CENG 483

Introduction to Computer Vision

Fall 2021-2022

Take Home Exam 1

Instance Recognition with Color Histograms

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1 3D Color Histogram

In this section, I chose 4 different quantization intervals as 128, 64, 32 and 16. Therefore, number of bins are 2, 4, 8 and 16 respectively. Here is the interval- query table for query_1, query_2 and query_3:

	Query_1	*Query_2*	*Query_3*
128	%93.5	%100	%7.5
64	%100	%100	%12
32	%100	%100	%12
16	%100	%100	%12.5

As it can be seen from the table, the algorithm is working very successfully with the first and second datasets. The reason is for the first one, images are just a bit zoomed; and for the second one, images are just rotated. Since we are looking whole image without dividing it into grids, the color values are almost same for query1 and exactly same for second query. Therefore, the accuracy is very high. On the other hand, some color values are different for query3 even if there is no rotation, and this causes very low accuracy on the query3. Finally, we can also say that increasing the number of bins causes getting higher accuracy by looking at that with 16 quantization interval (16 bins), we are getting highest accuracy values for all queries.

2 Per Channel Color Histogram

In this section, I chose 5 different quantization intervals as 128, 64, 32, 16 and 8. Therefore, number of bins are 2, 4, 8, 16 and 32 respectively. Here is the interval- query table for query_1, query_2 and query_3:

	Query_1	*Query_2*	*Query_3*
128	%60	%100	%4
64	%93.5	%100	%14
32	%97.5	%100	%13.5
16	%98	%100	%12.5
8	%98	%100	%12.5

In this table, the first thing we can observe is that accuracy of the second query is %100 for all quantization intervals. The reason is the same with the 3D one which is that images in the second query are just rotated versions of the source images and since we are looking images as one grid, total image information is the same. On the other hand, one of the major differences with the 3D table is that accuracy for the first query with 128 quantization interval is very low with respect to its 3D table version. Calculating dissimilarity for images per channel may cause this difference. Finally, we can see that almost every query increasing number of bins has a positive effect in terms of getting high accuracy.

Before diving in the grid-based image search section, we can easily observe that choosing 16 bins (16 quantization interval) for 3D color histogram is straight-forward since it has highest accuracy for 3 queries. Similarly, 8 bins (32 quantization interval) seem optimum.

3,4,5 Grid Based Feature Extraction – Query sets 1,2,3

Here is the accuracy value for each grid size with the query and histogram type order:

	Q1-PC	*Q1-3D*	*Q2-PC*	*Q2-3D*	*Q3-PC*	*Q3-3D*
48x48	%100	%100	%38	%78.5	%22.5	%15
24x24	%100	%100	%24	%63	%27.5	%18
16x16	%100	%100	%16	%58	%29.5	%22.5
12x12	%100	%100	%13.5	%56.4	%30	%26.5

Firstly, we can observe that for the first query, we get highest possible results. We have seen that histogram searches without grids gave almost top results but grid results are higher. The reason is that dividing an image into grids decreases the chance of mismatch since a local mismatch has less weights in terms of accuracy.

On the other hand, the accuracy values for second query are completely different with respect to first two tables both for per channel and 3D colors. The reason is straight forward, images in second query are rotated. Moreover, since we are looking at grids with same locations between images while we are comparing them, we are actually comparing different parts of the same image in terms of its color values. Therefore, as the grids are getting smaller, dissimilarity is increasing for the reason we just mentioned. Additionally, 3D accuracy values are higher than per channel ones since 3D location information is more accurate than average of RGB ones, and it decreases the chance of mismatch.

Finally, we can observe that the relation between number of grids and accuracy is different for third query. The reason is that in the third query color tones are different in some regions, and the same for some regions. Therefore, comparison an image with third query images has higher accuracy since local mismatches are not dominating correct ones.

6 References

Harris, C. R., Millman, K. J., van der Walt, S. J., Gommers, R., Virtanen, P., Cournapeau, D., … Oliphant, T. E. (2020). Array programming with NumPy. *Nature*, *585*, 357–362. https://doi.org/10.1038/s41586-020-2649-2