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

Explanation

- 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.

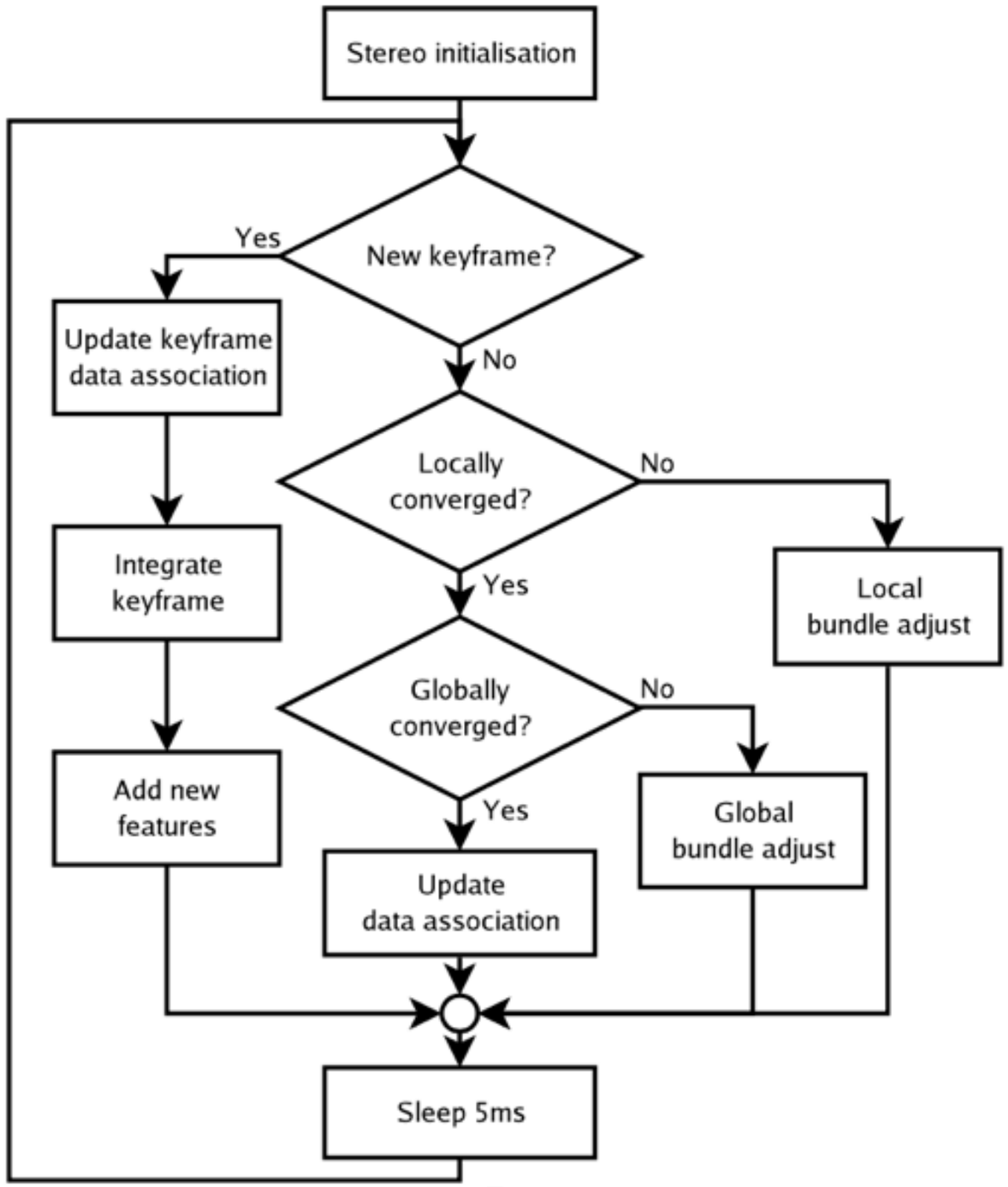
3. A small number (50) of the coarsest-scale features are searched for in the image.

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 initialisation
New keyframe?
Yes
No
Update keyframe data association
Integrate keyframe
Add new features
Locally converged?
No
Yes
Local bundle adjust
Globally converged?
No
Yes
Global bundle adjust
Update data association
Sleep 5ms

Demo

https://www.youtube.com/watch?v=Y9HMn6bd-v8

Progress report

- Done : Fix crowdsourcing server
- Todo : build the appearance of Pokemon app