

Liverpool John Moores University

Title: Software Engineering Concepts for AR/VR
Status: Definitive
Code: **7148COMP** (127315)
Version Start Date: 01-08-2021

Owning School/Faculty: Computer Science and Mathematics
Teaching School/Faculty: Computer Science and Mathematics

Team	Leader
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Academic Level: FHEQ7 **Credit Value:** 20 **Total Delivered Hours:** 44
Total Learning Hours: 200 **Private Study:** 156

Delivery Options

Course typically offered: Semester 1

Component	Contact Hours
Workshop	44

Grading Basis: 50 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Artefacts	AS1	Technical Analysis of applying AR/VR Components to an Enterprise Domain	40	
Artefacts	AS2	Enhancing an Application with AR/VR.	60	

Aims

- (i) To compare and contrast architectural approaches to building AR/VR Applications.*
- (ii) To critically appraise the Software Architectures and Algorithmic Principles which underpin modern AR/VR Applications.*

- (iii) To practically apply the structures and technologies of AR/VR Middleware in tandem with a modern game engine.*
- (iv) To assimilate data and resources from Enterprise software into an AR/VR application for visualisation purposes.*
- (v) To understand the deployment of software solutions across a range of AR/VR related hardware.*
- (vi) To provide opportunity for students to design and develop mixed reality solutions.*

Learning Outcomes

After completing the module the student should be able to:

- 1 Critically appraise the core algorithms that underpin a specific class of AR/VR problems.
- 2 Evaluate the software and hardware requirements for integrating AR/VR into an enterprise application.
- 3 Design and develop new application functionality and AR/VR Techniques using modern game engine methodologies and data structures.
- 4 Apply suitable programming techniques with AR/VR related game technologies to solve problems specific to mixed reality applications.
- 5 Practically apply a set of middleware and APIs to incorporate domain-specific data and resource into a VR/AR application.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Technical Analysis	1	2	
Application Enhancement	3	4	5

Outline Syllabus

AR/VR Concepts:

- Defining Augmented Reality and Virtual Reality; Reality to Virtuality continuum.*
- Mixed Reality: Definition, Augmented Telepresence, Taxonomy, Issues associated to Mixed Reality, Applications of Mixed Reality Technology.*
- Sensory Augmentation: Sound, Stereoscopic display, Force Feedback Simulation, haptic devices. User input: Viewer and object tracking, Pose and gesture recognition, Motion Capture, Accelerometers, Fiducial markers, User interface issues.*
- Virtual Reality and Virtual Environments: The historical development of VR: Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality.*
- Computer Vision and Augmented Reality*
- Software SDKs, APIs and Middleware for Virtual Reality*
- Software SDKs, APIs and Middleware for Augmented Reality*
- Mobile and Tablet-Based AR.*
- Consumer Virtual Reality HMDs, Commercial Virtual Reality HMDs, Holographic Displays, CAVEs*

- *AR/VR on the Web.*

AR/VR Development:

- *Software Engineering Principles for structuring real-time AR/VR Applications.*
- *Game Engines vs AR/VR Application Solutions.*
- *Core Game Engine API usage and the principles of interaction event-driven software.*
- *Asset Management, Asset Conditioning and Data Import/Export.*
- *Enterprise Application Data and embedding it into AR/VR.*
- *AR/VR Frameworks and their common components.*
- *Application Architecture Tiers:*
3RD Party SDKs; Core Systems; Platform Independence; Rendering, Physics Subsystems; Application Data Foundations; Visual Effects System; Application-Specific Subsystems;
- *Soft vs. Hard Architectures: Scripting Languages*
- *Feedback Models: User Interfaces and Orthographic/Perspective Interface*
- *Logical and Spatial Scene Structures*
- *Spatial Data Structures and Visibility Determination*
- *Physics in an AR/VR Context.*
- *Broad and Narrow Phase Collision Detection and Response.*
- *Material Systems and Rendering*
- *Data-Driven AR/VR Development*

Learning Activities

- Interactive Workshop – to deliver the concepts, methodologies and techniques relevant to developing AR/VR Software, alongside modern Game Engines.
- Workshop – Tutor-led workshop activities which will enable the students to practice the methods and techniques to design and prototype a mixed reality application.
- Further exercises – additional exercises for students to work on in their own time.
- Directed learning – provides additional reading to enable workshop work to be completed.
- Learning materials can be accessed digitally via University Virtual Learning Environment (VLE).

Notes

This module will introduce the student to the Mixed Reality domains, providing both a theoretical perspective on the classification of virtuality and reality, and the associated hardware and software requirements.

Students will be exposed to the current state of the art in AR/VR development by evaluating the hardware, software and middleware requirements of a modern AR/VR solution.

Students will learn the software engineering principles and core algorithms which are

used to implement Augmented Reality/Virtual Reality applications using aspects of a modern game engine.

We will focus on the architectural layers of a modern game engine and their relevance to building AR/VR Solutions in tandem with how we integrate AR/VR SDKs into a modern engine and deploy software to AR/VR supporting devices. We will look at various architectural design strategies and provide in-depth coverage of various core modules and tiers within a game engine. This involves applying real-time programming techniques and data structures, and practically applying them to develop mixed reality applications.