Course guides
804244 - RAVJ - Augmented Reality

Last modified: 02/09/2021

Unit in charge: Image Processing and Multimedia Technology Centre
Teaching unit: 804 - CITM - Image Processing and Multimedia Technology Centre.

Degree: BACHELOR'S DEGREE IN VIDEO GAME DESIGN AND DEVELOPMENT (Syllabus 2014). (Compulsory subject).

Academic year: 2021 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Fernández Ruiz, Marta

Others: Seinfeld Tarafa, Sofia
Omedas, Pedro

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
04 COE. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

Explanation by the teacher of the theoretical and practical concepts, which must allow the student to understand the current state and the possibilities offered by the different fields introduced in the subject, as well as carrying out the practices proposed throughout the course.

Some practices will be done individually, while the final work of the subject will be done in groups (3 to 4 people). The development of contents and some part of the practices will be carried out in class with the assistance of the teacher, while other activities will have to be carried out independently outside of class time.

The results of the final work, in addition to being delivered in writing, must also be presented in class. Both in the explanation of contents and in the realization of practices, it is about doing a participatory class where the student actively intervenes, asking questions and proposing solutions / alternatives in relation to the concepts and technologies used.

LEARNING OBJECTIVES OF THE SUBJECT

- Be able to design video games for interfaces based on augmented reality (AR) and immersive virtual reality (VR).
- Understand the principles of user-centered design for AR and VR, as well as the challenges and applications generated by these technologies.
- Show knowledge and be able to use libraries for the creation of video games and applications on mobile devices and/or other devices.
- To be able to design and build models that represent the necessary information for the creation and visualization of interactive images using virtual and augmented reality.
- Understand the current status and the different possibilities offered by computer graphics, computer vision systems and virtual and augmented reality.
- Understand the cognitive principles and perceptual illusions generated by AR and VR technologies.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours medium group	30,0	20.00
Guided activities	12,0	8.00
Hours large group	18,0	12.00

Total learning time: 150 h

CONTENTS

Theme 1. Introduction to AR and VR

Description:
Definition, evolution, current status and applications of augmented reality and virtual reality.

Full-or-part-time: 13h
Theory classes: 6h
Guided activities: 2h
Self study : 5h

Theme 2. Concepts, properties and effects of AR and VR

Description:
- Immersion.
- Presence.
- Embodiment.
- Agency.
- Plausibility.
- Spatiality.
- VR / AR hardware and software.

Full-or-part-time: 18h
Theory classes: 6h
Guided activities: 2h
Self study : 10h

Theme 3. Interaction and Interface Design in AR and VR Environments

Description:
- 3D User Interface (interaction techniques, selection, manipulation, navigation, visual perspective).
- User Centered Design Principles applied to VR and AR.
- Challenges (level of graphic realism, simulator sickness, social interaction, multisensory feedback, ethics).

Full-or-part-time: 29h
Theory classes: 8h
Practical classes: 2h
Guided activities: 4h
Self study : 15h

Theme 4. Video games and applications in AR y VR

Description:
- Storytelling.
- Mechanics.
- Genres / Typologies.
- Techniques (Unity, Unreal, Vuforia, AR Foundation, etc).

Related activities:
Critical analysis of two video games, one based on VR and the other on AR. The analysis should collect all the concepts seen throughout the course, including the perceptual illusions and properties of VR / AR, up to the principles of interaction and design that are used in the video game.

Full-or-part-time: 26h
Theory classes: 4h
Guided activities: 2h
Self study : 20h

Theme 5. Prototyping and testing

Description:
- Conceptualization and creation of a video game prototype based on VR or AR, applying all the contents explained in class.
- Testing of VR and AR applications.

Related activities:
Conceptualization and prototyping of a video game based on AR or VR. The prototype must collect aspects of game design and all the concepts seen throughout the course.

Full-or-part-time: 64h
Theory classes: 4h
Practical classes: 16h
Guided activities: 4h
Self study : 40h

ACTIVITIES

Practice 1 - Analysis

Description:
Critical analysis of two video games or applications, one based on VR and the other on AR. The analysis will collect all the concepts seen throughout the course, including the perceptual illusions and properties of VR / AR, up to the principles of interaction and design that are used in the video game.

Full-or-part-time: 25h
Self study: 25h

Practice 2 - Project

Description:
Conceptualization and prototyping of a video game based on AR or VR, collecting aspects of game design and all the concepts seen throughout the course. The supervision of the project will be carried out by milestones:

- Conceptualization and planning
- Functionality
- Interface and aesthetic elements
- Presentation of the prototype

Full-or-part-time: 44h
Guided activities: 4h
Self study: 40h

GRADING SYSTEM

- Assignment 1 (AR / VR game analysis): 30%
- Midterm exam: 20%
- Assignment 2 (AR / VR game prototype): 40% (Conceptualization: 10%; Prototype: 15%; Presentation: 15%)
- Participation and attitude towards learning: 10%

* Students' participation and learning attitude will be evaluated by monitoring their interventions in class and the interest shown during the course. This evaluation equals 10% of the final grade.

Students who do not pass the course during the continuous assessment may take the re-assessment (only the 20% corresponding to the midterm exam will be assessed, being 5 the maximum mark that can be obtained in the course).

EXAMINATION RULES.

- The activities, once completed, must be delivered to the Virtual Campus in the corresponding delivery and on the corresponding date.

- The evaluation of the activities does not only imply the resolution of the same, but also the presentation of the results (when the student or the group is required to do so during the classes).

- The documents must be completed following the instructions given therein, especially with regard to the file names and the content structure. The correct management of the documentation provided is an aspect related to the skills to be acquired and is, therefore, subject to evaluation.

BIBLIOGRAPHY

Basic:
- Geroimenko, Vladimir . Augmented Reality Games II: The Gamification of Education, Medicine and Art. Cham: Springer, 2019. ISBN 978-3-030-15619-0.
- Schmalstieg, Dieter; Hollerer, Tobias . Augmented Reality: Principles and Practice. Boston: Addison-Wesley, 2016.
- Aukstakalnis, Steve . Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors. Boston: Addison Wesley, 2017.
- Jerald, Jason. The VR book : human-centered design for virtual reality . [s.l.] : ACM Books , 2016. ISBN 978-1-97000-112-9.
- Murray, Janet Horowitz. Hamlet en la holocubierta : el futuro de la narrativa en el ciberespacio . Barcelona [etc.] : Paidós, cop. 1999. ISBN 8449307651.
- Papagiannis, Helen. Augmented Human: How Technology Is Shaping the New Reality. O`Reilly, 2017.

RESOURCES

Hyperlink:
- Unity3D. https://unity3d.com/es
- Vuforia Developer Portal. https://developer.vuforia.com/
- ACM Siggraph. http://www.siggraph.org/
- VR Developers Conference. http://www.vrdconf.com/
- IEEE Virtual Reality. http://ieeevr.org
- Spark AR Studio. Resource

Other resources:
Scientific Papers:

Azmandian, M., Hancock, M., Benko, H., Ofek, E., & Wilson, A. D. (2016). Haptic retargeting: Dynamic repurposing of passive haptics for enhanced virtual reality experiences. Conference on Human Factors in Computing Systems - Proceedings, 1968–1979. https://doi.org/10.1145/2858036.2858226

Azuma, R. (2015). Location-based mixed and augmented reality storytelling. Fundamentals of Wearable Computers and Augmented Reality, CRC Press, 259-276.

Datcu,D., Lukosch, S. & Brazier, F. (2015). On the Usability and Effectiveness of Different Interaction Types in Augmented Reality. International Journal of Human-Computer interaction 31, 193- 209. https://10.1080/10447318.2014.994193

Dirin, A. & Laine, T. (2018). User Experience in Mobile Augmented Reality: Emotions, Challenges, Opportunities and Best Practices. Computers, 7 (2), 1-18.

Dube, T. J., & Arif, A. S. (2019). Text Entry in Virtual Reality: A Comprehensive Review of the Literature. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 11567 LNCS, 419–437. https://doi.org/10.1007/978-3-030-22643-5_33

DuÅ¼maÅ□ska, N., Strojny, P., & Strojny, A. (2018). Can Simulator Sickness Be Avoided? A Review on Temporal Aspects of Simulator Sickness. Frontiers in Psychology, 9(NOV), 2132. https://doi.org/10.3389/fpsyg.2018.02132

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Kilteni, K., Groten, R., & Slater, M. (2012). The Sense of Embodiment in virtual reality. In Presence: Teleoperators and Virtual Environments (Vol. 21, Issue 4, pp. 373–387). MIT Press Journals. https://doi.org/10.1162/PRES_a_00124

Kim, M. (2013). A framework for context immersion in mobile augmented reality. Automation in construction, 33, 79-85.

Knauer, M. & Mütterlein, J. (2016). Two worlds, one gameplay: a classification of visual AR games. Proceedings of the 1st International Joint Conference of DiGRA and FDG.

Ko, S. M., Chang, W. S., & Ji, Y. G. (2013). Usability Principles for Augmented Reality Applications in a Smartphone Environment.

International Journal of Human-Computer Interaction, 29(8), 501–515. https://doi.org/10.1080/10447318.2012.722466

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Manovich, L. (2005). The poetics of augmented space. http://manovich.net/content/04-projects/034-the-poetics-of-augmented-space/31_article_2002.pdf

Seinfeld, S., Feuchtner, T., Maselli, A., & Müller, J. (2020). User Representations in Human-Computer Interaction. Human-Computer Interaction. https://doi.org/10.1080/07370024.2020.1724790

Seinfeld, S., & Müller, J. (2020). Impact of visuomotor feedback on the embodiment of virtual hands detached from the body. Scientific Reports, 10(1), 1–15. https://doi.org/10.1038/s41598-020-79255-5

Slater, M. (2009). Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1535), 3549–3557. https://doi.org/10.1098/rstb.2009.0138

Slater, M., Gonzalez-Liencres, C., Haggard, P., Vinkers, C., Gregory-Clarke, R., Jelley, S., Watson, Z., Breen, G., Schwarz, R., Steptoe, W., Szostak, D., Halan, S., Fox, D., & Silver, J. (2020). The Ethics of Realism in Virtual and Augmented Reality. Frontiers in Virtual Reality, 1, 1. https://doi.org/10.3389/frvir.2020.00001

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Zollmann, S., Langlotz, T., Grasset, R., Hong Lo, W., Mori, S. & Regenbrech, H. (2021). Visualization Techniques in Augmented Reality: A Taxonomy, Methods and Patterns. IEEE Transactions on Visualization and Computer Graphics, Vol 27 (9), 3808 - 3825. https://doi.org/10.1109/TVCG.2020.2986247