International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 5 | ISSN : 2456-3307

Review of Different Face Detection and Recognition Methods

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ABSTRACT

Image processing methods play a vital role in different applications, face detection and reorganization is one of them. In recent technology, the popularity and demand of image processing are increasing due to its immense number of application in various fields. Most of these are related to biometric science like face recognition, fingerprint recognition, iris scan, and speech recognition. Among them, face detection is a very powerful tool for video surveillance, human computer interface, face recognition, and image database management. There are a different number of works on this subject. Face recognition is a rapidly evolving technology, which has been widely used in forensics such as criminal identification, secured access, and prison security. The human face is a dynamic object and has a high degree of variability in its appearance, which makes face detection a difficult problem in computer vision. A wide variety of techniques have been proposed, ranging from simple edge-based algorithms to composite high-level approaches utilizing advanced pattern recognition methods. Various researchers have been suggested different human face detection and reorganization method for various application decades. This review paper presents a comparative analysis of various face detection and reorganization methods.

Keywords : Face Detection; Face Localization; Facial Feature Detection; Feature Based Approaches; Image-Based Approaches

I. INTRODUCTION

In the last decade, it can be observed that many algorithms were developed in image processing for face recognition and face detection but there was no algorithm for detecting a position in an image. The position detection in the controlled environment can be used in many environments where the positions are fixed. Some environments like seminar halls, conference halls, Auditoriums etc. And we can apply the same algorithm for some environments where the positions are reserved. With the help of this position detection algorithm, many applications can be developed like automatic attendance system in controlled environments [8]. Recently, improvement in face recognition performance has been accelerating owing to advances by leading technology companies such as Facebook and Google. In particular, deep-learning-based face recognition techniques have seen dramatic developments in the biometric industry. Deep Face, developed by Facebook, is an example of a structure that utilizes deep learning. However, this high-performance algorithm is difficult to use with low-resolution images characterized by various facial poses and lighting conditions [11].

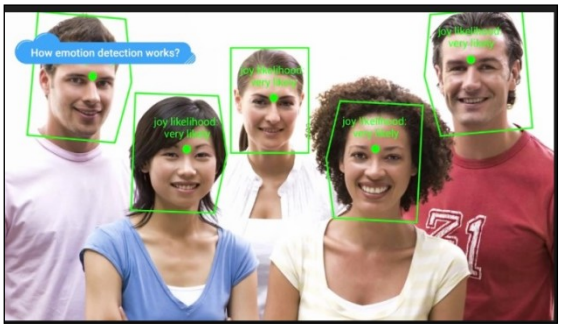

Figure 1 Face Detection and recognition

Therefore, we look at the traditional face recognition methods. Traditional face recognition methods can be classified into three types. First, appearance-based face recognition methods use global feature extracted from the face region. Principal components analysis (PCA) and linear discriminate analysis (LDA) can be categorized as appearance-based methods. Second, texture-based face recognition methods use textural

characteristics extracted from the local face region. In texture-based methods, local binary pattern (LBP) is generally used. Third, geometry-based face recognition uses the positions of feature points such as the eyes, nose, and mouth. For example, the active appearance model is regarded as a geometry-based method. This paper covers a survey of face detection method; it covers following topics, introduction, face detection and recognition method, applications and various existing methods [3].

II. Face Detection and Recognization

In recent technology, the popularity and demand of image processing are increasing due to its immense number of application in various fields. Most of these are related to biometric science like face recognition, fingerprint recognition, iris scan, and speech recognition. Among them, face detection is a very powerful tool for video surveillance, human computer interface, face recognition, and image database management. There are a different number of works on this subject. Face recognition is a rapidly evolving technology, which has been widely used in forensics such as criminal identification, secured access, and prison security [4].

2.1 Applications of face detection and recognition-

There are numerous application areas in which FR can be exploited for these two purposes, a few of which are outlined below [2].

- **Verification (one-to-one matching):** When presented with a face image of an unknown individual along with a claim of identity, ascertaining whether the individual is who he/she claims to be [11].
- **Security:** access control to buildings, airports/seaports, ATM machines and border checkpoints; computer or network security; email authentication on multimedia workstations.
- **Criminal justice systems**: Mug-shot/booking systems, post-event analysis, forensics.
- **Image database investigations**: Searching image databases of licensed drivers benefit recipients, missing children, immigrants and police bookings [3].
- **Identification (one-to-many matching):** Given an image of an unknown individual, determining that person's identity by comparing (possibly after encoding) that image with a database of (possibly encoded) images of known individuals [12].
- **Access Control-** Face verification, matching a face against a single enrolled exemplar, is well within the capabilities of current Personal Computer hardware. Since PC cameras have become widespread, their use for face-based PC logon has become feasible, though take-up seems to be very limited [5].
- **Surveillance-** The application domain where most interest in face recognition is being shown is probably surveillance. The video is the medium of choice for surveillance because of the richness and type of information that it contains and naturally, for applications that require identification, face recognition is the best biometric for video data [15].
- **Smart Card applications**: In lieu of maintaining a database of facial images, the face-print can be stored in a smart card, bar code or magnetic stripe, authentication of which is performed by matching the live image and the stored template.
- **Border Control -**Biometrics technology is used to provide effective identification processes, and definitely a relevant security solution for Border Control/ Airports. Iris recognition, fingerprinting, document verification and vascular verification are all burgeoning Biometric technologies.

III. Existing of Face Detection And Recognition Method

3.1 FACE RECOGNITION

- **HAAR CLASSIFIER** -The core basis for Haar classifier object detection is the Haar-like features. These features, rather than using the intensity values of a pixel, use the change in contrast values between adjacent rectangular groups of pixels. The contrast variances between the pixel groups are used to determine relative light and dark areas. Two or three adjacent groups with a relative contrast variance form a Haar-like feature.

Haar-like features are used to detect an image. Haar features can easily be scaled by increasing or decreasing the size of the pixel group being examined. This allows features to be used to detect objects of various sizes.

- **PCA-** Derived from Karhunen-Loeve's transformation. Given an s-dimensional vector representation of each face in a training set of images, Principal Component Analysis (PCA) tends to find dimensional subspace whose basis vectors correspond to the maximum variance direction in the original image space. This new subspace is normally lowered dimensional (t<<**s).**
- **ICA** -Independent Component Analysis (ICA) minimizes both second-order and higher-order dependencies in the input data and attempts to find the basis along which the data (when projected onto them) are - statistically independent. Bartlett et al. provided two architectures of ICA for face recognition task: Architecture I - statistically independent basis images, and Architecture II - factorial code representation.
- **LDA**- Linear Discriminant Analysis (LDA) finds the vectors in the underlying space that best discriminate among classes. For all samples of all classes the between-class scatter matrix SB and the within-class scatter matrix SW are defined. The goal is to maximize SB while minimizing SW, in other words, maximize the ratio det|SB|/det|SW|. This ratio is maximized when the column vectors of the projection matrix are the eigenvectors of (SW^-1 × SB).
- **EBGM**- Elastic Bunch Graph Matching (EBGM). All human faces share a similar topological structure. Faces are represented as graphs, with nodes positioned at fiducial points. (exes, nose...) and edges labeled with 2-D distance vectors. Each node contains a set of 40 complex Gabor wavelet coefficients at different scales and orientations (phase, amplitude). They are called "jets". Recognition is based on labeled graphs. A labeled graph is a set of nodes connected by edges, nodes are labeled with jets, edges are labeled with distances.
- **Kernel methods-** The face manifold in subspace need not be linear. Kernel methods are a generalization of linear methods. Direct non-linear manifold schemes are explored to learn this non-linear manifold.
- **EP**-A Eigen space-based adaptive approach that searches for the best set of projection axes in order to maximize a fitness function, measuring at the same time the classification accuracy and generalization ability of the system. Because the dimension of the solution space of this problem is too big, it is solved using a specific kind of genetic algorithm called Evolutionary Pursuit (EP).[2]
- **Trace transform-** The Trace transform, a generalization of the Radon transform, is a new tool for image processing which can be used for recognizing objects under transformations, e.g. rotation, translation, and scaling. To produce the Trace transform one computes a functional along tracing lines of an image. Different Trace transforms can be produced from an image using different trace functional.
- **SVM-**Given a set of points belonging to two classes, a Support Vector Machine (SVM) finds the hyperplane that separates the largest possible fraction of points of the same class on the same side while maximizing the distance from either class to the hyperplane. PCA is first used to extract features of face images and then discrimination functions between each pair of images are learned by SVMs.
- **AAM** -An Active Appearance Model (AAM) is an integrated statistical model which combines a model of shape variation with a model of the appearance variations in a shape-normalized frame. An AAM contains a statistical model if the shape and gray-level appearance of the object of interest which can generalize to almost any valid example. Matching to an image involves finding model parameters which minimize the difference between the image and a synthesized model example projected into the image.[2]

3.2 Face Detection

The Face detection has been one of the most studied topics in the computer vision literature. In this paper, this paper is about the recent advances in face detection for the past decade. This survey is about the various techniques according to how they extract features and what learning algorithms are adopted and after studied those methods we have divided them into different categories .we will discuss them one by one.

The total detection method is divided into two types

- **Model-based** In this section we placed the methods which detect the faces according to models means 2-d or 3-d model based. Some other methods which are related to face detection and process the steps according to models we had placed them on the list.

- **2-D Model-Based**
    - **3-D Model-Based**
- **Advanced based** In this section we had placed some advanced methods and techniques which are based on some other method

3.2.1. Two-D-MODEL Video security systems are a well-known concept in daily life, nowadays 2D systems are the systems that are used. Now we are listing out the technique which falls under the 2-d model. 2-d model is mainly divided into following types-

- **Feature-based** -The techniques under this method are Low-level analysis -This technique is based on the concept of analyzing low-level visual features by using pixel properties like intensity levels, edges, and color properties.
- **Edge-based face detection**- Edge is the most primitive feature in computer vision applications and it was applied in some earlier face detection techniques by Sakai et al. It was based on analyzing line drawings of faces to locate facial features.
- **Skin color-based face detection**-Skin color plays an important role in detecting faces in color images because skin chromaticity values of different color space can be effectively used to segment the input image. It helps to identify the probable regions containing faces.

3.2.2 Three-D MODEL BASED There is a growing demand for better facial recognition systems, those which have lesser or no problems with lightning, different angles and expressions. 3D facial recognition is an upcoming market, the techniques are getting better, the research completer and the hardware less expensive. Now we will discuss the techniques which fall under 3-D model

- **Knowledge-based methods** -This model based on human knowledge of the typical human face geometry and facial features arrangement A hierarchical approach may be used, which examines the face at different resolution levels.[4].
- **Feature invariant Method** -This aim to find structural features that exist even when the viewpoint or lighting conditions vary and then use these to locate faces. Different structural features are being used: facial local features, texture, and shape and skin color.
- **Template Matching Approaches-**To detect a face in a new image, first, the head outline, which is fairly consistently roughly elliptical, is detected using filters, edge detectors, or silhouettes. Then the contours of local facial features are extracted in the same way, exploiting knowledge of face and feature geometry.

3.2.3 Other Face Detection Methods-

Level based face detection-The gray information of an image can also consider as features. For example, facial features like eyebrows, pupils, and lips are usually darker than their surrounding regions. This property can be useful to differentiate various facial parts. Several recent facial feature extraction algorithms are basically searching for local gray minima within segmented facial regions.

Motion-based face detection- When the use of video sequence is available, motion information can be used to locate moving objects. Moving silhouettes like face and body parts can be extracted by simply Thresholding accumulated frame differences. Besides face regions, the facial feature can is located by frame differences.

- **Generalized measures** -So far we have considered low-level features like edges, skin color, gray level intensity and motion; all of these techniques are derived in the early stage of the human visual system. This visual system is nothing but the various responses made by our inner retina. This pre-attentive processing allows visual information to be organized in various bases prior to high-level visual activities in the brain.
- **Active Shape Models**-Active shape models focus on complex non-rigid features like actual physical and higher level appearance of features. Active shape models use local features (edges, brightness) to find the shape of feature models. Active shape models are divided into three groups: These are snakes, deformable templates, and point distribution models Snakes -In this approach, active contours or snakes are used to locate head boundary. Also, features boundaries can be found by these contours. To achieve our task we have to initialize the starting position of the snake, which may be in the proximity around the head boundary.

IV. Challenges in face detection and recognition

Face recognition in outdoor platforms still remains a challenging topic the effect of variation in the illumination conditions, which causes dramatic changes in the face appearance, is one of the most challenging problems that a practical face recognition system needs to achieve.

- **Face pose**- In a surveillance system, the camera is mostly mounted to a location where the people cannot reach to the camera. Mounting a camera a high location, the faces are viewed by some angle degree. This is the simplest case in city surveillance applications. The next and the most difficult case is that people naturally pass through the camera view. They do not even look at the camera lens. Authorities cannot restrict people behaviors in public places. Recognition in such cases must be done in an accurate way. However, even state-of-the-art- techniques have 10 or 15degree angle limitation to recognize a face. Recognizing faces from more angles is another challenge.
- **Face expression**-Face expression is a less significant issue compared with angle and illumination but it affects the face.
- **Recognition results**- Although a close eye or smiling face does affect the recognition rate by 1% to 10 percent, a face with a large laugh has an influence as more as 30% since a laughing face changes the facial appearance and distorts the correlation of eyes, mouth, and nose.
- **Face aging-**Face recognition algorithms are using either geometrical techniques or feature-based approaches or holistic methods. All of them do not solve the aging problem. Almost all of them give an age tolerance as long as 20 years after the training. Faces between 1 year and 15 years cannot be recognized since face appearance changes fast. Face appearance becomes stable after teenage years. A recognition algorithm that can recognize faces for all ages does not exist.
- **Dynamic Background**- It is easier to recognize a face when the background is stable or single but problems arise when the background is moving or dynamic. Multiple face-Single face recognition easy in comparison to multiple faces so it is also a big challenge in this field.

V. CONCLUSIONS AND FUTURE WORKS

In recent years face recognition has received substantial attention from researchers in biometrics, pattern recognition, and computer vision communities. There is a large number of commercial, securities, and forensic applications requiring the use of face recognition technologies. As you can see, face recognition system is very important in our daily life. It possesses a really great advantage. Among the whole types of biometric, face recognition system is the most accurate. In this paper the classification of face detection techniques been done with that some of the face recognition algorithms and techniques been discussed along with their advantage and disadvantage in tabular form.

In future work, we will present more efficient face detection and recognition method, which will be more accurate than the existing system. Also performed a comparative analysis in between existing method and the proposed method.

VI. REFERENCES

[1]. Michel Owayjan1, 2, Roger Achkar2, Moussa Iskandar2," Face Detection with Expression Recognition using Artificial Neural Networks", 2016 3rd Middle East Conference on Biomedical Engineering (MECBME), IEEE 2016 PP 978-983.

[2]. Wonjun Kim,1 Chanho Jung,2 and Simone Bianco, "Optimization for Detection and Recognition in Images and Videos", Hindawi Mathematical Problems in Engineering Volume 2017, Article ID 5190490, 401-403

[3]. G.Suvarna Kumar P.V.G.D Prasad Reddy R.Anil Kumar Sumit Gupta," Position Detection with Face Recognition using Image Processing and Machine Learning Techniques", IJCA Special Issue on "Novel Aspects of Digital Imaging Applications" DIA, 2011, PP 79-88

[4]. Wilson, Phillip Ian, and John Fernandez. "Facial feature detection using Haar classifiers." Journal of Computing Sciences in Colleges 21.4 (2006): 127-133.

[5]. Scheenstra, Alize, Arnout Ruifrok, and Remco C. Veltkamp. "A survey of 3D face recognition methods." Audio-and Video-Based Biometric

Person Authentication. Springer Berlin Heidelberg, (2005).
[6]. Viola, Paul, and Michael J. Jones. "Robust real-time face detection." International journal of computer vision 57.2 (2004): 137-154.
[7]. Jafri, Rabia, and Hamid R. Arabnia. "A Survey of Face Recognition Techniques." JIPS 5.2 (2009): 41-68.
[8]. Al-Ghamdi, Bayan Ali Saad, Sumayyah Redhwan Allaam, and Safeeullah Soomro. "Recognition of Human Face by Face Recognition System using 3D." Journal of Information & Communication Technology Vol 4: 27-34.
[9]. Siddharth Swarup Rautaray and Anupam Agrawal, "Real Time Multiple Hand Gesture Recognition System for Human-Computer Interaction, In International Journal of Intelligent Systems and Applications, 2012, 5, 56-64, DOI: 10.5815/ijisa.2012.05.08
[10]. Song, Fengxi, et al. "A multiple maxima scatter difference discriminant criterion for facial feature extraction." Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on 37.6 (2007): 1599- 1606.
[11]. Zhao, Wenyi, et al. "Face recognition: A literature survey." Acm Computing Surveys (CSUR) (2003): 399-458.
[12]. Abate, Andrea F., et al. "2D and 3D face recognition: A survey." Pattern Recognition Letters 28.14 (2007): 1885- 1906.
[13]. Colombo, Alessandro, Claudio Cusano, and Raimondo Schettini. "3D face detection using curvature analysis." Pattern recognition (2006): 444-455.
[14]. Zhou, Xuebing, et al. "A 3d face recognition algorithm using histogram-based features." Proceedings of the 1st Eurographics conference on 3D Object Retrieval. Eurographics Association, 2008.
[15]. Sadi, Vural. "Face recognition by using hybrid-holistic methods for outdoor surveillance systems." (2012).
[16]. Belhumeur, Peter N. "Ongoing Challenges in Face Recognition." Frontiers of Engineering: Papers on Leading-Edge Engineering from the 2005 Symposium. 2005.
[17]. Nigam, Aditya. A Novel Face Recognition Approach using Normalized Unmatched Points Measure. Diss. INDIAN INSTITUTE OF TECHNOLOGY, 2009.
[18]. Vully, Mahesh Kumar. Facial expression detection using principal component analysis. Diss. 2011.
[19]. Fladsrud, Tom, and False Acceptance Rate. "Face Recognition in a border control environment." Gjøvik University College (2005).
[20]. Patra, Arpita. "Development of efficient methods for face recognition and multimodal biometry." (2006).
[21]. Vucini, Emerald, Muhittin Gökmen, and Eduard Gröller. "Face recognition under varying illumination." Proceedings WSCG. 2007.