EROS TEAM

Team Description for Humanoid KidSize League of RoboCup 2016

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Abstract: RoboCup 2015 in Hefei 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. 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, trajectory landing foot repaired tailored to the degree of slope pose during the single support phase (SSP), 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, 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

adfa, p. 1, 2011.
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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 2015 in Hefei China, Robot EROS play until the final round and is positioned on the fourth. In the final match defeated by FC Rhoban, France. 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 the semifinals EROS team met with CIT-Brain. In this game EROS suffered mechanical damage in the ankle. This is caused by the uneven surface of the ground and the ball must be kicked burden heavier. Misidentification of the object is also experienced in this match, so could not put the ball into the goal CIT, and the final score was 1 to win CIT-Brain.

The development is currently focused on two sub-systems, the first is the improvement of the kinematic system. The approach taken is to make changes to the orientation of the feet landing taking into account the degree of slope posture on the condition of the single support phase (SSP). 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 2016 Leipzig Germany.

2 Previous Work

The approach method to detect objects in the field such a ball, the goal, and robot opponents using color-based object segmentation [4, 5]. This approach resulted in the introduction of the object was good and fast in the computing process. Disorders that may arise around the playing field are objects that exist around the pitch has the same color and similar shape. 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.

As shown in Figure 1, the atmosphere around the field at the time the robot was dribbling toward the goal. Around the wicket there are several objects with white and recognizable as goalposts. Behind the object there is also a white board that is recog-

nized as a top pole that connects the two objects. So the ball was kicked wide to the left the goal.

Figure 1. Two objects with white color standing around field sometimes recognized as the goal.

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 cannot recognize objects based on partial features.

3 Mechanical, Electronics, and Kinematic System

The robot has a total height of 59cm, sleeve 27cm, 13cm head and leg 32 cm, 4 cm higher than the previous robot weighs about 4.5 Kg. Mechanical structure consists of 20 DOF which includes 12 DOF on foot, 3 DOF in each arm and 2 DOF in the neck. Each joint actuator using two types of servo motors with different torque. At the foot using a type MX-64 and MX-28 on the other as illustrated in Figure 2. At the time standing and walking robot has a shorter height of about 5 cm.

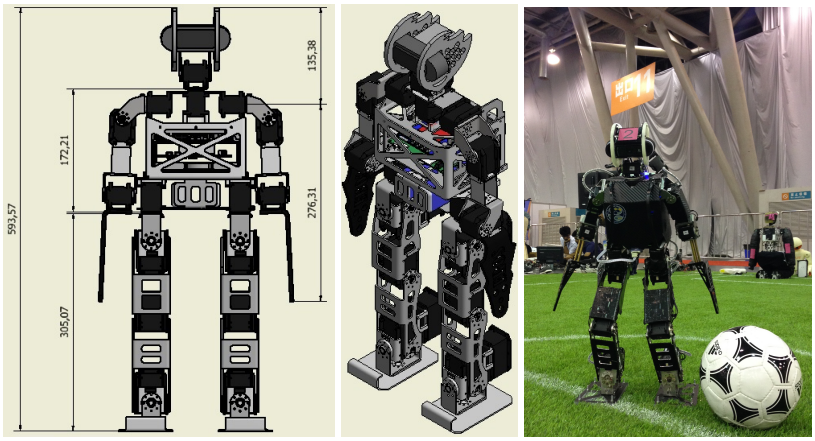

Figure 2. The layout of Mechanical structure and the dimensions of EROS robot.

The main CPU is used based on the Intel ATOM Z3, 2GHz and Linux Mint operating system. Part actuators are handled by an ARM-based CPU and are connected via serial port to the main CPU. Three parts are shown in Figure 3 includes parts sensors, game manager, and actuators. The camera is connected to the main CPU, while other sensors such as accelerometer, gyroscope, and compass actuator connected to the CPU. Game manager processed by the main CPU, this part also handles communication and strategy.

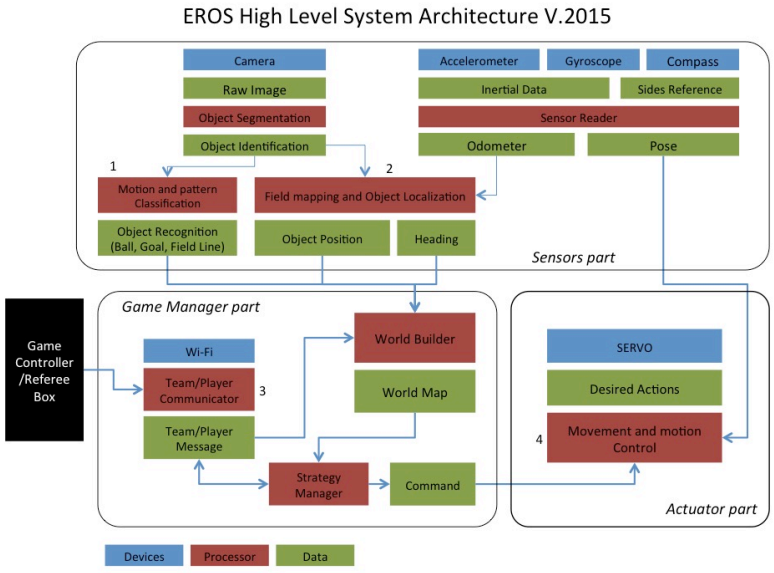

Figure 3. The latest system architecture customized 1, 2 in the image processing and system odometer. 3 in the game managers part and 4 in the actuator part.

Communication device using 802.11G Wi-Fi, serves as a communication line with the application game controller and other robots.

4 Vision System

This section describes the location based template selector in the process of object segmentation. Oddometry system is built to produce estimates of the location of the robot on the ground. Oddometry works by calculating the number of steps and heading calculation. Template Builder function to extract object features such as a ball, the goal, and the field.

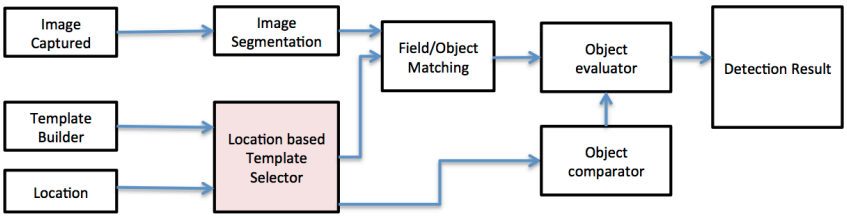

Figure 4. Object detection system using location based template matching approach.

Binary image segmentation is the process of separating the object and non-object. Then proceed with the matching process between the selected templates. The criteria for selection of the templates based on the location of the robot at the time. This section serves to ensure that the object to be segmented based on the whole or partial template. For example, the goal is composed of three wake geometry, is when seen as a whole, at a very close distance throughout the feature geometry can not be obtained. In this condition the template selector choose a template based on the location information. Set of features selected template is the identity of image segmentation based on object features.

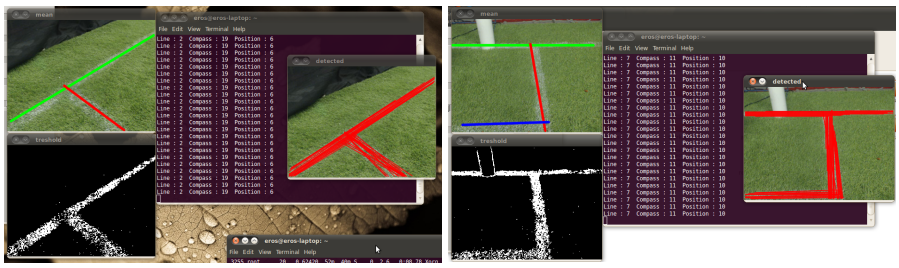

Figure 5. Object segmentation approach by using Hough transform to detect objects on the field line.

The results of matching process compared with the reference object generated by the comparator section. As shown in Figure 5, when the captured image is part of the field then the color of the object to be detected is a field line. Based on the location

information obtained may not be present at the site the goal. These results are used as a filter to separate some other object results from the previous segmentation.

From the experiments that have been conducted so far the system can recognize objects such as lines and the goal as a whole or piece, then it will be tested for several conditions in which there are two objects that have similar.

5 Conclusion

Results of experiments conducted with the change trajectory when landing the feet, the maximum speed of the robot walk on artificial grass is 25cm / sec. In this condition, the robot does not easily fall off and make stops perfectly. At the time of kicking a ball robot could still fall, it often occurs in conditions where the direction of the foot is not exactly at the center of the circumference of the ball. In experiments vision system to detect objects that look full and partial obtain the system recognizes objects, especially lines with uneven color and fade. The results of the experiment to recognize objects on the field by eliminating background that has similarities successful. The error occurs when the shape were detected in the background have almost the same height.

6 Statement of Willingness

Based on the results 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 be present to participate in the Robocup 2016 competition in Leipzig Germany. We delegate an official member Mr. Endra Pitowarno as a representative for duty as a match referee and other tasks assigned by the committee.

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