Inter-University Collaboration Aimed at Integrating Different Robotic Field: Development of Underwater Robots and Soccer Robots Though these Competitions

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Abstract

In robotics, the problems and solutions to be focused on may differ due to the different fields of robots to be developed. In this research, we will verify the effect of exchanging opinions and sharing knowledge by collaborating with students aiming to participate in different robot competitions between underwater robots and soccer robots. As a result of analysis using neural networks, it was found that collaborative research between universities contributes to maintaining student motivation.

Keywords: Inter-University Collaborative Education, Integrating Different Robotic Field, Robot Competition, Manufacturing Education, Under Water Robot, Soccer Robot, Neural Network

1. Introduction

Participating in robotics competitions is a very effective way to educate students about robotics[1]. This is because the results obtained by participating in the robot contest include not only technology and knowledge about manufacturing, but also collaboration with colleagues, team management, communication skills, and presentation skills. In many engineering laboratories, education is provided by participating in robot contests in each laboratory[2]. However, in many cases, participating students cannot afford to participate even if they are interested in competitions other than the robot contest they are in charge of. Not only does this narrow the horizons of students, but it also eliminates the opportunity to learn how to apply knowledge.

In this research, we will give students a chance to participate in multiple robot contests and verify the effect

by promoting education in collaboration in the laboratories of three universities participating in different robot contests. The activities and results of each robot contest are shown as objective facts. In addition, as educational results for students, the results of analyzing the answers to the student questionnaires obtained at each regular meeting using the neural network are shown. The purpose of this project is to confirm the usefulness of education using multiple robot contests.

2. Educational Policy

In this project, we target Multiple types students not only 4th graders students assigned to the laboratory as shown in Table 1. All students are voluntary participants and there is no coercion to all activities, including regular meetings.

Table 1. Breakdown of students who participated in the inter-university collaborative education project.

		University			
		NIT	HIT	Kyutech	Total
Grade	Bachelor 1	1	-	-	1
	Bachelor 2	-	-	-	-
	Bachelor 3	-	3	-	3
	Bachelor 4	2	2	-	4
	Master	-	-	1	1
	Total	**4**	**5**	**1**	**10**

These students are learning basic engineering knowledge in class, but often do not know how to apply it to manufacturing. In this paper, we will create and educate relatively large-scale system robots with reference to efforts with high educational effects, but the work that each student is in charge of is optimized.

2.1. *Target robot contest and schedule*

This project was planned by faculty members from three universities, Nishinippon Institute of Technology, Hiroshima Institute of Technology, and Kyushu Institute of Technology in April, and has been implemented since May. The target robot contest is for underwater robots and soccer robots that have participated in each university so far. Table 2 shows the schedule of the entire project and the schedule of the contests.

At regular weekly meetings, the faculty members confirmed the progress of each student, pointed out presentation practice, and provided knowledge in the field of robotics. In addition, the management of each student's tasks and the scheduling up to the contest were conducted mainly by the students.

3. Activity and results

This year, two contests were held for both soccer robots and underwater robots. Due to the influence of Covid-19, the method of participating in all contests has become online.

3.1. *Under water robots*

The following two were held in the underwater robot contest in 2021.

- Underwater Robotics Competition in Okinawa
- Techno-Ocean

These contests are divided into Remotely operated vehicle (ROV), Autonomous Underwater Vehicle (AUV), and Free style according to how the robot is operated. The 2 robots involved in this project participated in the freestyle category. In the freestyle category, in addition to the evaluation of the presentation,

Table 2. The planning of the inter-university collaborative education project.

Task \ Week	May	June				July				August					September				October				November					December			
	31	10	17	24	28	5	12	19	26	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27
Ivent				RoboCup 2021																				Underwater Robotics Competition in Okinawa 2021		RoboCup Asia Pasific 2021		Techno -Ocean 2021			
Regulaer Meeting	Kick Off																														
Research case introduction																															
Presentation practice																															
Basic learning (Software)																															
Basic learning (Hardware)																															

the evaluation of practicality, technical ability, originality, and perfection was performed by video screening. In this project, we verified the calibration technology in sensing and the strength of the robot by the material. The robots that participated in the contest are shown in Figures 1 and 2.

J. E. N. O. S. shown in Fig. 1 is a robot whose purpose is to exterminate a large number of jellyfish[3]. The project mainly improved the strength by changing the sensing technology and parts manufacturing method and materials. As a result of the contest, the robot was not able to win the Underwater Robotics Competition in Okinawa 2021, but was able to win the Freestyle category at Techno-Ocean 2021.

M. I. R. O. C. A. shown in Fig. 2 is a robot aimed at collecting water waste, especially PET bottles. As a project, we worked on improving the Resolution and Collection Corporation. As a result of the contest, the robot finished second in the freestyle category in both Underwater Robotics Competition in Okinawa 2021 and the Techno-Ocean 2021.

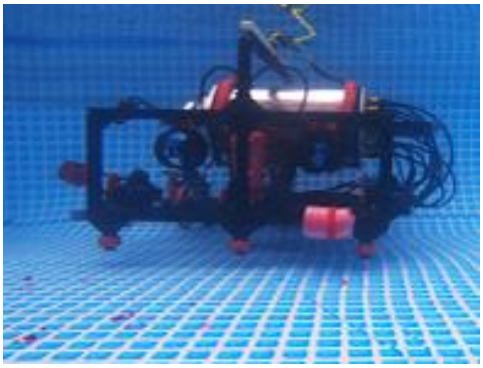

Fig. 1. Underwater robot for the purpose of exterminating jellyfish "J. E. N. O. S."

Fig. 2. Water robot for the purpose of collecting water waste "M. I. R. O. C. A."

3.2. *Soccer robots*

The following two were held in the soccer robot contest.

- RoboCup 2021
- RoboCup Asia Pacific 2021

RoboCup is a global landmark project, with competitions divided into various leagues. The original mission is to make a team of robots capable of winning against the human soccer World Cup champions by 2050. In this project, the students participated as "Hibikino-Musashi", a team participating in the medium-sized league. The robots that participated in the contest are shown in Figures 3.

In both contests, the presentation of the research (Scientific Challenge) and the introduction of the robot by video (Technical Challenge) were evaluated instead of the ranking by the soccer competition. Since both contests are international contests, the project worked to improve presentations in English and listen to presentations from other teams in the contest. We also shared the basics of sensing with a microcomputer and the basic knowledge of action decisions using AI[4]. The students worked on improving the omni wheel, which is the drive wheel, and the robot cover.

As a result of the contest, Hibikino-Musashi could not win the prize at the world competition RoboCup 2021, but at the RoboCup Asia Pacific 2021 where the students took advantage of their reflection, Hibikino-Musashi won both challenges.

Fig. 3. The soccer robot aiming to play soccer with humans "Musashi"

4. Evaluation

As shown in the feature map of Fig. 4, a tensor self-organizing map was used to evaluate changes in student motivation over the season.

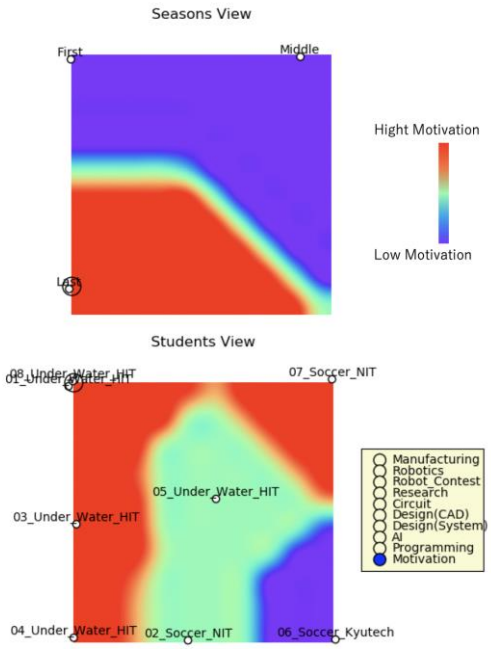

Fig. 4. Evaluation of motivation by TensorSOM

5. Conclusion

In this study, we examined whether collaboration between universities had a positive effect on student motivation, and confirmed that motivation improved as the season passed. In addition, this project was able to achieve good results in the contest as a result of cooperation between universities.

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