UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
META-526	Virtual and Augmented Reality Development	10
Prerequisites	**Department**	**Semester**
None	Digital Innovation	Fall/Spring
Type of Course	**Field**	**Language of Instruction**
Elective	Metaverse	English
Level of Course	**Lecturer**	**Year of Study**
2nd Cycle	Dr. Chris Christou	1st
Mode of Delivery	**Work Placement**	**Corequisites**
Face to face	N/A	N/A

Course Objectives:

The main objectives of the course are to:

1. Explain advanced issues related to AR and VR development in the Metaverse
2. Explore the Unity3D interface
3. Demonstrate how to build a smartphone app
4. Equip students with knowledge on how to create an AR interactive application for the Metaverse

Learning Outcomes:

After completion of the course students are expected to be able to:

1. Design and create applications which demonstrate the power and utility of extended reality and its use in the Metaverse.
2. Create an immersive VR application utilizing 3D computer generated content and use 360-degree media for creating photographic VR content.
3. Use Unity3D game engine for mobile game development.
4. Develop a reasonable understanding of C# coding for Unity scripting.

Course Content:

Session 1: Introduction

- Introduction to the course.
- Teaching methods and assessments.
- Software requirements.

- Guidelines for installing Unity3D software and the required modules.
- Preparing hardware for mobileVR and video pass-through AR.
- Definitions of AR/VR

Session 2: The Unity3D interface

- Interface components.
- Creating basic primitives.
- Coordinate systems.
- Transforms.

Session 3: Building and Deploying a Smartphone App

- Describe Assets and Packages.
- Introduce the Google Cardboard SDK and how it can be used to quickly create VR applications for smartphone devices.
- Describe the first-person 'Player' gameobject.
- Demonstrate how to preview the application in the editor.
- Build and deploy to either iOS or Android.

Session 4: MobileVR

- Further instruction of lighting and lighting settings
- Normal maps, height maps and occlusion maps for materials.
- Learn how to apply a Skybox.
- Learn how to create a mountain terrain using the Terrain asset
- Brief definition of global illumination baking and it benefits for VR

Session 5: Interaction – Gaze-Based Control

- Learn more about behaviors and scripting in C#.
- Learn to detect collisions using colliders and triggers.
- Discuss the physics of ray-casting.
- Introduce the gaze pointer or reticle.
- Demonstrate triggered behavior based on gaze pointer ray-casting.

Session 6: Interaction - Motion Control

- Learn about different VR locomotion methods.
- Discuss vector-based transforms.
- Learn to adjust transforms using scripting.
- Implement smooth movement and teleport location.

Session 7: 360° Media and VR

- Introduce equirectangular imagery.
- Describe 180° and 360° cameras.
- Discuss creation and sourcing of 360° media.
- Introduce the graphics rendering pipeline and shaders

Session 8: Creating a 360° image tour

- Learn to import and prepare 360° media in Unity
- Create canvases and buttons for gaze control

- Implement scripts for gaze control
- Implement scripts for fading between scenes

Session 9: Creating and animating 3D Biped Characters in Unity

- AR SDKs. Arkit, Arcore and ARFoundation
- Unity3D and AR
- Preparation for AR project
- Basic surface-based AR app

Session 10: Unity character animation and AI

- Image-based target placement
- Adding 3D models
- Adding animated character

Session 11: Augmented Reality for Developers

- Discuss the various forms of AR.
- Give a broad definition of AR that is device independent.
- Prepare students software and hardware for AR development in Unity3D.
- Introduce the objectives of AR Foundation framework.
- Demonstrate how to build the demos contained within ARFoundation including target-based markers and layout estimation.

Session 12: Creating a Metaverse AR Interactive Application

- Add components for AR session and plane detection
- Dynamically create a NavMesh on the detected plane.
- Dynamically position a NPC on a detected plane.
- Create script for initiating and controlling character animation.

Learning Activities and Teaching Methods:

- Faculty Lectures
- Guest-Lectures Seminars
- Directed and Background Reading
- Case Study Analysis
- Academic Paper Discussion
- Simulations
- Student-led Presentations
- In-Class Exercises

Assessment Methods:

- Interactive activities and classroom participation
- Assignments / Project
- Final exams

Assessment Methods in alignment with Intended Learning Outcomes:

		Intended Learning Outcomes to be assessed			
Assessment Method	**Weighting**	LO1	LO2	LO3	LO4
Interactive activities	15%	✓		✓	✓
Assignments	25%	✓	✓	✓	✓
Exams	60%	✓	✓	✓	

Student Study Effort Expected:

Student Study Effort Expected	Hours
Lectures	12h
Assignments / Project	75h
Interactive activities and forum participation	20h
Reading and research	140h
Exam	3h
Total	250h

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the power of Unity and become a pro at creating mixed reality applications.	Glover, J., & Linowes, J.	Packt Publishing Ltd.	2019	9781838644864

Recommended Textbooks / Readings:

- Christou, C. (2010). Virtual reality in education. In Affective, interactive, and cognitive methods for e-learning design: creating an optimal education experience (pp. 228-243). IGI Global.
- Christou, C., Herakleous, K., Tzanavari, A., & Poullis, C. (2015, September). Psychophysiological responses to virtual crowds: implications for wearable computing. In 2015 International Conference on Affective Computing and Intelligent Interaction (ACII) (pp. 35-41). IEEE.
- Christou, C. G., & Aristidou, P. (2017). Steering versus teleport locomotion for head mounted displays. In International conference on augmented reality, virtual reality and computer graphics (pp. 431-446). Springer, Cham.
- Christou, Chris. "Virtual reality in education." Affective, interactive and cognitive methods for e-learning design: creating an optimal education experience. IGI Global, 2010. 228-243.
- Christou C.G. and Parker A.J. (1995), Visual realism and virtual reality: a psychological perspective, in Simulated and Virtual Realities: Elements of Perception, eds.
- Okita A (2019) Learning C# Programming with Unity 3D, second edition 2nd Edition, ISBN-13 : 978-1138336810

- Pangilinan, E., Lukas, S., & Mohan, V. (2019). Creating augmented and virtual realities: theory and practice for next-generation spatial computing. " O'Reilly Media, Inc.".
- Schmalstieg, D., & Hollerer, T. (2016). Augmented reality: principles and practice. Addison-Wesley Professional.
- Wohl, M. (2019). The 360 video handbook: A step-by-step guide to creating video for virtual reality (VR). Vrrrynice. com.