HOCHSCHULE LANDSHUT
HOCHSCHULE FÜR ANGEWANDTE WISSENSCHAFTEN

NXP CUP
Technical Report

NXP CUP
INTELLIGENT
CAR RACING

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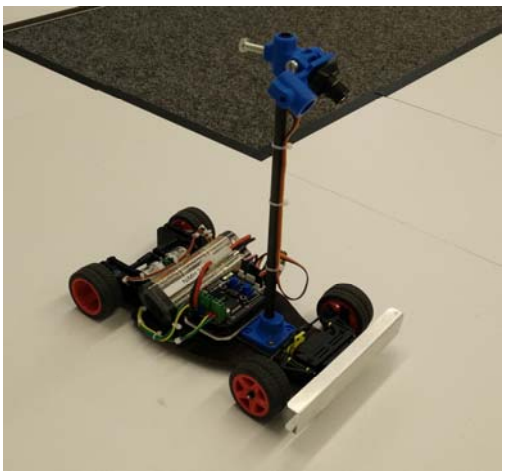

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Table of Contents

1. Description of mechanical design of vehicle model

One car has the changed chassis without suspension; the second car is built from the standard kit but without suspension.
The wheels are parallel.
As microcontroller board we use the FRDM-KL25Z.
The motor driver board is the FRDM-TFC.
For the circuit boards we installed on a plastic plate.
The camera fixture is made with a 3D-printer.
To measure the speed of the car we installed two photomicrosensors, one at each wheel.

For one vehicle, a 3d-printed bumper protects the front of the car against impacts. The second car uses an aluminum profile covered with a rubber as a bumper.

2. Description of control circuit design

The control circuit design for the servo motor is based on a control-algorithm that uses a look-up table.

The control circuit design for the drive motors is based on a PI-controller.

The torque vectoring values are based on the steering angle.

3. Description of the electronics design

We reduce the interferences of the engine with some bypass-capacitors and soldered the motor cable directly to the motor.

We used 6 ceramic capacitors. One 100 nF capacitor from positive to negative pole of each motor. Also two 47 nF capacitors per motor from each pole to the motor casing. With this construction the interferences of the motor no longer mess with the camera values.

In addition, we use a speed measurement sensor at each back wheel.

4. Description of control software design

The camera image is read every 4 ms.

The camera image is read every 4 ms. We detect both black lines and calculate the middle. If only one line is detected a fix offset of this line is taken for the steering control.

The speed of the back wheels is controlled by a closed loop controller based on a PI-Controller.

Button usage:

- Button A: Start
- Button B: Stop

DIL usage:

- DIL 1 to 4: Select different modes, for example race programs or test programs

5. Total weight and dimensions of the reengineered vehicle

Length / width / height: 28.5 cm * 16.5 cm * 30 cm

Weight: ca. 0.8 kg

6. Power consumption

The default configuration for the motors is used. Nothing changed there. The two photomicrosensors consume approximately 500 mW.

7. Count and type of sensors used

- 1x given line-camera which delivers 128 gray-values, type TSL1401-DB, manufacture Parallax Inc. (sensor) and Taos (board). This sensor is part of the standard car kit.
- 2x photomicrosensor (optical fork sensor), type EE-SX1106, manufacture OMRON, data sheet: http://www.omron.com/ecb/products/pdf/en-ee_sx1106.pdf
  This type of sensor is not available from NXP. NXP itself uses this type of sensor from OMRON in DC motor control applications which you can see in the application note AN4976, AN2955, or AN3008 (see for example: http://www.nxp.com/assets/documents/data/en/application-

notes/AN4976.pdf). In AN4976 the sensor EE-SX1137 is used, which is the same type as ours but with larger dimensions.

8. Numbers of servo motors besides the existing driving motors and rudder motors of the vehicle model

No additional servos are used beside the original servo and the two driving motors.