Name: Verdad, Jane Benneth Dione
Year & Section: BSCS IS 4B
Date: October 2024
Instructor: Sir Mark Bernardino

Feature Extraction and Image Matching in Computer Vision

Task 1: Harris Corner Detection

The first task is the Harris Corner Detection method applied to a grayscale image of a rose. The image processing begins with converting the original image to grayscale, enhancing its contrast to highlight structural features. Harris Corner Detection is then performed to identify corners. Detected corners are marked in red, making it easier to visualize keypoints. The side-by-side comparison of the original grayscale image and the corner-detected version allows users to see the algorithm's effectiveness in locating these corners.

Task 2: Histogram of Oriented Gradients (HOG) Feature Extraction

The second task is the Histogram of Oriented Gradients (HOG) , a feature extraction on the image of a rose.. HOG is a technique for extracting important gradient and edge information from an image, which helps capture structural patterns. The left side of the image shows the original image, while the right side shows the result for HOG features. This output provides a clear representation of the gradient orientations and their magnitudes across different regions of the image, making it useful as it captures shape and texture characteristics.

Task 3: ORB Feature Extraction and Matching

The third task is the ORB (Oriented FAST and Rotated BRIEF) feature extraction and matching between two similar images of flowers. In this task, both images are analyzed to identify key points and descriptors, which represent unique visual elements. The ORB algorithm extracts these features and matches similar points between the two images. The matched key points are connected by lines, clearly indicating correspondence across the images. The output highlights how ORB detects and connects features, demonstrating the algorithm's capability in matching corresponding points across similar images.

Task 4: SIFT and SURF Feature Extraction

The task shows the implementation of feature extraction using the SIFT (Scale-Invariant Feature Transform) and SURF (Speeded-Up Robust Features) algorithms in OpenCV. It begins by loading two images, converting them to grayscale, and initializing the SIFT and SURF detectors. Key points and descriptors are computed for both images using SIFT and SURF, and the key points are drawn. The output displays the key points detected by each algorithm, for comparison between the SIFT and SURF features extracted from both images. By comparing these visualizations, one can observe how each algorithm identifies and marks distinct points within the images.

Task 5: Feature Matching using Brute-Force Matcher

This task shows the process of feature matching between two images using the Brute-Force Matcher with ORB (Oriented FAST and Rotated BRIEF) feature descriptors. First step is, the two images are resized to match dimensions and converted to grayscale. ORB is used to detect and compute key points and descriptors for both images, capturing unique features. The Brute-Force Matcher then pairs these descriptors, sorting the matches by distance to ensure the best matches are prioritized. The matched key points are connected by lines on the image, highlighting areas with similar features in both images.

Task 6: Image Segmentation using Watershed Algorithm

In this task it demonstrates image segmentation using the Watershed Algorithm. The process begins by converting the image to grayscale and applying thresholding to separate the background and foreground regions.Noise reduction, followed by dilation to ensure accurate boundary detection are done. The distance transform is used to distinguish the foreground area, and a subtraction technique separates the foreground from the background. Connected components are labeled, and the Watershed Algorithm is applied, resulting in a segmented image with defined boundaries between different regions. The final output shows distinct regions separated by colored boundaries.