VOL. 13, NO. 22, NOVEMBER 2018 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

FACE RECOGNITION SYSTEM BASED-ON IMPERIALIST COMPETITIVE ALGORITHM AND NEURAL NETWORK (ICANN)

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ABSTRACT

This paper presents smart security system based-on Imperialist Competitive Algorithm Neural Network (ICANN). The proposed system consists from high-resolution camera, motion sensors, and control system. The Camera installed up side of security main gate, park's entry, and office's gate connected with motion sensors. The comparison process start in case person detected by motion sensor. The comparison process between saved image of authorized person with image of suspected person take it by (USB full HD camera), if there is a matching between them, the decision of control system will open the gate if there is no matching the gate stay in closed case. In addition to that, all gates controlled by central control office to send alarm in suspected cases. Principal Component Analysis (PCA) used for features extraction and ICANN for image detection and all software recognition process is based-on (Math Lab). The results obtained from the simulation system shows faster more accurate than other traditional methods. Moreover, the results show efficient and reliable security system with accuracy around 96%. Practical system shows excellent agreement with that obtained by simulation results.

Keyword: smart security system, face recognition system, ICA algorithm, neural network, PCA.

1. INTRODUCTION

Video surveillance has acquired wide attention and interest due to the growing concerns about security. Facial recognition in critical surveillance environments to identify potential terrorists and criminals on the watch list. While the performance of face recognition systems has improved substantially [1]. Making the problem difficult to recognize because of the rotation of the head and the large disparity tends levels, and the intensity and angle of illumination, facial expressions, aging, etc. It allows other attempts so in facial recognition with machine small or no inconsistency in these quantities. In any case, the way of correlation (or pattern match) equipped with the optical data, which users often for some of the researchers, is sure to fail in cases where a large fluctuation. In particular, the presence of very low correlation between the two images of the same person sessions from a different president. In particular, a very low correlation between the two images of the same person in different revolving President [2]. Some famous approach used in facial recognition (PCA, LDA, LPP, LLE, etc.) [3, 4]. The other techniques used to distinguish faces is to use deep learning algorithm or deep learning neural network [5, 6]. However, any intelligent security system, two elements that guarantee maximum security is a video monitoring and the recognition of access to grant system.

In this paper, smart security system based on face recognition are designed and implemented. This system combines excellent features extraction in image detection with high accuracy in face recognition using ICA and PCA algorithms respectively. The system show reliable with efficient detection in real time with high speed and high accuracy system using ICA algorithm compared with Back Propagation (BP) neural network. However, it can be use in wide range of practical applications which depend on face recognition concept.

2. CONCEPTOF IMPERALIST COMPOTITIVE ALGORITHM

The ICA mimics the procedure of rivalry between realms in human culture. It begins with a haphazardly produced introductory populace of size N, which called nations, much the same as the chromosomes in the hereditary calculation. The expense of every nation is compute by the condition particular for the issue to be upgrade. At that point, nations are separation into radicals and states. Radicals are the best nations in the populace, and provinces are the others exited. At that point the provinces arbitrarily conveyed to the radicals. The quantity of states that a settler gets is relative to its energy. Here the force of every settler is figured and standardized relied on upon its expense. The settler with greater force worth is better. One radical and its states comprise of a realm together, accordingly a few domains are introduce. After, inside every domain gather, the settlements moved to the position of the settler as indicated by a specific guideline. This procedure called "digestion" reenacts the osmosis procedure the settler actualizes on its provinces in a reasonable society. In the meantime, a few provinces are haphazardly chosen out and supplanted with new arbitrarily created nations. This procedure called "upheaval", simply like the transformation in the hereditary calculation, recreates the sudden change in the socio-political qualities of a settlement in a sensible society. During the time spent digestion and insurgency, if a settlement turns out to be superior to the settler does, the province and the radical will trade their parts.

The aggressive conduct between the realms is the center of the ICA. In this stage, all domains attempt to involve provinces from others [7]. The ingestion strategy appeared in Figure-1, makes the primary center of this calculation and causes the nations move towards to their base optima. The settlers assimilate these provinces towards themselves as for their energy. The aggregate

force of every radical is dictated by the force of its both parts, the realm power in addition to percent of its normal states power [8].

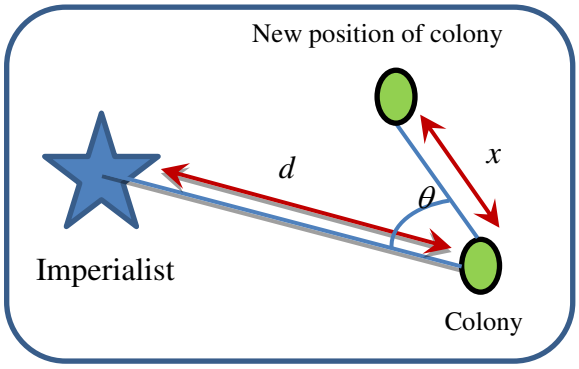

Figure-1. Moving colonies toward their imperialist.

Derive an expression of imperialist competitive algorithm (ICA) equation as follows [9], [10]:

The array of random points on the cost function defined as follows:

Country=[d_1,d_2,d_3,…,d_n]. (1)

The cost of a country found by evaluation of the cost function:

Cost=f(Country). (2)

To start the optimization algorithm, initial countries of size NCountry are produced. The selection of this number is based on trial and error and the amount of this number depends on the number of dimensions of optimization problem. We select Nimp of the most intense nations to shape the domains. The remaining Ncol of the underlying nations will be the states each of which has a place with a domain. To frame the underlying domains, the underlying number of settlements of a realm ought to be straightforwardly proportionate to its standardized force. The normalized cost of an imperialist defined by:

$$C_{j=}c_j - max\{c_i\}. \quad (3)$$

Where, c_j is the cost of the jth imperialist and C_j is its normalized cost. The normalized power of each imperialist is [11]:

$$p_j = \left|\frac{c_j}{\sum_{i=1}^{N_{imp}} c_i}\right|. \quad (4)$$

Then, the initial number of colonies of the jth Empire will be:

$$N.C_{.j} = round\{p_j \,.\, N_{col}\}. \quad (5)$$

To divide the colonies, $N.C._j$ of the colonies are randomly chosen and given to the *jth* imperialist.

In the settler aggressive calculation, the digestion strategy is demonstrated by moving every one of the states toward the colonialist. This development is appeared in Figure-1 in which a state moves toward the colonialist by x units. The new position of the state is appeared in darker shading. The bearing of the development is the vector from the province to the colonialist. In this figure, x is an arbitrary variable with uniform conveyance. Then:

$$x \sim (O, \beta \times d). \quad (6)$$

Where, β is a number greater than one and d is the distance between the colony and the imperialist state. $\beta > 1$ causes the colonies to get closer to the imperialist state from both sides [9]. On the off chance that there is a state in a realm which has lower fetched than that of the radical, trade the positions of that settlement and the settler, and afterward process the aggregate expense of all domains.

The aggregate force of a realm relies on upon both the force of the radical nation and the force of its provinces. This can be displayed by characterizing the aggregate force of a realm as the force of colonialist nation in addition to a rate of mean force of its states. Along these lines, the aggregate expense of a domain is controlled by [12], [13], [14]:

$$T.C_{.j} = f(imprialist_j) + \xi \frac{\sum_{i=1}^{N.C.n} f(colonies\ of\ empire_i)}{N.C._j}. \quad (7)$$

Where ξ is a positive small number. Next, pick the weakest state (provinces) from the weakest domains and give it (them) to the realm that has the most probability to have it (imperialistic rivalry). To begin the opposition, the standardized aggregate expense of a realm is gotten:

$$N.T.C_{.j} = T.C_{.j} - \max_i \{T.C_{.i}\}. \quad (8)$$

Where: $T.C._j$ = total cost, the possession probability of each empire is given by:

$$p_{pj} = \left|\frac{N.T.C._j}{\sum_{i=1}^{N_{imp}} N.T.C._i}\right|. \quad (9)$$

To divide the mentioned colonies among empires, vector P is formed as follows:

$$P = [pp1, pp2, \ldots, ppn]. \quad (10)$$

Then, the vector R with the same size as P whose elements are uniformly distributed random numbers is created. Next, vector D is formed by subtracting R from P.

$$D = P - R. \quad (11)$$

Referring to vector D, the mentioned colony is handed to an empire whose relevant index in D is maximized. Finally, eliminate the powerless empires and

if there is only one empire left, stop, if not go to assimilation [6].

The algorithm progresses to reach an optimum solution for the studied problem. Figure-2 shows the flowchart of the proposed method for estimation and detection of the image using imperialist competitive algorithm.

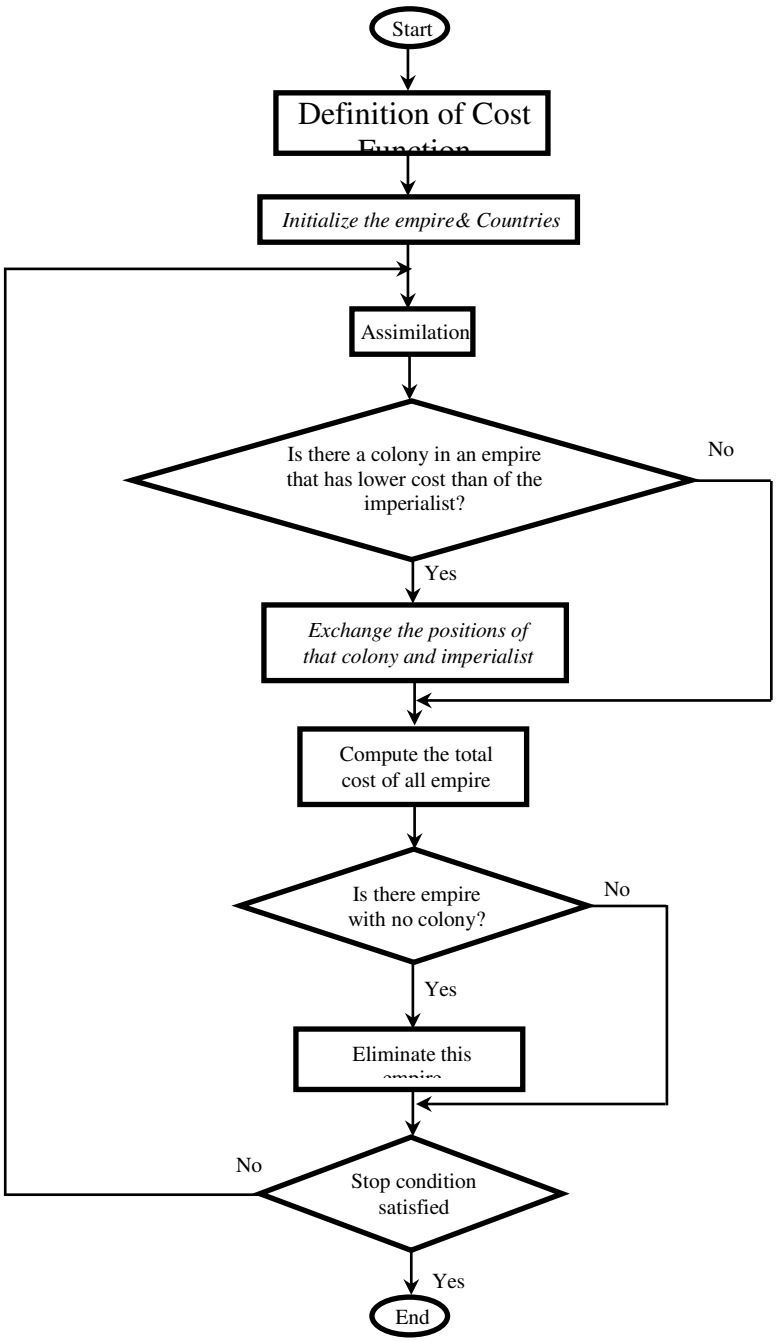

Figure-2. Flowchart of the proposed method using ICANN algorithm.

3. THE PRPOSED ARCHITECTUREOF ICANN

ICA is one of the most recent methods that can be fitted into ANN. A domain is comprised of nations, where every molecule has a position and a speed. The possibility of ICA in ANN is to get the best arrangement of weight (or nation cost) where a few nations (issue arrangement) attempt to move to get the best arrangement.

In ICANN, the expense of every nation in realm speaks to an arrangement of weights for the present age or cycle. The dimensionality of every nation is the quantity of weights connected with the system. The molecule moves inside the weight space endeavoring to minimize learning blunder (or Mean Squared Error-MSE or Sum of Squared Error-SSE). Changing the cost implies redesigning the weights of the system to diminish the blunder of the present age.

4. METHODOLOGYOF ICANN AND BPNN

In order to implement ICA in neural network and comparing the performance with BPNN, the following steps have been followed:

a) Determine training pattern from datasets.

b) Define neural network architecture.

c) Determine network parameters.

d) Run ICANN.

e) Run BPNN.

f) Comparison and analysis of the results.

5. TRANING ANN USING BP& ICA FORFACE IMAGES

Three-layers ANN are utilized to do the acknowledgment on this work for all datasets. The aggregate number of neurons for each shrouded layer is distinctive relying upon the grouping issue. Number of info layer and yield layer typically originate from number of trait and class quality. Notwithstanding, there is no fitting standard principle or hypothesis to decide the ideal number of shrouded hubs.

In this work, experimentation has been utilized to decide number of shrouded neurons. The actuation capacity used to figure yield for every neuron is tensing enactment (exchange capacity condition) aside from information neuron.

6. DESIGN OF PRACTICAL FACE RECOGNITION SYSTEM

The block diagram of the proposed security system is shown in Figure-3. There are hardware and software tools are used in the proposed security system. Hardware tools include, Full-HD USB Camera, PC (personal computer), motion detector (door image contact sensor), gate with electronics lock, alarm (Buzzer). Software tools include, (Math lab version14), Artificial Neural Network (ANN), Principal component analysis algorithm (PCA), Kalman filter module, and Imperialist competitive algorithm (ICA).

PC controls the hardware tools, where the motion detector installed in the upside of the entrance gate that send signal to PC in detected person case. These signals send into Camera by PC for taking image for that person. Software tools process this image. The first step is the face tracking. In the face tracking module Kalman filter are used to represent the appearances of the tracked head. The model is applied to the head appearance to keep head tracking and to predict the head position. The next step in processing is features extraction of the face using PCA. Finally, the recognition process is achieved using artificial neural network and imperialist completive algorithm (ANNICA). The results of recognition back to PC for comparison with data base saved in PC, if there is matching of the detection image, the decision is open the gate, in case of mismatch, the entrance gate still lock and the alarm (buzzer) is operate.

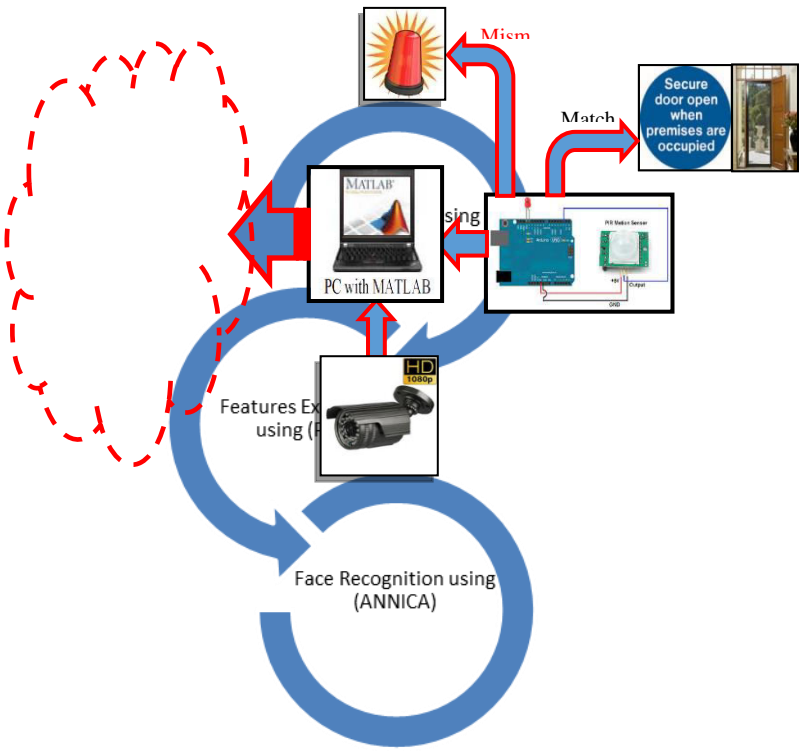

Figure-3. Block diagram of face recognition system.

7. RESULTS AND DISCUSSIONS

In our proposed, the MATLAB package used to solve equations (1 to 10). And for training the neural network. The face images (fingerprint) of selected persons are classified based on ICA algorithm. The face images of three different persons are shown in Figure-4.

Figure-4. Samples of images captured by full-HD camera

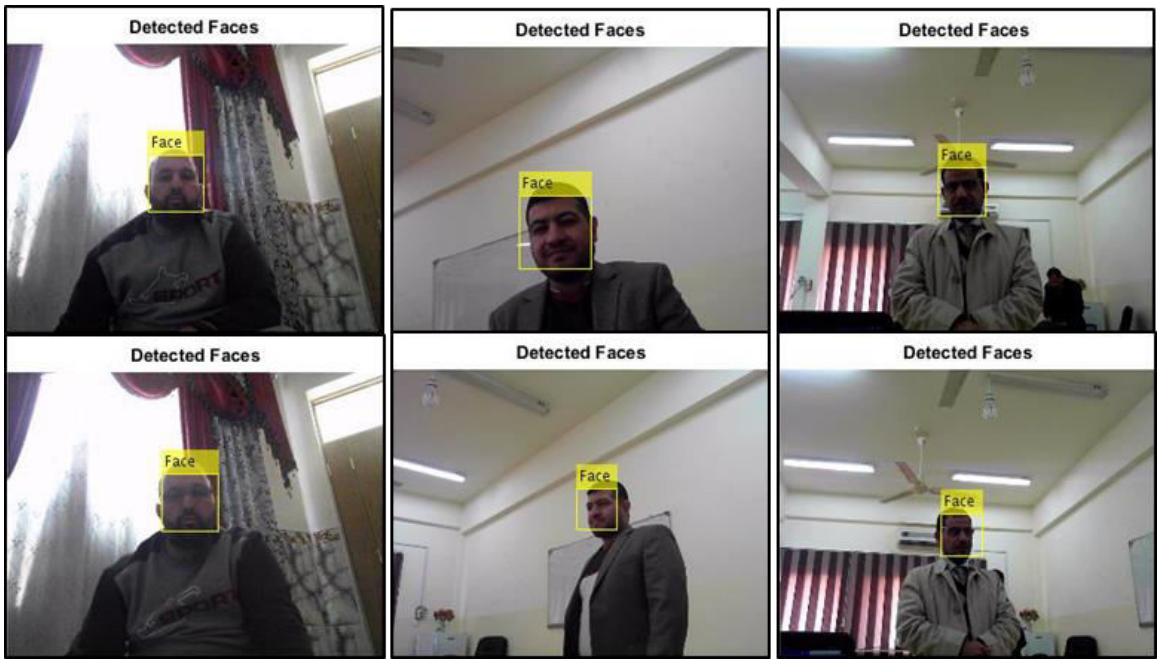

Figure-5. Samples of faces detected using Kalman filter.

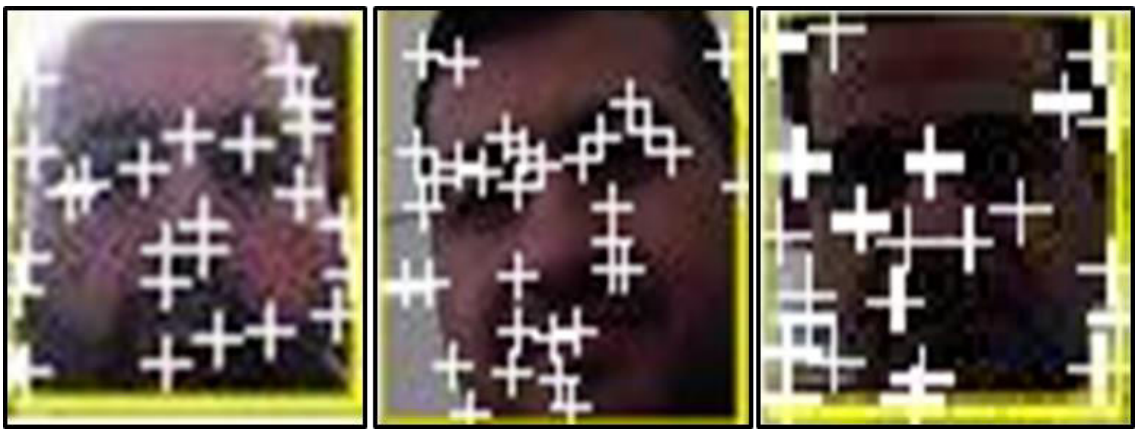

Figure-6. Samples of faces recognized using ANNICA.

Figure-5 shows the Face detected of the images using Kalman filter for stating the process on these images using Principals Component Analysis (PCA) for features extraction and face recognition using Artificial Neural Network (ANNICA) as shown in figure 6.

8. SIMULATION RESULTS OF TRANING ANN WITH ICA AND BP

Before training process, the parameters of training algorithm (ICA) are initial number of countries is set to 300 that 20 of them are chosen as initial imperialists to form initial clusters with 20 decades. In addition, β and α are set to 1.5 and 0.5 (rad) empirically. The initial weights are randomly generated between [-20, 20] and biases between [-15, 15]. The problem dimension (total number of weights and biases) represents the size of search space in X-Y dimensions, which is calculated from the relation below:

Dimension = (InputNN×Hidden) + (Hidden×OutputNN) + Hiddenbias + Output bias.

The parameters of Back-propagation algorithm are set to the momentum coefficient α=0.9 and the learning rate η =0.54.

The initial weights and biases are randomly generated between [-0.45, 0.45]. In the training process, three cases are discussed in this work as shown below. During training,

The ANNs were presented with output data. As shown in Figure-7, there are only five output variables in the training image data set.

Figure-8 represent the Mean Square Error (MSE) of ANN-ICA, while Figure-9 show the MSE of ANN-BP from the Figures, it can be seen that the ICA method is the most effective method.

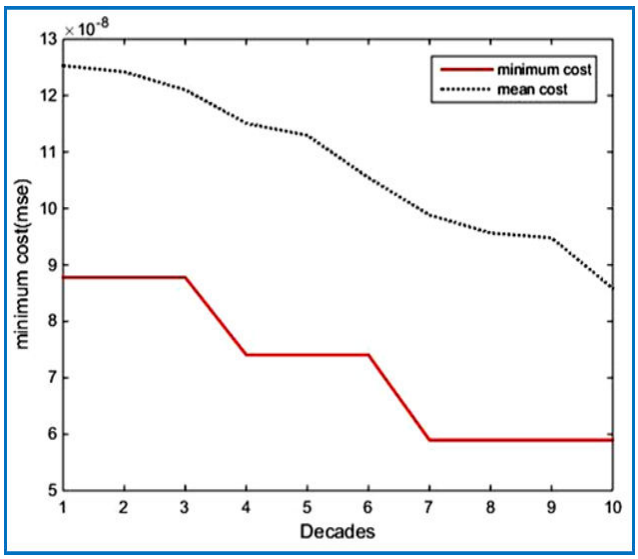

Figure-7. The performance of ANNICA training.

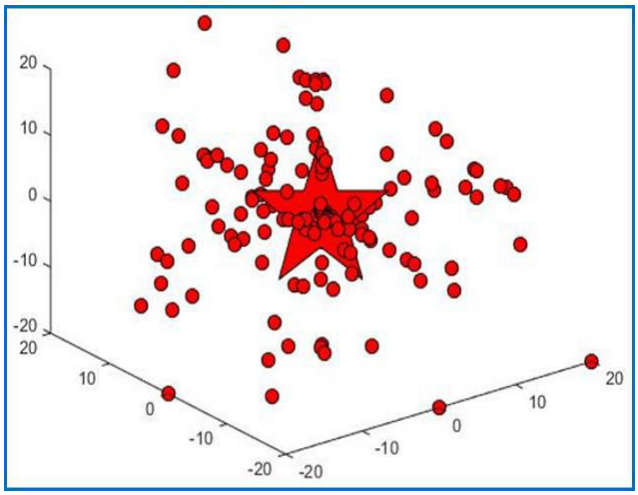

Figure-8. The accuracy of the performance.

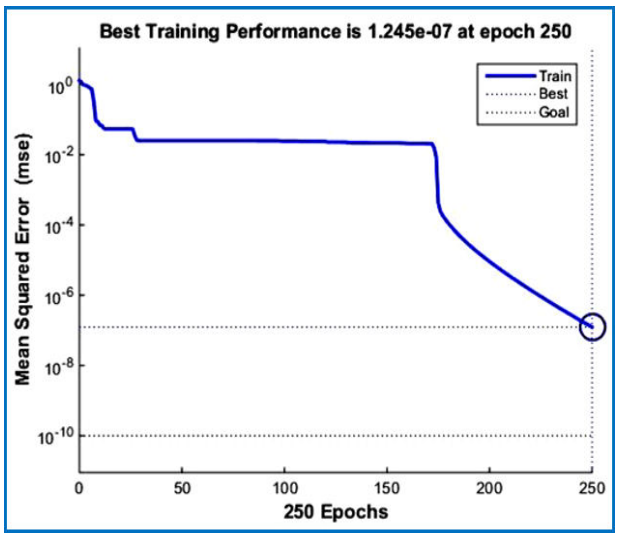

Figure-9. The performance of ANNBP.

Table-1 shows the performance parameters of the designed system using ICA algorithm compared with BP algorithm.

Table-1. The performance of the designed system.

Specification	**ICA**	**Back propagation** (BP)
Number of Iteration	20/1000 iterations	250
Population Size	30	-
MSE	5.8955x10-8	1.245×10-7
No. of Neuron	80	80
Time (Sec)	106	360
Accuracy (%)	99.2%	97.8%

9. CONCLUSIONS

Biometric advancements developed as the most encouraging choice to see people as of late since, rather than individuals establishing and permits them access to regular regions, and the default in view of passwords, shrewd cards, codes, keys et cetera, these strategies look at individual physiological and/or behavioral attributes to choose and/or his personality. Passwords and numbers are hard to recollect, and can be stolen or speculated. Cards, images, keys, and so forth can be lost, overlooked or rehash, and that the attractive cards can get to be adulterated and ambiguous. Be that as it may, the characteristics of the individual assorted qualities can't be lost, overlooked, stolen or biometrics strategies incorporate the distinguishing proof taking into account physiological attributes, (for example, face, fingerprints and finger geometry, hand geometry, and retina of the eye, ear and sound) get the keys.

The proposed framework taking into account face acknowledgment strategy is use ICA calculation to allow approved persons for intersection the doors and keep the suspected individuals confirmed high effective and exact framework. Simulation results showed an efficient, reliable and accurate security system especially in case of PCA algorithm design. The viable results demonstrate the 96% exactness rate.

REFERENCES

[1] Hyun-Cheol Choi, Unsang Park, and Anil K. Jain. 2010. PTZ Camera Assisted Face Acquisition, Tracking & Recognition. Theory, Applications and Systems (BTAS10), Washington DC. pp. 1-6.

[2] S. Thorat, S. K. Nayak, and Jyoti P Dandale. 2010. Facial Recognition Technology: An analysis with scope in India. (IJCSIS) International Journal of Computer Science and Information Security. 8(1): 325-330.

[3] Kresimir Delac and Mislav Grgic. 2007. Face Recognition. Published by the I-Tech Education and Publishing, Vienna, Austria.

[4] Pramod Kumar, Monika Agarwal and Stuti Nagar. 2013. Survey on Face Recognition System-A Challenge. International Journal of Advanced Research in Computer and Communication Engineering. 2(5): 2167-2171.

[5] Xavier SERRA and Javier Castan. 2017. Face recognition using Deep Learning. A Master Thesis Submitted to Poly Techic, University of Catalonia.

[6] Alessandro Luca Vilardi, Elisa Sayrol and Josep Ramon Morros. 2016. Very Deep Conventinal Neural Networks for Face Identification. A Master Thesis submitted to Faculty of Escola Tecnicad' Enigineryia Telecommuniaco, d' Barcelona.

[7] Shuhui Xu, Yong Wang and Aiqin Huang. 2014. Application of Imperialist Competitive Algorithm on Solving the Traveling Salesman Problem. Algorithms Journal. 7: 229-242.

[8] Somayeh Mirzaei, Abdolhakim Nikpey, Payam Zarbakhsh. 2014. Recognition of Control Chart Patterns Using Imperialist Competitive Algorithm and Fuzzy Rules Approach. International Journal Intelligent Systems and Applications. 10: 67-76.

[9] Mir Ehsan Hesam Sadati, and Jamshid Bagherzadeh Mohasefi. 2013. The Application of Imperialist Competitive Algorithm for Fuzzy Random Portfolio Selection Problem. International Journal of Computer Applications. 79(9): 10-14.

[10] Mojgan Ghanavati, Mohamad Reza Gholamlan, Behrouz Minaei and Mehran Davoudi. 2011. An Efficient Cost Function for Imperialist Competitive Algorithm to find best clusters. Journal of Theoretical and Applied Information Technology. 29(1): 22-31.

[11] A. Bagheri, H.R. Razeghi and G. Ghodrati Amiri. 2012. Detection and estimation of damage in structures using imperialist competitive algorithm. Shock and Vibration Journal. 19: 405-419.

[12] Helena Bahrami, Marjan Abdechiri, Mohammad Reza Meybodi. 2012. Imperialist Competitive Algorithm with Adaptive Colonies Movement. International journal Intelligent Systems and Applications. 2: 49-57.

[13] Ghasem Mokhtari, Ahmad Javid Ghanizadeh and Esmaeil Ebrahimi. 2012. Application of Imperialist Competitive Algorithm to Solve Constrained Economic Dispatch. International Journal on Electrical Engineering and Informatics. 4(4): 553-562.

[14] Zaynab Bozorgi, Mehdi Sadeghzade, and Seyyed Javad Mirabedini. 2014. Imperialist Competitive Algorithm for Improving Edge Detection. International Journal of Advanced Research in Computer Science and Software Engineering. 4(3): 227-230.