UGC Approved Journal

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified

Vol. 4, Issue 9, September 2017

Overview and an Approach to Real Time Face Detection and Recognition

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Abstract: The 'Real Time Face Detection and Recognition' represents a face parts information analyser, as a promising model for detecting faces and locating the facial features in images. The main objective is to build fully automated human facial measurements systems from images with complex backgrounds. Detection of facial features such as eye, nose, and mouth is an important step for many subsequent facial image analysis tasks. This paper presents the study of the tasks detection, landmark localization and measurement facial part by traditional approaches as separate problems with different techniques. The study is followed by a possible novel and simple model approach based on a mixture of techniques and algorithms in a shared pool.

Keywords: Real time, face recognition, face detection, facial features.

I. INTRODUCTION

Nowadays in many areas like security and surveillance, artificial intelligence, indexing, application of face detection and tracking will be found. With the detection and tracking process, recognitions also play a vital role in those areas. Face recognition is important for developing various applications and is also used in various fields. The human face plays a vital role to our identity. Face detection and tracking of various facial features opens a wide range of scope for implementing in various applications. In human-human interaction or human-computer interaction, face plays a vital role in that along with other body parts. Detecting and Tracking an object plays a very important role in computer vision applications which include fraud avoidance, activity recognition, etc. Tracking techniques having many safety applications like accidental and hazardous situations. Face detection and tracking is broad field and several research works carried out and continuing on these subjects. Initially, an image had been considered which was then rescaled. Then based on the skin color, using RGB combination the image was divided. With the edges of the corresponding images the divided skin tone image was combined. Then the morphological operations had been applied on the resultant image. Finally, a face was detected and that's shown by a bounding box.

II. VIOLA JONES FACE DETECTION ALGORITHM

It is obvious that feature is very significant to any object detection algorithm. Basically, there are a lot of features, such as eyes, nose, the topology of eye and nose, can be used for face detection. In viola jones face detection, a very simple and straightforward feature has been used. Fig. 1 shows four different feature in viola jones algorithm. Each feature can be obtained by subtracting white areas from the black areas. Here, the area means the summation of all the pixels' gray value within the rectangle. Aiming at calculating these features, a special representation named as integral image has been used.

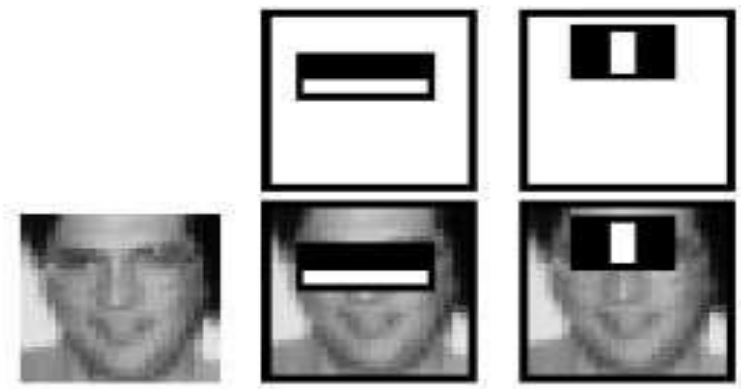

Fig. 1: Four Basic Features of Viola Jones Algorithm

UGC Approved Journal

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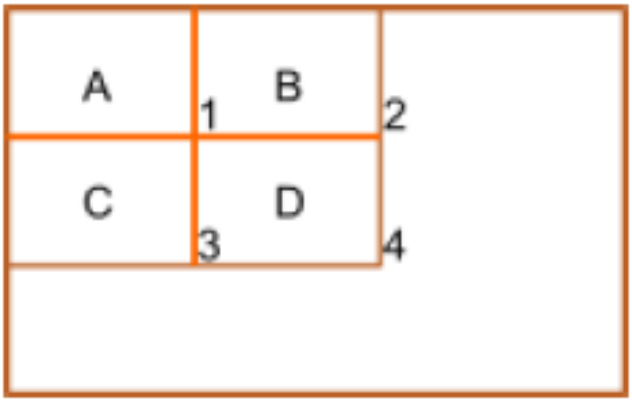

Fig. 2 : The calculation of pixel sum within a rectangle

Another important step in viola jones face detection algorithm is multi-scale detection. It is obvious that we have no idea with the size of face in an image before doing face detection. Therefore, multi-scale detection should be adopted to guarantee that faces with any size can be detected.

The complete set of features is quite large - 160,000 features per a single 24x24 sub-window. Though computing a single feature can be done with only a few simple operations, evaluating the entire set of features is still extremely expensive, and cannot be performed by a real-time application. Viola and Jones assumed that a very small number of the extracted features can be used to form an effective classifier for face detection. Thus, the main challenge was to and these distinctive features. They decided to use AdaBoost learning algorithm as a feature selection mechanism.

In its original form, AdaBoost is used to improve classification results of a learning algorithm by combining a collection of weak classifier to form a strong classifier. The algorithm starts with equal weights for all examples. In each round, the weight is updated so that the misclassified examples receive more weight. By drawing an analogy between weak classifier and features, Viola and Jones decided to use AdaBoost algorithm for aggressive selection of a small number of good features, which nevertheless have significant variety.

Practically, the weak learning algorithm was restricted to the set of classification functions, which of each was dependent on a single feature. A weak classifier h(x; f; p;) was then defend for a sample x (i.e. 24x24 sub-window) by a feature f, a threshold , and a polarity p indicating the direction of the key advantage of the AdaBoost over its competitors is the speed of learning. For each feature, the examples are sorted based on a feature value. The optimal threshold for that feature can be then computed in a single pass over this sorted list.

To achieve this, we need to maintain four sums for each element in the sorted list:

- T+ the total sum of positive example weights,
- T - the total sum of negative example weights,
- S+ the sum of positive weights below the current image, and
- S- the sum of negative weights below the current image.

The error for a threshold which splits the range between current and previous image in the sorted list is the minimum of the error of labeling all the image below the current example as negative (and all other examples as positive) versus the error of labeling all the image below the current example as positive (and all other examples as negative).

III.MATHEMATICAL FORMULATION/ EXPLANATION

Haar-Like feature is made up by 2-3 rectangular blocks, by integral image we can quickly calculate the sum of gray value in rectangle, thereby obtaining Haar-Like feature values. Similarly, new Haar-Like feature can be seen made up by the three rectangular blocks, so integral image can also be used to calculate feature value. As shown in Fig. 3, let four vertices of the rectangle D in Integral image are (xo' Yo)' (Xl' Yl)' (X2' Y2)' (X3' Y3)' the sum of all pixels in the rectangular region D can be expressed as:

$$SumD = II(x_3,y_3) - II(x_2,y_2) - II(x_1,y_1) - II(x_0,y_0)$$

among them, (x, y) represents the value of pixel (x, y) in integral image, That is the sum of all the pixel at the top left of the pixel gray.

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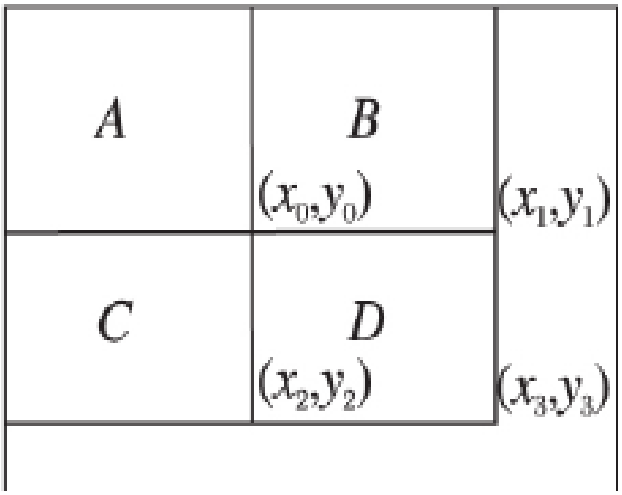

Fig. 3: Integral pixels in linage for calculating the summation of rectangle D

The method of calculate Haar-Like feature can be expressed as:

$$\lambda = \sum_{i\ [1,2,3..n\}}^{n} (\omega + \text{sum Ri})$$

among them, N represents the number of OJ rectangles, i represents the weight of the rectangle, Sum (J?,) represents the sum of the gray values of all pixels within the i-th rectangle.

IV. LITERATURE REVIEW

Early efforts in face detection have dated back as early as the beginning of the 1970s, where simple heuristic and anthropometric techniques is used. Face detection techniques can be categorized into two major groups that are feature based approaches and image based approaches. Image based approaches use linear subspace method, neural networks and statistical approaches for face detection. Feature based approaches can be subdivided into low level analysis, feature analysis and active shape model. Face detection is controlled by special trained scanning window classifiers Viola-Jones Face Detection Algorithm is the first real-time face detection system. There are three ingredients working in concert to enable a fast and accurate detection: the integral image for feature computation, Adaboost for feature selection and cascade for efficient computational resource allocation.

Eyes are detected based on the hypothesis that they are darker than other part of the face, finding eye analogue segments searching small patches in the input image that are roughly as large as an eye and are darker than their neighborhoods. a pair of potential eye regions is considered as eyes if it satisfies some constraints based on anthropological characteristics of human eyes. The study proposes a new algorithm for eyes' detection that uses Iris geometrical information for determining the whole image region containing an eye, and then applying the symmetry for selecting both eyes.

Edge detection techniques can be classified under two broad categories, gradient and Laplacian. The gradient method detects the edges by considering the minimum and maximum in first derivative of an image and Laplacian on the other hand look for zero crossing in second derivative of an image to detect the edges. Different gradient based method is Prewitt, Roberts, Sobel operators while Marrs-Hildreth and Log are a Laplacian method. The Sobel operator is fast, detects the finest edge and has smoothing along the direction of edge, this avoids noisy edges. The objective of this research work is to perform a comparative study between Camshift and KLT tracking algorithms. In this process, initially face is detected using Viola Jones algorithm. Several facial features have been identified in order to track the face across the frames by Camshift and KLT algorithms. Camshift and KLT algorithm 64 applied for tracking the face. Comparative study is performed to analyze for finding better performing algorithm. The Camshift algorithm includes other objects along with the face and part of the face is excluded while tracking the face. The experimental results show that the KLT algorithm performs better than the Camshift algorithm. Though we have seen that KLT algorithm also have one problem in tracking though the tracking process of the same perform much better than Camshift algorithm. The Camshift algorithm will be improved with new methodologies or functions for tracking face accurately and precisely. To improve the performance of both so that the time of computation decreased and the accuracy increased much more which in return will result in less memory consumption.

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4.1 Prominent Method/Approach

Color probability distribution varies accordingly whenever the video frame sequences changes over time. Maintaining proper size and location of the search window required for various experimentation purposes. Camshift algorithm is used to adaptively meet that requirement. Camshift Algorithm principal has been properly explained in . 2D probability distribution image is employed by the Camshift Algorithm. The back projection of the target histogram is produced by the Camshift algorithm with image to process. The Meanshift Algorithm is called by the Camshift algorithm whose purpose is to calculate the target center of the image employed by the Camshift algorithm, i.e. the probability distribution image. The flow of Camshift algorithm operation studied during the analysis in this paper shown in Fig. 4.

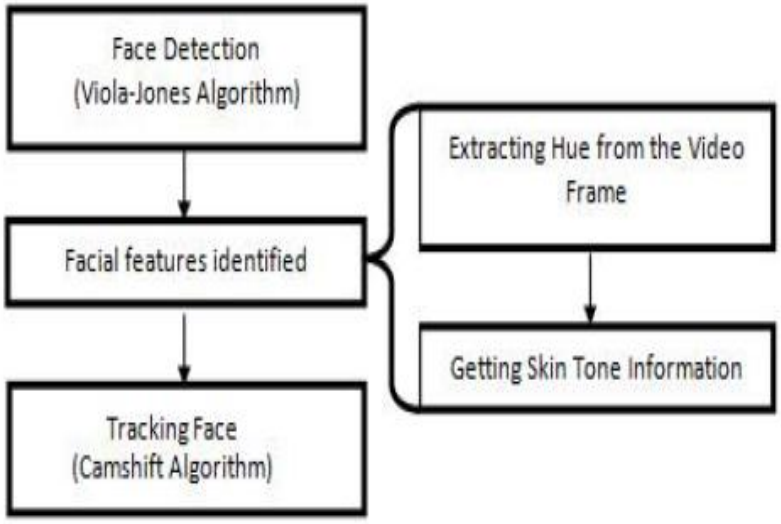

Fig. 4: Cam shift Working Model

The movement of the objects in the video frames is tracked by the KLT tracking. This approach calculates when the brightness constancy constraint of the image is fulfilled and the movement of the image is small.

A set of object points is detected by this algorithm through the video frames. After face detection been completed then the facial feature points to be identified that can be tracked constantly. The point tracker tracks the point throughout the number of frames one by one referring the previous frame.

After the face detection, the next process is extracting information of the facial expressions that is present. Several permanent facial features on which the several approaches depend upon are the eyebrows, eyes, mouth, etc. and also the facial lines. The flow of KLT algorithm operation that is studied during the analysis in this paper is shown in Fig 5.

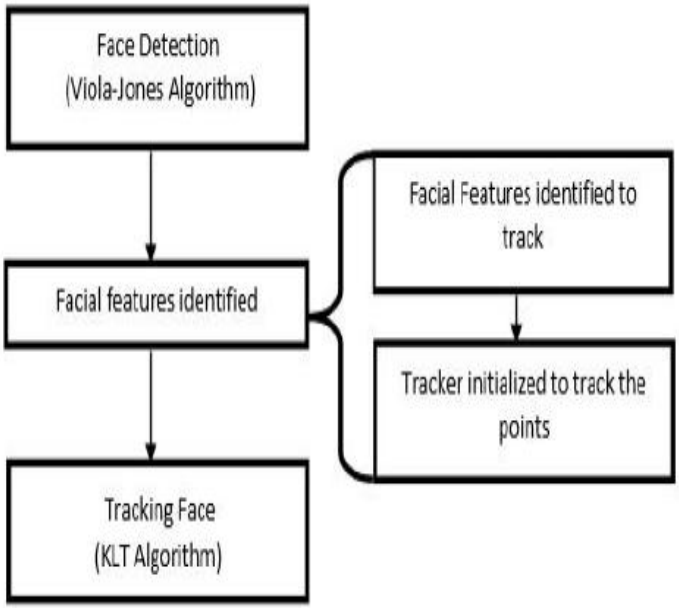

Fig. 5: KLT Working Model

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The objective of the experiment is to evaluate the performance of the facial features detection and face tracking algorithms KLT and Camshift. Viola Jones algorithm is used for Face detection before invoking face tracking algorithms KLT and Camshift.

Table 1: Classification of Studied Literature

Basic Concept	Database	Performance Evaluation Parameter	Merits	Our Findings
Camshift and KLT algorithms for Real Time Face Detection	Real Time Object Detection	Camshift and KLT tracking algorithms	The Camshift algorithm will be improved with new methodologies or functions for tracking face accurately and precisely	The KLT algorithm performs better than the Camshift algorithm.
Principal Component analysis (PCA), Linear Discriminant Analysis (LDA), and Elastic Bunch Graph Matching (EBGM)	Color FERET Database	PCA and LDA are two principle algorithms	PCA is simpler in algorithm realization, both in recognition accuracy and processing speed.	LDA seems to perform better than PCA
Adaboost and New Haar-Like Feature	601 face image for experiments	Haar-Like feature, train classifier and cascade by Adaboost algorithm,	Final 2452 weak classifiers has 893 weak classifiers use the new Haar-Like feature. Ibis proves effectiveness of new Haar-Like features in face detection	Haar-Like classifier have higher detection rate

4.2 Motivation

The study present a novel and simple model approach based on a mixture of techniques and algorithms in a shared pool based on Viola–Jones object detection framework algorithm combined with geometric and symmetric information of the face parts from the image in a smart algorithm. The study is a continued part of previous work the proposed model is modestly applied with hundreds of face images taken under different lighting conditions, a number of general assumptions used in this research field are identified.

Face detection is a technology that uses set of mathematical rules to describe landmarks to identify human face. It typically determines the precise face area. The human face plays crucial role in social interactions and conveying one's identity. It is an important early step in many computer systems and face processing system. Some current applications where face detection is being used are autofocus cameras, practical security systems, people counting system, lecture attendance system etc. Several US states now use face detection and recognition while issuing driving license. As a result of such systems person sensing and recognition become of fundamental importance hence such systems should be highly user-friendly. The idea of face detection can be combined with almost every smart system as face being a biometric identifier they ensure a better secure and immune to intrusions.

Biometric is the use of distinctive physical features (e.g., iris, fingerprints, face, and retina) and behavioural feature (e.g., gait, signature), called biometric identifiers, for automatic recognition of an individual. These identifiers cannot be easily misplaced, forged, or shared; they are more reliable for recognizing a person rather than other knowledge-based methods. It allows recognition without any physical contact with the sensor. The paper aims to present a face detection system based on edge detection and simple morphological steps in MATLAB.

V. PROBLEM DEFINITION AND REQUIREMENT ANALYSIS

5.1 Problem Domain and Definition

In Hybrid Face Detection System using Combination of Viola - Jones Method and Skin Detection the cascade object detector framework proposed by Viola-Jones was extended. The main objective was to detect face parts in still images or videos, especially in complex background images, by using Viola Jones upper body model to detect near-frontal upper-bodies as a region of interest. This is the primary detector where the high probability of finding the face instead of searching the entire image. In order to find an accurate face in that region of interest, Viola-Jones' face detector is used as a secondary detector to increase accuracy and reduces false negatives. Third detector pixel-based skin detection methods are applied on the region of interest which is not detecting a face using the secondary detector. The third detector classifies each pixel as skin or non-skin individually and independently from its neighbours and combines it with Viola - Jones upper body detection. This improves the performance of face detection systems in terms of

UGC Approved Journal

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ISSN (Print) 2394-1588

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increasing the face detection speed and decreasing false positive rate. The primary, secondary and third detectors are combined by this release and a single homogeneous set of face bounding-boxes are returned.

The new model determines the locations and sizes of human faces in digital images by extracting region of interest and apply Viola Jones proper object detector in the area of interest in order to limit search area. These techniques radically reduce computation time.

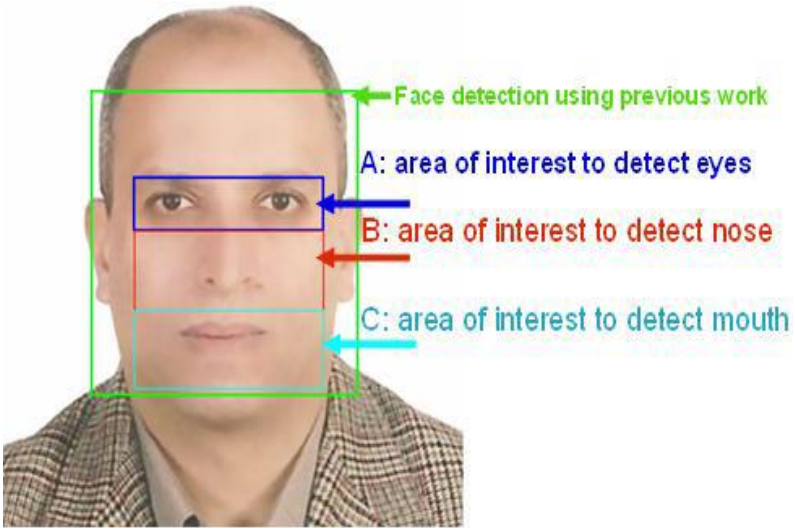

Fig. 6: Region of Interest (ROI) sub section parts

As shown in "Fig.6" the face detection area are divided to three regions of interest calculated using the following; From the Detected Face, the model apply Viola - Jones Eye Pair Big to detect eye pair in the face detection area and create the region for performing the eyes search.

Furthermore, the distance between the center of pupils called pupillary distance (PD) use the following formula to calculate distance between two points. This will get center points of the two eyes as detected by the proposed algorithm and enable to calculate the distance between the two pupil axis using the following equation

pupillary distance(PD) =sqrt((y2-y1)^2+(x2-x1)^2);
Where (x1,y1) and (x2,y2) are coordinates of two pixels of the center of the iris of the eye as shown in "Fig. 7".

Fig. 7: pupillary distance (PD)

Nose detection is highly important for face part detection in range images and is consider as simpler task than detecting a face because a nose is not as complex and variable as a face. To detect the nose within the face region. The nose provides a more accurate measure of the skin tone because it does not contain any background pixels. Viola-Jones algorithm is used as first step to Detect nose this model is composed of weak classifiers, based on a decision stump, which use Haar features to encode nose details the nose bounding box is relatively defined to the cropped face image.

Fig. 8: Nose detect and supratip detect

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For mouth detection this technique is a combination of existing Viola Jones mouth detection algorithm and physical location approximation is made in detected face to mouth. This method increased the accuracy of system and decreased consumed time as show in "Fig. 9"

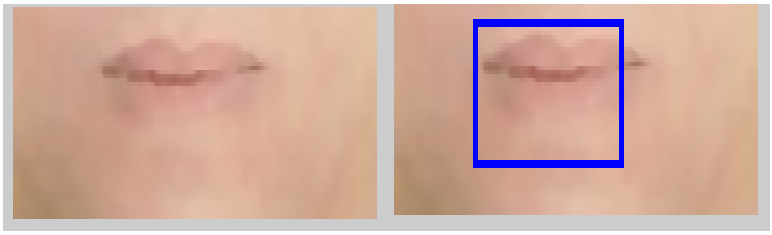

Fig. 9: mouth search region and mouth detect

The experimental test used AT & T Lab Dataset of color images containing many faces with various complex backgrounds. The resulting detector automatically returned bounding-boxes fitting detecting faces parts appearing in images.

VI. POSSIBLE SOLUTION AND STATEMENT OF SCOPE

6.1 Possible Solution

- To develop Algorithm for Feature Extraction using various different Classification Model.
- To develop a model for finding similarities real time and database facial images.
- To create system objects which detects objects using Viola Jones Algorithm.
- Classification of local binary patterns (LBP) to encode facial features
- Identifying pair wise distance between pair of objects to calculate cluster points.

6.2 Objectives to be achieved

- Developed a function for calculating similarities between pair wise and ehdHistograms distance.
- Filtering images by technique like horizontal mask, vertical mask, diagonal mask, anti-diagonal mask.
- Skin detection was performed on the image. Based on the results of face and skin detections, a set of features was extracted and inserted into the classifier. For each feature, the threshold value was defined.
- Developing a program to build fully automated accurate human facial recognition and classification system from images or dataset with complex backgrounds.
- The best performance was achieved when the person stays at 150cm from the system camera. The accuracy rate achieved is 90.59%. At the time the person facing directly towards the camera, the best performance is achieved.

6.2 Statement of Scope

The true challenge to build an automated system which equals human ability to detect faces and estimates human body dimensions from an image or a video. The conceptual and intellectual challenges of such a problem, because faces are non-rigid and have a high degree of variability in size, shape, color and texture. Numerous techniques have been developed and designed typically to deal with single images. Detect human appearance in image or track humans in videos become a very important task for many applications such as: auto focus in cameras, visual surveillance, traffic safety monitoring and human computer interaction.

Different set of techniques have been introduced recently, for example; principal component analysis, geometric modeling, auto-correlation, deformable template, neural networks, color analysis, window classifiers, view-based Eigen space methods, and elastic graph models. The study present a novel and simple model approach based on a mixture of techniques and algorithms in a shared pool based on Viola–Jones object detection framework algorithm combined with geometric and symmetric information of the face parts from the image in a smart algorithm.

The study is a continued part of previous work the proposed model is modestly applied with hundreds of face images taken under different lighting conditions, a number of general assumptions used in this research field are identified.

REFERENCES

[1] A.Maghraby M.Abdalla O.Enany, Hybrid Face Detection System using Combination of Viola - Jones Method and Skin Detection, International Journal of Computer Applications (0975 – 8887) Volume 71– No.6, May 2013

[2] W. Zhao, R. Chellappa, A. Rosenfeld, and P. Phillips. Face recognition: A literature survey. ACM Computing Surveys, pages 399–458, 2003.

[3] L. Sirovich and M. Meytlis. Symmetry, probability, and recognition inface space. PNAS - Proceedings of the National Academy of Sciences,106(17):6895–6899, April 2009.

[4] P.VIOLA and M.j.Jones, Robust real time face detection, international journal of computer vision, 57 (2004),

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified

Vol. 4, Issue 9, September 2017

[5] K. T. Talele, S. Kadam, A. Tikare, Efficient Face Detection using Adaboost, "IJCA Proc on International Conference in Computational Intelligence", 2012
[6] Phillip I.W.,Dr. John F. Facial Feature Detection Using Haar Classifiers,Jcsc 21, (2006)
[7] T. Sakai, M. Nagao, and T. Kanade, Computer analysis and classification of photographs of human faces,in Proc. First USA—Japan Computer Conference, 1972, p. 2.7.
[8] Z.H. Zhou and X. Geng, "Projection functions for eye detection", Pattern Recognition 37, no 5, pp. 1049-1056, 2004
[9] Daugman J (2006) "Probing the uniqueness and randomness of IrisCodes: Results from 200 billion iris pair comparisons." Proceedings of the IEEE, 94(11),
[10] Gomai, G. A new approach for pupil detection in iris recognition system, Computer Engineering and Technology (ICCET), 2010 (Volume:4)
[11] M. Hassaballah,KenjiMurakami, and Shun Ido, Eye and Nose Fields Detection From Gray Scale Facial Images, MVA2011 IAPR Conference on Machine Vision Applications, June 13-15, 2011, Nara, JAPAN
[12] S.Gurumurthy,B.K.Tripathy ,Design and Implementation of Face Recognition System in Matlab Using the Features of Lips,I.J. Intelligent Systems and Applications,2012,8,30-36.
[13] A.Vora, A.Raj, K.Manikantan, and S.Ramachandran, Enhanced Face Recognition using 8-Connectivity-of-Skin-Region and Standard-Deviation-based-Pose-Detection as preprocessing techniques, International Conference on Medical Imaging, m-Health and Emerging Communication Systems,pp.364-369, 2014.
[14] B. Dahal, AbeerAlsadoon, P.W.C. PrasadandAmrElchouemi, Incorporating Skin Color for Improved Face Detection and Tracking System, 2016 IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI), pp.-173 – 176, 2016
[15] M. DwisnantoPutro, TeguhBharataAdji, BondhanWinduratna, Adult Image Classifiers Based On Face Detection Using Viola-Jones Method, 2015 1st International Conference on Wireless and Telematics (ICWT), pp. 1-6
[16] JatinChatrath, Pankaj Gupta, Puneet Ahuja , Aryan Goel, ShaifaliM.Arora, REAL TIME HUMAN FACE DETECTION AND TRACKING, 2014 International Conference on Signal Processing and Integrated Networks (SPIN).
[17] Ma. Christina D. Fernandez, Kristina Joyce E. Gob, Aubrey Rose M. Leonidas, Ron Jason J. Ravara, Argel A. Bandala, Elmer P. Dadios, Simultaneous Face Detection and Recognition using Viola-Jones Algorithm and Artificial Neural Networks for Identity Verification.
[18] Donghe Yang, Jinsong Xia, Face Tracking Based on CamshiftAlgorithm and Motion Prediction, International Workshop on Intelligent Systems and Applications, 2009. ISA 2009.
[19] Corporation, "Open Source Computer Vision Library Reference Manual", 123456-001, 2001.
[20] G. R. Bradski. "Computer vision face tracking for use in a perceptual user interface", Intel Technology Journal, 2nd Quarter, 1998.
[21] OULD-DRIS Nouar, Ganoun Ali and Canals Raphaël, Improved Object Tracking with Camshift Algorithm, 2006 IEEE International Conference on Acoustics Speech and Signal Processing Proceedings.
[22] Y. Cheng, MeanShift, mode seeking, and clustering, IEEE Trans. on PAMI, vol.17, pp.790-799, 1995.
[23] J.Savitha, Dr. A.V. Senthil Kumar, Face Tracking and Detection using S-PCA & KLT Method, (Volume 2, Issue 2, February 2014International Journal of Advance Research in Computer Science and Management Studies).

BIOGRAPHY

Prof. Vikramsingh R. Parihar is an Assistant Professor in Electrical Department in PRMCEAM, Badnera-Amravati having 6 years of experience. His domain of research is Electrical Engineering, Instrumentation, Electrical Power Systems, Electrical and Electronics Engineering, Digital Image Processing, Neuro Fuzzy Systems and has contributed to research in a commendable way.