

# Computer Vision Assignment-2 Report

Enver KESMEN, Hacettepe University Department of Computer Engineering

Keywords: Object Recognition, Bag-of-Visual-Words, SVM

## 1. INTRODUCTION

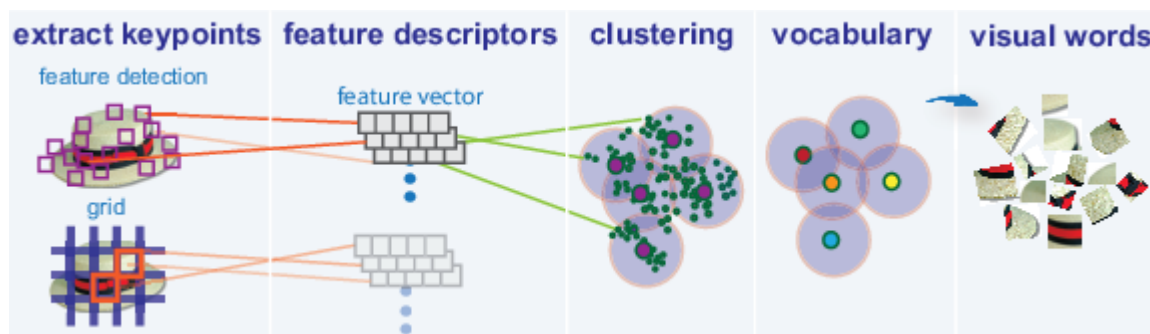
In computer science, there is a lot of method for image recognition. Nowadays, deep learning very popular. Image recognition is a hard problem but we have a different method which name is Bag Of Visual Words. Its different other methods because it has different story. It came another area. The bag-of-words model is a simplifying representation used in natural language processing and information retrieval.

## 2. METHOD

### 2.1 Image Category Sets

We need image data set for train model. In this assignmet I used a subset of the Caltech-101 Object Categories which given with assignmet.

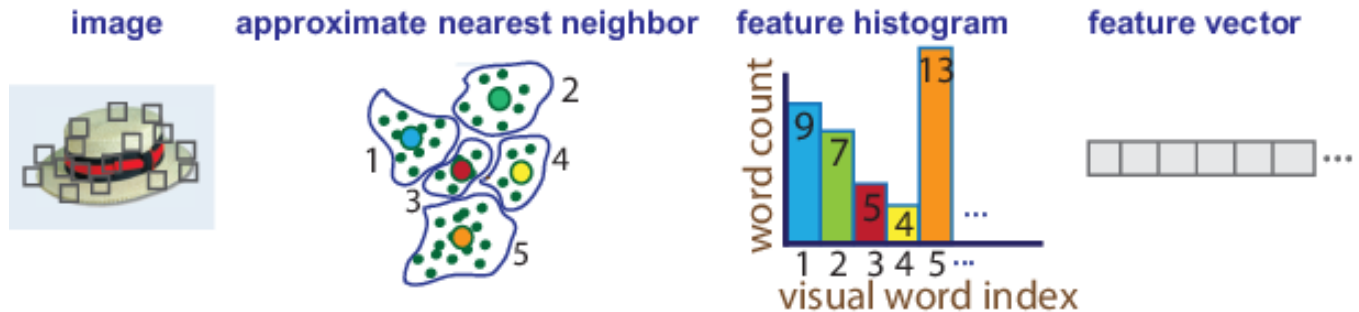
### 2.2 Create Bag of Features



Create a visual vocabulary, or bag of features, by extracting feature descriptors from representative images of each category. I extracted SURF descriptors from all train images and put into a matrix. For clustering I used k-means algorithm. After kmeans I have vocabulary for convert image to BoW model.

1:2 • Enver KESMEN

### 2.3 Train an Image Classifier With Bag of Visual Words



I dedected SURF features from all images in training set and put into a matrix with label id(e.g. 1 for airplanes). For training classifier I used libsvm which open source SVM library. After svmtrain step I had a model for image classifier.

### 3. EXPERIMENT

For Bag of Visual Words we had 2 fundemantal variable. For best result we have to try different values.

Accuracy = 90.0/100 (225/250) when c=1 k=200  
Accuracy = 92.8/100 (232/250) when c=1 k=400  
Accuracy = 92.8/100 (232/250) when c=1 k=500  
Accuracy = 92.4/100 (231/250) when c=1 k=600  
Accuracy = 93.2/100 (233/250) when c=10 k=500  
Accuracy = 94.4/100 (236/250) when c=10 k=400  
Accuracy = 95.2/100 (238/250) when c=100 k=400

When k is over 500, Accury began decrease and i fixed k to 500 and increase c. When c is 10 and k is 500 i give really nice result but i try to decrease k. when k is 400 and c is 10, accuracy increase to 94.4.

Best result is 95.2 when c=100 and k=400.

I think this numbers are really good. I was expecting numbers around 80 percent.

Confision matrix for c=100 and k=400;

$$M = \begin{bmatrix} 47 & 0 & 1 & 1 & 1 \\ 0 & 46 & 0 & 0 & 0 \\ 0 & 0 & 50 & 0 & 0 \\ 1 & 0 & 0 & 47 & 2 \\ 0 & 1 & 1 & 2 & 46 \end{bmatrix}$$