LARN

Latency- and Resilience-Aware Networking

Hands-On Cyber-Physical Networking (HoCPN)

BarCamp II @ SPP1914 2nd Plenary Meeting in Berlin

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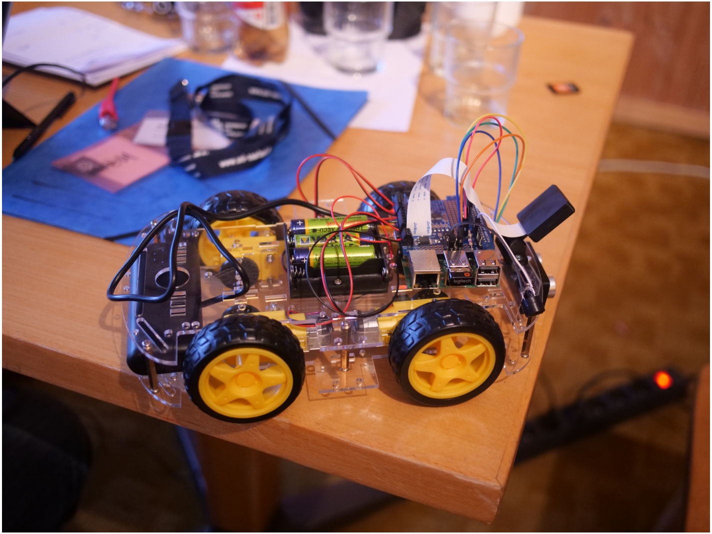
24. Apr. 2018

Networked Cyber-Physical System



- Dec 2017 Commited to organize the HoCPN BarCamp.
- Jan 2018 Planning, component purchase and prototyping of the *networked cyber-physical system* at SIC and FAU.
- Feb 2018 Winter School in Arosa.
- Mar 2018 Meeting at FAU & several Skype conferences.
- Apr 2018 Wrap-Up Talk in Berlin.

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Mid-End 2018	Publication and Demo of Results.

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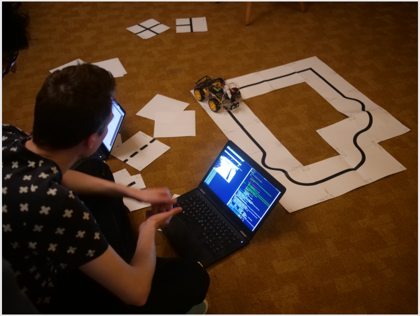
Minimal viable CPN to evaluate interactions between **network**, **operating system** and **control** in a practical implementation.

Line-Following (vision)

Edge2Car Communication & Control



Car-Following (vision and ultrasound)

Car2Car Communication & Control

https://upload.wikimedia.org/wikipedia/commons/0/04/Follow-me_Smart_Zeltweg.JPG

Scenario & Hardware

- Conception of non-standard scenario with control and network challenges.
- Prototype car design and implementation.

Systems & Networking

- PRRT Optimization (APIs, Performance, ...)
- System Optimizations (Performance, ...)

Control

- Control Laws
  - For angle-based line-following (+ Python implementation).
  - For velocity-based car-following.
- Control concepts, sensoring ideas, ...

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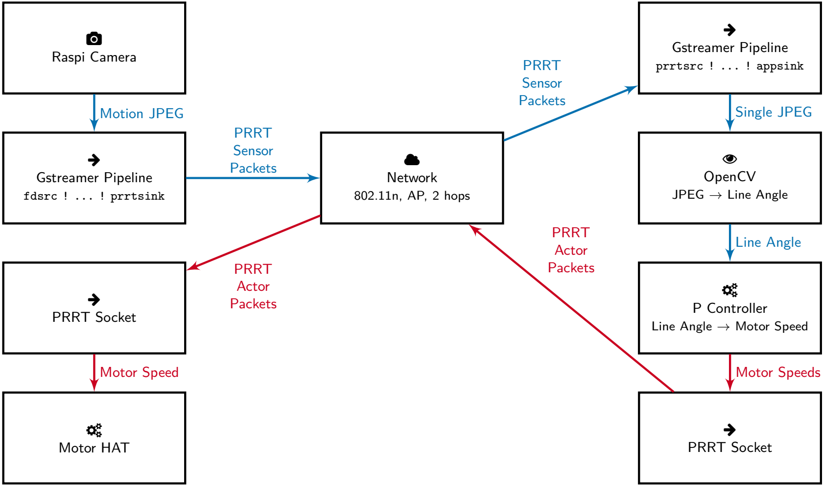

Control Task: Line shall be vertical in front of the car and aligned in the middle $\Rightarrow$ Orientation of the car shall be close to zero, ie., we want $\theta \approx 0$

- All wheels of the car are fixed and not steerable

$\Rightarrow$ Differential-drive car

- Distance between right and left wheel: $L = 12\,\text{cm}$
- Camera is located right in the middle of front axle
- For velocity v_d of that spatial point we thus have: $v_d = \frac{v_R - v_L}{2}$, where v_R, v_L are the velocities of the wheels
- Moreover, for the rotation of the car it holds: $\omega = \dot{\theta} = \frac{v_R - v_L}{L}$
- For desired v_d and fixed sampling rate t_A, we can compute the required velocities v_R, v_L of the wheels using a simple P law, where gain is such that stability is ensured

Engineering

- Optimize line-following scenario.
  1. Perform Camera calibration, i.e., determine intrinsic and extrinsic camera parameters
  2. Optimize image processing
  3. Implement more involved control laws, e.g., use PID or MPC
- Implement car-following scenario.

Research

- Publish a paper with the resulting prototype, faced challenges and research questions.
  - SenseApp'18? Deadline ca. May'18
  - ACM SAC'19? Deadline ca. Sept'18
  - CyPhy'19? Deadline ca. Jan'19
  - CPSWeek'19