

CS 5754 Final Exam – Virtual Environments – Spring 2004

Instructions: Read questions carefully before answering. Write all your answers using complete sentences. Put your name and student ID number on the exam you turn in. The exam is due by 5:00 PM on May 10. Turn in your exam by attaching an MS Word (preferred) or PDF file to an email and sending it to bowman@vt.edu.

This take-home exam is open-book, open-notes, but you may not consult with others, and you may not plagiarize text or ideas from publications, books, or web pages. You must cite all sources you use to answer the questions (except the lecture notes from this class). If you have any questions about what constitutes plagiarism, ask Dr. Bowman. All work is to be your own.

Please write the following pledge on the last page of your exam: “I have neither given nor received aid on this exam.” Following the pledge, type or sign your name.

Part I: Short Answer. Answer all eight questions. Answers should be 1-2 paragraphs long. If necessary, cite relevant articles or books in your answer. Each question is worth 5 points.

1. Define the terms *optical see-through* and *video see-through* as they apply to augmented reality displays. Describe at least two tradeoffs involved in choosing one of these two types of displays.
2. What is *lightmapping*? How does it help to address the speed-quality tradeoff in rendering 3D environments? What are its limitations?
3. Compare and contrast *data gloves* and *pinch gloves* as VE input devices. What are the pros and cons of each type of device? Give an example of one type of user interaction where it would clearly be preferable to have data gloves instead of pinch gloves.
4. In what ways could speech input be used for symbolic input in VEs? Name and describe (2-3 sentences each) at least four limitations or disadvantages of speech for text entry in VEs.
5. What are the differences between *route knowledge* and *survey knowledge* in wayfinding? What techniques can be used in a VE to promote the user's acquisition of survey knowledge?
6. Name and describe (2-3 sentences each) at least three different ways that researchers have attempted to measure the user's sense of presence in a VE. Suppose that you hypothesized that a greater sense of presence would lead to more effective acrophobia therapy in the “virtual elevator” environment. Which single method for measurement of presence would you choose, and why?
7. What characteristics of immersive VEs make them potentially useful for education? Why is there no definitive proof that VEs are better than any other teaching methods?

8. Define the term *awareness* as it applies to collaborative VEs. Of what, specifically, do users in CVEs need to maintain awareness? Describe two techniques for providing awareness in CVEs, and analyze how well the techniques support awareness.

Part II: Essay. Answer three (3) of the four questions. Answers should be approximately 1-2 pages long. Cite relevant sources in your answer. Each question is worth 20 points.

9. One of the “grand challenge” questions we saw at the end of the semester was this:

How do we create a seamless 3D UI from a given set of 3D interaction techniques?

- Suppose that you were going to do an MS thesis on this topic. Write a brief summary of your proposed thesis work. Include at least the following: a) motivation, b) related work, c) problem statement, d) hypotheses, and e) description of approach. Be sure to identify the scope of your work – what specific parts of this broad question are you going to address?
10. Most common 3D interaction techniques were developed and tested on HMD-based VE systems. Although most of these techniques could be implemented for other VE platforms, usability might suffer because these platforms were not considered in the original design of the technique. Discuss the implications of moving the World-in-Miniature (WIM) technique (Stoakley et al., CHI 1995) from an HMD to a 4-sided CAVE. What usability problems would likely result if the WIM technique were ported directly? How would you re-design the WIM technique for increased usability in a CAVE?
 11. We have seen a wide variety of proposed applications of immersive VEs this semester, but only a few have become “production” applications (Brooks, 1999). Suppose that you work for an organization that has come up with a 3D visualization tool for the stock market. Your task is to determine, through an empirical study, whether this tool should be marketed as a desktop application or an immersive (HMD-based) application. Describe, in detail, the study you would run. Include at least a discussion of the following: a) subjects, b) independent variables, c) dependent variables (metrics), d) procedures, and e) analysis.
 12. There often seems to be a disconnect between the VEs used in academia and industry and the 3D games available for PCs and consoles. Games render complex 3D scenes, at a very high frame rate, with very high-quality graphics, while many common VEs have less scene complexity, a lower frame rate, and lower-quality graphics. Discuss this disconnect in some detail. Consider some of the following questions: Given the inherent speed-quality tradeoff in rendering computer graphics, how is it possible that games have higher speed and higher quality? Are there some inherent characteristics of VEs that keep them from optimizing graphics performance? Are games using “tricks” or “hacks” that make them only *appear* to have better performance? What game-industry techniques could/should be applied to VEs?