CSIT5410 ASSIGNMENT 3 REPORT

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Written section:

(1)

20-67<0	67-67>=0	30-67<0
15-67<0		84-67>0
65-67<0	86-67>0	(21-67)<0

0	1	0
0		1
0	1	0

Feature vector:
Binary Representation: 01000101
Decimal Representation: 69

Perform circular rotation on the binary representation so that obtains a minimum value as the new feature vector

Rotation 1:
Binary Representation: 10001010
Decimal Representation: 138

Rotation 2:
Binary Representation: 00010101
Decimal Representation: 21

Rotation 3:
Binary Representation: 00101010
Decimal Representation: 42

Rotation 4:
Binary Representation: 01010100
Decimal Representation: 84

Rotation 5:
Binary Representation: 10101000
Decimal Representation: 168

Rotation 6:
Binary Representation: 01010001
Decimal Representation: 81

Rotation 7:
Binary Representation: 10100010
Decimal Representation: 162

The minimum is 00010101 (decimal representation: 21)

(2)
After 180 degree rotation:

21	86	65
84	67	15
30	67	20

0	1	0
1		0
0	1	0

Feature vector:
Binary Representation: 01010100
Decimal Representation: 84

After performing 7 circular rotations, we replace the current feature vector with the new feature vector with minimum value:
We find out that the feature vector:

- Binary Representation: 00010101
- Decimal Representation: 21

Current LBP is still the same as the original LBP; therefore, the LBP is rotation invariant.

(3)

21	70	32
16	69	82
66	86	20

0	1	0
0		1
0	1	0

After illumination change

0	1	0
0		1
0	1	0

Original patch

Compared with the original patch, they are completely the same, even though with changes of illumination condition.

So, the LBP is still the same:

- Binary Representation: 00010101
- Decimal Representation: 21

Report:

Dataset:

The original 2501 images with multiple objects are converted to dataset with 270 images of dogs and 271 images of non-dogs (i.e. when read an image, use the API to extract multiple objects from the image, and every time if there is a dog in the image, then add the sub-image into my dataset. The number of non-dogs are read to balance the number of dogs in my dataset). Then apply the feature_extraction function which uses LBP to encode the image with 5 different scales such as [128,128], [64,64], [48,48], [32,32], [16,16].

Weak classifiers:

There are a total of 5 weak classifiers which are trained with dataset above. With SVM auto determined 'KernelScale' heuristic and polynomial kernel function to get a better accuracy.

```
SVM_model1 = fitcsvm(fe1_set,labels,'Standardize',true,'KernelFunction','polynomial',...
    'KernelScale','auto');
SVM_model2 = fitcsvm(fe2_set,labels,'Standardize',true,'KernelFunction','polynomial',...
    'KernelScale','auto');
SVM_model3 = fitcsvm(fe3_set,labels,'Standardize',true,'KernelFunction','polynomial',...
    'KernelScale','auto');
SVM_model4 = fitcsvm(fe4_set,labels,'Standardize',true,'KernelFunction','polynomial',...
    'KernelScale','auto');
SVM_model5 = fitcsvm(fe5_set,labels,'Standardize',true,'KernelFunction','polynomial',...
    'KernelScale','auto');
```

Preprocessing methods:

If the image is in RGB, then I apply mat2gray function to convert it from RGB to grayscale.

I also apply the histogram equalization to increase the contrast of the image.

Selected Weak classifiers and its weight:

alpha

5x1 double

	1
1	0
2	0.0600
3	0
4	0.0324
5	0.0475

Alpha can be normalized to:

1. 0
2. 0.42887
3. 0
4. 0.23159
5. 0.33953

Weak Classifiers 2, 5, 4 are selected with decreasing weights due to decreasing accuracy

Classification Accuracy of Weak Classifiers in csit5410_test.txt:

```
Correctness (Weak Classifier 1):59/104
Correctness (Weak Classifier 2):55/104
Correctness (Weak Classifier 3):58/104
Correctness (Weak Classifier 4):61/104
Correctness (Weak Classifier 5):59/104
```

Classification Accuracy of Weak Classifiers and Strong Classifiers in "VOC2007\ImageSets\Main\dog_val.txt":

The Strong classifier has the best accuracy and indeed assign more weights on weak classifier 2, 5, and 4 due to higher accuracy.

```
Correctness (Weak Classifier 1):269/534
Correctness (Weak Classifier 2):283/534
Correctness (Weak Classifier 3):275/534
Correctness (Weak Classifier 4):280/534
Correctness (Weak Classifier 5):281/534
Correctness (Strong Classifier):299/534
```

alpha

5x1 double

	1
1	0
2	0.0600
3	0
4	0.0324
5	0.0475

A screen capture of the detection results of the given images in the "test_images":