COL780 : Computer Vision

Assignment 2

Creating Panoramas using Image Stitching

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Introduction

Panoramic photography is a method that allows for capturing a broader view by merging several pictures that are taken while rotating the camera around its vertical axis, resulting in a seamless image that presents the entire scenery. In our project, we have developed a custom implementation of various algorithms utilized in panorama creation to simulate the same process.

Problem Statement

We have been given the responsibility of producing panoramic images by utilizing either a collection of input images or a video file. Our objective is to align the images and blend them together flawlessly to produce a seamless panoramic output.

In the case of a video file, we must extract frames at regular intervals, treat them in a similar manner to image sets, and create panoramas.

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Approach used for Panorama Creation:

Step I : Input Data Handling:

To begin with, we first work on processing input data, which can come in the form of either a set of images or a video file. In the case of image sets, we read all the images from the designated folder and guarantee that they are arranged in the correct order. For video files, we extract frames at regular intervals to acquire snapshots that can be used for creating panoramas.

Step II : Cylindrical Projection:

Before stitching the images, we project them onto a **cylindrical surface** to correct for perspective distortion caused by the camera lens.

The *ProjectOntoCylinder* function performs this transformation, taking into account the image dimensions, focal length, and camera center. The transformation involves mapping each pixel in the input image to its corresponding location on the cylindrical surface, accounting for perspective effects.

Step III : Feature Matching:

We use the **Scale-Invariant Feature Transform (SIFT)** algorithm to detect keypoints and compute descriptors for the features in the images.

The **keypoints** and **descriptors** are obtained for both the base and transformed secondary images using the *computeKeypointsAndDescriptors* function. A **brute-force matcher** is then employed to find potential matches between the key-points in the base image and the transformed secondary image.

Step IV : Homography Estimation:

Using the matched keypoints, we estimate the **homography matrix** using the **Random Sample Consensus (RANSAC)** algorithm.

The *findHomography* function iteratively fits a homography model to the matched keypoints, rejecting outliers to improve robustness. The resulting homography matrix describes the **transformation** between the base and secondary images, accounting for perspective changes and distortions.

Step V : Stitching:

Finally, we **warp** the transformed secondary image to align with the base image using the estimated homography matrix.

The *warpPerspective* function is used to apply the **perspective transformation** to the secondary image.

We blend the overlapping regions of the images to create a seamless panorama, ensuring smooth transitions between them. **Linear blending** is applied to gradually blend the pixel values of the overlapping regions, resulting in a visually pleasing panorama.

Step VI : Artifact Reduction:

Careful handling of projection artifacts and other distortions is crucial for producing high-quality panoramas.

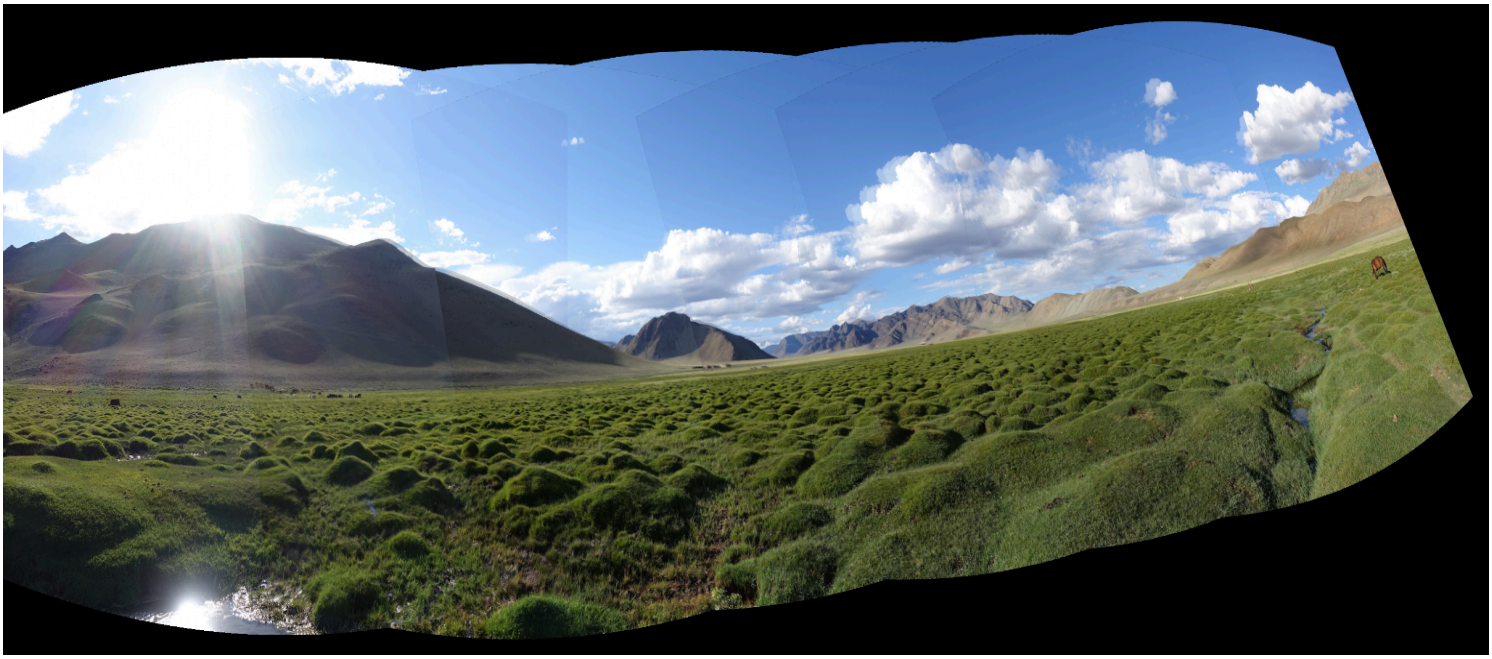
We address potential artifacts such as **misalignment** by iteratively refining the homography estimation and adjusting the blending process. Proper boundary handling and correction are performed to minimize artifacts introduced during the cylindrical projection and stitching stages.

Sample Images :






Output :



Result

Based on visual inspection and user feedback, we can confirm that our implementation approach has successfully stitched multiple input images into a single panoramic image. The resulting panoramas show minimal visible seams, distortions, and artifacts, which indicates good alignment, blending, and artifact reduction.