Course Title

Designing Interactive VR Application of Buildings

Course Description

This course includes knowledge of the techniques, technologies and tools needed to develop a VR application for historic buildings.

Prerequisites

Structural Programming Skills
Object Oriented Programming (C#)
Basic 3D Geometry(Vectors, Coordianate Systems etc.)

General Objectives

Teaching architectural modeling
Teaching architectural visualization
Teaching to develop VR apps
Teaching to desing and implement interaction tecniques

Main Topic	Sub-topic	Learning outcomes	Teacher-centred Activities	Student-centred activities	Assigned resources and materials	Explanations
Introduction to 3D modelling	Definition of a 3D model History of 3D technology Application fields of 3D modeling 3D modeling for architecture Challanges and opportunities	Students gain awareness of 3D modeling Studens gain awareness about history of 3D technology Students learn the use of 3D modeling in architectural field Students understand the potential of 3D modeling	Lecturing with slides Question&Answer Method Discussion Question&Answer Method	Discussing the first impression Searching 3D history milestones Discussing the future development Preparing one-minute paper	Slides Videos	We will provide fundamental information regarding 3D technology, how to use it in different fields and introduce these technologies to the students, with a particular focus on the architecture applications.
Building a 3D model	Open-source and commercial softwares for 3D modelling Introduction to Blender Editing tools Modelling steps for the architecture Creating and modelling objects	Students learn the 3D modelling fundamentals Students recognize the Blender software Students experiment the editing tools of Blender Students understand the 3D modelling process Students create their own 3D model	Lecturing with slides Demo on Blender Guided Discovery*	Installing and using Blender Practising with the editing tools of Blender Creating their first 3D model	Slides PCs	Students learn how to install a 3D modelling software (Blender) and how to use it to recreate an architectural 3D model
Editing the 3D model	UV unwrapping Nodes and materials Texturing Particle settings Lighting the environment Rendering and exporting	Students practice coloring the 3D model Students texturize the 3D model Students add particle settings to the 3D model Students add lights to the model Students render the model and export it in various formats	Lecturing with slides Demo on Blender Guided Discovery*	Searching and downloading materials for 3D model Unwrapping the 3D model Texturizing the 3D model Adding lights in the 3D environment Rendering the 3D model and exporting it	Slides PCs	Students learn how to use the editing tools of Blender and to export the rendered 3D model
Introduction to Virtual Reality Technologies	History of VR Technology Challanges,Oppurtunities Elements of VR	Students gain awareness of VR technologies Students can use VR equipment Students learn the usage of VR in different fields	Lecturing with slides Demo of VR devices Demo of VR products	Testing VR equipment Discussing the first impression Searching VR technology in internet	Slides Video VR Equipments	We will provide fundamental information regarding VR technology and how to use them for different fields and introduce these technologies to the students.
Introduction to Game Engines	Introducing and installing development environment (Unity Game Engine) Unity Interface and menus Unity assets and components Deploying an app to devices	Students comprehend the game engine fundamentals Students familiar with the game engine editor Students run the first app in Unity Students deploy the app to a device	Lecturing with slides Demo on game engine editor Question&Answer Method Demo on VR device	Installing the game engine editor Running the first sample app on the editor Deploying the first app to a device	Slides Video VR Equipments	Students learn game engine concepts and how to install game development environment, Unity Game Engine and code the first game app.
Game Development Fundemantals	Coordinate System Vectors Operations Dot Products, Cross Product Transforming game objects Built-in methods	Students apply mathematical knowledge and skills to 3D programming Students know how to transform game objects Students know lifecycle of built-in methods one	Lecturing with slides Demo of 3D Programming in Game Engine Demo of Built-in methods in Game Engine Discussion	Studying game mathematics on the paper Code practising for 3D programming in Game Engine Preparing one-minute paper	PCs Slides Sample codes 3D Vector Grapher App	This lecture gives background regarding game mathematics and how to use it in the game engine for object transformations.
Exporting 3D Building Model to Game Engine	Configuring 3D model Setup texturing Setup lighting	Students export the model into the game engine Students embed textures into materials Students configure environment lighting	Lecturing with slides Demo on game engine editor Demo on VR device Guided Discovery*	Creating a study group Each student creats a simple 3D model and exports it into the game engine Practising texturing and lighting on the model in game engine Comparison of each model in the group	PCs Slides VR Equipments Free 3D models	Students learn how to properly export 3D models to the game engines and successfully set up game object materials and global illumination for lighting.
Selection Techniques	Highlighting Virtual Hand Raycasting	Students highlight virtual objects Students select objects with virtual hands and raycasting Students gain awareness of state of art selection techniques	Lecturing with slides Demo of selection type with role play** Demo on game engine editor Demo on VR device Guided Discovery*	Code practising of selectinon tecniques Testing selection tecniques in VR equipments Searching and preparing a report about state of art selection tecniquies	PCS Slides Sample Codes VR Equipments	Students learn object selection which is a primary technique used in VR. Students will learn the most famous selection techniques such as virtual hand and raycasting.

Manipulation Techniques	Translating Rotating Scaling	Students move, rotate, and scale the objects in Game Engine Students move, rotate, and scale the objects on VR devices	Lecturing with slides Demo of manupulation methods with role play** Demo on game engine editor Demo on VR device Guided Discovery*	Practising manipulation methods on real life objects Code practising for manipulaiton tecniques in game engines Testing manipulaiton tecniquies in VR equipments	PCS Slides Sample Codes VR Equipments	Students will learn how to change the position, orientation, and scale of objects in VR environments.
Mixed Reality ToolKit (MRTK)	Integrating MRTK to Game Engine MRTK Interactions MRTK User Interface	Students utilize MRTK in-game engine Students perform MRTK interactions Students modify and use the MRTK interface	Demo on game engine editor Demo on VR device Guided Discovery*	Code practising using MRTK Testing MRTK in VR devices Preparation of a report regarding MRTK API	PCs Sample Codes VR Equipments	Students will learn how to implement MRTK, an input system for spatial interactions and UI supporting a wide range of platforms.
Measurement Interaction Tools for Architecture Education	Measuring Tape Hose Plumb Whiteboard Annotations	Students develop measurement interactions Students implement virtual measuring tape, hose, plumb, whiteboard, and annotations to measure the building	Lecturing with slides and videos Demo on game engine editor Demo on VR device Guided Discovery*	A case study: examining the measurement process of real building Code practising for interaction tecniques regarding these tools in game engines Testing these interaction tecniquies in VR equipments	Architectural Tools:measuring tape, hose, plumb PCs Sample codes VR Equipments	Students learn how to implement virtual interaction tools such measuring tape, hose, plumb, whiteboard, and annotations in VR architectural environments.
Multiuser Interaction in Virtual Building	Photon Unity Networking Creating Virtual Rooms Adding Multiuser (Meta Avatar SDK) Interaction Sychronization	Students create a multi-user VR environment using photon networking Students develop multi-user interaction in VR. Students implement the experience of social presence using Meta Avatar SDK.	Lecturing with slides and videos Demo on game engine editor Demo on VR device Cooperative Group***	Code practising for interaction tecniques regarding these tools in game engines Testing these interaction tecniquies in VR equipments Students customize their own avatars Cooperative Group***	PCs Sample codes VR Equipments Avator Creater App	Students willl learn how to create multi user interaction with Meta Avatars SDK.

*Guided Discovery: The teacher poses a problem for the students and provides hands-on training by providing the students with a series of steps to follow.

**Role Play: Students and teacher act out real life dilemmas or decisions to solve problems

***Cooperative Group:Small group work that features positive interdependence, individual accountability and collaboration skills