IKid Software (Kid Size League)

Zhang Chongyang[1], Ban Yubo[1], Wang Jun[1]

[1] Beijing Information Science＆Technology University,12 Xiaoying East Road, Qinghe, Haidian District, Beijing, China
zcy@mail.bistu.edu.cn

Abstract. In this Team Description Paper, we describe the main changes of our humanoid robot for RoboCup 2020 , France. We mainly illustrate the improvements of the algorithm of our robot in ball detection.

1. Introduction

Founded in 2010, the I-KID team is composed of over twenty students including undergraduates and postgraduates at different levels. The machine vision, as one of core technologies in the field of robot, has become the important study direction of the Instrument Science and Technology discipline opened in our university. Since 2011 when our I-KID team participated in the China Robot Competition and the RoboCup China Open 2011 for the first time and won the First Prize (Runner-up) and took the first name in the Soccer and Race Competition in Kid-size group, we have made great achievements and won many prizes in some competitions at home and abroad in the following six years including the 2012 Mexico RoboCup Competition, 2013 Netherlands RoboCup Competition, 2014 Brazil RoboCup Competition. We won the second place of the team competition in the RoboCup China Open 2017 in Kid-size group, which is held in Shandong province. We won the fourth place in the Technical Challenge in 2017 Japan Robocup Competition in Kid-size group. This year we won the Second Prize (The bronze) in the China Robot Competition.

In 2018, we also took part in so many competitions especially RoboCup China Open 2018 held in Zhejiang province and 2018 Canada RoboCup Competieion. We won the 3rd place in KidSize Technical Challenge in China, the 4th place in the Technical Challenge and the 8th place in KidSize 4 on 4 in Canada RoboCup Competieion. Besides, we also participated various robot competitions held in Beijing, five regions in north China (Beijing, Tianjin, Hebei province, Shanxi province and Nei Monggol Autonomous Region) and domestic competitions jointly held by both sides of Taiwan Strait. We have ceaselessly improved and updated the structure of software so as to enhance the level of our robots in accordance with the competition rules of Robocup World Cup.

2.object detection

With the change of RoboCup competition rules, we used a kind of object detection method to improve robots' ability in detecting ball which integrating a lookup table method and a connected domain method last year. However, the method above is difficult as white lines are heavily influenced by white blocks in ball and especially sensitive to light change and can only recognize four features such as ball, goals, field and white lines. This year we use a new network for performing feature extraction which called YOLOv3[1]. In this method, it is possible to work really well in ball detection during competition. In addition, the new method will help our robots behave more stability and accuracy.

YOLOv3 is the third object detection algorithm in YOLOv3 (You Only Look Once) family. It improved the accuracy with many tricks and is more capable of detecting small objects. It has fifty-two convolutional layers and one connection layer, so we can call it Darknet-53. We use convolutional weights that are pre-trained on our own images during testing. The process about YOLOv3 in Fig.1.

Fig.1. The process of YOLOv3

3.Localization

The positioning part includes robot self-positioning and target positioning. The localization of the ball is divided into local localization and global localization. Local localization refers to the calculation of the position of the ball relative to the robot. Global positioning refers to the positioning of the sphere in the world coordinate system. Local localization only requires the transformation of image coordinate system to robot coordinate system. Global positioning requires the robot to self-position first, and the relative position of the ball is transformed to the global coordinate system according to the position of the robot. The significance of global positioning lies in the ability to share data with teammates and optimize ball positioning based on multiple attempts.

The robot locates itself through the signpost information detected by its vision sensors. The signage mainly includes the sideline of the pitch and the key points of the pitch. We use particle filter which is widely used in robot to locate the robot. When road signs cannot be detected effectively, we use the tracking method to obtain the robot's posture based on the odometer [2] and the visual compass [3] on the robot.

4.Motion

The gait of the robot follows the gait of the old robot. Omni-directional motion refers to the ability of the robot to move in any direction and at any speed. It enables the mobile robot to quickly correct its motion direction and speed under the conditions of dynamic changes in the environment, so as to achieve obstacles, self-cruise and other goals[4].

At present, the gait parameters of the robot are divided into single-step operation parameters, inter-stride connection parameters and leg structure parameters[5] . single-step operation parameters are the key frames needed to set the robot to run when executing a certain gait. The step connection parameter is the transition calculation of the key frame parameters, and the leg parameters are combined to keep the robot stable during the movement of the two key frames.

5.Behavior

The robot's behavior is inspired by the hierarchical state machine (HSM) programmed by XABSL[6]. The whole is made up of multiple options. The selection tree for the robot is shown in Fig.2. In this structure, the decision choice of the robot means that the basic behavior is activated. After entering the root option, activate one of its sub-options and give corresponding parameters to the sub-option, and then recurse down until the lowest option is activated. In each option, including an initial state (initial state) and many other states, in the initial state when this option is enabled, the rest of the state of the decision tree, the decision tree made from the state to jump to other state conditions, the decision tree for the basis of a judgment is made by his father is passed to the parameters and the sensor information, etc.

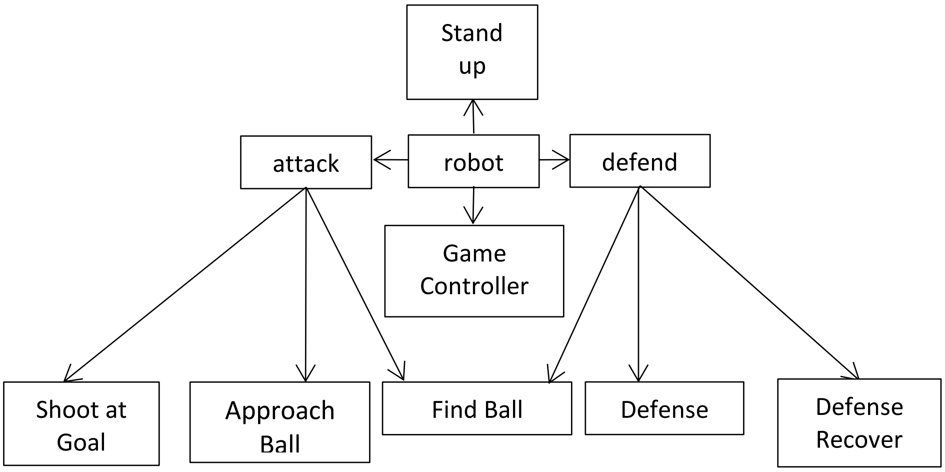

Fig. 2. A simplified option graph of robot behavior

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