Introduction to Virtual Reality

Course Code:

CSE 484

Course Period:

Autumn

Course Type:

Area Elective

Credits:

3

Theoric:

3

Practice:

0

Laboratory Hour:

0

ECTS:

5

Course Language:

English

Course Coordinator:

Esin Onbaşıoğlu [1]
Courses given by:

Esin Onbaşıoğlu [1]
Course Objectives:

This course covers a variety of topics related to virtual reality, with a special emphasis on haptic systems. The goal of the course is to convey the state-of-the-art technologies and underlying principles of virtual reality and 3D user interfaces, and develop a complete

virtual reality application through group projects. Theoretical topics include transformations, graphical and haptic rendering in 3-D virtual environments, and geometric modeling of virtual environments.

Course Content:

Fundamentals of virtual reality systems, geometric modeling, transformations, graphical rendering, haptic rendering, evaluation of virtual reality systems.

Course Methodology:

1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study

Course Evaluation Methods:

A: Testing, B: Experiment, C: Homework, D: Project

Course Learning Outcomes	Program Learning Outcomes	Teaching Methods	Assessment Methods
Knowledge about basic virtual reality concepts.	1,2,3,4	1,2	A, C
Ability to program a 3D virtual environment using Unity3D	1,2,3,4	1,3	D
Ability to program a virtual reality application through the use of Google Cardboard, haptics devices, or depth sensors	1,2,3,4	3	D
Ability to evaluate a system through user studies	5	1,2,4	A, D
Knowledge on the ethical and societal impacts of virtual reality technologies	11	1,2	A, C
Ability to work in groups	6	3	D

COURSE CONTENT

Week	Topics	Study Materials
1	Introduction: Course requirements and topics overview. Definition and history of VR	Online materials LaValle Ch.1

2	Enabling Technologies of virtual reality: Sensors, displays, alternate-world generators; applications of VR	Online materials LaValle Ch.2
3	Three-dimensional concepts	Hearn & Baker Ch.9
4	Spatial descriptions and transformations: Angle-axis representation; quaternions; 3D rotation inverses and conversions	LaValle Ch.3 Hearn & Baker Ch.11
5	Homogeneous transforms; transforms to displays; look-at and eye transforms	LaValle Ch.3 Hearn & Baker Ch.11
6	Canonical view and perspective transforms; viewport transforms	LaValle Ch.3 Hearn & Baker Ch.12
7	Midterm	
8	Graphical rendering; ray tracing; shading; BRDFs; rasterization; barycentric coordinates	Hearn & Baker Ch.14
9	Haptic rendering	Online materials
10	Rigid body dynamics, collisions and interaction with haptic systems	Hearn & Baker Ch.16
11	3D User Interfaces	Hearn & Baker Ch.8
12	Designing for evaluating VR Systems	Online materials
13	Project Presentations	–

14	Project Presentations	–

RECOMMENDED SOURCES

Textbook	LaValle, Steven M. Virtual Reality. To be published by Cambridge University Press. [http://vr.cs.uiuc.edu/vrbookbig.pdf] [2] Hearn, Donald, M. Pauline Baker, and Bjarne Stroustrup. Computer Graphics with OpenGL, 3/E. Prentice-Hall, 2003. APA
Additional Resources	Ming Lin and Miguel Otaduy. Haptic Rendering. A K Peters, 2008.

MATERIAL SHARING

Documents	Any material presented in lecture will be posted on the COADSYS page of the course.
Assignments	Assignments will be posted on the COADSYS page of the course.
Exams	Exams and sample solutions will be disseminated through the COADSYS page of the course.

ASSESSMENT

IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Programming assignments	4	20
In class discussion, participation	1	10
Project and peer review		35
Midterm		15
Final examination	1	20
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		20
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		80
Total		**100**

COURSE'S CONTRIBUTION TO PROGRAM

No	Program Learning Outcomes	Contribution

		1	2	3	4	5
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied information in these areas to model and solve engineering problems.					X
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.					X
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.					X
4	Ability to devise, select, and use modern techniques and tools needed for engineering practice; ability to employ information technologies effectively.					X
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating engineering problems.				X	
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.					X
7	Ability to communicate effectively both orally and in writing; knowledge of a minimum of one foreign language.					
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.					
9	Awareness of professional and ethical responsibility.					
10	Information about business life practices such as project management, risk management, and change management; awareness of entrepreneurship, innovation, and sustainable development.					
11	Knowledge about contemporary issues and the global and societal effects of engineering practices on health, environment, and safety; awareness of the legal consequences of engineering solutions.			X		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (excluding the exam week)	13	3	39

Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Project	1	48	45
Assignments	4	3	12
Midterm	1	2	2
Total Work Load			126
Total Work Load / 25 (h)			5.04
ECTS Credit of the Course			5