Image-Based Tracking and Localization on a Mobile Device

Yang Li yangli1@stanford.edu,

David Molin dmolin@stanford.edu

Introduction

This project aims to create an app which allows a user to accurately track their position in real time in an environment which has previously been mapped in such a way that a point cloud of the location is known.

The motivation of this project is to improve the localization accuracy using cameras in urban environment, where GPS measurement have large error due to signal obstruction. Photos of urban places are widely available from photo sharing sites and street view projects. Using structure-to-motion softwares, they can be used to reconstruct the sparse 3D point cloud of the scene. A mobile user can take a photo of a scene and use it to query the point cloud to find out the exact camera location. Ultimately this app can be applied on a city scale, although we restrict ourselves to a small scene for the scope of this project.

Platform

We plan to use the Android platform.

Technical details

3D Point Cloud Reconstruction

To solve the problem of generating a point cloud we plan to use already existing software for example bundler [3].

Find 3D/2D Correspondences

In order to find the pose of the camera we plan to use a method similar to the one described in [1] and [2]. However for tracking it would be possible to reduce the search space since the location is approximately known.

Compute Camera Pose

We will use the use the 6-point DLT algorithm in combination with RANSAC for pose estimation.

Using gyroscope and accelerometer to improve the update rate

An additional goal for this project would be to use the accelerometer and gyroscope to increase the update rate of the pose. In general it is not possible to integrate these sensors to get an accurate estimate of the position because of drift from the noise. But since the correct pose would be provided by the camera with a low update frequency, very little drift would build up in this time. One problem with this would be that it would

be necessary to know the correct metric positions of the points, which SfM does not provide.

Milestones (dates and sub-goals)

Name	Date	Description
Data Collection	05/21/14	Take multiple photographs of a location, in order to be able to create a point cloud of this location.
3-d reconstruction of collected data	05/23/14	Use software such as Bundler to obtain a point cloud with feature vectors of the scene.
Getting a basic app with UI elements running.	05/26/14	Design the basic user interface and add placeholder functions for the localization tasks
Implementation of the localization algorithm	05/30/14	Implement the image-based localization algorithm on the Android platform. Find out ways to maximize performance
Implement refining the position with accelerometer and gyroscope	05/31/14	(extension, might not be implemented if there is too little time)
Improvement and experimentation	6/2/14	Fine tune the parameters for our data, experiment with additional methods such as incorporating sensor input to improve efficiency.
Finish final report	6/7/14	

References

1. Sattler, Torsten, Bastian Leibe, and Leif Kobbelt. "Improving image-based localization by active correspondence search." *Computer Vision–ECCV 2012*. Springer Berlin Heidelberg, 2012. 752-765.
2. Sattler, Torsten, Bastian Leibe, and Leif Kobbelt. "Fast image-based localization using direct 2D-to-3D matching." *Computer Vision (ICCV), 2011 IEEE International Conference on*. IEEE, 2011.
3. Bundler, http://www.cs.cornell.edu/~snavely/bundler/
4. James Philbin, Ondrej Chum, Michael Isard, Josef Sivic, Andrew Zisserman. “Object retrieval with large vocabularies and fast spatial matching.” CVPR 2007