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Face Recognition Based on Artificial Neural Network: A review

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Abstract

The face recognition/detection process is considered one of the most popular applications in image processing and biometric pattern recognition systems. Although the face recognition approach improves the authentication procedure, many challenges still appear due to diversities in human facial expression, colossal image size, background complexity, variation in illumination, poses, blurry, etc. Therefore, the face detection procedure is classified as one of the most challenging tasks in computer vision. This research paper reviews the implementation of image processing based on the Artificial Neural Network approaches. ANNs represent it as a potential capability to enhance the method of extracting face patterns through an adaption of various ANN topologies. Furthermore, it means fundamental phases associated with the construction of any facial recognition system. Finally, it provides a comparison of different literature studies related to face recognition based on varying ANN approaches and critically analyzed them.

***Keywords**:* Biometrics Recognition; Facial Recognition; Image Processing; Deep Learning Algorithm; Artificial Neural Network.

1. Introduction

Many organizations draw their attention to maintain high information security level and control the grant access to the system by authenticating the individual's identity to evade cybercrime issues. On the other hand, standard authentication techniques such as PIN, password, username, ID card number, etc., become inefficient techniques. With the excessive advances in software computing and image processing, many emerging methodologies appeared mainly to improve the authentication procedure (Bhattacharyya et al., 2009). The "Biometric" word is constructed through combing "Bio" and "metrics" words which refer to useful sciences that concern is analyzing and measuring biological information through adapting intelligence machine learning and various mathematical algorithms. Nowadays, Biometrics Pattern Recognitions (BPR) methodologies are widely useable systems. It was defined as an efficient information system that is mainly employed to detect, verify, and authenticating individuals' true identity based on some of its behavioral characteristics like body movement, keystroke writing style, and unique physiological factors such as fingerprint, eye retina, or eye iris, voice pattern, DNA, facial pattern and handshape (Bhattacharyya et al., 2009).

The recent development in machine learnings and technologies; makes it possible to generate an intelligence system based on statistical learning methodologies as a Facial Recognition (FR). Although, the FR system is considered one of the significant applications in image processing. However, this form of recognition may deliver great challenges in computer vision and pattern recognition due to many reasons such as diversities in facial expressions, orientation problems, illumination effects, and image size and background complexity (Khan et al., 2019). Although many researchers place considerable efforts in this area to overcome the limitations of FR through the use of the Artificial Neural Network approach, many issues are still required to be solved. In general, the FR system analyzes the individual's facial characteristics from an image that is entered as input into the system. This image will go through a reprocess phase to extract all essential information based on using specific algorithms like the Deep Learning Algorithm (DLA) to recognize the target individual at the end (Khan et al.,2019).

This research paper will involve the following sections: Section 2 will briefly explain the structure of constructing any biometrics system. Besides, Section 3 will discuss the Artificial Neural Network concepts and their roles. This section will be concluded by explaining the work procedure for ANN. Section 4 will represent different literature studies about the face recognition system based on using various ANN architectures. It will clarify the strengths of architecture. Section 7 will critically analyze the obtained information of the literature studies and provide a brief

comparison among different ANN topologies regarding specific factors such as performance rate, error rate, and several training data set. Finally, the research will end up with a conclusion.

2. Structure of Face Recognition System

The construction of any Biometrics Recognition system like face recognition consists of four main contemporary phases: face detection, preprocessing, feature extraction, and face recognition (Shaaban, 2021; Hassin & Abbood, 2021). It serves individuals' verification and identification purpose, as presented in Figure 1 (Khan et al., 2019). The image acquisition is made through a video camera or importing it from a database, and then this image goes further over different phases as shown in Figure 1.

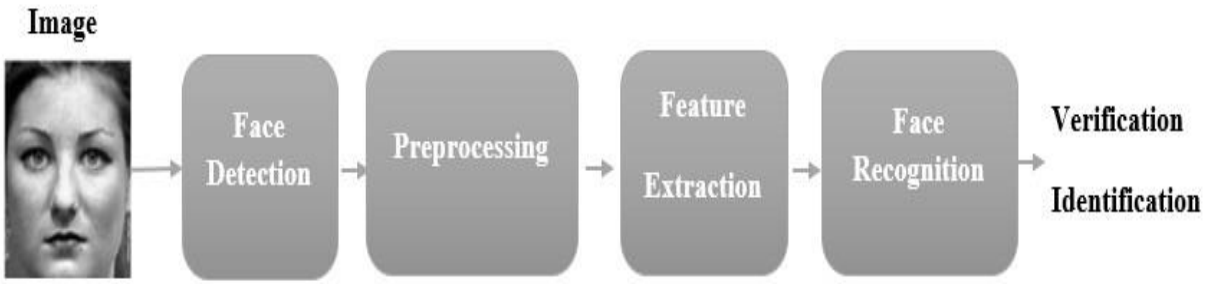

Figure 1: Structure of Face Recognition system (Khan et al., 2019)

2.1. Face Detection Phase

Detecting the target face image from a captured image or selected image from the DB is considered as the core function of this phase. Actually, the main purpose of the face detection process is to make sure and verify whether a given image has a face image region or not. When finish segmenting and detecting the target face area or region of concern, this output will be delivered into the preprocessing phase for further progressions (Zhao et al., 2003).

2.2. Preprocessing Phase

The image pre-processing steps usually forms as a combination of three important modules which are: histogram equalization, detection of edge, and matching of token that applied to enhance image quality, identify the edge point in the digital image, and finally perform removal and normalization based on specific algorithms (Al-Hatmi & Yousif, 2017; Hasoon, 2011). Through preprocessing technique, all undesirable image effects can be removed such as image noise, distortion, blur, shadow, or filters and it will make normalization for the image to generate smooth face image as an output which then will be utilized in extraction phase (Saudagare & Chaudhari, 2012) as shown in Figure 2.

Figure 2: Typical Preprocessing Method (Zaho et al., 2003)

2.3. Feature Extraction Phase

This stage will receive the detected face image region as an input. Through using feature extraction algorithms, all face characteristics will be extracted effectively from the face region such as the distances among eye, lip, and nose features (Saudagare & Chaudhari, 2012). The main purposes of feature extraction process are to perform specific functionalities including packing of information, cleaning of noise, and do salience extractions. After that, the obtained information is transferred into a vector for the subsequent process and use like comparison of obtained feature with stored data (Bhele & Mankar, 2012).

2.4. Face Recognition Phase

This is the last phase and it is utilized to achieve automatic authentication and identification of the individuals. To achieve this goal, each face recognition system should maintain a face DB that stores information about all extracted faces features in which for each individual several images should be taken and then extracted features stored in this dedicated DB (Bhele & Mankar, 2012). Consequently, Figure 3 shows the extracted features information that is received from the previous phase will be compared to each face class that stored in DB to perform authentication and recognize the person and the algorithm return the identity (Raheja & Kumar U, 2010).

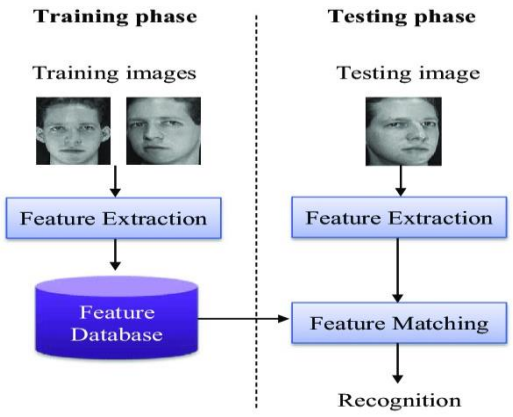

Figure 3. Feature Extraction (Saudagare & Chaudhari, 2012).

3. Artificial Neural Network Background

In the last decade, various models and architectures of Artificial Neural Network (ANN) have been developed and widely utilized for face detection and recognition based on the neural network (Kasar et al., 2016). An Artificial Neural Network (ANN) is an information processing paradigm that behaves like biological nervous systems. ANN is a powerful mathematical tool that processes input information to efficiently simulate or predicate the desired output data (Yousif & Sembokb2006a; Yousif & Sembokb2006b). Many ANN models are adapted in the development of different multi-view face recognition systems because these models have great ability and essential roles to efficiently simulate the methodology of neurons work and structure like in the human brain (Boughrara et al., 2012). Therefore, a Neural network (NN) is considered a robust classification methodology that works correctly in non-linear or linear datasets. It had been employed not only for face recognition applications but also in diverse areas such as fingerprint recognition, voice recognition, iris recognition, Natural Language processing, etc. (Yousif & Sembokb2005; Yousif & Fekihal 2012).

The effectiveness of NN and its increased use could be due to its ability to work in a non-linear network (Boughrara et al., 2012). Therefore, the feature extraction phase of face characteristics through using NN is more effective and efficient than using the linear karhunnen-loeve technique (Lawrence et al., 1997). The first ANN technique utilized for face recognition is a single-layer adaptive network known as "WISARD" (Stonham et al., 1986). The WISARD comprises a distinct network for each stored person. Constructing the NN structure is critical for making a successful face recognition system, and the model that should be applied depends on the intended application objectives (Stonham et al., 1986). Commonly, Convolutional Neural Network (CNN), as well as Multi-layers Perception (MLP) structure, have been employed for the aim of face detection (Sung & Poggio,1995). On the other hand, the Multi-Resolution Pyramid structure has been applied efficiently for face verification purposes.

In normal, ANN is formed as a base of Deep Learning and subset of Machine Learning where the algorithms are inspired by the structure of the human brain and it is made up of many layers of neurons known as "artificial nodes" (Yousif et al., 2017). These neurons are core passing units of the network. ANN is composed of three fundamental layers. The first layer is the input layer which receives the pixels as input, in between exist the hidden layers which perform most of the computation required by the network, and the final layer is the output layer that anticipates the ultimate output (Lawrence et al., 1997). In generic representation, ANN takes a set of data, train themself to recognize the parent that available in this data, then predict the output or new set of similar data (Tolba et al., 2006). The digital

image is composed of many pixels as shown in Figure 4, each pixel expresses a numerical value that is fit as input to each neuron in the first layer. Neurons of one layer are connected to the subsequent layer through "channels" that sign specific numerical value known as "weight"(Agarwal et al., 2010). In case of the wrong predication, the information will be passed back to neurons via the "backpropagation" process with adjustment of inputs and weights in which these passes continue until the network predicate and recognize the face correctly (Agarwal et al., 2010).

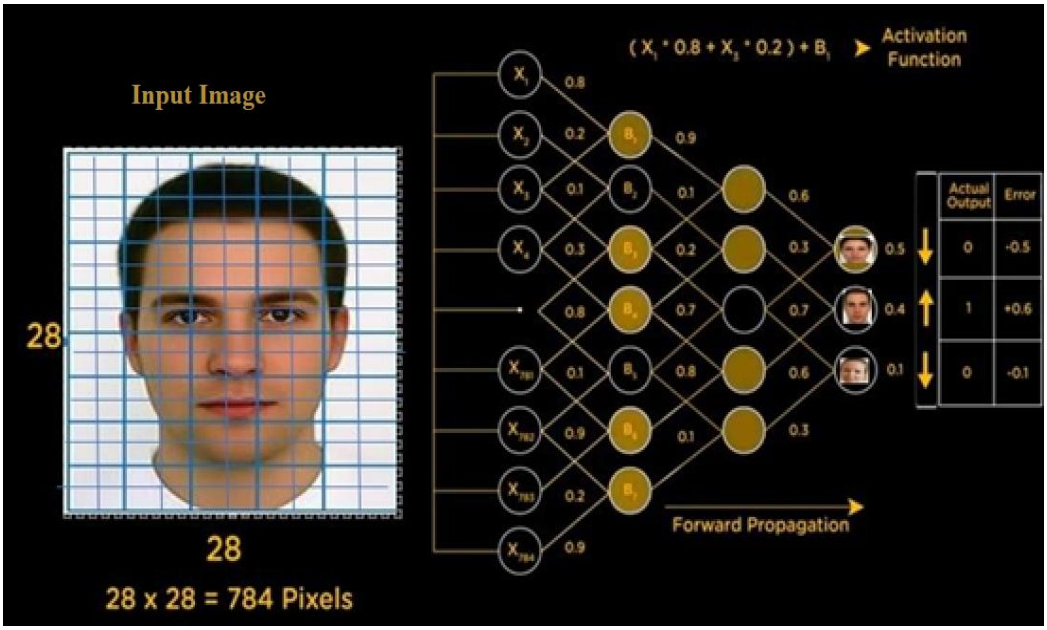

Figure 4. Simple Artificial Neural Network (Yousif et al., 2017).

4. Related Work

In the present study we examined patterns of responses for online and paper-based SET scores at a midsized, regional, comprehensive university in the United States.

5. Text body

The concept of face recognition isn’t the newest subject in computer vision and for many past decades researcher's grape their attention in this area due to its practical importance and great abilities in enhancing the way of verification and authenticating an individual's identity. Despite the fact that state other identification methods like fingerprint, iris scanning, etc., are classified as more accurate identification tools, "face recognition has always remained as a major focus of most researchers because it is people's primary technique for identifying individual "(Kasar et al., 2016). There are many of literature studies that focus on studying the modern ANN architectures and models which could be applied for constructing a successful face recognition system as shown in Table 1.

Table 1. Review of Modern ANN Architectures

Authors	Year	Methodology	Result
Li & Areibi	2004	Multi-Layer Perceptron (MLP) & feed forward learning algorithms (FFL).	The MLP and FFL can be applied in different pattern classification problems.
Kaushal & Raina	2010	Gabor Wavelet Transform (GWT) and Feed Forward Neural Network (FNN).	Proposed methodology achieves better results in compare with results of Graph Matching and Eigenfaces methodology
Tivive & Bouzerdoum,	2003	Convolutional Neural Network (CNN)	All three forms of architectures had achieved more than 96% correct classification of face.
Bouzerdoum, A.	2000	Conventional Feedforward Neural Network (CFNN)	CFNN architecture are more powerful architecture in compare with performance of MLP architecture.
Lawrence et al.	1997	Hybrid Neural Network (HNN)	Using topology that combine SOM and CNN approaches are performed better than using PCA along with CNN approach.
Huang, et al.	2003	Polynomial Neural Network (PNN)	The performance rate of PNN in comparison with MLP is more much superior.
Ming et al.	2010	Regression Kernel Discriminate Analysis (SRKDA)& NN	ARKDA efficiently improve the face feature extraction stage especially for nonlinear structure.
Rowley et al.	1999	Connected Neural Network (RCNN)	Architecture achieves 79.6% to 90.5% of correct face detection rate over 2 large training sets with lowest number of false detection rate.
Rowley et al.	1998	Rotation Invariant Neural Network (RINN)	RINN architecture are more efficient in detection face from many rotation degrees compared with other techniques.
Norris, J. S	1999	ANN and Principal Component Analysis (PCA)	The architecture made 2.23% incorrect classification and 1.2% as error rate after several training.
Lin-Lin Huang, et al	2003	Polynomial Neural Network (PNN)& Principal Component Analysis (PCA)	Correct detection rate was 84.6% and false detection rate was among 1.2%-3.1%.
Hazem M. El-Bakry	2002	Fast Neural Network (FNN)	High speed is achieved when applying FNN
Matsugu, M et al	2003	Convolutional Neural Network (CNN)	Proposed system achieves 97.6% as correct recognitions rate of faces.

Bojkovic, Z., & Samcovic, A. Zoran and Samcovic	2006	Multilayered Back Propagation Neural Network (MBNN)	Architecture achieves 94% performance rate for correct detection of faces over set of 500 images.
Sahoolizadeh et Al.	2008	Hybrid Neural Network (HNN)	The system attains between 77.9%-90.3% correct detection of faces over set of 130 sample images.
Shilbayeh, N., & Al-Qudah, G.	2008	Multi-layer Perception Neural Network (MLP)	Proposed system improves the detection efficiency where correct face detection rate was 91.6% and error rate was 7.54% for misclassification.
Mohamed, A et al	2008	Back Propagation Neural Network (BPNN) along with use of "Gaussian Mixture Modeling " (GMM)	The proposed system achieves 97.3% of correct face detection over set of 50 images.

Li & Areibi (2004) present an effective face recognition system with the use of Multi-Layer Perception (MLP) along with Feed-Forward Learning Algorithms (FFL). This algorithm has been chosen for the development of the proposed system due to its simplicity as well as its great ability to supervised different pattern matching problems efficiently. The results have shown that MLP and FFL are a successful model that could be applied for diverse pattern classification problems. Kaushal & Raina (2010) construct a face detection system through the use of the Gabor Wavelet Transform (GWT) and Feed Forward Neural Network (FNN). They employed these architectures in feature extraction face in image processing to find intended feature points, and extract and obtain efficiently the features from vectors. The results of the experimental NN have revealed that the suggested methodology had achieved better outputs in comparison with the result of Graph Matching and Eigenfaces methodology. Therefore, it is classified as the most powerful algorithms.

Tivive & Bouzerdoum (2003) introduce a new Convolutional Neural Network known as "Shunting inhibitory" CNN. they construct different training algorithms based on ML for developing face recognition systems and for training and testing 300 images. Also, they implement three different network topologies for training that was ranged from full connected network topology to partially connected network topology to distinguish among images that contain face pattern and those images with non-face patterns. The research results show that all three forms of architecture had achieved more than 96% correct classification of the face. The most efficient architecture achieved a 97.6% correct classification rate with 3.4% as the error rate. Bouzerdoum (2000) proposes an effective face detection system based on the use of Convolutional Feedforward Neural Network (CFNN) architecture composed of several

inhibitory neurons for the aim of classification task of face patterns and nonlinear regression. The experimental results showed that CFNN architecture with the usage of specific training algorithms is a more powerful architecture compare with MLP architecture due to its capability to effectively approximate many difficult decisions in the classification of patterns in hybrid planes much more readily compared with MLP.

Lawrence et al. (1997) applies the Hybrid Neural Network (HNN) approach which is composed of local image sampling, Convolutional Neural Network (CNN), and Self-organizing Map (SOM) structures in the implementation of their proposed human face recognition system. They utilized DB that contain 400 images as a sample of 40 people. SOM had been used to make efficient image quantization for the input image through performing dimensionality decrease and removal of invariance effects and changes. Besides, CNN is used for performing partial invariance regarding specific features like Translation, Scale, Rotation, and deformation. The experimental results show that using a topology that combines SOM and CNN approaches perform better than using PCA along with the CNN approach. However, both of them are superior in performance compare to the use of the Eigenfaces method. Huang et al. (2003) present a modern face detection approach through the adaption of Polynomial Neural Network (PNN) topology along with the Principal Component Analysis (PCA) method to improve the detection procedure of face. The PNN works as a classifier that determines the face region pattern in an image sample and separates it from the complex background. Despite this, the PCA method is utilized to adjacent and reduce image pattern dimensionality, as well as to readily extract face features from image for the PNN. The revealed results show that the proposed system achieves a high detection rate with the lowest error probability in an image that has a complicated background. The performance rate of PNN in comparison with MLP is more much superior.

Ming et al. (2010) represents a 3D face recognition system that developed with the use of ANN along with the Spectral Regression Kernel Discriminate Analysis (SRKDA) technique that relies heavily on the Spectral Analysis (SA) and Regression Analysis (RA) to solve face expression variations problem. The results show that ARKDA efficiently improves the face feature extraction stage especially for nonlinear structure, large sample size, and highest dimensional image. Additionally, it provides precise solutions compared with the use of normal learning analysis techniques like Eigenvector’s computations approach which consume huge time. Rowley et al., (1999) suggest a face detection system based on the use of the Retinal Connected Neural Network (RCNN) that was used as a classifier to investigate whether the countered window contains face pattern or not. They utilized a Bootstrap Algorithm as "training progresses " for a purpose of training the network to identify the positive false detection rate over the training

sample sets. This approach will remove immediately the train that doesn't contain a face. In the experiments, they employed three training sets A (23 images that hold 155 faces), B (65 images that hold 183 faces), C(images without faces and has a complicated background to measure the rate of false detection). The results show that this architecture achieves 79.6% to 90.5% of correct face detection rate over 2 large training sets with the lowest and reliable number of false-positive detection rate.

Rowley et al. (1998) represent a powerful face recognition system based on the use of Rotation Invariant Neural Network (RINN) that has the capability to effectively detect the faces from any rotation degree in the plane of the image. Despite, the normal face detection system that restricts face detection usually from the frontal or upright side. The system used multiple networks, different training sets, and they implement sensitivity analysis over the network. The results illustrate that RINN architecture is more efficient in detection face from many rotation degrees compared with other techniques. Norris (1999) offers an effective face recognition system with the use of ANN and Principal Component Analysis (PCA) along with the use of a particular class of linear projection to organize and identify the face region from a real-time video stream. The empirical training sets include 700 images sample that holds 1488 faces with noise and disinformation to train the network and identify the detection and error rate. The results show that the architecture made 86% correct classification and 1.2% as error rate after several training.

Lin-Lin et al. (2003) advocates a method for face detection through the adaption of Polynomial Neural Network (PNN). To detect whether an image contains the human face region, PNN had been used and after the training, the image set is classified into face pattern class and non-face pattern class. They measure the performance rate of PNN for three training sets (A: image samples with faces, B: image samples without faces, and C: image samples with pooled faces). The Principal Component Analysis is used to extract the features from the input image. The results of experiments show that the correct detection rate was 84.6% and the false detection rate was among 1.2%- 3.1%. Hazem (2002) proposes an effective approach for face recognition known as Fast Neural Network (FNN) which was developed mainly to eliminate the time computation that is required for detecting human face region in the image plane. Each image pattern is divided into sub-images and after that, all individual images will be tested through FNN. The experiment outcomes illustrate that high speed is achieved when applying FNN compared with a speed that is attained when the use of Conventional Neural Network (CNN). Matsugu et al. (2003) describe how to apply a robust algorithm known as "RuleBased" algorithms for developing facial expression recognitions and detection systems based on the use of Convolutional Neural Network (CNN) approach. Different problems had been addressed and

covered through this study including independence of subject, invariance in transformation, scale, and rotation of facial expression. The experiment includes 2900 fragment of facial images that were used in the training. The results show that the proposed system achieves 97.6% as the correct recognition rate.

Bojkovic & Samcovic (2006), developed face recognition system for surveillance based on the use of ANN and Multilayered Back Propagation Neural Network (BPNN). The images are captured from surveillance video as the input and then it will be trained by MBNN. Three forms of face image representation were used including Pixel representation, Eigenfaces representation, and partial representation of the profile. For each representation, there are specific sub-detectors are produced to detect the face representation. The experiment includes 1200 face image planes as training sets that were collected from different face databases. The empirical results demonstrate that the architecture achieves a 94% performance rate for the correct detection of faces over a set of 500 images. Sahoolizadeh et al. (2008) deliver different powerful hybrid methodologies for implementing a face recognition system that functions through combining the Gabor Wavelet faces (GWF) approach along with the use of ANN as feature classifier. For representing face image, GWF was used which is very efficient for identifying face and recognizing facial expressions. Besides, they decline dimensionality of the images and remove image illumination, pose, and noise effects via GWF. The GWF can enhance the discriminate ability to detect face and non-face patterns. They use an ORL dataset that contains 400 images with frontal faces and 40 grey images that have various effects like illumination, pose variation, etc. The system attains between 77.9%-90.3% correct detection of faces over a set of 130 sample images.

Shilbayeh & Al-Qudah (2008) represent an effective face detection system through the adaption of Multi-layer Perception Neural Network (MLP) along with the use of a robust classifier known as "Maximal Rejection Classifier" (MRC) to enhance the detection and classification efficiency in comparison with the usage of old ANN. The MLP was systematized to automatically discard all non-face pattern images through improving the way of detection, reducing the cost of computation, and maintaining high accuracy of detection. They used 2000 images as a training set which contain face and non-face pattern that imported from the MIT database. The proposed system improves the detection efficiency where the correct face detection rate was 91.6% and the error rate was 7.54% for misclassification. Mohamed A et al. (2008) provide a powerful face detection system through applying Back Propagation Neural Network (BPNN) along with the use of "Gaussian Mixture Modeling " (GMM) as a classifier to train, classify and segment the face image pattern based on skin color. The image features are collected from "Distinct Cosine Transform

"(DCT) coefficients. The obtained information that gained by GMM represents values of skin and non-skin face candidates will be passed to BPNN to detect face region in the image. The training dataset includes 50 real face images that were taken under diverse light conditions via digital camera. The proposed system achieves 97.3% of correct face detection over a set of 50 images.

6. Results & Discussion

In Table 1 is composed of information related to face recognition/detection system based on different ANN topologies, these data have been collected from many previous related works that were conducted among the year 1997 to 2010. Each of these research studies describes specific ANN architecture that was applied to develop a face detection system along with the use of various algorithms and techniques to overcame the drawbacks of normal authentication methodologies. Typically, the widely used architectures over the studies are Polynomial Neural Network (PNN), Convolutional Neural Network (CNN), Back-propagation Neural Network (BPNN), Multi-Layer Perception Neural Network (MLP), Retinal Connected Neural Network (RCNN), Fast Neural Network (FNN), etc. (Tivive & Bouzerdoum, 2003; Huang, 2003; Rowley,1999; Hazem, 2002 ; Shilbayeh & Al-Qudah, 2008; Mohamed, 2008). Some researchers combined use of Neural Network (NN) along with usage of particular analysis approaches such as Principal Component Analysis (PCA), Feed Forward Learning Algorithms (FFLA), and Gabor Wavelet Analysis (GWA) to enhance feature extraction procedure, image quality, and mitigate image dimensionality (Li & Areibi, 2004; Kaushal & Raina ,2010; Norris,1999; Lin-Lin et al., 2003).

Table 2 represents the performance evaluation strategy and DB type that had been employed for different research papers to assess system efficiency. Moreover, it shows the detection rate, and the error rate values that were obtained for some of the studies. The training set number that was utilized for the experiments is highlighted and it was different from one research paper to another. These research studies embed in their experiments various databases types like MIT DB and ORL databases that were employed for the aim of testing, storing, and training features of face image samples over selected ANN topologies (Sahoolizadeh et al., 2008; Shilbayeh & Al-Qudah, 2008). On other hand, a majority of research papers didn't identify exactly what is the type of DB, the researchers utilized a particular set of image samples to perform the training over network topology to measure system detection efficiency. It is worth mentioning that, many of these literature studies concentrated on different standards criterion for evaluating performance and efficiency level (Rowley et al., 1999; Norris, 1999; Lin-Lin et al., 2003; Bojkovic & Samcovic, 2006; Sahoolizadeh et al,, 2008; Shilbayeh & Al-Qudah, 2008; Mohamed et al., 2008). Some of it used detection rate

over training set as the main factor for performance measurement (Huang et al., 2003; Rowley et al., 1999; Lin-Lin et al., 2003), while others used just error rate as an indicator for performance level (Norris J, 1999) or even both (Lin-Lin et al., 2003; Shilbayeh & Al-Qudah, 2008).

Table 2. Performance Measurement Technique

Ref	Training Set	Performance Evaluation Strategy	Detection Rate	Error Rate
Tivive, F et al (2003)	300 images.	Error rate & Detection rate	97.6%.	3.4%.
Rowley, H et al (1999)	Three training sets: Set A:(23 images that hold 155 faces). Set B:(65 images that hold 183 faces). Set C:(images without faces and has complicated background).	Error rate & Detection rate	79.6% to 90.5%.	Fewest error rates are observed.
Norris, J. S al (1999)	700 images sample that hold 1488 faces with noise and disinformation.	Error rate & Detection rate	86%	1.2%
Lin-Lin H et al (2003)	Three training set: Set A:(image samples with faces.) Set B:(image samples without faces.) Set C:(image sample with pooled faces).	Error rate & Detection rate	84.6%	1.2%- 3.1%
Matsugu et al. (2003)	2900 fragment of facial images.	Detection rate	97.6%	-
Bojkovic & Samcovic, (2006)	1200 face image.	Detection rate	94%	-
Sahoolizadeh et al. (2008)	ORL dataset that contain 400 images with frontal faces and 40 grey images.	Detection rate	77.9%-90.3%	-
Shilbayeh, N., & AlQudah, G. (2008)	2000 images imported from MIT database.	Error rate & Detection rate	91.6%	7.54%
Mohamed, A et al. (2008)	50 images as sample.	Detection rate	97.3%	-

Nevertheless, the detection rate is seemed to be the most used factor for assessing system efficiency compared with other measurement standards as shown in Figure 6. According to the diagram as illustrated in Figure 7 that describes the detection rate level of diverse Artificial Neural Network approaches for many of previous research studies, we can perceive that the lowest detection rate is obtained from the use of the HNN approach (Lin-Lin H et al., 2003). Despite, the graph shows that the highest detection level can be gained through the adaption of the CNN

approach (Matsugu et al., 2003), and BPNN that was utilized in (Bojkovic & Samcovic, 2006) also acquire a good detection rate level. Furthermore, it was observed that each of these research papers have specific limitations as well as specific strengths over other topologies (Kaushal & Raina, 2010; Bouzerdoum, 2000). Table 3 presented the detection rate of all reviewed methods. Therefore, we can't specify exactly what is the most efficient architectures for building up a powerful face recognition/detection system with the highest accuracy and performance level.

Figure 6 Performance Evaluation Technique

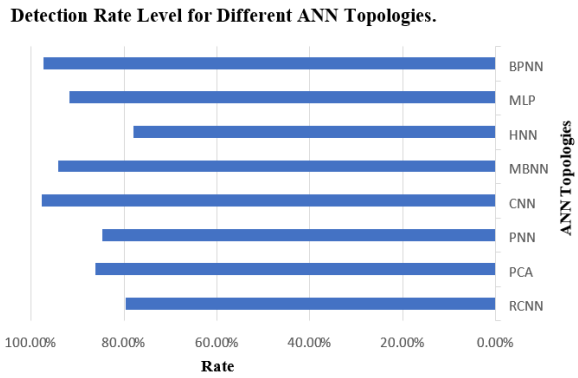

Figure 7 Detection Rate of Different ANN Topologies

Table 3. Detection Rate of reviewed methods

Topology	Detection Rate
CNN	98%.
RCNN	79.60%
PCA	86%
PNN	84.60%
MBNN	94%
HNN	77.90%
MLP	91.60%
BPNN	97.30%

7. Conclusion

Recently, different emerging techniques have been generated to improve identification and authenticating procedure for individuals and overcome weaknesses of traditional identification techniques. This paper aims to review and critically analyze the current methods to improve detection and validate the images. Also, the results show that the Biometric pattern recognitions are one of these modern techniques that have been applied widely to improve and enhance security levels and access control.

Moreover, in computer vision and image processing, face recognition/detection systems became one of the most popular applications, and a deep research area is much needed. Most researchers aim to solve common problems due to human face diversities and image issues such as illumination and lighting variation, background complexity, orientation issue, etc. Most of these problems had been addressed in many research papers. Researchers employ the ANN approach and several analysis techniques like Principal Component Analysis (PCA) to improve efficiency, performance, and computation time in the image processing procedure. These research papers cover the concept of Biometric Pattern Recognition and ANN. In brief, it explains the fundamental phases for developing any FR system and describes the work procedure of ANN. Besides, it represents different literature studies related to constructing FR based on different ANN architecture.

Finally, it provides a comparison among these architectures by demonstrating descriptive analysis with graphs. The currently used methods achieved excellent performance, reaching 98% in CNN and BPNN rate of 97.30%. On the other hand, some techniques show less performance, such as HNN that obtained 77.90%, and RCNN rate of 79.60%. Therefore, it needs to be more investigate and research to improve the performance of detecting images.

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