

# Team Description Paper 2012



## **Nao-Team HTWK**

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# 1 About the Team

The Nao-Team HTWK is a RoboCup team that consists of graduate and under-graduate students of Leipzig University of Applied Science and was founded in February 2009.

The team participated in RoboCup German Open 2009 for the first time and immediately reached the second place as well as the first place in the Technical Challenge of RoboCup 2009. In 2010 the Nao-Team HTWK reached the Quarter finals and the first place in Open Challenge during the RoboCup in Singapore, while achieving a fourth place at RoboCup 2011 in Istanbul.

# 2 Team Members

Nao-Team HTWK 2011 includes 11 student members from the Department of Computer Science, Mathematics and Natural Sciences:

**Rico Tilgner**, B.Sc., Student of Computer Science  
**Thomas Reinhardt**, M.Sc., Student of Computer Science  
**Tobias Kalbitz**, B.Sc., Student of Computer Science  
**Stefan Seering**, B.Sc., Student of Computer Science  
**Robert Fritzsche**, B.Sc., Student of Computer Science  
**Samuel Eckermann**, Student of Computer Science  
**Hannah Müller**, Student of Computer Science  
**Martin Engel**, Student of Computer Science  
**Michael Wünsch**, B.Sc., Student of Computer Science  
**Jonas Mende**, Student of Computer Science  
**Nadja Blättel**, Student of Computer Science

# 3 Notable Work and Fields of Interest

## 3.1 Vision

The object recognition in Nao's camera image and identification of the field and objects on it is an essential part of playing soccer. The biggest problems for most color-table based methods are their inability to cope with changing light conditions and the need to generate the color-table, which can be very time consuming. Changing lighting conditions (e.g. between daylight and artificial light which is common at the German Open) make it impossible to classify objects solely based on their color. Also, differing ball colors (Robocup 2010) or unexpected carpet colors (Robocup 2011) pose another problem for purely color based methods. Therefore, a real-time capable segmentation with no need for calibration would be advantageous. By applying the knowledge of the objects' shapes we developed a object recognition algorithm that can handle changing light conditions and colors robustly without the need for prior calibration.

An overview as well as an in-depth description of the method is available in [1] and [2] (in German) respectively.

## 3.2 Localization

Since 2011 we employ and keep developing a method to directly estimate the camera projection matrix from the segmented field-lines in the image (see [1] for details) instead of using the robot's kinematics or attitude sensors. This projection of field-lines is then used to find a complete set of hypotheses of the player's position, from which the true position can be determined by using prior data. This method increases robustness of the localization in case of permanent camera movement (e.g. after a robot fell), fast head motions or external influences, e.g. in a fight with an opposing robot. Together with a robust detection of the field surroundings, we are also able to resolve the symmetry of the field which was posed as a new challenge in the rules for 2012 by introducing two identical yellow goals.

## 3.3 Walking engine

Until the beginning of 2010 we used closed-loop walking motions evolved through a genetic algorithm. These motions were fast but not omni-directional (eventhough walking along a curve was possible). This was a big disadvantage at the German Open 2010, so we decided to develop a completely different walking engine. Our walking engine, introduced in Robocup 2010 and refined in 2011 is based on a parameterizable walking model and is supported by a newly developed balancing algorithm. The big advantage of this system is full omni-directional capability and the ability to make fast direction changes whilst still being very stable.

The new walking engine was tuned for stability and speed manually and achieves forward speeds in excess of 300 mm/s.

## References

- [1] Nao-Team HTWK. Team Research Report 2011. Technical report, HTWK Leipzig, 2011.
- [2] Thomas Reinhardt. Kalibrierungsfreie Bildverarbeitungsalgorithmen zur echtzeitfähigen Objekterkennung im Roboterfußball. Master's thesis, HTWK Leipzig, 2011.