Performance Evaluation of KNN and SVM Algorithm in Object Recognition Enhancing Intelligent

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Abstract— In this era of science and technology the need of intelligent system to perform human like task is ever increasing. To perform these tasks there are various tools, techniques and methods available. K-nearest neighbor or k-NN algorithm is a method used for classification and regression. In both cases the input is consisted of k closest training examples. Support Vector Machines or SVMs are supervised learning models (learning algorithm) classification and regression analysis. In this paper we use KNN and SVM algorithm to classify data and get prediction for target. Here we use CIFAR-10 dataset to classify and discover data pattern to predict the class of the test images enhancing intelligent of Agent like Robot.

Index Terms—KNN, SVM, Patterns, Analysis, Classification, Recognition, Intelligent.

1 Introduction

Image Recognition is very exciting and one of the prominent fields in interdisciplinary field of engineering and science which is the sub-field of computer vision. The actual task of image recognition is to determine the characteristics or class of the objects present in a given image through automatic or semiautomatic analysis of large quantity of images (image dataset) of similar kinds and predicting the class by nearest similarities of properties in between the image and the image dataset[1][2][18][20]. This prediction is formed by comparing properties of images and similar patterns in between same group of images by using different comparing and learning algorithm used in computer vision[17][11][15]. The generic recognition object categories with invariance to pose, lighting, diverse backgrounds, and the presence of clutter besides there have been attempts to detect and recognize objects in natural scenes using a variety of clues, such as color, texture, the detection of distinctive local features and the use of separately acquired 3D models[3][4][5]. Very few authors have attacked the problem of detecting and recognizing 3D objects in images primarily from the shape information even fewer authors have attacked the problem of recognizing generic categories, such as cars, trucks, airplanes, human figures, or four-legged animals purely from shape information [1]. Hiteshree et.al [8], described Feature Based Object Mining and Tagging Algorithm for Digital Images which is required to improved accuracy and system efficiency. Jim Mutch et.al [5], described the sparse localized features for visual object recognition which is suitable for large scale integration, very complex, less response for faster system; possess larger memory and circuitry making system bulky, costly, and larger error rate.Yi Yang et.al [10], system is suitable for enhancing intelligent in larger system and small system posses large error due to low sampling. Luo Juan and Oubong Gwun [13,] suggested PCA-SIFT plays significant role in extracting the best features for image deformation. LiLi et.al [16], proves that the kNN is easier and simpler to build an automatic classifier.

The motivation of this paper is to present simple neural network models and evaluating the performance. If this models implement in designing intelligent agent like robot or system, the k-NN and SVM provide a system economical, faster response, less memory storage and processing time for its simplified architecture and without having any hidden layer in recognizing pavement system, leaf, damaged vehicles like aircraft, bus. The effect of these techniques was discussed and the corresponding performance of these was compared. Finally visualized the performance evaluation corresponding classified and, also illustrates statistical value of test set performance.

2 Background

Detailed With ever increasing growth of data on the different domains like medical sector, automation, education, industries and others required to extract knowledge from data in such manner to explore much knowledge from that data. For such purpose we are using popular data mining algorithm SVM and KNN. To work with SVM and K-NN we decide to perform complete task under three steps.

A. Experimental data selection:

In this section we choose the data set. The dataset should be big enough to accommodate efficient performance analysis with varying number of test and train data and we also have to choose a dataset with optimum amount of image classes for better evaluation of performance criteria.

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B. Data analysis using the selected data models

In this stage we implement the learning algorithm. Data analysis using different algorithm includes data analysis or model building using both data models.

C. Result analysis

Performance parameter for different model is observed here. Result analysis includes the performance analysis of system on different parameters like accuracy, time taken for prediction based on varying number of dataset image size and test image size.

3 PROPOSED WORK

In this performance analysis we will add these works in our goal:

- Implementation of both Algorithms of SVM and KNN
- Model building
- Evaluation of the model
- Extraxtion of model feature
- Model testing

Our overall system consists of multiple sub systems. The following Fig. 1 given system diagram and their descriptions will discuss such sub systems.

A. Experimental dataset

These data sets contain information of real world, in which we have to find patterns for class recognition of image objects and evaluation of its correctness while predicting. The performance parameters also depend on the quality and quantity of elements present in the experimental data set. We have selected the CIFAR-10 data set for its simplicity and optimum quality for our experiment.

B. Data analysis models

Here we use two popular models of data analysis. These are KNN and SVM. The data model forming process depends upon the data supplied to build model.

C. Model building

It's a tree building process by which data is parsed and using the data system generates tree structure.

D. Parameter evaluation

In this stage we evaluate the effectiveness of the model. we randomly select data for both testing and training. And predicts their experimental outcome from the models and compare them with real values and determine the accuracy of predictions and training time.

E. Prediction

A constructed model can be used for prediction of the image class for test images from the dataset.

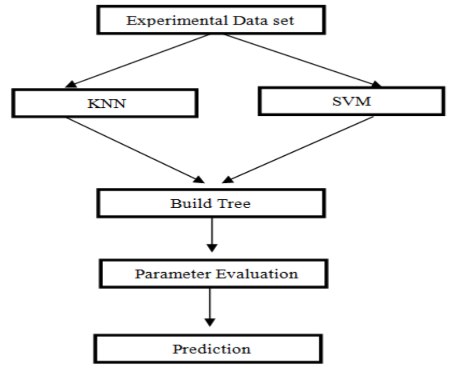

Fig. 1. Architectural Diagram

4 SYSTEM CONFIGURATION AND ALGORITHMS

The complete experiment is done with python programmi8ng language.We use PYCHARM as our interpreter and bench marking tool. We choose CIFAR-10 as our image experimental data set. The whole experiment was done on CPU computation, not on a GPU computation.

A. KNN

K-nearest neighbor algorithm is a well-known machine learning algorithm for pattern recognition or classification. Here classifying object is based on closest training examples in the problem space. KNN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification [2]. KNN is one of the simplest algorithms of all machine learning algorithms. An object is classified by a majority vote of its neighbours, with the object being assigned to the class most common amongst its k nearest neighbours (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of its nearest neighbour.

The k-NN algorithm can also be adapted for use in estimating continuous variables. One such implementation uses an inverse distance weighted average of the k-nearest multivariate neighbours. This algorithm functions as follows [1]:

- Compute Euclidean or Mahalanobis distance from target plot to those that were sampled.
- Order samples taking for account calculated distances.
- Choose heuristically optimal k nearest neighbour based on RMSE done by cross validation technique.
- Calculate an inverse distance weighted average with the k-nearest multivariate neighbours.

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B. SVM

The support vector machine has been chosen because it represents a framework both 0interesting from a machine learning perspective.SVM is a linear or non-linear classifier, which is a mathematical function that can distinguish two different kinds of objects. These objects fall into classes, this is not to be mistaken for an implementation [4]. To work with SVM we use leaner kernel for implementation. In linear algebra and functional analysis, the kernel of a linear operator L is the set of all operands v for which L(v) = 0. That is, if L: V → W, then

$$Ker(L) = \{v € V: L(v)=0\}$$

where 0 denotes the null vector in W. The kernel of L is a linear subspace of the domain V.

The kernel of a linear operator Rm → Rn is the same as the null space of the corresponding n × m matrix. Sometimes the kernel of a linear operator is referred to as the null space ofthe operator, and the dimension of the kernel is referred to as the operator's nullity.

5 Implementation and Results

The previous section describes the used algorithm for implementation. The implementation of both algorithms is performed. And the results are described in this section. Results were taken based on number of test images and with number of images for training or number of images in training dataset. Performance evaluation of both algorithms is obtained using N cross validation process. And performance analysis is conduct under accuracy, model build time.

A. Accuracy

It concludes how close our prediction is? Say In our data set, it contains 10 instances and we found 9 time our prepared model provides correct target values then the accuracy is 90%. Derived using the formula

Accuracy = (correct prediction/ total supplied values) * 100

B. Model building time

It is defined as time taken to build model using supplied data. Or we can simply say training time for the data model.

C. Search time

It is defined as time required predicting values.

D. Units of parameters

For results accuracy is measured in percentages and time is measured in seconds. And the experimental values are represented in both tubular and graphical form for easy understanding.

E. Results

For obtaining result we determine the accuracy and time for both KNN and SVM algorithm with different number of test images and different number of training images from CIFAR-10 dataset. The experimental results and their attributes are given below using tables and in form of graph.

6 Results

A. Accuracy

TABLE 3
BASED ON NUMBER OF TRAINING IMAGES

No. of Test images	No. of Training images	Accuracy (KNN)	Accuracy (SVM)
100	1000	24%	36%
100	2500	28%	39%
100	5000	34%	43%
100	10000	37%	40%
100	25000	35%	40%
100	45000	30%	43%

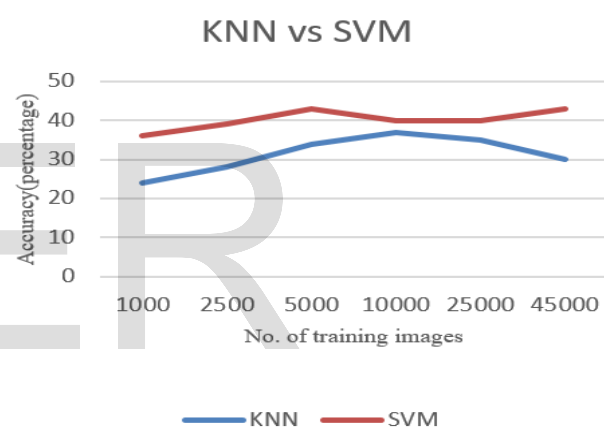

Fig. 2: Graphical representation of table 1 representing the performance evaluation of system accuracy.

From the above data we can see that, with increasing number of training images the accuracy improves for both SVM and KNN up to a certain number of training images. For SVM accuracy drops from 5000 and further increases at 45000. But for KNN the accuracy drops beyond 10000 training images. The accuracy of SVM always stays above of KNN for similar number of training images

TABLE 2
BASED ON NUMBER OF TRAINING IMAGES

No.ofTraining images	No.ofTest images	Accuracy (KNN)	Accuracy (SVM
45000	500	32.4	37
45000	1000	34.6	35
45000	2500	33.32	37.16
45000	5000	33.66	36.66

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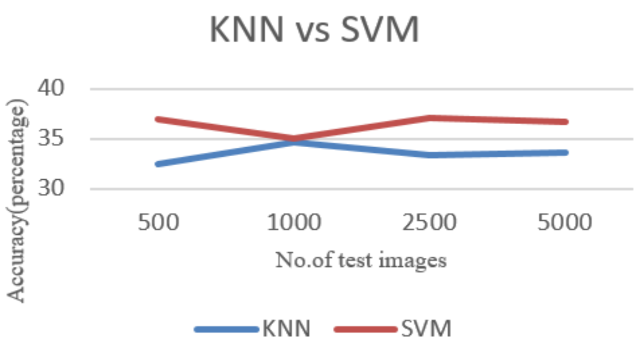

Fig. 3: Graphical representation of table 2 representing the performance evaluation of system accuracy

from the above data it is given the accuracy of SVM always stays above of KNN for similar number of test images.

B. Execution Timing

The timing is determined for both algorithm based on number of test and train images. Here the total time is the summation of model building and predicting time.

TABLE 3
BASED ON NUMBER OF TRAINING IMAGES

No.of Test images	No.of Training images	Time (KNN)	Time (SVM)
100	1000	5.50	150.61
100	2500	13.77	150.81
100	5000	27.15	150.51
100	10000	54.29	151.54
100	25000	134.04	152.83
100	45000	250.45	153.76

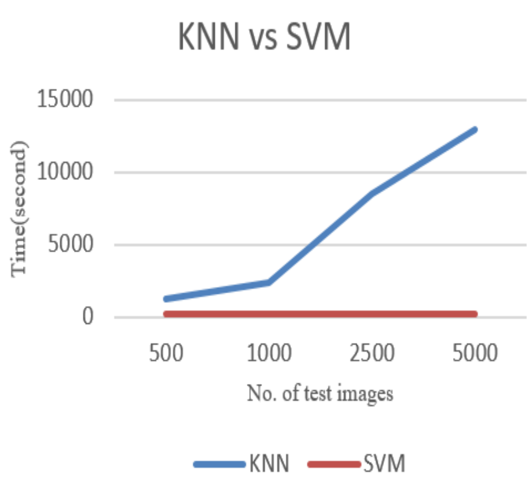

Fig. 4: Graphical representation of table 3 depicting the processing time in seconds.

Algorithm execution time for SVM remains constant with increasing number of training images whereas for KNN algorithm execution time increases with increasing number of training images

TABLE 4
BASED ON NUMBER OF TRAINING IMAGES

No.ofTraining images	No.ofTest images	Time (KNN)	Time (SVM
45000	500	1264.30	158.94
45000	1000	2375.21	158.84
45000	2500	8518.71	159.06
45000	5000	12927.51	159.07

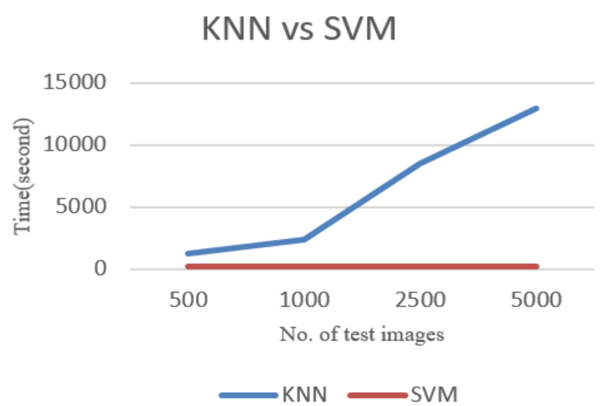

Fig. 5: Graphical representation of table 4 depicting the processing time in seconds.

7 Conclusion and Discussion

AlthoughAfter implementation we found that K-NN is less fast and efficient compared to SVM classifier. K-NN performs poor in execution time as the size of data set increases where as SVM maintains near constant time. So KNN is best fit for small data set. We found that the accuracy of SVM is better than KNN in all cases. So SVM is best fit classifier for our Image recognition in between KNN and SVM. SVM has the potential to be applied in a real time tracking or recognition system as intelligent agent like robot for example recognizing pavement system, leaf, damaged vehicles like aircraft, bus, ATM card number recognition, number plate recognition, phone number recognition etc. which can provide fast response. In future we will use SVM and KNN for text analysis or web contains data analysis to determine their performance in such cases.

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