Relocalization of Camera in a 3D Map on Memory Restricted Devices

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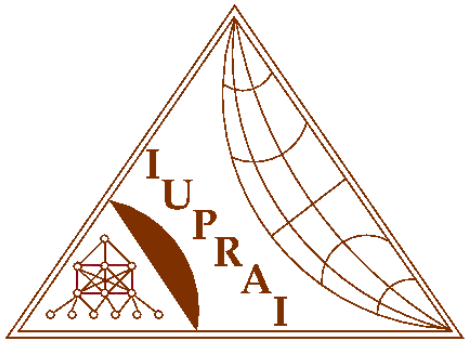
Seventh National Conference on Computer Vision, Pattern Recognition,
Image Processing and Graphics (NCVPRIPG)
22nd December 2019



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Introduction

Simultaneous Localisation and Mapping: (SLAM)

- Landmark based solutions
  - EKF with range measuring devices
- Raw data based solutions
  - **Visual SLAM**

Why is visual SLAM so popular?

- Image data enables the map to provide texture and visual information.
- High quality camera are becoming widely available at decreasing costs.

Visual SLAM on Low Memory Devices

- Many SLAM systems provide robust loop closing and relocalization capabilities **but run on conventional computers and processors with high computational capability.**

- Visual SLAM is often used for remote applications such as autonomous vehicles which **rely on low memory processors for control and decision making.**

We propose a system for memory and computationally efficient relocalization of a camera in a SLAM generated 3D map, capable of being run on low memory edge devices. **Our main contribution is a lightweight system for camera pose estimation based on hierarchical cluster tree of ORB features.**

Methodology

The proposed re-localization system is capable of being run on resource limited devices using a monocular camera rig. The process consists of 3 stages:

1. Generation of a 3D map
2. Creation of a visual word dictionary for captured video frames
3. Image mapping and retrieval to obtain camera pose and trajectory

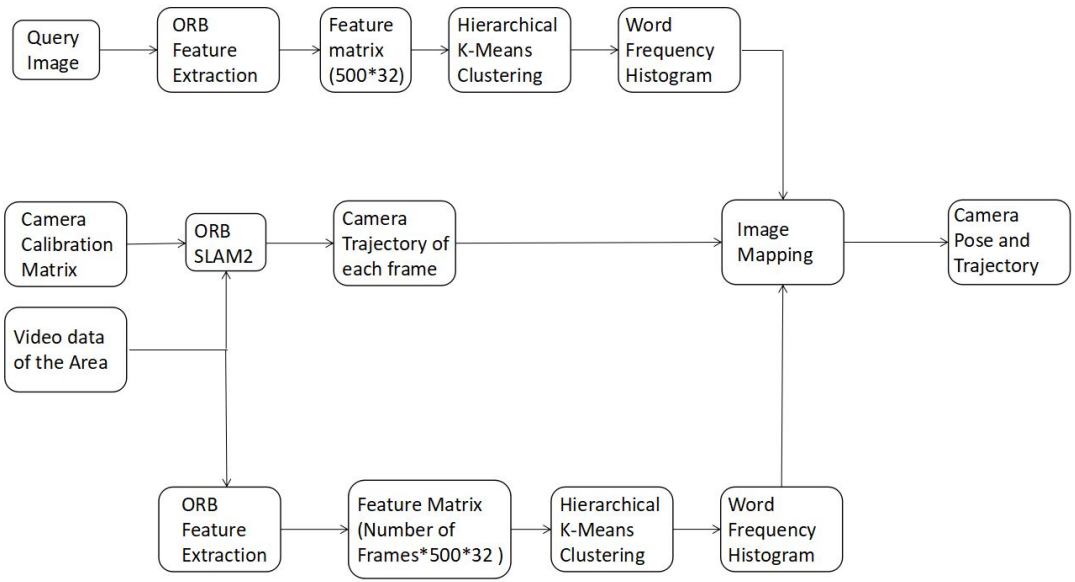


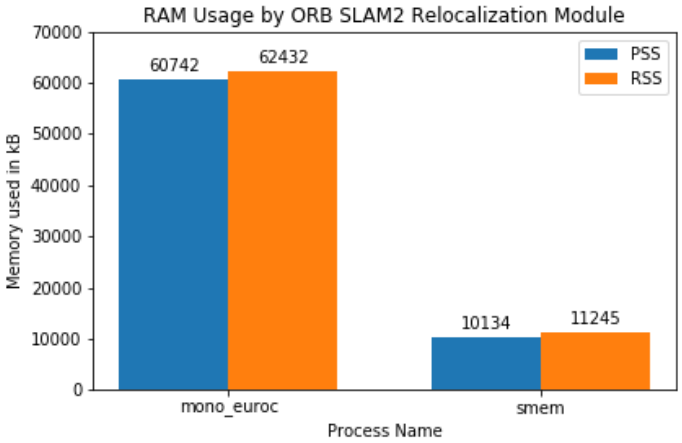
Figure 1: Overview of Methodology

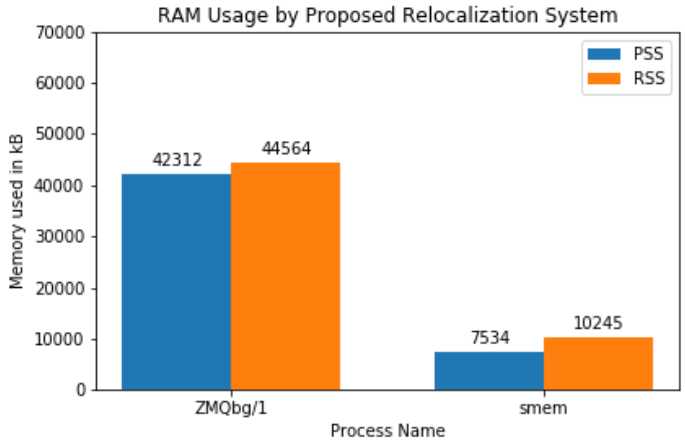
Experimentation details

- We demonstrate the system on three standard datasets, **EuRoC Machine Lab 1** and the **TUM xyz videos**.
- We analyse the memory footprint of our relocalization system when run on an **ARM Cortex A53 processor with 2GB RAM** by sampling memory used every 0.1 seconds.
- RAM usage and time taken for real time re-localization is analysed. Memory usage of the proposed method versus the complete ORB SLAM2 model running on the board are compared using smem memory profiler.

Results

- Improved RAM usage as measured by RSS and PSS





Dataset	Average Distance Error (meters)	Average Angle Error (degrees)
EuRoC Machine Lab 1	0.67	1.0564
TUM fr1/xyz	0.42	1.3245
TUM fr2/xyz	0.65	1.892

Table 1: Table of average error of proposed relocalization system over 50 test cases.

Thank You