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Discriminant face features extraction , analysis & its application in multipose face recognization: a survey

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***Abstract* – As one of the excellent learning and classification performance, SVM and ISVM has become a research topic in the field of machine learning and has been applied in many areas, such as face detection and recognition, handwriting automatic identification and automatic text categorization. Face recognition is a challenging computer vision problem. Given a face database, goal of face recognition is to compare the input image class with all the classes and then declare a decision that identifies to whom the input image class belongs to or if it doesn't belong to the database at all. In this survey, we study face recognition as a pattern classification problem.In this paper, we study the concept of SVM and sophisticated classification techniques for face recognition using the SVM and ISVM along with the advantages and disadvantages. This paper not only provides an up-to-date critical survey of machine learning techniques but also performance analysis of various SVM and ISVM techniques for face recognition are compared.**

Keywords – Face Recognition, Machine Learning, Support Vector Machine, Classification,Genetic algorithm

INTRODUCTION

Face recognition is a major issue in the field of pattern recognition, its research contributes to not only the realization of intelligent machines, but also the promotion of the human visual system itself. For a long time, face recognition has gotten earnest concern from the researchers in pattern recognition, artificial intelligence, computer vision, physiology, and other fields, a variety of identification algorithms have been proposed, many commercial face recognition systems have been applied in real world widely[10].There are three main methods of face recognition: 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; 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 is used for a preliminary identification, and then local Features for further identification[10]. However, a major challenge of face recognition is that the captured face image often lies in a high-dimensional feature space. These high-dimensional spaces are too large to allow effective and efficiency face recognition. Due to the consideration of the curse of dimensionality, it is often essential to conduct dimensionality reduction to acquire an efficient and discriminative representation before formally conducting classification. Once the high-dimensional face image is mapped into lower-dimensional space, conventional classification algorithms can then be applied [11].

1 BASIC CONCEPT OF SVM

Support vector machines (SVMs) are a general algorithm based on guaranteed risk bounds of statistical learning theory. A support vector machine (SVM) is a type of state-of-the-art Patten recognition technique whose foundations stem from statistical learning theory. We have found numerous applications, such as in face recognition, character recognition, face detection and so on [6]. In a support vector machine, the direct decision function that maximizes the generalization ability is determined for a two-class problem. Assuming that the training data of different classes do not overlap, the decision function is determined so that the distance from the training data is maximized. We call this the optimal decision function. Because it is difficult to determine a nonlinear decision function, the original input space is mapped into a high dimensional space called feature space. And in the feature space, the optimal decision function, namely, the optimal hyperplane is determined [9]. The basic principle of SVM is to find an optimal separating hyperplane so as to separate two classed of patterns with maximal margin. It tries 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.A common problem that can be observed in many AI engineering applications is pattern recognition. The problem is as follows – given a "training set" of vectors, each belonging to some known category, the machine must learn, based on the information implicitly contained in this set, how to classify vectors of unknown type into one of the specified categories. Support vector machines (SVMs) provide one means of tackling this problem[7].

1.2 Basic Concept of ISVM

Incremental learning is proposed by [Syed, 1999] to solve two typemachine learning problems: one is that computer's memory is not enough or training time too long when training data set is too large; another is we can obtain the maturity data set at beginning and have to use online learning, that may improve learning precision in the using process with increasing of samples. The key of incremental learning is which learning information should be retrained in the previous training and how to deal with newly adding data set. Syed proposed the incremental SVM learning algorithm at first. 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]. An approach to support incremental learning is to train the classifier using batches of data subsets, that is to say, only one subset of the data is to be trained at any one time and results subsequently combined. This method is called batch model learning or batch learning, using this method, the learning results are "incremental" combined and deposited. The batch learning methods utilize the property of SVM that only a small fraction of training data end up as support vectors, the SVM is able to summarize the data space in a very concise manner, and assume that the batches of data will be appropriate samples of the data.Clearly, the problem is the learning results are subject to numbers of batches and state of data distribution but always the distribution of data is unknown. In the beginning of the learning process, training dataset is not fully available as in batch learning, data can arrive at any time, so incremental learning algorithms differs from batch ones greatly.

It is proved that the location of the optimal hyperplane is only related with linear combination of support vectors[15].

2 CLASSIFICATION TECHNIQUES

2.1 Face Recognition By SVM's Classification Of 2D And 3D Radial Geodesics

Support Vector Machines (SVMs) are used to perform face recognition using 2D- and 3D-RGDs. Due to the high dimensionality of face representations based on RGDs, embedding into lower-dimensional spaces is applied before SVMs classification[1].Radial geodesicis defined as the particular geodesic that connects one point of themodel to the nose tip along the radial direction connecting the twosurface points.In this technique, an original framework is used to represent 2D and 3D facial data using radial geodesic distances (RGDs) computed with respect to a reference point of the face (i.e., the nose tip). The objective is to define a face representation that can be extracted from 2D face images as well as from 3D face models and used to directly compare them. In 3D, the RGD of a point on the face surface is computed as the length of the geodesic path that connects the point to the nose tip along a radial direction.[1] In 2D, the RGD from a pixel to the fiducial point is computed based on the differences of the image gray level intensities along a radial path on the image.2D radial geodesic distances (2D-RGDs) are computed according to the intensity variations and proximity of image pixels. 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].

Advantage: The objective is to define a face representation that can be extracted from 2D face images as well as from 3D face models and used to directly compare them [1]. Three-dimensional (3D) facial data has been exploited as a means to improve the effectiveness of face recognition systems.

Disadvantage: However, a common drawback of solutions that perform recognition by matching 3D facial data is that, despite recent advances in 3D acquisition technologies and devices, 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].

2.2 Facial Expression Classification from Gabor features using SVM :

In this technique facial expressions are analyzed using Gabor features. To reduce the computational complexity, Gabor features are selected in a different manner. 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].

***Advantage**:* The main characteristics of wavelet are the possibility to provide a multi resolution analysis of the image in the form of coefficient matrices [18]. These are used to extract facial appearance changes as a set of multi scale and multi orientation coefficients. 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[18].

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

3 ISVM FOR FACE RECOGNITION

When the dataset is too large to be fit in the memory at once or to be read into the memory, SVM suffers problem to train the dataset. In such a case online learning should be used if the data set is not at all obtainable in the beginning. So incremental learning is proposed to solve such machine learning problems like large memory requirement and large training time when the dataset is very large. At first the algorithm trains the current dataset and construct the initiatory optimal hyperplane i.e. read the entire support vector[22]. Then the algorithm checks the current dataset for the positive and negative group. If the current dataset lies in the positive group then the input feature vectors are matched with the output, if correct matching is found then success n return otherwise increment the value of lagrangian parameter up to 10% and continue this process until correct classification is achieved. If the current dataset lies in the negative group then again the input feature vectors are matched with the output, if correct matching is found then success n return otherwise the value of lagrangian parameter is decremented up to 10% and continue this process until correct classification is achieved[22].

***Advantage**:* Recognition rate achieved 100%.

Disadvantage : Matching time is little bit larger than SVM.

CONCLUSION

We have present a survey of face recognition based on SVM. This extensive survey has addressed how SVM can be applied for recognition of faces and how the performance of recognition system can be improved using SVM. The performance, concepts along with advantage and disadvantage of SVM techniques for face recognition are summarized in this paper.

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