

Analysis of Classification Techniques based on SVM for Face Recognition

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ABSTRACT

SVM and ISVM are the most prominent technique for excellent learning and classification in the field of machine learning such as face detection and recognition, handwriting automatic identification and automatic text categorization, video tracking, Number plate recognition, Traffic Control etc. Nowadays, Face recognition is a challenging task in the field of computer vision. Motive of face recognition is to compare between the Given face database with the input face image and then declare a decision that identifies to whom the input image class belongs to or doesn't belong to the face database. In this analysis we not only study and also compare the sophisticated classification technique i.e. SVM and ISVM for face recognition along with its pros and cons.

Keywords

Face Recognition, Machine Learning, Computer Vision, Support Vector Machine, Incremental Support Vector Machine, Classification

1. INTRODUCTION

Today, Face recognition is the huge research area of machine learning and computer vision. Automated crowd surveillance, access control, Mugshot identification (e.g., for issuing driver licenses), face reconstruction, design of human computer interface (HCI), multimedia communication (e.g., generation of synthetic faces) are the large number of commercial, security, and forensic applications requiring the use of face recognition technologies. [22]

Face recognition can be done by three basic techniques: structural matching method based on the characteristics, whole matching method and combination method. Geometric characteristics of the face, such as the location, size, relations of eyes, nose, chin and so on, are used to represent the face in structural matching method; whereas in whole matching method, the gray image of whole face acts as input to train and test the classifier, such as the wavelet-based.

Elastic Matching, the principal component analysis and so on; combination method is a combination of the two former methods, usually the overall characteristics are used

for a preliminary identification, and then local Features for further identification [10].

In an incremental world, We have a high resolution camera to capture facial images which have lain in the high dimensional space it causes a serious problem in accurate face recognition. So we mapped these high-dimensional spaces in lower-dimensional space, conventional classification algorithms can then be applied [11].

Basic Concept Of SVM

Support vector machines (SVMs) are the supervised learning and basic algorithm mostly for classification and pattern recognition based on guaranteed risk bounds of statistical learning theory. This support vector machine theory is developed by Vladimir Vapnik & his team in 1995 at AT& Bell Laboratories, and the principle is based on structural risk minimization, so it has very good generalization ability [23]

The basic principle of SVM is construct a hyperplane as the decision plane which is binary class with the largest margin to find the optimal hyperplane making expected errors minimized to the unknown test data, while the location of the separating hyperplane is specified via only data that lie close to the decision boundary between the two classes, which are support vectors. [9]

By using support vector machine classify all window patterns and if the class matches a face then make a square around the face in the output image.

SVM is fast and robust learning machine for binary classification, it has demonstrated good empirical results. It offers to detect faces in various poses and orientations. On the other hand, SVM suffers some demerits i.e. It is usually needed to look for the space and scale and It requires lots of positive and negative examples.

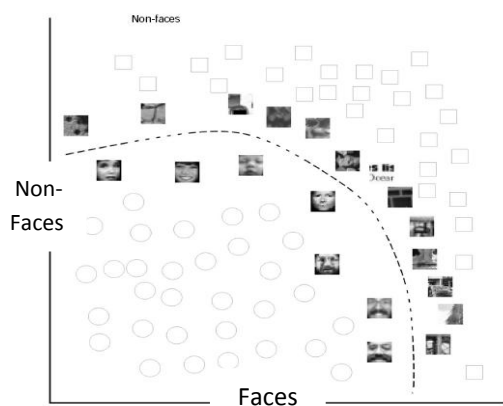


Figure1.1: SVM separate the face and non-face by geometrical interpretation. The patterns are real support vectors obtained after training the system [23]

Basic Concept of ISVM

Incremental learning means On-line learning process which was proposed by [Syed, 1999] to solve the problem of sequentially real time data updating[24]. The algorithm, first, train training data set and obtain classifier and all support vectors; then we obtain new training data set through merging support vectors and new adding data set; finally, we train new training data set [14].

Incremental learning can be implemented by to train the classifier using batches of data subsets, means at a time only one subset of the database will be trained after that result will be combined, we can also say that this technique follows divide and conquer using this method, the learning results is “incremental” combined and deposited. [15]

2. RELATED WORK

There are the some classification techniques for face recognition using SVM as :

1. Face Recognition By SVM's Classification Of 2D And 3D Radial Geodesics :

In this paper, Support Vector Machines (SVMs) are used to perform face recognition using 2D- and 3D radial geodesics. Motive of this technique is to analyze facial expression of 2D and 3D face images using radial geodesic distances (RGDs) computed with respect to a reference point of the face (i.e., the nose tip).

Matching between 2D- and 3D-RGDs results into feature vectors which are classified by a set of Support Vector Machines (SVMs). Since the feature vectors lay in a high-dimensional space, dimensionality reduction methods are applied before SVMs classification[1].

Pros:

1. 2D and 3D images feature extraction directly compare.

2. Three-dimensional (3D) facial data have been exploited as a means to improve the effectiveness of face recognition systems.

Cons:

1. Acquisition of 3D facial data of a person can be accomplished only in controlled environments and requires the person to stay still in front of a 3D scanning device for a time that ranges from some seconds up to a few minutes [1].

2. Facial Expression Classification from Gabor features using SVM :

Author analyzed facial expressions using Gabor features, which aims to reduce the computational complexity. For each fixed scale and orientation, a set of Gabor faces are obtained. The Gabor features extracted from different blocks of Gabor faces are used for further analysis. Support Vector Machine is used to classify different expressions [18].

Features based on Gabor filters have been used in image processing due to their powerful properties. The main characteristics of wavelet are the possibility to provide a multi resolution analysis of the image in the form of coefficient matrices. These are used to extract facial appearance changes as a set of multiscale and multi orientation coefficients. Gabor filter is shown to be robust against noise and changes in illumination. Gabor kernels are characterized as localized, orientation selective, and frequency selective. The Gabor wavelet representation of images allows description of spatial frequency structure in the image while preserving information about spatial relations[18].

Images are divided in to 5 blocks of 28 x 28 sizes. Mean and standard deviation are computed for each sub block. This is considered as feature vectors to an SVM classifier, which is used to discriminate different types of expressions. Initially one expression group is selected. All the images under this group are classified as +1 and others as -1.This iteration process continues until all the expression groups are classified properly[18].

Pros:

1. It reduces the complexity
2. The Gabor wavelet representation of images allows description of spatial frequency structure in the image while preserving information about spatial relations. This method improves both the processing speed and efficiency

Cons:

1. Evaluating filters to convolve the face image is quite time consuming.

3. A Heuristic Algorithm to Incremental SVM Learning:

Most incremental learning algorithm are based on improving SVM algorithm and collecting more useful data as support vectors, while some are based on concept drift. Heuristic algorithm is the first case[19].

Considering there are series of hyperplanes ψ_i closing up to the optimal hyperplane gradually. During this gradual change, the difference between any two partitions of data set

is slowing down gradually, ideally even to zero when assuming the optimal hyperplane can, separate the data completely and correctly [19]. The main idea of this consideration is that data points in difference are much closer to the optimal hyperplane, and a series of hyperplanes are gradually closer to the optimal one with the data points in partition difference set getting less and less, until less than a given ϵ .

Pros:

1. Based on improving SVM algorithm and collecting more useful data as support vectors.

Cons :

1. The difference between any two partitions of data set is slowing down gradually.

4. A Divisional Incremental Training Algorithm of SVM :

In this paper a divisional incremental SVM training algorithm was proposed to improve the classification. In this method actions are taken not only to support vectors but also these data between the merges of the two classes in each step of batch incremental learning model. We can easily summarize this method as: Firstly, classify the current/new new data set with fixed hyperplane to collect the data that are between the merges of the two classes. Then divide current training dataset into two or there smaller subsets and combine them with new coming dataset to collect support vectors respectively. After that combine the data collected in former steps to construct new hyperplane, until the classification precision is satisfying [2].

Pros:

1. Incremental or online data set handle more easily in other words we can say dataset classification is done accurately.

Cons :

1. It is known that the key to construct an optimal hyperplane is the support vectors and in batch incremental learning framework, a support vectors would not contribute its effect to the optimal hyperplane after several steps learning.

5. A Training Algorithm of Incremental Support Vector Machine with Recombining Method :

Proposed incremental SVM learning algorithm with batch model divides the training datasets in batches (subsets) that may fit into memory suitably. For each new batch of data, a SVM is trained on the new data and the support vectors from the previous learning step. It is proved that separating hyperplane is subject to support vectors of training dataset, so batch model learning may not collect all support vectors which are needed for incremental learning algorithm because the distribution state of batches of training datasets are usually unknown[20].

According to the distribution characteristic of support vectors, it is known that the data located between the marges of the two classes are not classifiable correctly and easily.

Therefore, less of these data exist, higher of the classification accuracy may be obtained. Meanwhile, the impact of the distribution differences between new coming data and the history training data can not be ignored in various practical applications. Taking the above into consideration, the implementation process of batch learning model should be improved. Since the support vectors are key factors to construct a hyperplane, the improvement to be done is collect more potential data as support vectors. To be more specific, in every step of batch learning model, some actions are taken not only to support vectors but also the data between the marges of the two classes. That is, the training dataset and the new coming dataset are divided into smaller-sized groups and then recombined in a crossed way to obtain several independent sets of support vectors. At last, combine these independent sets of support vectors and train the final hyperplane as the output of each step in batch learning model[20].

Pros: 1. Divides the training datasets in subsets that may fit into memory suitably.

Cons : 1. The distribution state of batches of training datasets are usually unknown.

6. Investigation of Feature Dimension Reduction based DCT/SVM for Face Recognition:

In this technique author was removed Some redundant information by truncating the DCT coefficients so that the dimensionality of the coefficient vectors can be reduced. After that detected face image is divided into blocks of 8 x 8 pixels size then On each block DCT is performed and 64 DCT coefficients covering all the spatial frequency components of the block are extracted. The obtained DCT coefficients are ordered using the zigzag scanning where the coefficients placed next to each other tend to be of similar magnitude, thus making the row of coefficients more suitable for generalization[21].

Later recognition is performed by using SVM classifier. The 'one-against-one' strategy is used to train the SVM classifiers. Selected feature vectors are then fed into multi-class SVM to classify the input data as a face ID or not[21].

When the powerful features of the SVM, such as margin maximization and kernel substitution for classifying data in a high dimensional kernel space, are combined with the low dimensional DCT feature vector as described, a good compromise between the computational efficiency and performance accuracy is obtained.

Pros:

1. Simplify the computational complexity by truncating the DCT coefficients.

Cons:

1. Statistical information and feature information are essential for human face recognition

7. Face Recognition Based on 2DLDA and Support Vector Machine :

In this paper author give a comparison of LDA ND 2DLDA methods. In LDA, a vector representation is used,

while in 2DLDA, a matrix representation is used, and in face recognition, the performance of 2DLDA is higher than that of LDA. this is a hybrid technique, in this, using wavelet transform firstly original face images are decomposed into high-frequency and low-frequency components. The high-frequency components are ignored, while the low-frequency components can be obtained. Then, the liner discriminant features are extracted by 2DLDA, and SVM is selected to perform face recognition. The idea of SVM is that through a nonlinear mapping the samples are converted into a higher dimensional space, and then the optimal separating hyperplane is solved[3].

Pros:

1.The SVM searches the optimal separating hyperplane which separates the largest possible fraction of samples of the same class on the same side.

Cons :

1.Maximizes the distance from either class to the hyperplane.

8. Fast SVM Incremental Learning Based on Clustering Algorithm :

An incremental SVM learning algorithm is proposed If memory size is less to fit the data, incompleteness of data set or in real time data set online learning is used. To solve these two problems, the This technique presents a new incremental learning algorithm combined SVM with clustering algorithm[5].

In this algorithm, firstly clustering algorithm is applied and found the cluster after that new training data set using centers of clusters is constructed. Then new training data set is trained with FSVM and support vectors are obtained. There are two strategies to deal with new adding data set as:

- (i) one is to add new adding samples into the support vector set that is get in the first step using clustering algorithm;
- (ii) only to add samples that contrary to KKT condition using UC algorithm and thrown away the samples that are satisfied with KKT condition.

In this technique, samples point near classification hyperplane in detailed are analyzed.[5]

Pros:

1.It not only decreases the training time and predicting time but also improves the classification accuracy rate[5].

Cons :

1.This technique sometimes proves to be time consuming when samples point near classification hyperplane are analyzed in detail.

9. Combination Of Dual-Tree Complex Wavelet And SVM For Face Recognition:

In this paper author was used DTCWT to extract the human face features by 2-D dual-tree complex wavelet transform. In this technique firstly each face image decompose into six band-pass sub-images that are strongly

oriented at 6 different angles and two low-pass sub-images. By this means, we connect the 8 sub-images to a feature vector. Then, we use a principal component analysis technique to reduce the extracted feature dimensions. Finally, support vector machine is used as the classifier to complete face recognition. 2-D DTCWT has the approximate shift-invariant property and good directional selectivity. It can obtain the optimal orientation in the space and frequency field. So, in this paper, the facial features are extracted The realization method is described as following: [17]

Pros:

1. This approach achieves a higher recognition rate.

Cons :

1. it depends on the frequency characteristics of the image to select the suitable frequency band.
2. It is also unpractical to realize the expansion of complete gabor wavelet transform because it need a great number of filter.

3. CONCLUSION

SVM is the most important machine learning technique for the pattern recognition, in this area research is going on to improve of Qos (quality of service).In this paper we have presented a survey of face recognition based on SVM. It also describes how SVM technique is helpful for recognition of faces and how to improve recognition rate using SVM. The performance, concepts along with pros and cons of SVM techniques for face recognition are summarized in this paper. Performance analysis of various SVM techniques is discussed in the table below.

S.No.	Techniques	Database	Recognition Rate
1.	RGD + SVM	Image	86.9%
2.	Gabor + SVM	Image	90%
3.	Heuristic algo. + ISVM	Text	95.0%
4.	Divisional algo.+ ISVM	Text	95.46%
5.	ISVM + Recombining	Text	96.18%
6.	DCT/SVM	Image	96.25%
7.	2DLDA + SVM	Image	96.67%
8.	Clustering algo. + ISVM	Benchmark	96.92%
9.	DTCW + SVM	Image	99.5%

4. REFERENCES

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