CSC 377: Introduction to Mixed Reality

1. CSC 377: Introduction to Mixed Reality

2. credit units 4 contact hours 6

3. Course Coordinator: Christian Eckhardt

4. Textbook (or other required material): -

5. a. Course Description: Project-based study and application of Mixed Reality (MR) topics including integrated mixed reality development environments, Human Computer Interaction (HCI) peripherals, 3D environment scanning, physics interaction, diminished reality, motion capture, facial recognition, and visualization hardware.

b. Prerequisite: Prerequisite: CPE/CSC 202. Recommended: ART 376.

c. Required/Elective/Selective Elective for CPE, CSC, EE, SE

<table>
<thead>
<tr>
<th></th>
<th>CSC</th>
<th>CPE</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Selective Elective</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. a. Course Learning Objectives

The student will be able to:
- Extend the behavior of a mixed reality integrated development environment through scripting language.
- Explain the basic concepts of virtual, augmented and mixed reality and Human Computer Interaction (HCI) for mixed reality.
- Create mixed reality applications and real world - virtual world interaction and present and discuss the result.
- Apply related linear algebra topics, which will be introduced in the course, to transform virtual object into the real world or read geometry from the real world into mixed reality with depth sensors.
- Analyze software development tools and application programming interfaces for mixed reality human computer interaction components.
- Evaluate HCI peripheral hardware devices for mixed reality in terms of immersion and usability for Mixed Reality based on their hardware properties such as sensor type and data micro-controller and micro controllers for data collection and processing.
- Evaluate the impact of mixed reality, especially information exchange, head up displayed information and diminished reality to humans to society.

b. Level at which Student Outcomes are addressed
(“B” = Basic level, “I” = Intermediate level, “A” = Advanced level)
7. Major Topics Covered: (number of lecture hours per)

- Introduction to the game engine: (1.5)
  UI, game objects, program loop, models & materials, transforms and physics, compiling and running, Virtual Reality connection. (1.0)

- Case Study: Ball Control Game: (1.5)
  Camera movement, following player, colliders, detecting and handling collisions, spawning and collecting Objects, debugging, building, cross platform Development. (1.5)

- Basics and review of vectormatrix algebra. Transformation s (Rotation, Scaling and Translation). Mathematic game engine datatypes. (1.0)
  Principles of n-body interaction. Physic of impulse transformation. Basics of animation hierarchical modelling. (1.5)

- Human Computer Interaction (HCI): (1.5)
  Hand movement (by motion detection or gamepad input). (1.0)
  General sensor discussion: Electronic basics, analog digital converter basics. (1.0)
  Motion capturing and mapping to a virtual representation (hand and full body mocap suit). (1.0)

- Augmented Reality: Equipment & displays. 3D scanning, point-clouds and mesh generation. (1.5)
  Head/body tracking to update camera orientation and position. (1.5)
  Use of scanned geometry to implement existing ball game and/or more complex interaction from previous labs/homework. (1.0)

- Billboards and particles. (1.5)
  Reading of 3D environment data along a path (ray tracing). (1.0)
  Interaction to determine depth and distance. Placing virtual objects on existing geometry. (1.0)

- Art and design of User Interface and investigations of usability in mixed reality. Interaction with buttons and sliders. Interfaces to streaming data and screen sharing from within the game engine. (1.5)

- HCI virtual keyboard. Interaction with mixed reality environment. (1.5)
  Ray tracing for HCI - object interaction. (1.0)
  Discussion: impact on society, new developments, ethics for altered and diminished reality. (0.5)

- Altered and diminished reality: (1.5)
  Find geometry, alter textures, hide existing geometry, add walls along existing planes. (1.5)