GrARVR Final Project Ideas

Some Basic Information

Competing Teams We plan to have around 9 teams, and float the final project around three major themes, each of which would be shared between 2-3 teams (with some different key objectives), and pitch the teams working on the same project against one another.

Build on Existing Knowledge and Research As several students are already a part of related, independent research work, (eg. on pose estimation, motion capturing etc.) it would be a great exercise for these teams to build on prior knowledge and enhance their project. The final project should try to include the strengths of each student in the team.

Tailor Project Requirements The following should serve as some general pointers and guidelines for projects, and independent teams are expected to come up with a detailed requirements expectation + deliverable breakdown themselves. Each project should try to solve a real problem, and each team should try to deliver a high quality project.

Immersiveness While not necessary, it would be a great exercise for students to try to get access to relevant hardware (even a cardboard VR headset) to try to experience and present an immersive version of their project. We want the projects to be something interesting and shareable with the community, and being able to experience your own work is an important aspect of it.

1. Telepresence Systems

Virtual / Augmented reality presents infinite possibilities in creating experiences that can make social interaction truly immersive. Leveraging their power to build immersive situations and worlds requires a great degree of seamlessness and immersion. Some great project ideas can include

creating something meaningful, like a virtual hospital where patients can interact with avatars of hospital staff and get access to good diagnosis virtually, or a virtual classroom to engage students in an environment where distance learning is as immersive as possible. Here is an example of an immersive VR public museum. VR and AR is also actively being used as part of team collaboration projects, and startups based around this are exploding all around the world.

There are several ways to take projects like this to the next level, using other domains of computer vision. As an example, we can imagine a VR meeting scenario between two or more people, who have avatars representing themselves in the virtual world. A secondary device is placed in front of the headset viewer, and is actively capturing and estimating the pose of the headset viewer, and is streaming this information in real time back to the headset. This pose is being replicated in the avatars viewed by the other members in the meeting, and this allows for a very realistic and immersive meeting experience, with not just vocal but body language cues used to communicate effectively. This can also be deployed in a classroom setting, where a secondary device is capturing a live feed of a blackboard, and is parsing the written information onto a virtual blackboard that is visible to all students. Since this will be a rendered blackboard, there will be no issues of low resolution streaming, and the pose of the teacher can be conveyed through the same method. This can create a very realistic classroom in VR, and can be a very viable alternative to online classes. There have also been very successful attempts at bringing heritage / tourist places around the world as detailed VR experiences to be enjoyed from anywhere in the world.

2. Mixed Reality System

A more augmented reality based project, mixed reality requires a seamless combination of virtual objects and the real world. At their core, mixed reality applications place holograms in your world to look and sound like real objects. This involves precisely positioning those holograms at places in the

world that are meaningful to the user, whether it's their physical room or a virtual realm you've created. The applications for this are again quite endless - they can be used as teaching aids in a classroom, as a personal assistant to guide the user through their day, or more involved applications like assisting healthcare professionals in a complex surgery.

As a challenging aspect to this project, one can attempt to implement adapted ghosting views in an augmented reality scene. This would mean placing virtual objects in a depth-aware manner, with adequate transparency effects to ground the virtual object as an extension to a real world object. Exploding views in AR triggered by specific objects in the real world are a great example, and you can find an example here and here.

3. Low Level SLAM / Odometry / Relighting Projects

This is a more low level project - and quite open ended. In order to work with VR applications, we need to have a system in place to replicate the movements of the user in the real world, and have them reflect as closely as possible in the virtual world. This would require leveraging research on vision based simultaneous localization and mapping (SLAM), and using visual odometry to accurately create a map of the motion of the user, from data available from the IMU sensors present in an HMD, or even a mobile phone. This low level information can then be passed on to a simple VR / AR demo, without using any existing tracking libraries.

The advantages to having such accurate, raw tracking data are many. Other computer vision tasks, like light estimation can also prove to be very helpful. As an example, the process of “relighting”, or accurately lighting virtual objects while accounting for the lighting conditions, with realistic shadows that can be changed with a change in the room lighting, can be accomplished with this. Here is a brief overview of this idea.