Silhouette Image Classification using Speeded Up Robust Features

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Introduction

The matching and retrieval of 2D shapes is an important challenge in computer vision. The recent progress in this domain has been mostly driven by designing smart shape descriptors for providing better measure between pairs of shapes. In our method, we provide a new perspective to this problem by considering the bag-of-keypoints representation. The presented experimental results demonstrate that the proposed approach yields better performance over the state-of-the-art shape matching algorithms. We obtained a retrieval rate of 98.75 percent on the MPEG-7PartB dataset with a specific 20 classes, which shows that the presented approach is better for classifying silhouette images.

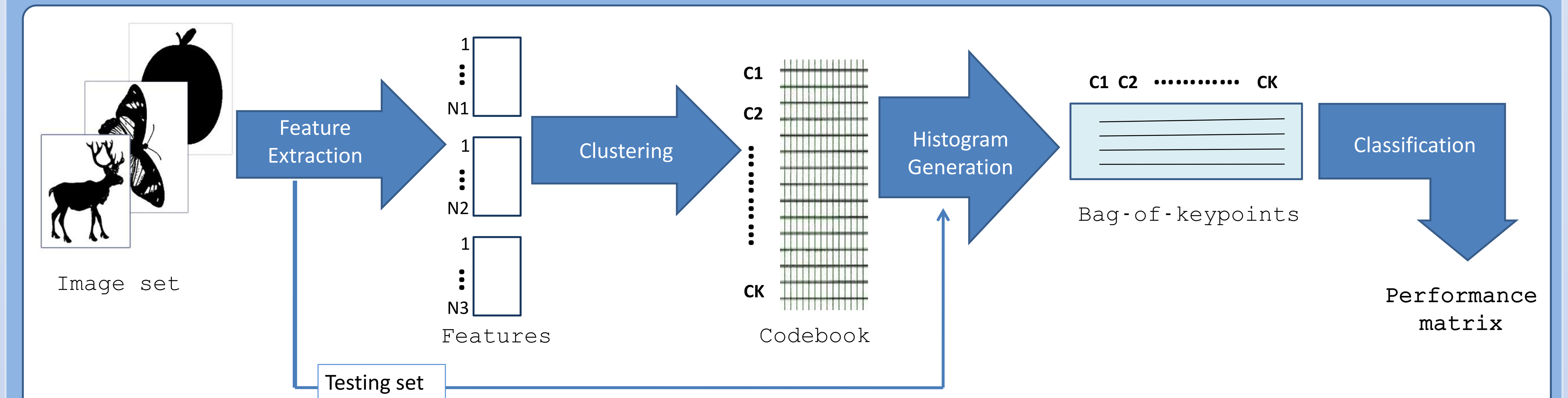
Shape representation and analysis are the oldest and most common areas in silhouette image classification, which have been studied extensively in the literature. However, despite all the intensive research, the shape matching method is general and can be built on top of any existing shape similarity measures[1][4]. Our technique in silhouette image classification was to develop a bag-of-keypoints approach which has been widely used in object recognition and texture classification.

Methodology

Our approach involves

- Dataset: 20 classes with 20 images per class from the MPEG-7PartB dataset[3].
- Feature extraction using Speeded Up Robust Feature (SURF)[2].
- Vector quantisation using K-means algorithm.
- Feature representation using histograms construction.
- The classification was performed in a two-fold cross-validation setup.
- Classification performance was compared with a Nearest Neighbour classifier and Support Vector Machine.

General Framework of Bag-of-Keypoints Classification



Dataset

MPEG-7PartB is a benchmark dataset[3] that has been widely used to test shape-based classification and retrieval methods on silhouette images. The dataset contains 1400 silhouette images divided into 70 shape classes of 20 images each.

In our experimental setup we choose the following twenty shape classes from the dataset:

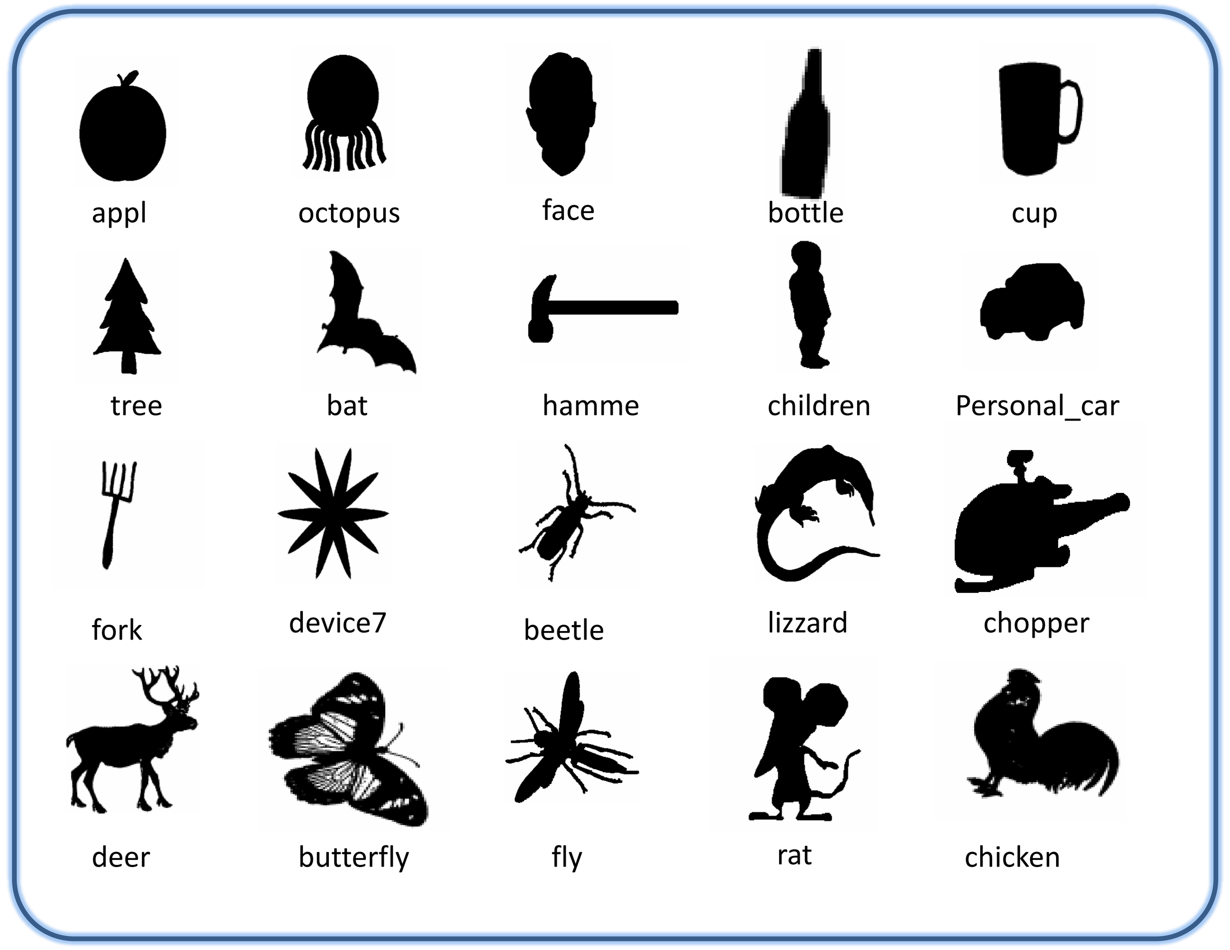


Figure 1: Dataset image sample

Experiments

Locally merged codebook and Global codebook approaches were compared in classification rate and the influence of the size of the codebook constructed by K-means method was also compared in this study.

The classification rate was influenced with the initial seed selection and the number of clusters of K-means algorithm as shown in Figure 2.

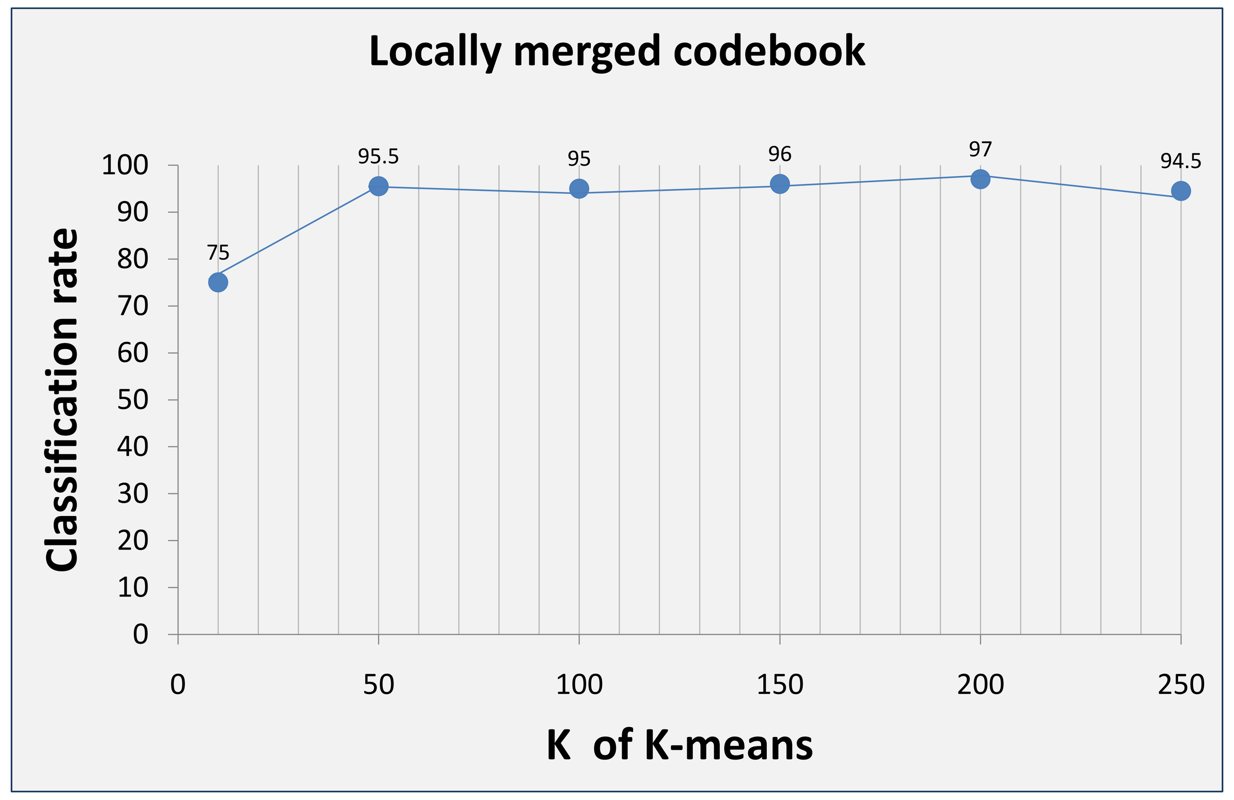


Figure 2: Influence of the cluster size on the classification rate when using k-means.

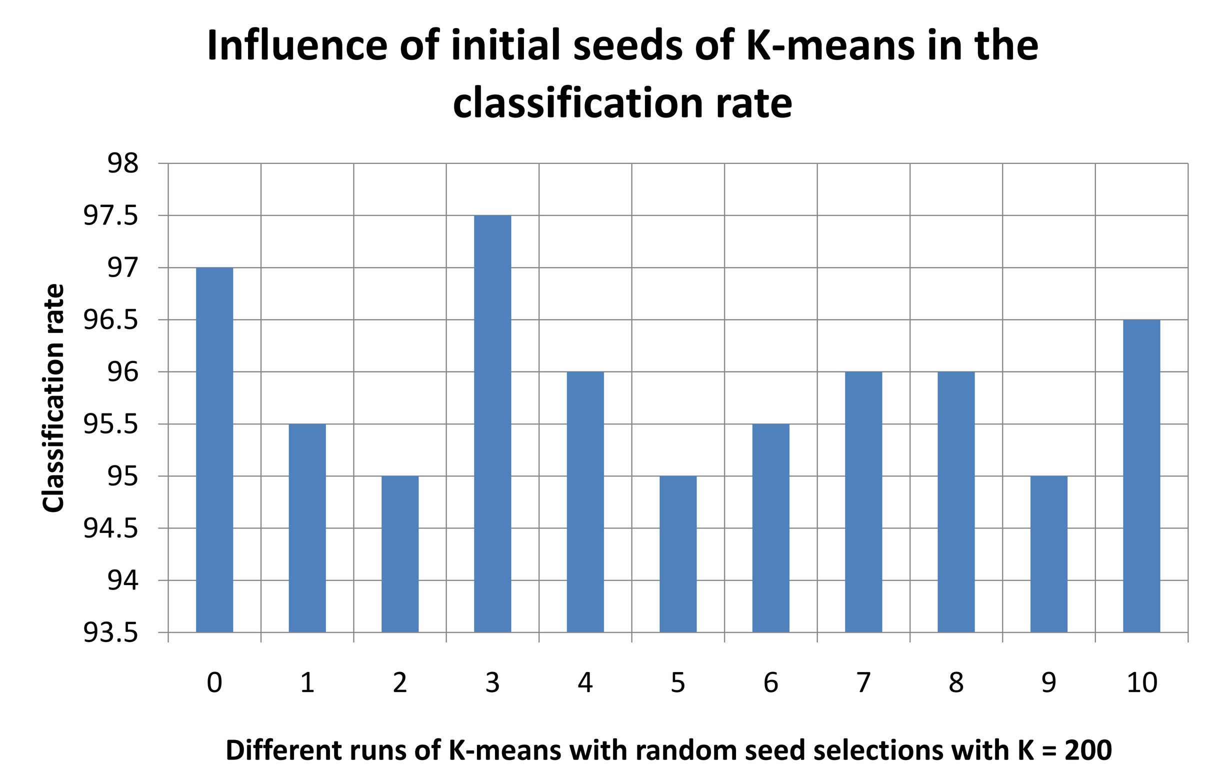


Figure 3: Influence of the initial random seed selection of k-means on the classification rate

Classification result depends on the initial cluster centres of K-means algorithm as shown in Figure 3.

Results

We report the classification rate obtained by our approach for silhouette image classification applied on MPEG-7PartB data set in which we considered 20 classes. The result compared the locally merged and global codebook models with NN and SVM.

Codebook	Classifier	Classification rate
Locally merged	NN	86.00
	SVM with linear kernel	93.50
	SVM with HIK	**95.00**
Global	NN	84.50
	SVM with linear kernel	93.50
	SVM with HIK	**98.75**

Table 1: A comparison of classification rate with locally merged codebook and global codebook model along with different classifiers: Nearest Neighbour(NN) and Support Vector Machine(SVM). SVMs were tested with Linear and Histogram Intersection kernel (HIK).

Discussion & Conclusion

- SVM performs better than NN
- HIK performs better than linear kernel as the choice of feature representation is histograms.
- Global (universal) codebook performs much better than locally merged single codebook.
- This method can be well adopted for medical images and satellite images classification.

Reference

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