Parallel Tracking and Mapping for Small AR Workspaces
Abstract

a system specifically designed to track a hand-held camera in a small AR workspace, and split tracking and mapping into two separate tasks, processed in parallel threads
Explanations

- Track: build 3D date by outside input message
- Map: display graphic model on the screen
Method Overview

• Tracking and Mapping are separated, and run in two parallel threads.

• Mapping is based on keyframes, which are processed using batch techniques (Bundle Adjustment).

• The map is densely initialized from a stereo pair (5-Point Algorithm)

• New points are initialized with an epipolar search.

• Large numbers (thousands) of points are mapped.
Environment

- A world coordinate frame: Each point feature represents a locally planar textured patch in the world. Each point also has a unit patch normal and a reference to the patch source pixels.

- Keyframes: These are snapshots taken by the handheld camera at various points in time. Each keyframe has an associated camera-centered coordinate frame. Each keyframe also stores a four-level pyramid of greyscale 8bpp images; level zero stores the full 640×480 pixel camera snapshot, and this is sub-sampled down to level three at 80×60 pixels.
Tracking

1. A new frame is acquired from the camera, and a prior pose estimate is generated from a motion model.

2. Map points are projected into the image according to the frame’s prior pose estimate.

3. A small number (50) of the coarsest-scale features are searched for in the image.

4. The camera pose is updated from these coarse matches.

5. A larger number (1000) of points is re-projected and searched for in the image.

6. A final pose estimate for the frame is computed from all the matches found.
Mapping

Stereo initialization

New keyframe?
  Yes: Update keyframe data association
  No: Locally converged?
      Yes: Integrate keyframe
      No: Globally converged?
          Yes: Add new features
          No: Local bundle adjust

Update data association

Sleep 5ms
Demo

https://www.youtube.com/watch?v=Y9HlMn6bd-v8
Progress report
• Done: Fix crowdsourcing server

• Todo: build the appearance of Pokemon app