Computer Vision Project2

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1. How can we improve the edge detection performance? Explain it by using the parameters given in the provided program, 'OpenCV-Canny-Edge-Detection'.
   The process of Canny edge detection can be summarized as follows: First, the noise in the image is reduced by the Gaussian Filter. Second, calculate the gradient of the image. Third, for non-maxima suppression, set the non-maximum pixel value to 0. Finally, edge tracking by calculating hysteresis thresholding. In the process of smoothing the image using a Gaussian filter, the locations of the edges might be off, depending on the size of the Gaussian kernel. This also causes problems with corners and junctions. The Gaussian smoothing blurs corners and junctions, making them harder to detect. The corner pixels also look in the wrong directions for their neighbors, leaving open-ended edges, and missing junctions. Sigma in a Gaussian filter determines the width of the filter and degree of blurring. The larger the sigma, the more blurring is. But, if the value of sigma is very large, then minute edges will not be detected. On the other hand, if sigma is very small, noise in the image will also be detected as edges. Therefore, rather than using the fixed filter of the gaussianfilter(im), we need to apply the Gaussian filter by setting the suitable sigma for each image characteristic. Additionally, in class edge_tracking, we apply decided thresholds to the whole image. However, as images become more complex, different thresholds are required for different local areas to find real edges.

2. How can we improve the key point matching performance? Explain it by using the parameters given in the provided problem, 'Harris-Corner-Detector'.
   The process of Harris-Corner-Detector can be summarized as follows: First, the noise in the image is reduced by the Gaussian Filter. Second, calculate the gradient of the image. Third, calculate the M matrix and apply the window function to the M matrix. Fourth, calculate Harris response and apply threshold to find interest points. Finally, apply non-maxima-suppression to leave only the largest value among image elements. Before executing create_Haar_wavelet_xy(sigma), we can get a clearer result if we go through the noise smoothing process. Because digital images are containing various types of noises which reduce the quality of images, image smoothing is a key technology of corner detection. After calculating the Harris response, we apply a threshold to find interest points. In this step, if not appropriate threshold set, noises are recognized as corners, or points that should be recognized as corners are ignored. In main function, we apply decided thresholds to the whole image, thresh = 0.75, so corner response that are less than thresh*mean(corner_response) are ignored. However, as images become more complex, different thresholds are required for different local areas to find real edges.