Project Title: Exploring the use of multi-wall immersive environments in early design decision making
Research Thrust Area: Visualizing and Virtual Prototyping
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Need and Industrial Relevance:
Immersive environments can be used to provide a simulated spatial scene where consumers, customers, designers and others can examine product or system features during all stages of the design process. Because the environment is simulated, multiple product configurations can be investigated quickly without the need for expensive physical prototypes.

Iowa State University has unique facilities that can be used to explore the effect of different immersive environment configurations on task performance. The C6 consists of a fully immersive, surrounding projection screen configuration with high resolution stereo images. Multiple configurations can be realized by turning on/off selected projection surfaces. The METaL facility presents just two projection screen walls and a projected floor with moderate resolution stereo images. These facilities can be used to test various potential configurations of interest to industry. The result will be a better informed industry consumer of immersive technology.

C6: Six projection surfaces
METaL: Three projection surfaces
**Project Goals:** Investigate the different characteristics of multi-wall and single-wall immersive environments as they impact use in early design decision making.

**Objectives:** Determine if working in an immersive environment with one wall is more likely to induce cybersickness than working in a multi-wall immersive environment when performing a given task.

**Approach and Methods:**
It is common to see single stereo projection power wall installations in industry that are used for product design reviews. There are several advantages of such systems including hardware and software simplicity and the ability for many people to view the application while seated in an auditorium arrangement. These are generally referred to as “fish tank” immersive displays because the user stands outside of the projected image while manipulating and navigating through the virtual space much as people view fish in a fish tank. The operation of the system consists of one person “driving” an application while others in the auditorium view the results or provide directions to the “driver”.

For some usage cases, the user of an immersive system is asked to make decisions based on spatial relationships or human/product relationships. In these specific situations, an immersive ergo-centric simulation is needed. This requires either a large surround projection screen environment or a head mounted display where the user sees herself surrounded by computer generated data. Instead of looking into the data, the user occupies a position within the data. In this proposal we are interested in examining the interplay between display configuration and cybersickness.

The causes of cybersickness are numerous and are affected by hardware, software, system configuration and personal differences. Our hypothesis, backed by anecdotal industry experience and a preliminary user study, is that users are less likely to experience cybersickness in a fish tank configuration compared to a multiple wall, floor and ceiling configuration. The results of a preliminary study have supported this hypothesis. We plan to test this hypothesis more rigorously through a series of carefully designed user studies. We are seeking funding for the first of these studies with this proposal.

Specifically, we will carefully design a user study, basing our work on existing research addressing the causes of cybersickness. The constants in the study will include the instructions and the task, the software and the hardware. The variable will be the number of projections surfaces. In collaboration with our industrial partners, we will carefully design the task to represent a common industry use of ergo-centric immersive technology. Participants will be recruited from the student body and our industry partners. Statistical analysis of the results will inform our conclusions.

**Outcome/Deliverables:**
The key deliverable will be a final report which includes a description of the study, a description of the participants, the results and a discussion of the results.
Impact:
The potential for cybersickness can reduce the effectiveness of using immersive technology in product design. A better understanding of how the projection screen configuration affects cybersickness will inform future industry purchases of immersive projection screen technology.

Project Duration (plan and timeline):
The duration of the project will be one year. One PhD student, assisted by undergraduate research assistants, will be funded on this project. The timeline will be as follows:

Q1: Literature review, design of the study, submission of the Institutional Review Board forms, pilot study
Q2: Recruitment of participants, conduction of the study, data gathering
Q3: Data analysis
Q4: Data interpretation, report writing, presentation preparation and delivery

Proposed Budget:
The budget request is for $40,000. The funds will be used for graduate student stipend and tuition and undergraduate hourly wages.