A REVIEW ON FACE RECOGNITION SYSTEM

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Abstract - In recent years the role of identification of the face has been studied vigorously. This report offers an up-to-date analysis of global studies into human facial recognition. First, we provide a summary and the uses of facial recognition. The new facial detection methods are then submitted to a literature review. Face databases used for checking the performance of such face recognition algorithms are defined and limitations are provided. A short overview of the summarized paper on facial recognition, a large-scale review and findings on the automatic face recognition technology. Finally, we have a review of the conclusions.

Keywords - Face, Identification, Biometric, Face Detection

I. INTRODUCTION

The field of computer vision and pattern recognition is very demanding in recognition of facial variations, poses and lighting. Several new uses, from law enforcement to enterprise, require an effective and automatic face detection device from industry. However many problems are yet to be overcome, several scholars have for several years focused on the issue of face recognition. Examples of some of the problems to be carefully discussed include the variations in scene lighting, shifts in stance, alignment and speech. The identification time often becomes a major restriction if the size of the database increases. Face detection has the merits of a high precision and low intrusiveness as one of the biometric approaches. It does not intrude itself with the exactness of a physiological solution. For this cause, facial recognition in the fields of defense and computer vision has attracted the interest of researchers. To that reason, researchers in areas such as security, psychology and image processing have drawn attention to computer vision. A number of algorithms for face recognition have been proposed and face recognition has also become useful in other fields of multimedia information. Facial recognition analyzes the properties of an input of facial images by means of a digital video camera or online face recording. Nowadays, we need to maintain global data on safety and want to improve their existing security system in every organization or individual. Most citizens need a stronger protection framework that offers a total safety solution.The need for information or physical property security to be maintained is becoming increasingly important and in-creasingly difficult. In a business, we learn about the crimes of credit card fraud or security breaches. The hackers were taking of a fundamental weakness in the traditional access control schemes such as cards ID, password. Therefore, the need for systems to verify the person appeared in ways that are not subject to fraud, as in traditional methods by knowing the password. A face recognition system is application for biometric identification or validation by analyzing patterns on the basis of their facial appearance [1].

Face recognition application enables a person to identify and interpret his or her facial features. This technology is ex-tremely important and can be used for different purposes in many applications. A facile recognition system can thus be implemented to recognize people for security monitoring, matching images, user authentication, user access control, etc. in public or restricted areas. The technology of face recognition still faces many problems that need to be overcome with more efficient methods. These challenges lead to the problem that due to lighting or pose, the variations of the face of the same individual.

In this paper, we make a deep investigation review on up-to-date face recognition systems, which have been used. The comparison table is based on different aspect such as the included classes, the methods used and the obtained results.

This paper is divided into five section. The first section given introduction about face recognition. Section 2 was related works, section 3 is methods that used, section 4 discussed the obtained results and the last section was the conclusion

II. LITERATURE REVIEW

There are plenty of researches arise since the twentieth century in the domain of face recognition. Joseph et al [1] propose a model called Deep transfer learning (DTL) which integrate convolution neural network with transfer learning to build system more effectively. We trained this model with two datasets. The accuracy of this model achieved 97% when training with dataset that contained 200 images of 100 classes, and the accuracy achieved 97.6% with dataset contained 2000 images of 1000 classes. Kulandai et al.[2] built a system for face recognition using machine learning. In this paper, a deep review in recent techniques used for recognizing faces either handcrafted features such as HOG algorithm or deep learning techniques. The proposed of this paper is for checks images in different pose and lighting conditions. the accuracy of this model achieved

90.2%. Suleman et al [3] presented a paper for smart glasses implementation using face recognition. In this paper, they used haar-cascade classifier for face detection and used Machine learning and Deep Learning for face recognition. The high-er accuracy given by CNN Model which is type of Deep learning that achieved 98.5%.

Musab et al [5] presented a paper for face recognition system using Deep learning. In this paper, Convolution Neural Network has been used to built the system. They modified CNN model by adding batch normalization into two layers in their model and used softmax classifier in fully connected layer. also they built the model by using different input layer which the accuracy of the model achieved 98.8%.

Riki et al [6] published a paper for implementation of face recognition system using ANN. They used Principal Compo-nent Analysis (PCA) as Algorithm for feature extraction and used ANN with neurons (20, 50, 100, 200) and with hid-den layers (1, 3, 5, 7, 9) with dataset that contain 100 images from five different persons. The best accuracy was when the number of neurons were 200 and the number of hidden layers were 7 which the accuracy achieved 80%.

Savath et al[7] proposed embedded system used GPU used for real time face recognition using Squeeze Net with VGG-Face. The dataset that used in this paper contains 3.31 million images of 9,131 classes. The test accuracy of this model achieved 83.67% with time of 0.23 second.

Saibal et al [8] are Used Deep learning to build face recognition system that recognize face images from video. In this paper, FaceNet pre-trained model has been used which is Convolution Neural Network (CNN) model based on cluster-ing. For face detection , MTCNN has been used which is Multi task cascade Convolution Neural Network and for face recognition, FaceNet model is used which recognizing images by found the distance between images. The accuracy of this model achieved 98.47%.

III. GENERAL STRUCTURE OF FACE RECOGNITION SYSTEMS

The common structure for face recognition systems are shown in the following system.

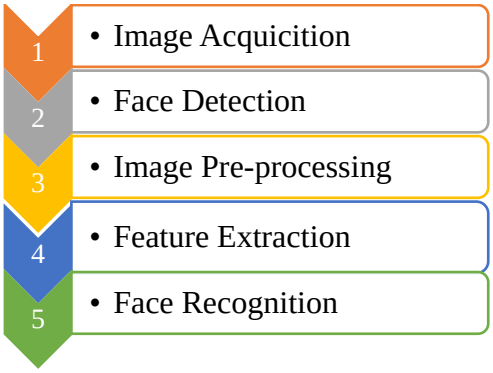


Fig. 1. **The general Architecture for face Recognition Systems.**

As depicted in Figure 1, The first role of the facial recognition system is to collect images and capture images from a film, camera or database. The furthersteps of face recognition system arediscussed in the following subsections:

A. Image Acquisition

This phase aims to acquisition the image using any terminal device such as mobile camera, tablet, iPad, and Web Camera.

B. Face Detection

The main aim of this step isdetecting the face from the captured image or the selected image from the database. This process of face detection actually verifies that weather the given image has face image or not, after detecting the face this output will be further given to the pre-processing step.

C. Image Pre-processing

In order to prepare the image for effective feature extraction process, the image must be preprocessed.In this stage unnecessary burning condition, various lightening states, nuisance and shadowing effects may be eliminated by means of pre-processing techniques.

D. Feature Extraction

This move attempts to retrieve the functions of faces using an extraction algorithm from the database. Extracts are made to pack information, extract salience, reduce measurements and clean noise. After this step, a face patch is typically translated into a fixed dimensional vector or a number of trustworthy points and their respective positions.

E. Face Recognition

Once extracting the function, phase-analyzes the image of each face; this last step identifies the identity of the faces in order to achieve automated face recognition. Several photographs are taken and the characteristics are deleted and stored in the database for each user. Then when the input image is identified, it is detected first, pre-processed, and interpreted by attributes, and then compares it with each facial class that is contained in the database. The first is called recognition and the other is called authentication. There are two basic implementations of face identification. Face recognition means that the face picture can be used even without his knowledge to establish the identity of an individual.

IV. METHODOLOGY

On the 6th of December 2020, a literature search was carried out using Google scholar. Holding emphasis on the importance of various face recognition methods which are used for authentication and identification in real-world systems. Google Scholar have been used with the same keywords to improve the sensitivity of search and to collect the most recent picture posts on

Face Recognition. Because of the vast number of documents found in literature, this Google Scholar scan was restricted to the key-words in the article names. All searches were restricted, with respect to the earliest validation of face recognition results, to papers published in the last five years. This review take in account the most recently used methods and the recent techniques such as deep leering or conventional machine learning. The process of collecting review data is depicted in the following diagram.

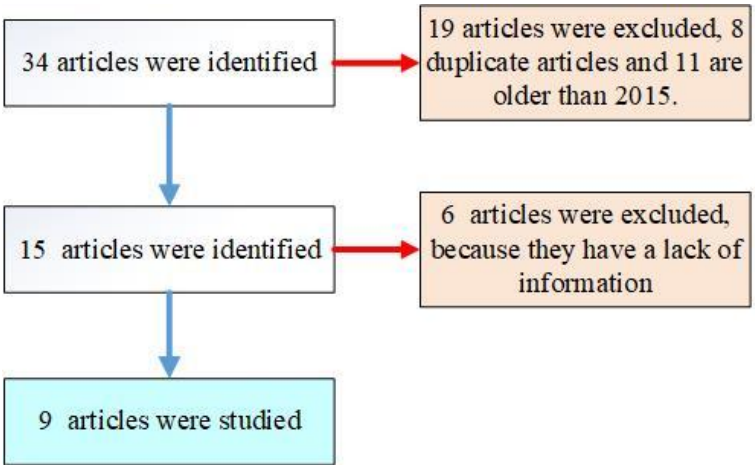


Fig. 2. **The process of collecting papers for this review.**

As shown in Figure 2, the selection process was so precisely. Firstly, we get rid of duplicated article and those have publishment date before 2015 year. Secondly, from the rest 15 articles, 6 articles have been excluded because they have a lack of information. Therefore, the summarized papers are only 9 papers.

The following figure (Figure 3) shows the steps that must be followed for training and validation of face recognition system.

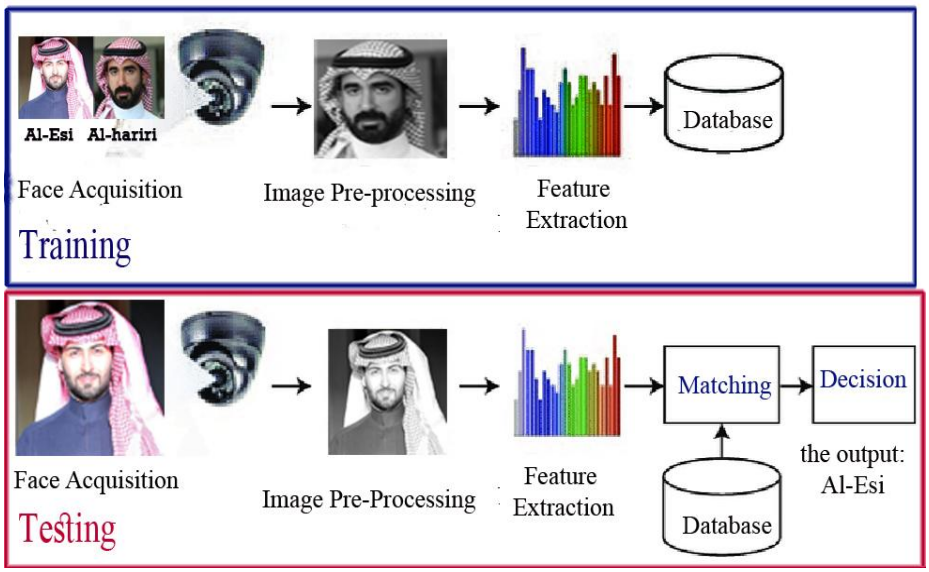


Fig. 3. **The required steps for building face recognition system .**

An automated face detection method is usually a four-stage process. In the majority of cases, these four steps are: pre-processing, facial recognition, retrieval of the features and finally classification. Figure 3 displays the flow map of a facial recognition device. The input images from image acquisition systems, such as cameras, can, due to noise or light conditions, not be appropriate for identification. The first step is then the preprocessing stage for noise reduction, lighting repair and color normalization. Faces in the input pictures can then be found and isolated. The next step is to remove such preset features to establish a

characteristic vector. In order to identify the user on the basis of these features, these features must provide unique details about each person in the database.

Salient features are derived from biometric photographs such that the obtained image is individually represented by way of a quantitative representation for reference, match or classification purposes incorporated in device databases. Other benefits of eliminating functions include decreased dimensionality, standardization, protection and quicker human identification.

Edge detection is a significant phase for the analysis of images, providing the fundamental foundation for extracting low-level attributes in biometric imaging systems, such as edges, intersections and crossing points. The usage of edge algorithms on biometrical images also enables extraction of facial features such as ears, hair, eye brows and hand geometry measurements.

The effects of face recognition rely very much on the features extracted.

The original picture is extremely repetitive, which may drastically decrease the dimensionality of the representation if only the facial patterns are interesting. In truth, the face image is viewed as a characteristic vector. Eigenfaces can be obtained from:

- Key study of the variable (PCA).
- Convert Karhunen-Loeve (KLT).

Face identification can be seen as the process of separating multiples of the image space between the face and non face, through the face recognition of multiple images. We detect several faces and faces and we discern various faces within the detected PCA space.

Researcher	Classifier	Dataset	Results
Joseph et al[1]	DTL (integrate between transfer learning and CNN)	200 photographs of the faces of 100 individuals.	97.0%
		2000 photographs of the faces of 1000 individuals.	97.6%
Kulandai et al[2]	SVM	400 images. 40 classes	90.24%
Suleman et al[3]	AlexNet	2500 images per person	98.5%
Musabet al [4]	New architecture CNN with input 16x16x1, 16x16x3, 32x32x1, 32x32x3, 64x64x1, and 64x64x1	50 classes	98.4%, 98.8%, 98%, 98.8%, 98.4% and 98.9%
Riki et al[5]	BP-ANN	100 images of face from 5 different people.	80%
Christian et al[6]	classical, residual and inception, VGGface	Final classification of faces	Best accuracy for VGG 91.6%
Savath et al [7]	SqueezeNet with VGGFace	The dataset contains 3.31 million images of 9,131 subject.	83.67%
Saibal et al [8]	FaceNet	800 images 8 persons	98.47%
Linget al [9]	SRANet	CASIA-WebFace has 494,414 face images belonging to 10,575 identities	95.82%

TABLE I. **Comparison between the studied works in the field of Face Recognitin**

As summarized in the above table, there are some existing works [2,5] used traditional machine learning techniques, while others such as [1,3,4,6,7,8,9] used deep learning techniques. The use deep learning techniques improved the recognition process. Joseph et al [1] employ a transfer learning (DTL) which integrates convolution neural network with transfer learning to build system more effectively. This model with two datasets. The accuracy of this model achieved 97% when training with dataset that contained 200 images of 100 classes, and the accuracy achieved 97.6% with dataset contained 2000 images of 1000 classes. In the domain of using handcrafted features, Kulandai et al.[2] built a system for face recognition using machine learning. HOG algorithm is used to extract features from images and SVM is used for classification. The proposed of this paper is for checks images in different pose and lighting conditions. The accuracy of this model achieved 90.2%. In the paper [3], Suleman et al presented smart glasses that has been implemented using face recognition. In this paper, they used haar-cascade classifier for face detection and used Machine learning and Deep Learning for face recognition. The highest accuracy obtained by CNN Model is 98.5%.

The use of much more classes makes the accuracy lower , such that in [7], the obtained accuracy 83% but for 3.31 million images of 9,131 subject. Musab et al [5] used a Convolution Neural Network to build a face recognition system. They modified CNN model by adding batch normalization into two layers in their model and used softmax classifier after the fully connected layer. also they built the model by using different input layer which the accuracy of the model achieved 98.8%. Similarly, Riki et al [6] used an ANN-based system. They used Principal Component Analysis (PCA) as Algorithm for feature extraction and used ANN with neurons (20, 50, 100, 200) and

with hidden layers (1, 3, 5, 7, 9) with dataset that contain 100 images from five different persons. The best accuracy was when the number of neurons were 200 and the number of hidden layers were 7 which the accuracy achieved 80%. In [7], much more classes are used when Savath et al [7] proposed embedded system used GPU used for real time face recognition using Squeeze Net with VGG-Face. The dataset that used in this paper contains 3.31 million images of 9,131 classes. The test accuracy of this model achieved 83.67% with time of 0.23 second. Saibal et al [8] are Used Deep learning to build face recognition system that recognize face images from video. In this paper, FaceNet pre-trained model has been used which is Convolution Neural Network (CNN) model based on cluster-ing. For face detection , MTCNN has been used which is Multi task cascade Convolution Neural Network and for face recognition, FaceNet model is used which recognizing images by found the distance between images. The accuracy of this model achieved 98.47%.

V. DIFFICULTIES OF FACE RECOGNITION

Face images undergo a host of changes in field conditions. This include the posing or viewing angle, lighting, occlusion, facial expression, time delay for the acquisition of photographs and human variations. The Scales of systems of face recognition are not well understood for certain reasons. Much of the study was limited to frontal views under uniform lightingwith no occlusion and neutral face or a small grin. Faces that are a valuable biometric can be objects that are irrelevant to the identity of an individual that affects the appearance of the face. While all of these variables are impossible to manage, theory and evidence indicate that it is not clear precisely where the issues lie and what their source could be.There is no awareness of the effect of facial expression on identification. Previous analysis was mainly restricted to neutral gestures and brief smiles. Due to its effect on the apparent geometry of facial expression andfacial characteristics which have a greater impact on the identification than the holistic algorithms for geometry related algorithms.

A. Occlusion

In general, the efficiency of occlusion facial recognition algorithms is poor. Other items in the scene or sunglasses or other stuff will occlude the face. Occlusion may be accidental or deliberate. Individuals may be driven under such circumstances to counteract attempts of identification by hiding parts of their faces. Because in many cases, the intention is to identify subjects that are not or even comply.

B. Time delay

Over time, faces change. Hair style, foundation, body strain and appearance improvement, face, glases or face jewelry involvement or absence, and long-term effects of ageing.

C. Pose

In a range of practical uses, some inevitable difficulties occur, such as individuals not always facing the camera, hence the question of posing is a great challenge to the proliferation of the facial recognition technology.

Essentially, the difference between the same people on different positions is greater than that between the different people on the same position. Therefore, if the poses of the test and gallery photos are distinct, it is difficult for the machine to recognize the face. The difference in poses is also a facial recognition challenge. Frontal pictures work better than novel.No frontal preparation images, rather than poses. A fair identification rate of over 90% can be obtained for frontal training poses.

D. Illumination

The changes in pure lighting on the face are well treated current algorithms for facial detection. Face recognition devices, however have trouble under intense lighting environments under which essential portions of the face are opaque. In comparison, lighting paired with pose variation can become especially difficult.

E. Expression

The algorithms are reasonably stable in facial expression with the exception of serious phrases like screaming. The algorithms have a problem with the deformity of your mouth and occlusion of the vision by closing and closing your eye. Faces are subjected to major facial deformations. People can tolerate this variety easily, but the algorithms have problems server voice. Face recognition remains an unresolved issue under intense face expression, and time details may be important for face recognition under expression.

F. Gender

The discrepancies between gender identification ratios were remarkably consistent with gender researchers. In two datasets, the degree of acceptance in women over a spectrum of disruptions is higher than in men. One theory is that, with the use of products for example, women make more attempts to change their face shape, leading to a broader distinction between women than men. Otherwise algorithms could just be more susceptible to anatomical variations in men and women's faces.

The discovery that algorithms are more receptive to the face of women indicates other individual variations in performance related to the algorithm. In certain ethnic groups or ages algorithms may prove more accurate than others for example. Total these studies demonstrate that complex challenges remain

thoroughly accepted. In specific, variance in location, occlusion and time delay are most challenging.

VI. CONCLUSION

This paper provides a summary review of literature research on image face recognition systems. We address various architecture and approach in this article, any research used algorithms, processes, database for pictures training or testing and the facial recognition system output evaluation. Every researcher has a new methodology to recognize the face of a database or film, but there are also benefits or disadvantages of the approaches addressed. Many researchers have attempted to overcome the problems of the previous methods. The expected future direction for face recognition is 3D facial recognition measures 3D face geometry by means of an infrared camera's invisible light and offers an ideal user interface mixing ease, usability and comprehensive protection. Currently about 94% of smartphones have fingerprint scanners, although this is projected to decline to 90% by 2023, with innovations like 3D facial recognition a normal user authentication approach.

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