270623 - VAR - Virtual and Augmented Reality

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science
Academic year: 2018
Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan

Prior skills
The course assumes advanced C++ programming skills, as well as computer graphics knowledge.

Degree competences to which the subject contributes
Specific:
CEE1.2. Capability to understand and know how to apply current and future technologies for the evaluation, implementation and operation of virtual and / or increased reality environments, and 3D user interfaces based on devices for natural interaction.

General:
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.

Transversal:
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

Teaching methodology
The course is based on weekly theory classes explaining the course concepts, techniques and algorithms.

The students will have to complete weekly assignments. The assignments require the student to read and analyse a few papers about the course topics and to answer questions or solve problems on the subject.

The students will have to complete a programming project involving the development of a moderate-complexity VR or AR application.

The course assumes advanced knowledge of the C++ language and OpenGL and GLSL APIs.

Learning objectives of the subject
2. Understand the elements, architecture, input and output devices of virtual and augmented reality systems.
3. Be able to develop and evaluate 3D interactive applications involving stereoscopic output, virtual reality hardware and 3D user interfaces.
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<table>
<thead>
<tr>
<th>Study load</th>
<th>150h</th>
<th>Theory classes:</th>
<th>27h</th>
<th>18.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Practical classes:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td></td>
<td>Laboratory classes:</td>
<td>27h</td>
<td>18.00%</td>
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<tr>
<td></td>
<td></td>
<td>Guided activities:</td>
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<td>0.00%</td>
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<tr>
<td></td>
<td></td>
<td>Self study:</td>
<td>96h</td>
<td>64.00%</td>
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</table>
## Content

### VR systems

**Degree competences to which the content contributes:**

**Description:**
VR as a discipline. Basic features of VR systems. Architecture of VR systems.

### VR hardware

**Degree competences to which the content contributes:**

**Description:**
VR input hardware: tracking systems, motion capture systems, data gloves. VR output hardware: visual displays.

### Stereoscopic Vision

**Degree competences to which the content contributes:**

**Description:**

### Haptic rendering

**Degree competences to which the content contributes:**

**Description:**

### VR software development

**Degree competences to which the content contributes:**

**Description:**
Challenges in VR software development. Windowing, viewing, input/output and networking issues. Master/slave and Client/server architectures. Cluster rendering. VR Juggler and XVR.

### AR software development

**Degree competences to which the content contributes:**

**Description:**
### 3D user interfaces

| Degree competences to which the content contributes: |
| Description: |
| Why 3D user interfaces. Major user tasks in VE. Interaction techniques for selection, manipulation and navigation. 3DUI evaluation. |

### Presence

| Degree competences to which the content contributes: |
| Description: |
| Presence: concept, definition, measurement and applications. |
### Planning of activities

<table>
<thead>
<tr>
<th>Project</th>
<th>Hours</th>
<th>Description</th>
<th>Specific objectives</th>
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</thead>
<tbody>
<tr>
<td><strong>Project XVR</strong></td>
<td>10h</td>
<td>Development of a programming project using XVR</td>
<td>3</td>
</tr>
<tr>
<td><strong>Project stereoscopy</strong></td>
<td>10h</td>
<td>Development of a project with stereoscopy</td>
<td>2, 3</td>
</tr>
<tr>
<td><strong>Project ARToolkit</strong></td>
<td>10h</td>
<td>Development of a project for Augmented Reality applications using ARToolkit</td>
<td>2</td>
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</table>
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Qualification system

The course assessment is based on three types of activities:

- 3 Programming project ( P1, P2, P3)
- Midterm exam ( MT )
- Final exam ( F )
- Presentation ( Pr )

Grade = 0.15*P1+ 0.15*P2 + 0.15*P3 + 0.10*Pr + max(0.20*MT+0.25*F, 0.45*F)

Bibliography

Basic:


Others resources:

Hyperlink

http://www.vrmedia.it/en/xvr.html

http://www.hitl.washington.edu/artoolkit/