ASSIGNMENT 2 WRITEUP

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Part 1: Harris corner detection

In this part, interesting points in the images are found with Harris corner detection. A second moment matrix *M* is constructed for each point that depends on the horizontal and vertical gradients at each point. The representative value for each pixel is

$$R = \det M - k(trace\ M)^2.$$

In the above equation, *k* is 0.04. To determine which points are corners, the maximum R value in the image is determined. The image is then thresholded at 0.01 times the maximum R value. This factor and the value for *k* were determined experimentally. Non-maximum suppression is performed by ignoring potential corners that are adjacent to a corner pixel.

This method works rather successfully and generates ~1000 points of interest that are clustered around areas that are corner-like.

Part 2: SIFT-like feature descriptors

To get feature descriptors for each corner, a SIFT-like algorithm was implemented. The orientation of the gradient at each point is determined and a 16x16 patch is extracted around each point. An 8-bin histogram of gradients for each 4x4 subcell in the patch is constructed and normalized. The 8 concatenated histograms are returned as the descriptor for the corner.

Part 3: Feature matching

To match features, the nearest neighbor distance ratio test is implemented. The Euclidean distance between each set of feature descriptors is determined in one image. Then, the nearest and second nearest neighbour are determined in the second image. When the ratio of the Euclidean distances between the nearest and second nearest neighbours is less than 0.8 (determined experimentally), the two points are considered to be a match.

The confidence of the match is the nearest neighbour ratio subtracted from one, as this goes to one when the ratio goes to zero.