<CS3001-CS3606 Advanced Topics in Computer Science and Business Computing>
Topic 4: Mixed Reality 2021/2022

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INTRODUCTION

The main purpose of each seminar in the module is to give you an opportunity to further explore the topic covered in the corresponding lecture through a structured session that will facilitate the exploration and exchange of the main ideas and issues in the topic. The seminar activities are directly related to the way that the topics will be covered in the examination, so preparing for the seminars, and engaging fully with them, will be an important first phase in your exam preparation.

BEFORE THE SEMINAR

You must prepare for the seminar – it will only be effective if you do. A set of core references might be provided at the end of this sheet, but you must undertake further background research, and be prepared to talk about your research and answers to the question during the seminar.

ATTENDANCE AND PARTICIPATION

It is in your interest to prepare for, attend and participate in the seminar, as it will help you to prepare for the examination. You are reminded that attendance and participation in the seminars might be monitored. Please refer to the study guide for more information

MIXED REALITY

ACTIVITY 1:

Read the lecture slides and additional resources to prepare for the quiz. The link for the quiz will be provided during the seminar.

ACTIVITY 2:

Case study #1

Prima is an Italian apparel retailer based in Rome, Italy. The company specializes in fast fashion, and products include clothing, shoes, and swimwear. There are 2045 Prima stores in 90 countries. However, recently Prima owners decided to close 600 stores and focus on e-commerce, where the company is planning on investing three billion pounds over the next three years on its e-commerce platform. One of the most important tools in

this platform that the company budgeting to introduce is FittingYOU. FittingYOU is a virtual fitting room experience using the mixed reality technology, which is compatible with a range of mixed reality head-mounted display devices. By connecting such a device with FittingYOU, the software can take as input the device's real-time video stream that captures the real world, and in turn, provide to the device a processed video stream where a live virtual imaging of the customer and virtual products are embedded and projected into the real world. FittingYOU allows customers to virtually check size, style, and try-on of a product they are thinking of buying.

Prima is currently in an initial stage of the development of its FittingYOU software and has recently hired more than 25 software developers specialized in computer graphics, vision, and perception with the goal to develop and deploy the company's FittingYOU tool. You have been appointed as the lead graphics developer of the software. The following questions apply to your role in the development of the project. In all of the questions, please provide an insightful explanation for your answers.

1. The FittingYOU software is compatible with see-through mixed reality head-mounted display devices. Explain what is a "see-through" mixed reality display.

2. One of the features that FittingYOU software should offer, is the ability to track the motions of the customer and map it correctly onto motions of a virtual product. This can be done using pose estimation and tracking techniques (techniques borrowed from marker-based and markerless augmented reality).

   (a) Explain what pose estimation is.

   (b) One of most important tracking techniques is Visual SLAM, can any form of Visual SLAM technique be used in this case to track the customer's motion? Explain your answer.

3. Mixed reality applications typically are modelled and developed through a pipeline, where each of the steps solve a fundamental problem toward realising the goal. One of these steps is known as mapping recognition, which refers to the registration and mapping performed to communicate between real and virtual objects. Explain why this concept needs to be implemented and how mapping recognition can be implemented in the FittingYOU *software.*

4. A requirement of FittingYOU is that the software must produce real-time rendering. However, producing real-time rendering is one of the most computationally demanding processes. Explain what is rendering and formulate 3 reasons for why rendering is a computationally demanding process.

5. Spatial mapping is one of the steps used in mixed reality applications, in order to create a convincing mixed reality experience.

   a. Explain what spatial mapping is.

   b. Does any form of spatial mapping need to be done in the case of FittingYOU? Explain why, or why not.

ACTIVITY 3

Please read the following articles:

Gasques et al. [*ARTEMIS*: "A Collaborative Mixed-Reality System for Immersive Surgical Telementoring". In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)]. *[Find a pdf of the article on Blackboard]*. After reading the article, please answer the following short questions.

1. Who are the potential beneficiaries of this research?
2. What are the potential benefits of this research to the identified beneficiaries?
3. Explain why a 3D reconstruction of the patient is needed in the expert surgeon's interface.
4. Why is a Kinect depth camera used in the novice side for ARTEMIS AR system?
5. Why is a Calibration marker used in the novice side for ARTEMIS AR system?

Additional reading material:

- Rokhsaritalemi, Somaiieh, Abolghasem Sadeghi-Niaraki, and Soo-Mi Choi. "A review on mixed reality: Current trends, challenges and prospects." *Applied Sciences* 10.2 (2020): 636.

- Speicher, Maximilian, Brian D. Hall, and Michael Nebeling. "What is mixed reality?." *Proceedings of the 2019 CHI conference on human factors in computing systems*. 2019.

- Kruijff, Ernst, J. Edward Swan, and Steven Feiner. "Perceptual issues in augmented reality revisited." *2010 IEEE International Symposium on Mixed and Augmented Reality*. IEEE, 2010.