Human-Data Interaction Though a Virtual Reality Interface

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Human-Data Interaction Through a Virtual Reality Interface

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1. Project Description

Visualizing and interacting with a large dataset through a user interface is an important capability of data exploration systems, which supports people to conduct scientific discoveries. Traditional systems limit human-data interactions to an equivalent of moving cursors in a limited screen space. Recently, researchers and developers have expressed that the rise of virtual reality (VR) technology has the potential to produce engaging user experience. The VR technology can organize data elements in an immersive 3D environment with space extendable infinitely. In regard to interaction modalities, keyboards, mice and touchscreens provide convenience to access digital information, but they do not offer an interaction as natural as humans interacting with objects in real world. Finding new interaction modalities that provide a higher degree of intuitiveness has been recognized as an important research task in human-data interactions, which is also important in VR applications in order to increase human engagement.

In the past few years, the mentor, graduate students at UAH and researchers from Army Research Lab (ARL) have worked together and developed engineering and algorithmic solutions for real-time gesture recognition, high-performance computer graphics algorithms and game technologies. Those solutions provide a computer science foundation to support real-time interactions with large datasets in VR. Continuing the mentor’s past research, in this proposed project, the student will contribute to the development of a VR software application particularly for image data visualization and interaction. The student will have opportunities to work with researchers from ARL. The following devices will be provided by the mentor for this project: a head-mounted device (HMD) with stereo display that simulates a VR environment, a voice command device to operate the software prototype and wearable motion sensors to detect hand motion as a gesture-based interaction modality. While the student will carry out their assigned research work under the mentor’s advising, he or she will be encouraged to develop his or her own ideas and share them to the team. This project will immerse the student in innovative activities of their education by connecting the knowledge in class to a research software development.
2. **Student Duties, Contributions, and Outcomes**

   **Specific Duties.** The main task of this project is to integrate input modalities including voice commands and hand gestures for the VR application. The student will need to use Unity3D game engine, along with the HMD, voice command device and motion sensors provided by the mentor. The student is expected to write C# or Java scripts within Unity3D to create an end-user interface or a middleware tool. Writing C# or Java scripts on a daily basis is the primary duty of this project. The student will be expected to have a weekly meeting with the mentor during the project period. The meeting will be either an individual meeting with the mentor or a group meeting involving other researchers or graduate students. Each meeting is expected to last 20-30 minutes discussing topics like thoughts on modality integration, code optimization and implementation progress.

   **Tangible Contributions.** The student will contribute to the development of the VR software application. We envision that the VR application will immerse users to interact with a collection of digital images in a 3D environment. It allows users to give commands by waving hands in the air to view digital images, just like flipping through a physical photo book. If success, a short paper or a poster based on the student’s work will be produced and submitted to a regional or national conference for presentation.

   **Specific Outcomes.** Students will have opportunities to extend their knowledge in computer graphics programming, game technologies, human-computer interactions and motion-tracking systems. Examples of knowledge that the student will gain from the project are the theory of computer graphics, an enhanced understanding of tradeoff analysis between computing performance and quality of visualization, and fundamentals of experimental design for usability testing.

3. **Faculty Requirements and Mentorship**

   The student must have taken the C/C++ programming course (CS121 or equivalent) and data structure course (CS221 or equivalent), and have earned a grade of B or above. The preference will be given to students who have also taken the courses of game programming (CS347) and computer graphics (CS445). The mentor will be able to teach the student how to use the Unity3D in the first week of project period. The student will work in the research lab side-by-side with graduate students and researchers, who will also be able to mentor the student on specific tasks, share their coding experience and debugging skills.