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Face Detection in Skin Color Model Using KNN and HBF Enhancement

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ABSTRACT:- Biometrics cannot be misplaced or one cannot forget it. They are hard for attackers to counterfeit and for users to renounce. Face feature is a peculiar characteristic that falls in the category of biometrics. Thus face detection plays a trivial role in face recognition system due to various challenges of illumination, occlusion. Detection of face from the large similar set of image database is becomes very essential. In this paper we propose a method which use KNN & High boost filter. The KNN classifier is used to select skin and non skin pixel then apply high boost filter approach which can eliminate the noise and blur from the image. We also use Gaussian probability density function to model the skin color in HSV and YCbCr color space sand also use canny edge detection technique to sharp the edge of images. The experimental analysis of the propose system is done using performance measuring parameter detection rate.

KEYWORDS:- ***Face Detection, KNN, Highboost Filter, Histogram Equilization***

1. INTRODUCTION

Due to the speedy growth of computational powers and accessibility of current sensing, exploration and representation tools and technologies, computers are becoming extra and additional intelligent. Various research projects and commercial products have demonstrated the potential for a computer to interrelate with human in a natural way by looking at people by means of cameras, listening to peoples through microphones, and reacting to people in a responsive behavior. Human face recognition and identification techniques have attracted a lot of concentration over the years and lots of algorithms are developed. Face detection has numerous potential applications in vision, closed-circuit television, linguistics video analysis and involuntary access management systems. The matter of involuntary face recognition are often declared as follows: given a picture of a personality's face (test set or probe), evaluate it with restored models of a group of face pictures labeled with the person's individuality (the coaching set or reference), and report the matching outcome. Face segmentation is a crucial step inside the face recognition system as a result of majority of face classification techniques tend to exclusively work with labeled face pictures. Taken as a whole the performance and tasks of a face recognition system depends on accurately localizing the face, hence correct face segmentation is one amongst the crucial tasks in face recognition system style. The reason of the face segmentation step is to mine the realm, from given massive image that surrounds solely face. On the other hand, pleasant variability in image look attributable to cause discrepancy, occlusion, image orientation, illuminating circumstance and facial features, engenders nice intricacy in algorithms implementation [1]. The factors that remarkably influence the segmentation are problematical background color, point of reference and also the distance of the device from the face. Thus identification of faces must be done in first step that is why face detection is of significance [2-3] In this work, we proposes a face detection using KNN classifier with High boost filter which is most efficient and for skin color determination Gaussian probability density function (PDF) is used.

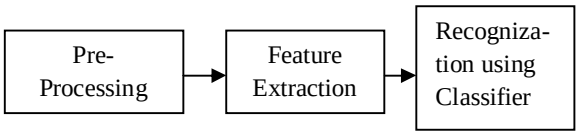

Fig.1 Block Diagram of typical Face Detection System

The arrangement of this research paper is organized in this way: Section presents the literature work about the face detection. In section III discusses some methodology for the face detection. In section IV describe our proposed methodology. In section V present experimental result and analysis of the proposed system comparing it with performance parameter and last section give complete conclusion of the work.

2. RELATED WORK

Jiang-Qiang-Rong et al. [15] proposed a face detection method which is based on the combination of the skin color model, edge information and feature of human eyes in color image. Firstly the speed of processing color is fast so YCbCr color space is used. Then elliptical model is constructed which helps in segmentation of skin pixels from the background image. Thus get the binary image. Then sobel operator is used on the gray version of the original image and an edge is obtained. This edge is the negated and eroded to connect across separated pixel in edge image. Now use median filter to remove noise from the final image. Then face verification is done by defining a number of criteria to narrow down the search space.

Maheshwari et al [4] anticipated a technique for color face recognition. The effectiveness of color information plays a noteworthy role when face images are taken under burly variations in enlightenment, as well as with low spatial resolutions. Firstly the input color image is converted into different color space models. In the subsequent step Eigen values and Eigen vectors are extracted from every color space models. In the last step a nearest neighbor classifier is designed for classifying the face images based on the extracted features. The precision of proposed method is remarkably better than the consequences of other FR methods over dissimilar FR challenges including highly uncontrolled illumination, restrained pose variation, and diminutive resolution face images. KNN method is used. This method is enhanced and proficient than other existing methods due to its condensed error rate.

Li-Zhu et al. [5] proposed a face detection method in which for skin segmentation and detection YUV color space is used. Now in order to separate the brightness information to the chroma information in the expression of color, cluttering method is used and which improves the velocity performances of the of the regional face separated from regional inhuman face. Then EM algorithm is used for convergence

A. Amjad et al. [6] has proposed a method which has been evaluated for wide range of poses, facial expression, and complex background and blur r noises. First of all a suitable color space is chosen for skin modeling which is YCbCr color space as chrominance and luminance are explicitly separated already, then explicit skin color model is used because of its simplicity and low computational requirement. Then the histograms are calculated for Cb and Cr components to find the lower threshold. Then segmentation is done using a segmentation coefficient. Now a pre processing process is taken out in order to remove the imperfections from the segmented image. Then edge detection is carried out with the help of classical gradient based Roberts edge detection operator. Then again post processing is performed in order to remove the imperfections from the generated mask. Then at last a hard decision algorithm for connected component analysis is carried out. And faces of detected.

Srinath et al. [13] proposed a high performance face recognition system to surmount the above difficulty mentioned based on confined binary pattern (LBP) using the probability distribution functions (PDFs) of pixels in unusual mutually independent color channels which are vigorous to frontal homogenous illumination and planer rotation is proposed. Probability distribution functions (PDFs) of a face image can be painstaking as the signature of the face, which can be used to the face image in a low-dimensional space. This method also used a KNN classifier to enhance the recognition ratio. Furthermore, systematic studies of false acceptance rate (FAR) and false rejection rate (FRR) analysis are incorporated. The performance of the proposed system is estimated by exploiting the OULU database.

3. FACE DETECTION METHOD

3.1 Histogram Equalization

Histogram Equalization is a technique of contrast improvement of an image by means of its histogram. If the pixel intensities in an image are deceitful in either dark or brighter side of histogram, after that the histogram will have its peak values at unusual levels. The histogram equalization enhances the contrast of image by uniformly distributing the intensities in complete range 0 to 255[7]. After histogram equalization, the histogram will have all its peak values at same level. Fig.2 illustrated the histogram equalized images.

Fig.2. Histogram equalized image

3.2 Homomorphic Filters

The Homomorphic filters are based on the widely used illumination-reflectance model [8].The Homomorphic filters manages the illumination and reflectance component and appropriate for illumination normalization. An image f(x, y) can be expressed as the product of the enlightenment i(x, y), and the reflectance component r(x, y) as follows:

$$f(x, y) = i(x, y).\ r(x, y)$$

This equation cannot be used to function disjointedly on the frequency components of illumination and reflectance openly because the Fourier transform of the product of the two functions is not distinguishable.

The Illumination component of an image is normally characterized by the sluggish spatial variations while the reflectance components diverge unexpectedly, particularly at the junctions of the unalike objects. These characteristics in reality lead to correlate the little frequencies of the Fourier transform of the logarithm of an image with enlightenment and the high frequencies with reflectance [9]. Fig.3 showed the homomorphic filtered image.

Fig.3. Homomorphism filtered image

3.3 KNN Classifier

K-Nearest Neighbor algorithmic (KNN) could be a line of attack for categorizing items supported adjacent coaching examples within the attribute vector. The associated object is classed by a majority vote of its neighbors [10]. The worth of k is set sustained the scale of the information used for classification. If k = 1, afterward the thing is just allotted to class of its nearest neighbor, larger values of k cut back the consequence of noise on the classification, though build boundaries between categories less absolutely different. Surrounded by alternative ways, SVM, neural network and theorem classifiers is also mentioned [11], [12].

3.4 Principal Component Analysis (PCA)

Principal component analysis is a mathematical process that employs to convert a set of observations of probably correlated variables into a collection of values of uncorrelated variables called principal components. The number of principal components is less than or identical to the number of original variables. It is for the reason that, in data sets with many variables, groups of variables often shift together. One reason for this is that more than one variable may be measuring the similar driving principle governing the behavior of the system. The method produced a novel set of variables, called principal components. Every principal component is a linear amalgamation of the original variables. All the principal components are orthogonal to each other so there is no superfluous information. The principal components as a complete form an orthogonal basis for the space of the data.

4. PROPOSED WORK

Face detection concludes the presence and location of a face in an image, by distinguishing the face from all other patterns existing in the scene. This entails a suitable face modeling and segmentation. Initially the selection of image from large set of database is performed then chooses the portion of image and identifies them on the basis of color using hybrid color space. Subsequently apply Gaussian probability function to model the skin and non skin pixel. This Gaussian curve is also used by Alok Verma et al. [14]. For classify the modeled skin and non-skin distribution apply KNN classifier and then to remove the blur from edge o image high boost filter technique is applied. Finally to remove the noise from image canny edge detection techniques is applied. Gaussian probability density function, KNN classifier and High boost filter is described below in detail.

Gaussian Probability Density Function

The Gaussian probability density function is the vertically normalized PDF that is produced from a signal or measurement that has purely random errors. The normal probability density function is:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

4. 1 K-Nearest Neighbor Classifier

The K- nearest neighbor (k-NN) classifier is an expansion of the simple nearest neighbor (NN) classifier system. The nearest neighbor classifier works based on an easy non-parametric decision. Every query image Iq is scrutinized based on the distance of its features from the features of other

images in the training database. The nearest neighbor is the image which has the minimum distance from the query image in the feature space. The distance between two features can be measured based on one of the distance functions such as, city block distance d1, and Euclidean distance d2 or cosine distance dcos.

$$d_1(x,y) = \sum_{i=1}^{N} |x_i - y_i|$$

$$d_2(x,y) = \sqrt{\sum_{i=1}^{N} |x_i - y_i|}$$

$$d_{cos}(x,y) = 1 - \frac{\vec{x}.\vec{y}}{|x||y|}$$

K nearest neighbor algorithm uses K closest samples to the query image. Each of these samples belongs to a known class C_i. The query image I_q is categorized to the class CM which has the majority of occurrences among the K samples. The performance of the k-NN classifiers highly related to value of the k, the number of the samples and their topological distribution over the feature space. Many approaches are introduced to improve the performance of the k-NN systems using wavelet techniques, Cluster-Based Trees and Tolerant rough sets and so on.

4.2 High Boost Filter (HBF)

A high boost filter belongs to a category of spatial filtering. A high boost filter is used to retain some of the low-frequency components to and in the interpretation of an image. In this filter the input image *f(m, n)* is multiplied with an amplification factor '*Af*' before subtracting. The low pass images are discussed as follows.

$$HBF = Af \times f(m,n) - LP$$

Adding and subtracting 1with the gain factor,

$$HB = Af - 1 \times f(m,n) + f(m,n) - LP$$

Where f(m, n)- LP-HP

$$HBF = Af - 1 \times f(m,n) + HP$$

Where,
HBF – High boost filter
LP – Low Pass
Hp – High Pass
Af – Amplification Factor

4.3 Proposed Steps:

The multistep process is shown in fig and explained as follows-

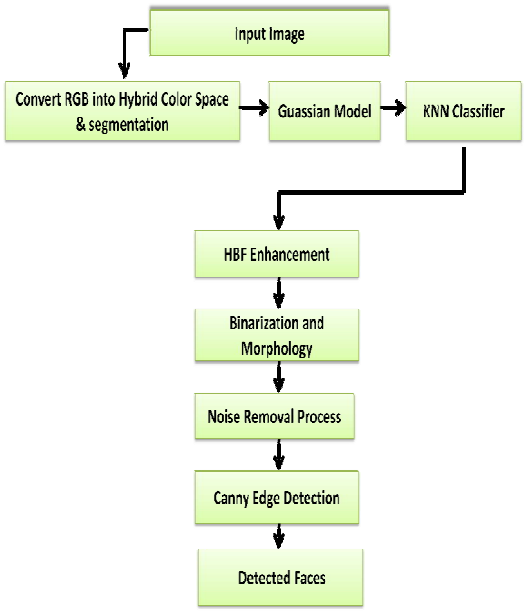

Fig 4: Block Diagram of Proposed Method

Step 1-: Select an image randomly either from a database or from own galleries consist of single and multiple faces with different pose and illumination conditions.

Step-2: In the low level process, first skin detection is done. The very first step in skin detection phase is to choose a suitable color space, according to our requirement we first convert the RGB color pixels into YCbCr and HSV color spaces, as luma and chroma component are explicitly separated. The skin color pixel should satisfy the following condition in HSV color space 0<=H<=0.26;0.16<=S;<=0.1 and for YCbCr it should satisfy 141 <=Cr<=164; 141<=Cb<=194;

Step-3: Now to effectively model color distribution suitable parametric distribution model. Gaussian probability density function is used productively as a method for skin color. The first parameter is mean vector and the second one is covariance matrix and segmentation is done.

Step-4: Then at the end of this low level process of skin detection to classify the skin and non skin pixels we use K nearest neighbor classifier for classification and also segmentation process is also running with this classification in order to remove the unwanted skin regions like neck and shoulder part.

Step-5: Then in order to extract the detail that is hidden or basically to draw attention to certain characteristics of importance in an image we use contrast enhancement technique along with high boost filter so that the perceptibility of objects in the image get enhanced by enhancing the brightness difference between objects and their background and this is done using contrast stretch.

Step-6: Then to fill the holes and gaps that originated from various sources we use morphological operations and binary mask is created.

Step-7: Now in the noise removal process we use high boost filter and Gaussian filter.

Step-8: To identify and locating sharp discontinuities of an image we use well known canny edge detection method. The edges identified still contain noise so the noise removal process starts in a loop with canny edge and the desired output detected faces.

5. EXPERIMENTAL RESULT

To verify the effectiveness of the proposed scheme, Matlab simulated experiments are performed. Most frequently used databases for face detection are PIE, CMU, MIT databases consists of single frontal grey color images. Therefore, images from own photo gallery and from web are taken into consideration consists of both single and multiple group images with various poses and illumination conditions. The test is performed on 25 group images containing 225 faces and 25 single face images separately. The examples of part experimental result are shown in fig.5-fig.11

Fig 5: Input test image and its skin detected image

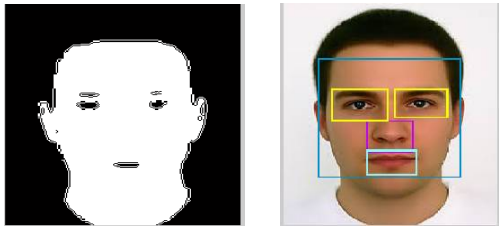

Fig 6 : HBF enhanced image and successfullt detected face

Fig 7: Input group image

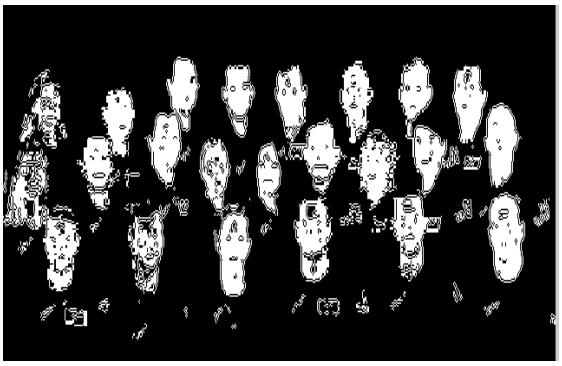

Fig 8: HBF enhanced image

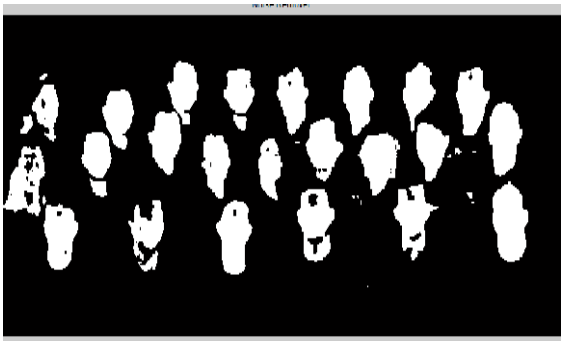

Fig 9: Noise removal process

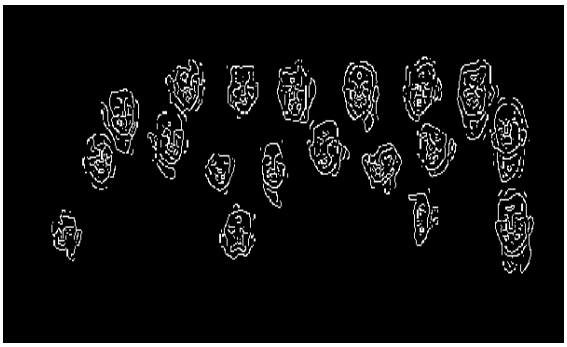

Fig 10: Edges detected using canny edge

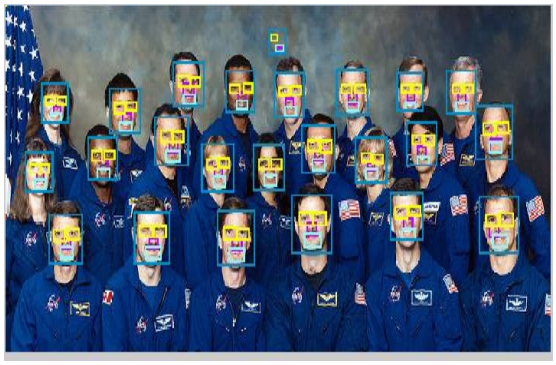

Fig 11: Successfully detected faces in group image

The performance of the proposed scheme is evaluated in terms of true detection rate and defined as:

$$\text{Detection rate (\%)} = \frac{\text{True detected faces}}{\text{Total no of faces}} \times 100$$

The success of face detection system can be estimated using two metrics. These two types of parameter are used in evaluating the performance accuracy of a face detection system. Different researches use different conventions for these parameters. The two metrics are true detection rate (DR) and false detection rate (FDR).

Experimental results show that the proposed scheme achieves good accuracy in single face image. And 95% true detection rate with 5% false detections for colored group images. As compared to the existing method the high detection rate achieves because of geometric features are also used in detecting faces instead of geometric constraints. The statistical data of 9 samples for group images are shown in table1. Also the comparison graph for existing and proposed method is shown in fig.12

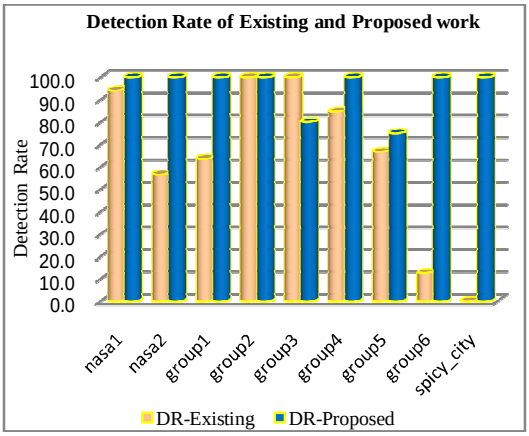

Fig 12: Graph for comparison of true detection rate of existing and proposed method of nine samples in group image.

6. CONCLUSION

Face detection plays a trivial role in face recognition system due to various challenges of illumination, occlusion and others. Contrast enhancement of image is one of the properties of digital image processing which helps us in different manner. In this paper, we propose a method for contrast image enhancement technique using KNN classifier with High boost filter technique. This image enhancement is mainly focuses on improvement in the perceptibility of face using high boost filter which simply remove blur from the edge of image and for removing the noise from image canny edge detection technique is applying. After applying all these process it gives better result. Moreover geometric feature are used to achieve less false and miss alarms. First the testing is done on single frontal images also testing on group images is performed which gives better results as compared to the existing method. Because the false alarm are very high in the existing method. But still there are miss and false

Table.1: Result Analysis: Comparison table of existing and proposed method for nine samples in group image

Images	Total Faces	True Detections		False Detections		Misses		Detection Rate (%)	
		Alok Verma[14]	Proposed	Alok Verma[14]	Proposed	Alok Verma[14]	Proposed	Alok Verma[14] (%)	Proposed (%)
nasa1	17	16	17	3	0	1	0	94.1	100
nasa2	23	13	23	0	1	10	0	56.5	100
group1	11	7	11	6	0	4	0	63.6	100
group2	4	4	4	6	0	0	0	100	100
group3	20	20	16	0	0	0	4	100	80
group4	13	11	13	3	1	2	0	84.6	100
group5	12	8	12	1	0	4	3	66.7	75
group6	8	1	8	2	0	7	0	12.5	100
Spicycity	13	0	13	4	0	13	0	0.0	100

alarms in the existing method. So in future need to develop such approach which can efficiently minimize the color space and must be less complex to handle or design.

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