Interactive Technology Education at Pusan National University

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Abstract: We introduce an introductory engineering education course for engineering majors and non-engineering majors. This course does not require any previous knowledge and experience on engineering. It requires strong curiosities and imaginations on current and future society we live in, where technology is inseparable ingredient. Course encourages attendees to explore fundamental issues of engineering: what is proper technology and what are proper ways of exercising engineering, issues dealt in soft engineering. Since course topics cover many aspects of technology, traditional learning methods fail to be successful and efficient. Various efficient learning methods have been proposed and implemented. We utilize various interactive tangible media, which include simulated thought experiments and physical media experiences. About 20 episodes in short film format are produced based on scenario written according to related issues selected. Physical media like interactive robots are introduced for attendees' stimulated experiences. We summarize our exciting experiments on interactive teaching experiences at Pusan National University which include on/off-line interactions, assignments, projects, and evaluations.

Keywords: Interactive engineering education, soft engineering, interactive teaching/learning, science fiction in education, interactive tangible media

1. INTRODUCTION

Course on "Interactive Technology at Pusan National University" is presented. To efficiently investigate difficult concepts of engineering issues, we present interactive learning methods based on interactive tangible media. Interactive technology is a technology paradigm focused on interactions among human, machines and environment. Soft engineering which explores proper technology and proper ways of exercising technology is a basic approach to understand this field [1-11].

Science fiction can be a useful source of ideas and information, for it is, in essence, detailed scenario development [12-17]. Based on science fictions, we explain how we develop contents and methods regarding the current and future technology of society we live in. We discuss education issues like topics, interactive media experiences, on/off-line interactions, assignments, projects, and evaluations. We also present some intermediate but valuable results we accumulated so far.

2. INTERACTIVE TECHNOLOGY

Interactive technology, an interactive paradigm, and tangible media based on interactive technology: iT_Media are summarized.

2.1 Interactive technology

Possibility of technology recycling raises questions regarding engineering process as means to achieve functions, performances and outcomes. More important questions should be addressed on intentions of engineering designs and qualifications of engineers as designers. The wide spread internet and wearables like cellular phones govern ordinary people's everyday life.

Technology nowadays no longer belongs to the limited expert group of engineers. Philosophy of technology that explores the proper technology and proper ways of doing engineering enters into the mainstream of philosophy. Philosopher Maurice Merleau-Ponty, media theorist Marshall McLuhan, and ubiquitous computing inventor Mark Weiser are representative philosophers of technology. Computer culture magazine like Wired and science fiction movies like Minority Report and Matrix are leading texts on philosophy of technology [1-5, 18-23].

Most fundamental questions in philosophy of technology are "What is technology serving humans?" and "How can we design it?" What is technology for humans? How can we design machines that can recover human pride instead of alienation? What will be most inhumane human condition that technology can overcome? Humans are all handicapped in a sense that humans dream about unlimited extension of their limited bodies. The most desirable way to start engineering is to examine engineering in most vulnerable situations [8].

Soft engineering is an area, which seeks proper technology and proper ways of doing engineering. To investigate soft engineering concept, a robot fabrication project based on rapid prototyping method has been organized and performed. We try to revive survival systems from primitive age when engineering process and tools are closest to and complete to human body. Pusan National University (PNU) junk robot project is aiming to experience the engineering process to self-suffice materials and technology on the spot and implement engineering intention easily. Recycling of technology and materials, power autonomy by natural energy, utilization of environment friendly technology, and popularization of engineering by easy construction and implementation are important issues [5].

All process is basically based on the principle of self-sufficiency and no a priori experience in electronics and mechanism is required. This type of engineering based on locality was named as "JunPoDong-JangJonDong engineering" meaning Pusan version of "ChongGyeChon engineering." JunPoDong is the name of place where local electronics shops and mechanic shops spread. JangJonDong is the name of place where local engineers are being trained. ChonGyeChon is the name of place where all kinds of low materials and skilled people are around. These places show characters of prehistoric society where everything can be done at one place to survive.

2.2 Tangible media based on interactive technology: iT_Media

A new technology paradigm based on soft engineering approach is investigated. Tangible space focuses on embodied interactions among humans and environment, virtuality, and sensation/perception. Science of emotion relies on the notion that emotions allow you to make quick and proper decisions. As emotions are critical to human behavior, they are equally critical for intelligent machines, especially autonomous machines of the future that will help people in their daily activities. By understanding these machines as interactive media we encounter in everyday activities, we can find a proper deign methodology. So interactive tangible media "iT_Media" is proposed to explore and synthesize these ideas [3].

3. INTERACTIVE TECHNOLOGY EDUCATION

We introduce an introductory engineering education course "interactive technology" for engineering majors and non-engineering majors. We summarize our interactive teaching experiences at Pusan National University which include on/off-line interactions, assignments, projects, and evaluations.

3.1 Course overview

An introductory engineering course, "Interactive Technology at Pusan National University," is a three (3) hour lecture per each week for fifteen (15) weeks, offered during the fall semester of 2003. Course encourages attendees to explore engineering issues lain in future everyday lives of ordinary people in terms of changes from object based technology to environment based technology. Ramification and reunification of technology from humans, evolution of technology in terms of arms and toys, reunification of mom and technology, interactive technology, technology as intentions and designs, and soft engineering [1, 11, 24].

Students expand their views on technology by various interactive learning experiences including thought experiments, interactive media experiences, invited lectures, assignments, and term projects as described in Table 1. Among 170 course attendees, one hundred forty six (146) were engineering students and twenty four (24) were non-engineering students. Trailer version of weekly course syllabus in the form of documentary film about 15 minutes long has been produced and was shown to the students at the opening lecture. Various images with captions are presented to attract attendees' curiosities.

This course does not require any previous knowledge and experience on engineering. It requires only strong curiosities on engineering. Since course topics cover many aspects of technology, traditional learning methods fail to be successful and efficient. Various efficient learning methods have been proposed and implemented. We utilize various interactive tangible media, which include simulated thought experiments and physical media experiences. About twenty (20) episodes in short film format are produced based on scenario written according to related issues selected. Physical media like interactive robots are introduced for attendees' stimulated experiences.

Multimedia contents are considered to be the best means to convey condensed information in short time. Contents are cinematized by student volunteers under the direction of lecturer. This interactive collaborative process is shown in Fig. 1. Each episode about twenty five (25) minutes long is shown to the students without any explanations. It needs to draw students' expectations for their emotional mental state toward course materials positive. Live discussions during the lecture are added to pre-produced contents [24].

Table 1 The weekly course materials.

	Topics	Assignments
1	Introduction & inter-disciplinary research	
2	Soft engineering and ubiquitous computing	Survey on list of three favorite Sci-Fi movies
3	Robotics in science fiction	Storyboard of one Sci-Fi movie
4	Technology in science fiction	
5	Industrial revolution and information revolution	
6	Evolution of technology Issues for humans & tech	
7	Invited lecture 1: Multimedia art	
8	Midterm examination: Term project planning	Ideas for presentation
9	Invited lecture 2: Mind and AI	Group discussion on laws of robotics
10	Invited lecture 3: Embodiment & AL	Ideas on robots to sell
11	Motion capture, wearables, design evolutionary eng.	Surveys on state of the art technology
12	Rapid prototyping (RP) technology & platforms PNU eng.: Junkbot	Scenario of term project contents
13	Tech for the handicapped & the elderly Research trends	Contents submission
14	Project presentation	
15	Review Open discussion	Revised contents submission

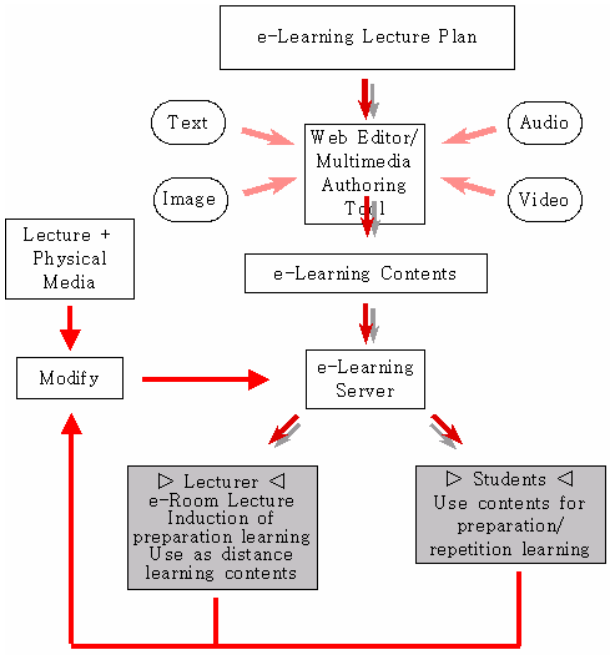

Fig. 1 Interactive e-learning contents production process.

These pre-lecture contents, post-lecture contents, and live discussion capabilities on cyberspace stimulate students' interests on subject matters which are considered to be relatively difficult to grasp. Contents viewing and live discussions were recorded for future recycling purposes as shown in Fig. 2.

Fig. 2 Interactive learning at a multimedia room.

3.2 Interactive learning

Learners take part in overall learning processes. Depending on students' interests, they volunteer in the various stages of production and operation, which include contents selection, conversion, editing, recording, monitoring, on-site engineering, web and internet cafe management, and equipments depending on their interests [1, 11, 24].

We organize each lecture content from one or two fundamental questions on engineering issues. Once the scenario is written, students collect and view the related contents, and make list of converting materials. Various related visual contents, carefully selected and edited with narrations, serve as excellent course materials. During the each course session, lecturer and student demonstrate physical media, which include HCI products, robot platforms, etc.

We produce narratives and interviews in addition to the edited segments from visual contents archives. During the recording session, a skilled student is invited to act as a host navigator of thought experiments, as shown in Fig. 3. We invite an experienced host for better delivery of contents. Basic contents production system for processing various visual, auditory sources is given at Table 2.

Fig. 3 Course contents.

Table 2. Contents production/operation system.

	Item	No.	Task
1	Multimedia PC	Three	Contents selection, converting, editing, exporting
2	Web server	One	Interactive web, Contents storage, data gathering, Assignment submission
3	Matrox RT.X10, Converse-Pro	one Each	Video capturing, editing, processing
4	Adobe Premiere 6.0	Two	Contents converting, editing, exporting software
5	DV camcorder Digital camera	one each	Visual and audio contents recording Making history
6	Portable hard drive (over 80G)	Ten	Contents storage
7	Lighting and audio system	one each	Visual/audio contents recording

We dedicate an interactive web and an internet cafe solely to the course, as shown in Fig. 4. In previous webs, users only upload/download the contents, check announcements, and on/off-line discussions. Easy accessibility often dampens interactions. To encourage interactivities, an interactive broadcasting form is a good alternative to look at. Any web structure with easy submission capabilities, like bulletin board type, works fine. Volunteers collaborate each other by sharing information on internet cafe. Student contributions are displayed at the end of contents to appreciate their efforts.

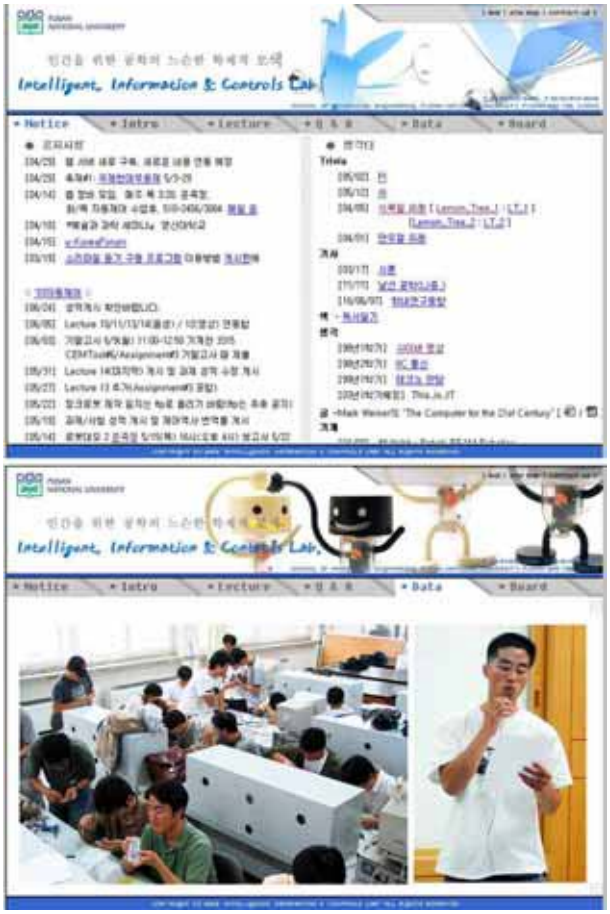

Fig. 4 An interactive web.

Term project is produced in visual form and presented with scenario written. Group of five students, four engineering majors and one non-engineering student, are required to make a film on future technological society we live in and present in public. Non-engineering student serve as a project leader and he/she lead this interdisciplinary group meetings many times, which give them a interdisciplinary and collaborative experiences to investigate for the technology issues of future society. Course attendance is checked utilizing PDAs and/or finger identification system, which gives you an excellent experience of future technology of ubiquitous computing, as shown in Fig. 5.

3.3 Science fiction film screening

Science fiction films like Metropolis, Space Odyssey 2001, and Minority Report are effective and exciting media to portray future society [12-17]. Many technological issues can be discussed as an explicit extension form of imagination. Issues regarding future technology and people in future society could attract many engineering and non-engineering students alike [1-69].

Ten science fiction films are selected by lecture and students. Students are required to see on two movies on the series and one movie of their own choice. Also, they have to write their essay on films on course web. Complete list of films shown at the weekly science fiction film screening during the first semester of 2004, as shown in Fig. 6, includes 1) Abre Los Ojos (Open Your Eyes) by Alejandro Amenabar (1997, 117 minutes), 2) Minority Report by Steven Spielberg (2002, 145 minutes), 3) Animatrix by Andy Jones, Peter Chung, et al. (2003, 89 minutes), 4) Blade Runner by Ridley Scott (1982, 117 minutes), 5) Metropolis by Fritz Lang (1926, 89 minutes),

Fig. 5 An internet cafe and attendance check.

Fig. 6 Weekly science fiction film screening.

6) Sleeper by Woody Allen (1973, 89 minutes), 7) Gattaca by Andrew Niccol (1997, 106 minutes), 8) The MATRIX (1999, 136 minutes) / The MATRIX 2 (Reloaded) (2003, 138 minutes) / The MATRIX 3 (Revolution) (2003, 128 minutes) by Larry Wachowski and Andy Wachowski, 9) Modern Times by Charlie Chaplin (1936, 89 minutes), and 10) 5/27: Solaris by Andrei Tarkovsky (1972, 169 minutes) [11].

3.4 PNU junk robot project

PNU junk robot project is aiming for students to experience engineering process. Information on parts and fabrication procedures are provided in pictures to the students. Except solar cells and some basic electronic parts, junk parts from computers and audios are encouraged to be recycled. Students fabricated their own solar powered robots in either spinning top or racer following guide lines in pictures and model robots in moving images via course internet. After less than one (1) hour in-class session, they tested basic operations in a breadboard circuit with a fan and a small electrical motor. Once basic function is confirmed, prototype is further refined with soldering of electronic parts and designing mechanical structures. For evaluation purpose, easiness and reproducibility in implementation is major checking points. Reports summarizing the fabrication process with final robots have to be submitted. Some restrictions imposed on cost and fabrication time are 1 hour and 5,000won. Junk robots operated on solar systems are artificial life forms, as shown Fig. 7 [5, 11, 69].

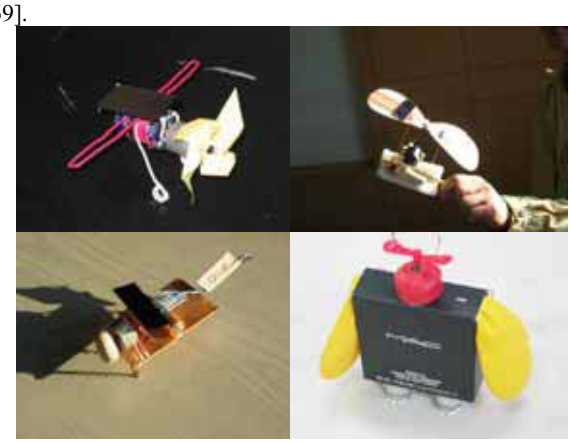

Fig. 7 Sample robots from PNU junk robot projects.

4. SUMMARY

We introduce an introductory engineering education course for engineering majors and non-engineering majors focused on technology issues for future society. We summarize our exciting experiments on interactive teaching experiences at Pusan National University which include on/off-line interactions, assignments, projects, and evaluations. We utilize various interactive tangible media, which include simulated thought experiments and physical media experiences.

About 20 episodes in short film format are produced based on scenario written according to related issues selected. Philosophical and historical views regarding evolution of technology and machines are presented. Interdisciplinary attitude toward engineering is emphasized and history of machines as arms and toys are introduced.

Interaction is maximized by encouraging students participating in lectures and projects. This new way of education suggests a promising future education format.

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