Optimized 3D Point Cloud Reconstruction for Distributed Medical Teleconsultation Systems

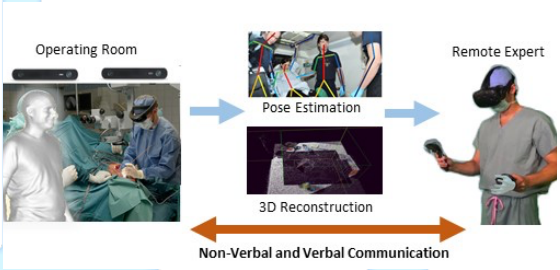
Project Management and Software Development
for Medical Applications

General Info

Contact Person: Dr. Daniel Roth
Contact Email: daniel.roth@tum.de

Project Abstract

The ARTEKMED Teleconsultation System for Medical Applications, such as surgery and emergency, requires context dependent asymmetric rendering for both, VR and AR devices. This includes a full 3D reconstruction of the operating theater. The goal of the project is to improve the point cloud visualization by optimizing the rendering (processing/compute shader), such as to include anisotropic depth-image filtering, temporal depth-image filtering, segmentation and alike. Other options may include meshing and hole filling.



Background and Motivation

Situations such as the Corona Virus Outbreak make it apparent that the future of the healthcare infrastructure will move to more a more digital and communication technology supported infrastructure. To that regard, teleconsultation can play an important role, for example in the case of emergencies or surgical situations that require further expert knowledge, not available in close location and small time frames, given the circumstances.

Tasks Description

The task for this project is to develop a rendering/compute shader optimization in Unity3D (or via native/non-native plugins).
To this regard the visualization can be improved through manifold techniques, mainly addressing structural and temporal filtering of the depth image of the existing system. This optimization is performed on a calibrated and synchronized point-cloud stream of 6 RGB-depth cameras. The stream is already available.
The rendering module should be integrated into the ARTEKMED Teleconsultation System. The framework should be evaluated on the basis of system efficiency/performance tests and a small user study.

Technical Prerequisites

Knowledge of or strong interest in C# and Unity3D are required (potential C++ integrations are possible). Interest in Point Cloud Reconstructions and Direct X / HLSL is required. Previous knowledge of VR and AR HMD devices is of benefit.

References

[1] Fuchs, H., State, A., & Bazin, J. (2014). Immersive 3D telepresence. Computer, 47(7), 46–52.
[2] Islam, A. T., Scheel, C., Pajarola, R., & Staadt, O. (2017). Robust enhancement of depth images from depth sensors. Computers & Graphics, 68, 53-65.
[3] Avetisyan, R., Rosenke, C., Luboschik, M., & Staadt, O. (2016). Temporal filtering of depth Images using optical flow.
[4] Diankov Rosen and Ruzena Bajcsy. 2007. “Real-Time Adaptive Point Splatting for Noisy Point Clouds.” In *GRAPP*.

Please send the completed proposal to javier.esteban@tum.de, ardit.ramadani@tum.de, mf.azampour@tum.de and zl.jiang@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance