HERoEHS, Team Extended Abstract

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Abstract. This team expansion abstract is about robot ALICE version 3 of HERoEHS, a team that participated in the RoboCup adult size league until 2022. Based on the 2022 RoboCup experience, I will improve the problems and show a good performance in the 2023 RoboCup.

Keywords: ALICE · RoboCup · Adult size league · Humanoid robot

1 Introduction

Team HERoEHS has been participating in the RoboCup humanoid adult-size league since 2018. In 2018, we have built ALICE version 1, and in 2019 we upgraded to ALICE version 2. In 2020, it was upgraded to ALICE version 3. In 2022 ALICE version 3 performed a lot of skills. And we are trying to show smooth competition performance in RoboCup 2023. [1], [2], [3], [4] We are studying and accumulating practical techniques for humanoid robots through RoboCup participation, that is the value we will continue to pursue. Therefore, we are currently working hard to show the Robocup participants ALICE version 3, a faster, more stable, and smarter robot in RoboCup 2023.

2 Technical Issues

2.1 Walking Algorithm

All humanoid robots of Team HERoEHS have used ZMP-based walking method. In particular, ZMP-based preview controls have been used to improve walking stability. [5] However, in a real-time situation such as soccer game, the preview control was not effective. To overcome this, we optimized the code to minimize the transition time between walking and walking. And we deviated from the discretized walking pattern by implementing omnidirectional walking using a bezier curves. Finally, we developed to modify a walking path close to real time according to the location of the target.

2.2 Mechanical Design

ALICE's neck was improved through four-bar linkage. Compared to previous structures in which the head frame is directly assembled to the motor, the robot can see the ball in front of its feet more clearly and has become more robust by dispersing the force when the robot falls. Improved neck and waist yaw allow robots to find a wide range of balls. ALICE's LiPo battery was previously attached and detached through the XT90 connector, which took a lot of time to replace the battery. To solve this problem, the battery replacement structure was improved to a sliding form.

2.3 Vision Recognition

Vision recognition uses Nvidia Xavier AGX to build deep learning-based object recognition and performs an average of more than 30 fps to recognize specific points in the field such as goalposts and ball. The weights learned via YOLOv4 used for object recognition were optimized using TensorRT. Through TensorRT, YOLOv4 with better performance than the existing YOLOv4-tiny was available and satisfactory results were obtained. Distance information is also extracted using a ZED2i stereo camera. Since the edge line of the existing field detection method has low accuracy, we want to increase accuracy by applying deep learning-based segmentation techniques.

2.4 Localization

We have implemented localization, which is using various specific points on the soccer field from vision recognition and control data. Our localization system uses various sensors for dealing with various situations during the game. We use particle filter and triangulation to improve our localization's accuracy. Currently, we are optimizing computing resource and overcoming noise on sensors for improving our localization.

3 Future Work & Conclusion

We plan to participate in the RoboCup 2023 with ALICE3. We will improve completely an omnidirectional walking and implement an omnidirectional kick. We will reduce the camera's shaking by making the robot's neck like a gimbal. We will use the extended Kalman filter to accurately track the ball's position and effectively approach the ball. We will actively use the robot's waist, arms, and landing points to implement a strong balancing method. Also, we do not yet have a strategy to utilize communication between robots, so we want to use a strategy to share the position of the ball through communication between the goalkeeper and kicker.

The robot ALICE is being upgraded to a superior robot by solving many technical problems uncovered by participating in RoboCup. As such, the continued improvement in performance with the continued participation in the RoboCup will be a simple and clear way to realize that the robots play against WorldCup winners in 2050.

References

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