

ROSCon 2014 - Chicago

State of Ubuntu and ROS on ARM

Austin Hendrix

Why ARM?

Performance per Dollar
quad-core, 1GHz+ CPUs
\$60-\$200

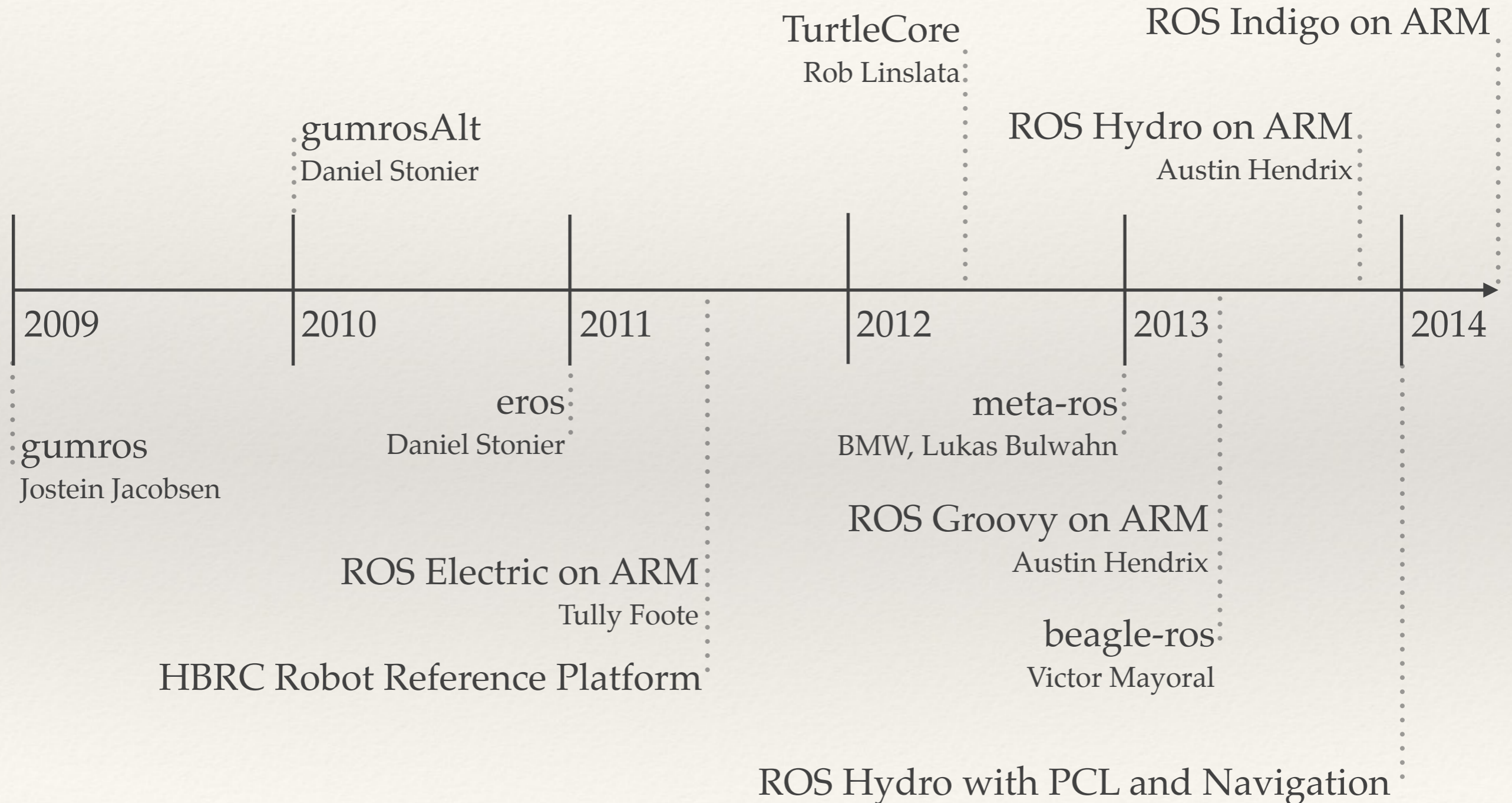
Power Consumption
usually < 10W

Size
usually less than 15x15cm

Everything Included



History of ROS on ARM



Why Ubuntu?

- ❖ Easy to install
- ❖ Lots of ARM boards already supported
- ❖ Already supported by ROS, minimal changes for ARM
- ❖ Victor, the original developer of BeagleROS (ROS on Ångstrom) has switched to Ubuntu.



Comparison with OpenEmbedded

Ubuntu

- ❖ Binary ROS packages
- ❖ Is compiled for a generic ARM architecture
- ❖ Installation with usual Ubuntu tools (dpkg, apt, etc.)

OpenEmbedded (meta-ros)

- ❖ A cross-compilation tool chain for ROS packages based on catkin
- ❖ Compiles all packages from source
- ❖ Supports many architectures: ARM, MIPS, PowerPC, and more!

Comparison with OpenEmbedded (2)

Ubuntu

- ❖ easy and quick installation
- ❖ no need to compile the basic ROS packages from source
- ❖ common Ubuntu feel
- ❖ additional compilation is on-board

OpenEmbedded (meta-ros)

- ❖ easy to adjust to new machines and architectures
- ❖ allows changes to the basic ROS packages
- ❖ small Linux kernels and images
- ❖ needs a big build machine for compilation
- ❖ needs some setup to get build machine and tool chain running

Package Counts

- ❖ **Groovy:** 495 packages
929 upstream
- ❖ **Hydro:** 1035 packages
1506 upstream
- ❖ **Indigo:** 772 packages
995 upstream



What Works?

- ❖ PCL
- ❖ Navigation
- ❖ libfreenect driver
- ❖ OpenNI2
- ❖ OpenCV
- ❖ Camera drivers

What Doesn't Work?

- ❖ OpenNI driver
- ❖ Third-party x86 binaries
- ❖ Lisp
 - ❖ Only works on Indigo and 14.04
- ❖ No Indigo on 13.10 (Saucy)

RViz and Gazebo

- ❖ RViz
 - ❖ Works **IF** your board has OpenGL support
 - ❖ Ok for simple tasks, slow for point clouds
 - ❖ No binaries yet. In progress
- ❖ Gazebo
 - ❖ Community reports that it works
 - ❖ No ARM binaries from upstream

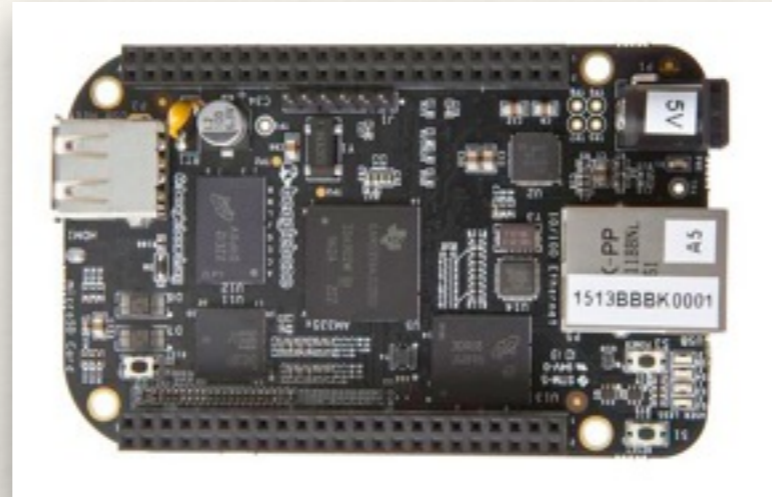
Supported Platforms

- ❖ Must run Ubuntu or Linaro
 - ❖ Linaro builds are customized builds of Ubuntu for specific CPUs and boards
- ❖ Same ROS to Ubuntu mappings as x86
 - ❖ Groovy on Ubuntu 12.04 and 12.10
 - ❖ Hydro on Ubuntu 12.04, 12.10 and 13.04
 - ❖ Indigo on Ubuntu 14.04
- ❖ Lots of user-contributed reports for individual platforms

Supported Platforms (1)



BeagleBoard xM



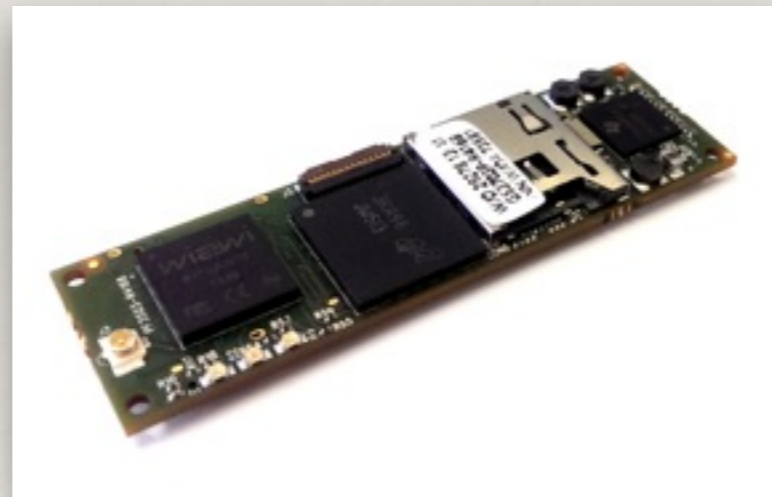
BeagleBone Black



PandaBoard



Cubieboard 2



Gumstix Overo



FXI Cotton Candy

Supported Platforms (2)



SolidRun CuBox-i Pro



Odroid U3 and family



Parallela



Radxa Rock



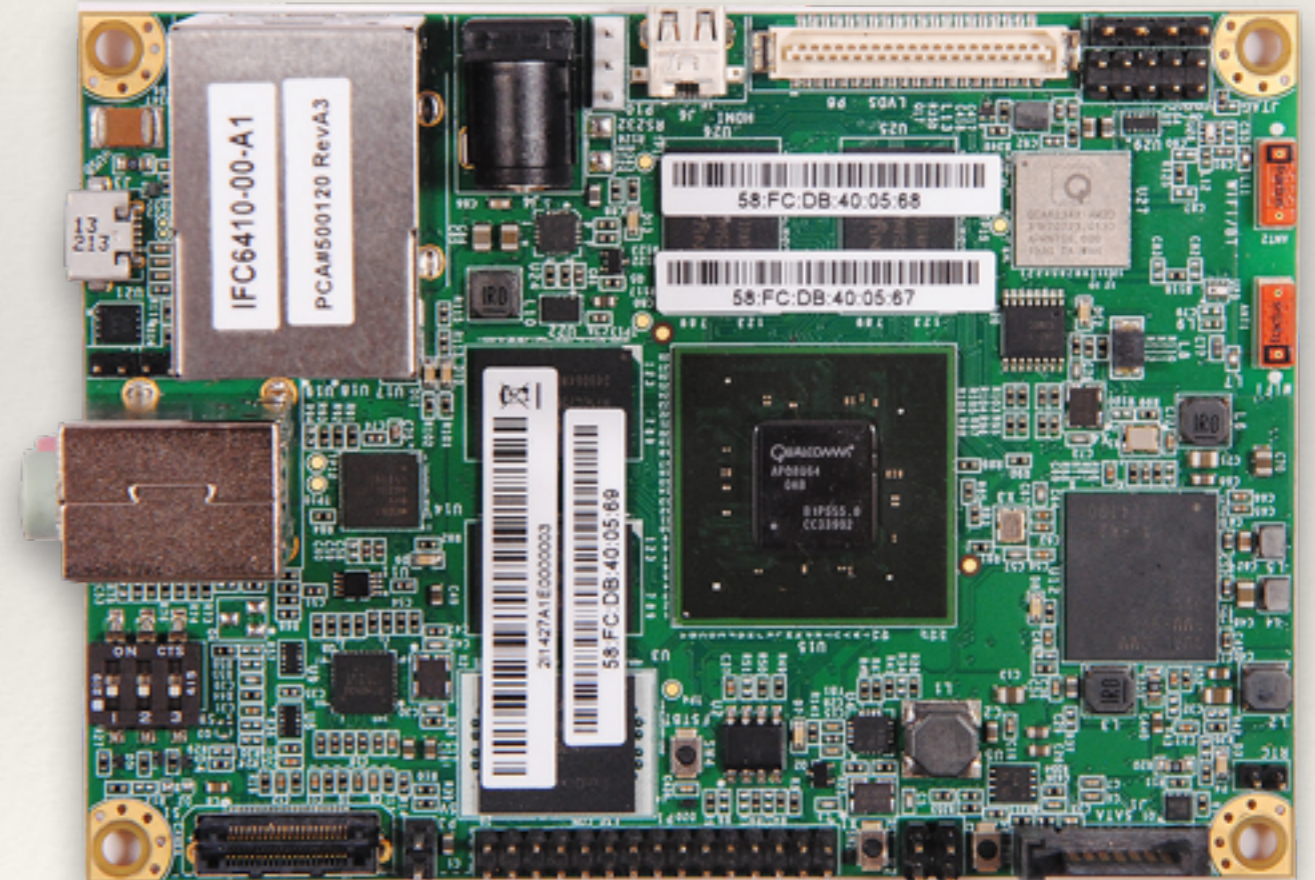
UDOO (Dual and Quad)



NVIDIA Jetson TK1

Supported Boards (5)

- ❖ Qualcomm Snapdragon
 - ❖ Inforce Computing: IFC6410
 - ❖ Intrinsyc: DragonBoard APQ8074 (not shown)



Robots using ARM

- ❖ **ROSie:** Qualcomm's TurtleBot with Snapdragon
- ❖ **Dan Barry:** Indoor Navigation
- ❖ **Erle Robotics:** rovers and quadcopters
- ❖ **Dagny (my robot):** Indoor and outdoor navigation
- ❖ **Korean Odroid TurtleBot project**
- ❖ **Ubiquity Robotics:** Indoor navigation
- ❖ **Alex Teichman:** 3D perception research

ROSie

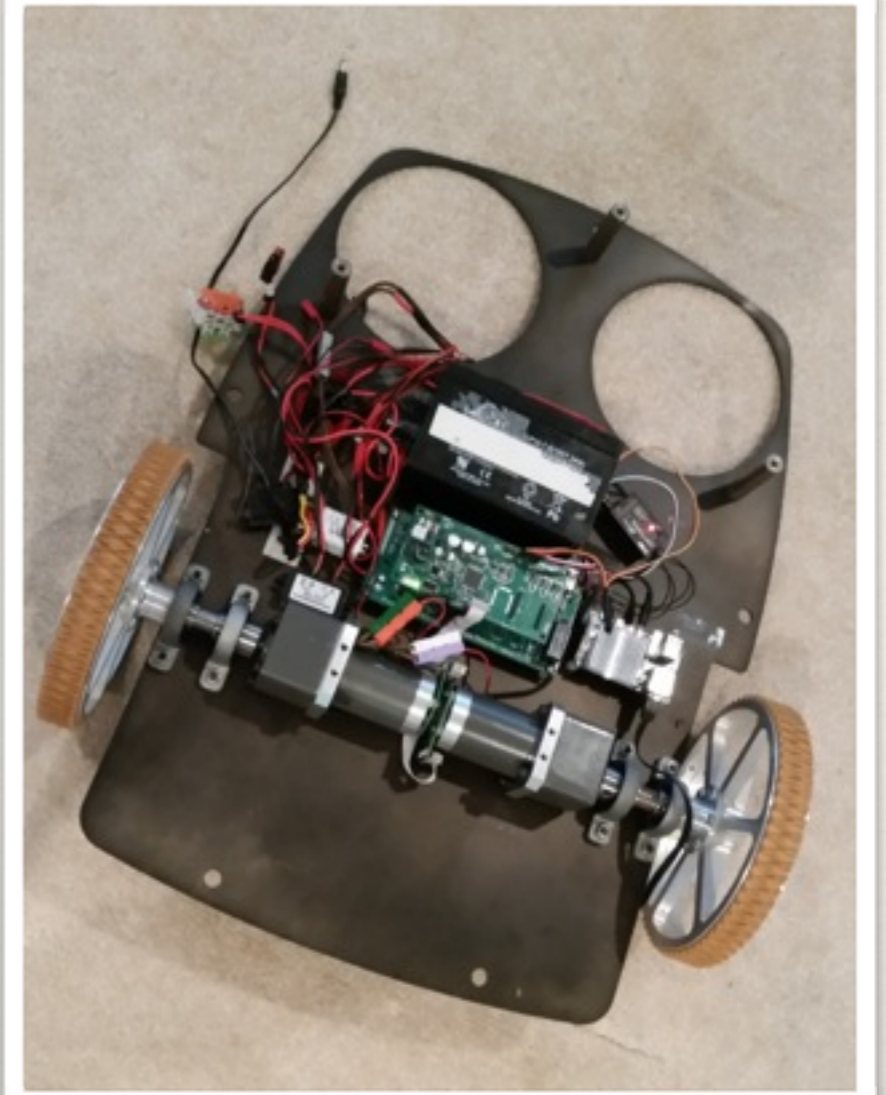
Qualcomm's Turtlebot with Snapdragon
ARM CPU





ROSie

Qualcomm's Turtlebot with
Snapdragon ARM CPU



Fellow Robotics

Dan Barry

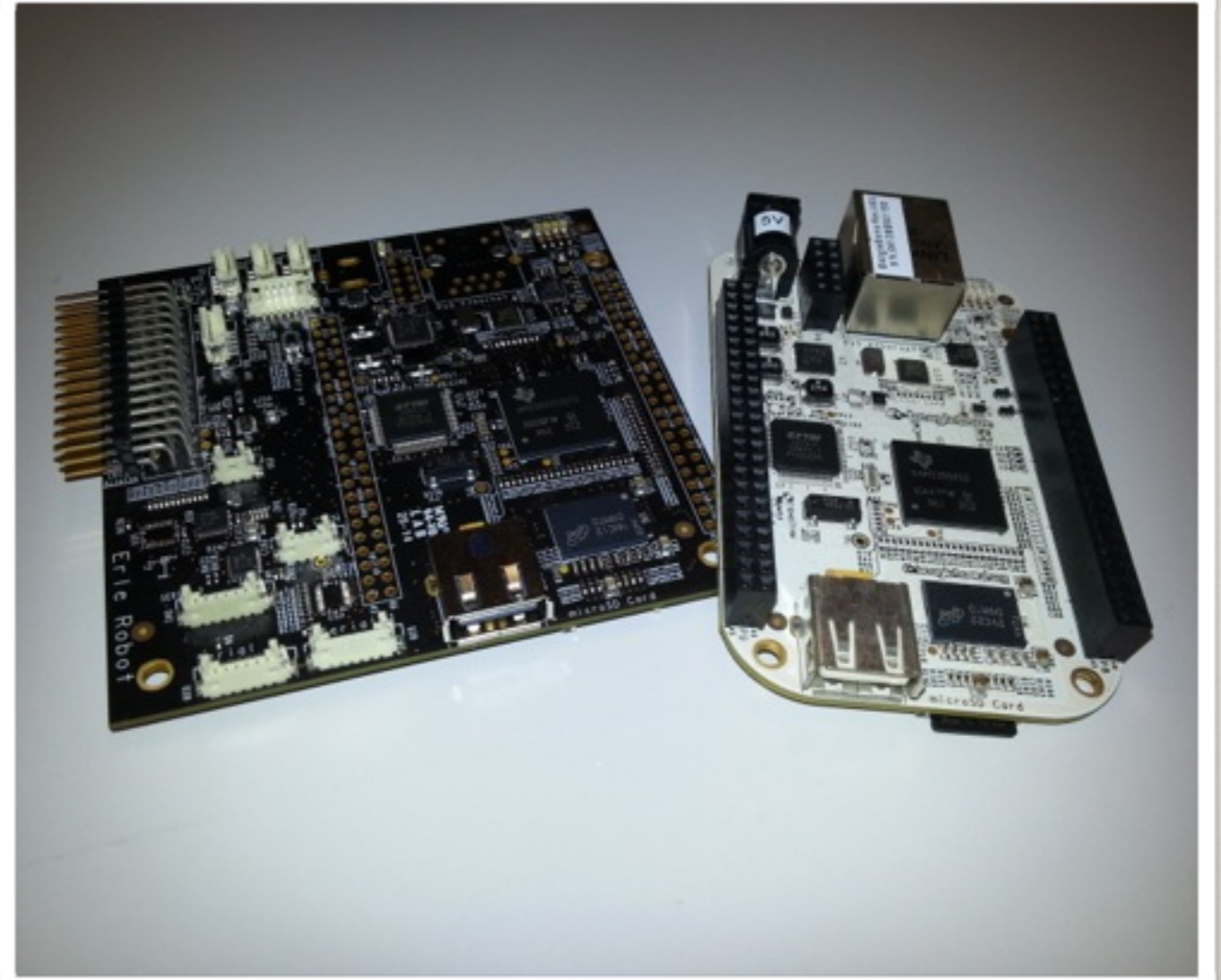
Custom platform with Odroid U3, doing indoor navigation.



Fellow Robotics

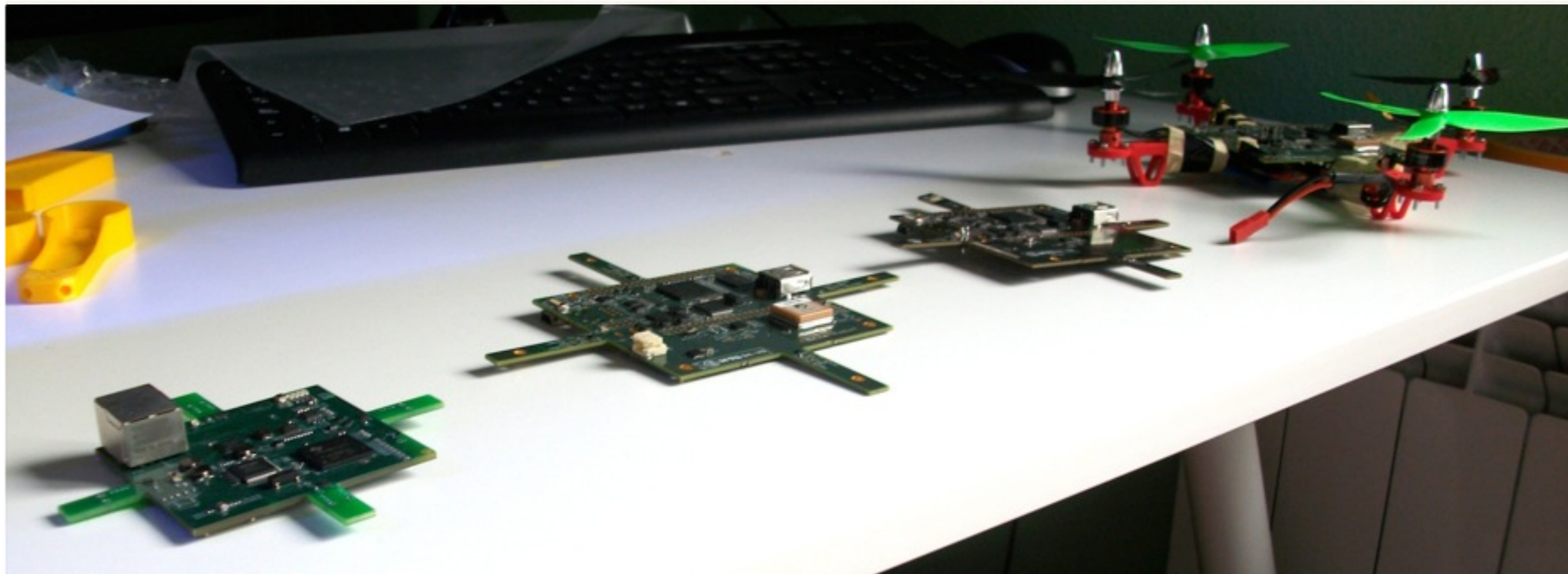
Dan Barry

Custom platform with Odroid U3, doing indoor navigation.



Erle Robotics

ErleRover
ErleBoard



Erle Robotics

ErleCopters



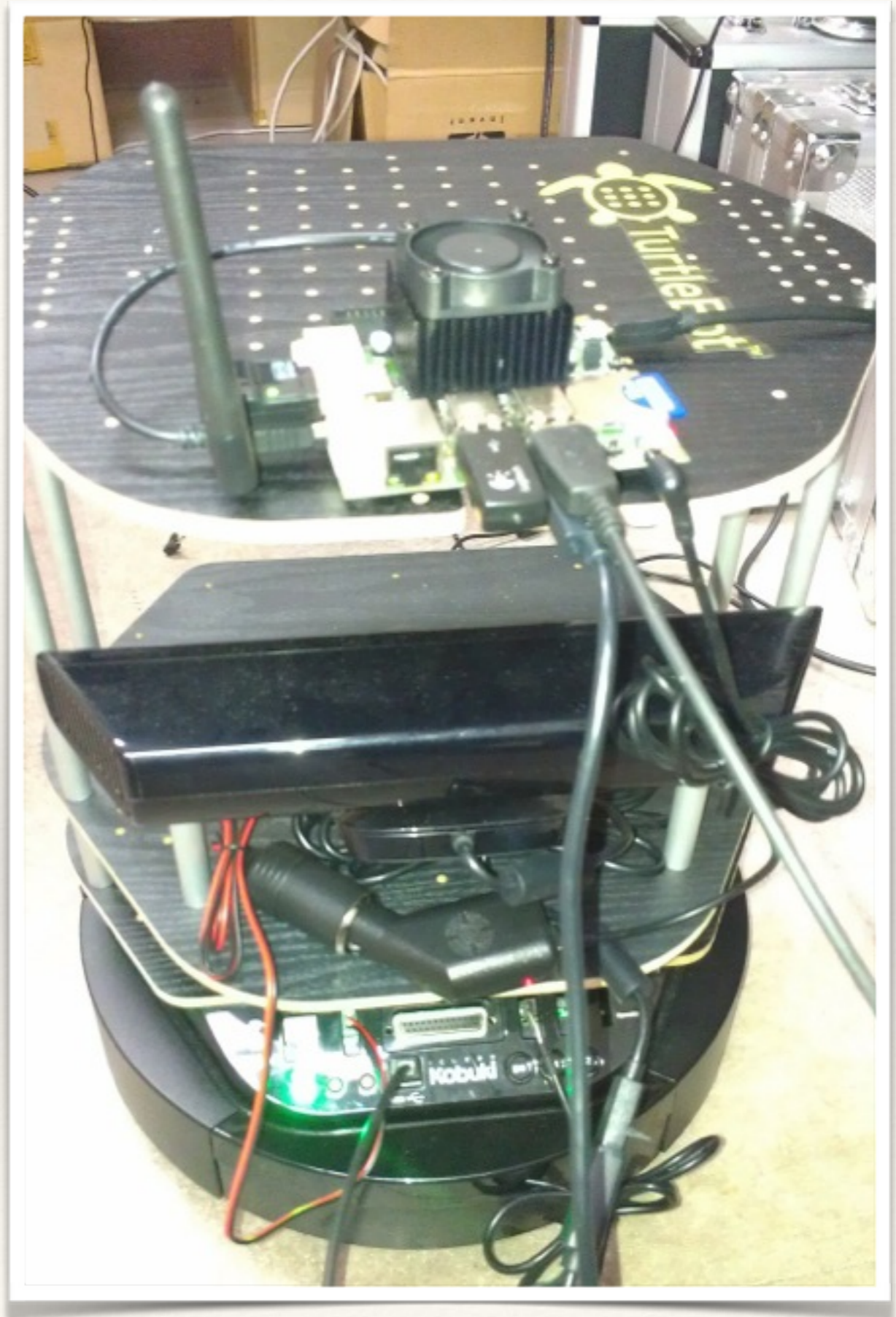
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Dagny: Indoor and outdoor navigation

Korean Odroid Turtlebot Project

Turtlebot with Odroid X2

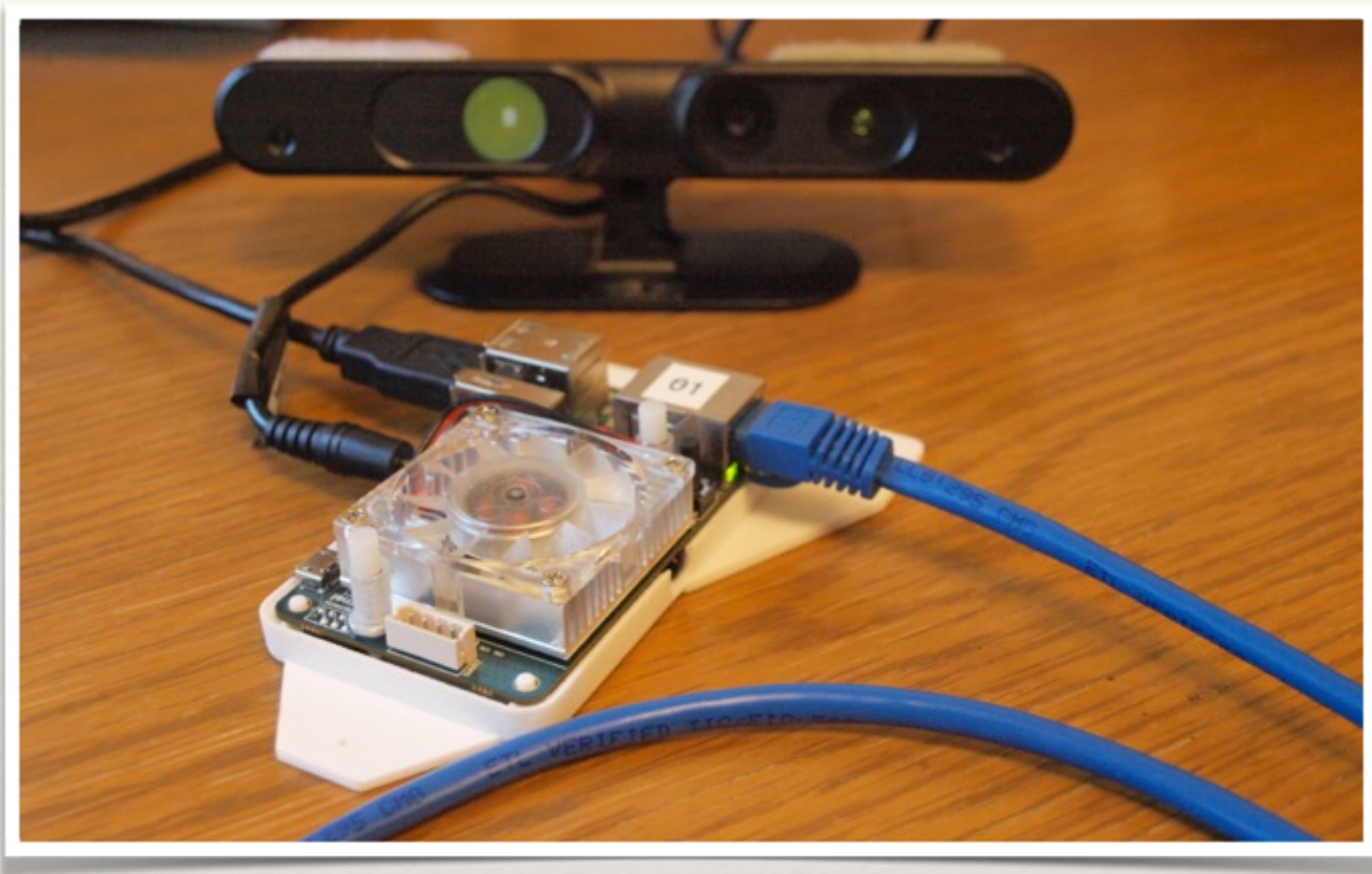
[http://www.ros.or.kr/index.php/
Install_ros_on_embedded](http://www.ros.or.kr/index.php/Install_ros_on_embedded)





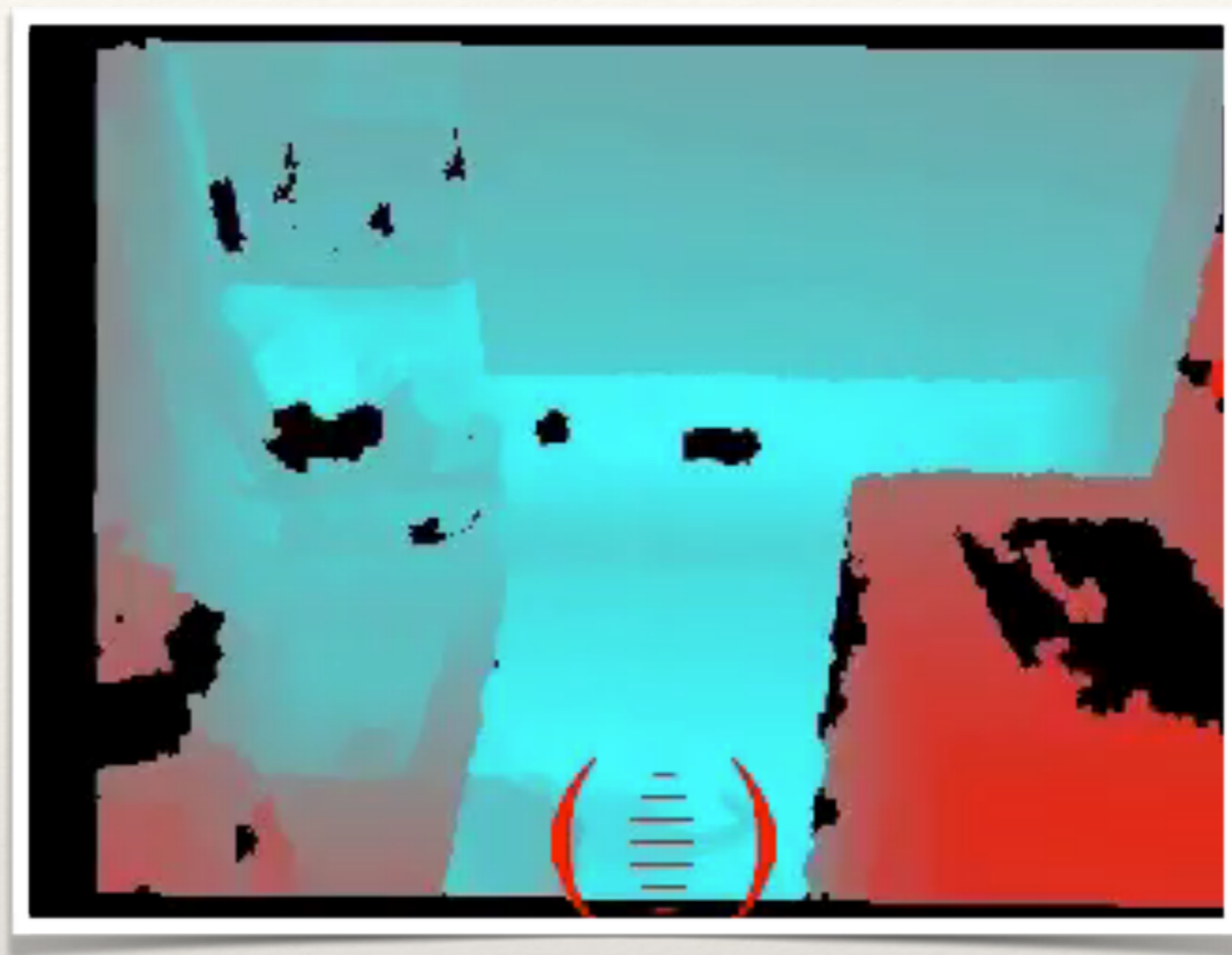
Ubiquity Robotics

Hercules: Indoor navigation



Alex Teichman

Asus Xtion Pro on Odroid U3
Perception research



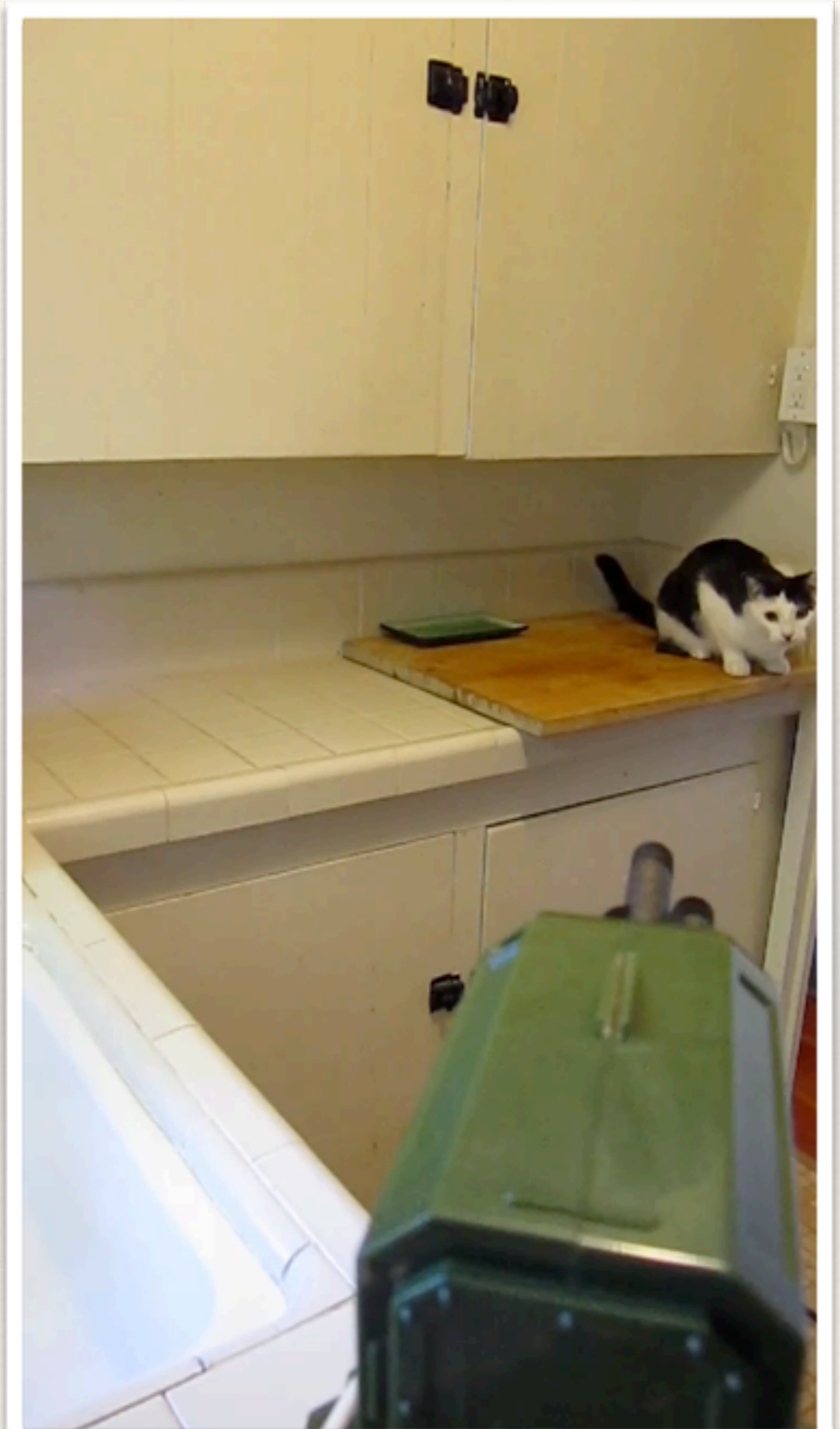
Alex Teichman

For part of his PhD thesis, Alex used this to detect cats walking on countertops.

Alex Teichman

The final goal was to deter cats from being on the counters.

It turns out shooting them is less effective than expected.



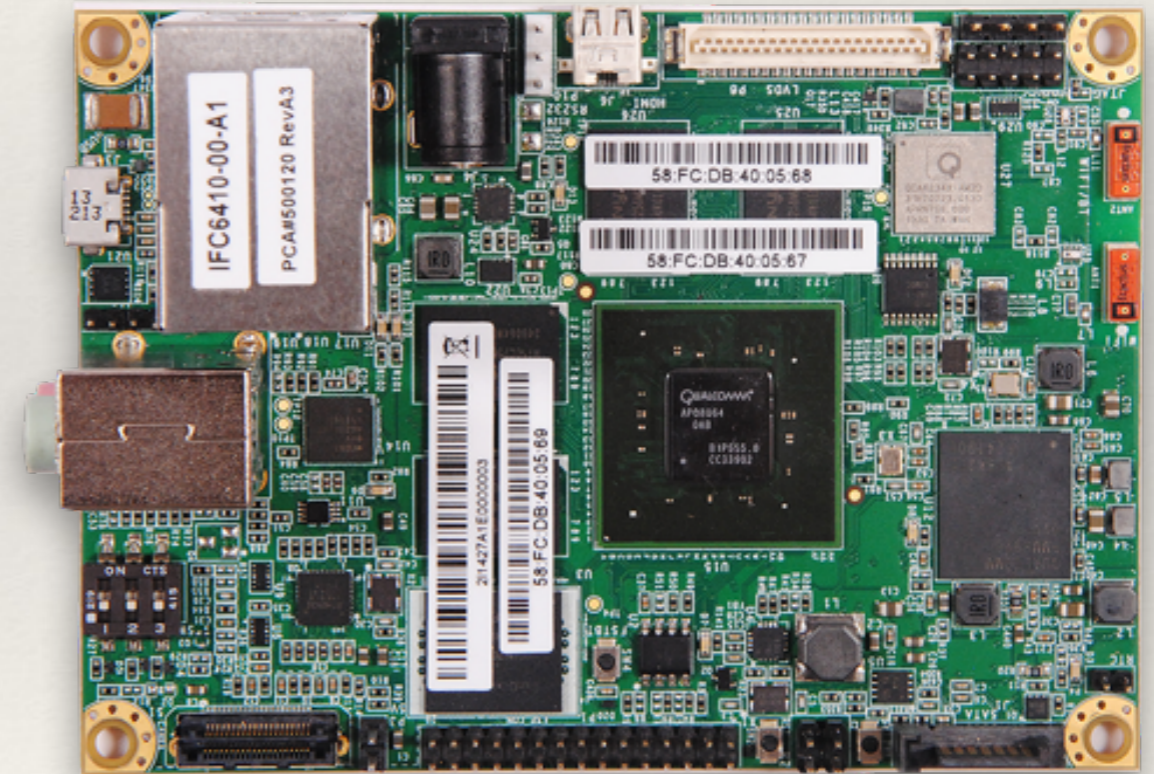
Questions?



Surprise!



- ❖ Qualcomm is sponsoring ROS development for ARM!
- ❖ Official support for ROS on the Qualcomm Snapdragon
 - ❖ ROS Indigo on Ubuntu in 3 months
 - ❖ Android in 6 months



Links

- ❖ My Blog
<http://namniart.com>
- ❖ Indigo on ARM
<http://wiki.ros.org/indigo/Installation/UbuntuARM>
- ❖ Hydro on ARM
<http://wiki.ros.org/hydro/Installation/UbuntuARM>
- ❖ Groovy on ARM
<http://wiki.ros.org/groovy/Installation/UbuntuARM>
- ❖ OpenEmbedded
<http://wiki.ros.org/hydro/Installation/OpenEmbedded>