Object classification Techniques using Machine Learning Model

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***ABSTRACT*-Detecting people in images is key for several important application domains in computer vision. This paper presents an in-depth experimental study on pedestrian classification; multiple feature-classifier combinations are examined with respect to their performance and efficiency. In investigate global versus local, as exemplified by PCA coefficients. In terms of classifiers, consider the popular Support Vector Machines (SVMs), Adaptive boost with SVM. Experiments are performed on a large data set consisting of 4,000 pedestrian and more than statistically meaningful results are obtained by analysing performance variances caused by varying training and test sets. Furthermore, to investigate how classification performance and training sample size are correlated. Our experiments show that the novel combination of SVMs with Adaptive Boost.**

***Keywords*-Object detection, Object classification, Computer vision,Principal component analysis (PCA), Support vector machine (SVM), Radial basis function (RBF), Adaboost (Adaptive boosting).**

I. INTRODUCTION

Computer vision is a field that includes methods for acquiring,processing, analysing the images. Computer vision has described as the enterprise of automating and integrating a wide range of processes and representations for vision perception. In computer vision the artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras [4]. Methods of computer vision are computer human interaction, detecting events, identification, and Object recognition. Object detection, object classification and object tracking are used to solve the surveillance problems. Most often computer vision systems can be decomposed into the following three parts.

1) *A data acquisition part:* which uses sensors or external interfaces to acquire one or more digital images. The data acquisition can also include Digital Image Processing techniques to pre-process the data, such as removing irrelevant noise.
2) *The representation of data:* arguably the most important part of the system. The acquired data is transformed into an alternative representation more suitable to the problem. Information irrelevant to the problem is supressed or discarded, while information likely to be useful is kept or amplified. Methods extracting useful pieces of information, so called feature extractorsare commonly used. If the representation is good, the remaining part of the system is trivial. Hence, the largest part of the computer visions literature deals with suitable representations and how to extract them from a digital image.
3) *A decision part:* achieving the system goal from the represented data. For complex tasks such as object recognition or face detection these often include state of the art techniques from the field of Machine Learning. Often probable hypotheses are formulated and verified.

A. Object detection

Object detection is the technology that is related tocomputer vision and image processing. Object detection is to detecting the instances of semantic objects into class such as vehicles, buildings and peoples [1]. The main research domain of object detection is face detection and pedestrian detection i.e. (face and vehicle detection).In an object detection system there is two main steps:

1) Extracting a number of features, and
2) Training a classifier

B. Object Classification

A classifier is an algorithm that takes a set offeatures that characterize objects and uses them to determine the class of each object. The classic example in astronomy is distinguishing stars from galaxies. For each object, one measures a number of properties (speed, size, compactness, boundary box etc.); the classifier then uses these properties to determine whether each object is a star or a galaxy. There are of two types of classification supervised and unsupervised [1]. In supervised classification, meaning that a human expert both has determined into what classes an object may be categorized and also has provided a set of sample objects with known classes. This set of known objects is called the training set because it is used by the classification programs to learn how to classify objects. In unsupervised classification methods in which the induction engine works directly from the data, and there is neither training sets nor pre-determined classes. There are four steps to develop classifiers:

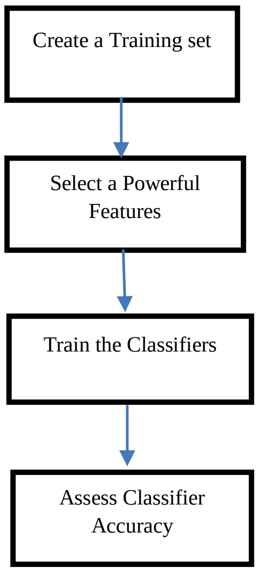

Fig 1: Object Classification

C. *Machine learning*

Machine learning, is a branch of artificial intelligence, which is concerned with the construction and study of systems that can learn from data. There are three approaches in machine learning model i.e. supervised learning, semi-supervised learning and unsupervised learning.For example, a machine learning system could be trained on images to learn to distinguish between pedestrian and non-pedestrian images. After learning, it can then be used to classify new images into pedestrian and non-pedestrian folders. The machine learning algorithms used in present work are:

- SVM RBF kernel
- Adaboost with SVM RBF Kernal

1) *SVMRBF Kernel* is a method for the classification of both linear and non-linear data. Support Vector Machine (SVM) are supervised learning models and it associated with learning algorithms that analyses data and recognizes patterns [3]. The basic SVM takes a set of input data, for each given input, which has two possible class forms the output making it a non-probabilistic binary linear classifier.RBF is a kernel function that used in various learning algorithm.RBF is a highly polynomial function. SVM is used for classification, pattern recognition, text categorizing and medical science.The advantages of support vector machines are:

a. Effective in high dimensional spaces.
b. Still effective in cases where number of dimensions is greater than the number of samples.
c. Uses a subset of training points in the decision function (called support vectors), so it is also memory efficient.
d. Different Kernel functions can be specified for the decision function.

2) *Adaboost(Adaptive boosting)* is a machine learning algorithm. It can be used with many different classifiers to improve the accuracy. Adaboost is adaptive in the sense that subsequent weak learners are tweaked[1]. Adaboost focuses on more previously misclassified samples. Initially all samples are equal weights. Weight may change at each boosting round. It can be less susceptible to the over fitting problem than other learning algorithms. The individual learners can be weak, but as long as the performance of each one is slightly better and the final model can be proven to converge to a strong learner. Steps of adaboost classifiers are Bootstrapping, Bagging, Boosting, and Adaboost. A boost classifier is a classifier in the form

$$F_t(x) = \sum_{t=1}^{T} f_t\,(x)(1)$$

Where f_t is a weak learner that takes the value of X as input and the real value.

$$E_t = \sum_i E\,[F_{t-1}(X_i) + \alpha_t\, h(X_i)](2)$$

Here $F_{t-1}(X)$ is a boost classifier that built up a previous stage of training.

II. METHODOLOGY

The given flow chart is explain the working in the easiest and the simplest way.

Step1:In a first step it will take an input that is the dataset of pedestrian and vehicle images.

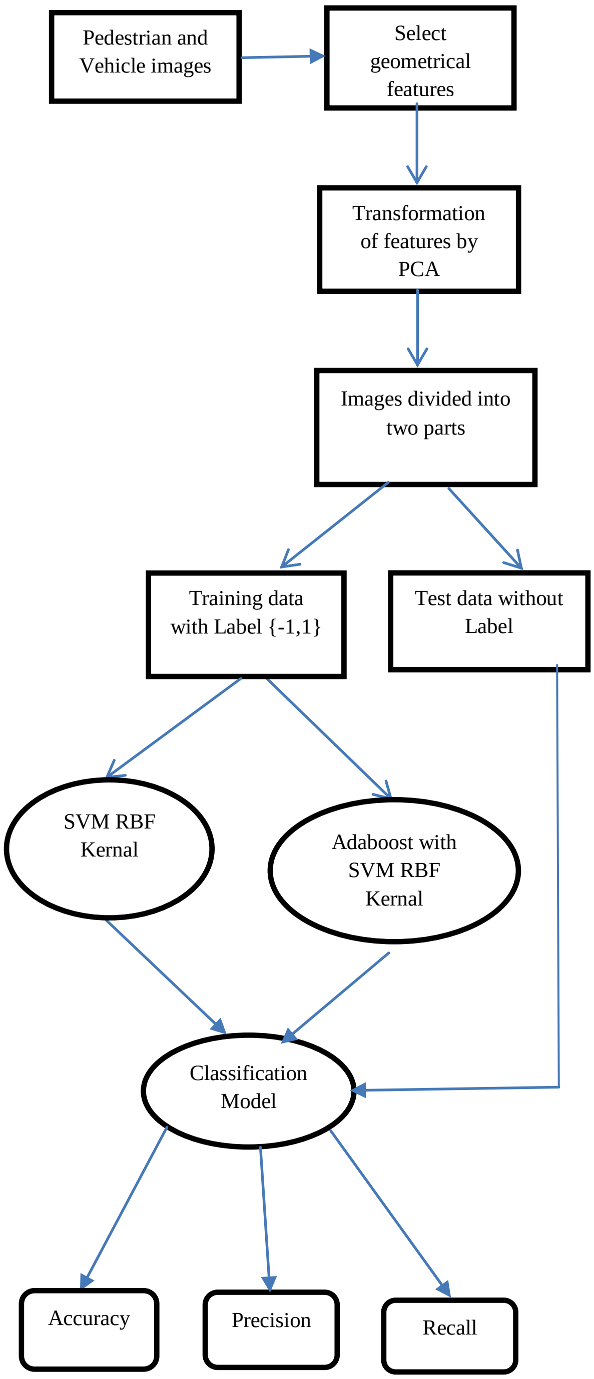

Fig2: various steps involved in object Classification

Step2: Select the geometrical features. Geometrical feature is a technique combining machine learning and computer vision to solve the visual tasks.

Step3:Transformation of features using PCA i.e. to merge the features. Merging the features is to reduce the dimensions as well as complexity.

Step4:After selection the features the images divided into two parts: the one is training data with label and other is test data.

Step5:In a training data apply two algorithm i.e SVM RBF kernel and Adaboost with SVM RBF Kernal, the classification model is generated. After that test the models and check the performance of the classification model.

Step6: Performance Measures

1) *Accuracy:* In the fields of science, engineering, industry, and statistics, the accuracy of a measurement system is the degree of closeness of measurements of a quantity to that quantity's actual (true) value.

$$\text{Acc} = \frac{\text{True positive} + \text{True Negative}}{\text{Total number of elements}}$$

2) *Precision:* In the field of information retrieval,precision is the fraction of retrieved documents that are relevant to the find:

$$\text{Precision} = \frac{\text{True Positive}}{\text{True positive} + \text{False Positive}}$$

Precision takes all retrieved documents into account, but it can also be evaluated at a given cut-off rank, considering only the topmost results returned by the system. This measure is called precision at n or P@n.

3) *Recall:* Recall in information retrieval is the fraction of the documents that are relevant to the query that are successfully retrieved.

$$\text{Recall} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$$

For example for text search on a set of documents recall is the number of correct results divided by the number of results that should have been returned.

III. EXPERIMENTAL RESULTS

In this thesis work thetwo algorithms are introduced in class to implement object classification in MATLAB and their performance is compared. The following figures show the experimental results of the classification methods like: SVM RBF Kernel and Adaboost with SVM RBF Kernel. Fig. 3, 4, 5, & 6 shows the Performance of the classifiers. These results provide qualitative analysis of methods.

Table1: Analysis of result Adaptive boosting

Classifier	Accuracy	Precision	Recall
Adaboost	93	94	95.3

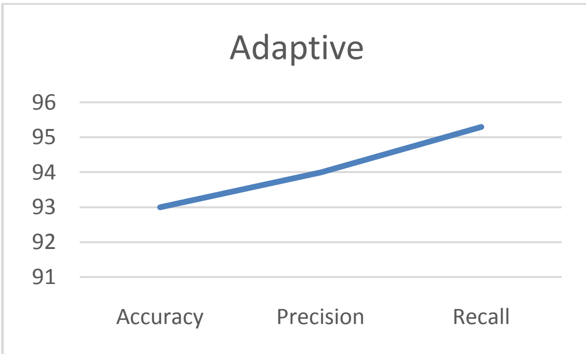

Fig 3: Analysis of result Adaptive Boosting

Table2: Analysis of result SVM with RBF

Classifier	Accuracy	Precision	Recall
SVM+ RBF	94.8	95.2	98

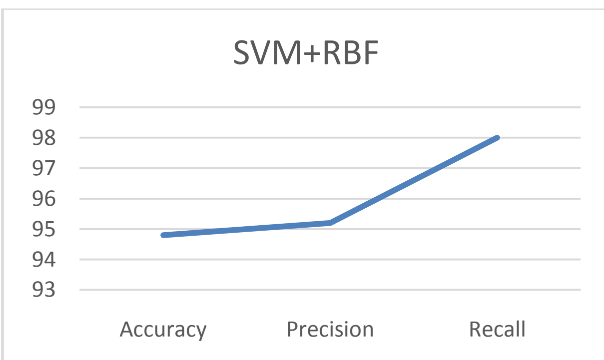

Fig 4: Analysis of Result SVM+RBF

Table3: Analysis of result Adaboost with SVM RBF

Classifier	Accuracy	Precision	Recall
Adaboost with SVM+RBF	96.2	96	97.34

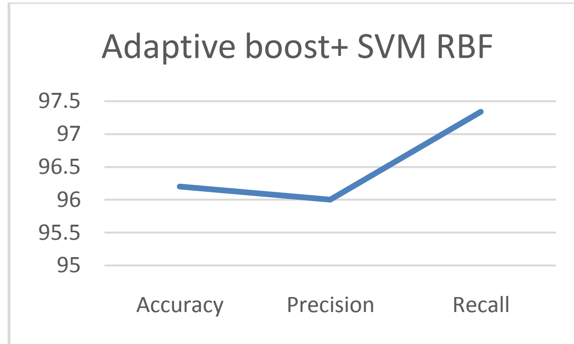

Fig 5: Analysis of result Adaboost with SVM RBF

Table4: Analysis of results of all classifiers

Classifier	Accuracy	Precision	Recall
Adaptive	93	94	95.3
SVM+RBF	94.8	95.2	98
Adaboost with SVM+RBF	96.2	96	97.34

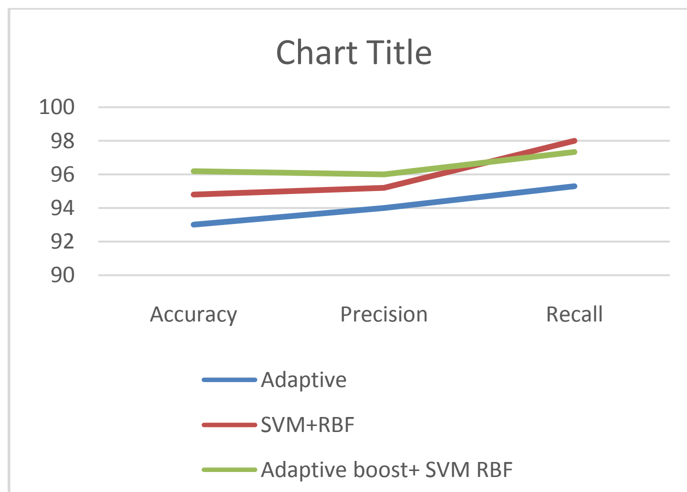

Fig 6: A graph showing analysis of results of all the classifiers

IV. CONCLUSION and FUTURE SCOPE

This paper presented an in-depth experimental study on pedestrian and vehicle image classification. Multiple feature-classifier combinations were examined with respect to their performance and efficiency on a large data set with ground truth. Global features, here represented by PCA coefficients, were found to be inferior to local features. A SVMs out-reformed the other classifiers tested, except for the Adaboost cascade approach, which achieved comparable performance atmuch lower computational costs. The greatest performance gain was, however, achieved by increasing the training sample size. Here, the automatic generation of non-pedestrian examples resulted in a performance gain that, after few iterations ran into saturation.In future, to enhance the work in following areas:

1) *Features Selection:* In this work used only geometrical feature but it's not represent context information of image because context information might be helpful in proper classification of image.
2) *Classifier:* In this work used support vector machine but it not represent relation between features. In future, to use graphical models like Hidden markov model, CRF etc.

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