Course guide
270506 - SGI - Interactive Graphic Systems

Last modified: 12/07/2022

Unit in charge:	Barcelona School of Informatics
Teaching unit:	723 - CS - Department of Computer Science.

Degree: MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Compulsory subject).

Academic year: 2022   **ECTS Credits:** 6.0   **Languages:** Catalan

LECTURER

Coordinating lecturer: MARTA FAIREN GONZALEZ

Others: Primer quadrimestre:
MARTA FAIREN GONZALEZ - 10
NURIA PELECHANO GOMEZ - 10

PRIOR SKILLS

Capabilities equivalent to the level of subject IDI Computer:

- Learn the basics of Computer Graphics.

- Ability to program in a high-level programming language and object-oriented (C++ or C#).

- Understand concepts of linear algebra, in particular foundations of geometric transformations and matrix calculus.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.

Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY

The course will be based on weekly theory classes (2h) and fortnightly laboratory (2 hours each fortnight).

In theory classes will introduce the concepts of the subject and where appropriate will be exercises and examples that may help in achieving the theoretical concepts and practical.

Students are expected to prepare additional materials will be provided during the year in the form of notes or references (bibliographic or web) to prepare examinations and laboratory practice.

In the lab, introduced the software to use and will consider the practices that students must develop and deliver. A part-time laboratory where students will focus on solving the practical help of the teacher raised.

LEARNING OBJECTIVES OF THE SUBJECT

1.Understand the concept of character, as with the simulation of motion of this character in a graphical environment and the problems arising in the simulation of crowds.
2.Learn all concepts related to Virtual and Augmented Reality, its architecture and the related software and hardware.
3.Being able to develop an application on a virtual or real + virtual 3D interaction.
4.Understand the concepts of 3D interaction and usability of systems in Virtual and Augmented Reality, and presence.

STUDY LOAD

Type	Hours	Percentage
Self study	96,0	64.00
Hours small group	18,0	12.00
Hours large group	36,0	24.00

Total learning time: 150 h

CONTENTS

Character animation.

Description:
Avatars. Simulation of motion of a character. Avoid collisions. Simulation of crowd.

Virtual Reality - Introduction and architecture.

Description:
Architecture of a Virtual Reality system. Applications.

Virtual Reality - Devices.

Description:
Input devices. Output devices. Haptic.

Virtual reality - stereoscopy

Description:
Concepts of depth perception. Generation of the stereoscopic pair. Stereo Active and passive stereo.

Virtual Reality - Software

Description:
Virtual Reality Software. VR-Juggler. XVR.

Augmented Reality

Description:
Concept of augmented reality. Different architectures. Software: AR-Toolkit.

3D user interfaces.

Description:
3D user interfaces. Selection and object manipulation. Navigation and control application.

Usability and presence.

Description:
Evaluation of usability. Usability tests. Sense of presence.

Haptic Rendering

Description:
Sentit del tacte. Dispositius hàptics. Algoritmes per rendering haptic.

Augmented Reality - Software

Description:
Software de Realitat Augmentada.

ACTIVITIES

Character animation

Description:
Avatars. Simulation of motion of a character. Avoid collisions. Simulation of crowd.

Specific objectives:
1

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.

Full-or-part-time: 8h
Theory classes: 4h
Self study: 4h

Partial review

Description:
Written examination of the view until the subject.

Specific objectives:
2

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 12h
Guided activities: 2h
Self study: 10h

Virtual Reality - Introduction and architecture.

Description:
Architecture of a Virtual Reality system. Applications.

Specific objectives:
2

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 8h
Theory classes: 4h
Self study: 4h

Virtual Reality - Devices.

Description:
Input devices. Output devices. Haptic.

Specific objectives:
2

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 8h
Theory classes: 4h
Self study: 4h

Virtual reality - stereoscopy

Description:
Concepts of depth perception. Generation of the stereoscopic pair. Stereo Active and passive stereo.

Specific objectives:
2

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

Virtual Reality - Software

Description:
Virtual Reality Software.

Specific objectives:
2, 3

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 16h
Laboratory classes: 8h
Self study: 8h

Augmented Reality

Description:
Concept of augmented reality. Different architectures.

Specific objectives:
2, 3

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 8h
Theory classes: 4h
Self study: 4h

3D user interfaces.

Description:
3D user interfaces. Selection and object manipulation. Navigation and control application.

Specific objectives:
4

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.

Full-or-part-time: 12h
Theory classes: 6h
Self study: 6h

Usability and presence.

Description:
Evaluation of usability. Usability tests. Sense of presence.

Specific objectives:
4

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.

Full-or-part-time: 8h
Theory classes: 4h
Self study: 4h

Part-2 Exam

Description:
Partial examination of second part of theory and exercises for the course.

Specific objectives:
1, 2, 3, 4

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 12h
Guided activities: 2h
Self study: 10h

Practical Virtual Reality

Description:
Practical exercise on Virtual Reality

Specific objectives:
2, 3

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 17h
Self study: 17h

Practice of Augmented Reality

Description:
Practical exercise on Augmented Reality

Specific objectives:
2, 3, 4

Related competencies :
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE10. Capability to use and develop methodologies, methods, techniques, special-purpose programs, rules and standards for computer graphics.
CTE1. Capability to model, design, define the architecture, implement, manage, operate, administrate and maintain applications, networks, systems, services and computer contents.
CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 17h
Self study: 17h

Haptic Rendering

Full-or-part-time: 4h
Theory classes: 2h
Self study: 2h

Augmented Reality - Software

Full-or-part-time: 16h
Laboratory classes: 8h
Self study: 8h

GRADING SYSTEM

The evaluation of the course is given by the combination of theoretical and practical part.

The theory is evaluated with 2 written exams, the first at 7 weeks of the course and the second at week 14. Both will have a 50% of the theoretical part of the course.

NT = + 0.5 * 0.5 * NPrimerExamen NSegonExamen

The practical part will be evaluated by two parts: the first will evaluate everything that has to do with Virtual Reality (NP1) and the second wit Augmented Reality and 3D interaction and usability (NP2). The two notes of the practical parts are coptaram 50% each.

NP = + 0.5 * 0.5 * NP1 NP2

Finally the final grade for the course is calculated as 40% of the practice and 60% of the theoretical part. Therefore the final grade:

NF = 0.4 * 0.6 * NP + NT

BIBLIOGRAPHY

Basic:
- Sherman, W.R.; Craig, A.B. Understanding virtual reality: interface, application, and design. 2nd ed. Morgan Kauffman, 2018. ISBN 9780128183991.
- LaViola, J.J. 3D user interfaces: theory and practice. 2nd ed. Addison Wesley, 2017. ISBN 9780134034324.