* How to get runcam nano3 to work?
* Next step after getting the multi-camera adapter board to work?
* RunCam will be for world view?
  + How many RunCam to be sourced (X2)?
  + Do we need a different microcontroller for the RunCam?
  + Will definitely need to make a mux board if we are using the RunCam
  + Can we get a mux chip from digikey?

<http://heywhatsthebigidea.net/projects/pi-vision-a-raspberry-pi-camera-controller/> https://github.com/local-vision/Pi-Vision

https://docs.google.com/document/d/1JIuX4zjlbivA0LBol1eEsJm2q1KSH\_DFZV2eXTA5htk/edit?usp=sharing

Camera Options

1. NanEye by ams
   1. Miniature CMOS image sensor
   2. 1x1mm with 4 contact pads
   3. $145.43
   4. 43-62fps @ 249x250 resolution
   5. 3-micron high sensitive pixel with 62k pixel resolution
   6. https://ams.com/miniature-camera-modules
2. 20RD45S by oemcameras
   1. 1/4" industrial grade CMOS sensor
   2. 13mm round board (*Too big*)
   3. $190
   4. https://www.oemcameras.com/20rd45s.htm
3. ~~DMM 24UJ003-ML~~
   1. Monochrome USB 3.0 Board Camera
   2. $443
   3. 8mm/7 fps/3MP/
   4. <https://www.oemcameras.com/dmm-24uj003-ml.htm>
4. AR0144CS
   1. CMOS Image Sensor, Digital, Global Shutter,
   2. 1.0 MP, 1/4-Inch
   3. <https://www.onsemi.com/products/sensors/image-sensors-processors/image-sensors/ar0144cs>
5. ~~acA2000-165umNIR - Basler ace~~
   1. 165 frames per second at 2 MP
   2. 11.3 mm x 6 mm
   3. $1526
   4. <https://www.baslerweb.com/en/products/cameras/area-scan-cameras/ace/aca2000-165umnir/>
6. 1080p HD DVR Nanny Cam D.I.Y Self-Install Camera Kit
   1. $130
   2. 1080p/90 degree angle
   3. 3.7 mm lens
   4. Low-Light CMOS Sensor (0.01LUX)
   5. <https://www.zetronix.com/1080p-hd-dvr-nanny-cam-d-i-y-self-install-kit-hidden-camera.html?gclid=EAIaIQobChMI0uj8gd6H6wIVQx-tBh0HVwmqEAQYAiABEgI2BvD_BwE>

***A Head-Mounted Camera System Integrates Detailed Behavioral Monitoring with Multichannel Electrophysiology in Freely Moving Mice***

***Arne F. Meyer, Jasper Poort, John O’Keefe,***

***Maneesh Sahani, Jennifer F. Linden***

* STAR Method: <https://open-ephys.org/showcase-overview>
  + CMOS sensor:
    - Adafruit: [Spy Camera for Raspberry Pi #1937](https://www.adafruit.com/product/1937)
    - 640x480p60/90
    - 8.5mm x 11.3mm / .34" x .45"
    - Lens Diameter: 7.4mm / .29"
    - Total Length: 300mm / 11.8"
    - Weight: 1.9g
  + External tracking cameras
    - 1/3 inch Aptina CMOS sensor (MT9V024)[The Imaging Source]
    - 752×480 (0.4 MP), up to 100 fps
    - H: 29 mm, W: 29 mm, L: 43 mm
    - <https://www.theimagingsource.com/products/industrial-cameras/usb-3.0-monochrome/dmk23uv024>/
  + Miniature infrared LED
    - 78-VSMB2943GX01 [Vishay]
    - Infrared Emitters - High Power 940nm, SMD 20mW/sr, +/-25deg.
    - <https://www.mouser.com/ProductDetail/Vishay-Semiconductors/VSMB2943GX01?qs=%2Fha2pyFadujDPJqlzM%252B6mkOqMogz6UX4%2FyfmXGdHCpAZXAOAWH6S4w%3D%3D>

***Dynamics of gaze control during prey capture in freely moving mice***

***Angie M. Michaiel, Elliott T.T. Abe, and Cristopher M. Niell\****

* Camera assembly and head-mounting
  + Arena camera
    - Basler Ace, acA2000-165 umNIR, 30HZ
  + Eye cameras
    - 1000 TVL Mini CCTV Camera; iSecurity101 (not found)
    - 5x6x6 mm/480x640p/78 degree/30HZ
  + IMU
    - 3-dimentional accelerator and gyroscope(Rosco Tech)

***Retinal optic flow during natural locomotion***

***Jonathan Samir Matthis1,\*, Karl S Muller2, Kathryn Bonnen3, Mary M Hayhoe2,***



***A head-mounted multi-camera system for electrophysiology and behavior in freely-moving mice***

* RHD2000 USB interface board
  + http://intantech.com/RHD\_USB\_interface\_board.html
  + With OpenEphys software
* Intan 32-channel electrophysiology headstage
  + http://intantech.com/RHD\_headstages.html?tabSelect=RHD32ch&yPos=111

Prototype:

* Max10 (fpga)
  + Lowest cost/power
  + 50,000 logic elements
  + Instant-on configuration
    - Traditional fpga has 6 components (requires hundred ms to enter user mode)
    - Max10 only has 2 components(few ms for user-M)