A practical use of patent writing in the creative engineering design course for freshmen education in the school of engineering

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Abstract

This paper deals with the practical use of patent writing and its effectiveness in the creative engineering design course for freshmen education in the school of engineering. The creative engineering design course is a representative course in the school of engineering of Korean universities and aims at the development of abilities for a group of freshmen to define an engineering design problem from various open problems, to find a solution for that defined problem, and to implement its solution step-by-step in cooperation. To develop these abilities, the creative engineering design course usually consists of theoretical lectures for each step of engineering design and laboratories for design, implementation and test. One of difficulties of education for this creative engineering design course is that almost all freshmen, at the last step, copy the best solution made by another student and just use it without recognition of intellectual property right. To overcome this difficulty, this paper introduces the practical use of institutional patent. Using the management of institutional patent in the course, almost all freshmen can recognize the intellectual property right of his/her idea and the idea from others. By an experiment in the Department of Information Technology, Dongguk University, 97 patents was submitted during 1 semester from 60 groups of freshmen in 6 classes for a simple racing robot project without using the wheel mechanism. Among 97 patents, 23 patents was approved and used by its own group of freshmen and others.

Introduction

One of issues in modern engineering education is to develop creativity, especially in the design education[1]. Until now, there have been many researches for the design education model related with creativity. For example, Kim and Kang[2] discussed on the effect of personal characteristics and design-related performances in a creative engineering design course. Ekwaro-Osire and Orono[3] studied on the coordination of individual and team creativity.

And as the society becomes highly complex and the appearance of many illegal software copies, hacking/cracking cases, and other internet crimes, the engineering ethics becomes more important item for the modern engineering education. But, it is not easy to educate students to have creativity and ethics together in the same practice subject.

This paper deals with an open design problem about racing robot for creative engineering design. And also, this paper addresses the effect of patent writing for the education of freshmen to have the engineering ethics including intellectual property rights.

Overview of the creative engineering design course

The creative engineering design course consists of theory and practice, studying basic design theory and practice to achieve engineering design ability. Students in this course should define an open engineering design problem related with racing robot with his/her team members and undergo the design process including modeling, implementation and test to realize their own robot. Through this process, they can develop the ability for creative design.

Each lecture for theory and practice was for 2 hours per every week. Practice lecture aims at the understanding of the developmental environment with emphasis on LEGO Mindstorms NXT. And, the students for this course are recomposed by several teams with 3~5 students.

Table 1 : Weekly schedule

Week	**Lecture Contents**	
1	Theory	Lecture introduction
	Practice	Lab 1. Introduction of Lego Mindstorms NXT
2	Theory	Overview of creative engineering design course
	Practice	Lab 2. Overview of Lego Mindstorms NXT
3	Theory	(Holiday)
	Practice	Lab 3. Introduction of developmental environment
4	Theory	Idea making and visualization
	Practice	Lab 4. NXC Programming I
5	Theory	Recent methods for idea making or invention
	Practice	Lab 5. NXC Programming II
6	Theory	Report writing , Presentation and communication skills
	Practice	Lab 6. NXC Programming III
7	Theory	Presentation of design project proposal
	Practice	Lab 7. Making a sample robot I
8	Theory	Design process and ethics in engineering
	Practice	Lab 8. Making a sample robot II
9	Theory	Specification of the functional components, optimization of design
	Practice	Lab 9. Making a sample robot III
10	Exam	midterm examination for basic design theory
11	Design	Team project for making a robot I
	Design	Team project for making a robot II
12	Design	Team project for making a robot III
	Design	Team project for making a robot IV
13	Design	Team project for making a robot V
	Design	Team project for making a robot VI
14	Design	Team project for making a robot VII
	Design	Team project for making a robot VIII
15	Racing	Robot racing and exhibition
16	Presentation	Presentation of final report for each team's design

By the proposed weekly schedule (see Table 1), creative thinking ability from resolving the given problem in various ways and the whole design process including basic elements of design and restrictions for design (see Table 2) could be educated.

The students in this course are evaluated as the following items in Table 3 to prove the ability and the understanding for creative design.

Table 2 : Design fundamentals

(_ : Used _ : Not used)

Basic elements of design	Purpose	Function	Performance measure	Specification	Task division	Detailed schedule	Verification process	Reporting
	_	_	_	_	_	_	_	_
Restrictions for design	Needs and market	Time Restriction	Reliability	Persistence	Ethics	Quality	Cost	Realizability
	_	_	_	_	_	_	_	_

Table 3 : Evaluation of design subject

Evaluation item	Measure	Assessment	
Design plan (5 point)	Presentation, proposal report	Purpose of design task(1 Point)	
		How to perform task(2 Point)	
		Task division, Detailed schedule(1 Point)	
Design report (15 Point)	Presentation, final report	Presentation / report-writing skills(1 Point)	
		Background and creativity of the design (4 Point)	Related knowledge(1 Point)
			Technology trends(1 Point)
			Creativity(2 Point)
		Use of design fundamentals (4 Point)	Basic elements of design(2 Point)*1
			Restrictions for design(1 Point)*2
		Result of the design (3 Point)	Completeness of the design(1 Point)
			Difficulty of the design(1 Point)
			Discussion on the results(1 Point)
		Presentation skills (2 Point)	Clarity of presentation(1 Point)
			Certainty of explanation(0.5 Point)
			Appropriate response to the questions(0.5 Point)
		Report-writing skills (2 Point)	Description of the developmental environment (0.5 Point)
			Overview of the design(0.5 Point)
			Specification of the design components(0.5 Point)
			Visualization of the report(0.5 Point)
Robot racing (30 Point)	Designed robot	Racing results (30 Point)	
Total(50 point)			

* 1 : Evaluated by purpose establishment, necessary function analysis, performance measure and verification process.
* 2 : Evaluated mainly by the considerations on the developmental environment and racing stadium.

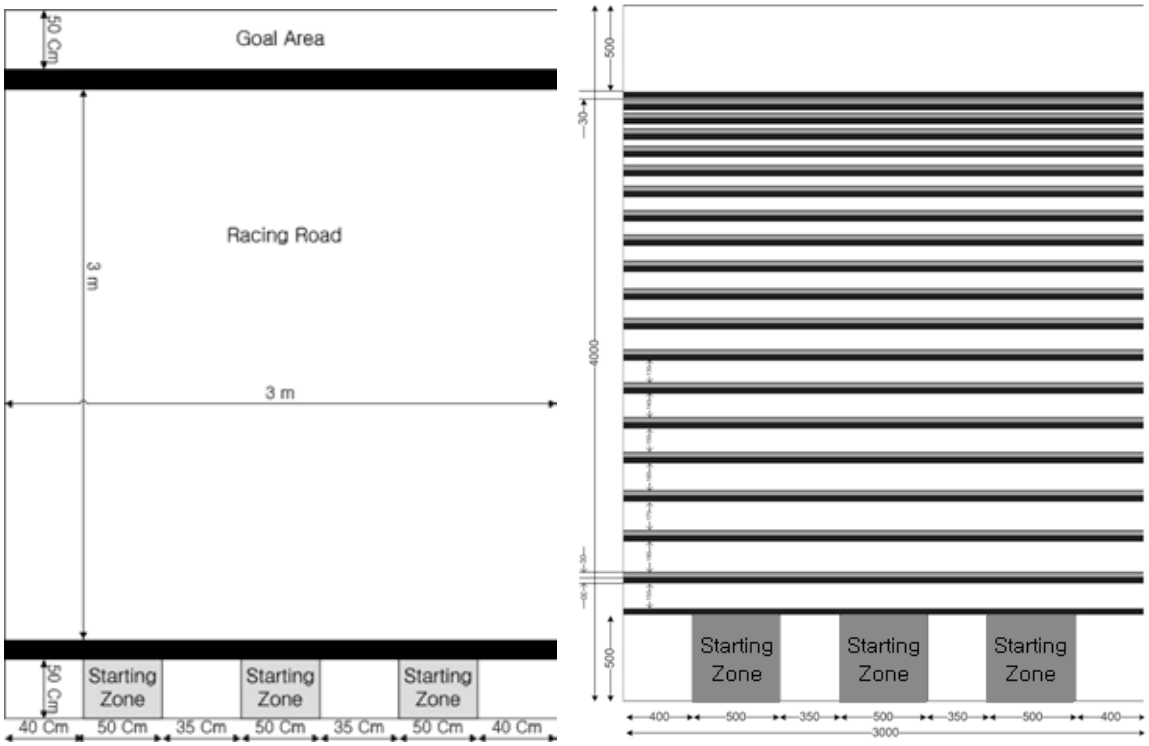
Design subject for students

The design subject is to design a robot for racing including making behavior pattern and structure of robot body considering the given design restrictions.

The robot race is started with more than two teams together in a given stadium (see Fig. 1). The race is managed by the tournament method. The robot which arrived the goal area first won the racing game. After the tournament is over, each team can get the grade as the ranking for robot racing.

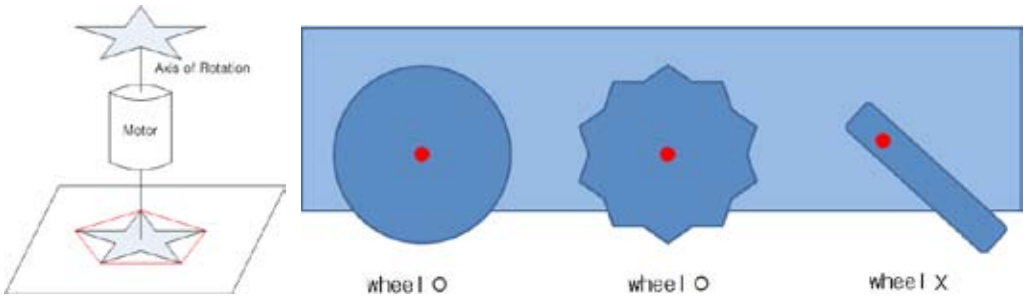
The stadium consists of three starting zones, wide racing road, and a goal area. The distance of racing road is 3m. The width of racing road is also 3m. And, there are some walls with 15 cm height on the left and right ends of the road. The bottom material of the stadium is a rubber. Obstacles do not exist in the middle of racing road. And, starting zone is a rectangular shape. In addition, there are asymptotic underlying lines with 3cm width on the racing road to indicate some clues for robot location.

Figure 1 : Structure of racing stadium



One of the characteristics of the proposed design subject is to restrict the use of wheels. Here, the wheel is defined with the contacting contour of the rolling component with the ground. If the contacting contour is same with the outer boundary of the rolling component, that component is a wheel. Even if the contacting contour is not same with the outer boundary of the rolling component, that component can be regarded as a wheel if minimal convex polygon with the convex vertexes of the rolling component is same with the contacting contour. In the left figure of Fig. 2, the rolling component is a star-like shape and the minimal convex polygon with the convex vertexes of the rolling component is a pentagon. Since the contacting contour of star-like shape is also a pentagon, the star-like shape can be regarded as a wheel. Therefore, in the right figure of Fig. 2, the first and the second rolling component is a wheel but the last rolling component can not be a wheel.

Figure 2 : Definition of wheel



After starting the race, no direct manipulation from outside is permitted including the direct operation and remote control. Mode change for the movement is permitted only through the sound such as hand clapping by the user.

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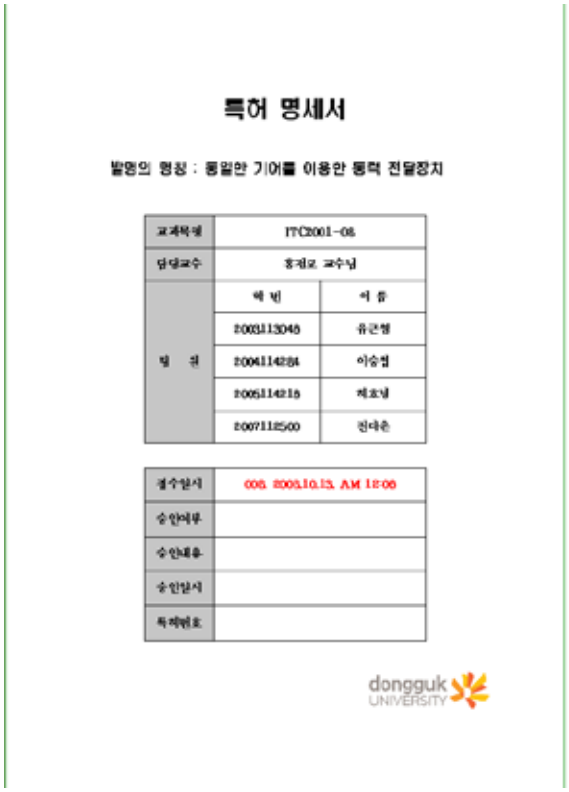
Patent writing in the design course

Proposed idea of this course can be protected from the illegal use of other teams by the submission of patent or keeping secret from other teams until the racing tournament.

Students can submit their team's patent with title of invention, name of inventors, application date, description of drawing, detailed comments on the invention, purpose of the invention, composition of the invention, effects of the invention, claims, and drawings for the invention (see Fig. 3) no later than 2 weeks from the racing tournament.

Figure 3 : Example of Patent Specification Report



특허 명세서

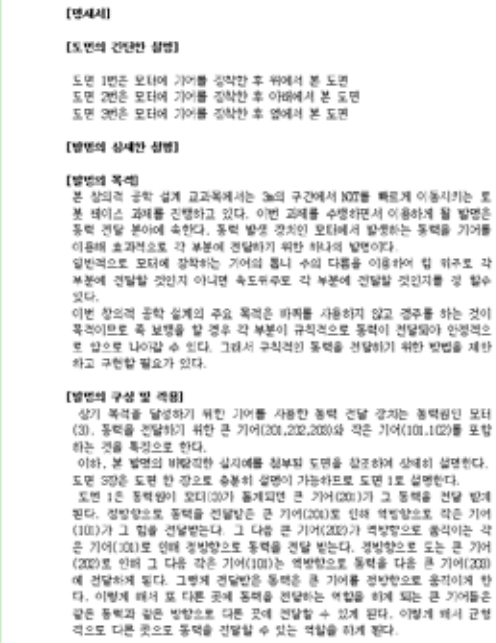
발명의 명칭 : 톱밀한 기어를 이용한 동력 전달장치

교과목명	ITC2001-08	
담당교수	홍길로 교수님	
팀 원	학 번	이 름
	20031123045	유근형
	20041142284	이승섭
	20051142215	최호내
	20071125500	진대준

접수일시	006 2009.10.13. AM 12:00
승인여부	
승인내용	
승인일시	
특허번호	

dongguk UNIVERSITY

(a) Specification of Invention-Title of invention, Name of inventors(students), Application date, Approval/Refused, Registered claims, Registration date



[명세서]

[도면의 간단한 설명]

도면 1번은 모터에 기어를 장착한 후 위에서 본 도면
도면 2번은 모터에 기어를 장착한 후 아래에서 본 도면
도면 3번은 모터에 기어를 장착한 후 옆에서 본 도면

[발명의 상세한 설명]

[발명의 목적]

본 창의적 공학 설계 교과목에서는 3m 구간에서 NXT를 빠르게 이동시키는 로봇 레이스 과제를 진행하고 있다. 이번 과제를 수행하면서 이용하게 될 발명은 동력 전달 분야에 속한다. 동력 발생 장치인 모터에서 발생하는 동력을 기어를 이용해 효과적으로 각 부분에 전달하기 위한 하나의 발명이다.

일반적으로 모터에 장착하는 기어의 톱니 수의 다름을 이용하여 힘 위주로 각 부분에 전달할 것인지 아니면 속도위주로 각 부분에 전달할 것인지를 정 할수 있다.

이번 창의적 공학 설계의 주요 목적은 바퀴를 사용하지 않고 경주를 하는 것이 목적이므로 즉 보행을 할 경우 각 부분이 규칙적으로 동력이 전달돼야 안정적으로 앞으로 나아갈 수 있다. 그래서 규칙적인 동력을 전달하기 위한 방법을 제안하고 구현할 필요가 있다.

[발명의 구성 및 작용]

상기 목적을 달성하기 위한 기어를 사용한 동력 전달 장치는 동력원인 모터(3), 동력을 전달하기 위한 큰 기어(201,202,203)와 작은 기어(101,102)를 포함하는 것을 특징으로 한다.

이하, 본 발명의 바람직한 실시예를 첨부된 도면을 참조하여 상세히 설명한다. 도면 5만을 도면 한 장으로 추출히 설명이 가능하므로 도면 1로 설명한다.

도면 1은 동력원이 모터(3)가 톱게되면 큰 기어(201)가 그 동력을 전달 받게 된다. 정방향으로 동력을 전달받은 큰 기어(201)로 인해 역방향으로 작은 기어(101)가 그 힘을 전달받는다. 그 다음 큰 기어(202)가 역방향으로 움직이는 작은 기어(101)로 인해 정방향으로 동력을 전달 받는다. 정방향으로 또는 큰 기어(202)로 인해 그 다음 작은 기어(101)는 역방향으로 동력을 다음 큰 기어(203)에 전달하게 된다. 그렇게 전달받은 동력은 큰 기어를 정방향으로 움직이게 한다. 이렇게 해서 또 다른 곳에 동력을 전달하는 역할을 하게 되는 큰 기어들은 같은 동력과 같은 방향으로 다른 곳에 전달할 수 있게 된다. 이렇게 해서 근접각으로 다른 곳으로 동력을 전달할 수 있는 역할을 하게 된다.

(b) Specification -Description of drawing, Detailed comments on the invention, purpose of the invention, composition of the invention

[발명의 효과]

같은 수의 톱니 수를 이용한 이번 발명은 즉 보행을 하는 NXT 이동 로봇의 앞과 뒤로 같은 동력을 전달하므로 안정적인 보행을 이끌어 냄수 있습니다.

[청구의 범위]

청구항 1.

NXT를 이동시키는 로봇에 있어서,
큰 기어(201,202,203)와 작은 기어(101,102)를 구동하기 위한 모터(3)을 포함하는 것을 특징으로 하는 동력 전달 장치: 및
다른 곳으로 동력을 전달할수 있는 큰 기어(201,202,203)을 포함하는 것을 특징으로 하는 NXT 동력 전달 장치.

청구항 2.
제 1 항에 있어서,
상기 동력을 전달 받은 큰 기어 201,202,203은 같은 속력으로 회전한다는 사실을 포함하는 것을 특징으로 하는 NXT 동력 전달 장치.

(c) Effects of Invention, Claims

도면 1

(d) Drawing for the invention (FIG. 1)

(e) Drawing for the invention (FIG. 2)

(f) Drawing for the invention (FIG. 3)

Patent evaluation is done with two stages in the steering committee that is consisted of all professors who take charge of the creative engineering design course. The first stage of patent evaluation is to check the duplication with the previous patents by the assistant. And, the second stage of patent evaluation deals with checking the originality, realizability and use of restricted components by two professors. The steering committee was gathered every two weeks through the whole semester and determined the approval or refusal of each patent. The approved patent was published in the website for the patent notification (see Fig. 4) within two weeks from the submission of the patent.

Figure 4: Website for the patent evaluation and notification

If some team wants to use a registered patent by other team and applies for the usage of that patent, the team which will uses the patent have a disadvantage of their grade reduction from 0 to 1 point, and the team which has the ownership of that patent can have advantage of additional grade addition with the limit of 30 point. The amount of grade reduction from 0 to 1 point is determined by the negotiation between the owner and the user. And, if there is

an illegal team who uses the other team's patent without application, the grades of that team members decrease more than 1 point.

The results of patent evaluation and the status of the used patents by other teams during the fall semester 2008 are in Table 5 and Table 6.

Table 5 : Results of patent evaluation

	Number of cases
Received patents	97
Rejected patents in the first evaluation	7
Rejected patents in the second evaluation	65
Accepted patents	25

Figure 5 : Results of patent evaluation

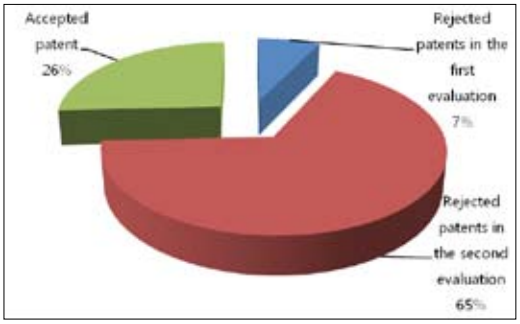


Table 6 : Status of the used patents by other teams

Used patents by other teams	**Number of the used**
A	4
B	2
C	2
Total	8

Conclusion and discussion

Using the management of patent writing in the course, almost all freshmen can recognize the intellectual property rights of his/her own idea and the idea from others. By an experiment in the Department of Information Technology, Dongguk University, 97 patents were submitted during one semester from 60 groups of freshmen in 6 classes for a simple racing robot project without using the wheel mechanism. Among 97 patents, 23 patents were approved and used by its own group and others.

Acknowledgements

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