MRL Team Extended Abstract for Humanoid Kid Size League of RoboCup 2024

Saeed Bazargan, Abolfazl Ashayeri, Alireza Golchin, Ramtin Kosari, Mehdi Zeinali, Yeganeh Almasi T., Erfan Ramezani, Maryam Shaban and Hamed Mahmudi

Mechatronics Research Lab, Dept. of Computer and Electrical Engineering, Qazvin Islamic Azad University, Qazvin, Iran

Email: Bazargan0241@qiau.ac.ir

Introduction and History: MRL-HSL from the University of Islamic Azad University, Qazvin, has been an active participant in RoboCup since 2011. This paper aims to elucidate the progress and improvement achieved in both the software and hardware aspects of the Ashkan robot platform.

1 Robot vision

We have incorporated the latest Sony Eye Camera into our robot vision sources. We have updated our model and retrained it with new and relevant data to improve line detection and accurate depth information.

1.1 Ball detection

from last year in order to trying to implement our object detection system in full resolution input size, we have changed our old ball detection system model to YOLOv3 and now we have better inference from our last ball detection model and minimized detection fps down to 35 milliseconds (in best case, worst 70) and maximize the accuracy.

1.2 Automated Camera and Neck Calibration

To enhance the robot's vision capabilities, we've implemented an automated calibration process for both the camera lens and robot neck. Precision is achieved through fine-tuning the lens focal length and biases, ensuring accurate data acquisition. Employing a real-time calibration method with a chessboard pattern, we continuously update parameters based on the real-world environment, seamlessly integrating results into the robot's configuration files. The Particle Swarm Optimization (PSO) algorithm is also used to dynamically refines neck movement parameters.

2 Behavior

As we mentioned in our last released Extended abstract [1], we were working on reinforcement learning algorithms in order to improve head tracking and body soft movement; and it’s been resulted effectively on webots simulation system, but unfortunately lack of enough electrical resurgence and mechanical limits, had prevent us to reach reliable results to deploy reinforcement directly on humanoid robots. We are going to use deep reinforcement learning methods on our robots instead of classical state-machines that make robots more human.

3 Mechanical design and dynamical analysis

Due to the new rules of RoboCup 2024 and integration of Kid Size and Teen Size into one league, we decided to design a new platform of the humanoid robot. The previous platform was made by entirely aluminum which makes the weight of the robot heavy [2]. For this reason, we're going to use a combination of carbon composite, 3D printer filament and aluminum for the robot's body structure. The dynamical analysis before manufacturing of the robot is needed to reduce costs and errors [3]. Since the new

platform of MRL humanoid robot is being designed, the use of simulator for dynamical analysis purposes is required. MRL-HSL real-time simulator [2] is a virtual humanoid robot which helps to dynamical analysis with considering forces on mechanical parts.

References

1. Mahmoudi, H., et al.: MRL Team Description Paper for Humanoid KidSize League of RoboCup 2019. Mechatronics Research Lab, Dept. of Computer and Electrical Engineering, Qazvin Islamic Azad University, Qazvin, Iran (2019)
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3. Mahmudi, H., et al.: MRL Team Description Paper for Humanoid TeenSize League of RoboCup 2019. Mechatronics Research Lab, Dept. of Computer and Electrical Engineering, Qazvin Islamic Azad University, Qazvin, Iran (2019).