RGB-D Reconstruction for Mixed Reality

Wojciech Zielonka, Patrick Radner, Juan Raul Padron Griffe, and Baris Yazici

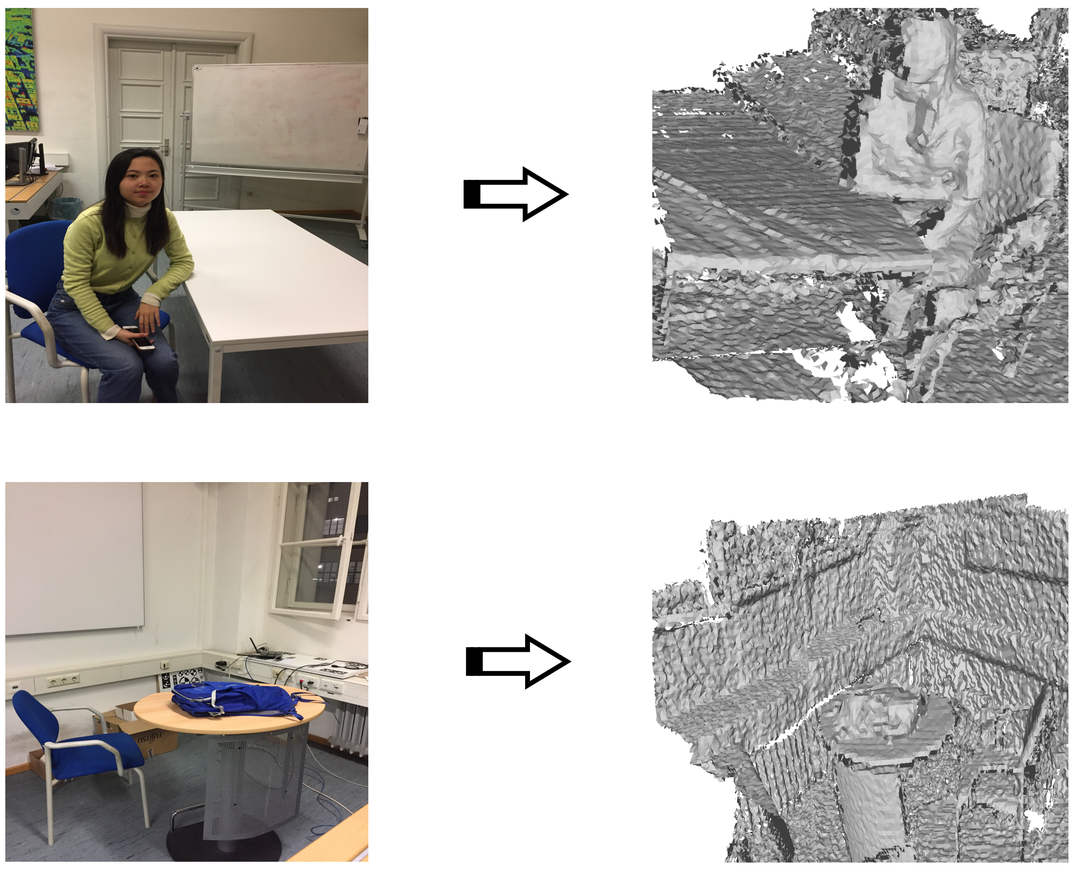
Technical University of Munich

ABSTRACT

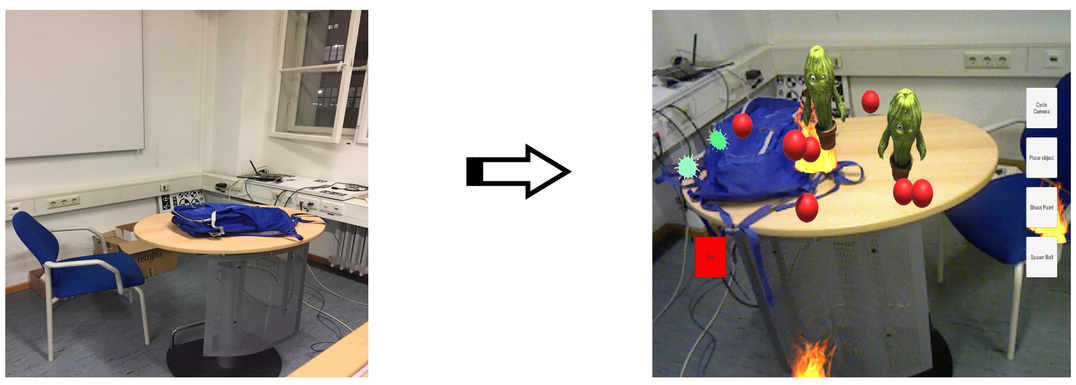
We present a real-time marker-less tracking and 3D reconstruction implementation and show how it can be used to create a mixed reality game using the Unity3D game engine. The concept was inspired by the spatial mapping technology created for Microsoft's HoloLens and our 3D reconstruction pipeline is based on the one used for Kinect Fusion. Tracking and reconstruction is performed in real-time using GPGPU acceleration. Finally, various Unity modules, such as collision detection, physics, particle systems, etc. can be used to create interesting mixed reality projects.

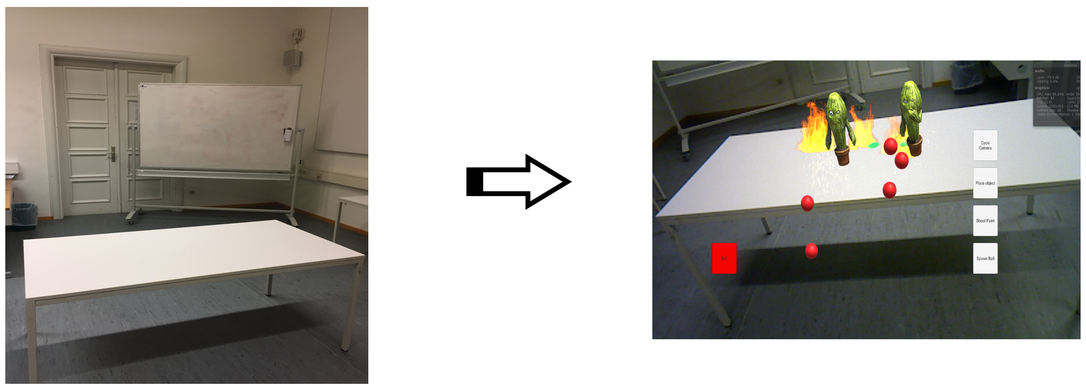
SHOWCASE

Reconstruction



Unity





PIPELINE

Data Stream

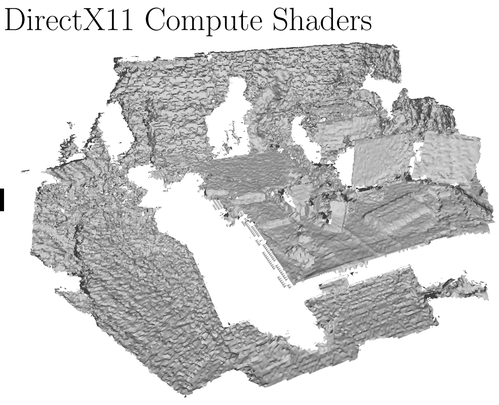
Xtion Sensor
Freiburg Dataset

Camera Tracking

Back-projection
ICP Frame to Frame
ICP Coarse-to-Fine
CUDA

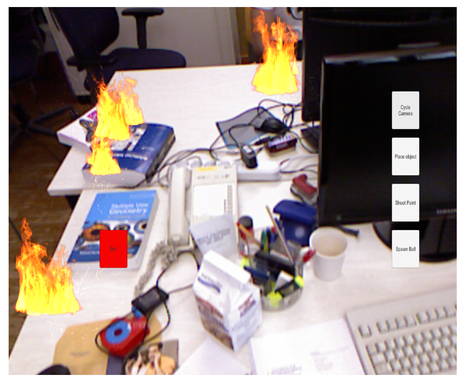
Reconstruction

Volumetric Fusion
Marching Cubes
DirectX11 Compute Shaders



Animation

Unity3D
Physics Module



EXPERIMENTS AND RESULTS

Method	Naive	PCL Non Linear	CUDA
Total time (s)	362.75	257.317	21.09
Average time (ms)	389.13	299.95	5.59
Error RMSE (cm)	18.24	18.34	26.01
Error mean (cm)	16.17	16.29	24.65
Error max (cm)	33.69	41.59	34.02

Tab. 1: ICP performance comparison using TUM RGB-D SLAM Dataset and Benchmark (Freiburg1)

Resolution	128x128x128	256x256x256	512x512x512
CPU (s)	24.45	154.02	873.69
GPU (s)	17.92	18.30	17.87

Tab. 2: Volumetric fusion performance comparison. 798 Frames were processed.