Prof. Dr. Christian Steger
Prof. Dr. Reinhard Wilhelm

Sebastian Altmeyer, M.Sc.
Michael Gerke, B.Sc.
Dipl.-Inf. Hans-Jörg Peter

Embedded Systems 2010/2011 – Project: RoboDog

RoboDog

The aim of the project is to design a Lego Mindstorm Robot able

- to drive autonomously along a black line,
- to react to clapping by the user, and
- to avoid driving into obstacles.

The RoboDog starts in *line-following mode*. In this mode, it simply has to drive along a black line which it can recognize using its light-sensor. We can assume that no obstacles block the way of RoboDog in this case.

As soon as RoboDog hears a clap, it enters *control mode*, where the driving direction is determined by the environment. In this mode, you can order RoboDog to drive left (one clap), to drive right (two claps) or to stop (three claps). In case an obstacle blocks the way of RoboDog, RoboDog has to drive backwards for a given number of cycles, turn left or right and try to avoid this obstacle. During this evasion mode, RoboDog can be ordered to stop (three claps), but ordering a specific direction (one or two claps) is not possible. When stopped, RoboDog starts moving again as soon as it hears a clap. In case RoboDog drives backwards against an obstacle, e.g. touch sensor at the rear of RoboDog is activated, RoboDog is afraid and stops moving immediately. It restarts moving as soon as the touch sensor is deactivated and RoboDog hears a clap.

Note that there is a prototype implementation, of which you can observe the wanted behavior and read the actual sensor values.

RoboDog's Sensors

Light Sensor Sensor used to recognize the black line which RoboDog has to follow. Located at the front of RoboDog, headed towards the floor. Its values ranges from 0 (bright) to 1023 (dark).

Touch Sensor Sensor to recognize if RoboDog moved backwards against an obstacle (located at the rear of RoboDog). It returns 0 (not touched) or 1 (touched).

Sound Sensor Sensor used to recognize clapping. It can only measure loudness. It ranges from from 0 (very loud) to 1023 (silent).

Ultrasonic Sensor Sensor used to measure the distance between RoboDog and an obstacle in front of it ('Eyes' of RoboDog). It ranges from 0 to 255, values give the distance in centimeter.

RoboDog's Actuators

The only actuators of RoboDog are the left and the right motor. Both motors accept values from -100 (full speed backwards) to 100 (full speed forwards), 0 means stop.

(Tentative) Course

The project consists of three milestone:

Specification In this phase, you have to develop a Sync Chart model of the behavior of *RoboDog* and simulate it.

Implementation Use *Scade* to generate source-code of your model and integrate this code into the actual *Mindstorm* software. Upload it to the *Mindstorm RoboDog* and test it.

Timing Validation Validate the timing behavior of your RoboDog using *aiT*.

Each group will be assigned time-slots in which the group can access a Mindstorm Robot, upload the software to it and test it. Note that access to the hardware is limited to these time-slot and to room 401, E.1.03. However, before you can upload your software to the Mindstorm, you have to submit the first milestone.

In Room 401, there is a computer available, where the complete tool-chain (Scade, nxtOSEK, Eclipse, a3) is available. Nevertheless, we strongly recommend to install the tool-chain (especially Scade) on your home-pc/laptop. In addition, the prototype implementation can be seen and the behavior of it can be observed in this room.

You **have to** work in groups of 2 or 3 students. Each group has to register by sending a mail to *altmeyer@cs.uni-saarland.de*. This mail must contain a) the names of the group members b) the preferred time-slots to access room 401. Please also state if the group can work on a laptop or must use the work station.