



UNIVERSITÀ DI PISA
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

“Virtual Reality: Theory and Practice”

Assoc. Prof. Giuseppe Turini

Computer Science Dept. – Kettering University – Flint (Michigan, USA)

E-mail address: gturini@kettering.edu

Short Abstract: Ph.D. course on the theory and practice of virtual reality applications, focused on the design of VR systems and on the software development of VR apps. These are some of the topics that will be discussed: history of VR, VR technology, game engines, HMDs and CAVEs, stereographics, motion tracking, VR interactions and haptics, VR locomotion, VR comfort and safety. Each course session will be a mix of theory (VR principles) and practice (VR coding examples).

Course Contents in brief:

Lecture	Title	Concepts
1A	Introduction to VR	Terminology, SW-HW Ecosystem, Application Fields.
1B	Introduction to Unity	Editor, Gameobjects/Components/Assets, Scenes.
2A	VR System Design	Architecture, Virtual Scene, Interactions, Presence
2B	Unity Scripting	Script Components, Event Functions, CD, Physics.
3A	Stereographics and HMDs	Stereo Pairs, Depth Cues, Stereo Frustum, Parallax
3B	VR Integration in Unity	XR Plugin, XR Interaction Toolkit, Device Simulator
4A	VR Interactions	Controllers/Hands, Target/Select/Manipulate
4B	Inputs and UI in Unity	Input Manager/System, Overlay UI, Diegetic UI
5A	VR Locomotion	Physical/Artificial, VR Movements, Teleportation
5B	Artificial Locomotion in Unity	Character Controllers, Tunneling, Teleport Pads,

Total # of hours of lecture: 20 hours

References:

- [1] *“Virtual Reality”* by S.M. LaValle. Cambridge University Press, 2019.
 - [2] *“Virtual and Augmented Reality (VR/AR)”* by R. Doerner et al. Springer, 2022.
 - [3] *“Designing Virtual Reality Systems”* by G. Kim. Springer, 2005.
-

CV of the Teacher

Giuseppe Turini is an Associate Professor of Computer Science at Kettering University (Flint, Michigan, USA), where he is currently the director of the Virtual Reality Lab (VR-LAB). He is also a visiting research associate at the EndoCAS Research Center of the University of Pisa (Pisa, Italy).

His teaching activity includes foundation courses in object-oriented programming, data structures, and algorithmics; and specialty classes on game development, computer graphics, and virtual reality. His main research interests include: computer graphics and vision, virtual and augmented reality, human-computer interactions, game development, and interactive physics simulation; applied to computer-assisted medicine (minimally-invasive surgery, surgical robotics, medical training, virtual surgery, medical imaging, pre-operative planning, intra-operative navigation, etc.).

Giuseppe Turini received both his M.Sc. and Ph.D. degrees from the University of Pisa; he is the author of more than 30 peer-reviewed publications, and he has been involved in several sponsored research projects in Italy, Europe, and the USA.

Final Exam: Written test.

Room and Schedule

Room:

Aula Riunioni del Dip. di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor

Schedule:

Day 1 – Friday, 2 February 2024, 9:00-13:00 – “Introduction to VR, and Unity”

Day 2 – **Thursday, 8 February** 2024, 9:00-13:00 – “VR System Design and Unity Scripting”

Day 3 – Friday, 16 February 2024, 9:00-13:00 – “Stereographics, HMDs, and VR in Unity”

Day 4 – Friday, 23 February 2024, 9:00-13:00 – “VR Interactions, Inputs and UIs in Unity”

Day 5 – Friday, 1 March 2024, 9:00-13:00 – “VR Locomotion and Artificial Movements in Unity”