Virtual Meeting Room

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Abstract

This project was done as a part of Advanced Graphics, AR & VR course instructed by Dr. Avinash Sharma and Dr. P.J.Narayan during the Spring Semester of 2020 at International Institute of Information Technology, Hyderabad. It implements a virtual meeting room app which can run on Android mobile devices. The app was built using Unity 3D Game Engine and Google VR Cardboard SDK.

1 Introduction

The outbreak of COVID-19 resulted in all organisations be it companies or educational institutes shifting to an online setting to carry out their regular day to day work. This situation has made it very difficult to perform certain tasks especially tasks which require collaboration or special apparatus present in laboratories. Virtual Reality Applications are sure to boom in this situation as such tasks can be made easy using VR Technologies.

In this project we take up the challenge to ease the task of collaboration much easier. Not only do we make it an easy-to-use app, but we also focus on an immersive experience so that team members at remote locations feel that they are present in a real meeting room. We also focus on additional features which features which are not possible on Video Conferencing Apps.

Our app can be used by companies to conduct their regular meetings as well as used by educational institutes to conduct regular lecture sessions. One of the challenges of working in an online setting is attention. This happens because one is present in a completely different environment from where the meeting/lecture is happening and that environment may present certain distractions. Our app disconnects the participant from his original surroundings and puts him in a virtual surrounding resulting him to believe that he is actually present in the virtual environment rather than being present in the real world environment.

Figure 1: Virtual Meeting Room apps will see a boom in these pandemic times as everyone is shifting to remote settings to carry out their regular work.

2 Unique features of our app

Our app presents some really unique features which have not been implemented previously. Such features have been carefully engineered to artificially stimulate participant's senses so that he is fooled to believe that he is actually present in the virtual setting. Some of the features are presented below:

- Stereoscopic Vision: Using Google Cardboard headsets, participants can get binocular vision which is crucial in perceiving depth. This involves projection of slightly shifted images to each eye which results in the brain perceiving depth.
- Ultra realistic graphics: The 3D models we used to create the meeting room are ultra realistic. Not only the models, but also the textures and lighting give a very realistic feeling to the participants. We use models/textures that users come across in their daily life. This carefully thought idea of keeping familiar objects in the scene makes perception of depth much easier for the participants.
- Ultra realistic avatars: We use sophisticated deep learning models to generate realistic 3D avatars from eight images of participants. This gives a very realistic experience to participants as they interact with their colleagues in a virtual world.
- Projection of slides: We have the feature of a projector projecting slides in a virtual screen in the meeting room. This is a must-have feature in order to conduct online lectures in a virtual classroom. A particular user can be designated to control the slides using a controller which comes with headsets. This gives a very interactive and realistic experience as the controller is very similar to 'pointers' used in the real world.
- Networking: We have sophisticated networking functionalities where users can create rooms and join particular rooms from any part of the world. Every participant will be allocated a unique spot in the meeting room according to his/her preference.
- Audio call: We have functionality for users to speak with their colleagues in the meeting room they are present in.
- Head Pose Sync: Are professors wondering whether my students are paying attention and listening to me or not? In this virtual meeting room, we have synced the head pose of participants into their virtual avatars. Hence, participants will know exactly where other participants are looking at. It is possible to get eye contact via this technology which adds to the experience immensely. Productivity of a person increases manifolds when he/she knows that someone is looking at me especially when this is a virtual face of your known boss!

3 Generating realistic 3D Avatars from multiple RGB images

We utilized the Octopus model from the paper "Learning to Reconstruct People in Clothing from a Single RGB Camera" to generate an SMPL model of the user. The Octopus model is a deep learning model that takes full body RGB images of the user from 8 angles as the input. From this, it regresses the SMPL body parameters: the shape and pose parameters. It also uses 2d pose parameters predicted by OpenPose and segmentation maps generated by CIHP PGN, to assist in the SMPL parameter prediction. Once the parameters are predicted and the mesh is generated, we then use Semantic Human Texture Stitching from the paper "Detailed Human Avatars from Monocular Video" to generate the texture for the mesh. Using the pose parameters, it unwraps the input RGB images and generates the texture map from it. All SMPL models have the same number of vertices and texture coordinates, so texture coordinates do not need to be regressed.

4 Networking

We implemented networking using Photon Unity Networking(PUN) Asset. PUN is a fast, scalable and reliable platform for developing Multiplayer games on Unity. It is hosted on the Photon Cloud

Figure 2: Our virtual meeting rooms are ultra realistic with great looking 3D models and lighting conditions. We place objects familiar to users. Hence, the experience provided is really good as users can perceive depth easily, a design principle making VR Apps pleasant to use.

Figure 3: We have a functionality to present slides on a virtual screen just like you will find in a real classroom. The lecturer can control the slides using a controller that comes with VR headsets.

Figure 4: We utilised the Octopus model presented in the paper titled "Learning to Reconstruct People in Clothing froma Single RGB Camera" to generate ultra-realistic SMPL model of users

which offers low latency globally. Photon makes use of reliable UDP, TCP web sockets to do networking. It allows the programmer to use Remote Procedure Calls to achieve what they desire. An unique distinction with Unity Networking is that Photon abstracts the relay server during communication of one client with another.

5 Features we want to add in future

Some features we could not implement due to lack of time but we wish to in future:

- Notes writing capability: We wish to add functionality of taking notes. This can be something easy like using virtual keyboard using gaze or something more sophisticated where the participant has a camera mounted on top of his display and when he looks down he is able to see his notebook on the table and can hence take notes by using pen and paper in the real world. This would be a more Mixed Reality kind of application.
- Positional Tracking: We did not want to add translation into the virtual avatars using joystick based controller because this may result in a nauseating experience for the participants due to the vestibular and vision system not agreeing with each other. We plan to implement some simple inside out tracking for 6 degrees of freedom in the near future so that professors can walk while lecturing.
- Using the blackboard: This is probably the most difficult functionality in the virtual setup. Writing! We plan to perform hand tracking using which participants can write on a virtual blackboard by moving his hand in the air.

6 Research challenges faced

Being in an online setting, a course like Virtual Reality is difficult due to restricted access to hardware and laboratories. Following are some of the challenges faced while developing this project:

- Some of the team members did not have access to phones with gyroscope sensors which made it really difficult to test and experience app.
- Due to access to low quality cameras, our avatars could not be generated as realistically as we expected. The textures suffered due to uneven lighting conditions.
- Since we did not have access to expensive VR devices like the Oculus Rift and HTC Vive, we had to fall back on Google Cardboard. As a result we could not implement positional tracking keeping in mind the uneasy experience it would produce if users moved around using joysticks due to vection contradicting the visual senses with the vestibular senses.
- We could have done so many more things if we could connect a camera to the HMD. But such mounting posed a challenge due to lack of access to appropriate hardware.
- Working remotely posed challenges to the team as we could not meet up in person. All these made testing really difficult as well as integrating certain components of the project.

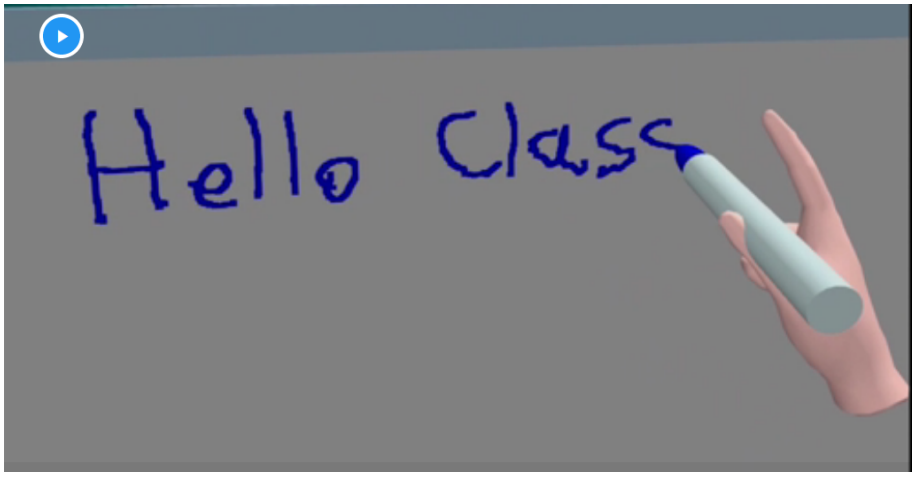

Figure 5: We plan to add functionality of writing on a white board by waving one's hand in air using sophisticated hand tracking algorithms. This would require mounting of a camera over the participants' head mounted displays.

7 Conclusion

It was an amazing learning experience working on the project. We would like to thank Dr. Avinash Sharma and Dr. P.J Narayan for their continuous guidance and support throughout the course, imparting us with concepts essential to design an app like this. We would also like to thank our TAs Mr. Anirudha Ramesh and Mr, Swaraj Renghe for their valuable advice through out the course of development of this app. This is just the start of something great we plan to build in the future. We plan to expand on this and make it a really great product helping the community in these difficult times.