RoboFEI Humanoid Soccer Robot - KidSize League - Team 2024

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Abstract. In order to prepare a team fully capable of playing soccer in RoboCup Humanoid League, this extended abstract presents the lessons learned and the main changes made since the competition in 2023.

Keywords: Humanoid Robots · RoboCup Competition · KidSize League.

1 Introduction

Since its first participation in the Humanoid Soccer KidSize League Competition 2014, the RoboFEI team has participated in each RoboCup edition to develop its robots. Being composed of graduation students, it has been our mission every year since the beginning of the project in 2012 to search, learn, and work on improvements for the Humanoid Kid Size robots. This mindset has been observed throughout the following years, as the team has always competed with different robots, always trying to achieve better results than the one obtained in the previous competition. Since 2019, the team has been trying to increase the height of its robot, taking part in the Teen Size League that year. This development led to the construction of the robot Prometheus, which is 80cm and 7.5 kg. This robot has competed in Bangkok and Bordeaux [1].

However, due to instabilities and mechanical difficulties, the team decided to reduce the size of its robots. The new robots, which already competed in the Brazilian RoboCup Open in October 2023, are an evolution of the Prometheus. Two new robots have already been built: Draco and Altair, with 74cm and 6.8 Kg. During the Brazilian competition in October, the team could visualize not only its improvements, given that it won second place, but also, once again, discover new areas for development.

2 Hardware Improvement

Regarding the mechanical improvements, the studies concerning the robot's center of mass resulted in a more organized chest, in which all the interior components are now fixed and well-planned. Also, the team has been on a mission to

decrease the robot's weight, as this was one of the most significant problems we had to deal with, considering the instability and difficulty when creating its movements. For that reason, Draco and Altair have multiple hollow mechanical parts, in addition to the replacement of some aluminum and steel for carbon fiber. Besides the practicality of making the necessary adjustments during competition, the new robot has accomplished better results in walking, kicking, turning, and the remaining movements. The team is also focused on studying ways to cushion the robot's fall so that it takes as minor damage as possible, and also different types of engine gaskets so that the robot will be able to succeed in realizing its movements without the amount of repairing that have to be made nowadays.

In the electrical sector, a new board for the communication of the motors and the IMU is being developed. For the motors' communication, it is necessary to have an RS485 to USB converter and a TTL to USB converter for the IMU communication. A hub USB will also be on this board because these converters, the camera, and the keyboard with the mouse require more USB ports than are available at the NUC. By doing that, we will have fewer wires that can cause contact problems or short circuits.

Our robot currently has two batteries, one for the motors and one for the NUC: we intend to leave just one battery in 2024. A new main board to power the motors and the NUC with only one battery is also being developed; that way, it will have less weight on the robot's chest. Besides these changes in our current robot, the team is also working on a completely different robot named Susteinaban, inspired by Rhoban's Sigmaban [2] and CIT Brains' Sustaina OP [3] robots. We are currently simulating this new robot using Nvidia's Omniverse platform.

3 Software

The software structure has been the same as the previous year (vision, decision, control, and communication with the game controller and sensors). The main focus has been remaking some ROS packages and removing programming errors, such as the one that does not allow the control of the head and the body simultaneously. We also plan on recognizing field landmarks and developing a robot localization system.

References

1. Oliveira et al. "RoboFEI Humanoid League Team TDP 2023." RoboCup Humanoid Soccer KidSize League (2023)
2. Loic et al. "Rhoban Football Club: RoboCup Humanoid KidSize 2019 Champion Team Paper." Robot Soccer World Cup (2019).
3. Hayashibara et al, RoboCup2022 KidSize League Winner CIT Brains: Open Platform Hardware SUSTAINA-OP and Software. In RoboCup 2022: Robot World Cup XXV. (2022)