



Progress and Research Results In Robot Soccer

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RoboCup : Goal

**By the year 2050,
develop a team of fully autonomous humanoid robots
that can win against the
human world soccer champion team.**

- More than 3000 researchers from about 35 countries / regions.
- The RoboCup Federation: a Non Profit Organization registered in Switzerland.
- National Committees in more than 10 countries. Supporting conferences and coordinating research with industry and related government organization.



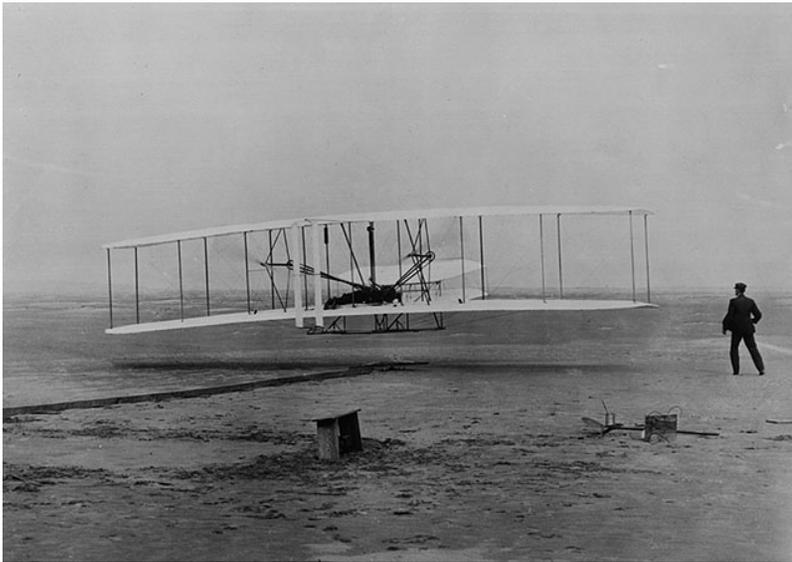
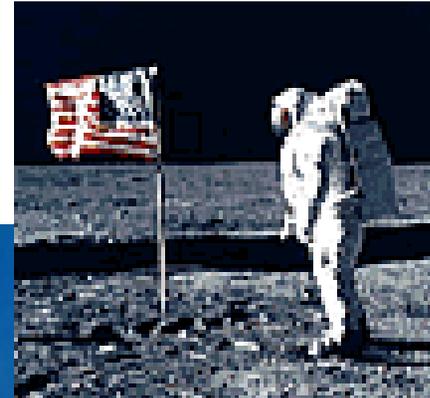


Can we accomplish the goal?

1903



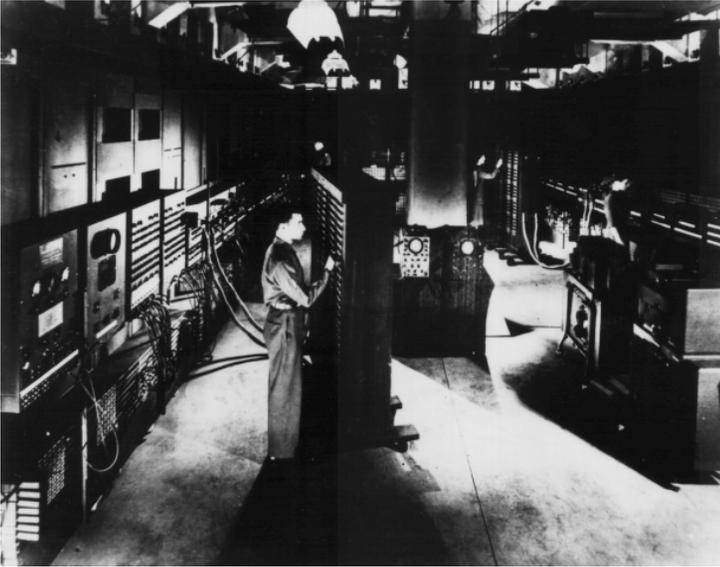
1969



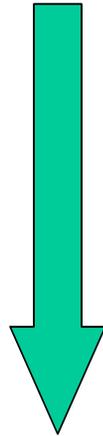
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Computer Chess



ENIAC
1946



Deep Blue
1997



© IBM



Why RoboCup?

- **A Landmark Project**
 - **Challenging goal and spill-over of technologies**
- **A platform for project-oriented education in science and technology**
- **A standard problem for AI and robotics.**



Apollo Project

- **Dream: Send men to the moon and safely return them to the earth. (J.F.K.)**
- **Technologies: systems science, electronics, aviation, project management, etc.**
- **Effects: Major impacts on U.S. industries.**



Computer Chess

- **Dream:** to develop a computer that can beat human chess champion.
- **Technologies:** Search algorithms, parallel computing, parallel machine architectures, etc.
- **Effects:** Basic computer algorithms, parallel programming, etc.



Computer Chess Vs. RoboCup

CHESS

- Static
- Turn-taking
- Complete information
- Symbolic
- Central control

RoboCup

- Dynamic
- Real-time
- Incomplete info
- Non-symbolic
- Distributed control



Application of RoboCup technologies

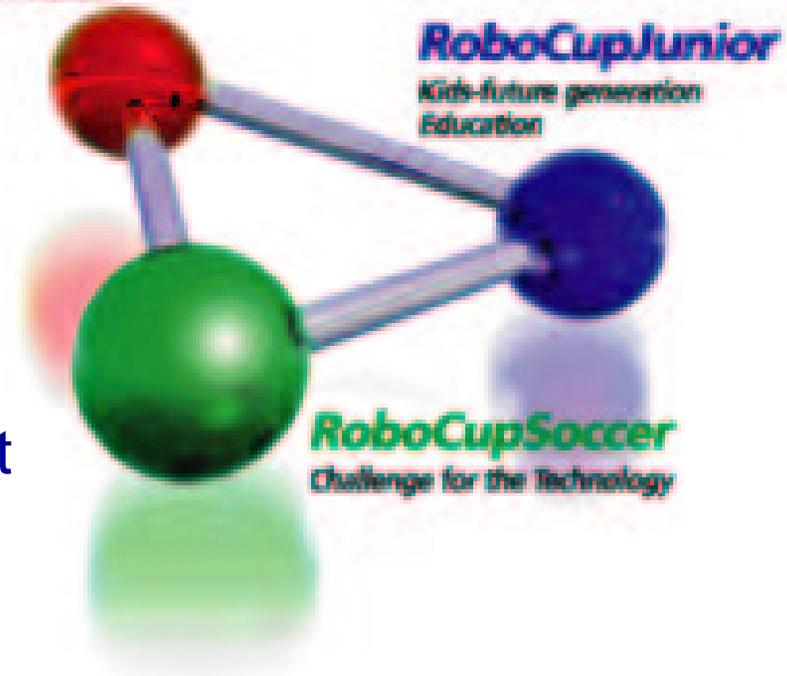
- Disaster rescue
- Intelligent Traffic Systems (ITS)
- Deep space exploration
- Office robots
- Distributed agents



RoboCup : Activities

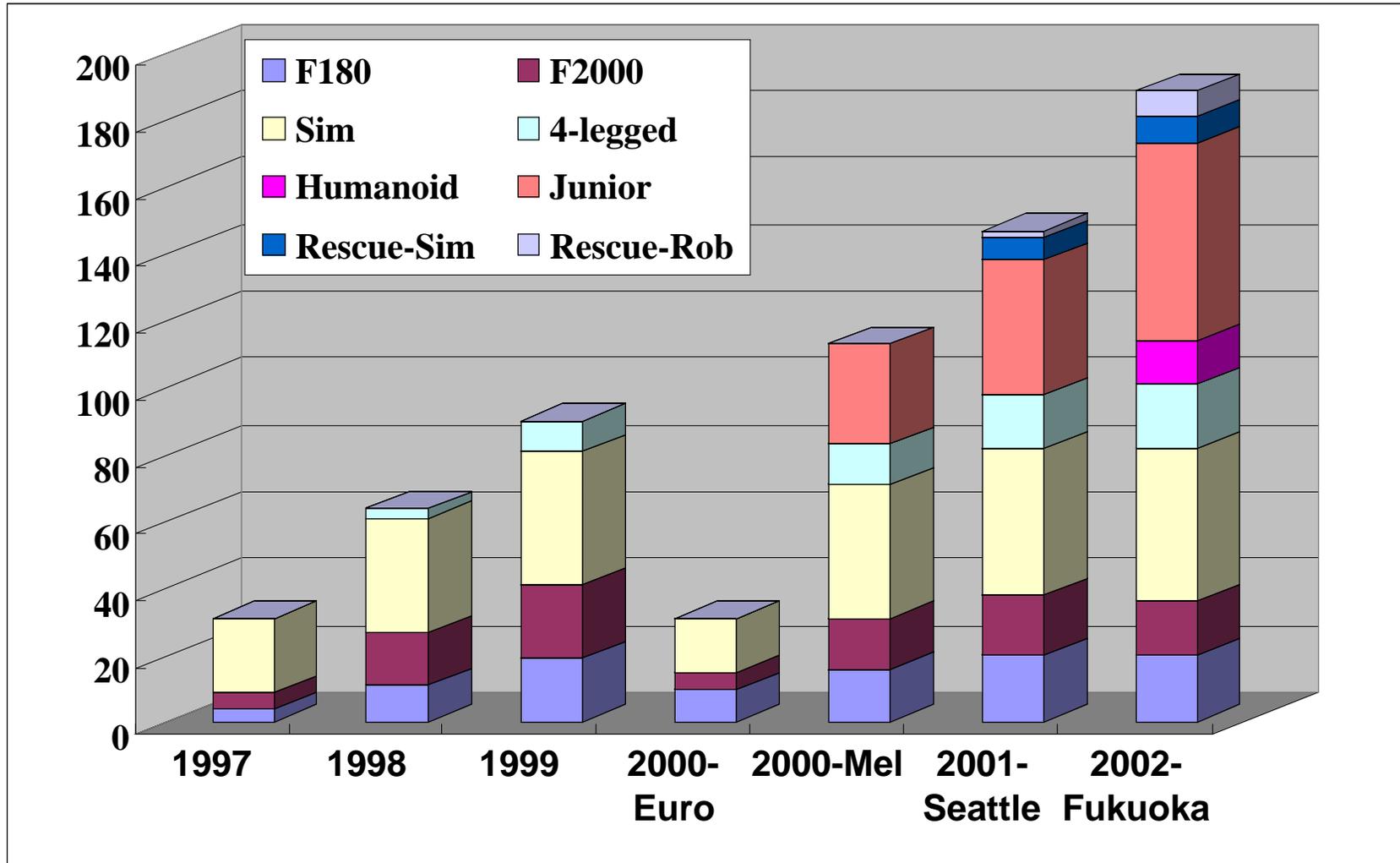
- ***RoboCupSoccer***
Research project
using soccer
- ***RoboCupJunior***
International education project
using robots
- ***RoboCupRescue***
Disaster rescue system research

RoboCupRescue
Application for Practice





Number of Teams





RoboCup

International Championship

- **RoboCup-97 Nagoya**
- **RoboCup-98 Paris**
- **RoboCup-99 Stockholm**
- **RoboCup-2000 Melbourne**
- **RoboCup-01 Seattle**
- **RoboCup-02 Fukuoka/Busan**
- **RoboCup 03 Padua (Italy)**
- **RoboCup 04 Lisbon (Portugal)**
- **RoboCup 2050**



RoboCup 2002

120,000 visitors in 3 days





- **7th International Championship games and conferences**
- **Biggest in size:**
242 teams
from 35 countries/regions
more than 1200 participants.
- **2nd year for Humanoid League**



RoboCup Soccer



Small-sized League



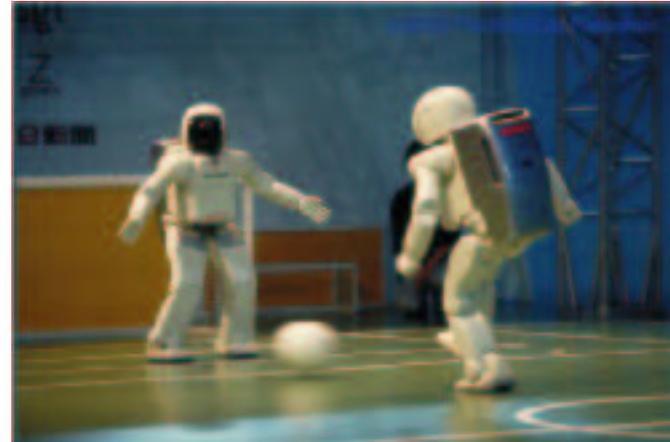
Middle-sized League



Legged Robot League



Simulation League



Humanoid League



Small-size robot league





Middle-size robot league





Four-Legged robot league



Humanoid League

1. Standing on one leg

2. Walking

Walk the distance 5 times of the robot height.

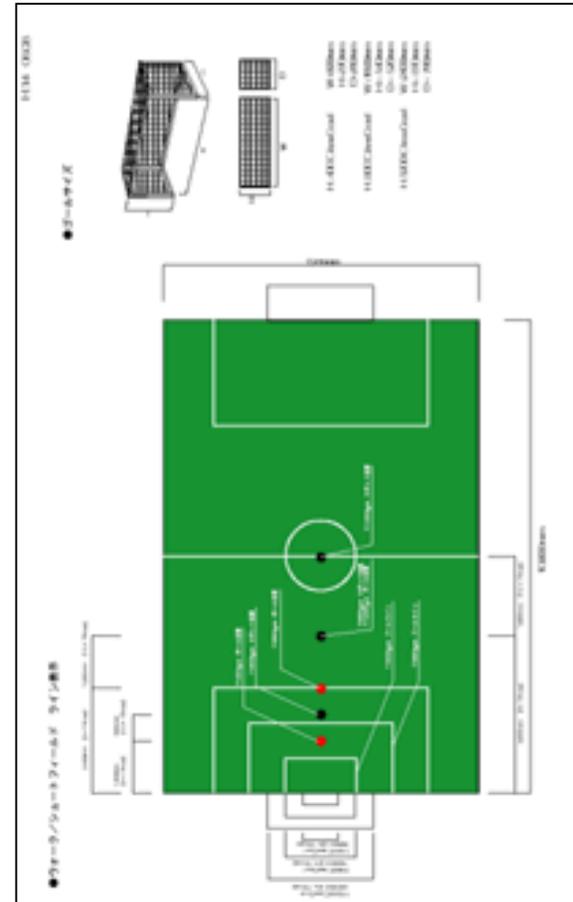
3. Penalty Kick

40cm, 80cm and 120cm classes.

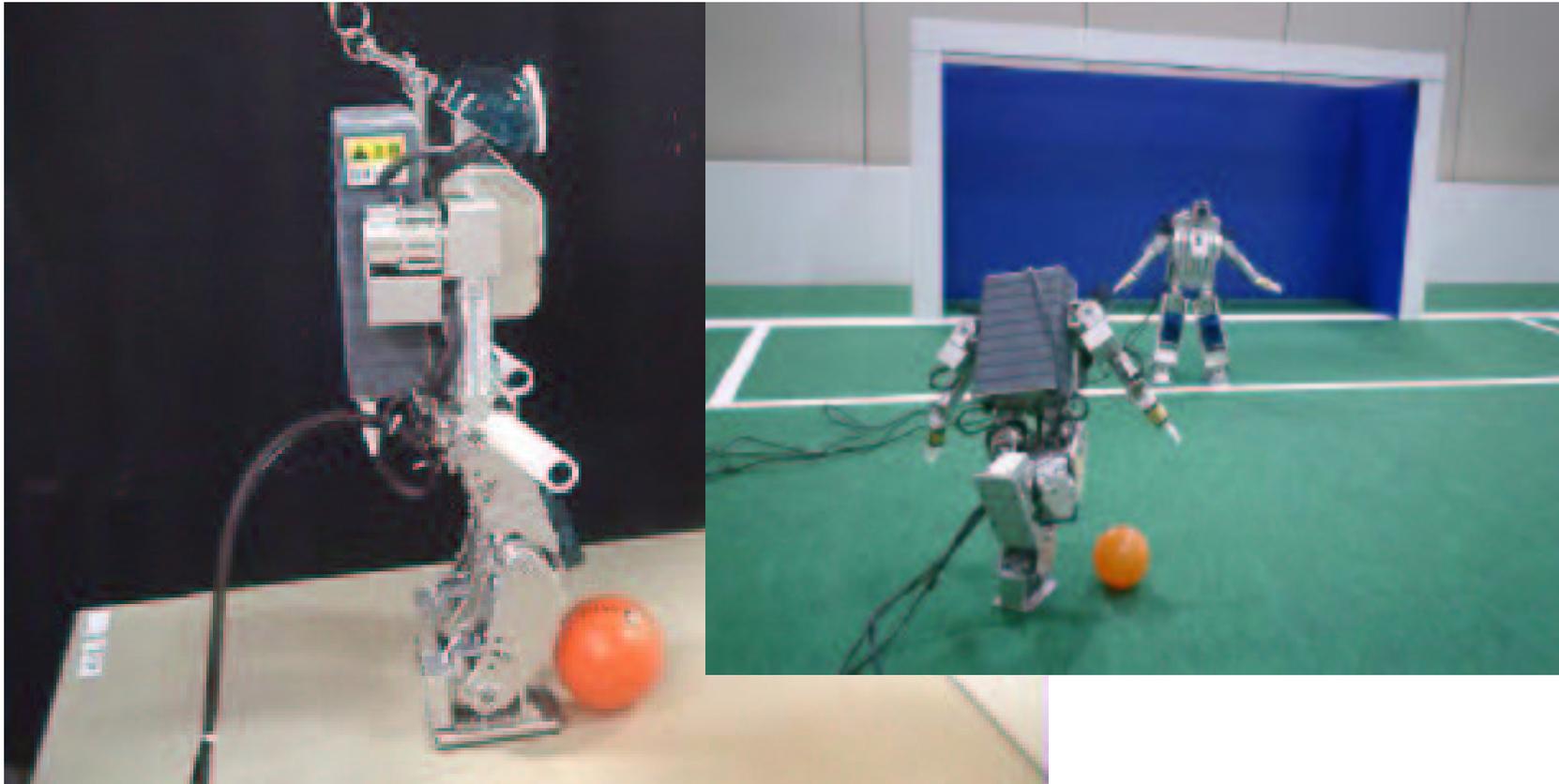
5 goals per team.

4. Free Style

5 minutes free demonstration



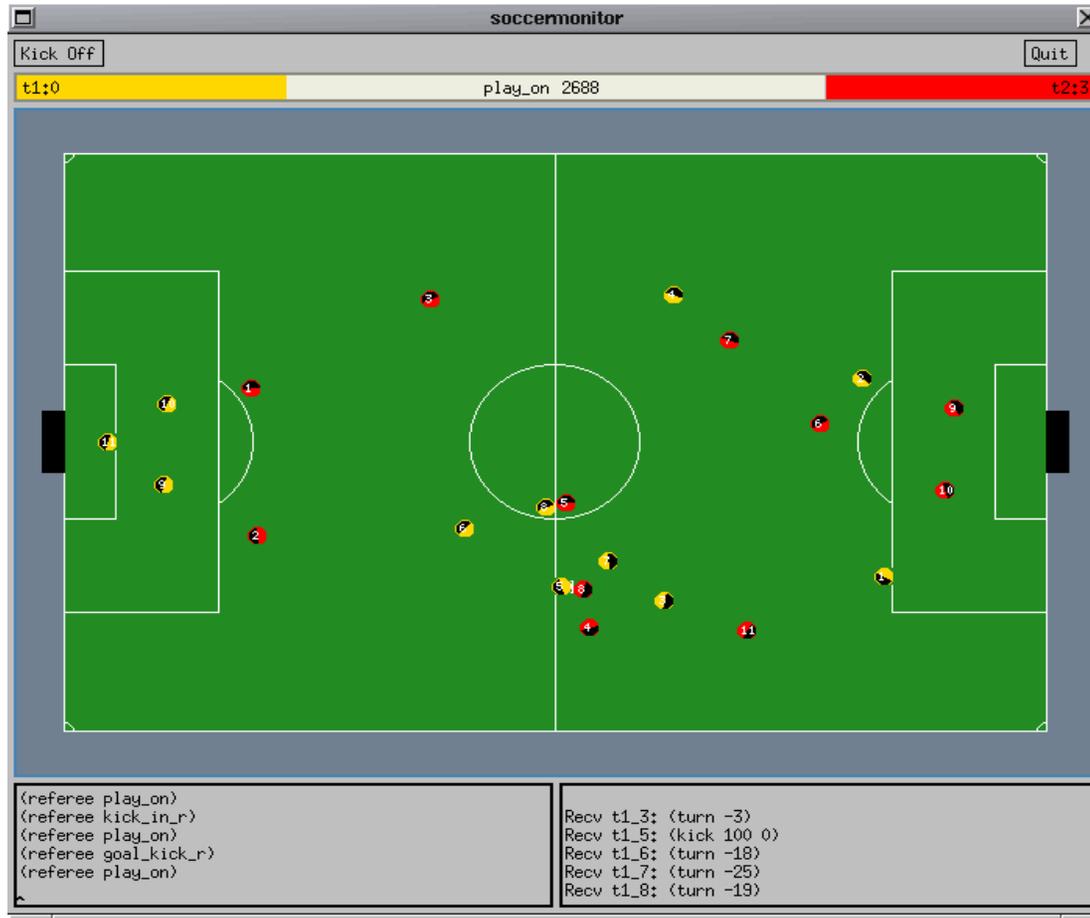
Humanoid PK



Osaka University "Senchans" team (HOAP-1)

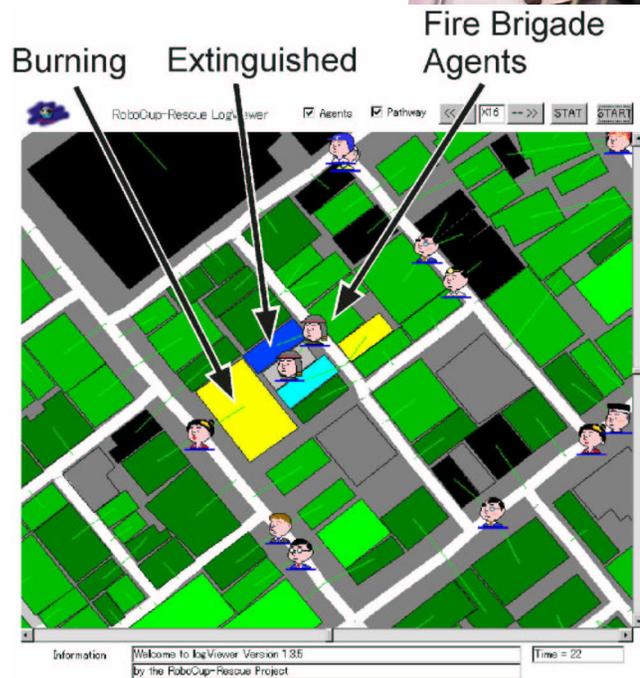


Simulator system





RoboCup Rescue





Rescue vs. Soccer

Heterogeneous agents

Homogeneous agents

Very large number of agents (> 1,000)

11 agents / team

Hostile environment

Hostile opponent

Logistics

Reactive teamwork

Resource sharing

Real-time planning

Emergent teamwork



Current Status

- Large Scale Disaster Simulator publicly available.
- Study on rescue robots underway.
- First competitions were at RoboCup-2001



3D Simulation and Visualization



Computer Graphics by the Port Authority Research Center, Ministry of Construction, Government of Japan



Vision of RoboCup-Rescue

- Develop a comprehensive Rescue Simulator and make it available to public.
 - Create “Rescue Science”
 - Evaluation of rescue strategies
 - Promote AI and robotics research
- Integrate with real command control system
- The standard for rescue systems.

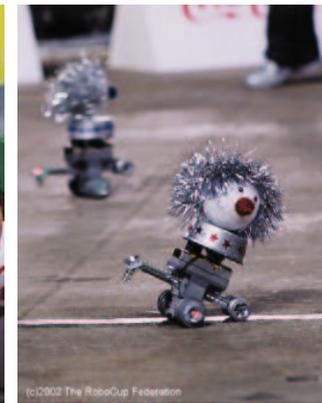


RoboCupJunior

SOCCER



DANCE





<http://www.robocup2004.pt/>

<http://www.robocup.org>



RoboCup Drives Research in

- Control algorithms,
- Machine vision, sensing and localization,
- Real-time distributed computing,
- Real-time ad hoc networking,
- Mechanical design,
- Machine learning, and
- Autonomous multiagent systems