Project X: 4D Mirror

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Background:
The School of Computing is currently renovating the front lobby and main office in order to be more welcoming and informative for visitors, staff, faculty, and students. As part of this process, the school will be be installing a Whale Tank Virtual Reality wall and a multidimensional camera system. Installation of the hardware is scheduled to be in phases starting late Fall. There is an opportunity for CISC 499 projects related to pose estimation, unsupervised learning, fourth dimensional projection, and real-time ray tracing."

Objective:
Implement a pose estimation system with a Whale Tank Virtual Reality system to track and project multiple viewers to another three dimensional space. Depending on available time, explore additional interaction possibilities including real time communication with another wall. The project will build on a hardware that is being installed in the main office, including a multi-dimensional camera system, a ray tracing NVIDIA GPU, and a mesh of 4K OLED panels. Installation of the hardware is scheduled to be in phases starting late Fall, and is not a part of the project.

Expertise Required:
Strong coding skills in OpenCV and OpenGL and Python. Experience in Unity or Unreal, image warping, ray tracing, shaders, pose estimation, and working with virtual scenes will be a bonus. The project can have one or more members.

Data sources and Background Reading:

Publicly available social media datasets.
The techniques required for implementation of the 4D wall are described in several published HCI studies, including Fish tank virtual reality in 1993 (https://dl.acm.org/citation.cfm?id=169066) and Whale tank virtual reality in 2010 (https://dl.acm.org/citation.cfm?id=1839247)

Instead of using IR cameras and markers for the spatial tracking we propose that the system is trained using pose estimation. Pose estimation is a problem in computer vision in which the position and orientation of an object is estimated using different algorithms. Recently, researchers have achieved outstanding results using deep learning/AI. https://arxiv.org/abs/1611.08050 https://github.com/ZheC/Realtime_Multi-Person_Pose_Estimation https://www.youtube.com/watch?v=pW6nZXeWlGM

Deliverables:

An unsupervised pose estimation system to perform location and head tracking. That data will be used to perform perspective distortion on a mesh of 4k OLED panels. One or more 3D scenes will have to be created to interact with, including a black mirror which projects a 3D digital representation of the viewer. Part of the project will be demonstrated at the 2019 Creative Computing Showcase. The Whale Tank, if completed, will have an opportunity to be featured at an AI conference in Kingston in late Spring.