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# CENG 483

## Introduction to Computer Vision

Fall 2021-2022

### Take Home Exam 1

#### Instance Recognition with Color Histograms

Student ID:

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## 1 3D Color Histogram

I picked 5 different quantization intervals which are 4, 8, 16, 32 and 64. Accuracies for quantization levels are as follows.

Intervals	query_1 - support	query_2 - support	query_3 - support
16	<b>%97</b>	<b>%100</b>	%14
32	%96.5	%100	%14
48	%95	%100	<b>%16.5</b>
64	%92	%100	%12

- Query 1 pictures are slightly zoomed support pictures. Because of that, feature extraction did good job on these sets. That was actually predictable because our attention is at the bird that is in the middle of the pictures and none of the zoomed versions are zoomed enough to get the bird out of the picture. There is a small reduce at interval 64 and that is because there is only 4 bins and that is not enough information but it is also very high (%92) which is because the bird is still in the picture.
- Support to query 2 comparisons are all correct because query2 pictures are actually support pictures rotated. So they have same histograms and accuracy is %100
- Support to query 3 comparisons are rather low because they are actually versions of support images that has their colors slightly changed, which means patterns are same but the colors are all changed so histograms are also changed. So feature extraction couldn't do much here besides the histogram type.

## 2 Per Channel Color histogram

I picked 5 different quantization intervals which are 4, 8, 16, 32 and 64. Accuracies for quantization levels are as follows.

<b>Intervals</b>	query_1 - support	query_2 - support	query_3 - support
4	%98	%100	%20
8	<b>%98</b>	%100	%20
16	%97	<b>%100</b>	%21
32	%96	%100	<b>%21</b>
64	%90	%100	%19

- Firstly, query 3 to support comparisons are improved using per channel color histogram compared to 3D color histogram. As it is mentioned in the first part, these images are support pictures that has its colors slightly changed. Since this histogram treats different color channels seperately, it is good at finding similarities between these pair of pictures.
- Support to query 2 comparisons are all correct because query 2 pictures are actually support pictures rotated. So they have same histograms (besides type of histogram) and accuracy is %100
- Support to query 1 comparisons are similar to results in the first part since these pictures are not so much different. Just as their histograms are very similar in 3d color histogram, they are also similar when seperated to RGB channels

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

Most accurate intervals are 16 for 3d color histogram and 8 in per channel color histogram.

#### 3.1 $48 \times 48$ spatial grid

- 3d color histogram: %100
- per-channel histogram: %100

#### 3.2 $24 \times 24$ spatial grid

- 3d color histogram: %100
- per-channel histogram: %100

#### 3.3 $16 \times 16$ spatial grid

- 3d color histogram: %100
- per-channel histogram: %100

#### 3.4 $12 \times 12$ spatial grid

- 3d color histogram: %100
- per-channel histogram: %100

#### 3.5 Questions

- Dividing into grids is better for query 1 to support pairs because in some pictures, zoomed versions also lost some of the pixels that belongs to birds. Dividing into grids helped finding similarities of smaller patterns.
- Sometimes looking at the whole picture itself is not so effective because one picture might not have all the features the other has but still have the same actual pattern so dividing into grids are better at finding specific patterns.

### 4 Grid Based Feature Extraction - Query set 2

Most accurate intervals are 16 for 3d color histogram and 16 in per channel color histogram.

#### 4.1 $48 \times 48$ spatial grid

- 3d color histogram: %43
- per-channel histogram: %37.5

## 4.2 $24 \times 24$ spatial grid

- 3d color histogram: %30.5
- per-channel histogram: %21

## 4.3 $16 \times 16$ spatial grid

- 3d color histogram: %25
- per-channel histogram: %20

## 4.4 $12 \times 12$ spatial grid

- 3d color histogram: %22.5
- per-channel histogram: %20.5

## 4.5 Questions

- For this set, dividing into pairs both failed because corresponding histograms have different colors because of the rotation. We are actually comparing wrong pieces of pictures with each other. Accuracy also dropped as grid size reduced because more the slices compares, more the result diverged and program starts to match different birds to each other since one picture can have the similar colors that the other has at the same slice when rotated.
- For this set dividing into grids is really a disadvantage because we are likely to find wrong similarities because of the rotation.

# 5 Grid Based Feature Extraction - Query set 3

Most accurate intervals are 48 for 3d color histogram and 32 in per channel color histogram.

## 5.1 $48 \times 48$ spatial grid

- 3d color histogram: %25
- per-channel histogram: %24

## 5.2 $24 \times 24$ spatial grid

- 3d color histogram: %39.5
- per-channel histogram: %32.5

## 5.3 $16 \times 16$ spatial grid

- 3d color histogram: %42
- per-channel histogram: %33.5

## 5.4 $12 \times 12$ spatial grid

- 3d color histogram: %44.5
- per-channel histogram: %37

## 5.5 Questions

- Dividing into more grids increased accuracy since we are looking at more slices and this means small patterns are more recognizable opposing to looking at whole picture.
- 3d color histogram did better job with this set.

## 6 Additional Comments and References

(if there any)