Histogram Refinement for Content-based Image Retrieval

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Abstract

Color Histograms are efficient and insensitive to small changes in camera viewpoint but provide a coarse characterisation of an image. In this project we test the performance of a split histogram called Color Coherence Vector (CCV), which partitions each histogram bucket based on spatial coherence. We also tested a Color-histogram with Center-Refinement.

Centering Refinement

- Add blur to the image by applying a mean filter with a window of 3x3.
- 75% of the centermost pixels are considered as “being in the center of image”.
- Find the boundaries on all sides and extract the submatrix from the original image matrix.
- Now find color histograms for the center part and the remaining part of the image.

Calculation of CCV

- Apply a mean filter on the image with a small neighbourhood.
- Discretize the image in a small number of colors say 64, i.e, for each of the 3 color channels take the most significant two bits.
- Define a 4-connected component in which each pixel can have edges with its top, bottom, left and right neighbours if they have the same discrete color.
- For each pixel, if the size of its component is greater than a threshold, call it coherent else incoherent.
- Calculate CCV as: <(A1,B1),(A2,B2),.....(AN,BN)> where Ai is the number of coherent pixels for ith color and Bi is the number of incoherent pixels for ith color.

Image Database

- We used Corel-10K image dataset which contains 100 groups of 100 similar images by taking one of the images to compare with other images in the set and images from other sets.

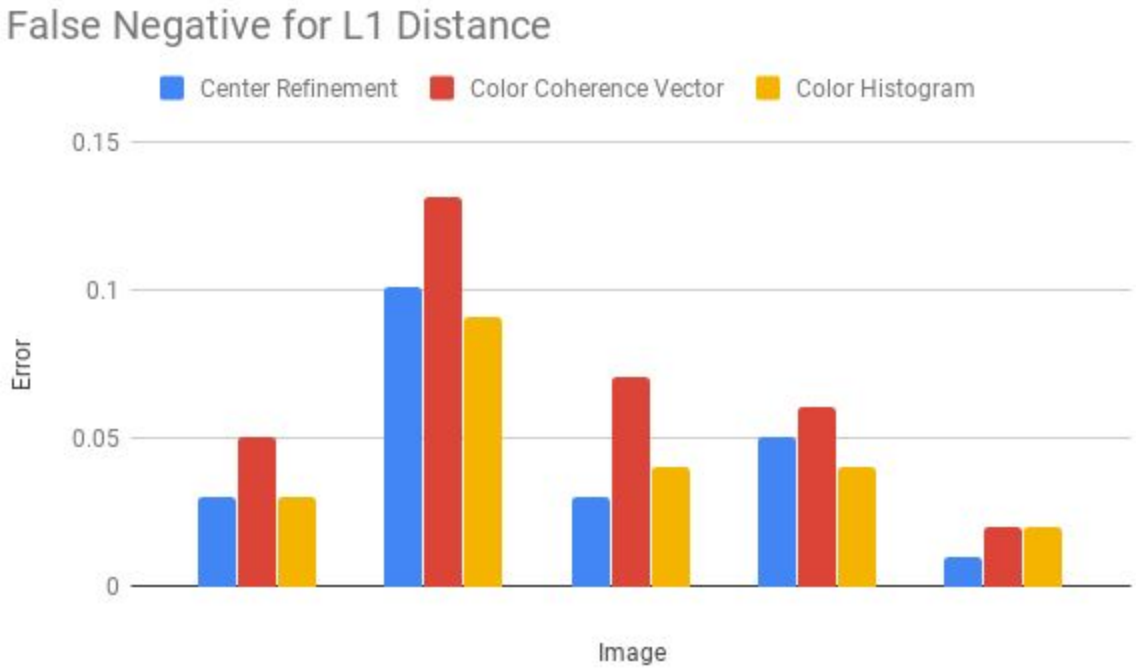
Results

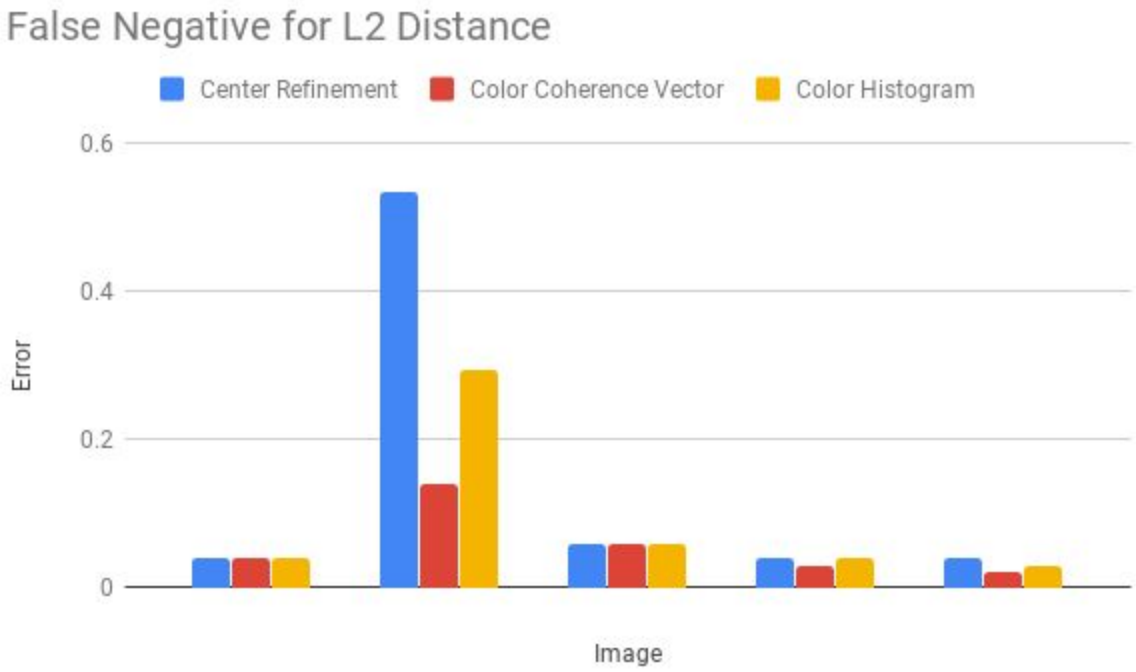
- We took 5 images and calculated their L1 and L2 distances with 200 images, 100 of which were similar and 100 were not.
- We calculated false negative and false positive rates as follows:

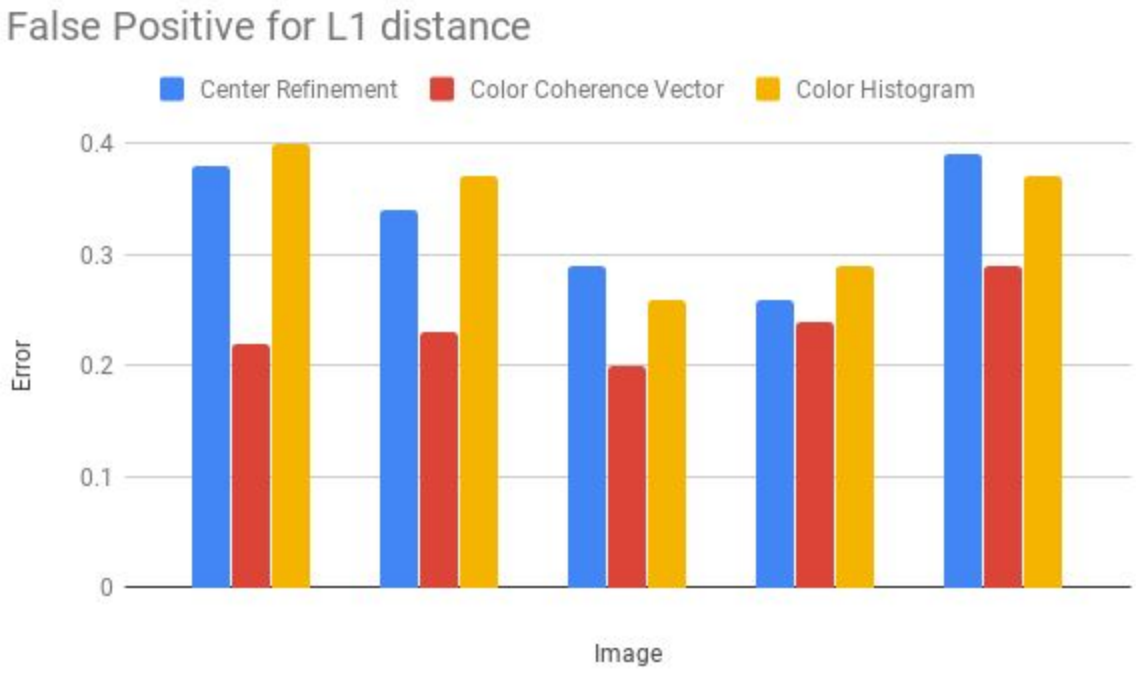
  Calculate the min and max L1 and L2 distances over all the 200 images and calculate the threshold for saying that an image i is similar if L1(i)<(0.4*min(L1)+0.6*max(L1)) for comparison using L1 and if L2(i)<(min(L2)+max(L2))/2 for comparison using L2. Then find number of false negatives and positives.

- It was observed that the false positive rates were lowest for CCV but the false negative rates were maximum for CCV using L1 distance.
- Using L2 distance, the false negative rate was lowest for CCV but the false positive rates were sometimes higher and sometimes lower for CCV.

  Bar graphs are shown below.


False Negative for L1 Distance
Center Refinement
Color Coherence Vector
Color Histogram
0.15
0.1
0.05
0
Error
Image


False Negative for L2 Distance
Center Refinement
Color Coherence Vector
Color Histogram
0.6
0.4
0.2
0
Error
Image


False Positive for L1 distance
Center Refinement
Color Coherence Vector
Color Histogram
0.4
0.3
0.2
0.1
0
Error
Image


False Positive for L2 distance
Center Refinement
Color Coherence Vector
Color Histogram
0.5
0.4
0.3
0.2
0.1
0
Error
Image