Assignment 1: Feature Detection, Matching, and Panorama Stitching with Experimental Evaluation

Visual Computing: Interactive Computer Graphics and Vision
Aarhus University
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Objective

The aim of this assignment is to design and evaluate a real-time panorama stitching system using a dataset of your choice. Students will implement feature detection, matching, homography estimation, and image warping, and then **run a set of controlled experiments** to understand how design choices affect performance and robustness.

Learning Outcomes

The learning outcome of this assignment is to demonstrate an understanding of how images are represented, transformed, and processed, including common image transformations. In particular, the assignment focuses on

1. Implement and visualize SIFT (or similar) feature detection.
2. Match features between images and filter using RANSAC.
3. Estimate planar homography and warp images to a common coordinate frame.
4. Blend multiple images to create a panorama.
5. Design and run experiments to compare feature detectors, match filtering strategies, and blending methods.
6. Interpret quantitative and qualitative results using the learned concepts.

Task Description

1. **Dataset and Capture**
   Capture at least 3 sets of overlapping images using your own device. Include at least one outdoor and one indoor scene. Record conditions (lighting, motion blur, texture richness).

2. **Feature Detection and Matching**
   Implement ORB feature detection. Repeat with one alternative (e.g., ORB, AKAZE). For each detector:

   - Count number of detected keypoints.
   - Measure descriptor matching time.
   - Plot histograms of match distances.

3. **Homography Estimation Experiments**
   Implement homography estimation with RANSAC. Vary the RANSAC reprojection threshold and record:

   - Number of inliers.
   - Visual quality of stitched images.
   - Runtime impact.

4. **Panorama Stitching**
   Implement image warping and blending. Compare at least two blending approaches (e.g., simple overlay vs. feathering).

5. **Experimental Analysis**
   Summarize results in tables and plots. For example:

   - Keypoint count vs. match quality.
   - Threshold vs. panorama alignment error.

6. **Reporting**
   A 3–4 page report including:

   - Method overview with diagrams.
   - Screenshots for each experiment.
   - Quantitative metrics and plots.
   - Discussion of which configurations worked best and why.

Deliverables

- Source code (C++/Makefile, submitted as Git repository)
- PDF report with results, analysis, and discussion.
- Short demo video showing panorama stitching.

Optional Enhancements

- Multi-image panoramas.
- Spherical/cylindrical projections.
- Automatic exposure compensation.