Study of Recent Face Descriptor Methods for Face Tracking and Recognition Systems

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Abstract: The process of human authentication and verification in many real-time applications is widely used to improve the security systems. The biometrics such as face and fingerprints are widely used for the human authentication systems. The face recognition is challenging as compared to the fingerprint recognition methods due to the different conditions of face capturing. For the robust face tracking and recognition, the face capturing techniques needs to address the problems of facial variations, various illumination conditions, plastic surgery, low-resolution images etc. These factors made the task of face tracking/detecting and recognition difficult. To address such challenges, recently various face descriptors designed. In this paper, we present the review of existing face tracking and recognition methods study. The comparative study presented in this paper along with the real-time datasets used for the evaluation. From the literature review, we present the various limitations and research gaps identified in this paper. The outcome of this paper is the future roadmap for the further development and enhancement in face recognition systems.

Keywords: Face recognition, face descriptors, feature extraction, face detection, classifiers.

I. INTRODUCTION

The Face Tracking and Recognition has got a continuous attention for many decades. It is an important research topic in computer face identification techniques. The many techniques are developed to obtain face image characteristics to lower dimensional features for tracking and recognition. Automatic Face Tracking and Recognition is the ability to establish a human identity based on facial characteristics. In that many techniques compare the facial features with the test images and facial databases. Usually, the face image of a test subject is matched to the gallery data using a one-to-one or one-to-many scheme [1-3]. The one-to-one and one-to-many matching are called verification and identification, respectively.

The face is one of the simplest approaches to recognize the individual identity of each other. Face recognition is an individual identification system that utilizations individual qualities of a man to distinguish the individual's identity. Human face recognition method fundamentally comprises of two stages, in particular, face detection, where this procedure happens quickly in people, with the exception of under conditions where the protest is situated at a short separation away, the following is the presentation, which perceives a face as people. A stage is then recreated and created as a model for facial image recognition (face recognition) is one of the much-examined biometrics advancements and created by specialists.

The face tracking and recognition popularity are growing; there are several reasons for it. Firstly, it has the advantage of passive identification in the sense that the person to be identified need not have any active participation and even then it can work unobtrusively in the background without disturbing or interrupting the subjects to be identified [4-6]. Secondly, the face image conveys several additional information like the gender, approximate age, the emotional state of the subject like happiness, anger etc [7].

The factors affecting the recognition performance of face biometrics are mainly the variation in lighting conditions, pose, expression variations, and aging [8]. Although in the last decade there are significant improvements in the performance of face tracking and recognition, in many cases, it requires further research and improvements to reach its acceptable levels. The Face tracking and identification are implemented as the process of extracting face characteristics from images and videos. It is used for identification image area as a face positively [9]. Nowadays in the market, many applications are available like face tracking, face identification, pose estimation and compression. Nowadays, In the feature extraction of the other hand is usually applied to obtain the relevant facial features such as face regions, face variations, different angles and measures etc. from the dataset. These phases are based on the other applications like Facial Feature Tracking and Emotions Recognition [10].

The fundamental objective of face tracking and detection are processed if there any faces in the image and if show; restore the image location and degree of each face. The trouble related to face detection can be credited to the variations in scale, location, introduction, pose, facial expression, lighting conditions, impediments and so on [11]. The different strategies for detection have four classes; learning based, include invariant, layout coordinating and appearance-based techniques. Learning based techniques utilize predefined rules separated from human information to decide a face [12]. The component invariant methodologies mean to discover face structure includes that are strong to pose and lighting variations. The layout coordinating strategies utilize pre-put away face formats to distinguish a face [13-14]. The appearance-based strategies take in face models from an arrangement of agent preparing face images to perform detection and the greater part of the cutting edge face locators belong to this category.

In this paper, the remaining contents are organized in sections in below. In Section II, we describe Existing Face Tracking and Identification Techniques. In Section III, the review of all the studied methods is presented in tabular form. In Section IV, we mainly introduced the designing of efficient face representation and feature extraction techniques. And the last conclusions and future work are described in Section V.

II. LETERATURE REVIEW

In this review paper, we discuss the existing face tracking and identification techniques, also discuss its efficiency, accuracy and real-time execution of datasets. The face tracking and identification are widely used in new software, in social media and etc. We discuss the all related existing techniques below.

Jing Wang, et al (2014)

In [1] this research the author is presenting the Sparse representation (or coding) - based arrangement (SRC) has expanded phenomenal accomplishment in face recognition of late. Be that as it may, SRC underscores the deficiency too much and dismisses the relationship information which has been appeared to be essential in certifiable face recognition issues. Besides, some paper considers the relationship anyway ignores the discriminative capacity of deficiency. Not the same as these present techniques, in this paper, we propose a structure called adaptive sparse representation-based arrangement (ASRC) in which deficiency and relationship are as one considered. Specifically, when the illustrations are of low relationship, ASRC picks the most discriminative cases for representation, as SRC; when the preparation tests are significantly associated, ASRC picks most of the compared and discriminative cases for representation, as opposed to picking some related examples haphazardly. As a rule, the representation display is adaptive to the connection structure that advantages from both 1-standard and 2-standard. Broad trials led on openly accessible informational collections confirm the adequacy and strength of the proposed calculation by contrasting it and the condition of-danger techniques.

Chuan-Xian Ren, et al (2014)

In [2] the author is discussing Face recognition under uncontrolled conditions, e.g., complex establishments and variable resolutions are up 'til now troublesome in image processing and PC vision. Yet various techniques have been shown all-around performer in the controlled settings, they are for the most part of feeble all-inclusive statement crosswise over various datasets. In the interim, a few properties of the source area, for example, foundation and the measure of subjects, assume an essential part in deciding the last classification comes about. A transferable representation learning model is proposed in this paper to overhaul the recognition execution. To significantly manhandle the discriminant information from the source space and the goal territory, the bioinspired face representation is exhibited as sorted out and generally stable depiction for the mutual trademark between different territories. The strategy yields an assembled increase in the highlights and shows a sensible way to highlight and sharing discriminant presentations and scales. Notice that the technique can be viewed as a framework, since other part age executives and classification estimations can be introduced in that, and a short time later, it can be associated with more expansive issues, for example,

low-determination face recognition, question detection, and arrangement, et cetera. Analyses on the benchmark databases, including uncontrolled Face Recognition Grand Challenge v2.0 and Labeled Faces in the Wild, show the capability of the proposed trade learning computation.

Huu-Tuan Nguyen, et al (2015)

In [3] the author presents a novel segment extraction methodology named as neighborhood patterns of gradients (LPOG) for solid face recognition. LPOG uses square wised roundabout neighborhood parallel patterns (BELBP), a refined variety of ELBP, and nearby stage quantization (LPQ) overseers direct on incline images for getting neighborhood surface patterns to build up a part vector of a face image. From one data image, two directional tendency images are figured. Symmetric match of BELBP and an LPQ executive are then freely associated upon each slant image to make neighborhood patterns images. Histogram courses of action of nearby patterns images' non-secured sub-regions are finally associated with outline the LPOG vector for the given image. In view of LPOG descriptor, we propose a novel face recognition framework which abuses Whitened Principal Component Analysis (WPCA) for estimation diminishment and weighted point based partition for classification. Exploratory results on three considerable open databases (FERET, AR, and SCface) show that LPOG WPCA framework is solid against a broad assortment of challenges, for example, light, expression, impediment, pose, time-slip by variations and low determination. Likewise, correlation with different systems demonstrates that LPOGWPCA altogether beats best in class methods. Computationally, timing benchmarks in like manner show that our LPOG technique is speedier than various pushed highlight extraction figuring's and can be associated in authentic applications.

Jiwen Lu, et al (2015)

In [4] the author is described Binary component descriptors, for example, local binary patterns (LBP) and its differences are broadly utilized as a part of multiple face recognition systems because of their fantastic heartiness and solid discriminative power. Nonetheless, most existing binary face descriptors are hand-made, which require strong prior figuring out how to plan them by hand. In this paper, we propose a compact binary face descriptor (CBFD) highlight the learning procedure for face representation and recognition. Given each face image, they first think pixel contrast vectors (PDVs) in nearby fixes by enlisting the distinction between each pixel and its neighboring pixels. By then, we take in a component mapping to broaden these pixel distinction vectors (PDVs) into low-dimensional binary vectors in an unsupervised way, where 1) the difference in each binary code in the preparation set is extended, 2) the disaster between the primary certifiable regarded codes and the informed binary codes is constrained, and 3) binary codes consistently fitting at each scholarly canister, with the goal that the redundancy information in PDVs is cleared and compact binary codes are procured. All in all, we group and pool these binary codes into a histogram incorporate as the last representation for each

face image. Additionally, we propose a coupled CBFD (C-CBFD) system by diminishing the approach gap of heterogeneous faces at the component level to make our technique correlated to heterogeneous face recognition. The broad trial comes about on five generally utilized face datasets demonstrate that our methods outflank cutting edge face descriptors.

Wen Wang, et al (2015)

In [5] this research paper author describes the technique which named Discriminant Analysis on the Riemannian manifold of Gaussian distributions (DARG) to avoid the problems of face tracking and recognition with image datasets. We will probably catch the hidden data conveyance in each set and in this manner encourage more hearty classification. To this end, they speak to image dataset as Gaussian Mixture Model (GMM) containing various Gaussian segments with earlier probabilities and endeavor to isolate Gaussian parts from different classes. In the light of information geometry, the Gaussians lie on a specific Riemannian manifold. To encode such Riemannian geometry suitably, they research a few separations amongst Gaussians and further induce a movement of provably positive particular probabilistic parts. Through these pieces, a weighted Kernel Discriminant Analysis is finally planned which views the Gaussians in GMMs as tests and their prior probabilities as test weights. The proposed methodology is surveyed by face identification and check assignments on four most troublesome and greatest databases, YouTube Celebrities, COX, YouTube Face DB and Point-and-Shoot Challenge, to demonstrate its predominance over the cutting edge.

Chuan-Xian Ren, et al (2015)

In [6] the author develops the vigorous descriptor-based subspace learning with complex data is a functioning subject in design analysis and machine insight. A couple of looks into focus the ideal plan on highlight representation and metric learning. However, customarily utilized highlights of single-type, e.g., image gradient orientations (IGOs), are missing to depict the whole variations in energetic and discriminant subspace learning. At that point, brokenness in edge course of action and highlight organize are not been meticulously treated in the written work. In this paper, nearby request obliged IGOs are abused to make solid highlights. As the distinction based channels unequivocally consider the nearby complexities inside neighboring pixel centers, the proposed highlights enhance the neighborhood surfaces and the request based coding capacity, along these lines discover trademark structure of facial images further. The multimodal highlights are thus interwoven in the most discriminant subspace. The utilization of adaptive communication work stifles anomalies in each measurement for hearty likeness estimation and discriminant analysis. The deficiency drove backslide show is changed in accordance with altering the classification issue of the compact segment representation. Wide preliminaries are coordinated by using some benchmark face informational collections, e.g., of controlled and uncontrolled conditions, to evaluate our new count.

Yulong Wang, et al (2015)

In [7] the author presents Representation-based classifiers (RCs) have pulled in extensive consideration in face recognition lately. However, most existing RCs use the mean square mistake (MSE) lead as the cost work, which relies upon the Gaussianity doubt of the blunder course and is fragile to non-Gaussian noise. This may genuinely corrupt the execution of MSE-based RCs in seeing facial images with sporadic hindrance and debasement. In this paper, we show a base mistake entropy-based atomic representation (MEEAR) framework for face recognition. Unlike existing MSE-based RCs, our structure depends on the base blunder entropy premise, which isn't subject to the error conveyance and appeared to be more vigorous to the commotion.

Zhihong Zhang, et al (2016)

In [8] the author is presenting the Sparse Representation (or coding) based Classification (SRC), it is expanded mind-boggling accomplishment in face recognition. In SRC, the testing image is depended upon to be best addressed as a sparse straight blend of training images from a comparable class, and the representation dedication is assessed by the ℓ 2-standard or ℓ 1-standard of the coding waiting. However, SRC stresses the deficiency exorbitantly and overlooks the spatial information in the midst of local part encoding process which has been shown to be fundamental in authentic face recognition issues. In addition, some work thinks about the spatial information yet overlooks the assorted discriminative ability in different face locales. In this paper, we propose to weight spatial locations based on their discriminative limits in sparse coding for solid face recognition. In particular, they take in the weights at face locations as demonstrated by the information entropy in each face locale, in order to highlight locations in face images that are basic for classification. Additionally, in order to create healthy weights to totally abuse structure information of each face locale, we used external data to take in the weights, which can cover all possible face image variations of different individuals, so the energy of procured weights can be ensured. At last, they consider the social event structure of training images (i.e. those from a comparative subject) and incorporated a ℓ 2,1-standard (total Lasso) basic upon the definition, which approving the deficiency at the social event level. Expansive examinations on three benchmark face datasets demonstrate that our proposed system is significantly more generous and reasonable than design methods in overseeing face obstacle, degradation, lighting and expression changes, etc.

III. COMPARATIVE STUDY

In In this section, the review of all the studied methods is presented in tabular form in table 1. Table 2 presents the various datasets evaluated and their accuracies measured.

Ref.	Title	Face Tracking/ Detection	Face Descriptor/Feature Extraction

No.			
1	Robust Face Recognition via Adaptive Sparse Representation	Adaptive Sparse Representation, face recognition, sparse representation based classification and trace lasso.	Eigenfaces and Gabor feature extraction
2	Transfer Learning of Structured Representation for Face Recognition.	Face recognition, heterogeneous data, image representation, transfer learning, low-resolution.	Discriminant feature extraction, structured feature representation, and discriminant subspaces, representation learning.
3	Local Patterns of Gradients (LPOG) for Face Recognition	Local Patterns of Gradients (LPOG), gradient local features based WPCA, block-wise ELBP, facial feature extraction, robust face recognition, robust occlusion face recognition, video surveillance face identification.	novel feature extraction method, LOCAL PATTERNS OF GRADIENTS (LPOG) FEATURE EXTRACTION
4	Learning Compact Binary Face Descriptor for Face Recognition	Face recognition, heterogeneous face matching, feature learning, binary feature, compact feature, biometrics	CBFD Feature Extraction,
6	Enhanced Local Gradient Order Features and Discriminant Analysis for Face Recognition	Discontinuity, image gradient, orders features, sparse representation, subspace learning.	Enhanced IGO descriptor is used to robust feature extraction
10	Class-wise Sparse and Collaborative Patch Representation for Face Recognition	class-wise sparse representation (CSR), Sparse representation, class-wise sparsity, classification, holistic, patch-based, face recognition	Gabor feature based SRC, SRC based feature extraction.
13	Face Recognition via Collaborative Representation: Its Discriminant Nature and Superposed Representation	superposed linear representation classifier (SLRC), Sparse representation, Collaborative representation, Sparse subspace clustering, Face clustering, Face recognition	Gabor feature, LBP feature and PCANet feature
14	Local Directional Number Pattern for Face Analysis: Face and Expression Recognition	local directional number pattern (LDN), Directional number pattern, expression recognition, face descriptor, face recognition, feature, image descriptor, local pattern	Local Binary Pattern (LBP)

Ref. No.	Datasets	Accuracy (%)
4	CASIA NIR-VIS 2.0	93.2%

5	YouTube Celebrities (YTC)	90.13%
8(a)	ORL dataset	96.3%
8(b)	YaleB dataset	98.5%
8(c)	AR dataset	93%
10	CMU PIE dataset	90.4%
12	LFW Dataset	78.7%
14	LDN	92.86%

IV. RESEARCH GAP

The methods studied in section II mainly introduced the designing of efficient face representation and feature extraction techniques. Only a few works reported addressing the problems associated with uncontrolled face recognition with very less efficiency. Therefore, the challenge of real-time face tracking and recognition is yet to address completely.

V. CONCLUSION AND FUTURE WORK

Nowadays the Face Tracking and Recognition is the important topic to research, many techniques are developed for the Face Tracking and Recognition but the efficiency or accuracy are not gathered by anyone. The Face Tracking and Recognition are not an easy task to develop for acquiring the efficiency and accuracy. In this Review Paper, we discuss some popular researches on face recognition of its techniques, feature extraction techniques, and datasets are used in research.

REFERENCES

[1] Jing Wang, Canyi Lu, Meng Wang, Member, IEEE, Peipei Li, Shuicheng Yan, "Robust Face Recognition via Adaptive Sparse Representation", IEEE TRANSACTIONS ON CYBERNETICS, 2014
[2] Chuan-Xian Ren, Member, IEEE, Dao-Qing Dai, Member, IEEE, Ke-Kun Huang, and Zhao-Rong Lai, "Transfer Learning of Structured Representation for Face Recognition", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 23, NO. 12, DECEMBER 2014
[3] Huu-Tuan Nguyen and Alice Caplier, "Local Patterns of Gradients (LPOG) for Face Recognition", IEEE Transactions on Information Forensics and Security 2015.
[4] Jiwen Lu, Member, IEEE, Venice Erin Liong, Xiuzhuang Zhou, Member, IEEE, and Jie Zhou, "Learning Compact Binary Face Descriptor for Face Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence, 2015
[5] Wen Wang1, Ruiping Wang1, Zhiwu Huang1, Shiguang Shan1, Xilin Chen1, "Discriminant Analysis on Riemannian Manifold of Gaussian Distributions for Face Recognition with Image Sets", 2015 IEEE
[6] Chuan-Xian Ren, Zhen Lei, Member, IEEE, Dao-Qing Dai, Member, IEEE, and Stan Z. Li, "Enhanced Local Gradient Order Features and Discriminant Analysis for Face Recognition", IEEE TRANSACTIONS ON CYBERNETICS, 2015.

[7] Yulong Wang, Student Member, IEEE, Yuan Yan Tang, Fellow, IEEE, and Luoqing Li, "Robust Face Recognition via Minimum Error Entropy-Based Atomic Representation", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 24, NO. 12, DECEMBER 2015
[8] Zhihong Zhang, Yuanheng Liang, Lu BaiEdwin, R. Hancock, "Discriminative sparse representation for face recognition", Multimedia Tools and Applications, April 2016, Volume 75, Issue 7, pp 3973–3992
[9] Niall McLaughlin, Ji Ming, and Danny Crookes, "Largest Matching Areas for Illumination and Occlusion Robust Face Recognition", IEEE TRANSACTIONS ON CYBERNETICS, 2016
[10]Jian Lai, Xudong Jiang, "Class-wise Sparse and Collaborative Patch Representation for Face Recognition", IEEE TRANSACTIONS ON IMAGE PROCESSING,2016.
[11]Yong Xu, Zuofeng Zhong, Jian Yang, Jane You, and David Zhang, "A New Discriminative Sparse Representation Method for Robust Face Recognition via l2 Regularization", IEEE TRANSACTIONS ON NEURAL NETWORKS AND LEARNING SYSTEMS, 2016.
[12]Weilin Huang, Hujun Yin, "Robust face recognition with structural binary gradient patterns", Pattern Recognition 68 (2017) 126–140
[13]Weihong Deng, Jiani Hu, and Jun Guo, "Face Recognition via Collaborative Representation: Its Discriminant Nature and Superposed Representation", IEEE Transactions on Pattern Analysis and Machine Intelligence, 2017.
[14]Adin Ramirez Rivera, Jorge Rojas Castillo, and Oksam Chae, “Local Directional Number Pattern for Face Analysis: Face and Expression Recognition”, IEEE transactions on image processing, vol. 22, no. 5, may 2013.