

A Comprehensive Review of Various Face Detection and Recognition Techniques

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Abstract- From the last decade the computer vision and the machine learning fields has various applications in almost every field of artificial intelligence. From object detection to recognition, bar code reading to biometric data matching, from vegetable classification to vehicle information extraction in almost every area both of these fields are dominating. For the identity verification face detection and recognition are one of the prime steps. Various researchers have developed various algorithms for face detection and recognition. All of these methods have some pros and cons. Some are fast in execution and some have high accuracy. In this review paper a comprehensive review is performed on the face detection and recognition techniques so that various researchers could find the insight of the various researches performed on this field of artificial intelligence.

Keywords- Face detection, recognition, neural network, classifier, Haar, Adaboost.

I. INTRODUCTION

Object detection and recognition is the field of image processing and which is the part of artificial intelligence domain. Various types of algorithms are designed which are used to detect and recognize various kinds of objects of various shapes and sizes irrespective of the color and texture of the object. Face detection and recognition also falls in this category. Face recognition has been found in various kinds of applications like user verification, access control, aadhar card identity verification and many more.

The main aim of this detection and recognition system is to find the faces present in the various images or frames of a video. After detecting the faces in images next step is to recognize the person by extracting the face features with some trained classifier and compare those features with the features present in the dataset of various persons and display the results.

During last decade it is one of the primary research areas for computer vision experts worldwide. Detecting and recognizing faces in the motion scene is very complex process. Various deep learning methods like convolutional neural network and other algorithms are used worldwide for the extraction of features of the faces with the training the classifier on various datasets. In this review paper different research papers are thoroughly studied and their summary is provided in detail so that other researchers could find the benefits of this comparative review.

II. LITERATURE SURVEY

T. Qing et al. [1] in 2012 proposed a robust face detection method and it was specifically designed for jpeg image format face images. Here authors used well known DCT method for creating coefficients from the low resolution face image. After it author used Adaboost like pixel based face detection method for further processing.

Authors performed the comparative analysis of the proposed method with the conventional face detection method. Detection rate as well as false detection rate were used as objective parameters. After evaluation of performance of both the methods it was found that the proposed algorithm was quite fast and as well as had high end accuracy.

P. Laytner et al. [2] in 2014 proposed a new face detection technique which was based on the analysis of histogram of the images. Benefit of this analysis was that dark and very bright regions were normalized. All the study was performed on the still images. Authors used well known Haar wavelet and Adaboost learning classifier techniques to prepare the framework of face detection.

Author used the well known Yale Face database for the training purposes. All the experiment was performed with the OpenCV library. Authors compared the proposed method with the Haar method and with the Histogram Equalization method. In comparison to other method proposed methodology performed better.

P. Shanmugavadivu et al. [3] in 2016 proposed a new methodology for fast detection which was robust in nature.

Here authors used the hybrid approach of the features relied and various part relied face detection algorithms. Here authors used nose as a central feature of the face for detecting other features of the face.

After localizing the face features normalization was performed on the face. It was used to perform scaling and rotating the face so that it could be easily matched with the images present in the databases. After normalization tagging of each part of the face was performed. All the implementation was performed on the Matlab software. The proposed technique was able to tag the various annotations like mouth missing, nose missing and many more.

A. Singh et al. [4] in 2016 proposed a method for detecting face as well as eyes from the frontal human faces. Authors used well known Sobel edge operator for detecting various features of the human faces. The proposed methodology had three stages. First was pre-processing in which various operations were performed like resizing and gray scale conversion and other steps.

In the second stage face region was detected with various operators using morphological image processing operations. In the last stage eyes were extracted with the help of various operators. Authors used well known IMM and FEI face databases. Authors were able to get very high accuracy in case of face detection and got good accuracy in extraction of eyes from the human faces.

L. Qiming et al. [5] in 2017 designed a human face detection system. Authors proposed a crown attention face detection system which was based on Haar and Adaboost classifiers. Authors installed the software in the hardware and then perform invigilation of the crowd online.

It detected the persons with various circled features and counted those also. All the proposed implementation was performed on the OpenCV. Further for processing of faces of persons authors used Gaussian filtering for smoothing of images and then use Gamma correction for getting the good illumination in the image and image sharpening and finally Histogram Equalization. Authors were able to get the good results from the proposed methodology.

M. Nehru et al. [6] in 2017 used well known Viola Jones algorithm for detection of human faces in the images. Prime aim of the methodology was to detect the human faces even in the low as well as high illumination. Authors used Haar algorithm for feature extraction of the faces. A machine learning algorithm was used for classification purposes. Various features of human faces were detected with various edge lines detections, line detections in different orientations and centre surrounded features. After creating a strong classifier various images were passed to it. Proposed technique was able to find the difference

between the human faces and the non human faces from the various set of images.

L. Pang et al. [7] in 2018 proposed a face detection and recognition system. Main feature of this system was to use parallelism for detection and recognition of face and with this feature processing speed improved significantly. This single layer convolutional neural network was trained in a multi tasking environment for learning purposes. Authors used various algorithms for extraction of features of faces. Authors used Caffe convolutional architecture.

Authors tested the framework on the 16 cores TITAN GPU. Authors compared the proposed method with the DeepFace, DeepId, DeepFace and Joint Bayesian methods. Proposed method achieved high accuracy in comparison to other methods.

N. R. Borkar et al. [8] proposed a hybrid face recognition algorithm which was based on the principle Component Analysis, Linear Discriminant Analysis. Here Jacobi method was utilized for computing Eigenvector. Proposed face recognition system was implemented on Embedded system relied on Raspberry pi 3 board. Authors used AT & T dataset for face recognition system.

Author first applied the algorithm to dataset of 100 training images for training purpose. Authors were able to get the accuracy of 91% in case of PCA and got 94% accuracy in case of LDA alone. When authors combined both the PCA and LDA algorithms it got accuracy of nearly 97% with the help of raspberry pi 3 module kit.

A. Zarkasi et al. [9] in 2018 proposed a face detection method which could identify the moving faces. Authors used the template matching. Main strategy used in detection of the face was separation of face region from the skin and non skin region. Algorithm first minimizes the face detection region. It separated the face into 3 regions namely left, right and middle part.

For template matching left and right part of the face were oriented by 90 degrees for face matching with the sample database images. From the results it was cleared that the proposed algorithm was able to detect the faces in neutral as well as in the movement positions in both the directions either clockwise or anti clockwise direction.

J. Deng et al. [10] in 2019 proposed a face detection method in which alignment of the face was also performed and all of combined effort in just one single step. Authors constructed a face detector which was based on the pyramid network, single stage face detection, modeling, multi tasking learning and regression techniques. Authors used the wider face dataset which had more than 32000 face images and were used for training, validation and the testing purposes. It had total number of 63 various scene criteria. Authors used Nvidia GPU with high ram. Authors

were able to get good accuracy in face detection in comparison to other methods.

X. Hu et al. [11] in 2020 proposed a new face detection algorithm which was based on two other algorithms. Author combined single shot detection algorithm for target classification and with this camshaft which was a tracking algorithm was also used. In order to increase the efficiency of the detection algorithm authors had used the ResNet50 which was used for extraction of features. Further authors had also used Kalman filter in addition to camshaft so that operation could be processed faster. From the experiment it was cleared that the proposed methodology was able to detect the vehicles efficiently and also with the good speed of classification. Even algorithm performed better in case of variations in external conditions of weather.

J. Hyun et al. [12] in 2021 proposed a new architecture for face detection system. This system was based on the Haar classifier and on the special skip strategy. Main purpose of designing the hardware system was to decrease the execution time of the face detection system. Here to reduce the time of classifying the face detection from a image authors used the Haar classifier.

All the implementation was done in OpenCV software and hardware was based on Verilog HDL. Authors were able to speed up the process of extraction of face from the images by nearly 4 percent in comparison to standard method of face detection with Haar classifier.

III. CONCLUSIONS

In this review paper a comparative analysis is performed on various face detection and recognition techniques. Various research papers of different regions of the world are taken into consideration. Every paper is deeply studied and its conclusion is provided with best efforts. In the future work various other research papers can be studied and can be evaluated for the performance evaluation of various algorithms so that research could get insight of the face detection and recognition problems.

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REFERENCES

[1] T. Qing and Z. Shiwei, "A fast face detection method for JPEG image," IEEE 11th International Conference on Signal Processing, pp. 899-902, 2012.

- [2] P. Laytner, C. Ling and Q. Xiao, "Robust face detection from still images," IEEE Symposium on Computational Intelligence in Biometrics and Identity Management (CIBIM), 2014, pp. 76-80, 2014.
- [3] P. Shanmugavadivu and A. Kumar, "Rapid face detection and annotation with loosely face geometry," 2nd International Conference on Contemporary Computing and Informatics (IC3I), pp. 594-597, 2016.
- [4] A. Singh, M. Singh and B. Singh, "Face detection and eyes extraction using sobel edge detection and morphological operations," IEEE Conference on Advances in Signal Processing (CASP), pp. 295-300, 2016.
- [5] L. Qiming, H. Ligang, X. Qiuyun, Y. Tongyang, G. Shuqin and W. Jinhui, "The design of intelligent crowd attention detection system based on face detection technology," 13th IEEE International Conference on Electronic Measurement & Instruments (ICEMI), pp. 310-314, 2017.
- [6] M. Nehru and S. Padmavathi, "Illumination invariant face detection using viola jones algorithm," 4th International Conference on Advanced Computing and Communication Systems (ICACCS), 2017, pp. 1-4, 2017.
- [7] L. Pang, Y. Ming and L. Chao, "F-DR Net: Face detection and recognition in One Net," 14th IEEE International Conference on Signal Processing (ICSP), 2018, pp. 332-337, 2018.
- [8] N. R. Borkar and S. Kuwelkar, "Real-time implementation of face recognition system," International Conference on Computing Methodologies and Communication (ICCMC), pp. 249-255, 2017.
- [9] A. Zarkasi et al., "Face Movement Detection Using Template Matching," International Conference on Electrical Engineering and Computer Science (ICECOS), pp. 333-338, 2018.
- [10] J. Deng, J. Guo and S. Zafeiriou, "Single-Stage Joint Face Detection and Alignment," IEEE/CVF International Conference on Computer Vision Workshop (ICCVW), pp. 1836-1839, 2019.
- [11] X. Hu and B. Huang, "Face Detection based on SSD and CamShift," IEEE 9th Joint International Information Technology and Artificial Intelligence Conference (ITAIC), pp. 2324-2328, 2020.
- [12] J. Hyun, J. Kim, C. H. Choi and B. Moon, "Hardware Architecture of a Haar Classifier Based Face Detection System Using a Skip Scheme," IEEE International Symposium on Circuits and Systems (ISCAS), pp. 1-4, 2021.