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BSCS-4B

CSST106

Perception and Computer Vision

Exercises No. 3 Advanced Feature Extraction and Image Processing

Exercise 1: Harris Corner Detection

In the Harris Corner Detection exercise, the first step involves loading an image and converting it to grayscale, as the algorithm operates on single-channel images. Next, the Harris Corner Detection method is applied, which involves calculating the gradient of the image to identify points with significant changes in intensity. Following this, the detected corners are dilated to enhance visibility, allowing for clearer identification of key points in the image. The corners are then visualized on the original image, highlighting areas of interest. Finally, the processed image is displayed, showcasing the effectiveness of the Harris Corner Detection algorithm in identifying corners where edges intersect.

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

In the second exercise, the focus is on using the HOG descriptor for feature extraction from an image. The process begins with loading an image and converting it to grayscale, as HOG analyzes the intensity gradients within the image. Subsequently, the HOG descriptor is applied, which computes the gradient orientations and magnitudes, capturing the structure of the objects within the image. The results are then rescaled for visualization, allowing for a clearer interpretation of the extracted features. The final step involves displaying both the original grayscale image and the HOG feature image side by side, highlighting the effective representation of object structures through gradient orientations.

Exercise 3: FAST (Features from Accelerated Segment Test) Keypoint Detection

The FAST keypoint detection exercise begins with loading an image and converting it to grayscale, which is necessary for the algorithm's operation. The FAST detector is then initialized, followed by the detection of keypoints in the grayscale image, which identifies significant features based on intensity differences. Once the keypoints are detected, they are visually marked on the original image to highlight areas of interest. This visualization effectively demonstrates the efficiency and speed of the FAST algorithm in detecting keypoints. The final output showcases the marked keypoints, emphasizing their potential usefulness in various applications, particularly in real-time scenarios.

Exercise 4: Feature Matching using ORB and FLANN

In the feature matching exercise, two images are first loaded and converted to grayscale to prepare them for ORB descriptor extraction. The ORB detector is then employed to identify

keypoints and compute their corresponding descriptors for both images. Following feature extraction, a FLANN-based matcher is utilized to find and match the features between the two images, enhancing the matching process's efficiency. To filter out less reliable matches, Lowe's ratio test is applied, ensuring that only the best matches are retained. Finally, the matches are visualized by drawing lines between corresponding keypoints in the two images, illustrating the effectiveness of ORB and FLANN in feature matching.

Exercise 5: Image Segmentation using Watershed Algorithm

In the final exercise, the process begins with loading an image and converting it to grayscale to facilitate segmentation. A binary image is created through thresholding, distinguishing foreground objects from the background. The Watershed algorithm is then applied, which requires determining the sure background and foreground areas, effectively identifying regions to segment. After applying the Watershed algorithm, the boundaries between segmented regions are marked to visualize the results clearly. The exercise concludes with displaying the segmented image, showcasing how the Watershed algorithm efficiently separates overlapping objects and enhances image analysis.