RoboFEI Humanoid Soccer Robot - KidSize League - Team 2025

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Abstract. To prepare a team fully equipped to compete in the RoboCup Humanoid League, this extended abstract highlights the lessons learned and the major improvements implemented since the 2024 competition.

Keywords: Humanoid Robots · RoboCup Competition · KidSize League.

1 Introduction

Since its debut in the Humanoid Soccer KidSize League Competition in 2014, the RoboFEI team has consistently participated in every edition of RoboCup, aiming to improve its robots. Composed of undergraduate students, the team's mission since the project began in 2012 has been to explore, learn, and implement advancements in humanoid robots. Over the years, the team transitioned from the KidSize League to the Teen Size League, reflecting a shift in focus toward building taller and more capable robots. This effort led to the development of **Prometheus**, an 80 cm, 7.5 kg robot that competed in Bangkok and Bordeaux. However, mechanical instabilities and other challenges prompted the creation of smaller, adapted versions of Prometheus: **Draco** and **Altair.**

While Draco and Altair showed improvements during the Brazilian RoboCup Open in 2023, where the team earned second place, the results were not entirely satisfactory. As a result, the team decided to develop a completely new robot from scratch: **Atom**. This new robot competed in the most recent RoboCup, held in the Netherlands, and in the Brazilian Robotics Competition (CBR) in Goia nia, delivering excellent performances. At the national level, Atom secured second place, marking a significant achievement for the team and validating the efforts invested in its design and development.

2 Hardware Improvement

In the mechanical sector, only minor adjustments were made to Atom to address wear and tear on components from previous competitions, along with structural reinforcements to enhance durability. However, the mechanical team is now focused on developing a new robot, which will be a smaller and lighter version of Atom. This new design aims to increase speed and agility, addressing specific performance needs. The team plans to complete this robot in time for the 2025 RoboCup, which will take place in Salvador.

On the electrical side, an integrated communication board was implemented, alongside a complete reorganization of the robot's chest electronics. This redesign made the internal structure more compact and organized, reducing potential issues with wiring and improving accessibility. Additionally, the electrical team is working on integrating strain gauges using load cells in the feet of the smaller robot to enhance balance and force measurement capabilities. A new IMU system, based on Arduino, is also under development, aiming to optimize motion control and stability for the next-generation robot.

3 Software

The software is composed of packages that communicate with each other based on resources offered by Robot Operating System 2 (ROS2) in the Humble Hawksbill version and is written in Cpp and Python. The system is divided into motors, control, decision, vision, imu, game controller, custom interfaces, GUI (Graphical User Interface) and robot bring up. In addition, YOLOv8 is used for vision.

Previously, the camera used three vertical lines and two horizontal lines to help the robot identify the ball's position, classifying it as right, left, centered, centere left, centered right, far, or near. However, the system was updated to only use two vertical lines and two horizontal lines, allowing the robot to classify the ball as right, left, center, far, or near. Additionally, the real-time camera feed can now be toggled on or off via an external UDP server for debugging purposes. The team also integrated the robot's CAD model into ROS, aiding in programming and improving the overall development process.

In the decision-making system, the players now behave differently on the field. One player follows a "walk and shoot" strategy, while the other only handles the ball. Moreover, the decision process for the goalkeeper has been simplified to streamline its actions during the game.

References

1. “RoboFEI Humanoid League Team TDP 2024.” RoboCup HumanoidSoccer TeenSize League (2024)
2. “RoboFEI Humanoid League Team TDP 2023” RoboCup HumanoidSoccer TeenSize League (2023)