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A Review On Face Image Recognition & Clustering By Using Various Types Of Approaches In Deep Learning

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ABSTRACT
The foremost computationally costly portion of numerous computer vision calculations comprises of looking for the most comparative matches to high dimensional vectors, also referred to as closest neighbor coordinating. Having an efficient algorithm for performing expeditious most proximate neighbor matching in immensely colossal data sets can bring speed amendments of several orders of magnitude to many applications. For matching high dimensional features, two algorithms are proposed in this paper, the K-nearest neighbor (KNN) and SVM support learning technique using KNN. Two-way filtering of clusters are done to increase the quality of cluster with the help of SVM and KNN.
Keyword – *Nearest Neighbor, Face Recognition, Deep Learning,*

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I. INTRODUCTION

The foremost computationally costly portion of numerous computer vision calculations comprises of looking for the most comparative matches to high dimensional vectors also referred to as closest neighbor coordinating. Having an efficient algorithm for performing expeditious most proximate neighbor matching in immensely colossal datasets bring speed amendments of several orders of magnitude to many applications. Examples of such issues in corporate finding the best matches for neighborhood pictures highlight in huge information sets, clustering nearby highlights into visual words utilizing the K-means or comparative calculations, worldwide picture featuring matching for seen acknowledgment human posture estimation, coordinating deformable shapes for question acknowledgment or performing normalized cross-correlation (NCC) to compare images patches in huge information sets.

It has appeared utilizing expansive preparing sets is key to getting great real-life execution from numerous computers vision strategies. Nowadays the web may be tremendous assets for preparing information, but for huge information sets the execution of calculations utilized rapidly gets to a key issue. When working with huge dimensional highlights, as with most of those experienced in computer vision applications (Image patches neighborhood descriptors, worldwide picture descriptors), there's regularly no known nearest neighbor look calculation that's correct and have satisfactory execution. To get a speed change, numerous common sense applications are constrained to settle for an inexact look, in which not all the neighbors return are correct, meaning a few are surmised but ordinarily still near to the precise neighbors. In practice, it is common for inexact closest neighbor look calculations to supply more than 95% of proper neighbors and still be two or more orders.

To get a speed change, numerous practical applications are constrained to settle for an approximate search, in which not all the neighbors returned are exact, meaning a few are surmised but typically still near to precise neighbors. In numerous cases, the closest neighbor look is fair apart of bigger applications containing other approximations and there's exceptionally small misfortune in performance from utilizing inexact or maybe than exact neighbors.

1.1. FACE RECOGNITION

Facial recognition is a biometric programming application able to do extraordinarily recognizing or checking an individual by looking at and dissecting designs dependent on the individual's facial shapes.

Facial recognition is generally utilized for security purposes, however, there is expanding enthusiasm for different territories of utilization. Indeed, facial recognition innovation has gotten critical consideration as it has the potential for a wide scope of utilization identified with law authorization just as different undertakings.

There are diverse facial recognition procedures being used, for example, the summed up coordinating face discovery technique and the versatile local mix coordinating strategy. Most facial recognition framework works de-

pendent on the distinctive nodal focuses on a human face. The qualities estimated against the variable related with purposes of an individual's face help in particularly recognizing or checking the individual. With this method, applications can utilize information caught from countenances and can precisely and rapidly distinguish target people.

There are sure downsides related to facial recognition:

- Facial recognition can possibly distinguish individuals when the conditions, for example, lightning are good.
- The application could be less dependable in the event of deficient light or if the face is somewhat clouded.
- Another weakness is that facial recognition is less successful when outward appearance differs.

II. LITERATURE REVIEW

In this paper [1], the author finds two algorithms as very efficient for matching. Different algorithms are reviewed so as to get the knowledge of which algorithms should be helpful for getting a better result and after comparing, two algorithms i.e., randomized k-d tree and Priority search k-means tree are used. For approximate matching of binary features, one more algorithm is proposed in this paper. This paper mainly helps in solving the issues created during matching of huge datasets with the help of Map Reduce algorithm using message passing interface (MPI).

In this paper [2], a face recognition attendance system is proposed and gives a good knowledge about CNN. This paper proposed a method by integrating different types of modern approaches using deep learning to provide a solution. In this paper, a Radio Frequency Identification (RFID) is integrated with face recognition systems which are connected to an IP camera and match it to verify the user. The author concludes that the solution is independent of GPU during runtime and can run on cheaper and low-capacity hardware.

In this paper [3], the author tries to check whether the face image quality is challenging for deep learning in unconstrained face recognition and after the investigation, a problem has occurred. To solve the problem, the quality partition is done for examining the face image quality issue and cross quality protocols are used to discover real challenges in unconstrained face recognition. The author uses two public databases and based on the quality of face images, a partition is done and FR protocols are developed for face identification and verification on both databases. Though different types of face image are stored in training sets, the variations in face image quality are challenging to unconstrained FR.

In this paper [4], the author gives a good knowledge of real-time face recognition system by discussing its architectural and detailed design. The author uses three types of algorithms which are Local Binary Pattern Histograms (LBPH), Principal Component Analysis (PCA) and Fisher Face to provide the security in restricted areas. All the three algorithms are compared in terms of accuracy and speed and concluded that LBPH is best in terms of accuracy and Fisher Face is best in terms of time. Also, the usage of Raspberry Pi removes the dependencies of the hardware platform and said that we can use Raspberry Pi on different platforms or as a side component with no major difference observed.

In this paper [5], the author compares the K-nearest Neighbor(KNN) and Modified-KNN(MKNN) algorithms to differentiate the data of conditional cash transfer implementation unit consisting of 7395 records in it. After the collection and processing of records, K-fold cross-validation of both the algorithms is done using the rule of CM in order to calculate the accuracy of both algorithms and concludes that MKNN has higher accuracy than KNN, having a difference of 5-7%.

In this paper [6], the author attempts to take care of the issue of acknowledgment rate of LBPH calculation which is diminished under specific states of enlightenment enhancement, articulation variety and disposition avoidance which can be solved by utilizing changed LBPH calculation based on pixel neighborhood gray median. After the testing is performed on the FERET database, train the face database and extract the LBP and MLBP texture features of each test image, classify and recognize the information of every face in the database. In the end, the author concludes that MLBPH algorithm is better that LBPH algorithm in terms of recognition rate.

In this paper [7], the author analyzes the face detectors and then performance on benchmark dataset FDDB and also compares the design protocols of the given algorithms. Also, reviews the degradation in performance while testing of low-quality images which are either blur, noise or contrast. After the comparison done on testing of different levels of images, the results show that the hand-crafted and deeply learned feature are sensitive to low-quality images and also concludes that scale variant design of neural networks collecting features from a different number of layers could help in detection of blurry tiny faces.

In this paper [8], the author proposed an algorithm by combining VP-tree and optimized pruning search method. Method of selecting the vantage point is increased by selection of points where the degree of distinction is the largest, then a second method is proposed for construction of VP-forest, by serializing the neighbors which are returned from tree, then select the closest neighbor from query point to improve the efficiency of nearest neighbor search, an improved pruning search is done. By this paper, the author concluded that when a certain number of VP-tree is constructed, the accuracy is improved under various conditions.

In this paper [9], the author takes care of the issue of uneven and inflexible bunching by proposing a calculation and taking help of K-means and Fuzzy C-mean (FCM) for grouping. Here, based on a number of elements in a cluster outlier were detected from each and every cluster and construct a new cluster of outliers and find the nearest neighbor from at least two clusters. As many methods are proposed in which some removes outliers, some classify them in appropriate clusters, etc. That's why this method is proposed which is useful for applications where each and every element is searched and it requires high accuracy of search result. The proposed method is more efficient and has better accuracy.

In this paper [10], as deep learning is hard to be utilized, so to conquer the issue of preparing one example in a single sample per person (SSPP) face acknowledgment. Thus, the author proposes different techniques to make it conceivable to be utilized in it. This method becomes possible firstly by proposing a novel expanding sample method for SSPP FR, then a well-trained DCNN is brought and finely tune the model of DCNN by using the expanding samples and finally AR face database is used to test the accuracy of SSPP FR. This paper provides the method which achieves the highest accuracy on all images of the AR face database and also has a better performance on SSPP FR than DCNN model.

In this paper [11], the author utilizes two deep learning models which are prepared on VGGFace2 dataset to remove the deep face portrayal. For this situation, a display and mismatched pictures are taken under various conditions. A group of four models is used in this paper in order to obtain 91.78% Rank 1, (8.00% Rank 5 and 0.997 AUC of CMC, which increases by 21.98%, 12.7% and 0.045 from the previous results. The future work of this paper was that FR in probe conditions should be improved more for recognition like a face with sunglasses cell phones, or blur effect of images which is captured in the real world.

In this paper [12], the author takes four types of datasets (Happy, Angry, Neutral, Sad) for facial recognition by using raw pixels. The author takes four models, Restricted Boltzmann Machine (RBM), Deep Belief Networks (DBN) and Stacked Auto encoder with Softmax function (SAE+SM) and compares them. The raw pixel values of all images are taken in a black and white form with a different pose and angles having 640 images. The results show that SAE+SM has an accuracy of 99.68% having only 19 hidden nodes in both the auto encoders while RBM's a DBN's accuracy did not exceed 25.52% even by varying the hidden nodes in hidden layers. Thus, the author concludes that RBM a DBN is good in feature extraction while SAE+SM is good in feature extraction as well as feature classification.

In this paper [13], a good knowledge of Linear Discriminant Regression Classification (LDRC) is provided. The author introduced a deep learning method to completely review the four samples present n the system and also improves the LDRC's performance by keeping track of all the incoming face inputs and history also. The author uses two types of databases, ORL and YALE, and values which are provided by the improved LDRC method and concludes that LDRC has more accuracy and efficiency of LDRC is improved by the propose DL-method.

In this paper [14], the author proposed a health management system by extraction of the visual face features i.e., face contours, face colors, smile lines, hairlines and melanocytes using image processing techniques. These visual face features are extracted with the help of software services in cloud computing environments. This long-term metadata which is stored on the cloud are evaluated for checking the personal health of the patients/users and when any abnormal situation held, the user gets a warning message. They can also check their facial shapes and texture features.

In this paper[15], the author tries to improve the accuracy of facial recognition by removing errors occurred due to occlusions, pose and illumination changes with the help of hog descriptors as hog feature captures gradient structure. With the help of Hog, a robust face recognition system is built using python for security and verification purposes. As the number of images increases, the accuracy of face recognition also increases and gives a better result.

In this paper [16], the shape and pattern of different facial images are studied for representation for providing a method for face recognition. First of all, the face can be divided into many small parts as blocks for getting the Local Binary Pattern Histograms. Development of LBP is done for texture description and KNN method is used for training purpose. Around 90% of images were recognized easily and when the illumination of face images change, the accuracy rate decreases by 10%, i.e., 80%.

In this paper [17], on the basis of spatial and temporal features, a face recognition scheme is proposed and find out the recognition rate for both the features using diffused rules. By utilizing PCA calculation, spatial highlights are removed and discrete wavelet Transform (DWT) is connected to separate transient highlights. The system incorporates minimal portrayal, dimensionality decrease. The intertwined highlights improved order precision. This strategy performs better contrasted with different techniques (DWT+PCA). Acknowledgment rate fluctuates by changing the number of PCs.

In this paper [18], a face acknowledgment framework is displayed utilizing skin division as highlight decrease. KNN algorithm is applied for each channel of segmented image and PCA algorithm is used as a reduction method and then chooses the two different spaces for skin region segmentation, i.e. RGB and YCbCr. Three databases are tested, two in a controlled environment and one in an uncontrolled environment. The KNN classifier

applied on segmented images gives an accuracy of 88-90% and the results obtained are best in RGB and YCbCr spaces. PCA method permits us the reduction in the system. PCA strategy licenses us the decrease in the framework. PCA strategy doesn't ensure a decent acknowledgment rate when contrasted with straightforward KNN classifier.

In this paper [19], an enhanced approach to improving human face recognition using a Back-Propagation Neural Network and feature extraction based on the correlation between the training images is proposed. By using LBPH descriptor and multi-KNN a training dataset is provided with different patterns based on the correlation between the original training images. The new T-datasets which is obtained in this model helped the BPNN to converge faster. Higher accuracy and reduction in time is obtained. Separation techniques are consolidated and which reinforces the entire framework. Higher accuracy can be achieved even with traditional feature extraction and domain reduction method using correlated training datasets between images.

In this paper [20], HFI is very big size images as compared to normal RGB images. To execute a large number of files, a big memory is required due to high dimensions and to solve this problem PCA is used with double layer feature extraction to reduce the dimensional size without losing its prominent features. The double layer PCA is applied for feature extraction with different on Hong-Kong Polytechnic University's Hyperspectral database and its classification is done on the basis of K-nearest neighbor. By and large, precision is gathered and the acknowledgment rate will be improved later on. Hyperspectral based face recognition framework is utilized different areas resembles a two mainstay of the biometric framework. In HFR, when the numbers of bands are increases, the computational burden also increases.

In this paper [21], an authentication mechanism is proposed in this paper, in which authentication is based on verifying facial features of the cloud user. First of all datasets of authenticated cloud users are stored in the database and after that face recognition mechanism is applied on each user who use cloud categorized in 4 types: legitimate, possibly legitimate, possible not legitimate, and not legitimate. A threat detection model which is proposed uses these types to detect the threat in the cloud by using KNN classification. On the basis of users: legitimate, possibly legitimate, possible, not legitimate, and not legitimate, threats in the cloud can be detected easily. So, to address the security reviews, mutual risks and trust this model is proposed. Utilization of KNN grouping is done as the KNN algorithm is best in an arrangement. The execution is marginally moderate when face acknowledgment is accomplished for all the 4 kinds of datasets.

In this paper [22], an unknown aware classifier is proposed by extending the well-known KNN classifier. An unknown aware classifier is mostly used for face recognition and is achieved by using average distances of instances in each individual class and this method is done for iris datasets. The results are very good for the iris datasets. The simplicity of this method is that it does not need any computational resources. It is limited for real-valued attributes.

In this paper [23], firstly parallel implementations of KNN classifier is proposed and then compares it with serial implementation to find out whose performance is better. Implementation of parallel and the serial version of the KNN algorithm for CUDA is done in C. Then, calculate the distance and sort in the first phase and then shared by both versions in the second stage. Rank sort algorithm is used for sorting. Comparisons of both versions demonstrate the capabilities of massively-parallel processing. Use of global memory instead of shared memory increases a slight performance. The execution time for a parallel version is worst then serial versions for massive datasets.

In this paper [24], correlation and examination of the execution of three AI calculations, for example, KNN, SVM, Random Forest was accomplished for ordering human outward appearance. CK+ datasets are used and Luxand FaceSDK is used to process the images to get facial points. The expressions at that point grouped into 7 classifications as angry, disgust, neutral, fear, happy, sad, and surprise. From that point onward, these 3 calculations are connected to it and examination of their precision is determined. The precision for arranging the information into 7 classes is 97.7%. The precision for KNN is 98.85%, for SVM it achieves 90% and 98.85% for Random Forest calculation. It is helpful in getting a person's mood without getting indirectly contact. If the amount of data is small, accuracy will not be good enough.

In this paper [25], different classifier methods are described with their minimum means of clusters to achieve a face recognition rate of humans from the feature extracted from image datasets by using PCA. Principal component analysis is utilized to investigate the information in classes and PCA calculation effectively diminishes the elements of face pictures. Firstly, unknown face images are picked from the ORL database which consists of 10 classes and each class consists of one person having at least 10 images. The picture is then changed into JPEG design and with the assistance of three distance methods face acknowledgment is pursued. PCA with mean clustering gives the best result with Squared Euclidean distance method with a recognition rate of 100% then Euclidean distance method with a rate of 98% and City-Block Distance classifier with a rate of 95%. Normalization of training face images minimizes the errors caused by lighting conditions and background. On the basis of the average person's clusters with these three methods, the decision of recognition is done.

In this paper [26], the author focuses on face recognition of face images before and after plastic surgery. Viola-Jones algorithm is used to detect the face and modified PCA algorithm is used to recognize faces from images with some near real-time variations. By utilizing the Eigenface acknowledgment calculation, PCA settles the acknowledgment issue for 2-D pictures of appearances. Results show that increasing the number of training images eigenvalues up to a particular level has improved the performance. As the quantity of preparing pictures and eigenvalues builds, the execution likewise increments. Eigenface recognition is sensitive, its performance is good under controlled background and recognition rate decreases under varying pose and illumination.

In this paper [27], a strategy is proposed for facial acknowledgment of human looks by utilizing Eigen's countenances and it depends on ascertaining Euclidean separation for the Eigenfaces. Firstly, the face images are classified into seven basic emotions with the help of PCA and then 50 facial expression images are considered and trained by eigenfaces. Then the eigenfaces are compared with test images and results are calculated. This method works best with eigenfaces and gives 98.5% accurate emotion recognition rate. Despite the fact that the match is found toward the starting the example is contrasted with whole preparing dataset which gets precise outcomes. Highlight extraction diminishes the dimensionality of the information picture.

In this paper [28], an approach is proposed for facial recognition of faces which are undergone surgery by using PCA for dimension reduction and LBP for feature extraction from the facial region and peculiar region. LBP-PCA is tested on plastic surgery database and then, face images are normalized and pre-processed to remove noise and illumination. The average increase of 67.3 % in prediction accuracy is observed. Prediction accuracy is increased gradually. The recognition efficiency of face recognition techniques is decreased in global surgery as compared to the local surgery. For smaller noise pollution, Weiner filtered more information as compared to PCNN.

In this paper [29], face recognition is performed using Principal Component Analysis and does an extensive investigation on ORL database to compare various distance metrics: Euclidean, Mahalanobis, and cosine to check the efficiency on the basis of training datasets. ORL database is separated into preparing sets and test. Each picture in preparing sets is spoken to in direct blend and has its commitment to eigenvectors which can be shown as an eigenface. When the face images are recognized, weights are obtained which are compared with the original image weights. Cosine, 3, Mahalanobis measures showed higher recognition accuracy. Cumulatively, the cosine method can be declared to have higher recognition. Recognition skill is robust while developing a computational model for face recognition is difficult.

In this paper [30], an access control vehicle system for parking is presented based on the camera installed at the parking entrance. Firstly, a non-adaptive method is used to detect moving objects and then an algorithm is proposed to detect and recognize the driver's face that is willing to enter and its authentication. Additionally, the Viola-Jones strategy for face identification and another method is proposed dependent on PCA and LDA calculation for face acknowledgment. Results are satisfactory and encouraging having 92.88% accuracy for a frontal face. Numbers of eigenvectors are the same as the number of poses and retains information of that eigenvector for that pose only. The variation of pose is considered as a major problem.

In this paper [31], the importance of an algorithm which is used to identify the facial image without human intervention is discussed. In this work, how facial recognition is done and how it is stirred in memory and the mechanism used to point out the face of users with the help of an algorithm(PCA), and how to deal with it and its significance. The result was highly positive and it helps in analyzing the data and access to low and interrelated data. Great outcomes are gotten by utilizing PCA in light of the fact that it diminishes measurements without influencing the picture. Picture acknowledgment is very troublesome for enlightenment, picture development, and so forth.

In this paper [32], comparison of performances of Text-Independent Speaker Recognition systems implemented using Gaussian Mixture Model(GMM) and i-vector method with probabilistic Linear Discriminant Analysis(PLDA) metrics. In this work, both the GMM and PLDA have been realized with two features: Power Normalized Cepstral Coefficients (PNCC) and Relative Spectral Perceptual Linear Prediction(RASTA PLP) coefficients. Performance of the SR system better than GMM for short utterances and is better for the i-vector method for longer utterances.

In this paper [33], comparison of two popular computer vision libraries i.e., OpenCV and dlib are done and also explore their features, analyze pros and cons each of them and understand in what situation each of them suit the best. In this work, a comparative analysis of the productivity of both libraries in relation to the time of execution to the number of iterations of the applied algorithms was presented and also built two simple applications for face recognition based on these libraries and comparing their performance. OpenCV library is more productive, has better performance for face detection and also using OpenCV helps to build better recognition applications for IOT platform. The proposed approach can be used for big data processing. For a large number of face images, OpenCV is not so good, so the Haar cascade algorithm is better to be implemented.

In this paper [34], a real-time night face detector is proposed and an image feature named PRO-NPD is also proposed. Firstly, histograms equalization methods are used to process the input image of the night to increase

its contrast, then image feature named PRO-NPD is proposed. Lastly, the deep quadratic tree is used to learn the optimal subset of PRO-NPD features and their combination. After the evaluation of FDNS database, the proposed method shows superior performance in face detection without constraint during the night. The proposed detector is able to achieve real-time face detection in the front-end devices. The proposed method is only working for a front angle of face images.

In this paper [35], a methodology is proposed for faster execution of face recognition process with accurate result. The proposed face recognition process was done using a hybrid process of Haar cascades and eigenface methods, which can detect multiple faces in a single detection process. The proposed method was able to recognize multiple faces with 91.67% accuracy level. The FR process proposed in this method can be performed at a distance of 200cm using a webcam. The type of detection is only for frontal faces.

III. CONCLUSION

From the above papers that I have reviewed are introduced in various ways using different algorithms. But those strategies and algorithms are using a single algorithm to make clusters of face image and also they were making a different block for storing the clusters, whereas in my work I've done two-way filtering of face image datasets. Firstly by using SVM, we classify the face image points and after that, we use KNN to classify it to make the points more clear so as to make the quality of cluster better. Hence, by using these two algorithms together with the accuracy increases.

REFERENCES

[1]. G. Guo and N. Zhang, "What Is the Challenge for Deep Learning in Unconstrained Face Recognition?," 2018 13th IEEE International Conference on Automatic Face & Gesture Recognition (FG 2018), Xi'an,2018,pp.436-442.

[2]. M. Arsenovic, S. Sladojevic, A. Anderla, and D. Stefanovic, "FaceTime — Deep learning based face recognition attendance system," 2017 IEEE 15th International Symposium on Intelligent Systems and Informatics(SISY), Subotica,2017,pp.000053-000058.

[3]. Umm-e-Laila, M. A. Khan, M. K. Shaikh, S. A. bin Mazhar, and K. Mehboob, "Comparative analysis for a real-time face recognition system using Raspberry Pi," 2017 IEEE 4th International Conference on Smart Instrumentation, Measurement and Application (ICSIMA), Putrajaya, 2017, pp.1-4.

[4]. Okfalisa, I. Gazalba, Mustakim, and N. G. I. Reza, "Comparative analysis of k-nearest neighbor and modified k-nearest neighbor algorithm for data classification," 2017 2nd International conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE), Yogyakarta,2017,pp.294-298.

[5]. X. Zhao and C. Wei, "A real-time face recognition system based on the improved LBPH algorithm," 2017 IEEE 2nd International Conference on Signal and Image Processing (ICSIP), Singapore, 2017, pp. 72-76.

[6]. Y. Zhou, D. Liu, and T. Huang, "Survey of Face Detection on Low-Quality Images," 2018 13th IEEE International Conference on Automatic Face & GestureRecognition(FG2018), Xi'an,2018,pp.769-773.

[7]. D. Jiang, H. Sun, J. Yi and X. Zhao, "The research on nearest neighbor search algorithm based on vantage point tree," 2017 8th IEEE International Conference on Software Engineering and Service Science (ICSESS), Beijing,2017,pp.354-357.

[8]. G. L. Prajapati and R. Bhartiya, "High dimensional nearest neighbor search considering outliers based on fuzzy membership," 2017 Computing Conference, London,2017,pp.363-371.

[9]. J. Zeng, X. Zhao, C. Qin, and Z. Lin, "Single sample per person face recognition based on deep convolutional neural network," 2017 3rd IEEE International Conference on Computer and Communications (ICCC),Chengdu,2017,pp.1647-1651.

[10]. O. A. Aghdam and H. K. Ekenel, "Robust deep learning features for face recognition under mismatched conditions," 2018 26th Signal Processing and Communications Applications Conference (SIU), Izmir, 2018,pp.1-4.

[11]. D. Das and A. Chakrabarty, "Emotion recognition from face dataset using deep neural nets," 2016 International Symposium on Innovations in Intelligent Systems and Applications (INISTA), Sinaia, 2016, pp. 1-6.

[12]. K. Shailaja and B. Anuradha, "Effective face recognition using deep learning based linear discriminant classification," 2016 IEEE International Conference on Computational Intelligence and Computing Research(ICCIC), Chennai,2016,pp.1-6.

[13]. S. Hsu, C. Han, M. Wen, Y. Wu and K. Fan, "Extraction of Visual Facial Features for Health Management," in IEEE Systems Journal, vol.10,no.3,pp.992-1002, Sept.2016.

[14]. P. J. Thilaga, B. A. Khan, A. A. Jones and N. K. Kumar, "Modern Face Recognition with Deep Learning," 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), Coimbatore,2018,pp.1947-1951.

[15]. O. S. Kulkarni, S. M. Deokar, A. K. Chaudhari, S. S. Patankar and J. V. Kulkarni, "Real Time Face Recognition Using LBP Features," 2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA), Pune, 2017, pp.1-5.

[16]. K. Sett et al., "Face recognition using a fusion of spatial and temporal features," 2018 Emerging Trends in Electronic Devices and Computational Techniques (EDCT), Kolkata,2018,pp.1-4.

[17]. F. Z. Chelali, N. Cherabit, and A. Djeradi, "Face recognition system using skin detection in RGB and YCbCr color space," 2015 2nd World Symposium on Web Applications and Networking (WSWAN), Sousse,2015,pp.1-7.

[18]. M. A. Abuzneid and A. Mahmood, "Enhanced Human Face Recognition Using LBPH Descriptor, Multi-KNN, and Back-Propagation Neural Network," in IEEE Access, vol.6,pp.20641-20651,2018.

[19]. S. B. Dabhade et al., "Double Layer PCA based Hyper Spectral Face Recognition using KNN Classifier," 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC), Mysore, 2017, pp. 289-293.

[20]. M. S. Sarma, Y. Srinivas, M. Abhiram, L. Ullala, M. S. Prasanthi and J. R. Rao, "Insider Threat Detection with Face Recognition and KNN User Classification," 2017 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM), Bangalore,2017,pp.39-44.

[21]. H. Khastavaneh, H. Ebrahimpour-Komleh, and A. Hanaee-Ahwaz, "Unknown aware k nearest neighbor classifier," 2017 3rd International Conference on Pattern Recognition and Image Analysis (IPRIA), Shahrekord, 2017, pp. 108-112.

[22]. F. Despotovski, M. Gusev and V. Zdraveski, "Parallel Implementation of K-Nearest-Neighbors for Face Recognition," 2018 26th Telecommunications Forum (TELFOR), Belgrade,2018,pp.1-4.

[23]. R. A. Nugrahaeni and K. Mutijarsa, "Comparative analysis of machine learning KNN, SVM, and random forests algorithm for facial expression classification," 2016 International Seminar on Application for Technology of Information and Communication (ISemantic), Semarang, 2016, pp. 163-168.
[24]. A. L. Ramadhani, P. Musa and E. P. Wibowo, "Human face recognition application using PCA and eigenface approach," 2017 Second International Conference on Informatics and Computing (ICIC), Jayapura, 2017, pp. 1-5.
[25]. G. George, R. Boben, B. Radhakrishnan, and L. P. Suresh, "Face recognition on surgically altered faces using principal component analysis," 2017 International Conference on Circuit, Power and Computing Technologies (ICCPCT), Kollam, 2017,pp.1-6.
[26]. M. B. S. Divya and N. B. Prajwala, "Facial Expression Recognition by Calculating Euclidian Distance for Eigen Face Using PCA," 2018 International Conference on Communication and Signal Processing (ICCSP), Chennai, 2018, pp. 0244-0248.
[27]. S. Feifei, H. Min, N. Rencan and W. Zhangyong, "Noisy faces recognition based on PCNN and PCA," 2017 13th IEEE International Conference on Electronic Measurement & Instruments (ICEMI), Yangzhou, 2017, pp. 300-304.
[28]. Manjunath N, A. Nayak, Prathiksha N R, and Vinay A, "Performance analysis of various distance measures for PCA based Face Recognition," 2015 National Conference on Recent Advances in Electronics & Computer Engineering (RAECE), Roorkee,2015,pp.130-133.
[29]. I. Taleb and M. O. Mammar, "Parking access system based on face recognition," 2015 12th International Symposium on Programming and Systems (ISPS), Algiers, 2015, pp.1-5.
[30]. R. Kaur and E. Himanshi, "Face recognition using Principal Component Analysis," 2015 IEEE International Advance Computing Conference (IACC), Banglore,2015,pp.585-589.
[31]. Y. Ren, Z. Wang, M. Xu, H. Dong and S. Li, "Learning Dynamic GMM for Attention Distribution on Single-Face Videos," 2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), Honolulu, HI, 2017, pp. 1632-1641.
[32]. N. Boyko, O. Basystiuk and N. Shakhovska, "Performance Evaluation and Comparison of Software for Face Recognition, Based on Dlib and Opencv Library," 2018 IEEE Second International Conference on Data Stream Mining & Processing(DSMP),Lviv,2018,pp.478-482.
[33]. S. Sharma, K. Shanmugasundaram and S. K. Ramasamy, "FAREC — CNN based efficient face recognition technique using Dlib," 2016 International Conference on Advanced Communication Control and Computing Technologies (ICACCCT), Ramanathapuram,2016,pp.192-195.
[34]. X. Geng, Z. Zhou and K. Smith-Miles, "Individual Stable Space: An Approach to Face Recognition Under Uncontrolled Conditions," in IEEE Transactions on Neural Networks, vol.19,no.8,pp.1354-1368,Aug.2008.
[35]. M. Muja and D. G. Lowe, "Scalable Nearest Neighbor Algorithms for High Dimensional Data," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 36, no. 11, pp. 2227-2240, 1 Nov. 2014.

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