An Overview of RoboCup 2002 Fukuoka/Busan

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1 Introduction

The sixth Robot World Cup Competition and Conference (RoboCup 2002) Fukuoka/Busan took place between June 19th and 25th in Fukuoka: competitions were held at Fukuoka Dome Baseball Stadium from June 19th to 23rd, 2002, followed by the International RoboCup Symposium on June 24th and 25th, 2002.

RoboCup is an attempt to foster research on intelligent robotics by providing a standard problem with the ultimate goal of building a team of eleven humanoid robots that can beat the human World Cup champion soccer team by 2050. It is obvious that building a robot to play soccer is an immense challenge; readers might therefore wonder why we even bother to organize RoboCup. Our answer is: It is our intention to use RoboCup as a vehicle to promote robotics and AI research, by offering a publicly appealing but formidable challenge [1,2].

A unique feature of RoboCup is that it is a systematic attempt to promote research using a common domain, mainly soccer. Also, it is perhaps the first benchmark to explicitly claim that the ultimate goal is to beat a human World Cup champion team. One of the more effective ways to promote engineering research, appart from specific application developments, is to define a significant long term goal. When the accomplishment of such a goal has significant social impact, we call it a *grand challenge project*. Building a robot to play soccer is not such a project. But its accomplishment would certainly be considered a major achievement in the field of robotics, and numerous technology spin-offs can be expected during the course of the project. We call this kind of project a *landmark project*, and RoboCup definitely falls into this category.

Since the first RoboCup in 1997 [3], the event has grown into an international joint-research project in which about 3000 scientists from 30 nations around the world participate (see Table 1 and Figure 1). It is one the most ambitious landmark projects of the 21st century. RoboCup currently consists of three divisions: RoboCupSoccer, aiming towards the final goal stated above, RoboCupRescue, a serious social application to rescue activities for any kinds of disasters, and RoboCupJunior, an international education-based initiative designed to introduce young students to robotics. The RoboCup 2002 competition was the largest

G.A. Kaminka, P.U. Lima, and R. Rojas (Eds.): RoboCup 2002, LNAI 2752, pp. 1–7, 2003.

Table 1. Evolution of RoboCup Initiatives

Leagues/years	1997	1998	1999	2000	2001	2002
RoboCupSoccer						
Simulation	official	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$
Small-size	official	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$
Middle-size	official	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$
Legged		exhibition	official	$\Longrightarrow$	$\Longrightarrow$	$\Longrightarrow$
Humanoid				exhibition	exhibition	official
RoboCupRescue						
Simulation				official	$\Longrightarrow$	$\Longrightarrow$
Real robot				exhibition	official	$\Longrightarrow$
RoboCupJunior			exhibition	official	$\Longrightarrow$	$\Longrightarrow$

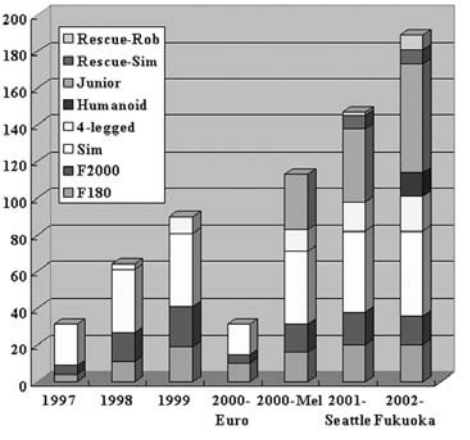

Fig. 1. The number of teams

since 1997, and set epoch-making new standards for future RoboCups. 1004 team members of 188 teams from 30 nations around the world participated. The first humanoid league competition was held, with participation from 13 teams from 5 nations. Further, the first ROBOTREX (robot trade and exhibition) was held with about 50 companies, universities, and institutes. A total of 117,000 spectators witnessed this marvelous event. To the best of our knowledge, this was the largest robotics event in history. Figs. 2 (a) and (b) show the dome and competition site.

This article presents the summary of the RoboCup 2002 (for more details, refer to [4]). The reports and symposium proceedings of past RoboCups are available [5,6,7,8,9,10,11,12,13].

2 RoboCupSoccer

RoboCup Soccer has the largest number of leagues: the simulation league, the small-size robot league, and the middle-size robot league (since the first RoboCup

(a) The RoboCup 2002 flag and the dome

(b) Inside the dome

Fig. 2. The competition site

Fig. 3. All participating members

in 1997); also the four-legged league (which was introduced at the exhibition in 1998 and became an official league in 1999). From this year on, there is also a humanoid league, a big challenge with a long term and high impact goal, which could generate major spill-over effects. The expected industrial, scientific and educational impacts will be enormous [14].

Table 2 summarizes each league's settings and challenges.

3 RoboCupRescue

Simulation League

A rescue team is composed of heterogeneous agents - fire brigades, ambulances, police, and their control centers. The agents cooperate each other in order to

Table 2. RoboCupSoccer Leagues and Challenges in 2002

Items Leagues	robot size	On-board sensing	Off-board sensing	# of players	filed size	Challenges & Issues
Simulation	N/A	YES	coach agent	11	N/A	coach competition visualization
Small-size	[diameter] $<$ 18cm	allowed but almost not used	TV camera from ceiling color markers on the players	5	2.4m x 2.9m	navigation shooting passing
Middle-size	[diameter] $<$ 50cm	YES color uniform & color corner poles	NO	4	5m x 8m	dribbling cooperation
Legged	AIBO	YES color uniform six color poles & wireless comm.	NO	4	3m x 4.5m	pattern recognition collaboration ball collection
Humanoid	[Height] $\approx$ 40cm $\approx$ 80cm $\approx$ 120cm $\approx$ 180cm	YES	YES	1	7.2m x 10.4m	one-leg standing walking PK free performance

save buried victims, to extinguish fires, to repair roads, etc., in a virtual disaster field. Programming rescue agents provides a concrete platform for multi-agents research issues such as: handling incomplete information, no global system control, decentralized data and asynchronous computation. The teams are ranked based on the total points of their rescue operations.

Real Robot League

Ten teams from five countries participated in the RoboCupRescue Robot League in 2002. Most robots were remotely teleoperated and had limited autonomy. Due to the complexity of the problem, fully autonomous robots cannot be practical, yet. Adjusted autonomy, shared autonomy, and autonomy for human interfaces are suitable to apply AI to real disaster problems.

4 RoboCupJunior

In 2002 the third international RoboCupJunior tournament was held. As indicated by the number and range of registrations, the initiative has exploded in popularity. Fifty-nine teams from twelve countries participated. For the first time, the event attracted teams from a wide geographical region. Three challenges were offered: *dance*, *1-on-1 soccer* and *2-on-2 soccer*. In total, 240 students and mentors were involved.

Fig. 4. Robovie is playing with kids at ROBOTREX 2002

5 ROBOTREX

To promote the robot technologies necessary to achieve the final goal of RoboCup, we organized the first ROBOTREX (Robot Trade and Exhibition) at the same site of the sixth RoboCup. A wide range of the most advanced robot technologies for perception, action, and intelligence should be evolved toward our final goal. Therefore, it has been said that robotics is the main industry in this century. The main aim of ROBOTREX is to promote robotics research and development by providing the space for researchers and industry to meet each other. It also allows ordinary people to be informed about the current technology and to think about its future, through experiences with robots.

In spite of being the first event of this kind, fifty companies, institutes, universities, and local governments participated. A variety of exhibitions covering a wide range of applications, such as factory automation, security, care, and entertainment were shown and many people enjoyed the exhibitions.

6 Symposium and RoboCup Milestones Panel

The International RoboCup Symposium, an annual event at RoboCup, was held on June 24 and 25, 2002, immediately following the RoboCup competition events. The symposium attracted approximately 300 researchers, some who participate in RoboCup and others who came for the symposium itself. The symposium was multi-disciplinary, sporting research results in areas such as learning, planning and plan-recognition, vision, robot localization and navigation, education, and simulation. 17 oral presentations were given, marking an acceptance rate of 22%. In addition, 21 short papers were presented in two poster sessions.

The 2002 RoboCup Symposium held a number of special events. Three papers were selected for awards signifying science and engineering excellence (see the

Preface). A long-term milestone road-map for RoboCup was discussed in a panel including all league-chairs (see below). Finally, there were five invited talks, two of which took place in a joint session with DARS 2002, the 6th International Symposium on Distributed Autonomous Robotic Systems, which was also held in Fukuoka.

The RoboCup road-map panel was held to discuss recent and future work from the perspective of the year 2050 goal: develop a team of fully autonomous humanoid robots that can win against the human world soccer champion team. The RoboCup leagues started the discussion about the Roadmap in 2001 ([15]). The panelists from the different leagues were asked to think about milestones in the following way: What do we need in 2040 to reach the 2050 goal? To reach this milestone in 2040, what do we need in 2030? Then the milestones for 2020 and 2010 can be defined with the view to 2030.

Many of the milestones discussed require progress in fields very different from AI, including material engineering, power supply, mechanics, artificial muscles and sensors, etc. Other milestones pose significant, but more familiar challenges, including integrated perception, planning, and learning, vision, action-selection, multi-agent collaboration and coordination, etc. Combined efforts in all these fields will lead to new scientific and technological issues and new results. In addition, The panel touched on the educational challenges facing the RoboCup Junior league in teaching children to build and work with robotic technology.

7 Conclusion

The RoboCup 2002 competitions, the exhibitions, and the conference were a great success. Many people, not only researchers but also ordinary people, especially children, participated and enjoyed the whole event. RoboCup 2003 will be held in July 2003 in Padva, Italy.

Acknowledgement

We thank all participating team members, the organizing committee members, and the local arrangement committee members for their efforts. Special thanks should go to the Fukuoka City people for their tremendous efforts to make RoboCup 2002 possible. Two photos in Fig.2 were taken by Dr. Kaori Yoshida, CS, Kyushu Institute of Technology.

References

1. H. Kitano, M. Asada, Y. Kuniyoshi, I. Noda, E. Osawa, and H. Matsubara. "robocup: A challenge problem of ai". *AI magazine*, 18(1):73–85, 1997.
2. Minoru Asada, Hiroaki Kitano, Itsuki Noda, and Manuela Veloso. Robocup: Today and tomorrow – what we have learned. *Artificial Intelligence*, 110:193–214, 1999.
3. Hiroaki Kitano, editor. *RoboCup-97: Robot Soccer World Cup I.* Springer, Lecture Note in Artificail Intelligence 1395, 1998.

4. Gal Kaminka, Pedro U. Lima, and Raul Rojas, editors. *RoboCup 2002: Robot Soccer World Cup VI*. Springer, Lecture Note in Artificail Intelligence, 2003 (to appear).
5. I. Noda, S. Suzuki, H. Matsubara, M. Asada, and H. Kitano. Robocup-97 the first robot world cup soccer games and conferences. *AI magazine*, 19(3):49–59, 1998.
6. Minoru Asada, Manuela M. Veloso, Milind Tambe, Itsuki Noda, , Hiroaki Kitano, and Gerhard K. Kraetzschmar. Overview of robocup-98. *AI magazine*, 21(1):9–19, 2000.
7. Silvia Coradeschi, Lars Karlsson, Peter Stone, Tucker Balch, Gerhard Kraetzschmar, and Minoru Asada. Overview of robocup-99. *AI magazine*, 21(3):11–18, 2000.
8. Peter Stone, Minoru Asada, Tucker Balch, Raffaello D'Andrea, Masahiro Fujita, Bernhard Hengst, Gerhard Kraetzschmar, Pedro Lima, Nuno Lau, Henrik Lund, Daniel Polani, Paul Scerri, Satoshi Tadokoro, Thilo Weigel, and Gordon Wyeth. Robocup-2000: The fourth robotic soccer world championships. *AI magazine*, 22(1):11–38, 2001.
9. Manuela Veloso, Tucker Balch, Peter Stone, Hiroaki Kitano, Fuminori Yamasaki, Ken Endo, Minoru Asada, M. Jamzad, B. S. Sadjad, V. S. Mirrokni, M. Kazemi, H. Chitsaz, A. Heydarnoori, M. T. Hajiaghai, and E. Chiniforooshan. Robocup-2001: The fifth robotic soccer world championships. *AI magazine*, 23(1):55–68, 2002.
10. Minoru Asada and Hiroaki Kitano, editors. *RoboCup-98: Robot Soccer World Cup II*. Springer, Lecture Note in Artificail Intelligence 1604, 1999.
11. Manuela Veloso, Enrico Pagello, and Hiroaki Kitano, editors. *RoboCup-99: Robot Soccer World Cup III*. Springer, Lecture Note in Artificail Intelligence 1856, 2000.
12. Peter Stone, Tucker Balch, and Gerhard Kraetzschmar, editors. *RoboCup-2000: Robot Soccer World Cup IV*. Springer, Lecture Note in Artificail Intelligence 2019, 2001.
13. Andreas Birk, Silvia Coradeschi, and Satoshi Tadokoro, editors. *RoboCup 2001: Robot Soccer World Cup V*. Springer, Lecture Note in Artificail Intelligence 2377, 2002.
14. H. Kitano and M. Asada. The robocup humanoid challenge as the millennium challenge for advanced robotics. *Advanced Robotics The international Journal of the Robotics Society of Japan*, 13, 2000.
15. H.-D. Burkhard, D. Duhaut, M. Fujita, P. Lima, R. Murphy, and R. Rojas. The road to robocup 2050. *IEEE Robotics and Automation Magazine*, 9(2):31 – 38, June 2002.