IG.3504 – 3D and Immersive Reality

General information

Title: 3D and Immersive Reality
Module leader: Maria TROCAN
Module ID: IG.3504
ECTS: 5
Average amount of work per student: 120 hours, including 42 hours supervised
Teamwork: yes
Tags: 3D, virtual reality, augmented reality

Presentation

The field of immersive 3D technologies, active since 1990, has experienced a very strong expansion in recent years with the arrival on the market of accessible and high-performance hardware (VR headsets, AR smartphones, MR glasses, compatible PCs and consoles, etc.)

Extended Reality (XR) includes various forms of immersive reality, such as augmented reality (AR), mixed reality (MR) or virtual reality (VR). All these fields are now based on real-time 3D application development tools such as the Unity3D game engine.

Educational objectives

At the end of this module, students will have an overview of the state of the art and use cases of XR technologies, the design principles and associated specificities, as well as a working knowledge of the 3D application development pipeline with Unity3D.

The final objective of this module is to develop an immersive 3D application or experience (in support of VR or AR hardware) using the various features of the Unity3D engine and respecting the associated design best practices

Prerequisite

Good level in algorithmics and Object-Oriented programming, ideally having followed module II.2315 (Algorithmics and Advanced Programming).

Content/Program

Concepts

- Definition, history and state of the art of VR, AR and MR technologies
- The field of XR hardware, its specificities and use cases (training, collaboration, dataviz, medicine, multimedia, video games, etc.)
- Effects of immersion on humans and consequent design principles
- User interfaces for Immersive applications
- 3D rendering (geometry, texturing, shading, and illumination)
- Real-time 3D simulations (animations and physics engines)
- 3D application development (game engines, SDKs, OOP, component-oriented programming, CPU and GPU optimization)
- 3D software project management (design stages, asset pipelines, collaboration, key roles, user testing, etc.)

Tools used

- Unity3D Engine, Visual Studio, C#
- VR headsets, AR smartphones.

Pedagogical methods

Learning methods

- Lessons: 7 sessions of 3 hours of lessons
- Project: 7 supervised sessions of 3 hours

Evaluation methods

The evaluation of this module is based on group activities (graded project) and individual exams in continuous assessment after each class.

- Individual continuous assessment: 2 * 4 pts = 8 pts/20
- Collective evaluation of the project: 12pts/20 (demo, deliverable 8 pts + defense 4 pts)

Language of work

Module entirely taught in English, student productions in English or French, as desired.

Bibliography, Webography, Other sources

- Unity3D
    - Official Introduction to Unity3D Application Development
      https://learn.unity.com/course/getting-started-with-unity
    - Official Manual and Documentation of the Unity3D Software
      https://docs.unity3d.com/Manual/UnityManual.html
    - Introduction to the C# Programming Language with Unity3D
      https://learn.unity.com/project/beginner-gameplay-scripting
- 3D computer graphics
    - Excellent video cutting the fundamental components used in 3D synthesis
      https://youtu.be/TEAtmCYYKZA
- Immersive Technologies
    - Documentary following the history of Virtual Reality to the present day
      https://youtu.be/UW8NapTA9oc
    - Article presenting the history of AR, how it works and its applications
      https://thinkmobiles.com/blog/what-is-augmented-reality/