

ECE661: Homework 8

Fall 2016

Deadline : November 8, 2016 , 1:30 pm

Turn in your solution via Blackboard. Additional instructions given at [I]

1 Introduction

In this homework you will implement a very simple image classification method using a texture operator for feature extraction and a nearest neighbor classifier. You are provided with two sets of images – one for training and the other for testing. The images in the database belong to four different classes.

The first step in the process of image classification is to extract feature vectors from all the images. You will implement the Local Binary Pattern (LBP) feature extraction procedure as discussed in class. After obtaining feature vectors for all the training and testing images, use them to find the k -nearest neighbors of each testing image in the training set. For determining the class label of a test feature vector, use the majority vote from amongst its k -nearest neighbors.

2 Tasks

You will use the dataset available at [I]. Your assignment consists of the following steps:

2.1 Understanding the dataset

- You are provided with a dataset containing 4 types of images – building facades, trees, mountainous ranges, and cars. There are 20 training images and 5 testing images for each class. One sample image from each class is shown in Figure I.
- The dataset folder available at [I] contains two subfolders called ‘training’ and ‘testing’. Inside the folder named ‘training’, there are four subfolders belonging to the four types or classes of images. Each folder contains 20 training images. The images inside ‘testing’ folder are named as follows: <class of image>.<image number>.jpg. Note that there are 5 images for each class in the ‘testing’ folder.



(a) building



(b) car



(c) mountain



(d) tree

Figure 1: Sample images

2.2 LBP Feature Extraction

- Implement **your own LBP feature extraction** algorithm to obtain a histogram feature vector for each image in the database. You can refer to Prof. Avi Kak’s implementation [II].

2.3 NN-Classifier

- Using Euclidean distance metric find the k -nearest neighbors of the feature vector of each testing image in the feature space of training images. As a result you will obtain k possible labels to associate with the testing image. You can empirically set $k = 5$.
- To choose which label – out of the k labels – to assign to the testing image, you need to find the label which appears maximum number of times in the set of k labels.

2.4 Performance Measures

- Construct a confusion matrix based on your classification results. Your confusion matrix will be a 4×4 matrix since there are 4 classes. Rows correspond to the actual class labels while columns correspond to the predicted class labels. Note that a perfect confusion matrix will be a diagonal matrix with all diagonal values equal to 5. For more information on confusion matrix please see the wikipedia page [III].
- Calculate the overall accuracy of your algorithm.

3 Submission

You can download the dataset from [I].

1. Turn in a typed pdf of your report via Blackboard.
2. Your pdf must include the following : -
 - A good description how you implemented each of the tasks above.
 - LBP histogram feature vector of at least one image from each class
 - Your performance measures as described above.
 - Your observations on the performance of your image recognition system.
 - Your source code.

References

[I] <http://web.ics.purdue.edu/~sakbar/ECE661/>

[II] <https://engineering.purdue.edu/kak/distTextureAndColor/CodeForTextureAndColorTutorial.tar.gz>

[III] https://en.wikipedia.org/wiki/Confusion_matrix