Dutch Aibo Team: Technical Report RoboCup 2006

Arnoud Visser [a] Jürgen Sturm [a]
[a] *Universiteit van Amsterdam*

Paul van Rossum [b]
[b] *Technische Universiteit Delft*

Joost Westra [c] Thijmen Bink [c]
[c] *Universiteit Utrecht*

http://www.dutchaiboteam.nl/

Abstract. In this report we describe the improvements made in 2006 by the Dutch Team for the Sony 4-Legged League. The soccer-competition in Bremen was a success for the Dutch. The quarterfinals were reached for the first time of our history and the third price for the Technical Challenges was won. The focus of our improvements was from the beginning on the Challenges. A complete new concept of localization was worked out, which no dependence of the typical colors or objects of the 4-Legged League soccer-field. The demonstration of this new approach will be described here. Some of the modules used in the soccer-competition were also improved, although no new modules were introduced to the code-base. In this report these improvements will be shortly clarified.

1. Introduction

In the third year of participation of the Dutch Aibo Team [8] we trusted on the previous year's developments (accurate and robust localization, stable goal keeper, role switching policies). Some modifications were made on Perception and Object Modeling modules (see table 1), but these changes were mainly made for the Passing, New Goal or Open Challenge[1]

Table 1. Modules modified by the Dutch Aibo Team in 2006

modules	**DT2005 solutions**	**DT2006 solutions**	**details**
ColorTableModule	ColorTable64	**ColorTableACC**	Automatic Color Calibration demonstrated at Dutch Open [3,5]
ImageProcessor	DT2005	**DT2006**	added Panoramic solution demonstrated at Open Challenge
BallLocator	DT2005	**DT2006**	modification for Passing Challenge [4]
ObstaclesLocator	DT2005	**DT2006**	opponent penalty area obstacle for penalty shooter
SelfLocator	DT2005	**DT2006**	added Panoramic solution and rely more on motion model
BehaviorControl	DT2005-soccer	**DT2006-soccer**	several improvements

The developments made for the soccer-competition were concentrated in the BehaviorControl module. Some options were modified and a number of new options were created (see table 2). The main improvement was the incorporation of the localization inside the behaviors. Instead of constantly chasing the ball, some moments were included to look around and to update the current location. This improved our scoring ability. In the second round of the 2006 competition the Dutch Aibo Team scored 10 goals (compared to 3 goals in the second round of the 2005 competition). This secured us from a place in the quarterfinals and a qualification for Atlanta 2006[2]. In the quarterfinal the later world-champion NuBots was met. This allowed us to concentrate our resources on the Technical Challenges, were we were successful in the Open Challenge and the New Goal Challenge.

Table 2. Soccer-options created and modified by the Dutch Aibo Team in 2006

options	**description**
playing-and-localize	new high-level option between play-soccer and playing. Players localize after a waiting time, dependent on the position and handling of the ball
playing	task-vision-request is set to odometry when head down
playing-goalie	goalie blocks more often
playing-supporter	supporter blocks more often (but less than goalie)
playing-stricker	ball is considered to be out-of-the-field earlier
turn-and-release	corrected turn-and-release
walk-with-ball	new option to avoid obstacles
grab-ball-with-head	increased the speed the ball is approached
penalty-playing	when too close to the goal, robot walks a little back
handle-ball-penalty-shooter	modified to shoot exactly

[1] the source-code of the competition is available on `http://www.dutchaiboteam.nl/robocup/robocup2006/` since 19 July 2006. This code is intentional not standalone, but requires the prior installation of the 2004 distribution of the German Team and the 2005 distribution of the Dutch Aibo Team.

[2] see also `http://www.dutchaiboteam.nl/robocup/robocup2006/` for the competition results and more extensive dayly reports.

2. Passing Challenge

For the Passing Challenge a strategy was developed based on communication [2]. Information about the ball state ('ball is free' or 'ball is possessed') is exchanged. The robot that is going for the ball sends out a team-message to let this decision be known to its teammates. When the teammates receive this message, none of them will try to approach the ball. Instead, they prepare to receive the ball. After the first robot performs a kick, it will send another team-message to inform the teammates that they can go for the ball. This strategy will reduce the confusion of multiple robots going for the ball. This strategy allowed passing the ball around between three robots, but every time on a different position.

This strategy was adapted at the RoboCup so that it could cope with the fixed position as specified in the Challenge rules [3]. Unfortunately, during the Challenge there was a miscommunication, and the confusion that should have been prevented occurred. This challenge was no success.

3. New Goal Challenge

This year an attempt was made to solve a Challenge completely with the Tekkotsu framework. This framework is a good choice for educational projects, because its learning curve is not that steep. Inside the project [1] good progress was made. The robots were able to find the goal and to find the ball, localize, to grab and to shoot. Unfortunately at the latest moment a bug prevented us to present this solution. Instead the normal penalty behavior was used, with the improved scoring capability already demonstrated during the competition. In spite of the placement of the defending robots on inconvenient places a goal was scored, enough to guarantee a shared third place.

4. Open Challenge

For the Open Challenge a new approach for localization [7] was demonstrated. The localization is based on a visual compass sensor [6] that can provide a mobile robot with heading likelihoods for each supplied camera image. The visual compass sensor can provide this information purely based by learning the visual appearance of a room as a whole. There is no dependence on color-tagged objects on the soccer-field, as demonstrated during the Open Challenge. The same approach also works for other environments, as demonstrated during the RoboCup symposium and at many other locations [9]. The visual compass algorithm is efficient, scalable and can therefore work in real-time for any contemporary robotic platform. More details can be found in [6].

This approach was demonstrated in the Open Challenge by placing the robot at the center of the field. The robot turns one round to learn the most important colors in the surroundings. Then a second round is made to learn the distribution of transitions between those important colors as function of the orientation. After that the distribution is learned, the surroundings were changed by removing the goals and beacons. The field lines were covered by a number of flags from the participating teams. The robustness of the approach was demonstrated by kidnapping the robot and placing it on a random position with a random orientation. The robot turned than back to yellow goal, as learned in the previous step. The orientation estimation has an accuracy depending on the position from the learned spot. Until a distance of 2 meters the error in the orientation is less than 10 degrees. This demonstration was well received and resulted in the 4th place for this Challenge.

[3] `http://www.tzi.de/4legged/pub/Website/Downloads/Rules2006.pdf`.

5. Acknowledgements

Our participation in the RoboCup 2006 event (as well as the Dutch Open 2006 event) could not have been possible without the help from many groups and persons from the Dutch AIBO Team. Although the overall team consists of several research groups (see www.dutchaiboteam.nl/partners for an overview), we especially wish to thank the following groups and their people for their contributions and involvement in our AIBO soccer and RoboCup activities: Ad Feelders, Jeff Ouwerkerk, Rico Slagmolen and the other Bachelor students from this year's Software Project (Universiteit Utrecht), Pieter Jonker (Technische Universiteit Delft), Dave van Soest, Mark de Greef and the other Master students (Universiteit van Amsterdam), Gert Kootstra (Universiteit Groningen) and Technical Committee member Niek Wijngaards (DECIS Lab). Further, we would like to thank our sponsors, who made the journey to Bremen possible. A part of the research conducted this year is performed in the context of the Interactive Collaborative Information Systems (ICIS) project, supported by the Dutch Ministry of Economic Affairs, grant nr: BSIK03024.

References

[1] R. van den Beukel *et al.*, "Software Project 2006, AIBO", Universiteit Utrecht, June 2006.
[2] I. Esteban, M. de Greef, D. van Soest and A. Mahdi, "Cooperative Robots: Expectation and Message Driven Behavior", Universiteit van Amsterdam, February 2006.
[3] M. de Greef and D. van Soest, "Automatic Color Calibration on a Robosoccer-field", Technical report, Universiteit van Amsterdam, June 2006.
[4] A. Mahdi, M. de Greef, D. van Soest and I. Esteban, "On Joint Actions for an Aibo Team", Technical report, Universiteit van Amsterdam, February 2006.
[5] D. van Soest, M. de Greef, J. Sturm and A. Visser, "Autonomous Color Learning in an Artificial Environment", in "Proc. 18th Dutch-Belgian Artificial Intelligence Conference, BNAIC'06", Namur, Belgium, October 2006.
[6] J. Sturm, *An appearance-based visual compass for mobile robots*, Master's thesis, Universiteit van Amsterdam, December 2006.
[7] J. Sturm, P. van Rossum and A. Visser, "Panoramic Localization in the 4-Legged League", in "Proc. 10th RoboCup International Symposium", Bremen, June 2006, to be published in the Lecture Notes on Artificial Intelligence series, Springer Verlag, Berlin.
[8] A. Visser, P. van Rossum, J. Westra, J. Sturm, D. van Soest and M. de Greef, "Dutch AIBO Team at RoboCup 2006", in "Proceedings CD RoboCup 2006, Bremen, Germany", June 2006.
[9] A. Visser, J. Sturm and F. Groen, "Robot companion localization at home and in the office", in "Proc. 18th Dutch-Belgian Artificial Intelligence Conference, BNAIC06", Namur, Belgium, October 2006.