Team-KMUTT Extended Abstract
Robocup 2022 Humanoid Kid Size League

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Abstract. This paper is an extended abstract of Team-KMUTT to participate in Robocup 2022. In this article, we try to explain our problems that we found in 2019 Robocup competition and how could we solve those problems. The main problem that we have solved is the computing unit, as a result, after fixing it, we can improve object detection and localization, and we also explain about a robot framework that we planned to implement for sustainable development in the future of our team.

Keywords: Humanoid Robot, Robocup, Object detection, Localization.

1 Problem From Last Competition

In Robocup 2019, Australia, our team's biggest problem was performance of the computer that we use on the robot. There wasn't enough computing power to run heavy CNN. Our Vision system was slow and unstable to find ball. Since then, we upgraded the entire computer system to NVidia jetson tx2 and coral edge TPU. The preliminary results were very good and satisfactory. Vision system now recognize the ball and goal allowing the robot can play games and there still enough computing resource to do other processing. Therefore, in 2022, our goal in this year is the vision system. The significant part that we would like to develop is full localization by detecting landmark such as goal, field lines and intersections. We hope that in this year our team will be able to operate all robots to take their position on the field and play the game perfectly.

2 Vision and Localization Improvement

To perform object detection for locating balls in the field, we used a SSD-MobileNet V2 model [1] that was quantized from 16-bit to 8-bit so that it could be implemented onto Coral Edge TPU, with the input dimension at 300x300 pixels, but we didn't di-

rectly use the camera image because the model is quiet small, it may not be able to distinguish the ball which is small compared to the whole image. Therefore, we use a method to separate the image from the camera which has a resolution of Full-HD (1920*1080 pixels) into parts and bring it into this object detection model by dividing into two types according to the distance of the tracked ball from the previous frame. As a result, it can detect the ball when the robot is standing in the diagonal opposite corner of the field. This is the best distance possible on the pitch and make the sampling rate to detect the ball as high as the camera's refresh rate (except for the initial tracking where the ball was not detected).

For localization, we use 3 main parts to estimate robot's position, Semantic Segmentation, IMU and Key Point Tracking. Semantic Segmentation will use DeepLab V3+ model [2] which will divide the field, background, robot and goal apart, and the field border lines were used to estimate the robot's position relative to the field (using the Hough Line Transform) together with the robot odometry data obtained from Track Key Points from the ground in combination with the IMU. Both the DeepLab V3+ model and key point acquisition are based on the Nvidia Jetson TX2 GPU.

3   Robot and Framework in 2022

In the past, we didn't have a clear system framework. It depends on the participation students of each year who interested in humanoid robot and their works are not getting further extension after graduated. This year we planned to migrate the entire system to ROS2 Foxy for ease of further development and sharing with the community.

We currently have four robots, and we are developing a new robot for the fifth player and a walking system that allows the robot to dribble instead of kicking. Since our robot has small size, we therefore will take advantage of higher mobility to move with the ball to get away from the opponents. This is a plan we're interested in testing this year.

References

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