

Virtual Reality

Credit Hours: 2-1

Contact Hours: 2-3

Pre-requisites: None

Code BI-434

Course Introduction

Virtual Reality (VR) is a transformative technology with broad applications. This course provides the main aspects of virtual reality technology by integrating concepts from computer graphics, design, and human-computer interaction, providing a comprehensive learning experience. Students would develop practical expertise in areas such as virtual environment design, and programming for VR applications, enhancing their employability. The course would also foster research and innovation, allowing students to contribute to the advancements in VR technology.

Educational Objectives

This course aims to provide students with an in-depth understanding of the fundamental knowledge of virtual, augmented, and mixed reality. The students will be introduced to new kinds of user experiences by creating fully immersive virtual world experiences of superimposing digital content onto the real-world view of the user.

Objectives

2. This course aims to provide students with fundamental knowledge of the molecules of life, as well as their function in the context of a living cell. More specifically, the course aims to achieve the following objectives.

5. To develop a deep understanding the fundamental concepts and technologies in VR
6. To provide an understanding of the fundamental building blocks of VR systems.
7. To provide an overview of VR development approaches with focus on how human body responds to presented stimulus
8. To analyze and evaluate usability of VR systems that are both effective and comfortable
9. To enable articulation of trends and directions in current and future VR systems

Outcomes

1. Students will be able to demonstrate an understanding of fundamental principles of human response to presented stimulus

2. Students will be able to design VR systems using the technological building blocks
3. Students will gain proficiency in creating basic immersive virtual experiences

Proposed Contents

Week No	Description	Quizzes	Assignment
1	Introduction to Virtual, Augmented and Mixed Reality		
2	3D Graphics – Rasterization, Shading, Geometry		01
3	-		
4 - 5	Light, Optics and the visual system (04 Contact hrs)	01	
6	Perception – Color, Depth, Motion	02	
7	-		
8	Place, plausibility and embodiment illusion		
9	MIDTERMS		
10	Visual Rendering and Latency Reduction	03	
11	-		

12	Physics of the virtual world		02
13	Interaction and haptics		03
14	Tracking and Navigation		
15	Generic VR System and Recent trends in VR	04	
16	-		
17	-		04
18	END SEMESTER EXAMINATION		

3. Details of lab work/workshop practice, if applicable

Lab 1: Introduction to game engines and VR	<ul style="list-style-type: none"> - Introduction to the game engine and its interface - Creating a new project, navigating the editor, and understanding the basic components of the scene
Lab 2: Scene Building and Asset Management	<ul style="list-style-type: none"> - Manage scenes in the game engine for VR applications - Importing assets, placing objects in the scene, organizing the hierarchy, and setting up the VR camera rig
Lab 3: Scripting in Unity	<ul style="list-style-type: none"> - Basics of scripting in the game engine - Write scripts to control VR interactions, handle player movement, and manipulate objects within the virtual environment
Lab 4: VR Interactions and User Input	<ul style="list-style-type: none"> - Implementing VR interactions and user input within the game engine. - Techniques for hand presence, object grabbing, teleportation, and other common VR interactions
Lab 5: VR Interactions and User Input	<ul style="list-style-type: none"> - Mapping input from VR controllers to in-game actions and create intuitive and immersive interactions
Lab 6: User Interface	<ul style="list-style-type: none"> - Design and implementation of user interfaces in VR, including menus, buttons, and interactive elements using game engine's UI system.
Lab 7: Locomotion	<ul style="list-style-type: none"> - Various methods of VR locomotion, including teleportation, smooth movement, and room-scale navigation

	<ul style="list-style-type: none"> - Implement locomotion techniques and understand the considerations for user comfort and reducing motion sickness
Lab 8: Audio and Visual Effects	<ul style="list-style-type: none"> - Integrating audio and visual effects to enhance VR experience - Add spatial audio, implement particle effects, create dynamic lighting, and optimize visuals for VR performance
Lab 9: Optimization	<ul style="list-style-type: none"> - Optimizing VR applications for performance and ensuring a smooth frame rate - Techniques for optimizing graphics, managing draw calls, and reducing the impact on system resources
Lab 10: Testing VR Applications	<ul style="list-style-type: none"> - Testing and debugging VR applications in the game engine. - Debugging tools, test VR interactions, and address common issues and bugs that may arise in VR development

Recommended reading, including textbooks, reference books

4. Steve Lavalley, (2023). Virtual Reality. Cambridge University Press. ISBN
 5. William R. Sherman and Alan B. Craig, (2018). Understanding Virtual Reality - Interface, Application, and Design. 2nd Edition. The Morgan Kaufmann Series in Computer Graphics, Elsevier ISBN 978-0128183991
 6. Samuel Greengard (2019) Virtual Reality (The MIT Press Essential Knowledge series) ISBN 978-0262537520
 7. Helen Papagiannis (2017) Augmented Human: How Technology Is Shaping the New Reality ISBN 978-1491928325
 8. Robert Scoble, Shel Israel (2016) The Fourth Transformation ISBN 978- 1539894445
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