Pulurobotics: Open Source Robotics

Fosdem 2018 - 4th February 2018, Brussels, Belgium, Europe, Earth

Antti Alhonen – The Nerd

Miika Oja – the other guy
Pulurobotics Community Launch

- Software fully GPL v2, in GitHub
- Hardware licensing still unclear, but schematics, drawings, etc. available
- The 3D Sensor under development
- Call for participation
Ultra-low-cost autonomous platform: project spawned from a real need

- No real alternative available
  - Horrendous price from 20K up to over 60K
  - No ability to stand rough terrain
  - Complex as hell
- Remote controlled “toys” (see right) were prototyped, no good
- Need autonomy
2017: design principles defined

- Simplicity & robustness
- Easy manufacturing
- Cheap electronic components – no special “robot parts”
- Must be:
  - Autonomous – perform tasks
  - Able to map autonomously – no teaching, any environment
- Platform thinking: autonomous platform is the smallest component

- PLATFORM = PRODUCT
- INTEGRATION = SIMPLIFICATION
- INTEGRATION = COST REDUCTION
Found the definition of autonomous robot

- A fully autonomous robot can
  - Gain information about the environment
  - Learn about changing surroundings
  - Work for an extended period without human intervention
  - Move itself throughout its operating environment without human assistance
  - Avoid situations that are harmful to people, property, or itself (unless those are part of its design specifications)
We don’t use ROS
We don’t use ROS
We don’t use ROS

... but will support it.

Need help for that.
ROSsian HW
ROSsian HW

- $100
- $50
- $40
- $5000
- $200
- $100
- $100
- $100
- $100
- $200
- $10
- $30
- $2000
- $10
- $100
- $10
- $10
- $100
PULU vs. ROSSsian HW

$150

$100

$50

$100

$100

$100

$5000

$100

$40

$10

$200

$10

$2000

$100

$30

$100
SLAM – simultaneous localization and mapping

- Chicken-egg problem
- Analytically hard
- Not too difficult in practice, given full control over HW+SW
- More effort should go here
- Our SLAM now is a very simple prototype, yet usable
SLAM, how Pulu M does it
From yesterday: J building
Pulu Robotics established Company established in July 2017 after we decided to do open source

Decided to go to the first possible international venue

Visited Robot World 2017 in September

Found out we had done something unique
Navigating future

- Basic hardware is ready
- The Groundbreaking 3D Sensor is almost there
- Manufacturing small batches, different models
- Open Sourcing
- Application development
  - Platform is very good, suitable for most needs
  - Extremely affordable
  - Needs more hands to make YOUR applications
Software architecture

- 99% in C, approx. 35000 lines of code
- 15000 of which is firmware
- No “frameworks” or “middlewares” of any kind
- Very few dependencies:
  - libpng
  - rsync, ssh
  - opencv in near future
  - libwebsockets for web UI prototype
  - SFML for standalone client prototype
Software structure

GUI: map display, commanding...
  rn1-client
  on user machine
  Status: prototype, requires rewrite

OR

Browser version
  rn1-server
  on the Internet
  Status: prototype, requires rewrite.

TCP

SLAM
Routefinding
Obstacle avoidance
Communication
Autonomous exploration

rn1-host
on Raspberry Pi 3
Status: needs some refactoring. Maintained by us.

UART

Misc. dev tools
rn1-tools
Status: Random stuff

Microcontroller firmware:
sensor data management
feedback loops, motor control
micronavigation

rn1-brain
on STM32F205
Status: Fairly mature, maintained by us.

SPI

Microcontroller firmware:
3-phase motor control

rn1-motcon
on STM32F051
Status: Fairly mature, maintained by us.
Back to PULU vs. ROSsian HW
Back to PULU vs. ROSSsian HW

Magical Groundbreaking 3D TOF Sensor system

+$150

+$350

$100

$100

$100

$10

$10

+$100

+$200

+$300

+$100

+$350

+$5000

+$40

+$50

+$2000

+$10

+$10

+$200

+$100
3D Time of Flight explained

- Distance measurement, like 2D LIDAR, but:
- From 2D plane to 3D point cloud!
- From 500 to 500000 samples/second
- Replacing all other sensors with 3D TOF
- Unique challenges – mostly solved!
- LIVE DEMO (or a demo effect)
We Want YOU!

- Let's make open source robotics affordable again!
- Participate!
- Get a 999€ (+ VAT) Pulu S developer special by ordering now – deliveries in June
Thank You!

(Pulu is Finnish and means pidgeon)