

HRT Extended Abstract for Humanoid Kid-size

League of Robocup 2026

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Abstract. This paper outlines the lessons learned from our participation in previous RoboCup Humanoid League competitions and presents the planned system improvements for RoboCup 2025. This season, our development focuses on multi-robot cooperation, kicking strategy optimization, robust visual perception, gait stabilization, and faster recovery motions after falling. The primary goal is to improve overall behavioral efficiency by refining cooperation and decision-making strategies, thereby reducing low-reward actions. These enhancements aim to shorten target localization time and enable faster goal scoring.

Keywords: RoboCup · Algorithms · Strategy · Cooperation

1. Introduction

The HRT team has participated in RoboCup China since *2024*. Based at Huazhong University of Science and Technology, the team originated as a student research group and has since evolved into a university spin-off startup. The team is currently developing a full-sized humanoid robot platform, Zhixing II.

RoboCup competitions provide a comprehensive benchmark for evaluating humanoid robot systems under real-world constraints. Through continuous participation, the team identifies system limitations in perception, motion control, and decision-making. This paper summarizes the major lessons learned from previous competitions and presents the planned improvements for RoboCup 2026.

2. Lessons Learned and Major Problems

Several challenges were observed during recent competitions.

2.1 Vision Perception

The current system employs YOLOv5 for object detection, achieving reliable ball recognition. However, goalpost detection is frequently affected by white field lines, and lighting variations further degrade stability, resulting in inconsistent localization.

2.2 Motion Control

The robot lacks a well-trained powerful kicking motion. Existing kicking models do not support long-distance passing, which limits offensive performance during matches.

2.3 Decision-Making

Current strategies are mainly designed for ideal scenarios and do not sufficiently consider opponent interference. Consequently, ball loss occurs more frequently in real games, indicating limited robustness in adversarial environments.

3. Planned System Improvements

To address the above issues, several major upgrades are scheduled for RoboCup 2025.

3.1 Vision

TensorRT acceleration will be introduced to improve inference speed. In addition, the goalpost detection pipeline will be refined to reduce interference from field markings and enhance robustness under varying illumination.

3.2 Motion

A powerful kicking model will be trained using the LASSC simulation environment, enabling stronger shots and improved adaptability across diverse field conditions.

3.3 Decision-Making

We plan to enhance global map construction by sharing obstacle information among teammate robots. Furthermore, a probabilistic mapping framework will be introduced, converting the field into probabilistic grids. Each robot updates ball existence probabilities within its local regions based on its own observations and those of teammates. Using analytical methods or reinforcement learning, the system estimates likely search directions after ball loss, reducing unnecessary exploration and improving search efficiency.

4. Conclusion

Building on accumulated experience, our team aims to achieve substantial improvements in humanoid robot systems. By upgrading training pipelines, developing more stable gait and vision algorithms, and establishing a robust decision-making framework, we seek to overcome previous technical limitations. Our objective is to deliver stronger performance at RoboCup 2025 while contributing practical advances to humanoid robotics research.