UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Virtual and Augmented Reality

2526-2-F1801Q174

Aims

1. Knowledge and Understanding

The course introduces the basic concepts of Virtual Reality (VR) and Augmented Reality (AR), from both theoretical and practical perspectives.
It covers the fundamental principles distinguishing VR and AR, including design guidelines and the rationale behind their applications.
Both enabling hardware and software technologies are examined for VR and AR.

2. Applying Knowledge and Understanding

Students learn to design and develop a simple VR application prototype using Unity.
Practical Unity-based projects will be implemented, leveraging head-mounted displays as enabling devices.

3. Making Judgements

By the end of the course, students will be able to critically assess the actual usefulness of VR and AR techniques and their applicability in various contexts.

4. Communication Skills

Students must be able to describe and justify the design and technological choices made during the prototype development.

5. Learning Skills

The course provides a foundation for independently studying and experimenting with emerging VR and AR technologies.
Students are introduced to evaluation methods for VR/AR applications, including user testing and analysis of

adverse effects.

Contents

The aim of the course is to introduce the basic concepts of VR and AR from both a theoretical and a practical point of view.
The fundamental principles that characterize VR and AR will be addressed, with basics of design principles and motivations of VR and AR applications.
For both VR and AR, basic enabling technologies will be studied (hints on HW and SW)
For VR, examples of simple Unity projects that use headsets as enabling tools will be developed.
Finally, we will see basics of the evaluation (user tests, evaluation of adverse effects) of VR / AR applications.

Detailed program

Theory

- Introduction to the basic concepts of VR and AR in the “mixed reality continuum” (a line that starts from a real environment, passes through augmented reality and arrives at virtual reality), differences and similarities between the two technologies
- Notes on design principles, motivations and history of VR and AR
- Output devices and vision
- Input Devices, Tracking
- Virtual Worlds, Locomotion, Interaction
- Notes on the evaluation of VR / AR applications (usability, evaluation of adverse effects, user tests), concrete case studies
  Practice
- Introduction to the Object Oriented Programming
- Introduction to Unity
- Intro to VR, basic enabling technologies (physics, collisions, interaction with objects, events, GUI, locomotion) and advanced (animation of objects and avatars, scripting, autonomous movement of avatars)
- development of simple Unity projects that use headsets as VR tool
  The course has a strong practical and applicative component, especially focused on VR.

Prerequisites

Basic knowledge of IT and programming

Teaching form

Lectures (21 hours, in presence, in erogative modality: If necessary for organizational reasons, some hours may be held remotely, either online or offline.) concerning the theoretical aspects of both VR and AR, and the introduction to the practical ones (including the basic knowledge of Unity).
Exercises in the classroom (28 hours, mainly in presence, with an initial erogative part to explain and show the

exercice to be done, and the remaining part in interactive modality) for the guided development of practical exercises (on personal PCs needing Unity to be installed). If necessary for organizational reasons, some hours may be held remotely, either online or offline.
Other 4 hours are usually devoted to visiting VR/AR laboratories of the University, or to seminars (interactive modality, in precence).
All lessons and exercices are recorded and made available one/two days after they were done.
The official language of the course is English.

Textbook and teaching resource

Slides from the teacher.
Technical documentation and tutorials for Unity.
Books:
Virtual and Augmented Reality (VR/AR), Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung Editors. Springer, 2022
Augmented Reality: Principles and Practice (Usability) - Dieter Schmalstieg Tobias Hollerer, 2016

Semester

Second semester

Assessment method

Written test (carried out in the laboratory on examonline) on the topics, technologies and exercises seen in lectures and exercises, and an optional group project (2-3 people) which allows you to obtain some additional points on the final grade (a single submission then kept valid for all exam sessions during the academic year).
The written test includes both closed multiple choice questions and open questions, and covers all the topics seen in class (the theory part) and those tested during the exercises (Unity). Regarding the practical part, the questions include both closed multiple answers, open answers, and questions relating to the use of Unity and the programming within it, as seen in the classroom.
The project aims to show how much the student has learned both theoretically, and his ability to realize it in a design of a simple VR application, and practically, implementing it in Unity. The project must be accompanied by a report that presents and describes it, and will then be delivered to and discussed with the teacher.
Oral exam upon request by the professor or the student, which may cover both theoretical and practical topics (including questions or small exercises in Unity).

Office hours

By appointment

Sustainable Development Goals

REDUCED INEQUALITIES | SUSTAINABLE CITIES AND COMMUNITIES