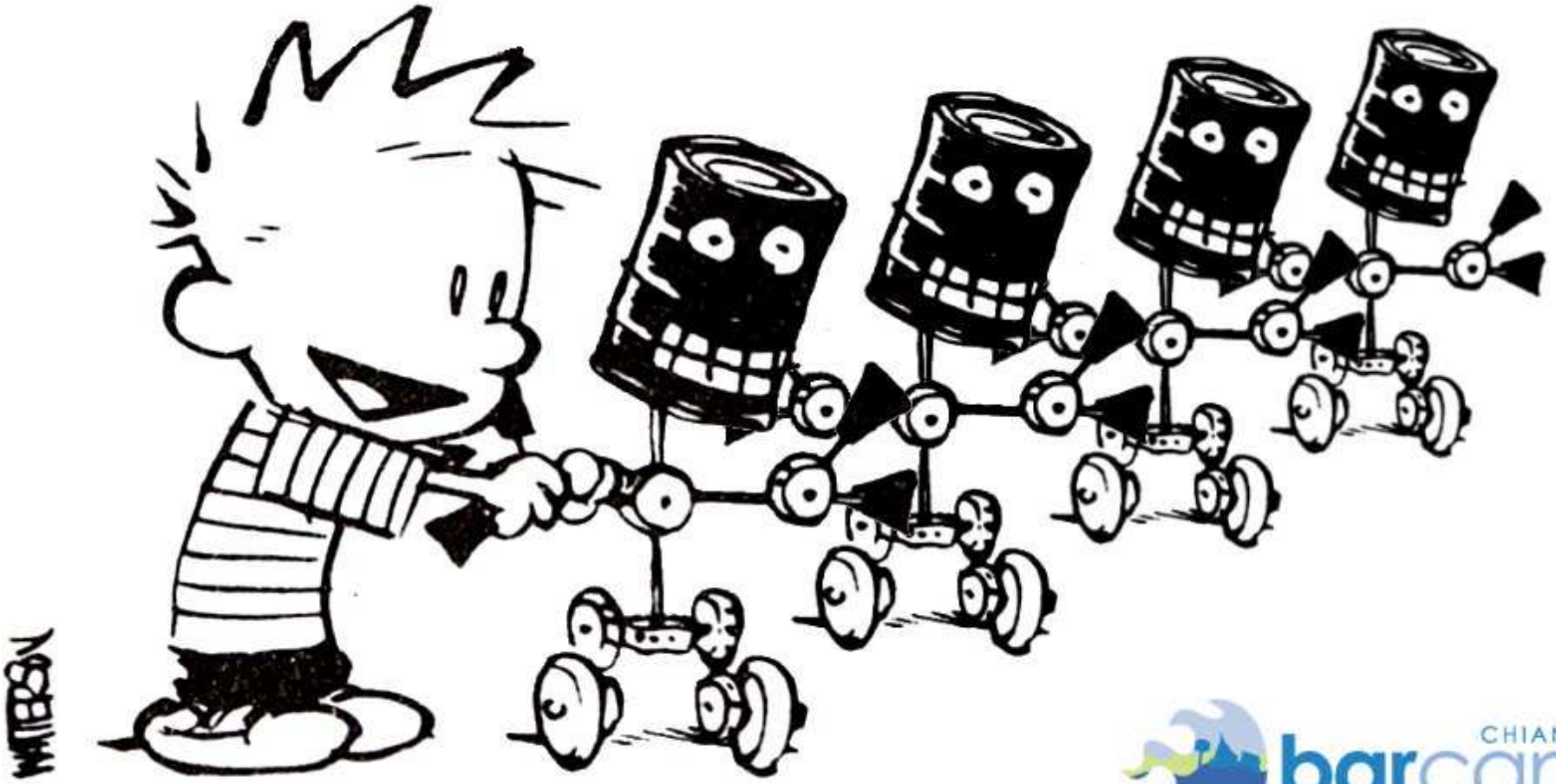
Building an Army of $10 Robots

with HTML5 & node.js



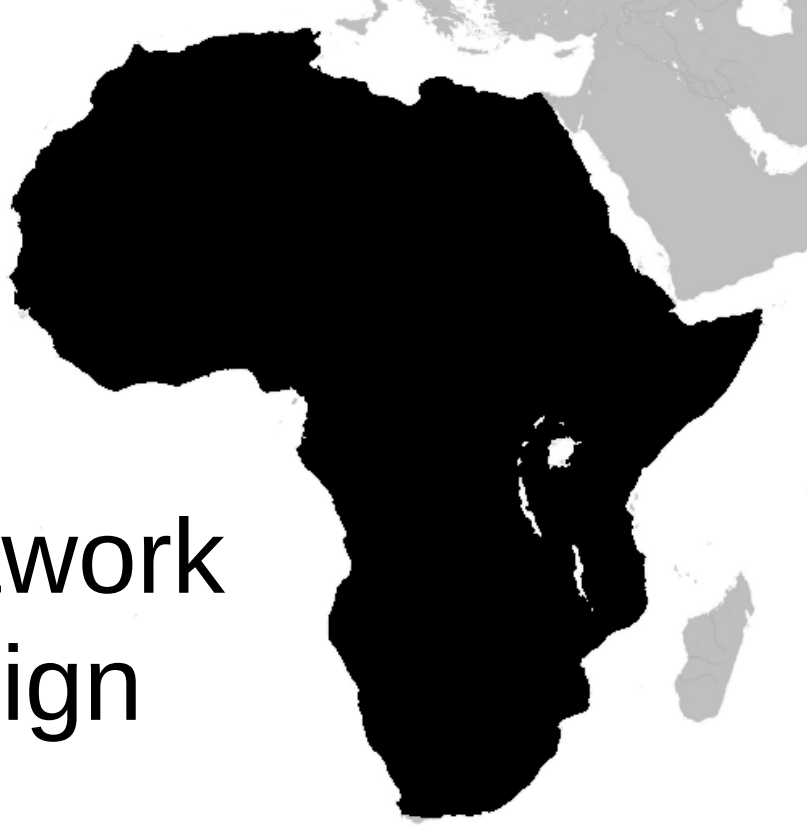
CHIANG MAI barcamp

Robotics in Africa

Robots can inspire
student interest in computers,
science, math, & engineering but…
often too expensive for African
students & universities

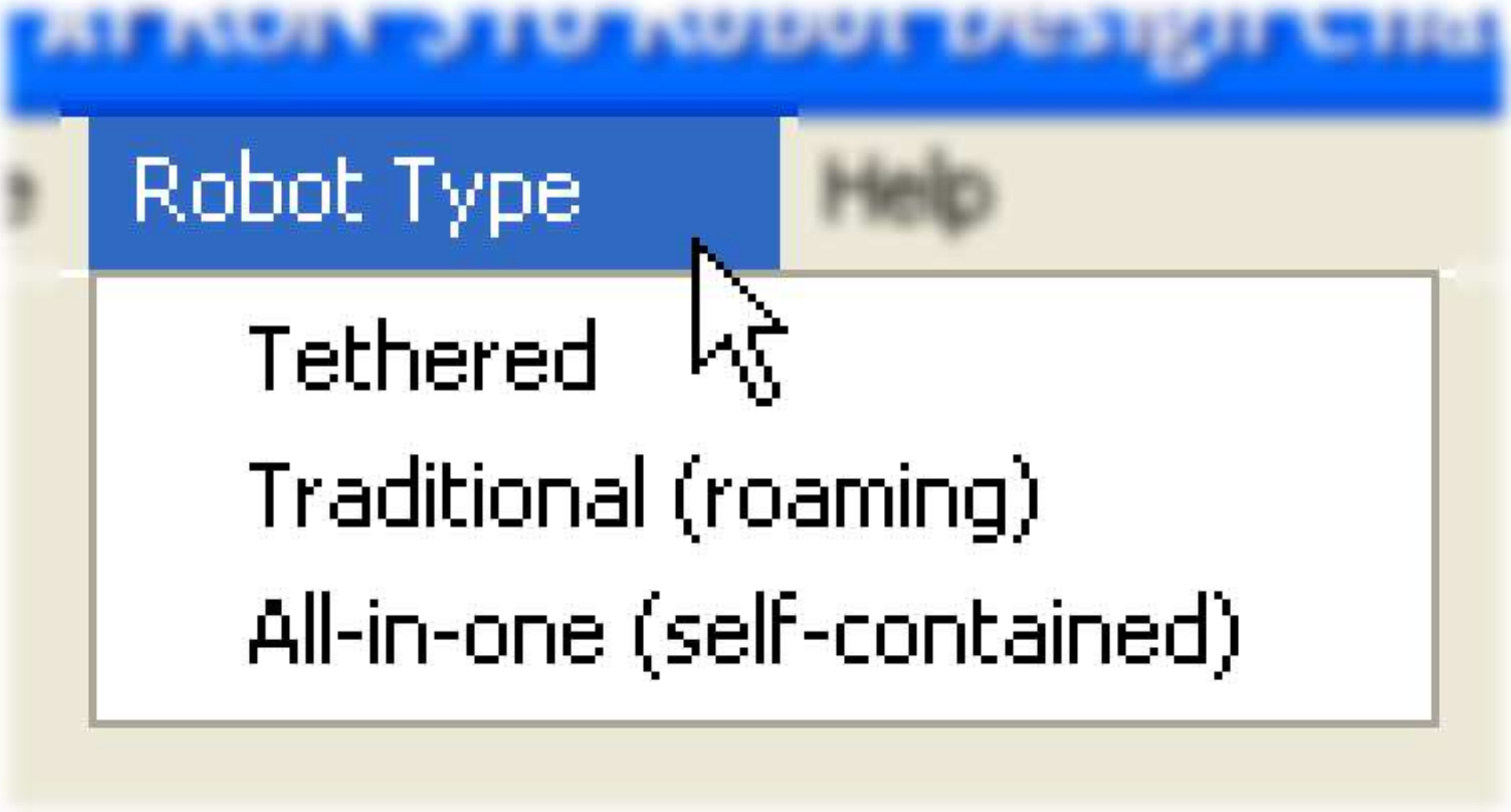
Image: Ayorkor Korsah/ Ashesi University

The Competition…



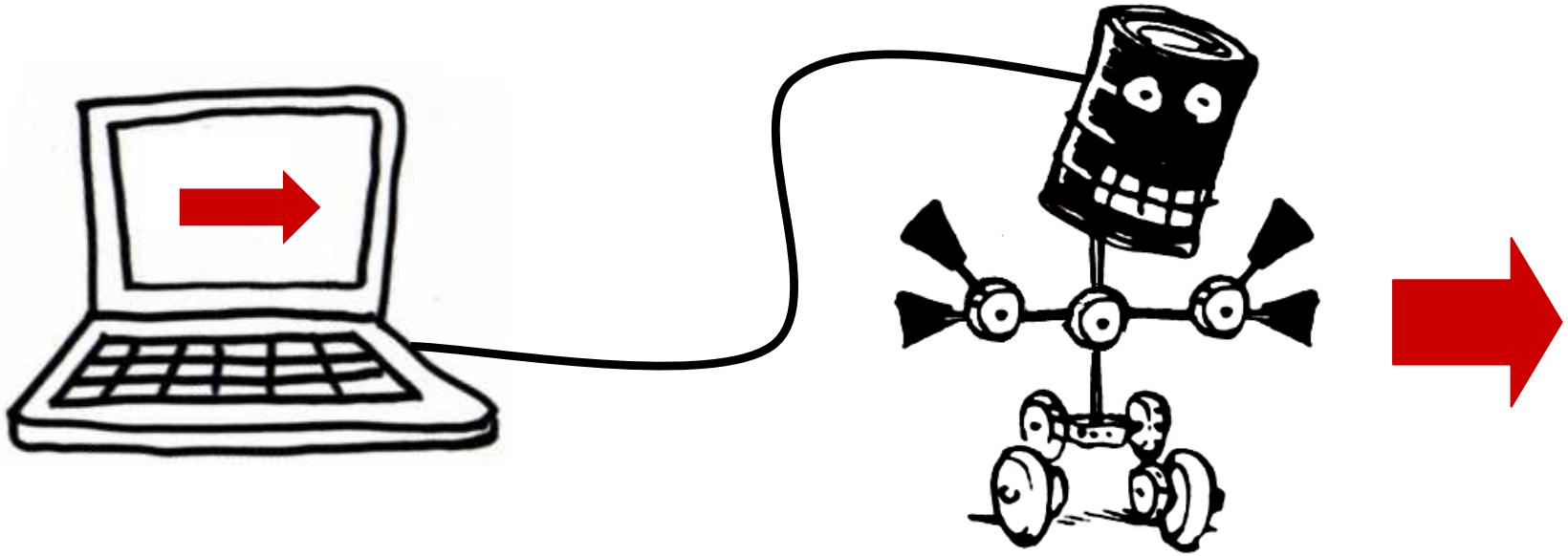
The African Robotics Network (AFRON) $10 Robot Design Challenge:

Try to build an educational robot for use in African schools for $10!


Robot Type
Help
Tethered
Traditional (roaming)
All-in-one (self-contained)

Tethered Robot

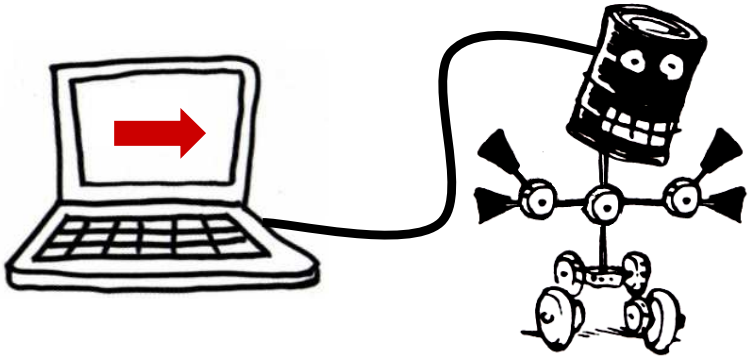
- Computing and programming off-board (e.g. laptop)

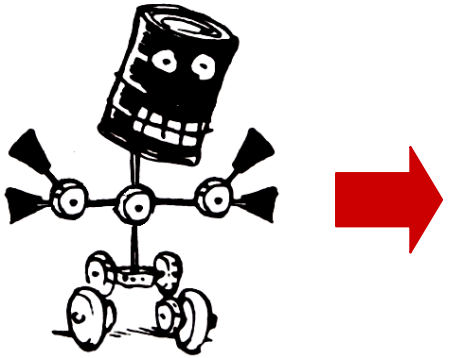


Traditional (Roaming) Robot

- Computing on-board, programming off-board (e.g microcontroller)

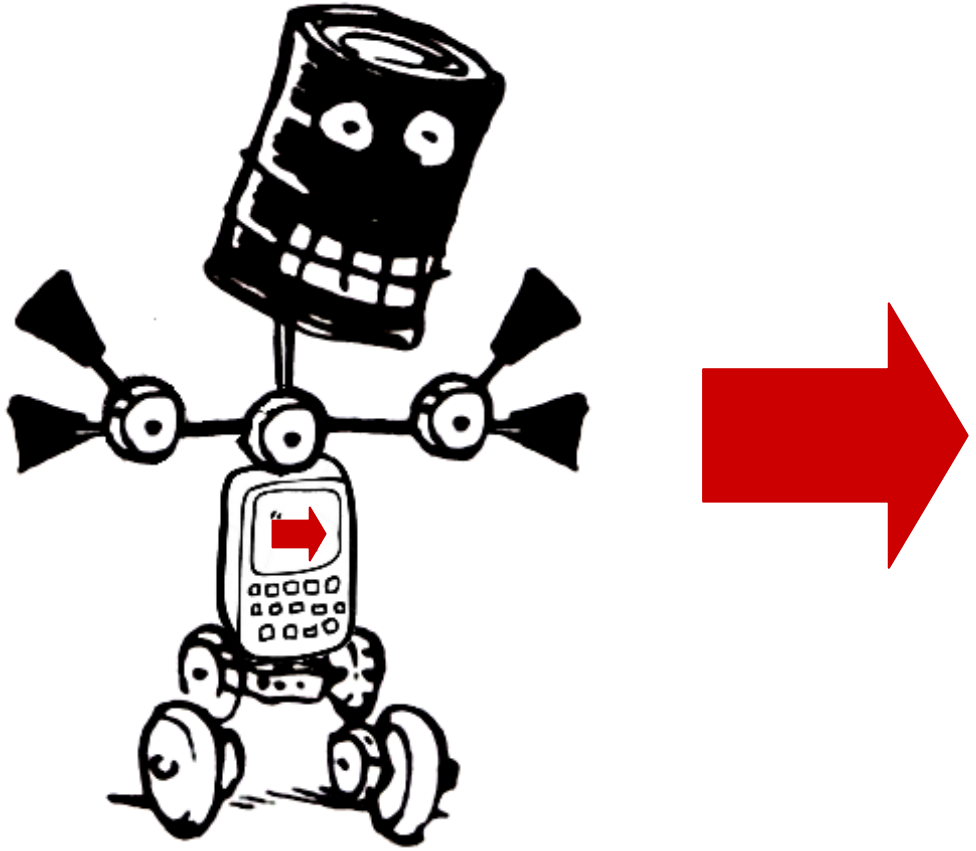
1.

2. 

3. 

All-in-one (Self-contained) Robot

- Computing and programming on board



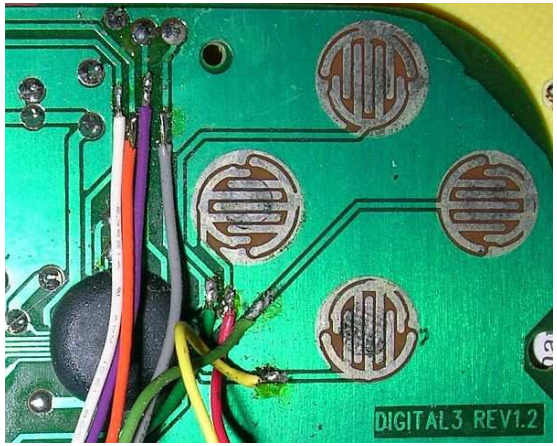
The Competition…

- June 14 to September 15, 2012

- Robot must be:
  - programmable (open source)
  - able to respond to its environment (-> at least one sensor)

Past Projects: 2005 - Present

Connect a wooden DDR mat to an Open Source simulator using a hacked joystick



ATARI

The PIZZA Company

PAYAP
Payap's
Got
Talent

My Idea…

- Make a tethered robot from a 100 Baht USB joystick.

- Use easy to find tools, parts & materials
- Simple design & construction so school students can make their own

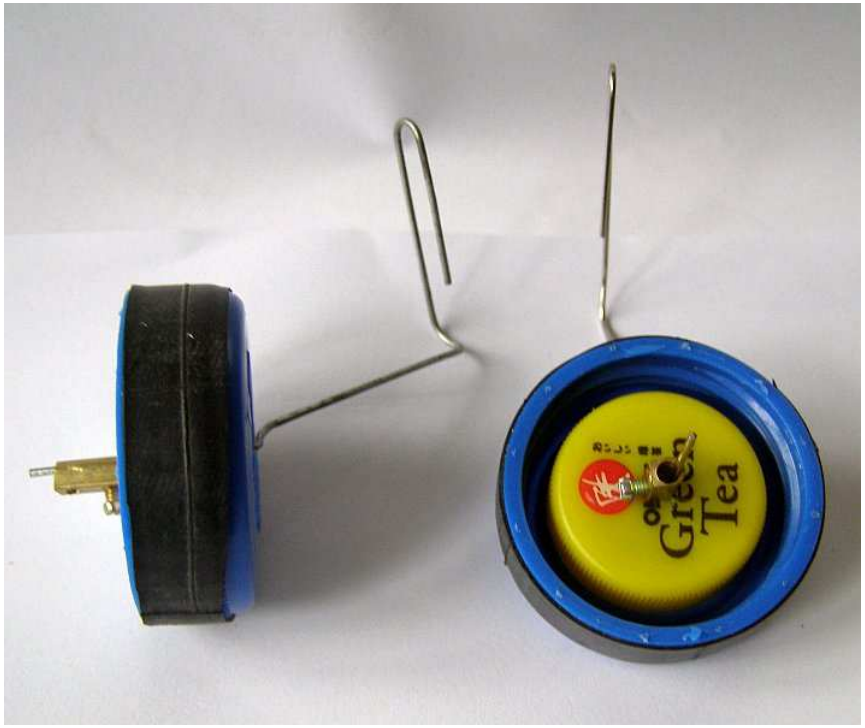
Locomotion

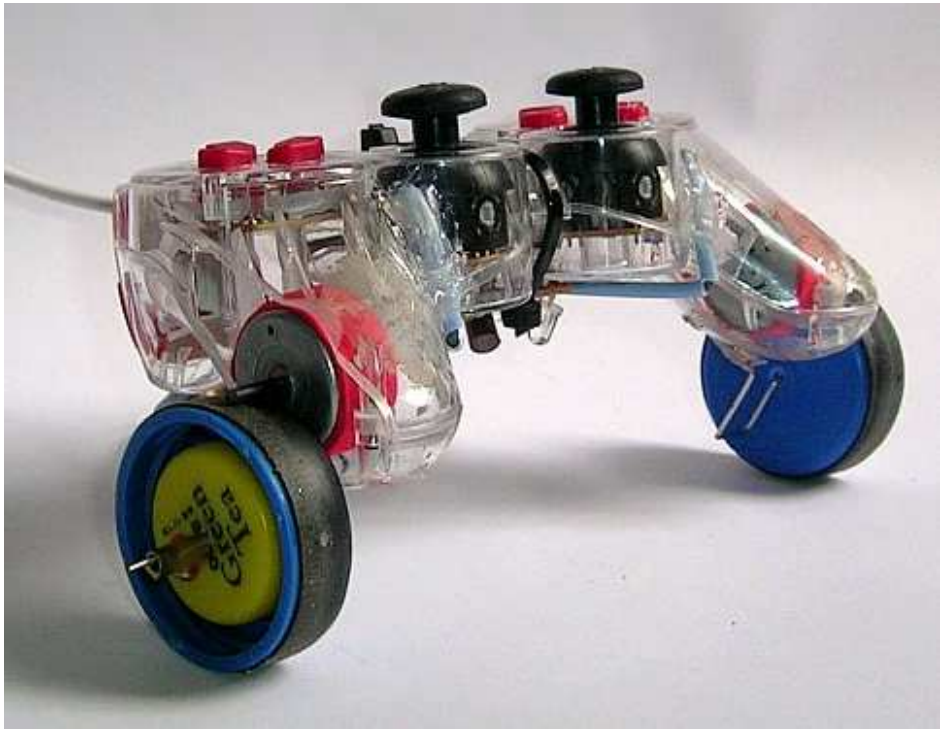
Use the joystick's rumble motors to drive wheels

1. Cut off the sides of a joystick
2. Remove the rumble weights
3. Turn the motors sideways

Wheels

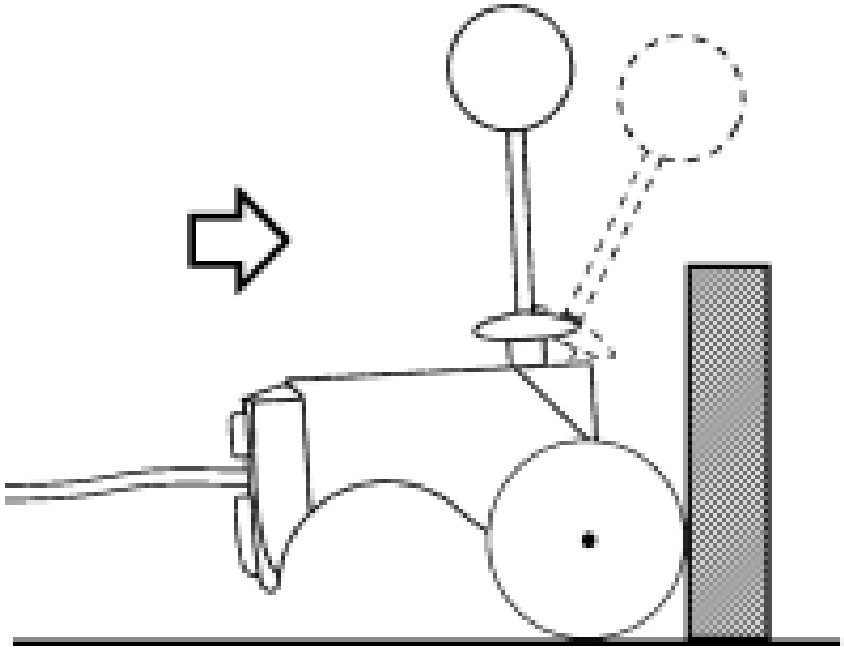
- After a lot of experimentation I found a wheel design that worked!
- Paperclips provide suspension





Bump Sensor

- A Chupa Chupa lollypop mounted on a joysticks act as an inertia sensor
- When the robot is hit or if it hits something the joysticks move



The Name

"Chupa Chup" translates to something like "suck suck" in Spanish…

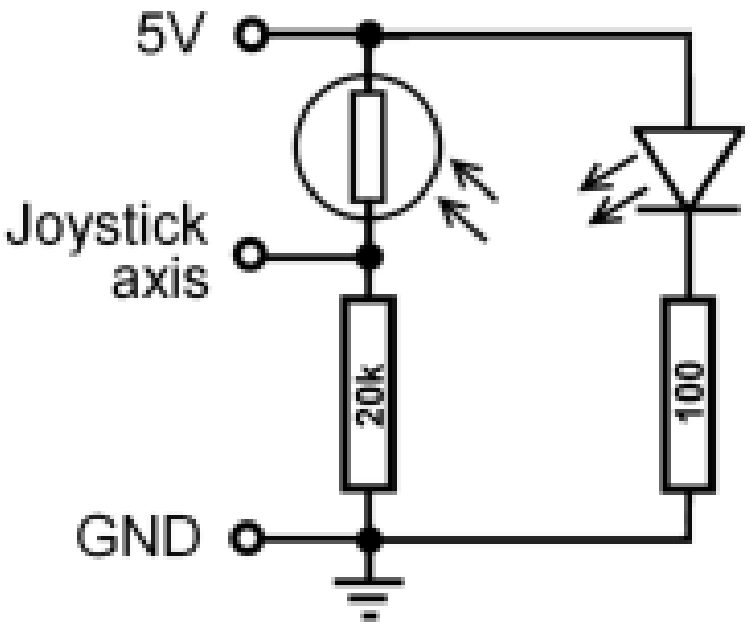
…so I called my robot "**Suck**erbot"

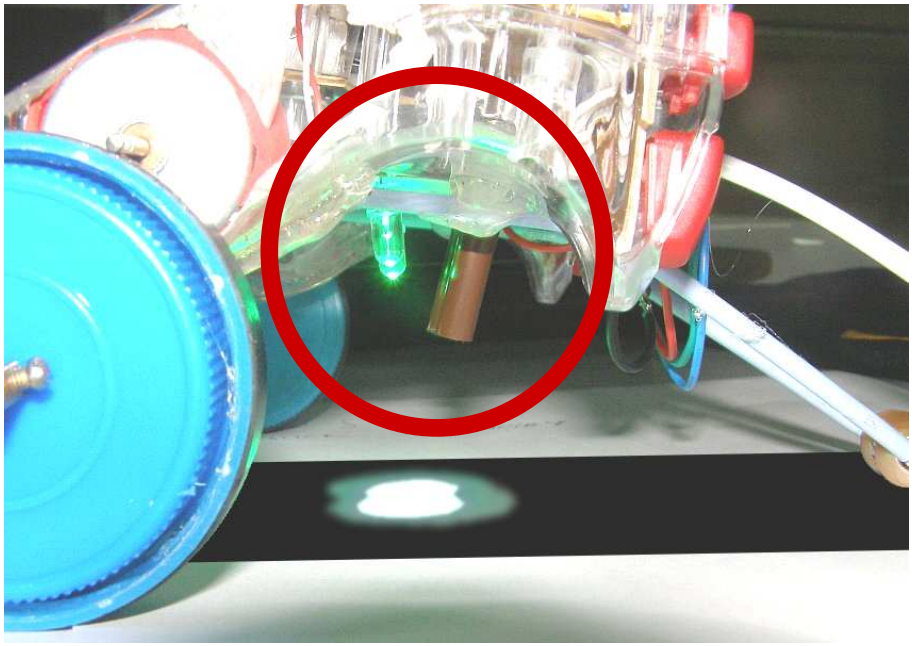
The Name

There were concerns about possible negative connotations of “sucker” in the US so I changed the name to:

Line Detector

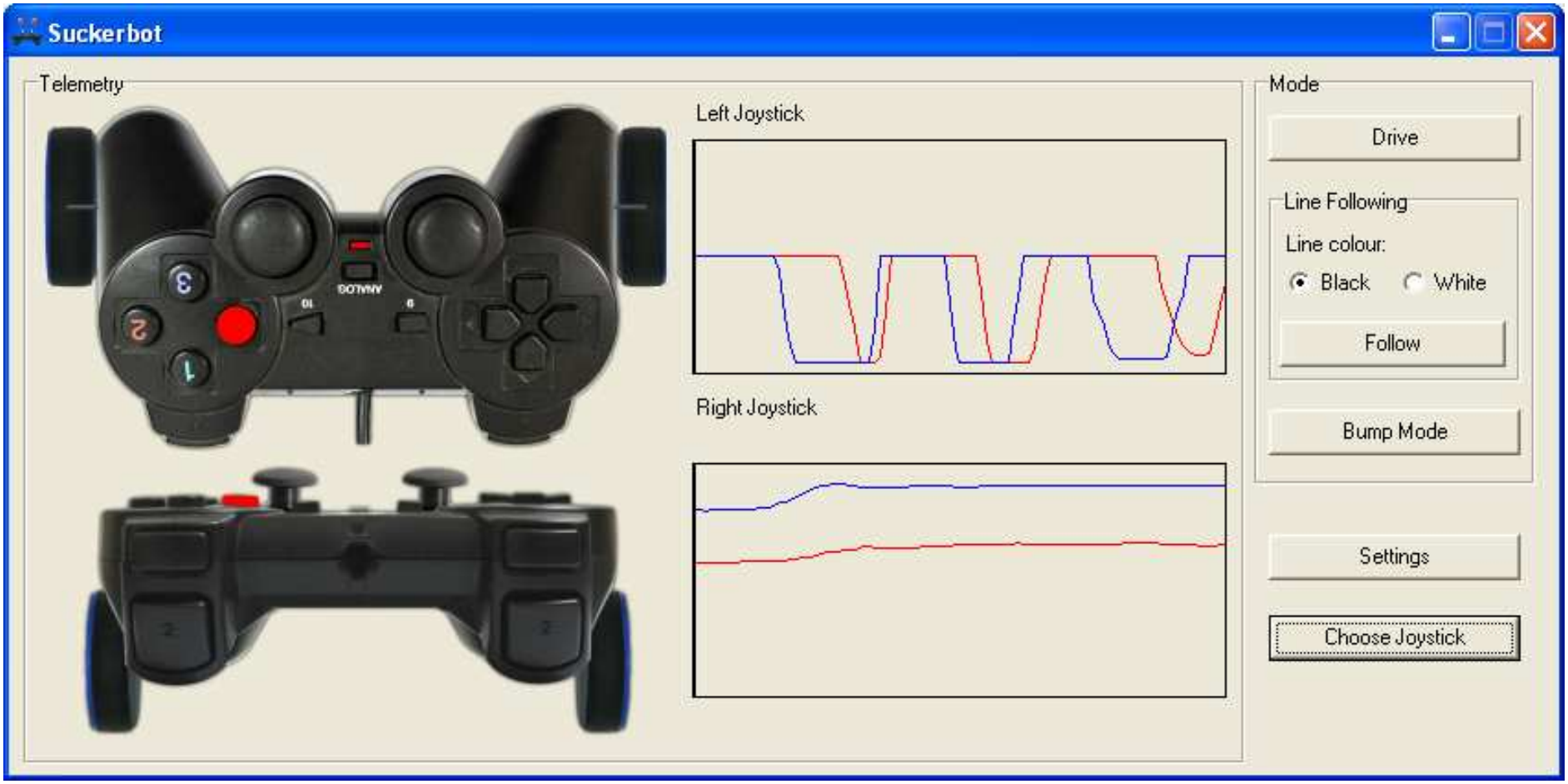
- I built a very simple circuit for detecting brightness using LEDs and Light Dependent Resistors (LDRs)
- The circuit is patched into one axis of the joysticks





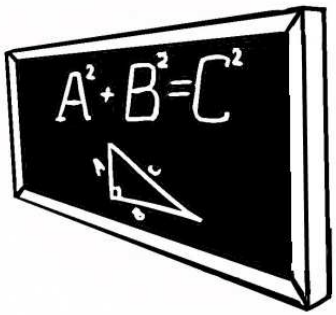
Control Software

- Open source (GPL, on Google Code)
- Written using Delphi (Object Pascal)

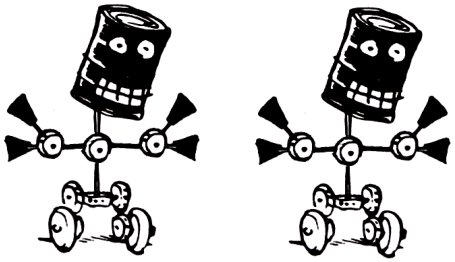


Judging

- 28 entries from all over the world
- 6 expert judges
- Criteria:
  - Educational impact



  - Reproducibility



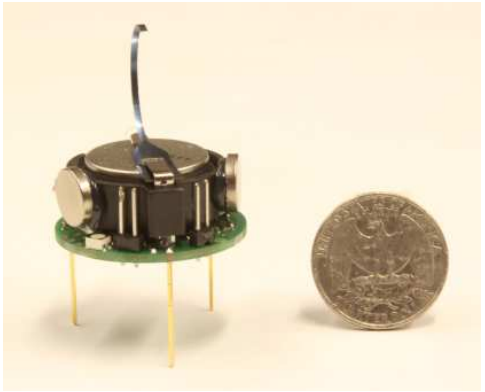
  - Affordability

$??

And the Winner is…

- Tethered
  - Suckerbot ($8.96)
    Payap University

- Traditional (Roaming)
  - Kilobot ($43)
    Harvard University, USA



- All-in-one
  - MITBOTS ($33)
    India

Video

http://youtu.be/Tt3yOkGEcKI

In the Media

ieee spectrum
INSIDE TECHNOLOGY

Slashdot
News for Nerds. Stuff that matters.

WIRED

Popular Mechanics

engineering FOR CHANGE

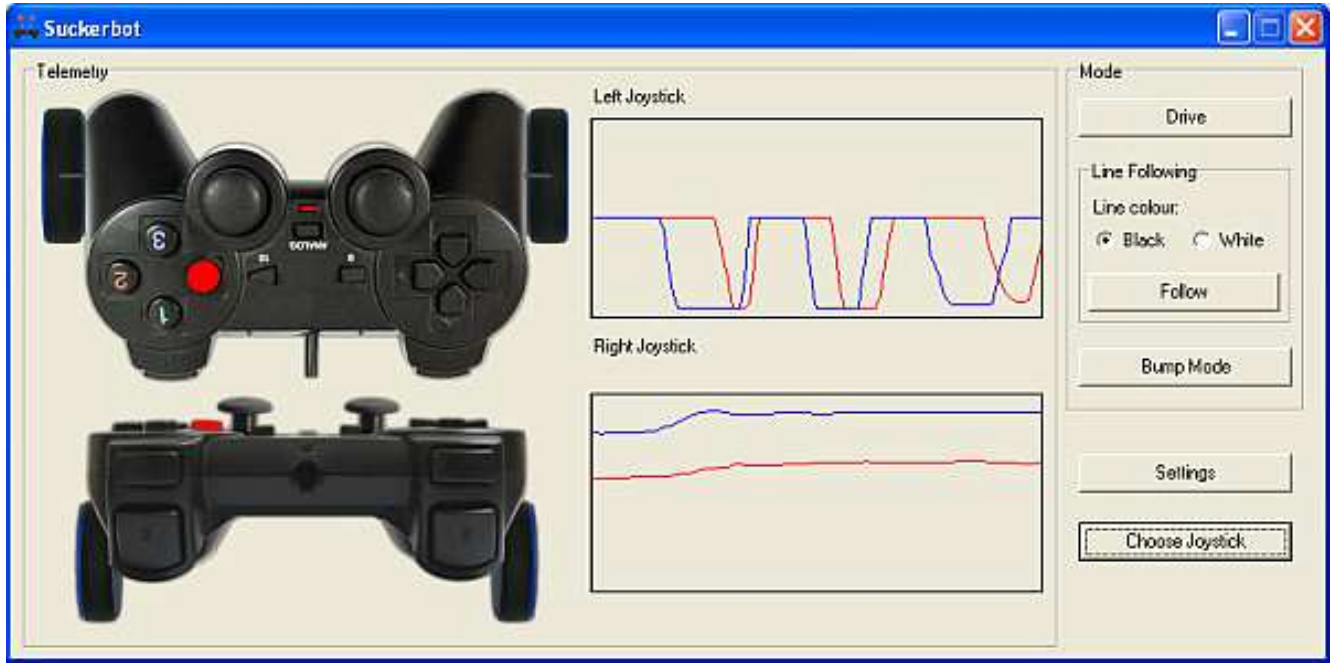
golem.de
IT-NEWS FÜR PROFIS

Solidot
奇客的资讯，重要的东西

webwereld

Software Limitations

- The original control & telemetry code:
  - Only runs on Windows (USB HID library)
  - Requires a commercial IDE (now Delphi XE4 from Embarcadero)



Software Limitations

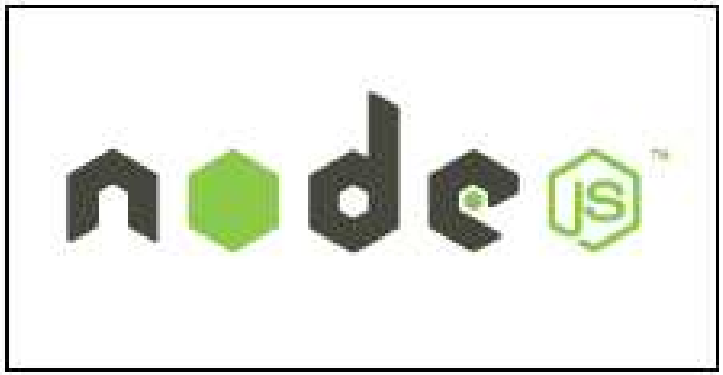
My son suggested building an HTML5 + JavaScript interface, but…

web browsers are sandboxed and can't access USB devices

Telemetry & Control

Solution: simple client-server architecture using Node.js - a stand alone JavaScript engine with access to the operating system

node-hid

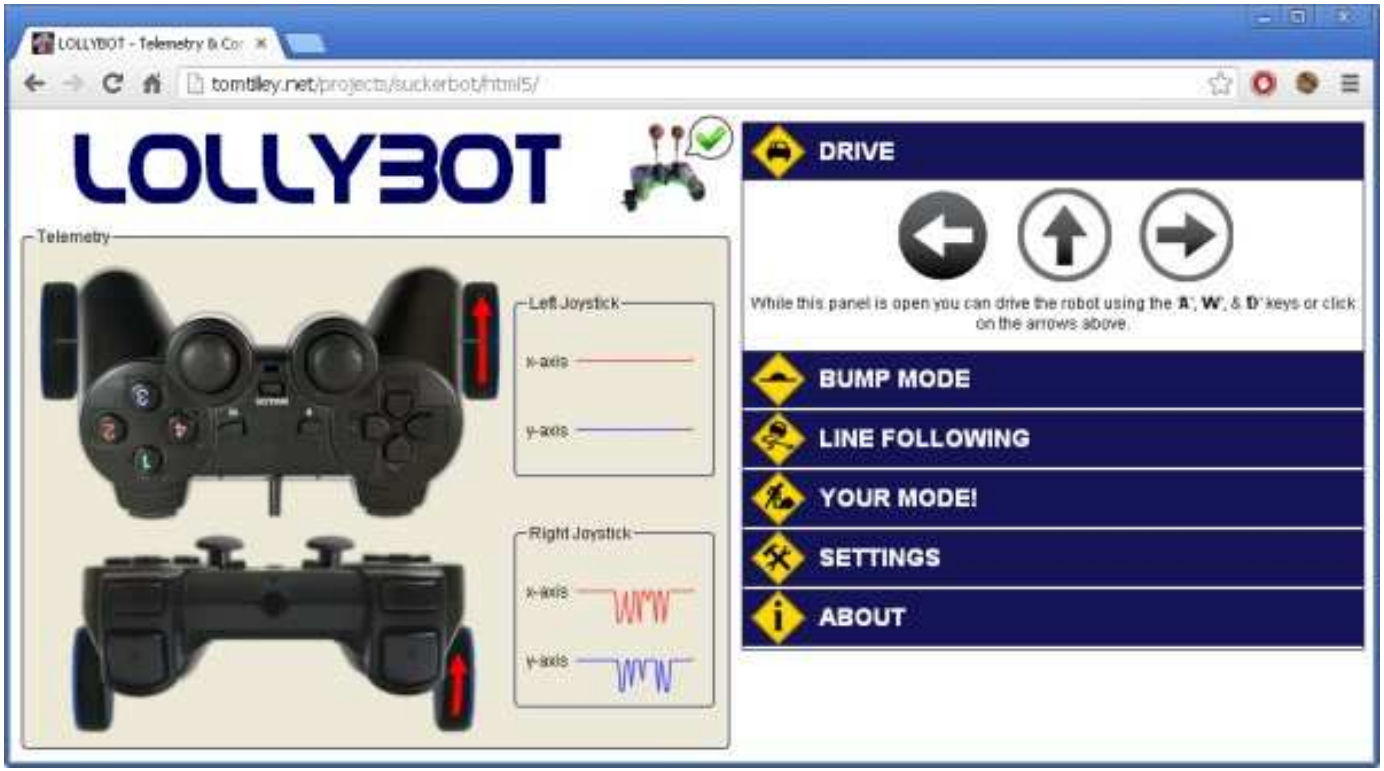


Socket-IO

Telemetry & Control

Implemented in HTML5 & JavaScript using:

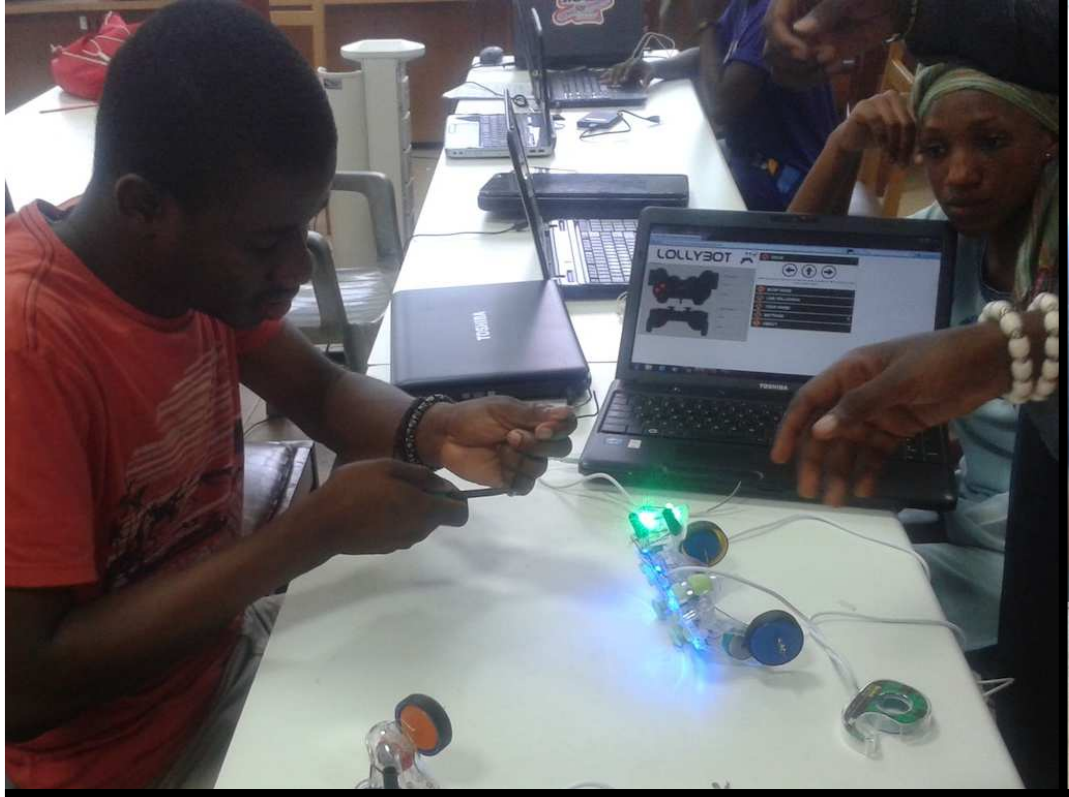
- Node.js
- Commander.js (plug-in for Node.js))
- jQuery
- jQuery Sparklines
- node-hid
- Socket.IO



Telemetry & Control

- Now free and cross-platform
- Client page can run in any HTML5 compliant browser – including mobile devices

CMU, March 2013



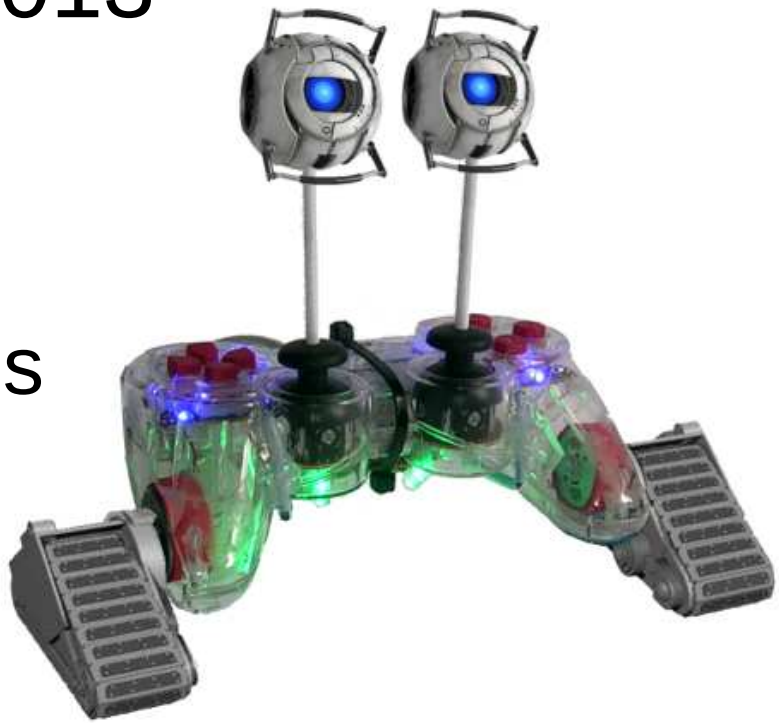
Ghana, May 2013

Funding

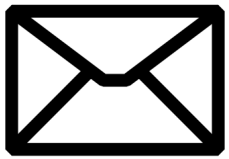
- “Ultra Affordable Robot Project”
- Reducing the cost of educational robotics by an order of magnitude
- IEEE Robotics & Automation Society are funding the first 100 - 200 Lollybots to be assembled in Ghana & distributed to African schools

2013 Design Challenge

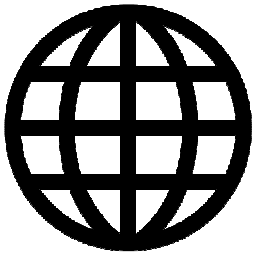
- Encouraging people to build, improve upon, and create teaching materials for the winning designs
- June 18 – September 18, 2013
- Four categories:
  - Improve Software
  - Improve H/W or build process
  - Create teaching curriculum
  - Run a workshop



Questions?



thomas_t@payap.ac.th



http://tomtilley.net/projects/suckerbot
http://code.google.com/p/lollybot