SfM from RGB-D data

3D Photography Project Proposal
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GROUP MEMBERS

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I. DESCRIPTION OF THE PROJECT

This project aims to reconstruct a 3D model of an environment using structure from motion (SfM). A pipeline will be assembled which makes use of depth data taken from a Kinect [1]. Our work will be devoted to investigate whether or how depth information may simplify the scene registration and improve the global accuracy.

II. WORK PACKAGES AND TIMELINE

First, a small base dataset will be acquired using a Kinect. A basic pipeline will be assembled where (i) SURF/SIFT features are detected (ii) then matched to find coarse estimations of camera pose (iii) then a final step where a finer estimate of the scene is found.

We aim to follow the following timeline:

22nd March	Acquisition of small initial dataset using the Kinect. Review and planning of specifics of the pipeline implementation.
2nd April	Feature extraction from acquired images using vlfeat and matching of image pairs or triples.
24th April	Coarse estimation of camera and feature pose and initial visualization using PCL.
8th May	Finer estimation of feature pose via Bundle Adjustment using ceres.
22nd May	Implementation of alternate scene registration methods. Evaluation of results.

A challenge is the evaluation of various scene registration methods, including 2D-2D, 3D-3D and 3D-2D point registration. Furthermore a suitable global optimizer is to be found, which incorporates sensors depth information as prior.

The implementation will mainly be carried out using C++. Various libraries will be used, such as vlfeat (feature detection), PnP solvers (scene registration), and ceres (bundle adjustment).

III. OUTCOMES AND DEMONSTRATION

The project should yield a 3D reconstruction of a room environment. This procedure can be verified by applying to an unknown scene. A visualization of the result will be shown using the Point Cloud Library (PCL) or Meshlab, with comparisons to a video feed.

REFERENCES

[1] Shawn Recker, Christiaan Gribble, Mikhail M Shashkov, Mario Yepez, Mauricio Hess-Flores, and Kenneth I Joy. Depth data assisted structure-from-motion parameter optimization and feature track correction. In *Applied Imagery Pattern Recognition Workshop, October 2014*, 2014.

[2] M. Varga. *Practical Image Processing and Computer Vision*. John Wiley & Sons Australia, Limited, 2008.

Fig. 1: A 3D reconstruction of houses on a street[2]