
CENG 483

Introduction to Computer Vision

Fall 2021-2022

Take Home Exam 1

Instance Recognition with Color Histograms

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Please fill in the sections below only with the requested information. If you have additional things you want to mention, you can use the last section. For all of the configurations make sure that your quantization interval is divisible by 256 in order to obtain equal bins.

1 3D Color Histogram

In this section, give your results without dividing the images into grids. Your histogram must have at most 4096 bins. E.g. Assume that you choose 16 for quantization interval then you will have 16 bins for each channel and 4096 bins for your 3D color histogram.

- Pick 4 different quantization intervals and give your top-1 accuracy results for each of them on every query dataset.
- Explain the differences in results and possible causes of them if there are any.

Bins	Query 1 Top-1 Acc.	Query 2 Top-1 Acc.	Query 3 Top-1 Acc.
4096	1.0	1.0	0.11
512	1.0	1.0	0.105
64	1.0	1.0	0.115
8	0.93	1.0	0.08

As the bin count decreases, or bin size increases to say, the overall accuracy is observed as decreasing. The reason behind the 100 percent accuracy is because of the datasets:

- The Query 1 consist of same birds but zoomed-in to birds versions of the test set. This means the bird pixels covers more area compared to the test version. The histograms however should resemble each other in the cases where bird is clearly distinguished from the backgrounds, which results in a unique pattern in histograms.
- The Query 2 only consist of same birds but rotated versions of the test set pictures. This means the histograms will remain same, because the pixel values are assigned to bins without considering their position.
- In the Query 3, the images are altered with a color filter (something like a support of color-blind people filter in games) and therefore blues changed to purple, brown to green etc. So the color histograms are drastically changed. Therefore, by looking at color histograms the accuracy fall harshly.

2 Per Channel Color histogram

In this section, give your results without dividing the images into grids.

- Pick 5 different quantization intervals and give your top-1 accuracy results for each of them on every query dataset.
- Explain the differences in results and possible causes of them if there are any.

Bins	Query 1 Top-1 Acc.	Query 2 Top-1 Acc.	Query 3 Top-1 Acc.
32	0.975	1.0	0.135
16	0.98	1.0	0.125
8	0.98	1.0	0.125
4	0.98	1.0	0.105
2	0.98	1.0	0.1

As mentioned in the previous question,

- In query 1 and query 2 the accuracy remained same since there is not much of a change in their histograms.
- However, since we are not considering individual colors now but instead checking each channel independently, accuracy has fallen inevitably in query 1.
- As expected, in query 3 since the color histograms are changed drastically accuracy also fell. However, since a filter is applied on the images and we are checking the channels individually, accuracy is slightly higher than the 3D histograms. I think this is because of the filter's nature; its alteration on colors might have changed the colors totally but probably didn't effect individual channels difference.

Before starting the next section, please pick up the best configuration for two properties above and continue with them.

3 Grid Based Feature Extraction - Query set 1

Give your top-1 accuracy for all of the configurations below.

3.1 48×48 spatial grid

- 3d color histogram:
- per-channel histogram:

3.2 24×24 spatial grid

- 3d color histogram:
- per-channel histogram:

3.3 16×16 spatial grid

- 3d color histogram:
- per-channel histogram:

3.4 12×12 spatial grid

- 3d color histogram:
- per-channel histogram:

3.5 Questions

- What do you think about the cause of the difference between the results?
- Explain the advantages/disadvantages of using grids in both types of histograms if there are any.

4 Grid Based Feature Extraction - Query set 2

Give your top-1 accuracy for all of the configurations below.

4.1 48×48 spatial grid

- 3d color histogram:
- per-channel histogram:

4.2 24×24 spatial grid

- 3d color histogram:
- per-channel histogram:

4.3 16×16 spatial grid

- 3d color histogram:
- per-channel histogram:

4.4 12×12 spatial grid

- 3d color histogram:
- per-channel histogram:

4.5 Questions

- What do you think about the cause of the difference between the results?
- Explain the advantages/disadvantages of using grids in both types of histograms if there are any.

5 Grid Based Feature Extraction - Query set 3

Give your top-1 accuracy for all of the configurations below.

5.1 48×48 spatial grid

- 3d color histogram:
- per-channel histogram:

5.2 24×24 spatial grid

- 3d color histogram:
- per-channel histogram:

5.3 16×16 spatial grid

- 3d color histogram:
- per-channel histogram:

5.4 12×12 spatial grid

- 3d color histogram:
- per-channel histogram:

5.5 Questions

- What do you think about the cause of the difference between the results?
- Explain the advantages/disadvantages of using grids in both types of histograms if there are any.

6 Additional Comments and References

I've used the `sys` and `os` libraries in order to get arguments and system paths for the code. As a user manual, you can use the program with arguments like this:

For question 1 and 2, there is no need for type and grid-size, hence

`the1.py q1 16` \longrightarrow For bin size of 16, 4096 bin count

`the1.py q2 64` \longrightarrow For bin size of 64, 4 bin count