

## Module Information

2022.03, Approved

### Summary Information

Module Code	7151COMP
Formal Module Title	Advanced Topics in Augmented Reality
Owning School	Computer Science and Mathematics
Career	Postgraduate Taught
Credits	20
Academic level	FHEQ Level 7
Grading Schema	50

### Teaching Responsibility

LJMU Schools involved in Delivery
Computer Science and Mathematics

### Learning Methods

Learning Method Type	Hours
Lecture	11
Workshop	22

### Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
JAN-CTY	CTY	January	12 Weeks

### Aims and Outcomes

Aims	(i) To develop advanced theoretical and practical research skills in Augmented Reality. (ii) To develop a critical appreciation of the theoretical and practical issues related to Augmented Reality. (iii) To understand the Hardware Limitations of Mobile Vision Systems in supporting the Digital Augmentation of a real-world scene. (iv) To develop a student's appreciation of a variety of approaches to constructing a Digital Representation of a real-world scene captured via an AR device. (v) To enable students to use state-of-the-art technologies and hardware in the development of Augmented Reality applications. (vi) To practically apply state-of-the-art development techniques in order to Augment a real-world scene with knowledge and interactions.
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**After completing the module the student should be able to:**

**Learning Outcomes**

Code	Number	Description
MLO1	1	Use a range of technologies, algorithms and associated data structures and choose an appropriate architecture for an Augmented Reality application.
MLO2	2	Critically evaluate and select appropriate techniques for detecting artefacts in the real-world and construct a digital representation.
MLO3	3	Employ advanced skills in Augmented Reality development to augment a real-world scene with virtual objects.
MLO4	4	Demonstrate a deep and systemic understanding of the interrelationships between AR Research Topics and associated development techniques.
MLO5	5	Technically describe the key challenges, state-of-the art technologies and algorithms for Augmenting Reality with digital information.
MLO6	6	Critically evaluate a real-world setting and describe the challenges this environment poses.

**Module Content**

Outline Syllabus	Hardware Concerns for AR: • Mobile Augmented Reality• Digital Camera Technologies and Real-Time Capture• Depth Sensing and 3D Camera Technologies, Time of Flight, Laser Driven Devices. • Camera Intrinsic• Sensors and Mobile Services to Support AR (Geolocation Services, Accelerometers, • Mobile CPU and GPU Limitations and Processing Architectures• Holographic Displays• Integrating AR Frameworks for Mobile Devices• Cross-Platform Interoperability. Vision Problems in Augmented Reality:• Simultaneous Location and Mapping (SLAM)• Motion Tracking and Stability• Monocular SLAM • Real-World Detection and Shape Approximation o Real-time Techniques: Geometric Approximation, Point Clouds, Meshing, Collision Detection and Responseo Offline Techniques: Machine Learning, Neural Networks, Vision Algorithms. • Environment Sensing and Estimation• Tracking and Visualising Planes and Surfaces• Occlusion in Augmented Realityo Convex and Concave Geometryo Rendering Ordero People Trackingo Pose Detectiono Face Trackingo World Approximation, Clipping and CullingAlgorithms and Components for AR: • Fiducial Markers • Temporal Tracking and Prediction• Stabilisation of Tracing• Markerless Algorithms • Anchors and Cloud Anchors• AR Frame Processing• AR Camera Characteristics• Ray Casting and Ray Intersection Techniques• Processing Hit Tests. • Rendering Techniques for AR• Lighting and Rendering Challenges in AR
Module Overview	This module explores the theoretical and technical domains that underpin the current state of the art in Virtual Reality development. From fundamental fields of study such as Data Visualisation and Neuro Perception, through to hardware concerns, visual fidelity and real-time rendering approaches required to achieve smooth, immersive environments, you will evaluate and practically apply the latest development techniques to produce a Virtual Reality Visualisation system.
Additional Information	This module explores the hardware, theoretical and technical domains that underpin the current state of the art in Augmented Reality development. From fundamental fields of study such as Camera Inputs, Depth Sensing, to virtual world detection and approximation techniques to state-of-the-art approaches to key aspects such as Occlusion, students will evaluate and practically apply the latest development techniques to apply Augmented Reality to various real-world problems.

## Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Technology	Augmenting a Real World Scene	60	0	MLO2, MLO1, MLO3
Centralised Exam	Examination	40	1.5	MLO6, MLO5, MLO4

## Module Contacts

### Module Leader

Contact Name	Applies to all offerings	Offerings
Christopher Carter	Yes	N/A

### Partner Module Team

Contact Name	Applies to all offerings	Offerings
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