



AUTOMATED PANORAMIC IMAGE STITCHING TOOL: A COMPUTATIONAL PHOTOGRAPHY APPROACH

Seamlessly Combining Overlapping Images Using
Python and Advanced Image Processing
Techniques

Abstract

This project will create a Python-based panoramic image stitching tool that combines overlapping images into a seamless panorama. Using feature detection, homography, and blending techniques, the tool will align images and remove seams.

Contributors:

Fall 2024:

CSCI3240U

Professor. Faisal Qureshi

Sandeep Virk – 100750061 –
sandeep.virk@ontariotechu.net

In recent years, panoramic photography has gained widespread popularity, allowing users to capture wide-angle views by seamlessly combining multiple images. The goal of this project is to develop a panoramic image stitching tool using Python, leveraging computer vision techniques to automatically stitch a sequence of overlapping images into a single, wide-angle panoramic photograph.

This tool will use various algorithms and techniques to detect image features, align overlapping regions, and blend them into a cohesive final image. The user interface will be developed using **PySimpleGUI** to provide an intuitive way for users to upload images, view results, and adjust stitching parameters.

The project will be developed in **Python**, utilizing the following libraries and frameworks:

- **OpenCV**: For image processing, including feature detection, matching, homography calculation, and image warping.
- **NumPy**: For efficient matrix operations and image manipulations.
- **PySimpleGUI**: To create a simple graphical user interface (GUI) for image input/output and user interaction.
- **Matplotlib**: To visualize and display images during the development and debugging stages.

Methodology and Algorithms

The core of the panoramic stitching process involves several key steps and algorithms commonly used in the field of computer vision:

- **Feature Detection and Matching**

- ⇒ The first step is detecting distinct key points in overlapping images. This will be achieved using algorithms like **SIFT** (Scale-Invariant Feature Transform) or **ORB** (Oriented FAST and Rotated BRIEF), both of which are well-suited for finding robust feature points in images. These key

points will then be matched across overlapping images using feature matching algorithms such as **FLANN** or **Brute Force Matcher**.

- **Homography Estimation**

- ⇒ Once corresponding feature points are identified, a **homography matrix** will be computed to map the coordinates of one image onto the corresponding points in another. This matrix is crucial for determining the transformation needed to align the images. The **RANSAC** (Random Sample Consensus) algorithm will be used to improve the robustness of this transformation by filtering out incorrect matches.

- **Image Warping**

- ⇒ Using the computed homography, the images will be warped to align them correctly. This involves transforming each image so that overlapping regions are seamlessly aligned with one another.

- **Blending**

- ⇒ To create a smooth transition between the overlapping areas of images, blending techniques will be applied. Basic approaches such as linear blending or feathering can be used

Conclusion

This panoramic image stitching tool is a strong fit for computational photography because it applies essential image processing techniques to solve real-world problems. By combining feature detection, homography, and image blending, the project demonstrates key concepts in computer vision. It offers practical value by creating seamless panoramic images, a common task in photography. This project not only enhances technical skills but also showcases the creative potential of computational approaches, making it a valuable addition to our portfolio and is an amazing and challenging learning experience.

References

GeeksforGeeks. (2024, June 17). *Image stitching with opencv*.

<https://www.geeksforgeeks.org/image-stitching-with-opencv/>

Kommineni, V. (2020, November 14). *Image stitching using opencv*. Medium.

<https://towardsdatascience.com/image-stitching-using-opencv-817779c86a83>

Morgan, J. (2023, March). *Panorama creation in opencv*. How to use OpenCV.

<https://www.opencvhelp.org/tutorials/advanced/panorama-creation/>

Prem Singh, P. (2024, August 20). *Image stitching using opencv-a step-by-step tutorial*.

Medium. <https://medium.com/@paulsonpremsingh7/image-stitching-using-opencv-a-step-by-step-tutorial-9214aa4255ec>

Rosebrock, A. (2023, June 8). *Image stitching with opencv and python*.

PyImageSearch. <https://pyimagesearch.com/2018/12/17/image-stitching-with-opencv-and-python/>