Lego Racing Team

Final presentation

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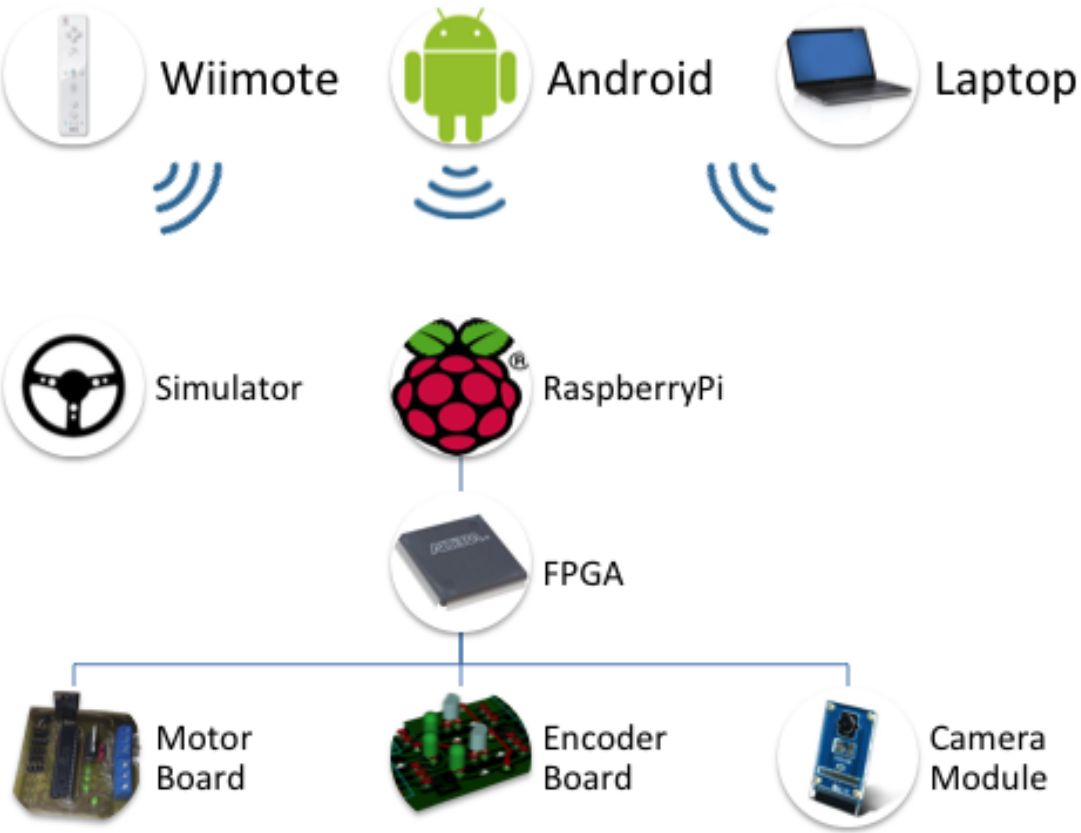
Motivation

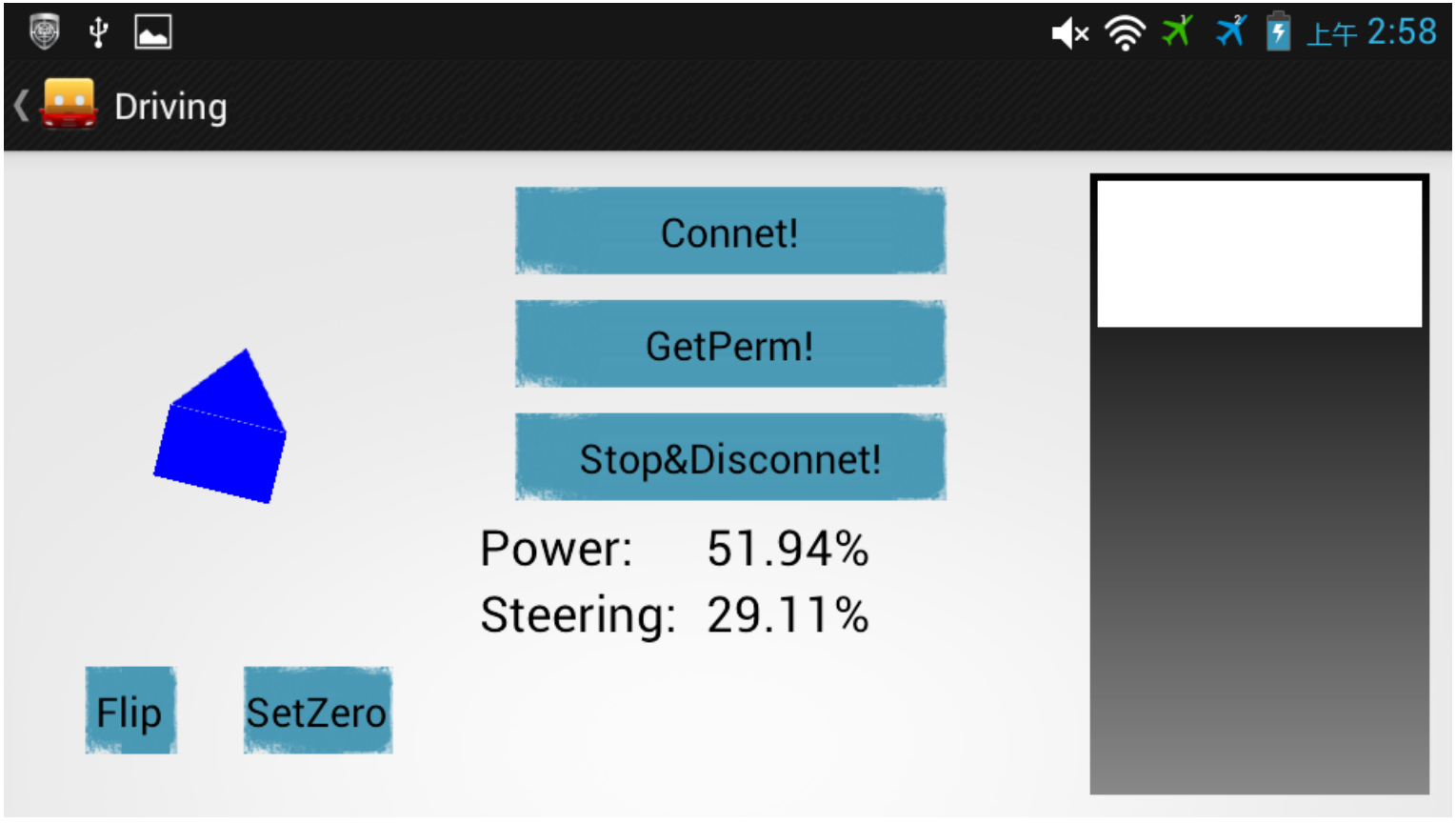
Build a high speed capable car

- with flexible heterogenous user interfaces (Android, Wiimote, Laptop)
- assist the user (traction control, obstacle avoidance, emergency brake)
- leverage the power of the FPGA where suitable

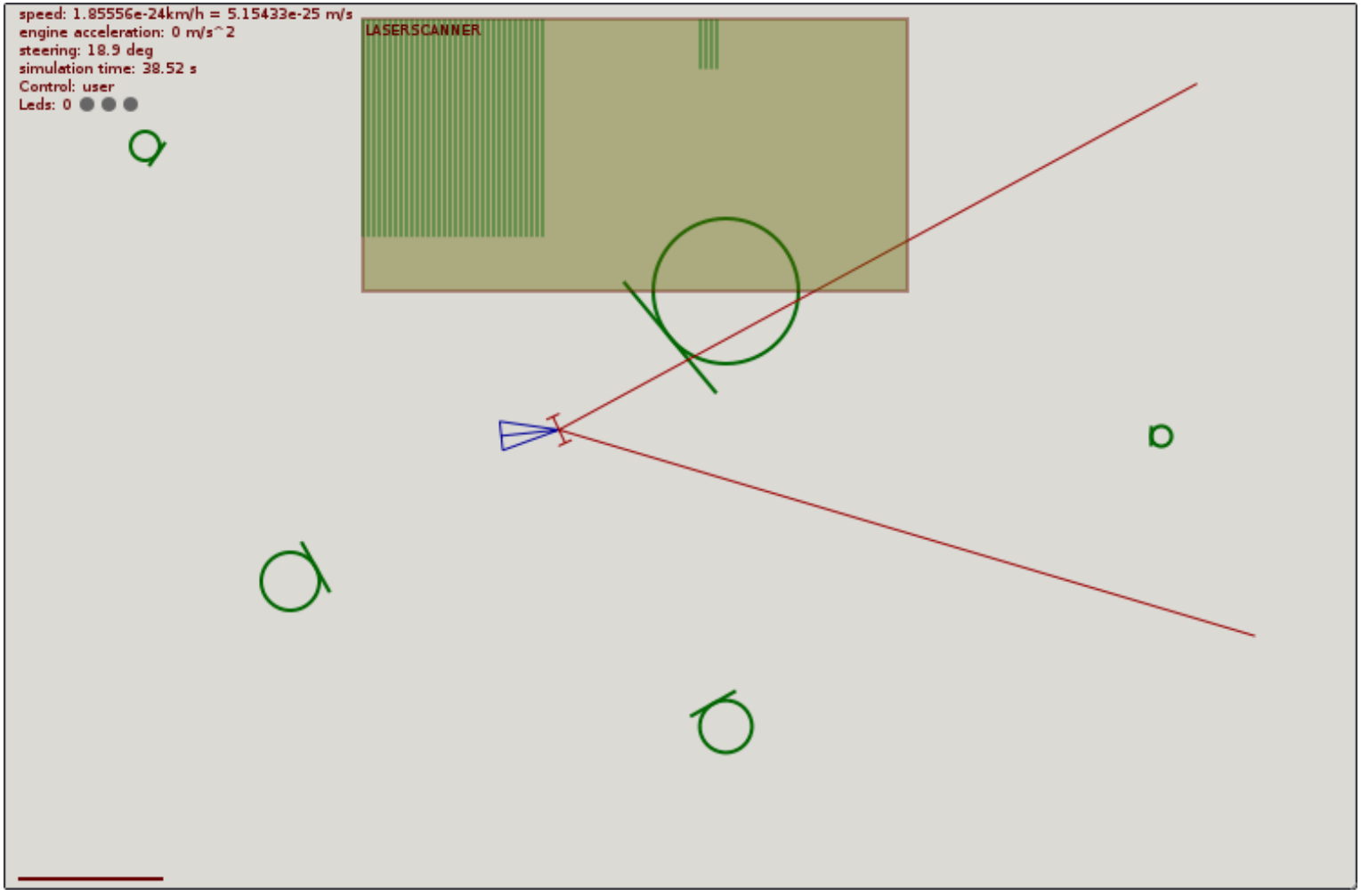
Architecture



Built an Android App

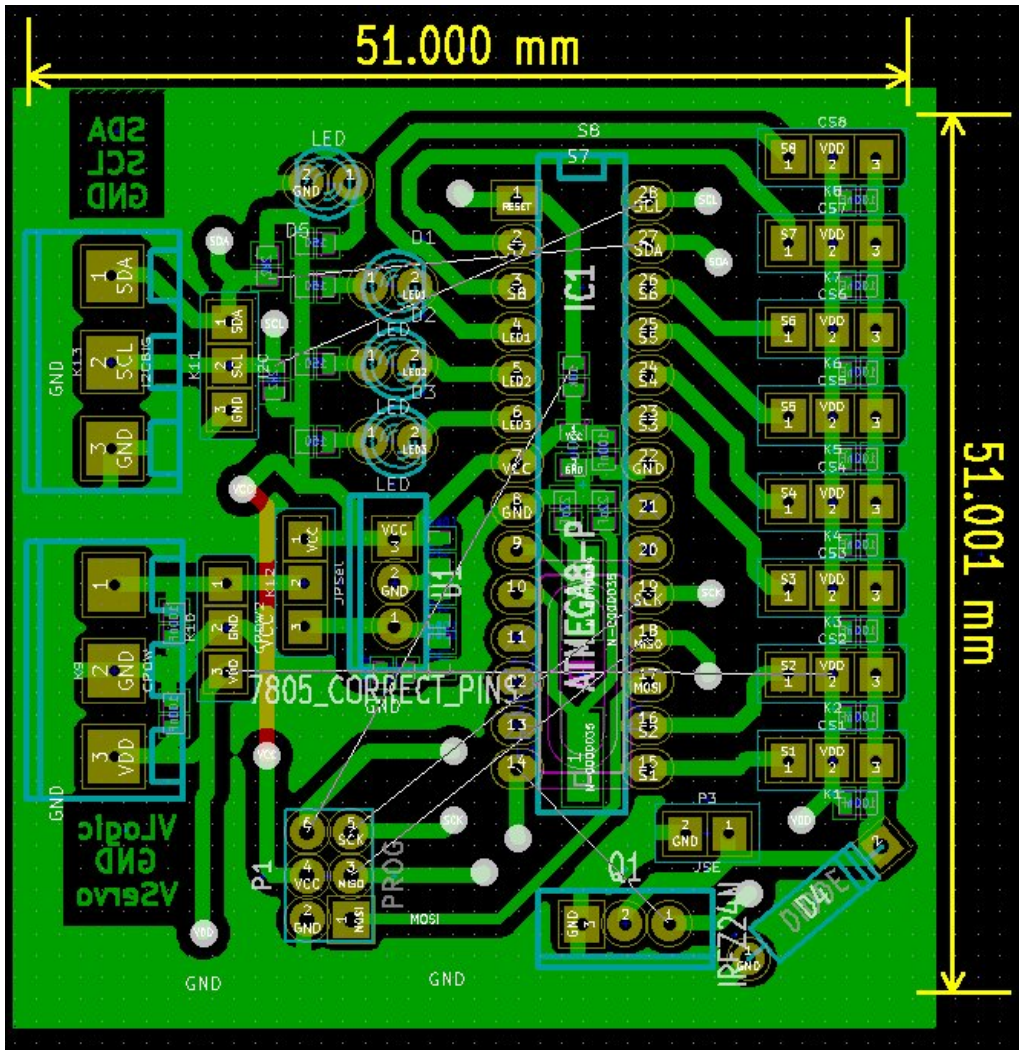


Built a simulator



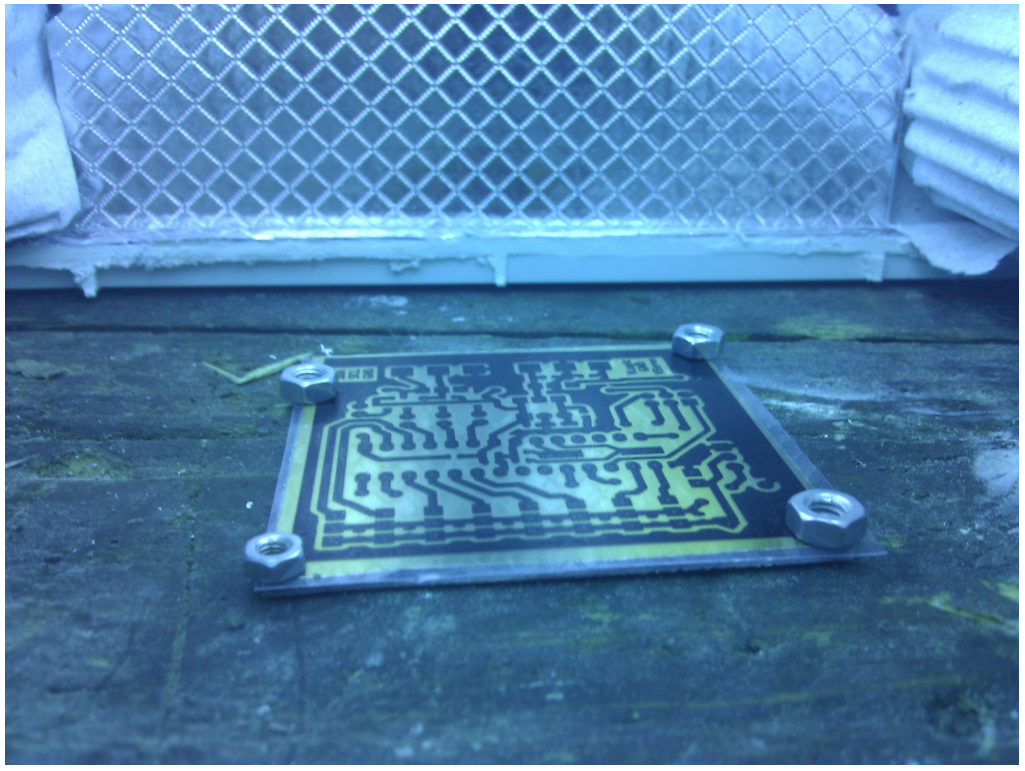
Made our own hardware

- from design, routing, exposure, to etching and soldering



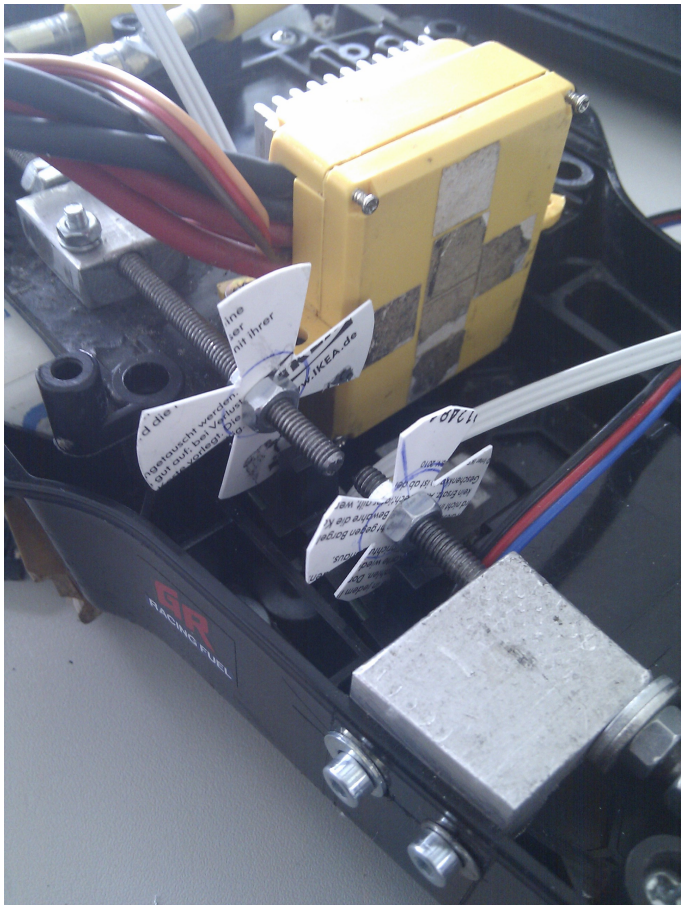
Made our own hardware

- 2 motor control boards with micro controller
- power regulation board
- encoder level conversion board



Made our own hardware

- dual encoder setup to detect wheel slippage
- custom machined, to connect directly to cardan joint
- encoder level conversion board



Hardware

Update

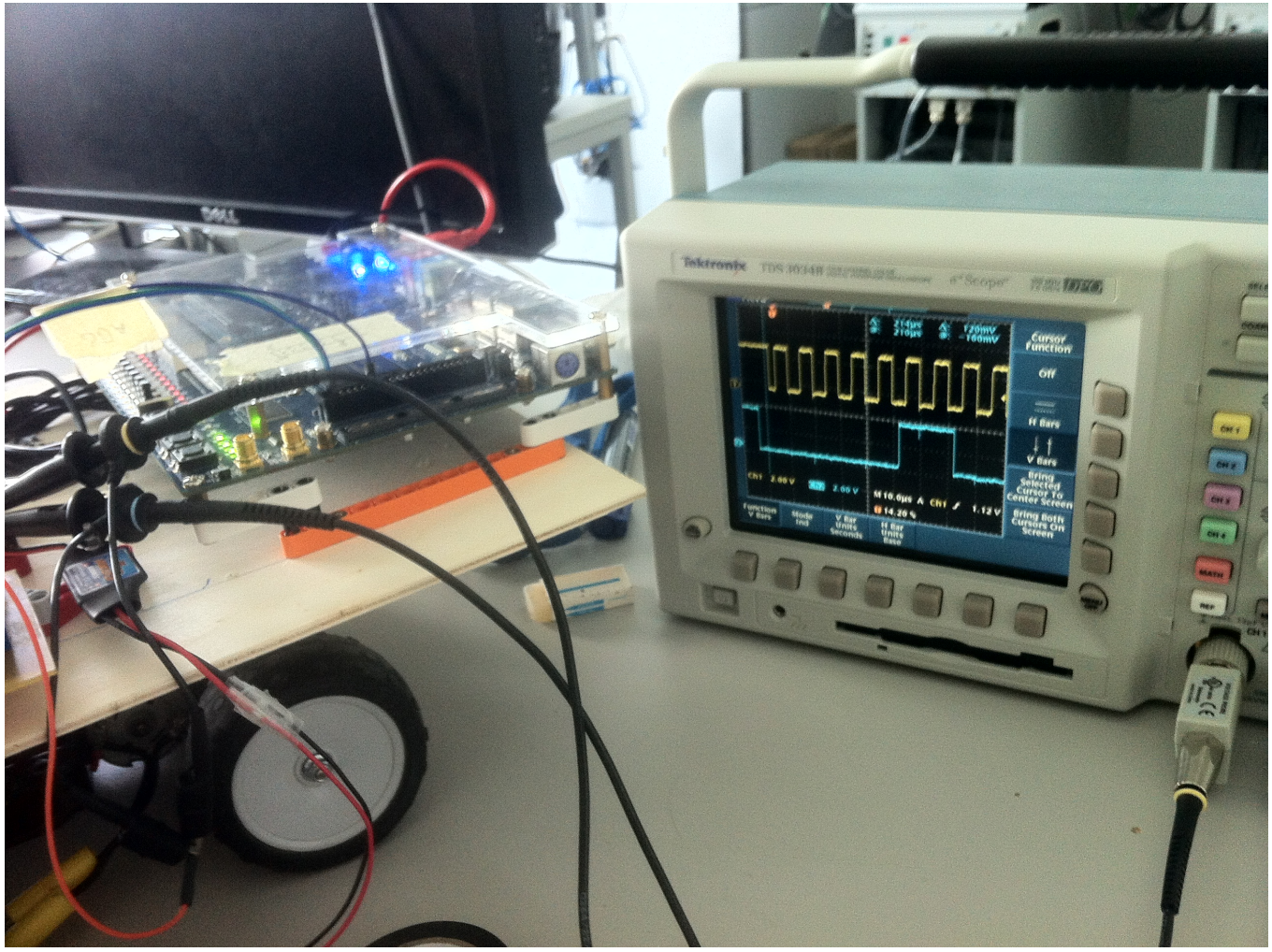
- Integrated new high power wireless access point
- Built second servo board to parallelize development on RASPI and FPGA
- Connect all components with pin-socket connectors for faster reconnection

FPGA

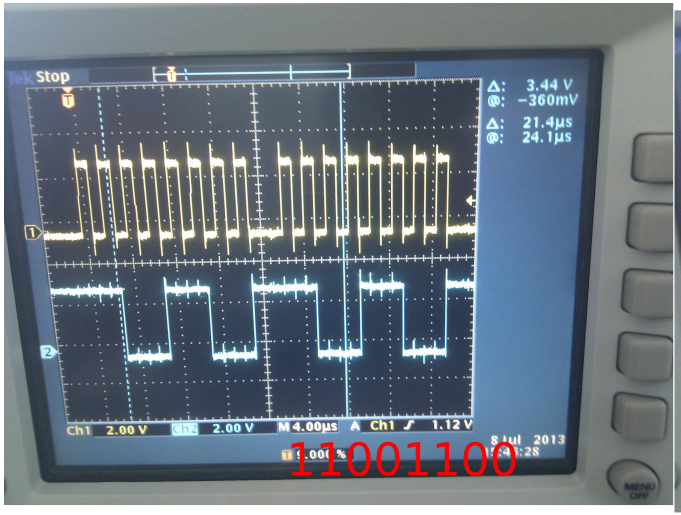
Update

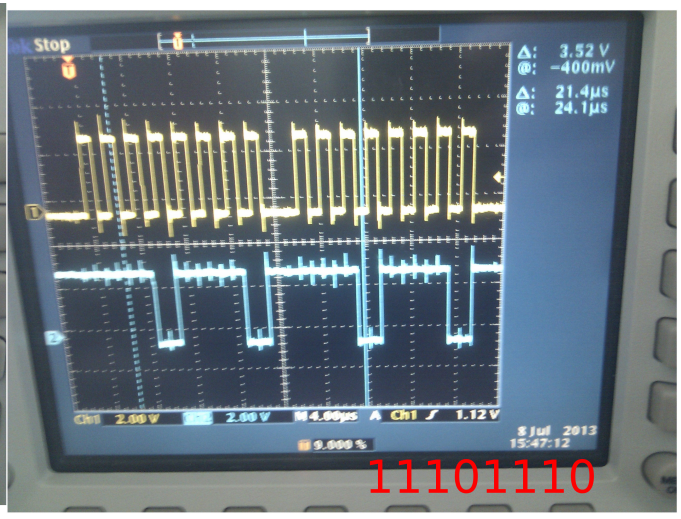
- Implemented reading out the encoders
- Implemented I2C protocol for motor control
- Implemented SPI protocol to communicate with top-level (RASPI)
- Implemented PID motor speed control

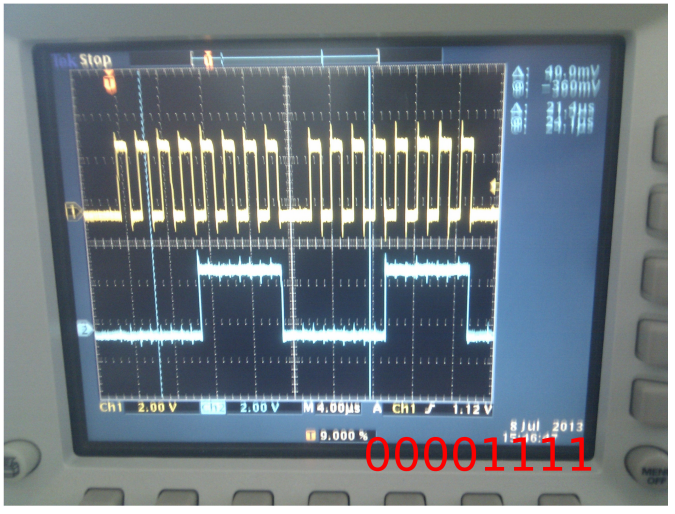
FPGA


Tektronix
TDS 3034B
Cursor Function
Off
H Bars
V Bars
Bring Selected Cursor To Center Screen
Bring Both Cursors On Screen

FPGA







Raspi

Update

- Implemented SPI interface to FPGA
- Moved some general input processing to the RASPI

Next steps

Plan

- Implement toplevel communication protocol between FPGA and RASPI

Abandoned due to time restrictions

- Get the camera to work on FPGA
- Implement laser scanning algorithm on FPGA
- Implement obstacle avoidance on RASPI

Lessons learned

- Implementation in VHDL on the FPGA extremely time-consuming
- Simuluated FPGA != real FPGA
- Debugging on the FPGA is tedious, memory oscilloscopes or logic analyzer are of great help
- Watch out for endianness when connecting different systems

Discussion