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Iris recognition using SVM and BP algorithms

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ABSTRACT

Iris recognition means to recognize an iris image by using computational algorithms. Identifying people in Iris recognition technology show the highest accuracy. In this paper, the Principal Component Analysis (PCA) is used as a reduction algorithm which gives the reduced iris feature set that is recognized using Support Vector Machine (SVM) and Back-propagation(BP) algorithms. The accuracy of using PCA with SVM is increased from (62%- 90%), while using PCA with BP is decreased from (40%-3.4 %)for the variable number of persons (10-70).

Key Words: Neural Network, *Principal Component Analysis , Support Vector Machine , Back-propagation.*

1. INTRODUCTION

In the 1st decades, the IRS has become a very important research topic since the conception of an IRS was initially proposed by the researchers Flom and Safir in 1987 [1]. From the most reliable noninvasive techniques of human verification and identification, IRS is the most reliable one, iris structure is fixed over the person's lifetime. Below some advantages of the iris identification technique [2]:

1-Human iris are internal organ of the eye, therefore it is highly protected.
2- Iris can be recognized obviously from a surrounding area.
3-Iris patterns have a great degree of irregularity.
4- It has a restricted hereditary penetrance .
5- Iris remain unchanged through lifetime and not effected by surgical operations.

A major approach for iris recognition today is to generate feature vectors
Corresponding to individual iris images and to perform iris recognition based on
Some recognition algorithms. For a large number of people, their iris features will be huge and the need for reduction algorithms will be a necessity so that they can reduce not only the cost of recognition by reducing the number of features, but also provides a better classification accuracy due to finite dataset size effects [2].

2. FEATUR EXTRACTION AND DIMENSIONALITY REDUCTION

Feature extraction and dimensionality reduction is defined as follows: given a set of candidate features, select subset or a feature that performs the best under some classification algorithms. This process can reduce not only the cost of recognition by reducing the number of features, but also provide a better classification accuracy due to finite dataset size effects [3].

2.1. Principal Component Analysis (Pca)

The PCA is a famous feature extraction method in the multivariate analysis. It is an orthogonal conversion of the coordinate in which the data is defined. A small number of principle components are commonly adequate to estimate for the most of structure in the data[4].

3. PATTERN RECOGNITION

Rapid advances in computing technology not only enable us to process huge amounts of data, but also facilitate the use of elaborate and diverse methods for data analysis and classification. At the same time, demands on automatic pattern recognition systems are rising enormously due to the availability of large databases and stringent performance requirements (faster recognition speed and higher accuracy at a lower cost). In many emerging applications, it is clear that no single approach for classification is "optimal" and multiple methods and approaches have to be used. Consequently, combining several sensing modalities and classifiers is now a common practice in pattern recognition. [5].
Some recognition algorithms are illustrated in the following sections:

3.1. Support Vector Machine Algorithm (Svm)

Support Vector Machine (SVM) is a supervised machine learning algorithm which can be implemented for both approaches (regression or classification) problems. However, it is commonly used in classification problems. In this algorithm, each data item is schemed as a point in n-dimensional space (where n is number of features) with the value of each attributes that being the value of a specific coordinate. Then, complete Classification by finding the hyper-plane (decision line) that differentiates the two classes which are accurate [6].

3.2. Back Propagation Neural Network (Bpnn) Algorithm

The mathematical model of the biological neural network is defined as Artificial Neural Network. One of the Neural Network models which are used almost in all the fields is Back Propagation Neural Network [7].

The name "back propagation" comes from the fact that ANN is presented by an input pattern, for which an output pattern is calculated. Then, the error between the desired and actual output can be estimated, and passed rearward through ANN. Depending on these errors, weight editions are estimated, and errors are delivered to a previous layer, continuing until the first layer is reached. The error is thus propagated back through ANN[8].

4. THE PROPOSED IRS:

An IRS model has been proposed which consist of four basic stages :Preprocessing, Feature extraction , Feature reduction and Iris recognition. The first stage is used to enhance the iris images and determining the region of interest (ROI) of the iris. The second stage includes feature extraction based on 41 equation and instruction. The third stage is responsible for feature reduction using PCA algorithm and the final stage will be used to recognize the persons from the previous stage information. All these stages are illustrated in figure (1).

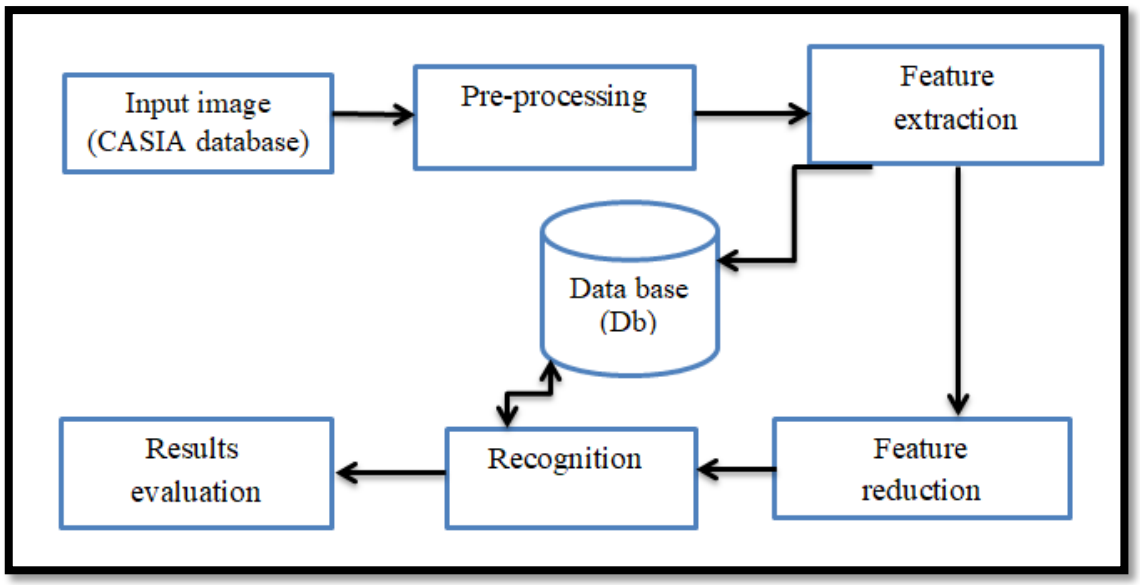

Figure. 1: The proposed IRS System

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4.1. Input image:
A specific class of iris images dataset is provided from CASIA-Iris-Interval dataset version 4.0. is used. This set contains 2639 images with different left and right samples for each person ,figure (2) shows images samples from CASIA-V4.0.

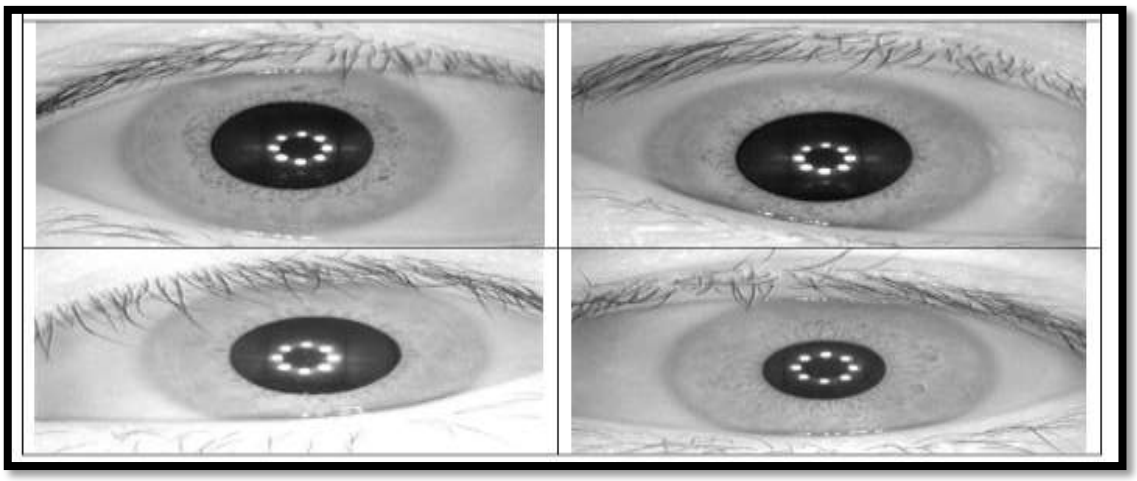

Figure. 2: Image samples from CASIA-V4.0

4.2. Pre-processing: At this stage converting to black and white, removing noise and determining the ROI were implemented to the CASIA iris image sample to determine the required reigon .
4.3. Feature extraction: Features will be extracted according to 41 equations and Matlab instructions . Therefore every preprocessed image will have 41 features.
4.4. Feature Reduction: Reducing the dimensionality of the extracted features to be given as an input to the next stage by using the Principal Component Analysis (PCA). It is an orthogonal conversion of the coordinate in which the data is defined. A small number of principle components are commonly adequate to estimate for the most of structure in the data.
4.5. Recognition: Support Vector Machine (SVM) and Back propagation (BP) algorithms are used to recognize different persons according to their iris images set features.
4.6. Results evaluation: Evolution for the results of the recognition stage is done using different criteria.

5.RESULTS

CASIA images must be preprocessed before extracting the essential features. Converting to black and white, removing noise and determining the ROI. Each CASIA image is transformed to 41 features using Matlab equations and instructions. Table (1) shows the extracted 41 features for 3-persons with one sample each as an example.

Table .1:The extracted 41features for 3 persons iris images

Feature number	Person1	Person2	Person3
1	0.008064	0.008064	0.008064
2	6.50E-05	6.50E-05	6.50E-05
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	244	255	255
9	7.18403	7.609894	7.219982
10	16209054	14086636	15482900
11	2423.648	3638.154	2310.123
12	180.9046	157.2169	172.8002
13	14.58838	46.44745	27.99117
14	7.36E+08	5.56E+08	6.71E+08

15	0.69633	0.616537	0.677648
16	30042.94	20488.21	25699.16
17	49.23056	60.31711	48.06374
18	908.25	9011.375	3930
19	52	211	83
20	57	113	85
21	0.912281	1.867257	0.976471
22	0.167744	-2.48665	0.046505
23	2964	23843	7055
24	983	9063	3915
25	88617	80537	85685
26	0.008362	0.074013	0.020584
27	1.096154	1.867257	1.024096
28	3.015259	2.630807	1.802043
29	0.00037	7.80E-05	0.000145
30	26	105.5	41.5
31	28.5	56.5	42.5
32	218	648	336
33	77.15569	239.3533	118.8024
34	1.154701	1.154701	1.154701
35	1.154701	1.154701	1.154701
36	0	0	0
37	1	1	1
38	1	1	1
39	180.9046	157.2169	172.8002
40	205.8	188.1714	197.1393
41	160.7429	117.325	140.1821

The previous extracted features are normalized to values between (0) and (1) to be more convenient to the next stages.
PCA algorithm has been proposed as a method to reduce the data dimension without much loss of information. The normalized 41 features are presented to PCA to remove the redundant features and get a smaller feature group for each person as shown in table (2).

Table .2: The reduced feature set using PCA

Feature Number	Original Feature	Feature Number	Reduced Feature
1	0	8	1
2	0	9	0.465
3	0	10	0.675
4	0	11	0.272
5	0	12	0.675
6	0	13	0.607
7	0	14	0.65
8	1	15	0.675
9	0.465	16	0.283
10	0.675	17	0.294
11	0.272	18	0
12	0.675	19	1
13	0.607	20	0.604
14	0.65	21	1
15	0.675	22	0

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16	0.283	23	1
17	0.294	24	0
18	0	25	1
19	1	26	1
20	0.604	27	1
21	1	28	1
22	0	29	0.151
23	1	30	1
24	0	31	0.604
25	1	32	1
26	1	33	1
27	1	39	0.675
28	1	40	0.459
29	0.151	41	0.82
30	1		
31	0.604		
32	1		
33	1		
34	0		
35	0		
36	0		
37	0		
38	0		
39	0.675		
40	0.459		
41	0.82		

Every iris image is converted to iris code or pattern to be recognized using two classification algorithms BP and SVM as illustrated in the next sections:

5.1.USING PCA WITH SVM

A data set for 70 persons with (29) PCA features each, were tested and recognized by SVM algorithm to evaluate the performance of PCA as shown in table (3) and figure(3). It can be noticed from the table that the accuracy value is increased with the increasing number of persons and it reaches 90% for 70 persons.

Table .3:The accuracy for different number of persons with 29 features using PCA and SVM algorithms

Person	Accuracy%
10	62
20	71
30	74
40	77
50	83
60	85
70	90

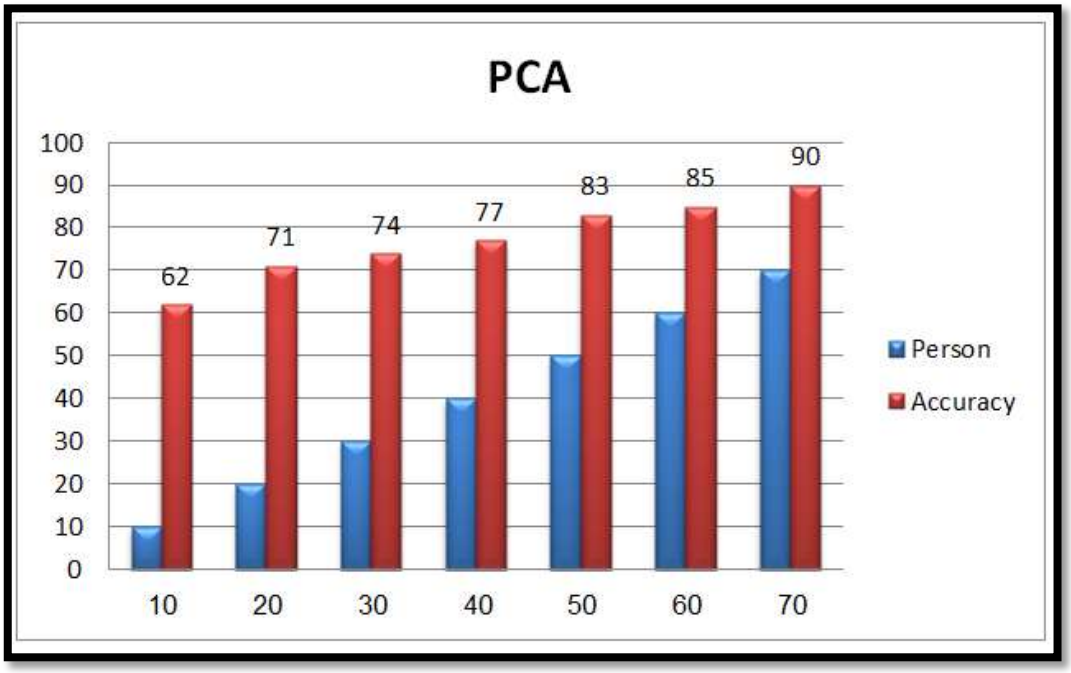

Figure .3: Accuracy of using SVM with PCA

5.2. Back-Propagation Algorithm (Bp)

The reduced PCA set of features (29) for three persons is presented to BP algorithm as shown in table (4).

Table .4: Input to BP neural network.

Number	Person1	Person2	Person3
8	1	1	1
9	0.465	0.223	0
10	0.675	1	0.549
11	0.272	0.677	0
12	0.675	1	0.549
13	0.607	0.02	0
14	0.65	1	0.521
15	0.675	1	0.549
16	0.283	1	0.536
17	0.294	0.699	0
18	0	0.102	0.111
19	1	0	0.022
20	0.604	0	0.063
21	1	0.015	0
22	0	0.989	1
23	1	0	0.032
24	0	0.088	0.098
25	1	0.912	0.902
26	1	0	0.032
27	1	0.159	0.182
28	1	0.042	0.056
29	0.151	1	0.914
30	1	0	0.022
31	0.604	0	0.063
32	1	0	0.042
33	1	0	0.041
39	0.675	1	0.549
40	0.459	1	0.507
41	0.82	1	0.572

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therefore the number of input layer nodes is 3, the number of hidden layer is 10 by trial and error and the number of output layer nodes is equal to number of persons to be recognized (3).The BP network is shown in figure(4).

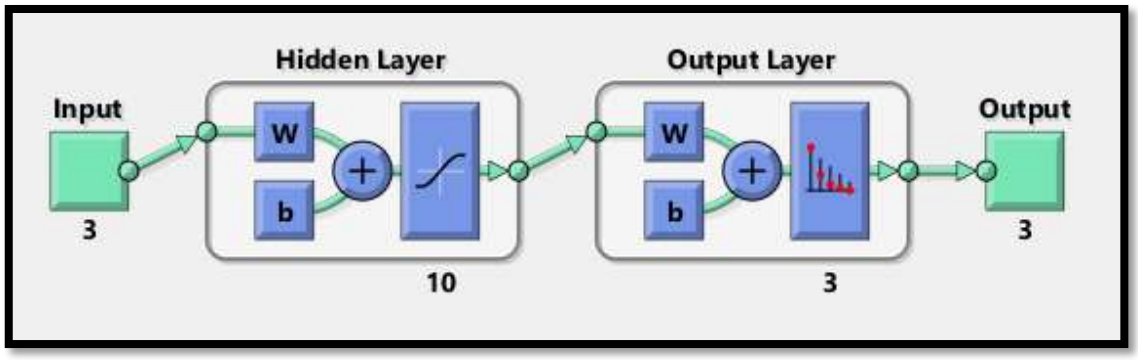

Figure.4:Proposed BPNN with PCA

Figure (5) shows the BP performance curves with respect to number of epochs to three persons with 29 features.

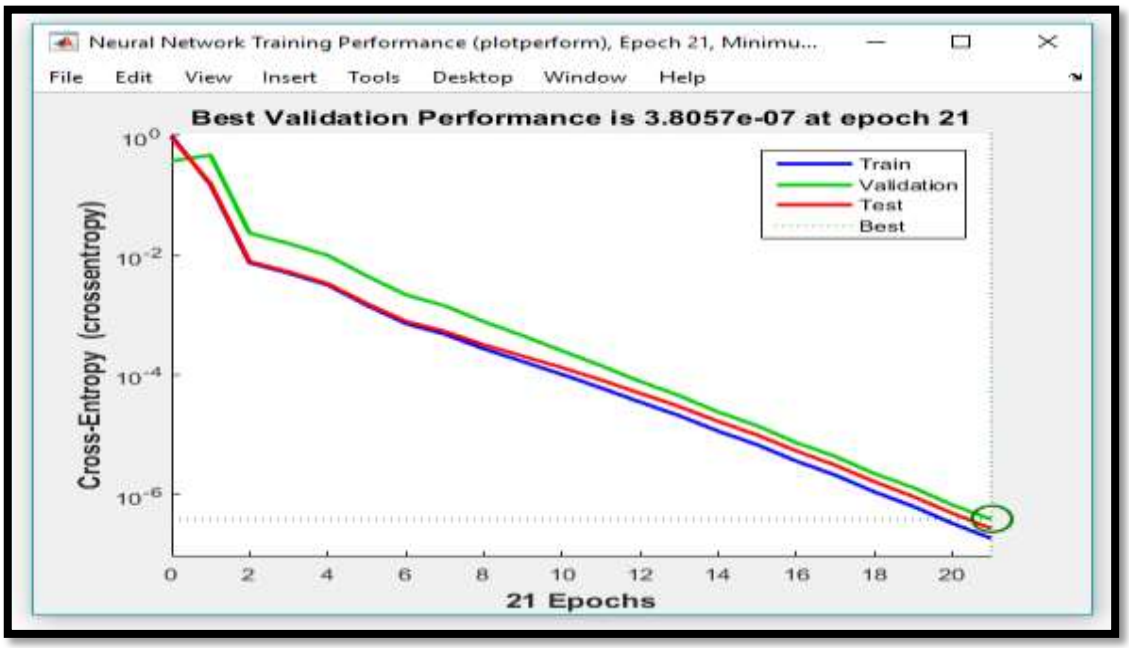

Figure .5: BP validation performance when PCA feature set =29

According to the above figure the BP algorithm reaches the required solution after 21 epochs with validation performance =3.8057 e-07. A data set for 70 persons with (29) PCA features each, were tested and recognized by BP algorithm to evaluate the performance of PCA as shown in table (5) and figure(6). It can be noticed from the table that the accuracy value is decreased with the increasing number of persons and it reaches 3.4% for 70 persons.

Table .5:The accuracy for different number of persons with 29 features using PCA and Bp algorithms

Person	Accuracy%
10	40
20	30
30	8.3
40	6.0
50	5.7
60	5.3
70	3.4

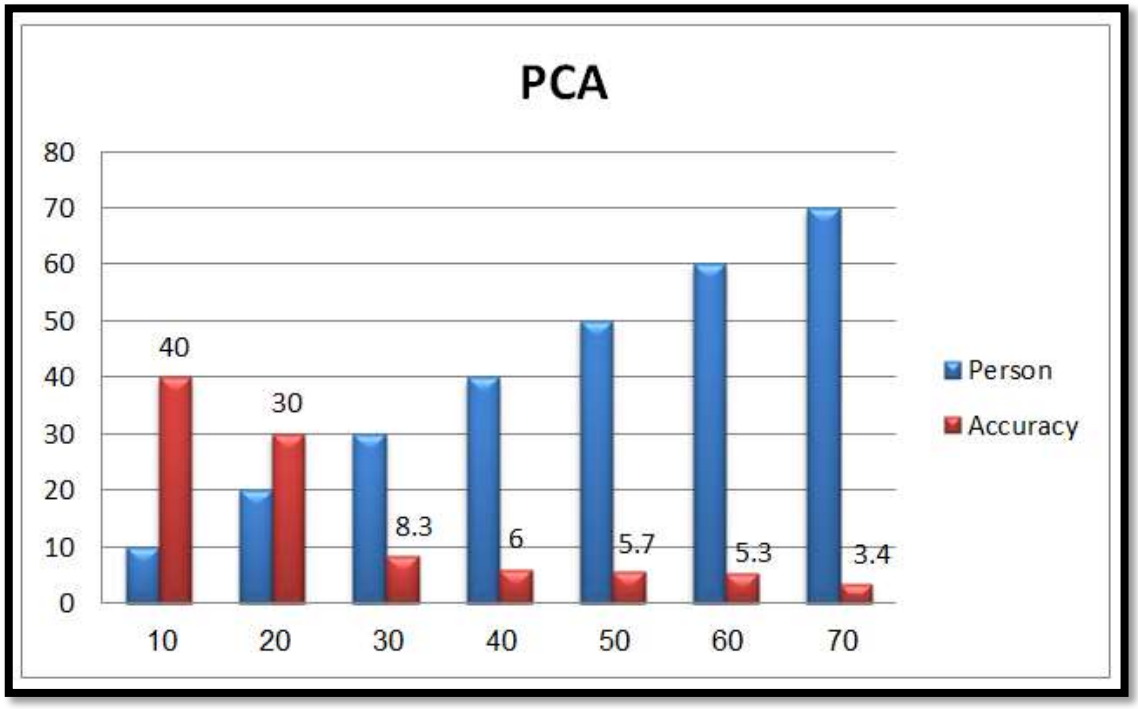

Figure .6: Accuracy of using BP with PCA

6.CONCLUSIONS

According to table(3) the accuracy of SVM algorithm is increased from 62% to 90% to variable number of persons (10-70), while the accuracy of BP algorithm is decreased from 40% to 3.4% for the same group of perons according to table(5). This means that SVM algorithm recognition is much better than BP algorithm for the proposed IRS especially with a large number of persons.

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