EROS EXTENDED ABSTRACT 2022

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ABSTRACT- The last participation of the EROS Team is in RoboCup 2019, Sydney, Australia. This Paper contains an evaluation of previous participation. With this evaluation, EROS did several innovations and developments to improve the robot performance. In general the problems in previous participations regarding connection, ball detection, and robot communication.

Keywords: Humanoid robot, Vision, Ball detection

1. Introduction

EROS (EEPIS Robot Soccer) is a humanoid robot researched by undergraduate students at Politeknik Elektronika Negeri Surabaya (PENS), Indonesia. Our robot is capable of playing football. EROS has been participating in the RoboCup Humanoid KidSize League Competition. The latest competition agenda was in RoboCup 2019, Sydney, Australia. Sadly, we stopped in round 16 due to some problems, such as unstable connection and wrong detection in vision, that affected robot communication.

2. Lessons learned

Lessons learned that we have from the last participation of the EROS Team at RoboCup 2019, Sydney, Australia consisted of:

a. Check the network condition before the competition. Because in RoboCup 2019 against the Zju Dancer team, we unfortunately chose an unstable network and it affected our robot decision and communication.
b. Understand the rules carefully. When against the CIT Brains team, we failed to get the points because the free-kick that led to the goal was disallowed.
c. Improved ball detection capabilities. Due to several false detections in previous matches, those false detections lead us to several wrong decisions and miscommunication between robots.

3. Changes that have been made

Based on the lessons learned, we develop our robot in several fields,

Vision- In RoboCup 2019, our vision uses the Cascade classifier algorithm, but it has many problems such as objects often going undetected, and light greatly affecting accuracy. To overcome this, in the next RoboCup we use deep learning technology with the SSD MobileNet architecture [1] combined with the tracking method. In last year's national championship, this algorithm had fast

performance and excellent accuracy and did not depend on the surrounding light

Localization- In order to estimate the location of the robot in the field, we implemented several localization methods. In Robocup 2019, we implemented a simple localization system using k-NN that determined robot position based on the gradient of the field line [2]. We then improve our localization method by combining robot movement (robot trajectory + kalman filter) and vision feedback [3]. We also implemented a novel method using a particle filter algorithm. Those implementations have several advantages compared to our previous method, such as simultaneous and the ability to localize robot position in any direction.

Inertial Measurement Unit (**IMU**)- The advantage of the gy-952 compared to the gy-25 is that the sensor readings are more linear, making it easier for the robot to balance.

Motion Trajectory- For the movement robot in RoboCup 2019, we need to send a command to run a specific motion package to move the servo, it causes the robot unable to move flexibly in a certain direction according to the situation, it is also difficult to estimate the odometry and speed of the robot, so we make changes to the motion that based on inverse kinematics to request movement in omnidirectional motion planning, this will improve the robot's performance and better odometry calculation.

Motion Balancing- The main problem in developing humanoid robots is how to make humanoid robots run stably on uneven surfaces. optimizing walking movements by adjusting the movement of walking to the footing conditions. The default robot position will be adjusted based on the position of the robot's center of pressure (CoP), which is then combined with the Linear Inverted Pendulum Model (LIPM). To find out the condition of the pedestal base, the pressure sensor is mounted on the sole of the robot's feet. So it is known the position of the pressure center on the robot, which will be used as a parameter in planning the walking motion.

Mechanics- In terms of mechanical Eros robots, we did research on making high-size robots (EROS 2). By adding dynamixel MX- 106 as a replacement for the foot that previously used dynamixel MX-64. Then in the arms and body that previously used dynamixel MX-28, we replaced it with dynamixel MX-64. This research is used to increase the power of robots, to improve the performance and durability of robots. So that when competing and there is a collision between robots can be more powerful to maintain their position.

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