Image Stitching: Obtaining wide-view panorama out of several photos
First interim report

Authors: Alina Voronina, Viktoriia Maksymiuk, Yuliia Maksymiuk

1. Description

The Image Stitching project is a work in the field of computer vision. Image stitching algorithms are widely used in various spheres: panorama photography, space imaging, satellite image data processing, etc. The main purpose is to represent several images as a single one, solving the problem of limited resolution and frame dimensions. The obtained “stitched” image is easier to process and is more informative than tens or hundreds of smaller shots. Therefore, the development of such an algorithm is essential for the sphere of computer vision. In addition, it is interesting to try to create one’s own image stitching algorithm from scratch using knowledge of linear algebra.

The aim is to implement an algorithm that composites multiple overlapping images captured from different viewing positions into one natural-looking panorama, using linear algebra principles and algorithms. It will help obtain a full-range view in a single photo, excluding the necessity of manual stitching in photo editors. The final goal is to create a program that receives some images of an object/surface/scene as an input and outputs a single picture of that.

2. Algorithms overview

The literature suggests several ways of implementing image stitching algorithms: Global homography, APAP (As-Projective-As-Possible), SPHP (Shape-Preserving-Half-Projective), robust ELA, VFISNet + Bicubic. However, the RANSAC (Random Sampling Consensus) algorithm will be used for the project. This algorithm calculates the homography based on randomly chosen features and then takes a consensus based on the inliers of the homography. Finally, the best homography is the one that has the most inliers.

RANSAC is based on linear algebra approaches, meaning that the matrix operations lie at the base of the algorithm — the reason it was chosen for the project. It suggests estimating the homography matrix, detecting outliers, and then solving equations to estimate this matrix, which is later used to generate a perspective for stitching the images together. Moreover, it shows pretty good results compared to the other algorithms and is understandable to implement.

The implementation of the algorithm itself includes several steps: image acquisition through reading user input, data preprocessing, feature detection, feature matching, homography/overlap calculation, image assembling (obtaining the panorama image), outputting the result.

3. Datasets

During the realization process of the Image stitching algorithm, some pictures from datasets of smaller images from Kaggle and other resources will be used. Moreover, own photos will be fed to the algorithm in order to check the quality of the implementation. Examples of datasets:

- Image stitching from drone capture OpenCV (Kaggle)
- Image for stitching in computer vision (cv2)python (Kaggle)
- Night sky Images (Kaggle)
- Earthdata Dataset (NASA)

4. Work breakdown

For better work, the plan was created, breaking down one goal into several logical steps, with deadlines for each one included. The work plan looks as follows:

- Reviewing the literature on the topic and searching for datasets (*April 7*)
- Outlining the algorithm implementation from the linear algebra background (*April 14*)
- Implicitly coding the algorithm (*April 21*)
- Testing the algorithm on datasets, and improving it (if needed) (*April 28*)
- Implementing a simple interface for a user to be able to use a program (*May 5*)
- Preparing for the presentation of the project (*May 8*)
- Presenting the final version of the project (*May 11*)

As for the current progress, the literature was found, reviewed, and analyzed. The possible approaches for solving the problem were discussed, and the most suitable option was chosen. Moreover, the required datasets for testing the algorithm were found and downloaded.

Having done the research, the conclusion about possible problems is as follows:

- Lack of knowledge about algorithm implementation and libraries that help to do it;
- Necessity to use topics that have not been covered in a course yet;
- Troubles with some images that will not be analyzed like others;
- Differences between light intensities, a contrast of stitched images;
- Presence of overlit areas due to reflective objects in the scene;
- The presence of some noise, which can be caused by clouding of camera lenses, dust, etc.

The next steps include plunging into the mathematical formulas and linear algebra approaches to outline the algorithm for the future image stitching program.

Keep strong, stay healthy and learn LA!