EROS TEAM

Team Description for Humanoid KidSize League of RoboCup 2016

Ahmad Subhan Khalilullah, Naufal Suryanto, Adi Sucipto, Imam Fajar Fauzi, Fendiq Nur Wahyu, Muhammad Lutfi Santoso, Krisna Adji Syahputra, Aulia Khilmi Rizgi, Ilham Fakhrul Arifin, Ryan Satria Wijaya.

EEPIS Robotic Research Center (ER2C)
Politeknik Elektronika Negeri Surabaya (PENS)
Kampus Politeknik Elektronika Negeri Surabaya, Jl Raya Kampus ITS Keputih Sukolilo
Surabaya, 60111 Jawa Timur Indonesia
Email: er2c@pens.ac.id, subhankh@pens-ac.id
Web: er2c.pens.ac.id

Abstract: RoboCup 2016 in Leipzig use field with artificial grass surface, the size and weight of the ball Fifa-1 with 50 percent white, and each wicket white. Almost all robots including EROS difficult to walk on the surface of artificial grass, it becomes easy to fall and kicking power is not strong enough. Very chaotic situation around the field such as many objects have similar color and shape of an object on the field make the robot sometimes confused to determine the original object. In this paper presented some improvements and changes to the system architecture of our robot, mechanical improvement especially on its leg, adding the system odometer by combining footsteps and sensor inertial, in the image processing method Hough transform is applied in the process of object segmentation combined with the selection of templates based on location. The experimental results obtained running stability maximum speed 25cm / sec and kicking power has just increased, while the vision system is able to recognize objects well.

1 Introduction

RoboCup encourage the development of a humanoid robot on the mechanical aspects, vision, and interaction. To achieve the vision of RoboCup 2050, the rule changes gradually. RoboCup rules changes in 2015 to encourage the development of the mechanical structure and vision humanoid robot. Robots must have the ability to walk on uneven grass surface and supple. In conditions of unstable foothold robot should be able to kick the ball.

Other rule changes are a reduction in the number of colors differentiating objects on the field such as the ball and the goal of both white base color. It encourages the development of image processing and object recognition based on a combination of colors and patterns. Shape pattern that is processed into a feature with the statistical approach so that the object can be identified and recognized.

In the event RoboCup 2016 in Leipzig, Robot EROS play until the quarter-final round. In the last match defeated by Robo-Erectus, Singapore. During the preliminary round EROS team has always managed to put the ball into the net with a small amount compared to the ability of the previous year. Walking speed is slower because the playing surface is not flat and the grass is high enough. The diameter and weight of the ball great distances decrease kicking and ability to dribble slowed. In robot vision systems sometimes fail to recognize the ball and the goal. Object recognition system by combining the colors and forms of harassment which exist around the field such as the two people in the audience wearing a white shirt and stand in line with a certain distance. The vision system identifies the object and is recognized as a goalkeeper, so the ball was kicked toward the object. In all of the matches on Leipzig 2016, EROS couldn't

kick the ball as far as usual, it is because of the servos performance has been decreased. Therefore, the first development is currently focused on mechanical system, how to make a mechanical system that could kick the ball faster and robust on walking, Secondly is the vision system on the process of object segmentation to reduce the misidentification of the object with the background colors and shapes are similar.

This paper structured as follows, an explanation of the system that has been developed previously, followed by the development of mechanical systems that include mechanical structures and hardware systems and actuators in the third part. Section four describes the approach taken in the vision system is followed by an overview of the system of coordination between robots. In the final section we discuss the results of the development that has been done and that will be executed to obtain a more optimal result and statement of commitment to participate in the RoboCup 2017 Nagoya, Japan.

2 Previous Work

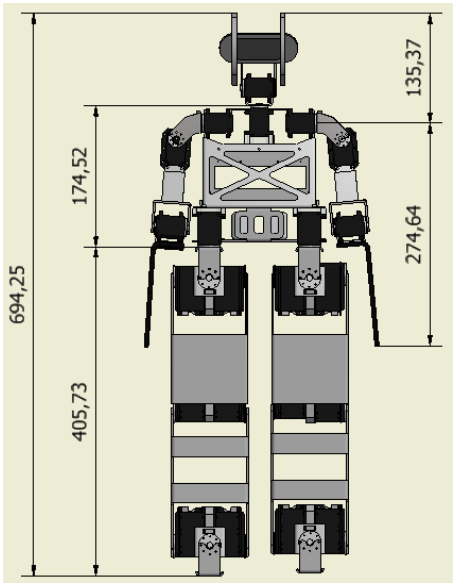
This approach method to detect objects in the field such a ball,the goal , and the robot opponents using binary-based segmentation. This approach resulted in the introduction of the object was good and fast in the computing process. In this case the system cannot determine the distance vision with each object known with precision. This error resulted in subsequent processes such as determining heading toward the goal becomes inaccurate.When the robot head down and see the ball, the ball position is located very close to the goalpost, frequent misidentification of the ball with a pole. Object recognition system can not recognize objects based on partial features.

3 Mechanical, Electronics, and Kinematic System

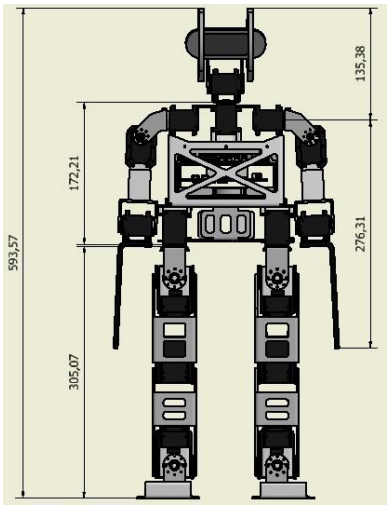
EROS used dynamixel MX-28 and MX-64 for its actuators since 2010 and every year have to compete on Indonesian Robot Soccer Competition even RoboCup Mexico (2012) till the last event Leipzig (2016) with no majority of replacing the motors. Only the partial replacement that we can do to replace the vital joint that receive the extra force than any else joint. Usually we just replace on the leg area such as knee and ankle. Because the motor's performance that we used is not equal, robot cannot walk and kick robustly and the kicking power is not strong enough.

Due to the reason we initiate to design new mechanical system, especially to improve the robot performance on walking and kicking. We decide to use 2 motors dynamixel MX-64 every link on its leg. The usage of 2 motors every joint will increase the torque and absolutely with the increase of the torque will increase the total of force that ever joint can hold.

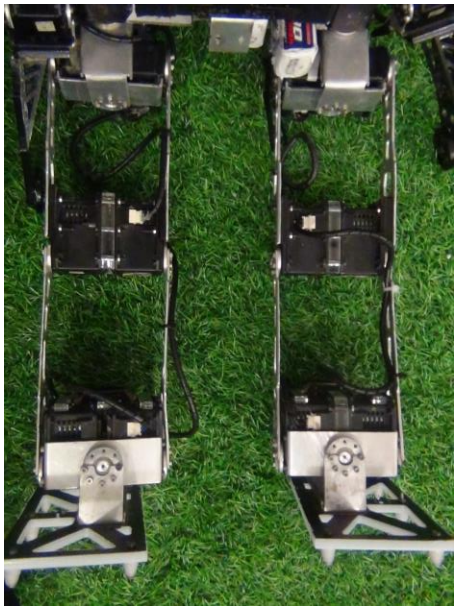
The new design of EROS has a total height of 69cm, leg 40cm, slevee 27cm, and head 13cm. The significant difference of the two design is on the leg. The new design has 2 motors per joint and has 10cm higher than the old EROS. Mechanical structure consists of 20 DOF which includes 12 DOF which includes 12 DOF on foot, 3 DOF in each arm and 2 DOF in the neck.



a. New design



b. Old design



c. Realization of new design

Figure 1 The Layout of Mechanical structure and the dimensions of EROS robot.

The increasing complexity of the RoboCup rule make the robot should have the capability to solve the new problem.The new algorithm that is applied on the robot will increase the computing process. We try to do the optimization by dividing each task to be performed optimally and efficiently. We design and implement a software framework that is compatible with robot soccer tasks.

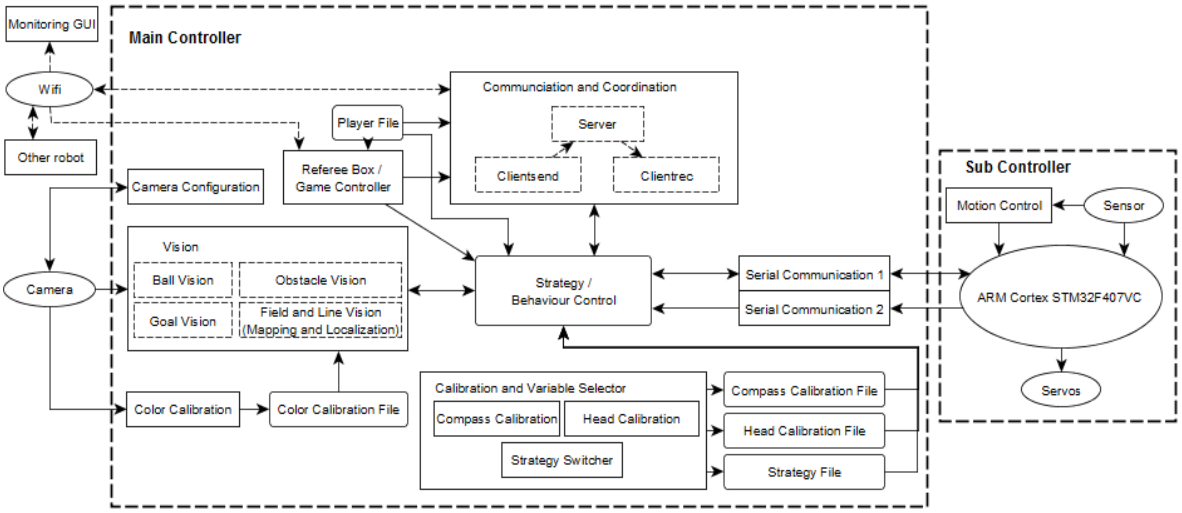


Figure 2 Software Framework on EROS Platform

EROS using Linux operating system with Ubuntu 14.04 LTS version. All of the EROS program is written in the C ++ programming language and compiled using GCC (GNU Compiler Collection) that have been installed in it. Most of the programs was written by adding pthread library (POSIX thread) to allow the multithreed programming. Multithreaded programming will make the computer become faster and can optimize the available resource of multi-core CPU.

On the main controller there are 4 primary software that run simultaneously when the robot is running. The primary software are strategy / behavior control, vision, communication and coordination and serial communication software. Each software can be divided again into some threeds. All the software is able to communicate using IPC (Inter Process Communication).

Now, we are doing some research to migerate our software framework to support ROS (Robot Operating System).

4 Vision System

Despite the the rule of the field that has colorless space, EROS vision system still relies on color segmentation. Gaussian blur is applied first before implementing color segmentation in order to reduce noise. After that, color segmentation can be done. Color segmentation in use to produce region of interest especially for the field. However, reliability and effectiveness is subjective to conditions of the environment.

The field is the first feature to be extracted to produce primary region of interest. After getting this primary region of interest, system will continue to extract feature like goal, ball, line, and also obstacle. Even though line, goal, and ball has mainly same color, it is not difficult to identify them by circularness and the orientation of white line. The fact that goal is always standing up right in the field can be used to identify whether it is a goal or possibly a line.

On the last year, by using this algorithm, EROS already can locate any object for up to 4m without major problems even though it needs hard effort in calibrating to compact with environment. This year, EROS will reduce false positive detection by using histogram of gradient to evaluate an object that has been highly believed to be it is.

5 Conclusion

Results of experiments conducted with the double servo in every link on its leg on new mechanical design make the result of walking more robust and kicking further, because the torque in every link increase twice. In experiment of vision system to detect the ball, goal, and line using colour segmentation is easier than before. The results of the experiment to recognize objects on the field by eliminating background that has similiarities successful. The error occurs when the shape were detected in the background have almost the same height.

6 Statement of Willingness

Based on the result of the development we have done, we are hoping to qualify for RoboCup 2016. We hereby declare the ability when administered the opportunity to participate and will be very happy to present to participate in the RoboCup 2017 competition in Nagoya Japan. We delegate an official member Mr. Endra Pitowarno as a representative for duty as a match referee and other assigned by the committee.

References

1. https://www.robocuphumanoid.org, last accessed February 2016.
2. Azhar Aulia Saputra, Achmad Subhan Khalilullah, Indra Adji Sulistijono, Naoyuki Kubota: ”Adaptive motion pattern generation on balancing of humanoid robot movement”. CCECE 2015: 1479-1484
3. Azhar Aulia Saputra, Achmad Subhan Khalilullah, Naoyuki Kubota: ”Development of Humanoid Robot locomotion Based on Biological Approach in EEPIS Robot Soccer (EROS)”. RoboCup 2015: 303-315
4. Achmad Subhan KH, Iwan Kurnianto W, Dimas Pristovani, EROS Team Description Paper for Humanoid Kidsize League for Robocup 2015.
5. Achmad Subhan KH, Ardiansyah Al-Farouq, Dimas Pristovani, EROS Team Description Paper for Humanoid Kidsize League for Robocup 2014
6. Azhar Aulia Saputra, Indra Adji Sulistijono, Achmad Subhan Khalilullah, Takahiro Takeda, Naoyuki Kubota: ”Combining pose control and angular velocity control for motion balance of humanoid robot soccer EROS”. RiiSS 2014: 16-21