Iris Authentication using SIFT with SVM

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ABSTRACT

In this paper, the proposed system is Iris authentication using SIFT with SVM. This method provides best, accurate matching between two set of Iris. Iris authentication is one of the developing research fields in the biometrics. The features of the Iris image is extracted using SIFT algorithm. The features are perfectly extracted from eye image using this algorithm. Then the extracted features are given to the SVM classifier. The support vector machine is used as a classifier, it accurately matches the two set of iris features quickly.

Keywords

SIFT, Iris authentication, Support Vector Machine (SVM).

1. INTRODUCTION

In human identification, the emerging recent research is mainly on the biometric applications. The biometric applications are mainly used for security purposes. The biometric applications make use of many features of human they include palm print, voice, face, and finger print, knuckle print, Iris. All these features are unique for every individual human. The biometrics is mainly used to avoid the fraudulent like faking ID. Government also funding for security and safety platforms based on biometrics to replace the traditional methods like pin and password. The national ID cards supplied by the government, mainly focuses on the biometrics so that they can perfectly identify the individuals and no other persons can able to fake them or use them. Some of the biometrics applications can be faked by the attacker. But among all the biometrics applications, Iris have more advantages they cannot be faked by others, because they are unique for every person, they are protected by cornea the iris also varies based on the age of every person.

Iris recognition initiated by Flom and safir [1]. Later Daugman developed the Iris recognition using Gabor 1-D wavelets [2].Wildes et al. Used the four level Laplacian pyramid to extract the features of iris, used normal correlation for classification[3].Boles and Boashash [4] used zero crossings for classification. Ma et al. [5] used the bank of spatial filters. Sun et al. [6] developed the Gaussian filters to estimate the local direction. Sanchez [7] used multiple zero crossings based signatures of Iris. Geodesic active contour (GAG) is used to segment Iris from the surroundings [12].

Miyazawa et al. [8] developed the phase components of the iris image using 2-D discrete Fourier transform. Brigle [9] reduces the time of execution by preventing the time consuming normalisation. Zhu et al. [10] adapted the Scale Invariant Feature Transform (SIFT) for the feature extraction, but the classifier used is to match the features are not so perfect , so the support vector machine (SVM) [13] is used as classifier to produce the accurate classification.

The rest of the paper is arranged as follows, Section II describes about the proposed work. Section III describes about the feature extraction. Section IV describes the classifier used in the proposed system. Section V describes the simulation results.

2. PROPOSED WORK

In the proposed method, there are two phases, used to authenticate the genuine user used.

2.1 Phase-I Enrolment phase:

In this phase shown in Fig (1). The iris images are used for this paper from the CASIA database [14]. The features of Iris are extracted using the Scale Invariant Feature Transform (SIFT). The extracted features are classified using the support vector machine (SVM).The classified results are stored in the data base.

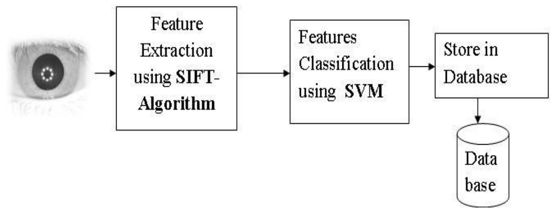

Fig. 1 Proposed Block Diagram for Enrolment Phase

2.2 Phase-II Verification phase:

The verification phase is shown in Fig (2). The first two process of feature extraction and classification is same for both enrolment and verification process. The features are extracted and classified from query input image using SIFT and SVM.

The matching process is to be performed using classified query image with the data stored image.

If the matching process is successful, the person is an authenticated one, else the person is not a valid one.

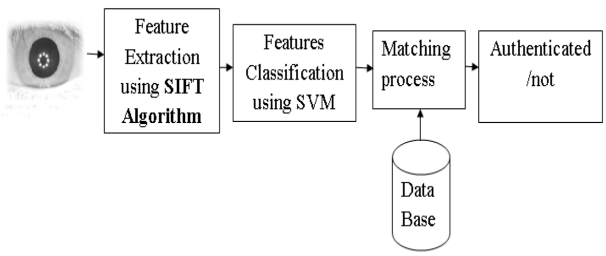

Fig. 2 Proposed Block Diagram for Verification Phase

3. FEATURE EXTRACTION USING SIFT

The feature extraction of iris is done by using SIFT algorithm. The process of feature extraction includes two steps i.e. Histogram equalization and SIFT key point extraction. Each valid key point is been characterized by two parameters: x-coordinate and y-coordinate.

The first process of feature extraction is histogram equalization, which is used to enhance the input image of iris in order to acquire the spatial characters correctly. Histogram equalization is used to enhance the visualization effect by increasing the pixel size.

The next step of feature extraction to extract the key points from iris using the (SIFT) shown in Fig(3). The SIFT algorithm is mainly used for image matching purpose. Scale invariant feature transform is used for detection and extracting local features of an image.

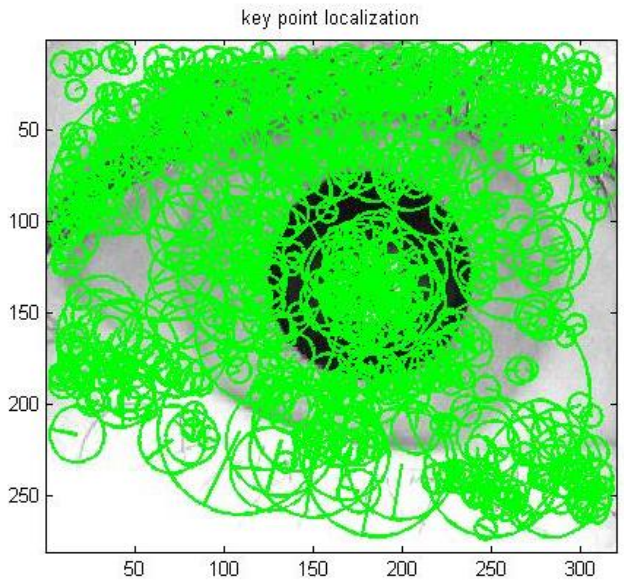

Fig. 3 Key Point Localization of Iris

The first step of SIFT process is to find the difference of Gaussian function convoluted with the iris image to detect the key point locations which is invariant to scale change. The difference of Gaussian is calculated by equation (1) and (2).

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y) \quad \text{---} \quad (1)$$

$$D(x, y, \sigma) = G(x, y, k\sigma) * I(x, y) - G(x, y, \sigma) * I(x, y)$$

$$D(x, y, \sigma) = L(x, y, k\sigma) - L(x, y, \sigma) \quad \text{---} \quad (2)$$

In the above equation I(x, y), G(x, y, σ), L(x, y, σ), and D(x, y, σ) are represents the image, Gaussian function, scale-space of image and Difference of Gaussian function respectively.

The Gaussian function is calculated by using equation (3).

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e^{-(x^2+y^2)/2\sigma^2} \quad \text{---} \quad (3)$$

The second step is to detect the local maxima and minima of D(x, y, σ) by comparing the each pixel value of iris image with the neighbour pixel values.

The neighbouring pixel value is selected, if the pixel value is higher or lower related with the neighbour pixels.

These localized key points are selected. These selected values are named as key points. To eliminate the low contrast points along the edge of the image, Taylor's expansion method is used. After applying the Taylor expansion, stable key points are selected and located by eliminating the low intensity pixel key points. The localized key points are shown in Fig (4).

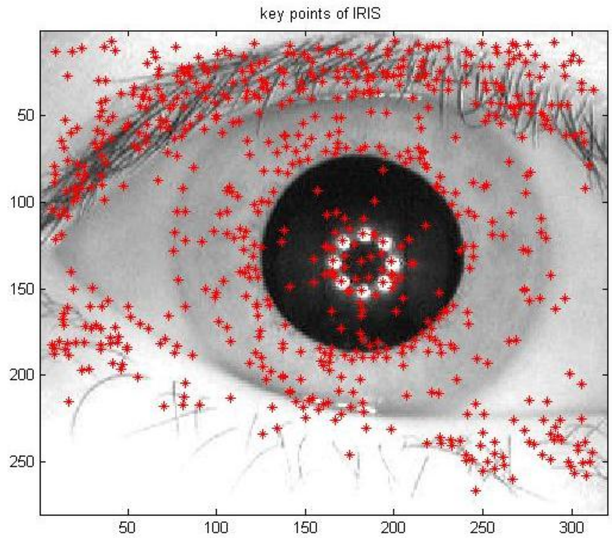

Fig. 4 Key Points of Iris

The orientations of key points are assigned for the selected key points. The key points taken from the iris is shown in Fig (4).The key points selected are scale invariant points. The selected key point's co-ordinates are plotted in a graph which is shown in Fig (5). The features are extracted using the SIFT algorithm. Then the features are classified using the Support Vector Machine (SVM) is discussed in next section.

4. FEATURE CLASSIFIER USING SVM

SVM is a good technique for data classification. The classification work usually involves separating data into training and testing sets. Each time the training set contains one "target value" (the class labels) and several "attributes" (the features or observed variables). The SVM produce a model (based on the training data) which predicts the target values of the test data given only the test data attributes.

SVM finds a linear separating hyper plane with the maximal margin in this higher dimensional space. In machine learning, (SVMs), also support vector networks are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. The basic SVM takes a set of input data and predicts, for each given input, which of two possible classes forms the output, making it a non-probabilistic binary linear classifier.

Let a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other.

An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on.

The problem of separating the set of training vectors belonging to two separate classes,

E={(a1, b1), . . ,(al, bl)},a€ R n,b€ {− 1, 1 } --- (4)

With a hyper plane,

< v, a>+ x = 0. --- (5)

The set of vectors is said to be optimally separated by the hyper plane if separated without error and the distance between the closest vector and the hyper plane is maximum.

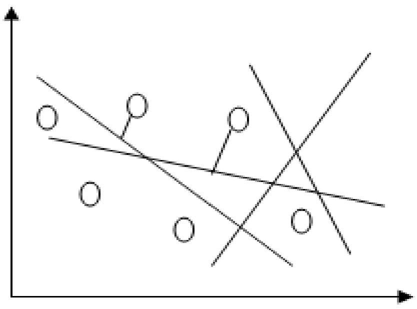

Fig. 5 vector's hyper plane

The canonical hyper plane is obtained as shown in Fig(5). The features which are obtained from the SIFT algorithm are classified by using this support vector machine (SVM).This algorithm perfectly classifies the features and give the output.

5. EXPERIMENTAL RESULTS

The iris image is obtained from the CASIA database it is the database for iris. The image is given to the SIFT algorithm. The SIFT algorithm first localize the key points as shown in Fig (3). Then from that point, the key points are extracted. The figure is shown in Fig (4).

The selected key points, coordinates are plotted in the graph as shown in Fig(6)

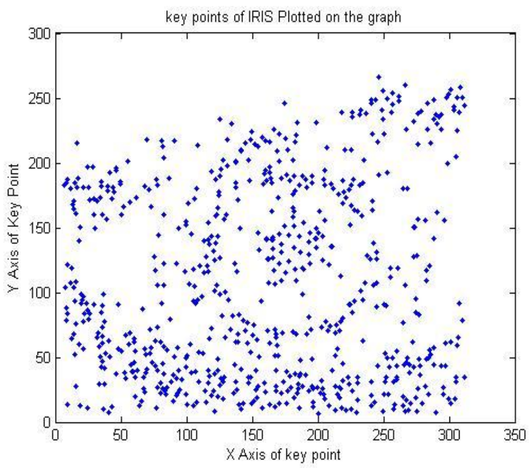

Fig. 6 Key Points Plotted graph

The key points are extracted from the iris image then it is given to the Support Vector Machine classifier. The classifier classifies the key points and produces the data and they are stored in the data base.

In the verification phase the same process is repeated and the classification results are verified with the data base where the data are already stored based on the result the person can be identified as whether he is authenticated person or not.

The experimental results shows that the obtained result is most fast and accurate compared to other techniques which are used already.

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