HERoEHS, Team Extended Abstract

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Abstract. The HERoEHS team has been upgrading the ALICE3 with a height of 1.3m which will participate in RoboCup 2022. Based on the technical problems found in previous games and the team's experience, it is focusing on improving the performance of walking algorithms, mechanical design, vision recognition, and localization. The HERoEHS team hopes to be able to show more dynamic performances with improved robots in the RoboCup 2022.

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, and we are trying to further improve the performance of ALICE version 3 to participate in RoboCup 2022. [1], [2], [3] 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 2022.

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. [4] However, in a real-time situation such as a soccer game, the preview control was not effective. In order to use the preview control, it is necessary to spend some time to calculate before walking, but in many cases, the position of the soccer ball is changed so that it is not possible to respond immediately to changing the walking pattern. Therefore, we are working to make a new preview control walking method that does not cause a time delay in RoboCup 2022.

2.2 Mechanical Design [1]

A special device that can disperse the impact from the falling situation has been added to ALICE. These devices are expected to effectively absorb shocks when falling using special materials.

ALICE's arm length was changed, and the degree of freedom was added to the arm. As a result, ALICE is expected to stand up better after falling. In addition, ALICE performs throw-in using the degree of freedom added to the arm.

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[1] Jeakweon Han et al.,'Robocup2022 humanoid adult size league, HERoEHS Team Robot Specification', Jan. 2022, p.3(Appendix B)

The waist pitch is equipped with a high-power actuator to make it easier to stand up when the ALICE falls. It can be expected to scan a wider range when performing searching motion by adding a degree of freedom to the waist yaw.

2.3 Vision Recognition

Vision recognition constructs a deep learning-based object recognition using NVIDIA Xavier AGX, and performs an average of 15 fps or more in recognizing specific points in the stadium, including goalposts and balls. YOLO V4-tiny was introduced to improve the performance of the object recognition, and satisfactory results are being produced.

In addition, distance information is extracted using a ZED stereo camera. Since the existing edge line of the stadium detection method requires a lot of resources, we intend to improve the system by applying machine learning-based segmentation techniques to reduce resource use.

2.4 Localization

We have implemented vision-based localization, which is using various specific points on the soccer field from vision recognition and control data. Our localization system uses less computing power as much as we can run its vision system together on Xavier AGX. Currently, we are overcoming noise on both control data and vision data to work up our localization.

3 Future Work & Conclusion

We plan to participate in the RoboCup 2022 with ALICE3. As mentioned above, we plan to actively utilize the waist, such as standing up when falling and turning the waist and searching it widely. Localization can be performed through the field's main key points. Moving to the ball, aiming at the goalpost, and kicking are all performed appropriately. 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 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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