ECE697SD-Project-Proposal

Xiaohao Xia, Yinxuan Wu, Xintao Ding, Xin Zhao

September 2021

1 Motivation

Virtual Reality systems have the potential to digitally transport you into your collaborator's geographically-distant physical space and makes you feel their presence. Alice and Bob are two collaborators that reside at different geographical locations. Alice wears a Virtual Reality headset and sees a virtual version of Bob's physical space. Alice also sees Bob's Avatar moving, talking, and pointing at things. To enable this use case, external cameras should be deployed in Bob's physical space to create its 360 panorama and render this view in Alice's virtual space. This panoramic view helps in placing digital objects, locating and tracking Bob's avatar. Bob's motions should also be tracked using IR cameras and shown in Alice's virtual view.Everyone can learn the knowledge of the Internet of Things about VR and master the basic development technology.

2 Design Goals

Generate the panoramic view of Bob's physical space from distributed depth cameras, and render this view in Alice's virtual view. Alice should see Bob's avatar move, and point at things.

3 Deliverables

1. Design camera cluster that generates panoramic scenes of Bob's room and stream it to Alice VR
2. Develop Bob's avatar and place it at its current physical location
3. Track Bob's physical motions using depth cameras and replicate in Alice's VR

4 System Blocks

1. The depth camera will collect data in certain frequency and then send the data to user's computers;
2. After the computer gets the data from depth cameras, 3D models will be generated automatically by Unity3D.
3. Finally, the complete 3D models data will be sent to the VR head set.

5 HW/SW Requirements

5.1 Hardware preparation

Intel Depth cameras, HTC vive cosmos elite VR headset

5.2 Software preparation

Visual Studio 2019, Vive, Unity

5.3 Computer Languages

C++/C, Python (for demo)

6 Team Members Responsibilities

6.1 Xiaohao Xia

Develop the project time plan, lead the team members to complete the project, perform Unity modeling based on the data sent by the depth camera, write experimental reports, etc.

6.2 Yinxuan Wu

Responsible for importing computer data into the VR headset, debugging the final result of the project, save hardware, etc.

6.3 Xintao Ding

Responsible for the depth camera to capture information, convert the data and send it to the computer, prepare for project display, etc.

6.4 Xin Zhao

Responsible for the preprocessing of the converted data (mainly responsible for the computer to process the data of the depth camera), project records, and the second inspection of the experimental report.

7 Project timeline

7.1 Preparation part

7.1.1 October 01-October 10, 2021

Considering that the team members need to prepare for the half-term exam of the course, we plan to study the basic knowledge in one week, such as Unity model construction, Vive use and interface call. At the same time, configure the hardware and software development environment.

7.2 Early collection part

7.2.1 October 11-17, 2021

Use depth camera to complete object capture and image processing;

7.2.2 October 18-24, 2021

Complete the algorithm development of point cloud processing, and perform point cloud processing on the data of the taken pictures. Import the captured image data of the depth camera into Unity

7.3 Post-processing part

7.3.1 October 25-31, 2021

Write logic code to realize motion tracking. Use the toolkit interface provided by the Vive device to interact with Unity data

7.4 Summary part

7.4.1 November 01-04, 2021

Test projects and write reports

7.5 Final inspection part

7.5.1 November 05, 2021

Second inspection project results and experiment report

7.5.2 November 05-06, 2021

Presentation preparation (PPT production, speech draft writing, etc.) And in order to ensure the demonstration effect, we plan to use Python to develop a front-end window for successful demonstration.

8 References

1. User Study on Mixed Reality Remote Collaboration with Eye Gaze and Hand Gesture Sharing (CHI'20)
2. Exploring interaction techniques for 360 panoramas inside a 3D reconstructed scene for mixed reality remote collaboration (Journal on Multimodal User Interfaces-2020)
3. SCeVE: A Component-based Framework to Author Mixed Reality Tours