

Application to Mixed Reality Competition: TatsunoOtoshigo's Team description Paper

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1 Introduction

A large resources such as space, human operators and etc., are required to participate in the middle size robot league (MSL) and even the small size robot leagues (SSL). The requirements are impediments for our team, so Micro robots league are good news to us.

Table 1 shows specifications of RoboCup Soccer leagues. The mixed league provides platforms like soccer real robots. The platform of 2007 mixed league has similar specifications as the SSL. Their vision systems are local vision ones and they are controlled by one center server. The platform after 2008 can support a platform like the MSL. The new robots have local cameras and are supposed to be controlled distributed.

Table 1. Comparisons of RoboCup Soccer Leagues

		Real Robot		Simulation	Mixed	
		MSL	SSL	2D	2007	After 2008
Perception	Vision	Local	Global(*1)	Local	Global	Global
	Frame Rate	Video rate	More Video		Less Video	
Control		Distributed	Central	Distributed	Central	
Number of players		5 vs.5	5 vs.5	11 vs.11	2 vs.2	5 vs.5
Filed Size (unit:cm)	1997	457.5 * 822	152.5 * 274		20inch	42 inch
	2008	1200 * 1800	420 * 610		26.5 * 43	
Robot Size		50 (*2)	15 (*2)		1.6 * 1.6	2.5 * 2.5
Ratio (*3)	1997	150	185			
	2008	864	1138		445	730

*1: Local vision system is permitted by rules.

Actually, some teams used a local camera at early times.

*2: Within a circle of diameter (other rule specifies a square shape robot)

*3: ratio of the field size to a robot size

2 Players program description

At present, we have environments to test 2 vs.2 matches. Our player is programmed with potential field approach [1]. A ball produces a negative potential

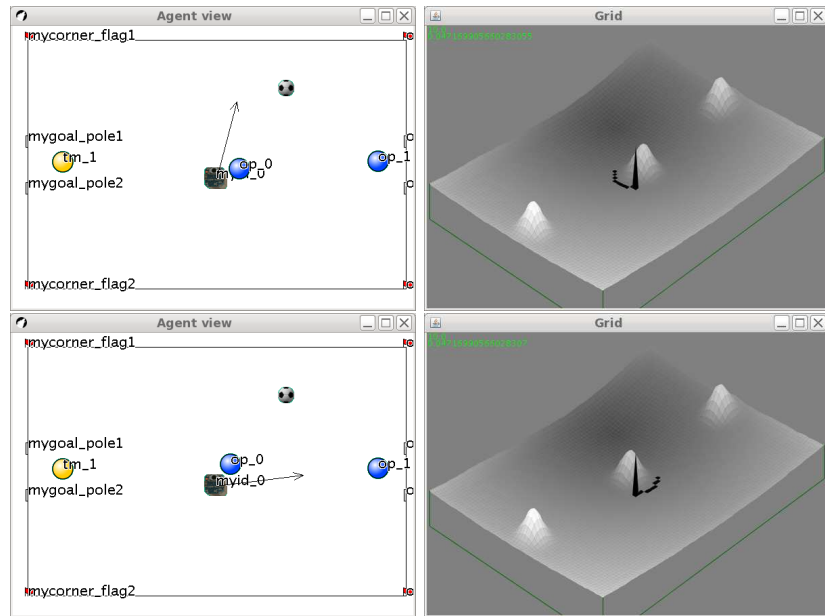


Fig. 1. Potential field approach at 2007 platform, the left figures are two dimensional layout of robots and a ball and the right ones are the corresponding potential field.

field and other players produce positive potential field. Figure 1 shows our robot movements at a 2 vs. 2 match are decided by the gradient directions of the composite potential field. The left figures show two dimensional layout of a 2 vs.2 match. The right figures show the corresponding potential field of the black corn that corresponds to the square robot in the left figures. The upper figures correspond to the situation that the gradients of the square robot lean to the left and at the lower situation the robot goes to the right side.

3 Development to league and platform

3.1 Background of educational initiative

Educational courses using robots have been provided all over the world. Figure 2 shows an experiment course of our university. The course is consisted of lego system and a web camera. The assignments of the experiment are image processing, communication between a robot and a server, robot control based on sensing and the students are required to move robots along the course as quick as possible.

At present, our university has prepared one block of the experiment system for several students. The compactness of the platform makes it possible that a

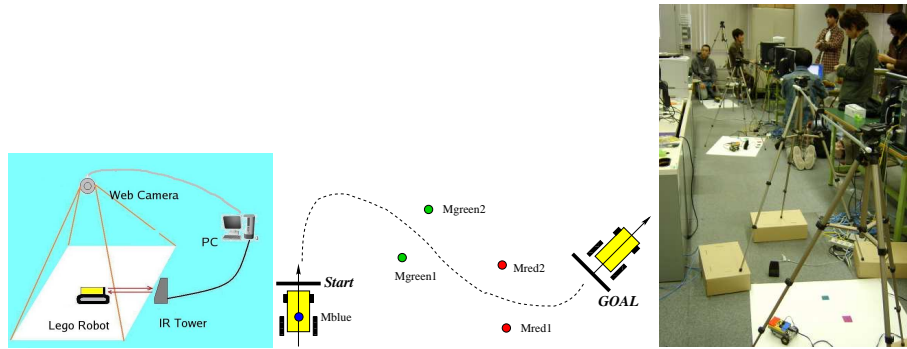


Fig. 2. Students experiments (Left: system architecture. Middle: course setting example, a Lego robot will be controlled to do slalom runs between color marks. Right: snap shots of experiments, white papers are fields which field size is 80×130 (cm))

student can use one experiment system. The Mixed Reality platform provides a more interesting and a compact stuff for undergraduate students.

3.2 multi-Web-camera system

The most expensive component of the Mixed platform is an IEEE-1394 based digital camera. We are going to propose to use a multi-Web-camera system instead of the IEEE-1394 camera,

- to make the system cheap,
- to make the system compact by reducing the camera position low when the size of the field becomes bigger.¹

Figure 3 shows the micro robot image is overlapped on the PV league server. The camera parameters and the images are created by ARToolKit [3]. ARToolKit is a software library for building Augmented Reality applications. It overlays the virtual imagery of the object on the real world and also provides parameters of camera. The upper two figures show the idea of ARToolKit. The left one is the real world and the right one shows an imaginary square overlaid on the mark of the robot. The imaginary square are displayed on the mark when the white paper is moved.

The left below one in the Figure3 shows an imaginary object overlaid on the EcoBe robot. It indicates the camera parameters fit well on the Mixed league field. The right below figure shows the web camera position. Preparing several cameras around the field is sufficient to create the same information from the IEEE-1394 camera.

¹ At SSL, they used one camera to get the image of the field. As the size of the field has increased year by year, the wide-angle lenses are required and the camera is installed at the higher position. At present, they used multi cameras system to capture the whole area of the field.

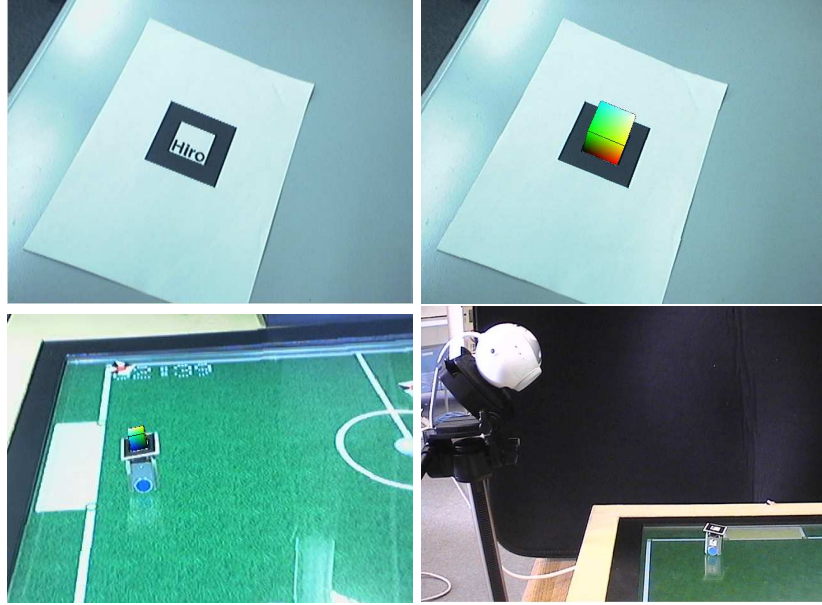


Fig. 3. Images over displayed ARToolkit. (The upper two figures show the idea of ARToolkit. The left one is the real world and the right one shows an imaginary square overlaid on the mark of the robot. The left below figure shows an imaginary object overlaid on the EcoBe robot. The right below figure shows the web camera position.)

4 Proposal of research program

4.1 Background and future application

Looking inside the body of patients has been one of very effective medical technologies. For patients, it is desired there is little pain to get tested. An endoscope has been widely used to look the interior surfaces of an organ by inserting a tube into the body. The endoscope consists of a flexible tube, a lens system, and medical instruments or manipulators to examine the organ such as a stomach. Passing the endoscope through the throat causes pains to persons who are checked using endoscopes.

Capsule endoscopy which size is 10mm(diameter) by 20mm(length) has been presented to alleviate pains [5]. The capsule does not have any actuators to control their motions, so it cannot stay the position where more inspections are needed.

Figure 4 shows our image of inspecting tumors micro robots system. The micro robot has equal abilities of the capsule endoscopy and also has actuators to control their positions according to the directions of doctors.

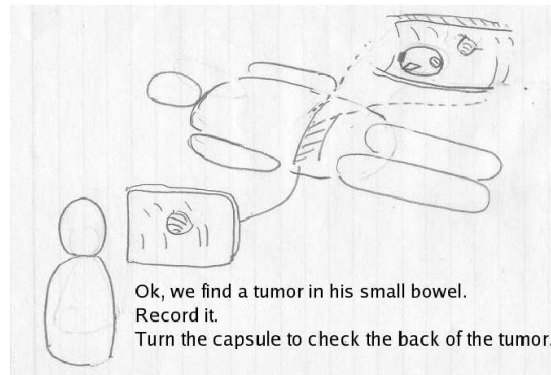


Fig. 4. An image of micro robots exploring tumors.

4.2 Research themes and new competition

Our research proposal is to make a small robot that can move in fluid. For the first step, we propose a micro see horse robots racing in water (Figure 5). The shape of a robot is a see horse and its size is about 5cm. The positions of robots in an aquarium will be measured with cameras around or in the aquarium. And its motion will be controlled with fins actuated by motors. Figure 5 shows images of competitions using the see horse robots. The see horse robots go through the tube that is not necessary straight and compete for the time.

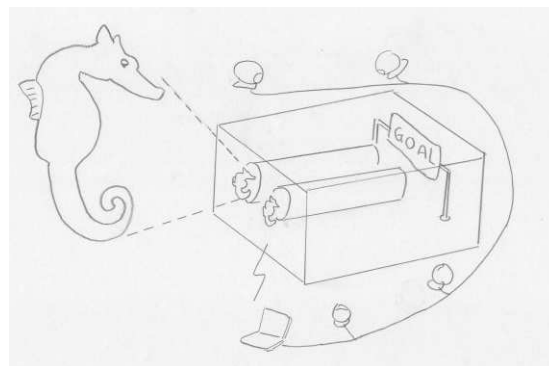


Fig. 5. An image of micro see horse robots racing.

5 Summary and Discussion

We are going to participate in mixed league not only with interest in soccer games but also with hopes to apply the micro robots in other new application. We target two applications. One is developing an education kit for juniors. The price of kits for juniors is desired to be not expensive. This is a short range target. The other application is a wire less endoscope system. It requires moving in the fluid and a see horse robots racing is proposed.

References

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