RO:BIT Team Extended Abstract for Humanoid Kid Size League of RoboCup 2023

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Abstract. this extended abstract presents RO:BIT's new hardware and improvement plans and current progress for RoboCup 2023. Based on the problems and lessons from the participation in previous RoboCup competitions.

1 Introduction

This paper describes the team RO:BIT, which was developed and will be developed based on experience through RoboCup 2019 and RoboCup 2022 for RoboCup 2023. In previous competitions, the hardware weight was so heavy that it caused walking instability that it often fell while walking toward the ball, which eventually slowed the robot down. Also, in the past [1], YOLO v4 was used to detect the ball and the characteristic lines of the field were obtained by video processing. This method had the disadvantage of low accuracy. To solve the above problems, we have redesigned the hardware, improved the existing walking control algorithm, and plan to introduce a new algorithm to our vision to localize and classify the lines and objects in the field.

2 Hardware Developments

We found two major drawbacks in the hardware of RoboCup 2022. The leg frame was distorted, causing problems with the overall robot operation, and the heavy mass of the foot, which increase the inertia moment, takes its toll on the actuator and made it difficult to control. In order to solve these problems a fitting design was applied, and the aluminum material alloy was changed from 5052 (AlMg2.5) to 6061 (AlMg1SiCu) with a higher strength. In addition, the model of load cell sensor for ZMP (Zero Moment Point) control was changed. The weight of this sensor was reduced by 20%p compared to the previous one, reducing the weight of the foot by 200g.

Localization And Vision

In the RoboCup 2022 accuracy of our Vision and Localization technology was not enough to play game stably. So, we are trying to apply Semantic Segmentation to Vision to improve Observation Model. Last year, we recognized the ball and x-cross through deep learning using Yolo v4-tiny. However, the new Vision system will recognize all the balls, fields, lines and robots through Semantic Segmentation using deep learning. In addition, we will apply OpenPose's Joint prediction model, extract the line's Joint, and then compare it with Likelihood Field to compensate for the position [2]. Also, we have the plans to increase the depth of Likelihood and compare not only lines but also robots and ball positions on the field.

3 Walking Control

Our team have a problem of having to adjust the parameters again when the environment changes because we work on adjusting the parameters and walking in a limited environment. To prevent this, posture control was performed through IMU and ZMP (Zero Moment Point) [3]. Our team's posture control is achieved with performing a set motor offset at a predefined walking cycle, but through the previous RoboCup, we found it difficult to obtain applicable posture control values in various situations, such as walking forward or sideways. So we plan to develop a simulation and use it to apply reinforcement learning to posture control. Additionally, we will add the current walking state to the criteria for posture control to facilitate posture control.

Reference

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3. Nakaura, Shigeki, and Mitsuji Sampei. "Balance control analysis of humanoid robot based on ZMP feedback control." IEEE/RSJ International Conference on Intelligent Robots and Systems. Vol. 3. IEEE, 2002.