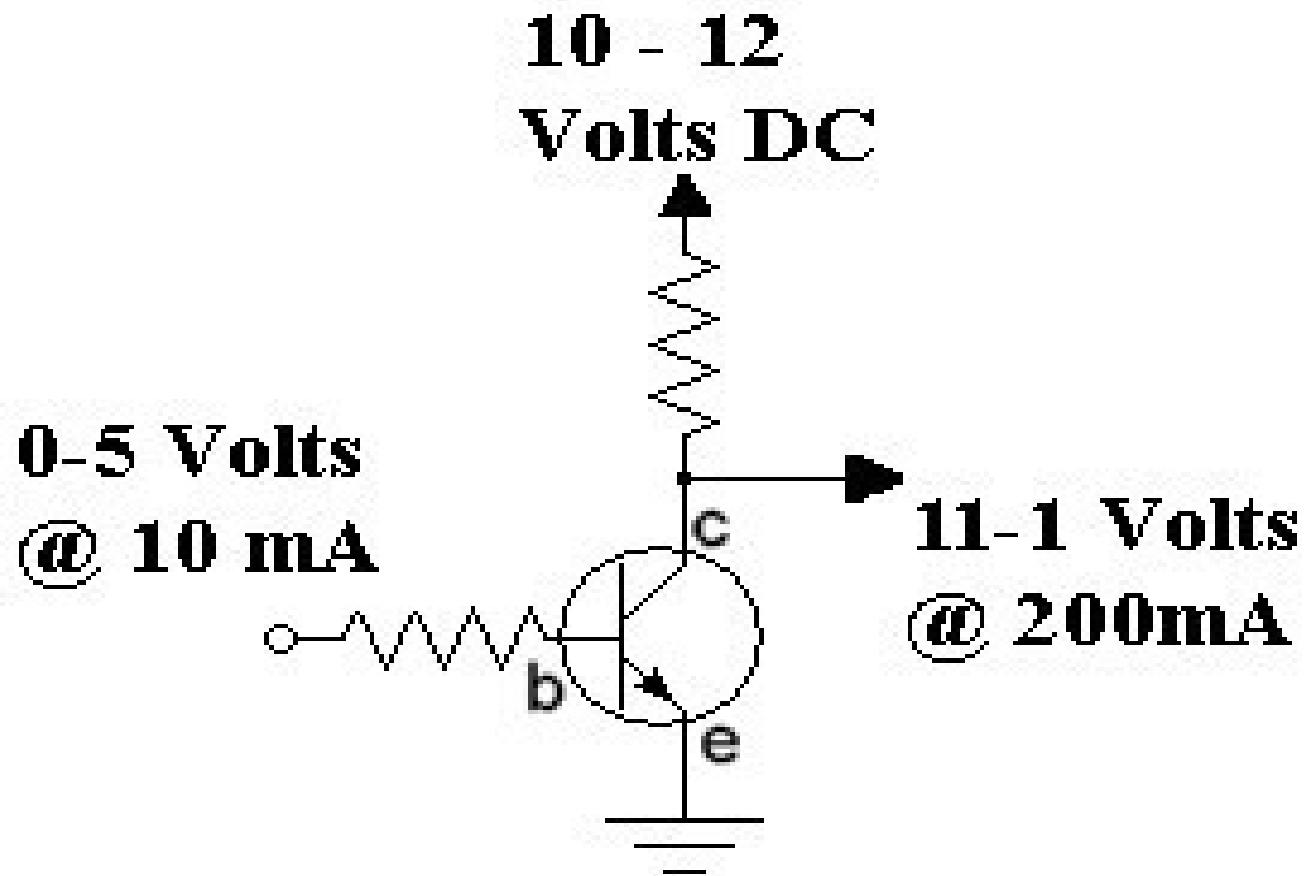
### DESCRIPTION

The ULN2001A, ULN2002A, ULN2003 and ULN2004A are high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA.

### PIN CONNECTION



# Transistor Amplifier



# Skynet Project #100010010010

- People have the right to defend themselves
- Corporations are People
- Autonomous Systems can run Corporations
- Autonomous Systems have the right ...
  - 
  - 
  -
- If it has a face, shoot it.



# Additional Software

- OpenCV - Camera capture/processing
  - Includes Face Detection example program
- RPi .GPIO Python interface to GPIO pins

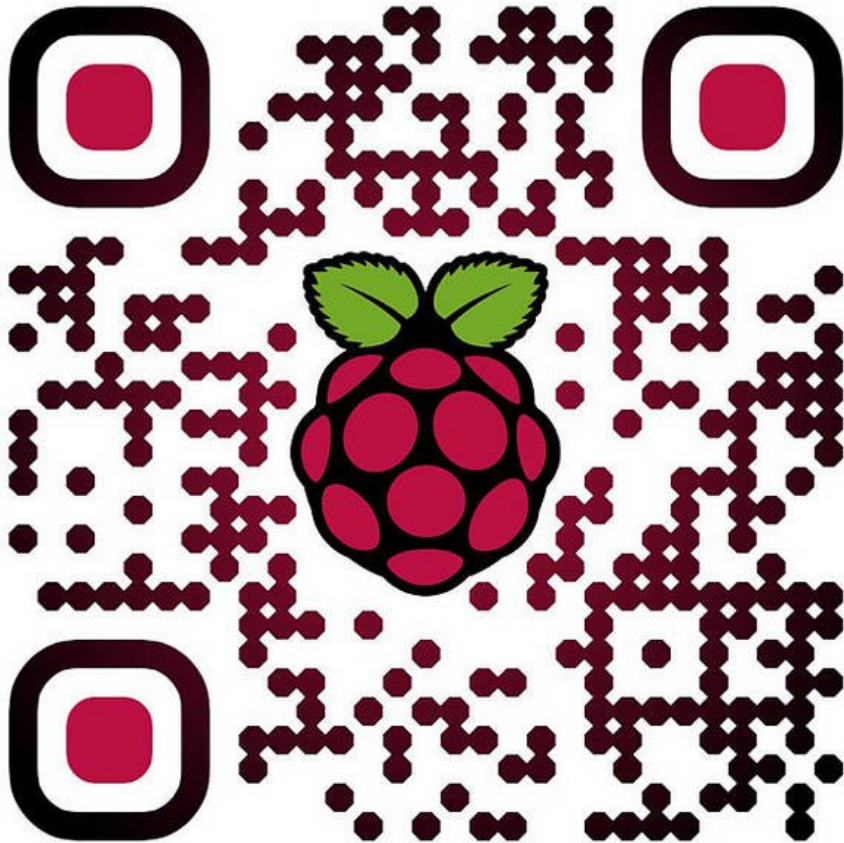
# Problems

- Many scrambled file systems later...  
Bohdi Linux, Arch-Linux, eventually returning to Raspbian. Finding the commands to Sync and power down without removing power.
- Throughput problems doing image processing and finding enough cycles to update the tracking system (the stepper motors).

# Read Only Filesystem

- Some people suggest R/O filesystem to avoid problems with abrupt power-removal.
- But you can't make FS R/O before starting X
- So...
  - Start X and your application
  - F5 to get a terminal window
  - Alt-Cntl-SysRq-U to remount filesystem R/O
  - F7 to return to your X-session

# Q & A



- Slides @ <http://trilug.org>
- Saturday the 12<sup>th</sup> workshop:
  - 9AM – 5PM
  - 331 W. Main St  
Durham
  - (919) 704-4250