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Face Detection's Various Techniques and Approaches: A Review

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Abstract: ***In the past few years, face recognition owned significant consideration and is appreciated as one of the most promising applications in the field of image analysis. Verification and Identification have become a significant issue in the present computerized world. Various variabilities are present across human faces such as pose, expression, position and orientation, skin colour, the presence of glasses or facial hair, variations in camera gain, lighting conditions, and image resolution, because of these variabilities face detection is very complicated. In this paper, several existing face detection methods and strategies are analyzed and studied. The main goal of this paper is to present or suggest an approach that is an excellent choice for face detection.***

Keywords: Face detection, Recognition, CPU, Multiple layer

I. INTRODUCTION

In the last few years, facial recognition has been known to beone of the most promising technologies in the area of image processing. Face identification may be assumed to be a major aspect of face recognition operations. Based on its power to concentrate computing energy on the portion of the picture, that holding a face. The process of facial detection in pictures is complicated by variations across human faces such as stance, speech, location and orientation, skin tone, appearance of glasses or facial hair, differences in camera gain, lighting conditions, and image resolution. Detection ofobjects is one of the computing systems related to image recognition and computer vision and interacts with the detection of objects such as human faces, houses, plants, vehicles, etc. The primary objective of face detection algorithms is to decide whether or not there is a face in the picture. In recent years, a lot of research paper has been suggested in the field of Facial Recognition and Face Detection to make it more sophisticated and precise, but it isa breakthrough in this field because Viola-Jones arrives withits Real-Time Face Detector, which is capable of detecting faces in real-time with high precision.

Facial detection seemsto be the most important step in the identification of the faceand is used to detect the faces in the images. It is part of object detection that can be used in many fields such as defense, biometrics, enforcement agencies, entertainment, personal protection, etc. The purpose of facial detection is tofigure out whether or not there are faces in the picture and, ifpresent, to return the position and size of each face [1].

Although facial detection is a trivial activity for human vision, it is a challenge for computer vision due to variations in size, position, direction, posture, facial expression, light condition, and different appearance features (e.g. appearance of glasses, body hair, make-up, etc.). It is also used to detect faces in real time for the monitoring and monitoring of individuals or objects. It is commonly used in cameras to detect numerous appearances in Ex-Mobile cameras and DSLR photos. Face Book also uses a face recognition algorithm to identify and recognize faces in the images.

II. LITERATURE SERVEY OF SEVERAL FACE DETECTIONTECHNIQUES

The major face detection approaches are offers by M.H.Yang et al. [2], such as: Knowledge-based, Template matching, Feature invariant and Appearance-based approaches. Knowledge based approaches are relying on a collection of laws, which is based on human knowledge, for the identification of faces. For example, the face always consists of two eyes, a nose and a mouth within certain lengths and locations relative to each other [3][4][5].Featureinvariant approaches, detect faces by extracting the structural characteristics of the face. Generally, for differentiating facial and non facial regions, a statistical classifier is trained and then used [6][7][8]. Template matching approaches, to locate and detect the face by calculating the similarity values between the template and the input image, uses a predefined and parameterized face template[9][10].Appearance-based methods, rely on a selection of delegated face training photographs to classify face models[11][12][13]. Generally, appearance-basedapproaches have demonstrated better results relative to other methods. It is commonly used in real-life applications such as digital cameras and digital picture management tools.

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A. Approach Of Face Detection Using Geometric Structure

For automatic face detection, PCA-based modeling of the geometric structure of the face is given by Padma Polash Paul et. al.. For detecting a face in an image and video Skin Color Modeling (SCM) is one of the best techniques. The technique improves the face detection rate and limits the search space. However, for better template matching performance in terms of detection rate and time, feature selection is very important. This paper presents an effective component extraction and choice strategy dependent on geometrical design of the facial picture. Principle Component Analysis (PCA) and canny edge detection are used, to model the geometric structure of the face. A combination of PCA-based geometrical modeling and SCM technique gives higher face identification precision and improves time intricacy. Both models provide very fast and efficient techniques that provide filtration of image in terms of pixel values to determine the face position in very large image database. Direction invariant edge dependent on the mathematical model and improves the framework further. For solid layout coordinating, highlight extraction and choice dependent on a novel mix of a mathematical channel with an SCM channel is presented. The suggested method consists of two main components: first, the skin regions are segmented using a skin color model. In the second section, the segmented regions are filtered using a geometric face model. They should concentrate on four color spaces that are normally used in the field of image processing:
RGB: Colors are correct in terms of the three primary colors: red (R), green (G) and blue (B).
HSV: Shades may be reprinted separately in terms of hue (H), saturation (S) and intensity value (V). There are three characteristics that are transparent about hue. These are the three attributes. Nonlinear conversion is done between HSV and RGB. Eliminating the background of the image from skin region is the goal of segmentation process, this has been done by using skin color model (SCM).

At the initial stage, the input image is transformed into color space. The Gaussian model has produced a grayscale image of skin possibility. Skin pixels have a collection of stable values for each r, g, and b element. Three principles of a normalized image are normalized-red, normalized-green andnormalized-blue. Through the Segmentation process, these normalized elements are obtained, and after that two images are created. A normalized input image is generated by applying a unique threshold. Each of these images is changed into a black and white image. The geometric modeling of these images has three key steps. In the first step, PCA has detected the skin region and then projectingit. In the second step, projected skin regions are reconstructed using a smaller number of Principal Components (PCs). Lastly, edges are caught from reconstructed skin regions. The size of detected skin regions is different; these regions are resized into the sameresolution. After resizing every skin region, a predefined mask is applied to it. The origin value is rotation invariant because we are using the total sum of the projected geometric structure.

Another benefit of the present approach is that it is very fast in computing due to filtering. time complexity to identify the face become O(1), If the filter values of skin segments are within the range of a face or non face system. Theconvergence of PCA-based geometric modelling and SCM- based approach ensures better surface detection precision and increases time complexity.

The presenting method is very fast and efficient for large image database, and also enhances the detection rate of the face and restricts the search space [14].

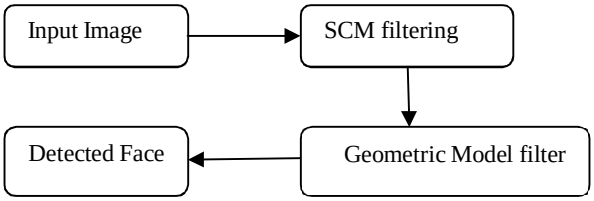


Fig. 1 Geometric-Based Face Detection Block Diagram

B. Face Detection Approach Using High-Level Language

A new method for face detection on the user oriented language model presented by Daesik Jang et. al. for solving the face detection difficulties. Many open source librariesare available here to solve their problems. It is very easy, if they have detailed knowledge of algorithm and techniques, otherwise it seems difficult to acknowledge. For a system development, it provide High-level language model to user, so the user can easily developed a system. Developer may use the language model to express the various problems. The conditions are recognizing here and express in term of language model. Once the user create the condition, the proposed interpreter interrupt the condition and then it determine and analyze the condition and after that it provide best algorithm to solve the described problem with identical condition. The main goal of this technique is to provide a best way to develop a face detection system without specificknowledge about face detection theories and algorithms. So, for user they provide High-level language model.

Due to this technique, the problem of selecting method and complicated parameter are separated from the development phase. Engineers simply need to characterize the issue and express it with the language model recommended and a mediator will select calculations fitting for the related sub- space of the issue. They initially think about the significant conditions to group the enormous issue of face location. The conditions recognized here are then communicated regarding a language model with the goal that designers have been utilized them to communicate different prerequisites of a given issue. This high-level language model is a part of open-vision language. Through this vision- language developer define their problems in terms of what they want to do, rather how they want it done. For the support and ease of developer various sample problems and proof-of-concept are available, for testing and analyzing. In this paper two distinctive problems are proven and explain. So, the developer can easily use proof-of-concept language model.

The AdaBoost-based algorithm, neural network based algorithm, and color-based algorithm are introduced for facial detection, firstly identify an upright, frontal, and large face characteristics of a face. For identification of person, or for the improvement of the facial detection algorithm is done by analyzing and adding more practical and better usability of language model is needed. For selecting an algorithm some smart suggestions are needed to be analyzed for a more optimal selection process [15].

C. Face Detection Approach Using Haar-Like Features

To enhance the performance of Haar- feature based cascade detector Ning Jiang et. al. defines two techniques. In first, for cascade detector they give new features, called separate Haar- feature. In second, for improving the detection, they provide new decision algorithm. There are three key conditions are as follows: The first condition creates don't care region between the squares of Haar-features, and this condition called separate Haar feature. Second condition shows an algorithm for selecting the most expanses for this don't care region. Lastly, new decision algorithm is proposed that determines not only stage result in the cascade detection but also improve the detection percentage. In new algorithm, if the image was not selected at any of the stages, so it can not counted at the last. In this new algorithm, the background images can be immediately discarded, but if a faulty detection occurs in an earlier stage, this faulty detection will occur in the last stage also. For eliminating the faulty detection, a comparison between the result of the first stage and the current stage is needed. This new algorithm has a limitation, when a wrong detection occurs in any stage it also discards the face images. This new algorithm wants to use more information to produce the best decision. To overcome the limitation and to produce the best decision they proposed to save the value distance between stage worth and the edge of the primary stages which is recognized and acknowledged and utilizing this message along with the edge and incentive in the current stage to do the choice. And second, the addition of more information from the results of the first stages to do the stage decision is an excellent way to improve the cascade decision algorithm. for face recognition, most of the cameras are placed in front of a door and the person needs to stand in a correct position, so the face of the person should be obtained perfectly. As a result, the well-placed face image is taken, which is good, not only for detection but for recognition also. The second case simulates face detection and investigating of activity is one of the important functions of intelligent surveillance. The problem of selection of best algorithms and selecting complex parameters for algorithms are separated from development with the proposed language model [16].

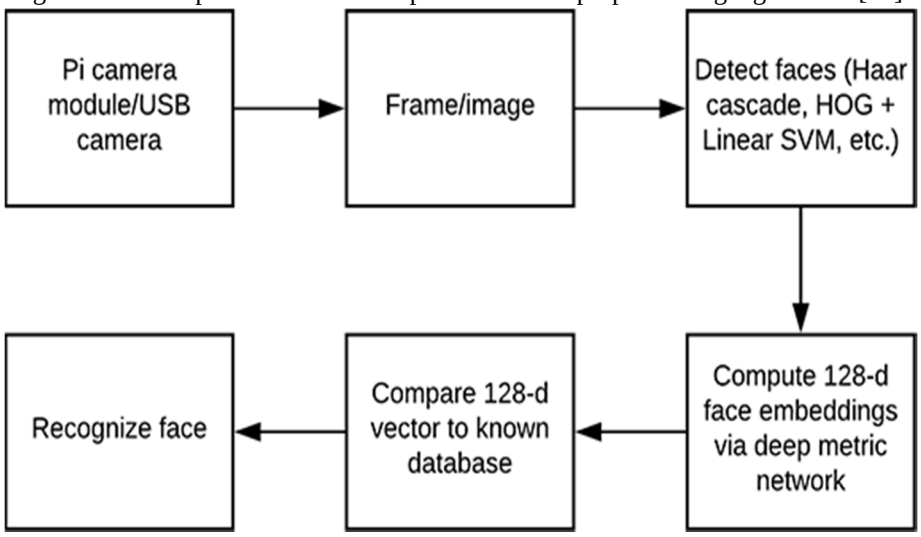


Fig. 2 Haar-like Feature Face Detection Block Diagram

D. Approach of Face Detection Using Facial Features

An approach for automated facial feature recognition is presented by Anima Majumder et. al. . New techniques may use basic facial geometry concepts. They proposed to find the location of the eyes, the position of the nose and the position of the mouth. The estimate of the detection area for characteristics such as the ears, nose and mouth improved the detection accuracy substantially. To detecting an eyes pupil in the eye detection field, H-plane of the HSV colour space is used.

The suggested solution would, at first, detect the face using the Viola and Jones Boosting algorithm and a collection of Haar-like cascade functions. The eye look for the area is reduced by suggesting that the eyes are supposed to be inthe upper part of the face. Haar-like cascade characteristics are used to detect the eye. It locates the rectangular regions of the eyes. To locate the eye pupil an algorithm is created, this algorithm use Hue information of the eye image, for given the eye ROI. The colour image is the origin andcontours are detected in the original image. The contour centric is detected as the eye pupil. Having known the middle of the eyes and the direction of the nose, a method isproposed based on the facial anatomy for estimating the location of the lips. To detect the lip corner points, an algorithm is created; this algorithm has good features for tracking lips. Next, they use haar-like-features detection for nose detection. Nostrils are eventually identified from the nose ROI by taking an origin of the dim nose picture, and counter is obtained in the original image. For the automated and reliable identification of various facial characteristics a robust algorithm is presented. The identification of eyes, mouth, and nose has been improvised by using by estimating the probable region for each feature.

Geometric representation of the position of facial characteristics, utilized in the efficiency of features detection is considerably enhanced with the use of facial geometry, without using only the algorithm in the whole face image. The proposed lip identification method is discovered to be precisely distinguishing the lips corners forboth unbiased face pictures and grinning face pictures. The eye understudy discovery technique utilizing the H-plane of the HSV shading planes picture is discovered to be heartily distinguishing the student regardless of obstructions like wearing displays, terrible light of eye zone, variety is sizesof eyes. For utilizing corner identification strategy an algorithm has been created, for recognizing both internal and external eye corners are discovered to be giving precise outcomes even in faces wearing exhibitions. The proposed strategy for nostrils recognition is additionally discovered tobe precisely distinguishing taking all things together sort of frontal pictures tried. Future work should be possible by broadening the proposed approach in presented/shifted face pictures. The work can likewise be stretched out for articulation acknowledgment and programmed following of highlights in recordings [17].

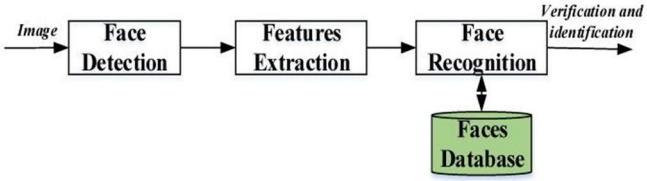


Fig. 3 Feature base Face Detection method Block Diagram

Comparison Graph between some methods is shown in Fig 4. Theoretical comparison of several existing methods shows in table 1, in terms of key parameters with Feature base face detection. The advantages and disadvantages of several existing methods are shown in table 2.

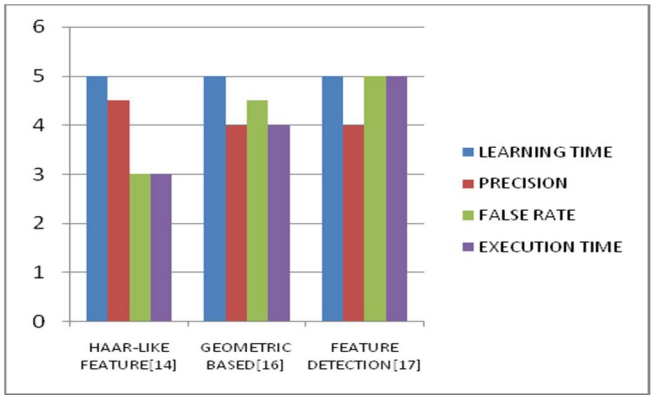


Fig. 4 Comparison Graph Of Best Existing Methods In Terms Of KeyParameters

Table 1

Theoretical Comparison of Best Existing Methods In Terms Of Key Parameters

Parameter	Haar like Feature base Face Detection	Geometric Base Face Detection
Learning time	High	High
Precision	High	Low
Ratio between detection rate and false alarm	High	Low
Execution time	Low	High

Table 2

Advantages and Disadvantages of Existing Methods

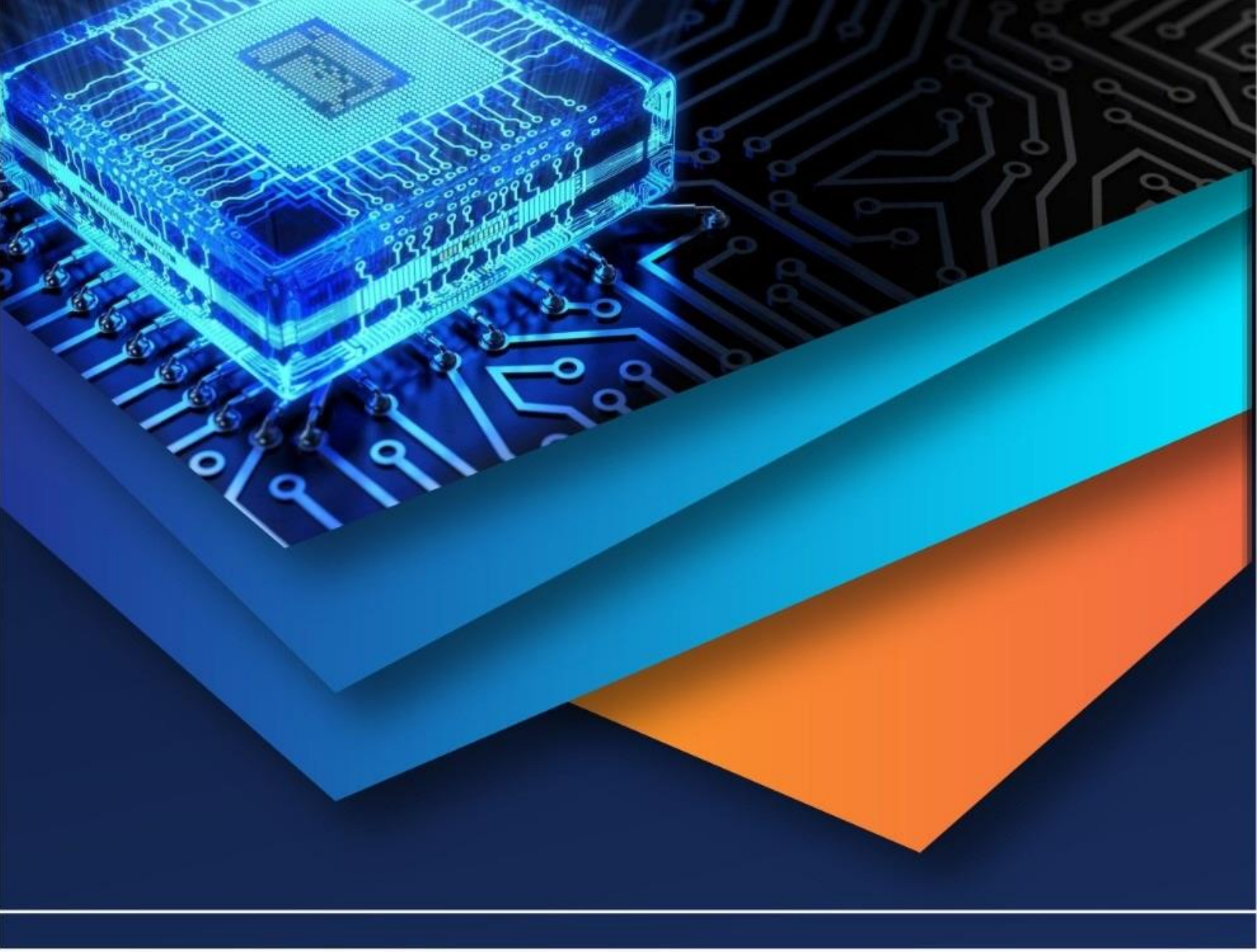
Technique	Merits	Demerits
Haar-Like Feature Base Face Detection	• Improved feature extraction part • Less false alarm	• low execution time • Complex to implement
Feature Base Face Detection	• More accurate • Low execution time	• High learning time
Geometric Base Face Detection	• Effective approach • Easy to implement	• Low accuracy • More false alarm

III. CONCLUSION

In the past few years, face recognition owned significant consideration and is appreciated as one of the most promising applications in the field of image analysis. Verification and Identification have become a significant issue in the present computerized world. Various variabilities are present across human faces such as pose, expression, position and orientation, skin colour, the presence of glasses or facial hair, variations in camera gain, lighting conditions, and image resolution, because of these variabilities face detection is very complicated. In this paper, several existing face detection methods and strategies are analyzed and studied. As a conclusion Haar-like feature extraction method is a very excellent approach for facial detection and recognition.

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