Team Description Paper

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1 Team & Background

The University of Koblenz-Landau would like to apply for participation in the RoboCup Mixed Reality League in Suzhou, China 2008. Our team is composed of ten team members and two supervisors. All members are graduate students of Computational Visualistics. Our supervisors are Ph.D candidates currently researching in the working groups of artificial intelligence and computer graphics.

1.1 Team

Oliver Abert
Team supervisor. For his dissertation he works on interactive raytracing of NURBS surfaces.

Markus Maron
Team supervisor. He is primarily engaged in artificial intelligence methods for different kinds of information networks.

Matthias Bohnen
Graduate student. As a member of the 2007 World Champions "Team HELENA" from Osaka University in RoboCups Physical Visualization Sub-League, he is our team coordinator.

Martin Freidank
Graduate student. Part of the application development team.

Andreas Koch
Graduate student. Part of the application development team.

David Mann
Graduate student. Part of the application development team.

Carsten Effert
Graduate student. Part of the vision tracking development team.

Eckard Großmann
Graduate student. Part of the vision tracking development team.

Thorsten Habelitz
Graduate student. Part of the vision tracking development team.

Lina Brühl
Graduate student. Part of the graphics module development team.

Sebastian Bzdak
Graduate student. Part of the graphics module development team.

Bastian Sdorra
Graduate student. Part of the graphics module development team.
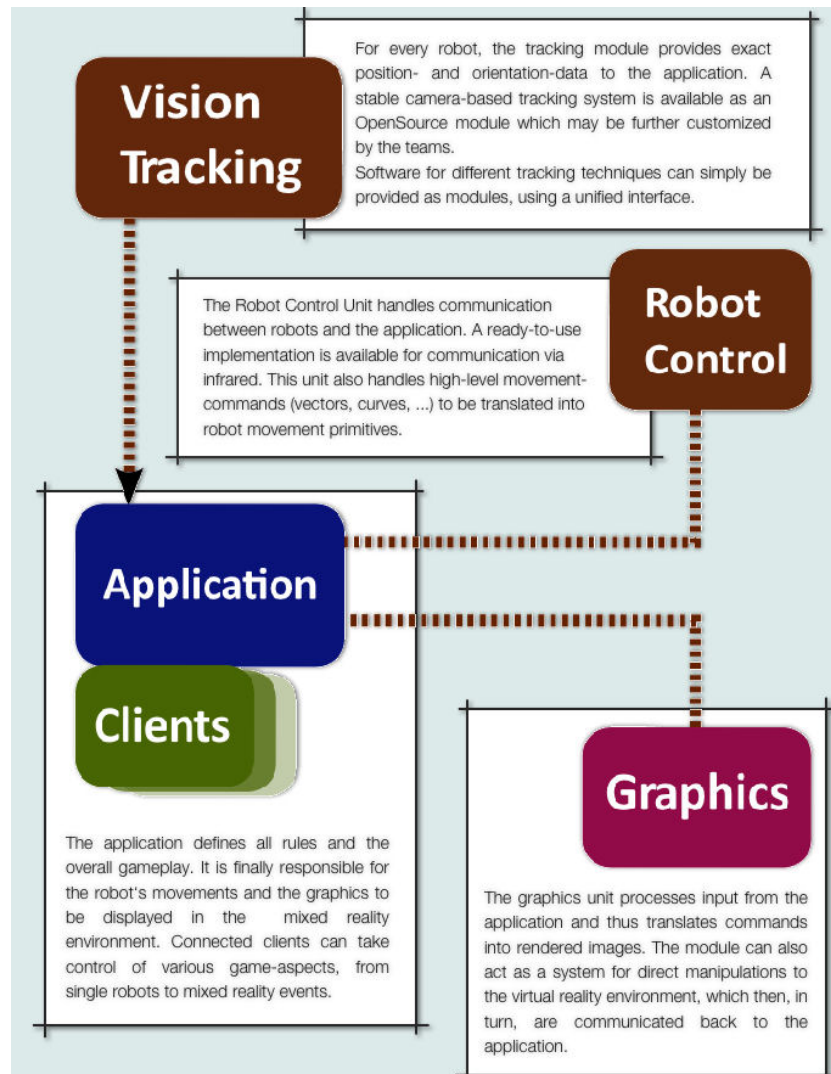
1.2 Background

The University of Koblenz-Landau first took part in the 2D Soccer Simulation League in RoboCup 1999. Since then we participated in various competitions of the RoboCup tournaments such as the 2D and 3D Soccer Simulation League and the RoboCup Rescue League. We did not only take part, but also contributed a lot to the organization and development of the RoboCup. Until 2003 all competitions were held in the 2D Soccer Simulation League. Later Marco Kögler, Markus Rollmann and Oliver Obst developed a simulator for the 3D Soccer Simulation League which was presented 2003. It was possible to start the first official 3D Soccer Simulation League competition at RoboCup 2004. [1] In addition, some of the university members like Oliver Obst, Jan Murray und Joschka Boedecker were involved in organizing the RoboCup events as well as the German Opens as members of the Technical committee, the Organizing committee, the Maintenance committee or as the Organizing chair. The University of Koblenz-Landau also organized RoboCup related events, e.g. a RoboCup workshop during a german AI conference (KI 2005). Over the years we also had a lot of teaching activities like student research projects, diploma theses and lectures.

The bibliography at the end of this document gives an overview of our involvement in RoboCup.

2 Contributions to the Platform

Our team seeks to contribute three software components to the mixed reality platform. The software for this league has been organized into four modules: vision tracking, graphics, robot control and the application (see Fig. 1).

Each module is a seperate process and they communicate over the network.

Vision Tracking

For every robot, the tracking module provides exact position- and orientation-data to the application. A stable camera-based tracking system is available as an OpenSource module which may be further customized by the teams.
Software for different tracking techniques can simply be provided as modules, using a unified interface.

Robot Control

The Robot Control Unit handles communication between robots and the application. A ready-to-use implementation is available for communication via infrared. This unit also handles high-level movement-commands (vectors, curves, ...) to be translated into robot movement primitives.

Application

Clients

The application defines all rules and the overall gameplay. It is finally responsible for the robot's movements and the graphics to be displayed in the mixed reality environment. Connected clients can take control of various game-aspects, from single robots to mixed reality events.

Graphics

The graphics unit processes input from the application and thus translates commands into rendered images. The module can also act as a system for direct manipulations to the virtual reality environment, which then, in turn, are communicated back to the application.

Fig. 1. Mixed Reality platform diagram (taken from: http://jeap-res.ams.eng.osaka-u.ac.jp/~guerra/MR08/)

2.1 Application Framework

Extending upon Fig. 1, we are developing a framework for application modules. This framework takes the job of coordinating the communication with the other modules over the network via XML and provides the application-developer with a standard world data model, collision detection, an event system and several minor features such as a class for vector operations, statistics, debugging and so

on. A developer who uses this framework should not need to worry about the other modules, it should work out of the box if the modules he is using adhere to the XML structures that we have defined.

2.2 Graphics Module

The second contribution is a graphics module. This module is intended to be completely generic, which means that it can be basically used by any application. To use this generic graphics module, the application has to deliver all content to the graphics module on start up in an archive we call "themepack". While the application is running, it has to send commands to the graphics module. Commands state which effect from the themepack should be displayed at which position. Effects can be textures, sounds, 3D models etc.
Furthermore, our graphics module provides a small standard set of primitives such as 2D line, circle or rectangle.

2.3 Markerless Tracking

The third software component we want to contribute is an algorithm for the vision tracking module that allows tracking of markerless, randomly shaped objects on the screen. This algorithm will be an important improvement for the

Fig. 2. Vision tracking algorithm in action

mixed reality platform. Only if the application can detect randomly shaped objects it will be able to make meaningful use of the *mixed* reality environment. Fig. 2 shows the result of this markerless tracking. The shape of the objects are precisely detected (red line). For each shape a list of up to 40 coordinates is encoded in a XML structure and send to the application.

3   Proposed Research Program

We propose two research programs at our university.

1.) The mixed reality hardware and software are a good fit to our multi agent research project "Focus program on RoboCup", sponsored by DFG. As a part of this research project, we extend and apply our work on formal verification of properties of multi agent systems to the mixed reality platform.

2.) When investigating the possibilities that the mixed reality platform provides for us, we came to the conclusion that it would be a real benefit to the platform if the vision tracking module was able to detect randomly shaped objects placed on the screen. Detecting these objects without requiring markers would be even better. Therefore, the mixed reality platform is an opportunity to research, invent and examine different computer vision algorithms for markerless tracking. The expected outcome is a robust vision tracking algorithm.

4   Prior, Ongoing or Planned Educational Activities

After investigating the possibilities that the mixed reality platform offers, the University of Koblenz-Landau decided to put efforts into this project. In October 2007 we received ten Eco-Be! robots from Citizen of Japan. Since then, we have one ongoing practical exercise around the mixed reality platform. This exercise is performed by the ten members of our team under supervision of Ph.D candidates Markus Maron and Oliver Abert. After a verification of the robots and their hardware we started to explore the existing official soccer server from RoboCup 2007. The next step was to develop our own application framework, a vision tracking module and a graphics module. At the moment, the work is in the testing phase and we are planning to have a running version in the next few weeks.
Important parts of this work, such as the graphics module and the application framework, is intended to become part of the official mixed reality platform as outlined in section 2.

With the beginning of the summer term in April, we plan to use the mixed reality competition hardware and software in student diploma theses or student research projects on multi agent systems, vision tracking and 3D computer graphics and will possibly start a new practical exercise that continues where the current exercise leaves of.

Furthermore, the mixed reality league plays an important role in our plans for our exchange program with Osaka University. Our team member Matthias

Bohnen was involved with the mixed reality league development in Osaka as an exchange student in the winter term 2006/2007. [2] Currently, another student from Koblenz, Rafael Spring, is working on his student research project on the mixed reality league in Osaka as an exchange student, too. As this exchange program continues, students from Osaka can come to Koblenz to work on mixed reality league related topics and vice versa.

References

1. Kögler, M.: Simulation league: The next generation. Fachberichte Informatik 3-2003 (2003)
2. Bohnen, M.: Verwendung von genetischen Algorithmen zur Verbesserung der Wegfindung von Eco-Be! Robotern (Using genetic algorithms to improve the path finding of Eco-Be! robots). Studienarbeit, Universität Koblenz-Landau, Germany (November 2007) (German only).
3. Ben Amor, H., Boedecker, J., Maas, A., Murray, J., Obst, O., Rettinger, A., Ringelstein, C.: Team Description RoboLog Koblenz 3D. In Noda, I., Jacoff, A., Bredenfeld, A., Takahashi, Y., eds.: Proceedings of RoboCup 2005: Robot Soccer World Cup IX. (2005)
4. Boedecker, J., Mayer, N.M., Ogino, M., da Silva Guerra, R., Kikuchi, M., Asada, M.: Getting closer: How simulation and humanoid league can benefit from each other. In Murase, K., Sekiyama, K., Kubota, N., Naniwa, T., Sitte, J., eds.: Proceedings of the 3rd International Symposium on Autonomous Minirobots for Research and Edutainment (AMiRE 2005), Awara-Spa, Fukui, Japan, Springer-Verlag (September 2005)
5. Dylla, F., Ferrein, A., Lakemeyer, G., Murray, J., Obst, O., Röfer, T., Stolzenburg, F., Visser, U., Wagner, T.: Towards a League-Independent Qualitative Soccer Theory for RoboCup. In Nardi, D., Riedmiller, M., Sammut, C., Santos-Victor, J., eds.: RoboCup 2004: Robot Soccer World Cup VIII. Volume 3276. Springer, Berlin, Heidelberg, New York (2005) 611–618
6. Furbach, U., Murray, J., Schmidsberger, F., Stolzenburg, F.: Model Checking Hybrid Multiagent Systems for the RoboCup. In Visser, U., Ribeiro, F., Ohashi, T., Dellaert, F., eds.: Proceedings of the RoboCup Symposium 2007. (2007) (An LNAI version will appear later).
7. Lima, P., Custódio, L., Akin, L., Jacoff, A., Kraezschmar, G., Ng, B.K., Obst, O., Röfer, T., Takahashi, Y., Zhou, C.: Robocup 2004 competitions and symposium: A small kick for robots, a giant score for science. AI Magazine **26**(2) (Summer 2005) 36–61
8. Mayer, N.M., Boedecker, J., da Silva Guerra, R., Obst, O., Asada, M.: 3D2Real: Simulation league finals in real robots. (2006)
9. Murray, J.: Specifying agents with UML statecharts and StatEdit. In Bonarini, A., Browning, B., Polani, D., Yoshida, K., eds.: RoboCup 2003: Robot Soccer World Cup VII. Volume 3020 of Lecture Notes in Artificial Intelligence. Springer (2004) 145–156
10. Murray, J.: Soccer Agents Think in UML. Diplomarbeit (D 610), Universität Koblenz-Landau, FB4 Informatik (2001)
11. Murray, J.: My goal is my castle – Die höheren Fähigkeiten eines RoboCup-Agenten am Beispiel des Torwarts. Studienarbeit, Universität Koblenz-Landau, Germany (March 1999) (German only).

12. Murray, J., Obst, O., Stolzenburg, F.: RoboLog Koblenz 2000. In van der Hoek, W., ed.: Proceedings of the Workshop for the Robocup European Championship, Vrije Universiteit Amsterdam (2000) Team description.
13. Murray, J., Stolzenburg, F., Obst, O., Bremer, B.: RoboLog Koblenz: Complex agent scripts implemented in logic. In Sablatnög, S., Enderle, S., eds.: Proceedings of the Workshop RoboCup during KI'99 in Bonn. (1999) 12–25 SFB 527 Report 1999/12, Universität Ulm.
14. Obst, O.: Specifying rational agents with statecharts and utility functions. In Birk, A., Coradeschi, S., Tadokoro, S., eds.: RoboCup-01: Robot Soccer WorldCup V. Number 2377, Berlin, Heidelberg, New York, Springer (2002) 173–182
15. Obst, O.: Using model-based diagnosis to build hypotheses about spatial environments. Springer, Berlin, Heidelberg, New York (2004) 518 – 525
16. Obst, O.: Controlling Physical Multiagent Teams: Getting League-Independent Results from RoboCup Soccer. PhD thesis, Universität Koblenz-Landau, Koblenz (February 2006)
17. Obst, O.: The RoboLog Soccer Server Interface. 3rd edn. (February 1999)
18. Obst, O.: RoboLog: Eine deduktive Schnittstelle zum RoboCup Soccer Server. Master's thesis, Universität Koblenz (February 1999)
19. Obst, O.: RoboCup: FC-Linux - Mit Linux zur Fußball-WM. Linux-Magazin (8) (1998) 48–51
20. Obst, O.: RoboLog – An ECLiPSe-Prolog SoccerServer Interface: Users Manual. (March 1998)
21. Obst, O., Boedecker, J.: Flexible coordination of multiagent team behavior using HTN planning. In Noda, I., Jacoff, A., Bredenfeld, A., Takahashi, Y., eds.: Proceedings of RoboCup 2005: Robot Soccer World Cup IX. (2005)
22. Obst, O., Maas, A., Boedecker, J.: HTN planning for flexible coordination of multiagent team behavior. In Visser, U., Lakemeyer, G., Vachtesevanos, G., Veloso, M., eds.: Proceedings of the IJCAI-05 Workshop on Agents in Real-Time and Dynamic Environments, Edinburgh, Scotland (July 2005) 87–94
23. Obst, O., Murray, J., Dettori, M., Stolzenburg, F.: The RoboLog Soccer Server Interface. Universität Koblenz-Landau. (2000)
24. Obst, O., Rollmann, M.: SPARK: A generic simulator for physical multiagent simulations. Computer Systems Science and Engineering **20**(5) (September 2005) 347–356
25. Stolzenburg, F., Murray, J., Sturm, K.: Multiagent matching algorithms with and without coach. In Schillo, M., Klusch, M., Müller, J., Tianfield, H., eds.: Proceedings of the 1st German Conference on Multiagent System Technologies. LNAI 2831, Erfurt, Springer, Berlin, Heidelberg, New York (2003) 192–204
26. Stolzenburg, F., Obst, O., Murray, J.: Qualitative velocity and ball interception. In Jarke, M., Köhler, J., Lakemeyer, G., eds.: KI-2002: Advances in Artificial Intelligence – Proceedings of the 25th Annual German Conference on Artificial Intelligence. Number 2479, Berlin, Heidelberg, New York, Springer (2002) 283–298
27. Stolzenburg, F., Obst, O., Murray, J., Bremer, B.: RoboLog Koblenz: Spatial agents implemented in a logical expressible language. In Coradeschi, S., Balch, T., Kraetzschmar, G., Stone, P., eds.: Team Descriptions — Simulation League, Linköping University Electronic Press (1999) 116–120
28. Stolzenburg, F., Obst, O., Murray, J., Bremer, B.: Spatial agents implemented in a logical expressible language. In Veloso, M.M., ed.: Proceedings of the 3rd International Workshop on RoboCup in Conjunction with 16th Joint International Conference on Artificial Intelligence, Stockholm, IJCAI press (1999) 205–210