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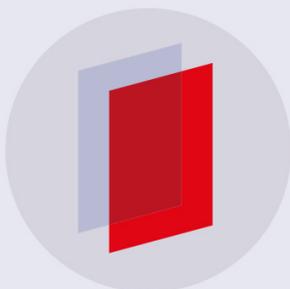
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A review study: The effect of face aging at Estimating Age and Face Recognition

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Abstract. The face may be a made supply of data for indicating the personal characteristics like identity, ethnicity, expression, age and gender. The face characteristics measure thought-about jointly of the necessary individual characteristics. This could be utilized in several software, like age estimation and face recognition. The value of those applications depends on different areas, like security applications and group action application. Additionally, face expression square measure notably important with finding the lost kid, this applications have accomplish high level of accuracy. The paper offers a survey of face aging recognition. Furthermore, the analysis faced many challenges in face recognition space that had been explored. The analysis all over that face algorithms performance is distinct from one to another. This research contributes to display the gaps for different methods on this line of research.

1. Introduction

The external body part could be a made supply of knowledge for indicating personal characteristics like identity, quality, expression, gender and age . This information has been used widely in face-based Human-Computer Interaction (HCI) to process facial features showed in human-to-human communication [1]. Especially, analysis associated with facial age simulation is additional necessary than ever as a result of it's employed in several real-world applications together with public and industrial systems. Facial age simulation is employed as a core technology in several public systems like rhetorical montages of semi-permanent unsolved cases, the rummage around for missing youngsters or separated families, and biometric authentication sturdy to aging. Identification and authentication characteristics like fingerprints, face, signature , hand geometry , voice , and iris signature dynamics are distinctive to each individual and may be used for human biometric verification and/or identification strategies .Up to now, face recognition systems may be viewed because the most triple-crown application of biometric strategies that have gained vital attention .One final goal of image analysis is to mechanically detect/recognize real objects or scenes. for several applications, merely knowing the presence or absence of associate degree object is beneficial. one in every of the most important issues within the style of recent face process systems (e.g. face recognition) is automatic face detection from pictures.

Face detection is becoming an active research area spanning several disciplines such as biometrics , image processing, , machine learning, artificial intelligence , computer vision and pattern recognition **.** Automatic face recognition systems are presently deployed in several necessary applications. Face recognition plays a key role in de-duplication to stop someone from getting multiple ID cards, like passports and driver's license. Automatic face recognition applications are currently more accurate, as well as "tag" suggestions on Facebook, organization of private exposure collections, and portable unlock. Among them face maturing is a dynamic aggregation of changes with time, and how quick we age shifts starting with one individual then onto the next. Ageing impacts both shape and

surface, and is normally contributed by our qualities, natural impacts and way of life. Face discovery and facial component extraction have increased extensive consideration in parallel with the progression of human-machine. Face is the most particular piece of a human body, which is utilized to recognize and recognize an individual. This clarifies why face discovery, a procedure of restricting and separating the face district from the foundation is an essential initial phase in facial acknowledgment frameworks. Face detection is a basic piece of a programmed picture handling applications, for example, secure access control , human-computer interaction , financial transaction systems , surveillance systems , video conferencing, forensic application , pedestrian detection, image database management systems and driver alertness monitoring systems. The applications of face detection mentioned above are only a few of many showing the importance of this technology. Detection of faces in images is not a trivial task. This task becomes even more challenging for images containing variations in the orientation, lighting conditions, occasions, background, pose and facial expressions. The challenge in detecting facial patterns is findings a way to extract features that are consistent and fast to compute.

2.   Methodology
The most significant keywords in this paper is face aging recognition. This except any software, which does not utilize facial features in its processes. Moreover this study criteria relevant to the English papers. Also, this paper reflects all aging areas.

A. Information Sources
The review articles were chosen from five databases, Web of Science (WoS) service, Springer database, Science Direct database, ACM Digital Library and IEEE Xplore library.

B. How to select the Paper:
There were two stages to select the paper: extract papers and filtering. Through the extraction procedure, irrelevant paper and duplicated papers were taken away. The filtering stage took place after reading the paper.

C. Eligibility Criteria
Any article that met the criteria which presented in Figure 1 was selected. The key terms are face recognition and facial features .Also the articles must be in English. The standard for filtering was based on the dated from 2011 to 2017.
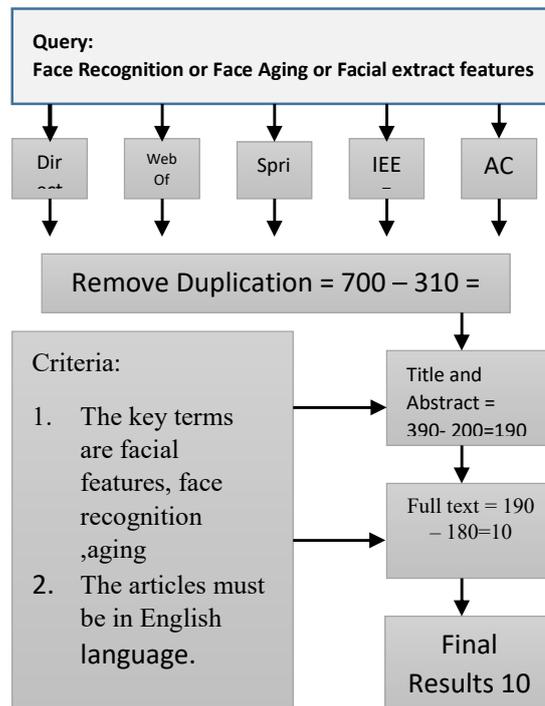
Fig 1. The Flowchart for the selection process .

3. Results and Discussion

3.1 Databases

During the evaluation procedure for different methods and algorithms in the selected review papers, as shown in Table 1.

Table 1. Image Database

Name of Database	Number of Images	Approach
LFW	13,233	Orthogonal embedding CNN (OE-CNN)
FG-NET	1,002	Orthogonal embedding CNN (OE-CNN)
CACD-VS	163,446	Orthogonal embedding CNN (OE-CNN)
Morph	20,000	Orthogonal embedding CNN (OE-CNN)
Children Longitudinal Face (CLF)	3, 682 face images of 919 subjects	longitudinal study of face recognition
Cross-Age Celebrity Dataset (CACD)	160,000 face images of 2,000 ranging from 16 to 62	Identity-Preserved Conditional Generative Adversarial Networks
MORPH	79897	Multi-feature discriminant analysis
FGNET	1006	Multi-feature discriminant analysis
CACD	575	Contextual Generative Adversarial Nets
FGNET	649	Contextual Generative Adversarial Nets

LFW	1, 962	Contextual Generative Adversarial Nets
SUP	166	Contextual Generative Adversarial Nets
Morph	695	Contextual Generative Adversarial Nets

3.2 Taxonomy Based On Face Recognition

Generative Adversarial Networks have been used to generate synthetic images of exceptional visual fidelity. The framework have two steps: first step is to input face reconstruction, and the second is face aging itself accomplished by a simple variation of condition y at the input of the generator. The framework was been evaluated by IMDB-Wiki cleaned dataset with 82.9% performance[1]. Also Recurrent neural network have been used to recognize the ages from 0 to 80 .This algorithm were evaluated in 3 datasets Cross-Age Celebrity Dataset (CACD) , Labelled Faces in the Wild (LFW) and Morph Aging Dataset , in general the performance was 98.40%[2]. A model have been presented for face aging recognition. This model have two-level for aging face recognition. In the first level local pattern selection (LPS) have been used to learned the effective features. In the second level, the input came from the first level , where a higher visual information is retrieved. The model was been evaluated on the MORPH data set and FGNET dataset with performance 94.87%[3].

A deep network framework was built for to verify face aging based on the Siamese deep neural network. This framework have 2 tasks , the primary learning task which is face verification and the secondary learning task age estimation . It was evaluated by MORPH dataset with MAE 5.13 [4]. A framework based on fuzzy cmeans proposed to assessment person age by analysis the wrinkle .

The framework was evaluated by collected dataset from 120 images, the accuracy was up to 87.5%[5]. Orthogonal Embedding CNNs, or OE-CNNs is an approach used for facial features age-invariant. It has two component the orthogonal components to represent age-related and identity-related features. I t was evaluated by 4 dataset : LFW with accuracy 99.47%, FG-NET with accuracy 58.21% , CACD-VS with accuracy 99.2% and finally Morph with accuracy 98.67%[6] .The framework was built for automatic face children recognition , it was evaluated by Children Longitudinal Face (CLF) with accuracy 90.18%[7] . Identity-Preserved Conditional Generative Adversarial Networks (IPCGANs) is an approach to face aging recognition. It was evaluated by Cross-Age Celebrity Dataset (CACD) , which have 160,000 face images , this images were with range age 16 to 62 years .The accuracy become 99.07 %[8]. An algorithm have been development called multi-feature discriminant analysis (MFDA) , which is improvement of the Linear Discriminant Analysis (LDA) . As an effective matching framework for age invariant face recognition remains an open problem . The Framework was evaluated by 2 datasets MORPH and FG-NET , with accuracy 83.9% and 47.50% . But the proposed framework have vulnerable to detect pose changes [9] . Contextual Generative Adversarial Nets (C-GANs) have been proposed to resolve the face aging challenges. This system evaluated by 5 datasets CACD , FGNET , LFW , Morph and SUP[10].

Table 2. Past Research

Citation	Objective	Dataset	No. images	Problem	method	Result
[11]	GAN-based method for automatic face aging	IMDB-Wiki cleaned	12k	synthetic aging of human faces	Generative Adversarial Networks	82.9%
[12]	estimate the age of a person by analysis of	Collected images	120	**age progression effect with skin texture**	**fuzzy cmeans**	87.5%.

	wrinkle on face images.					
[10]	to improve cross age face verification performance with age information	MORPH	15000	**the aging factors in face recognition**	Siamese network	MAE 5.13
[3]	matching a person's older face to his (or her) younger one	MORPH , FGNET	22692	**Facial appearance changes significantly in the human aging process**	local pattern selection (LPS)	94.87%
[2]	To identify the ages of people from 0 to 80	LFW , MORP ,CAD	10635	the lack of labeled face data of the same person captured in a long range of ages	recurrent neural network	98.40
[6]	To learn the age-invariant deep face features.	LFW , FG-NET , CACD-VS	13,233 , 1002	age-invariant face recognition (AIFR) remains a major challenge in face recognition community		99.47% , 58.21% , 99.2%
[7]	Investigate the feasibility of automatic face recognition for children in the age group of 2 to 18 years	Children Longitudinal Face (CLF)	3, 682 face images of 919 subjects	*The features for recognition*	*longitudinal study of face recognition*	90.18%
[8]	To synthesizing a face whose target age lies in some given age group instead of synthesizing a	Cross-Age Celebrity Dataset (CACD)	160,000 face images of 2,000 celebrities with age ranging from 16 to 62	Identity-Preserved Conditional Generative Adversarial Networks (IPCGANs)	*lack of labelled faces of the same person across a long age range*	99.07

	face with a certain age.				
[9]	To discriminative model to address face matching in the presence of age variation	(MORPH and FGNET	80903	Multi-feature discriminant analysis (MFDA)	Build a system for age invariant face recognition remains is one of the problems
[10]	To distinguish the real transition patterns with the fake ones.	CACD , FGNET , LFW , Morph and SUP dataset	4, 047	Contextual Generative Adversarial Nets (C-GANs)	All most the algorithm fail to capture the transition patterns aging

Open issues and challenges with possible solutions
a. Large number of images:
    There are lack in the number of images for the same person in different age , which need to learn the aging patterns [13].
b. Ignore some important features
    Some important features have been ignored by the models, also some models failed in labelling facial variation in different age, that lead a lack in detect crucial aging details as pigments and wrinkles[13].
c. Difficult to describe the stochasticity aging process
    The main issues is to study the aging changing stochasticity, it is difficult to predict the different aging changing from person to another.

3.3 The Proposed Framework
The architecture for the proposed work is shown in Figure 2, where the input for the framework is the person image that need to recognise.
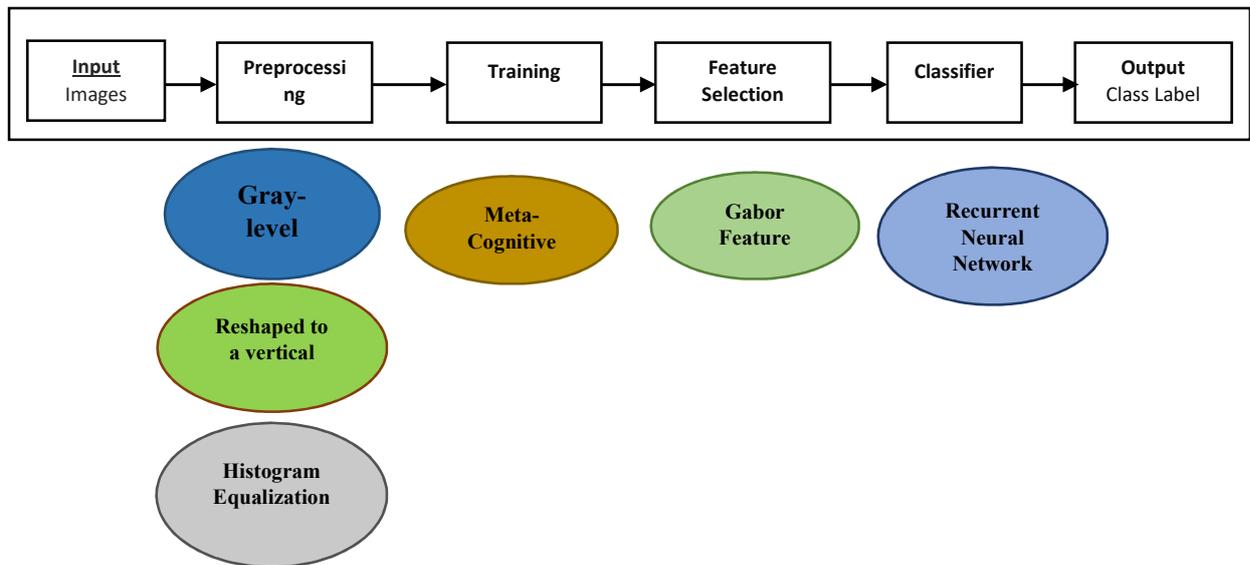
Fig 2. Architecture for face aging recognition framework

a.   Recurrent Neural Network

Recurrent Neural Networks (RNN) are powerful models that offer a compact, shared parametrization of a series of conditional distributions. RNNs have been shown to excel at hard sequence problems ranging from handwriting generation (Graves, 2013), to character prediction (Sutskever, 2011) and to machine translation (Kalchbrenner, 2013).

b.   Meta-cognitive component of the model

The meta-cognitive component models the dynamics of the cognitive component, its corresponding knowledge measures and the self-regulated thresholds. During the learning process, the meta-cognitive component monitors the cognitive component and updates its dynamic model of the cognitive component. The meta-cognitive component uses predicted class label $\hat{C}t$, maximum hinge loss (Et), confidence of classifier ($\hat{p}(ct|xt)$) and class-wise significance (ψc) as the measure of knowledge in the new training sample. The meta-cognitive component builds two sample-based and two neuron-based learning strategies using the knowledge measures and the self-regulated thresholds. One of these strategies is chosen for the new training sample such that the cognitive component learns them accurately and achieves better generalization performance.

4.   Conclusion

Based on this study, a complete survey of the state-of the art techniques for face aging recognition have been reviewed and discussed via face images. Face aging have become important in recent times in several emerging fields. In this paper, different techniques have been proposed by the researchers, with different databases to evaluate the methods. Also a proposed framework have been proposed to solve face aging recognition.

References

[1]   G. Antipov, M. Baccouche, and J.-L. Dugelay, "Face aging with conditional generative adversarial networks," in *2017 IEEE International Conference on Image Processing (ICIP)*, 2017, pp. 2089-2093.

[2]   W. Wang, Z. Cui, Y. Yan, J. Feng, S. Yan, X. Shu*, et al.*, "Recurrent face aging," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 2016, pp. 2378-2386.

[3]   Z. Li, D. Gong, X. Li, and D. Tao, "Aging face recognition: a hierarchical learning model based on local patterns selection," *IEEE Transactions on Image Processing,* vol. 25, pp. 2146-2154, 2016.

[4]   X. Wang, Y. Zhou, D. Kong, J. Currey, D. Li, and J. Zhou, "Unleash the black magic in age: a multi-task deep neural network approach for cross-age face verification," in *2017 12th IEEE International Conference on Automatic Face & Gesture Recognition (FG 2017)*, 2017, pp. 596-603.

[5]   R. Jana and A. Basu, "Automatic age estimation from face image," in *2017 International Conference on Innovative Mechanisms for Industry Applications (ICIMIA)*, 2017, pp. 87-90.

[6]   Y. Wang, D. Gong, Z. Zhou, X. Ji, H. Wang, Z. Li*, et al.*, "Orthogonal deep features decomposition for age-invariant face recognition," in *Proceedings of the European Conference on Computer Vision (ECCV)*, 2018, pp. 738-753.

[7]   D. Deb, N. Nain, and A. K. Jain, "Longitudinal Study of Child Face Recognition," in *2018 International Conference on Biometrics (ICB)*, 2018, pp. 225-232.

[8]   Z. Wang, X. Tang, W. Luo, and S. Gao, "Face aging with identity-preserved conditional generative adversarial networks," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 2018, pp. 7939-7947.

[9]   Z. Li, U. Park, and A. K. Jain, "A discriminative model for age invariant face recognition," *IEEE transactions on information forensics and security,* vol. 6, pp. 1028-1037, 2011.

[10]   S. Liu, Y. Sun, D. Zhu, R. Bao, W. Wang, X. Shu*, et al.*, "Face aging with contextual generative adversarial nets," in *Proceedings of the 25th ACM international conference on Multimedia*, 2017, pp. 82-90.

[11]   G. Antipov, M. Baccouche, and J.-L. Dugelay, "Face aging with conditional generative adversarial networks," *arXiv preprint arXiv:1702.01983,* 2017.

[12]   R. Jana and A. Basu, "Automatic age estimation from face image," in *Innovative Mechanisms for Industry Applications (ICIMIA), 2017 International Conference on*, 2017, pp. 87-90.

[13]   J. Suo, S.-C. Zhu, S. Shan, and X. Chen, "A compositional and dynamic model for face aging," *IEEE Transactions on Pattern Analysis and Machine Intelligence,* vol. 32, pp. 385-401, 2010.