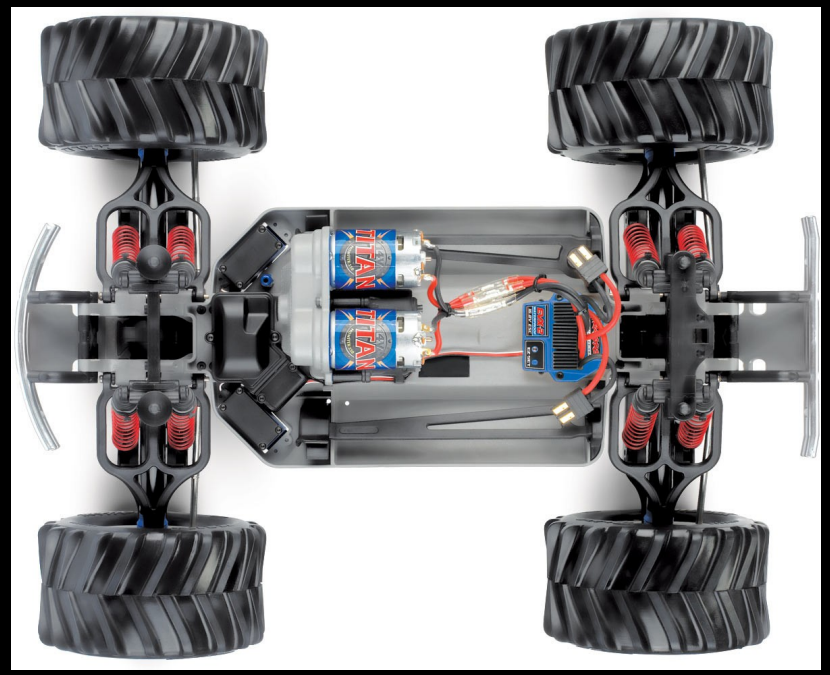
Istrobotics

Robotour 2016, 18.9.2016

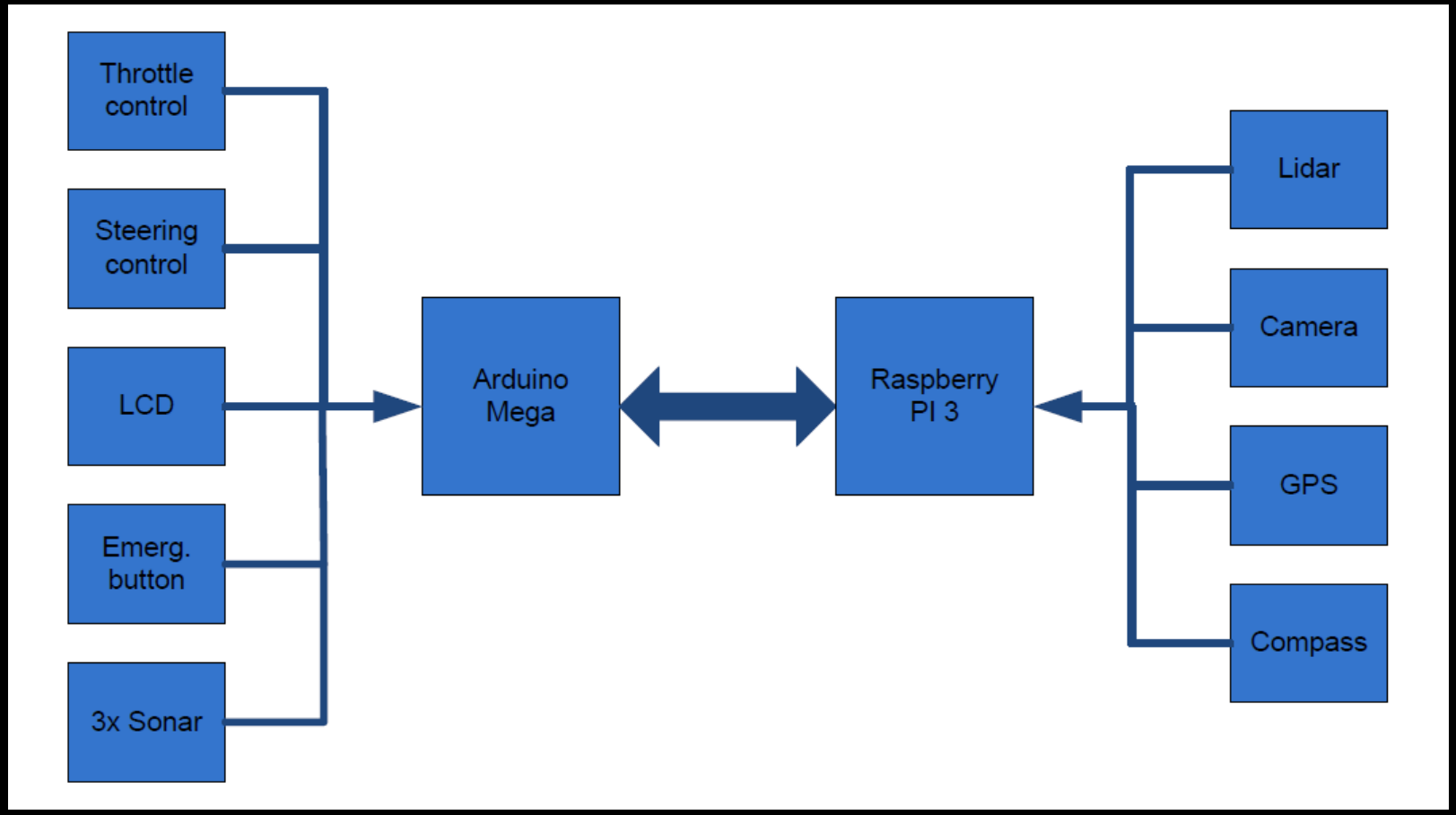

Pilsner Urquell

ROBOT CHASSIS

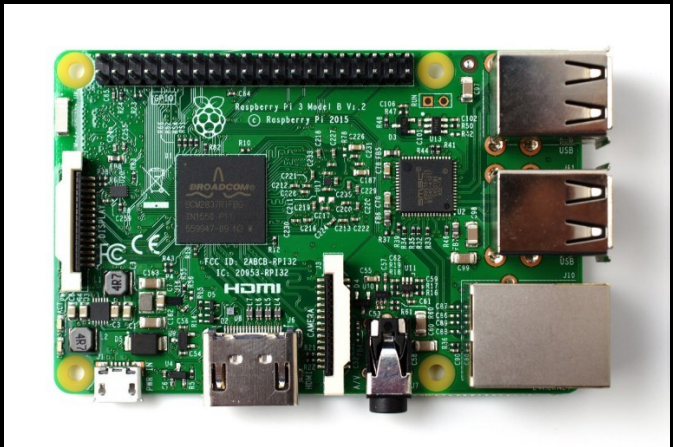


- RC model: Traxxas E-Maxx 4x4 monster truck
- Top Speed: 48 km/h
- Waterproof electronics, servos

HARDWARE DESIGN



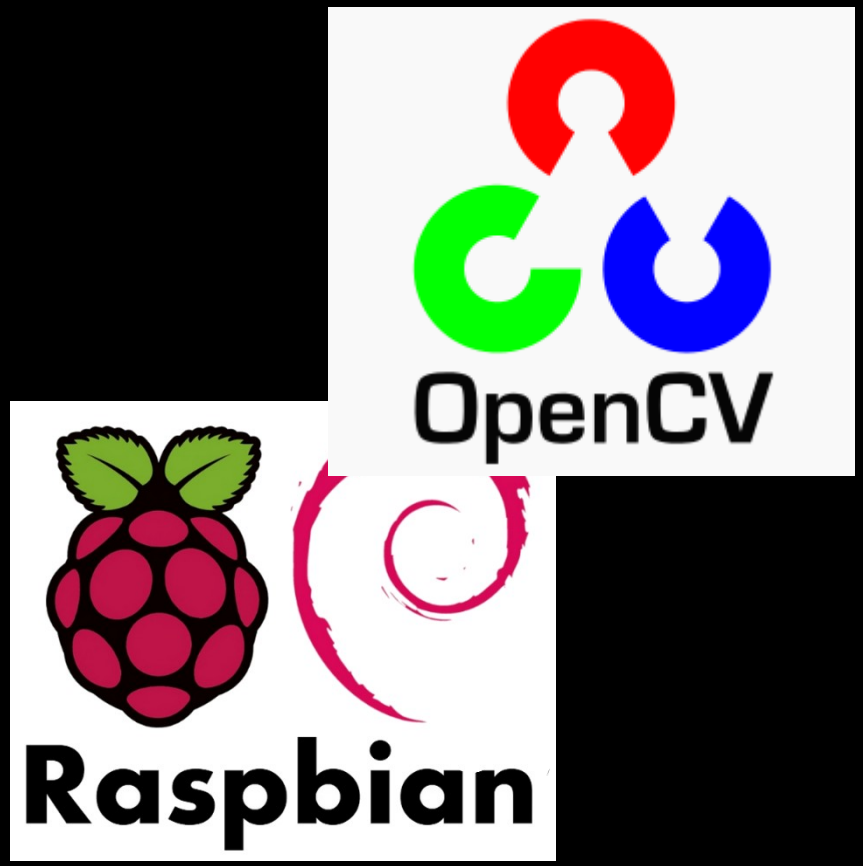
HARDWARE



- Raspberry Pi 3: 1.2GHz 4-core ARM, 1GB RAM
- Arduino Mega: 16MHz, 8KB RAM

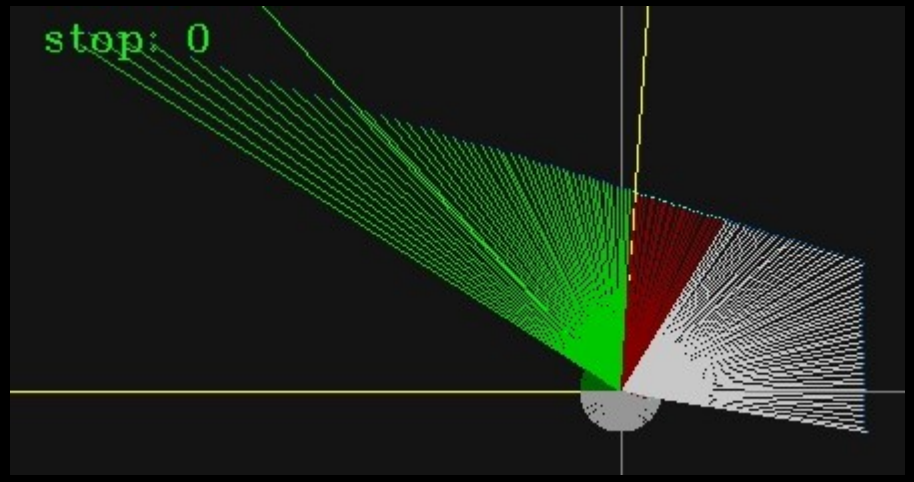
- 2D Lidar: RoboPeak RPLIDAR 360 ($400)
- Camera: Odroid USB Cam (640x480)
- Mouse type GPS/Glonass: Holux M-215+
- Compass: myAHRS+
- 3x Sonar: HC - SR04
- +additional USB hub

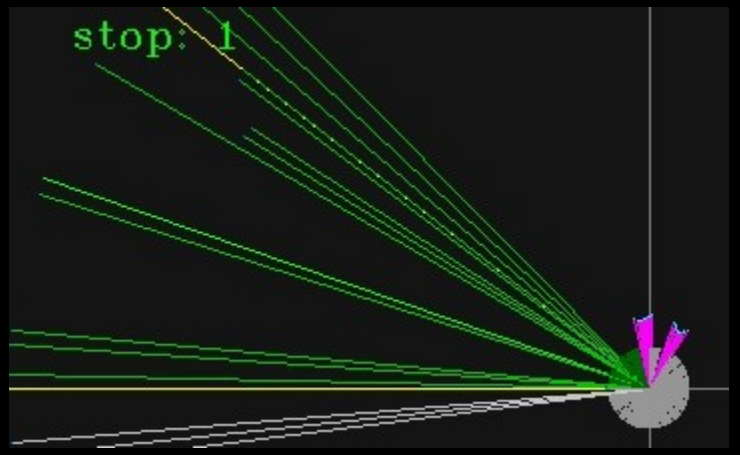
SOFTWARE



- Operating system: Raspbian
- Source codes: C++, 150kB
- Vision library: OpenCV
- Geo library: GeographicLib
- Main application + 6x pthreads
  - 4x sensors (Camera, Lidar, GPS , Compass)
  - image processing
  - output: image saving (1GB of data/ round)
  - control board

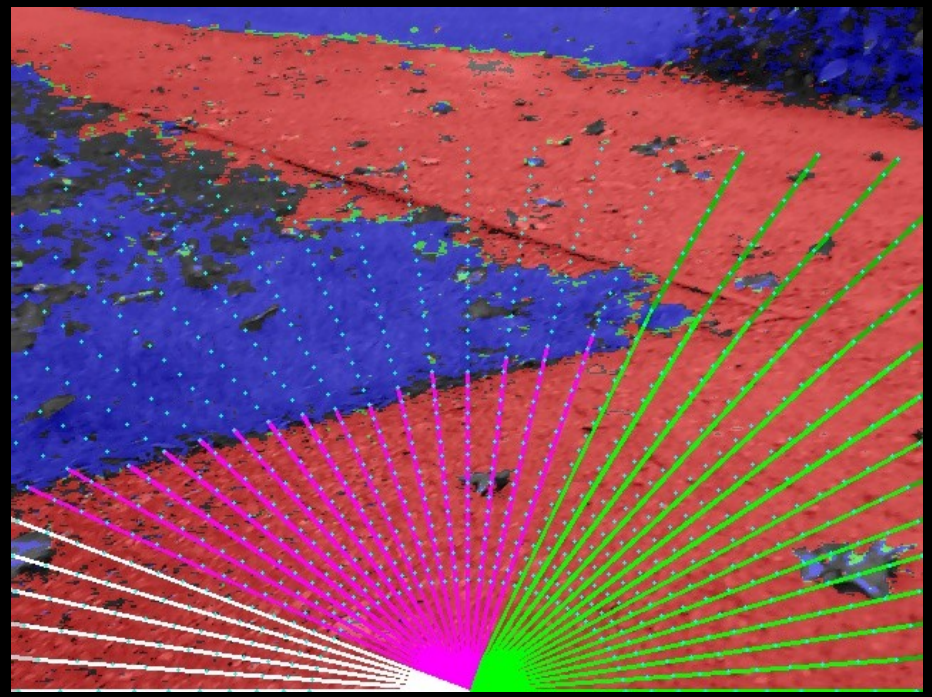
LIDAR – obstacle detection





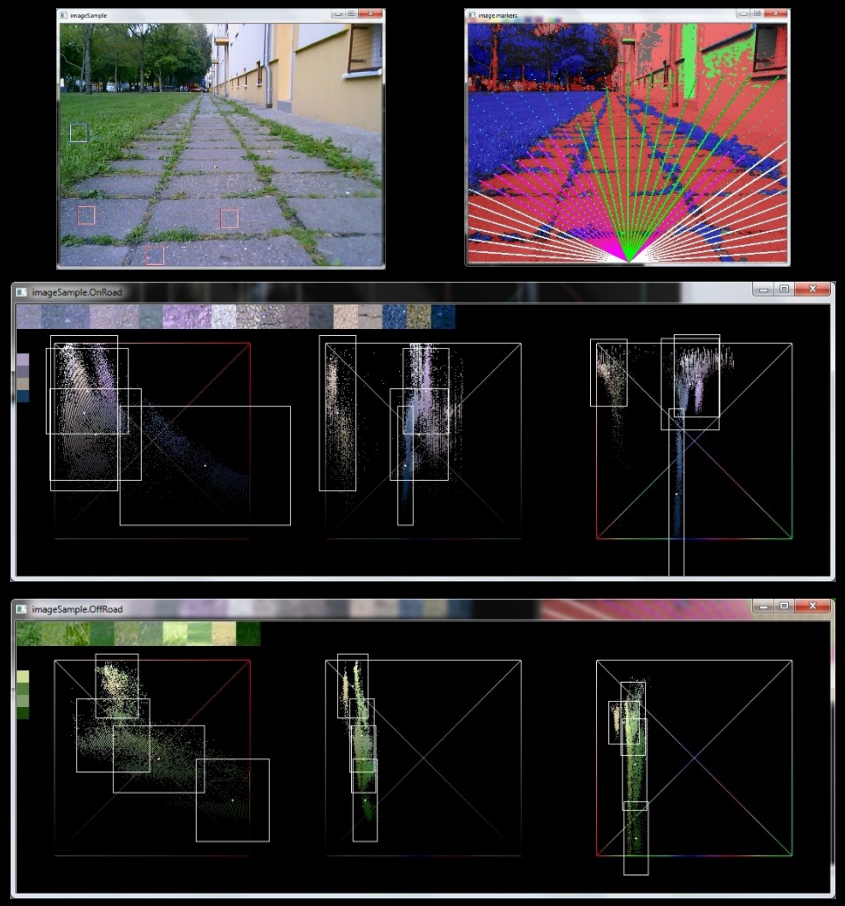
- Obstacle detection condition (red):
  - If distance is < 100 cm
  - Filtering: distance < 1cm (grey)
- Stop condition (pink):
  - Check angle: -45 to +45 degrees
  - If distance is < 50 cm at 3 diff. degs
  - Sonars were also used (rain issue)
- Obstacle avoidance (green/white)
  - Find OK intervals of > 20 degrees
  - Choose the closest to going straight

VISION – approach



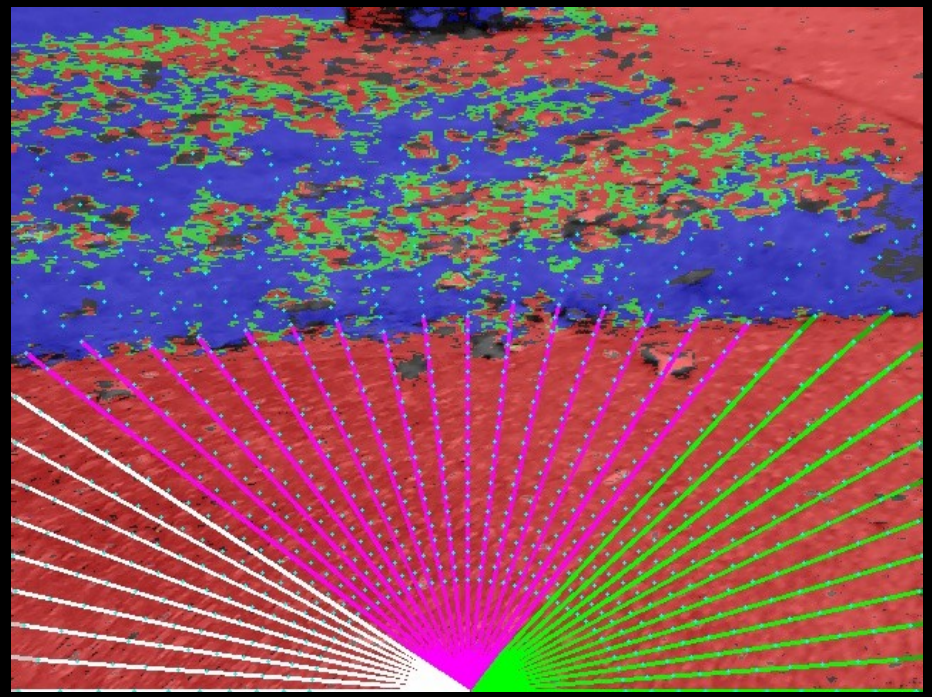
- Our approach: **lidar-like local map**
  - For any seen angle is obstacle closer than 1 meter?
  - 1 meter or to the image border
- Algorithm:
  - Pixel color classification
  - Evaluate grid points
  - Calculate distance to obstacle
  - Find OK intervals – same like LIDAR

VISION – Pixel color classification



- Approach:
  - Choose sample pixel blocks (32x32) from training images
  - Calculate 4 clusters centers in color space (OpenCV kmeans)
  - Calculate cluster radius (histogram based)
  - Repeat for 2 classifiers : road and off-road (grass)
- HSV color space + Euclidian distance
- Tool was developed - to define pixel blocks and evaluate images

VISION – Algorithm



- Pixel color classification - 4 results:
  - Road (red)
  - Off-road (blue)
  - Both (green)
  - None (grey)
- Evaluate grid points
  - Cca 1000 points in 37 lines (5 deg)
  - Evaluating nearby pixels (80x80)
  - Majority of “Road” pixels is checked
- Calculate distance to obstacle
- Find OK intervals + merge with LIDAR

HIGH LEVEL NAVIGATION

- Navigation points: 53 manually predefined
- Navigation path: e.g. “S4S2S3S6”
- Limited turning only if no obstacle is detected
- not used during the competition:
  - Not enough time for testing
  - Compass calibration issues

PROBLEMS

- Sonar sensors did not work correctly in rain
- Corrupted SD card filesystem
- Dettached sonar rack
- USB devices exchanged names after restart

PRACTICAL EXAMPLES

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THANK YOU