Silhouette Image Classification using Bag of Local Features

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Abstract

Shape is an important feature to identify an object in the image. Classifying objects by using their shape has been an interesting and important area in computer vision. It has improved a lot in the last decades.

In this work, an approach is proposed for shape classification that uses both local and global image representation using Histogram of Oriented Gradient (HOG) Pyramid of Histogram of Orientation Gradients (PHOG) and CENsus Transform hISTogram(CENTRIST).

By evaluating these descriptors it can be concluded that the combined HOG, PHOG gives better performance than CENTRIST in the context of silhouette image classification.

Introduction

- Shape feature is undoubtedly transcending landmark in its ability to produce a complete description of an object where texture or color cannot be used as a cue for recognition.
- Shape representation methods can be classified into two main categories: Contour-based methods and Region-based methods.
  - Contour-based shape techniques use shape boundary information.
  - Region based techniques use all the pixels within a shape region are taken into account to obtain the shape representation.
  - ✓ Contour-based methods are widely used than region-based methods since individuals can easily identify shapes by using their contour features.
- There are three levels of feature extraction such as pixel, global and local.
  - By using pixel values of the image we can identify the features.
  - The global feature can be extracted to describe the whole image.
  - Local features are extracted from small sub region of interest from the original image.
  - ✓ Local features can improve the computational speed and may focus on the object rather than the background.
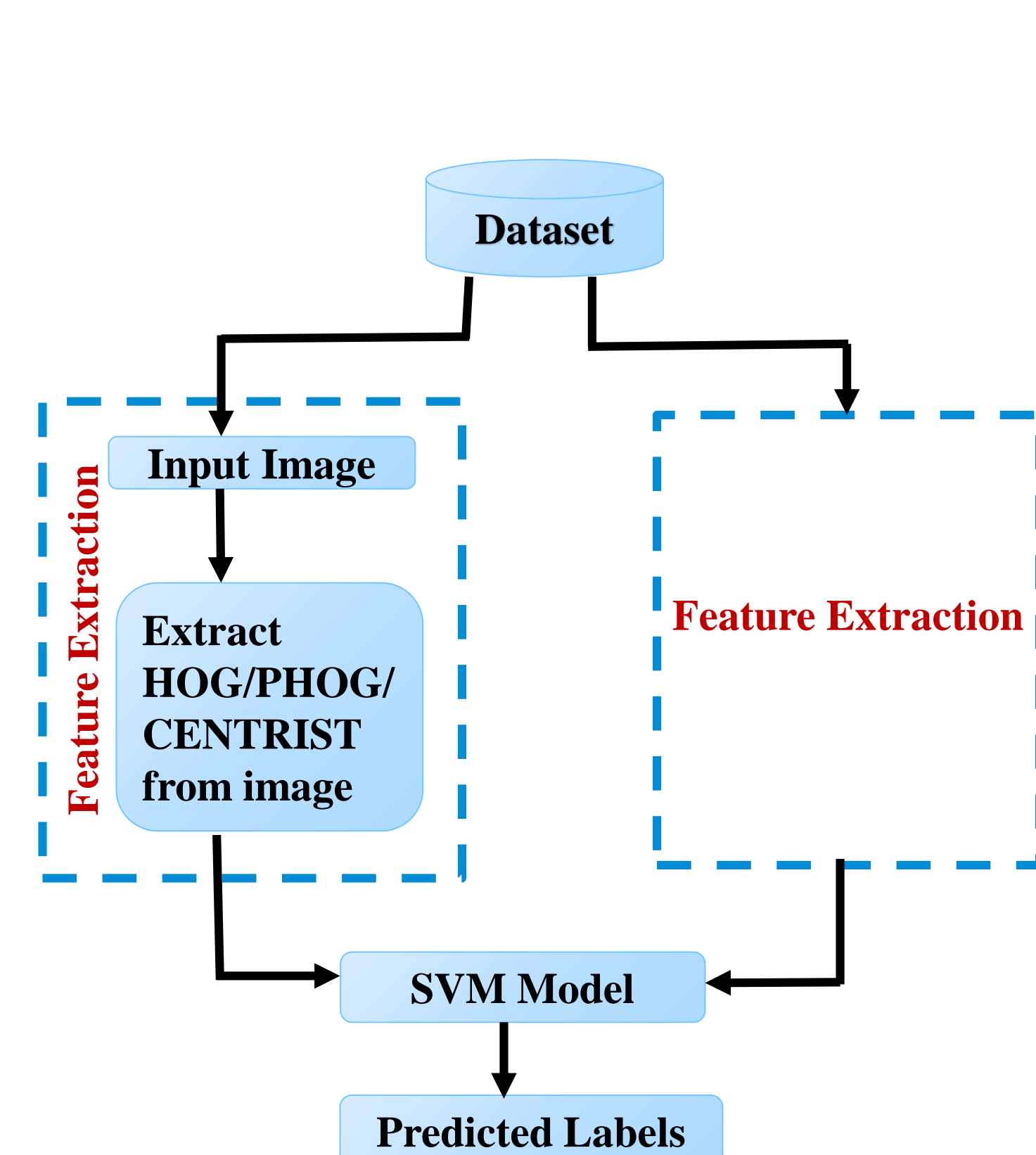
Methodology

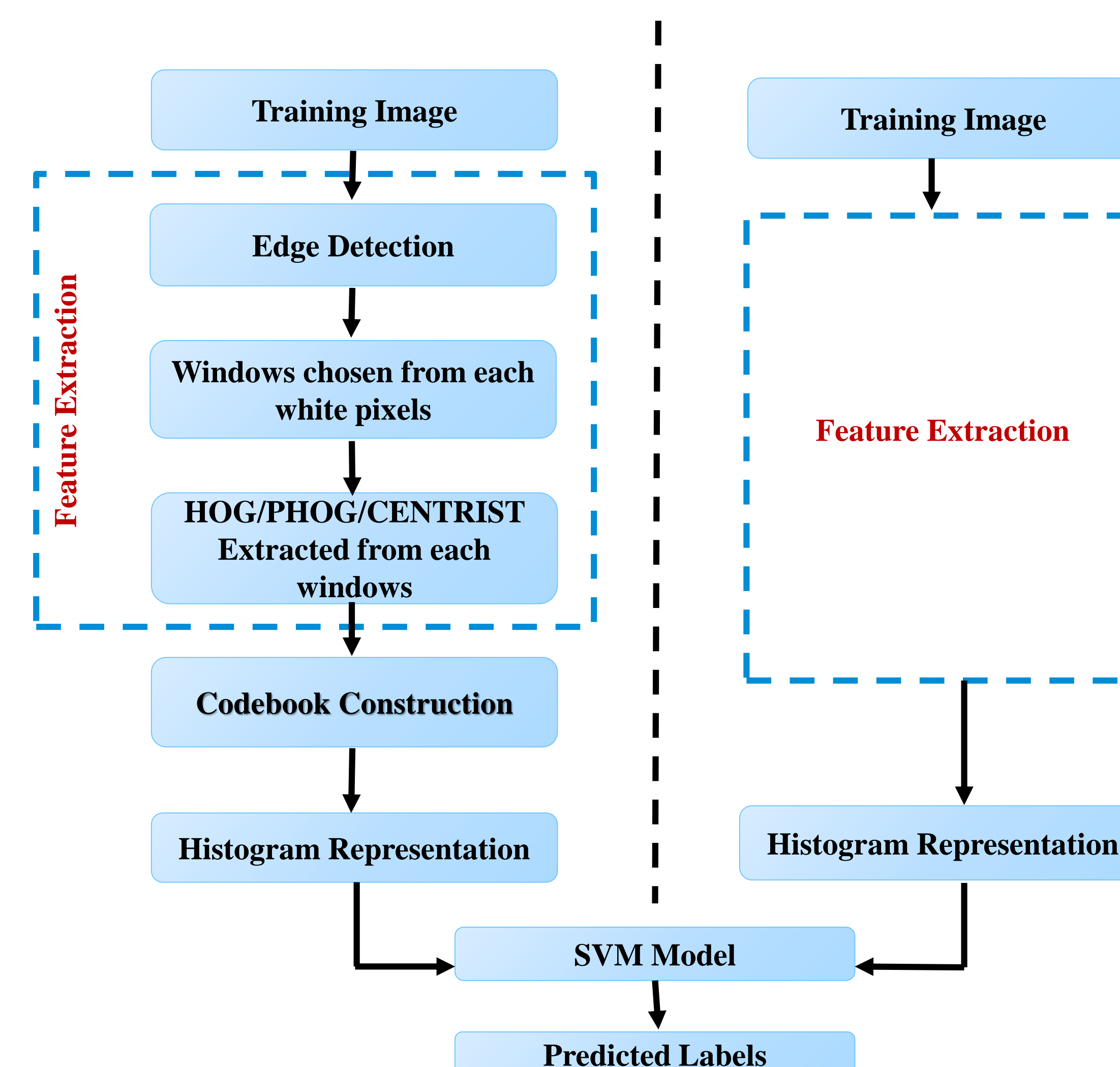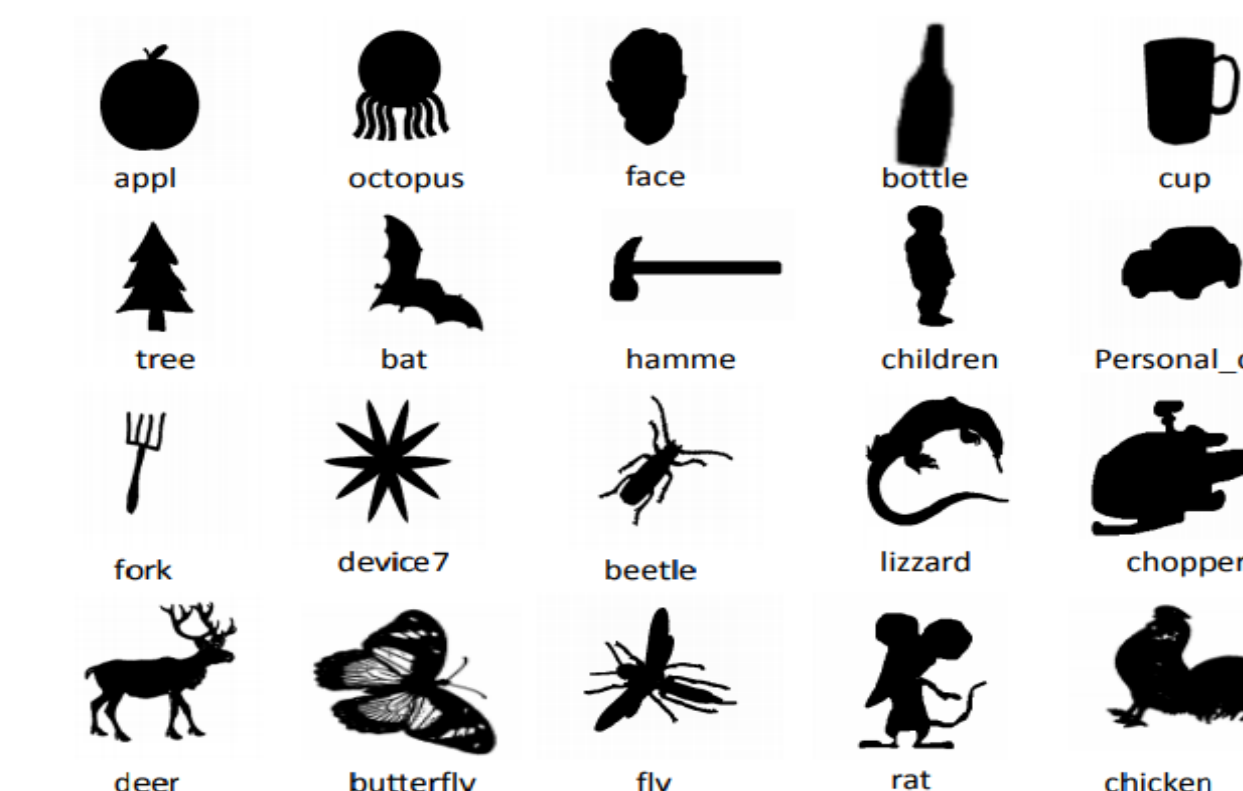Figure 1: Global representation of image

Figure 2: Local representation of image

Testing Results

Descriptor	Performance
HOG	84.14
PHOG	82.29
CENTRIST	55.43
HOG + PHOG	84.14
HOG + CENTRIST	79.86
PHOG + CENTRIST	55.43

Table1: Classification performance for Global representation of image

Descriptor	31,31 sized window	61,61 sized window
HOG	78.14	80.00
PHOG	79.76	79.71
CENTRIST	72.00	74.57
HOG + PHOG	92.14	93.14
HOG + CENTRIST	76.14	80.14
PHOG + CENTRIST	89.14	91.57

Table2: Classification performance for Local representation of image

Methods		Performance (%)
Proposed method	HOG	84.15
	PHOG	82.29
	CENTRIST	74.57
	HOG + PHOG	**93.14**
	PHOG + CENTRIST	91.57
	HOG + CENTRIST	80.14
State-of-the-art method	Sirin et al (2017) [2]	92.70
	Shekar et al (2015) [3]	91.05
	Wang et al (2014) [4]	97.16
	Shu & Wu (2011) [5]	76.56
	Gopalan et al (2010) [6]	93.67

Table3: Performance comparison of the proposed method with state-of-the-art methods

Experimental Setup

- **Dataset**

- The proposed method was tested on MPEG-7 Part-B [1] silhouette dataset .
- The dataset has been split into 50 % for training and 50 % for testing.
- Edges are detected using sobel edge detector with one pixel thinning.
- 31×31, 61×61 sized window is selected from each white pixel.
- HOG, PHOG, CENTRIST descriptors are extracted from each of selected window.
- Codebook Construction: K-means is run K = 50, 100, 150, 200, 300, 500 and found the best K to be at 100.
- Linear OVA-SVM is used to determine the category of test image.

Conclusion

- Proposed method which integrates the use of the HOG, PHOG and CENTRIST in the bag of words
- Silhouette image classification improved by combining different feature of shape descriptors rather than individual feature.
- Future work aims to explore methods for efficient windows and feature selection and it will focus on experiment with other databases

References

1) JS. Jeannin and M. Bober, "Description of core experiments for MPEG-7 motion/shape", Seoul, 1999.
2) Y. Sirin, M.F.Demirci, "2D and 3D shape retrieval using skeleton filling rate", Multimed Tools Appl, Vol. 76,pp. 78237848, 2017.
3) B.H.Shekar, B.Pilar, J.Kittler, "An unification of inner distance shape context and local binary pattern for shape representation and classification" 2nd International Conference on Perception and Machine Intelligence, pp. 4655, 2015.
4) X. Wang, B. Feng, X. Bai, W. Liu, and L. Latecki, "Bag of contour fragments for robust shape classification", Pattern Recognition, vol. 47, no. 6, pp. 2116-2125, 2014.
5) X. Shu and X.-J. Wu, "A novel contor descriptor for 2D shape matching and its application to image retrieval", Image Vis. Comput., vol. 29, no. 4, pp. 286-294, 2011.
6) R.Gopalan, P.Turaga, R.Chellappa, "Articulation-invariant representation of non-planar shapes", European Conference on Computer Vision Springer, pp. 286299, 2010.