Blenders Football Club: Extended Abstract

RoboCup Humanoid KidSize Soccer 2024

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Abstract. The following extended abstract presents the most relevant scientific development of our humanoid system as well as the team's research interest.

Keywords: Humanoid · Soccer · RoboCup.

1 Introduction

Blenders F.C. is the humanoid soccer team of the Monterrey Institute of Technology, Campus Guadalajara, in Mexico. The team has been working on this project since 2021. We have participated in the Mexican Robotics Tournament in the same category and winning a Special Exhibition Recognition with our 4 humanoid robots [1].
Blenders F.C. is part of Robotec, the Guadalajara campus' robotics student group dedicated to participate in national and international competitions. Specially, in mobile robotics where we have participated before in several Sumo competitions like Robo Rave in 2018 and 2023.

2 Humanoid Robotic System

Scientific Development Our prior experiences, though not in RoboCup, have taught us a lot. They've been crucial in fine-tuning our project and figuring out where we could improve. We have faced different challenges, like the walk we developed using a kinematic model not being enough to maintain the robot's balance and being quite slow. For this reason, we decided to use the walking algorithm installed in the robot's libraries based on [2]. We plan to find the ideal parameters and tune accordingly as we have observed grass and irregular terrains can have a great impact on the robot's stability. Moreover, the movement algorithm is calculated through dynamics in three dimensions in order for the robot to walk towards the ball.
For the vision algorithm, we can define three different strategies, mainly using OpenCV: Ball detection, Goal detection and Line detection.

Ball detection For this strategy, a HSV segmentation algorithm was used originally. It was then replaced by a machine learning algorithm to be more robust and to avoid variations depending on the illumination and calibration. Now, a Haar Cascade [3] is trained with a creation of our own dataset with pictures of footballs in our test environment.

Line detection With the robot's camera, green is segmented in a mask and inverted to obtain everything inside the field. Then, Hough Line Detection [4] is used to process the image and identify field markings.

Goal detection with the above masks, the white lines are subtracted in order to have only the goalpost and ball. However, as the ball is detected with a different algorithm, it is removed. For the goalpost, a region of interest is defined, and its histogram is calculated. The image is scanned to find the highest white value, determining the goal's position. False positives are minimized by focusing only on elements within the green mask.

Research Interests As we keep on working and improving our algorithms, our next step is to implement dynamic walk with our own calculations based on ZMP [2], as well as implementing YOLOv5 to process the image in the cloud and returning the result. We also plan to create a more robust controller as well as a velocity controller to make the movement smoother. With this in mind, we can make the robots have specific positions and improve their performance, for example, equip our goalie with a Kalman filter for prediction. Ultimately, we aspire to train a neural network for human-like behavior in a soccer match.

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