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Hybrid Facial Color Component Feature Identification Using Bayesian Classifier

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ABSTRACT- Interest and examining activities in habitual face recognition have increased drastically over the past few years. Faces represent composite, multi-dimensional, significant visual motivation and mounting a computational model for face recognition. For most of the face recognition techniques, solution depends on the feature extraction representation and matching. These lessons are summarized by reflecting the facial expression recognition in general and typically, lack in providing the particular aspect with minimal cost. This, in turn, developed a technique named Color Component Feature Identification using the Bayes Classifier. The model is associated with RGB and HSV color bands along with its corresponding facial feature components. Performance of Color Component Feature Identification using the Bayesian Classifier (CCFI-BC) technique reliably segments the facial color depending on the texture and identifies the features. These regions are further combined with RGB and HSV bands for robust pixel detection and with better visibility. CCFI-BC improves the performance measure and evaluated in terms of recognition rate and true positive rate. A systematic and experiential result shows a minimal cost in restricting the participant's choice of classifiers.

Keywords: Biometrics, Face Recognition, Bayes Classifier, Feature Identification, Color Component, Pixel detection.

1. INTRODUCTION

The fast growth in the world's economy causes the huge destruction and violence's around the world with the decline in social orders. The importances of security are raised and demand rose to the automatic identification systems. Alternatively, numerous techniques are used in the automatic identification systems. Usually, the person uses the passwords, encrypted and decryption key to access the confidential data in the society. But the password may be forgotten or misused by some other users who are authenticated to the owner. The key can be lost by the user or by antiauthority copied by others.

Facial expression is a observable manifestation of the exciting state, cognitive activity, intention, individuality, and psychopathology of a person. It acts
as a communicative role in interpersonal relations. Facial expressions and other signal convey non-verbal communication cues in face-to-face interactions. These cues may also complement speech by helping the listener to draw out the intended meaning of spoken words. Facial expressions have a substantial effect on a eavesdropping interlocutor. The facial expression of a speaker accounts for concerning 55 percent of the result, 38 percent of the second is converse by voice modulation and 7 percent by the spoken words.

As an outcome of the information include facial expressions. It can participate in a significant role everywhere humans interact with machines. Automatic recognition of facial expressions capacity act as a component of natural human mechanism interfaces. Such boundary enable the automatic stipulation of services that require a good approval of the expressive state of the service user, as would be the case in communication that absorb concession. For e.g., little machines can also benefit from the ability to recognize expressions.

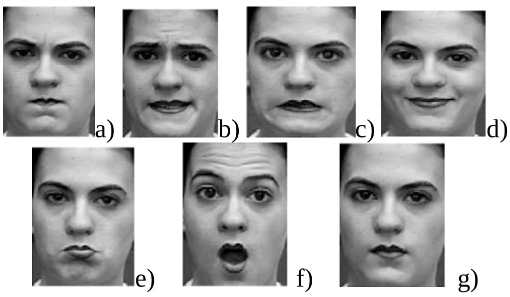

Fig. 1.1 Facial Expressions
a) Anger b) Disgust c) Fear d) Joy e) Sadness f) Surprise g) Neutral

Fig. 1.1 shows the various kinds of Facial Expressions. Programmed analysis of facial expressions for behavioral science is another possible application domain. From the viewpoint of automatic recognition, a facial expression can be measured to deformations of facial components and their spatial relations. There is a change in the pigmentation of the face. Research into habitual recognition of facial expressions addresses the problems surrounding the representation and categorization

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of static or dynamic characteristics of these deformations or face pigmentation.

Michel F. Valstar., et.Al., 2012 presents a meta-analysis in automatic recognition of facial expressions, held during the IEEE conference on Face and Gesture Recognition 2011. It details the challenge data and evaluation protocols. The results attained in two sub challenges perform the action unit detection and classification of facial expression imagery in terms of a number of discrete emotion categories.

Andrew Wagner., et.Al., 2009 propose a conceptually simple face recognition system that achieves a high degree of robustness and stability to enlightenment variation, image misalignment, and partial occlusion. The system uses tools from sparse depiction to align a test face image to a set of frontal training images. The section of attraction of our alignment algorithm is computed empirically for public face datasets such as Multi-PIE. It demonstrates how to detain a set of training images with sufficient illumination variation that they distance test images taken under unrestrained elucidation.

In this work, introduce a Bayesian Classifier model for the purpose of face recognition with the hybrid of (RGB and HSV color band) component. On the principle of a pattern-based recognition approach, the proposed classifier is formulated based on a mutual probability function. That seeks to include chronological continuity between successive frames and to encode the fundamental relationship between patterns and their respective pattern-set classes. It also present non-parametric approaches to the judgment of prospect densities using matching scores that are computationally inexpensive.

We provide here an overview of Hybrid Color Component Feature Identification for face recognition. The rest of this paper is arranged as follows: Section 2 describes about the different surveys. Section 3 introduces architecture diagram of the proposed scheme. Section 3.1 and 3.2 describes about proposed method; Section 4 shows the evolution and experimental evaluation; Section 5 evaluated the results and discuss about it. Section 6 describes conclusion and outlook.

2. LITERATURE REVIEW

The Face recognition is a significant and secured way to protect the frauds at everywhere like government agencies are investing a substantial amount of resources into improving security systems as consequence of recent terrorist proceedings that dangerously exposed flaws and weaknesses in today's safety mechanisms. Badge or password-based authentication events are too easy to hack. Biometrics represents a valid alternative but they experience of drawbacks as well. Mr. Dinesh Chandra Jain., and Dr. V. P. Pawar., 2012, present a new way to distinguish the face using facial recognition software and using neural network methods. That makes a facial recognition system to protect frauds and terrorists.

Prof. Y. Vijaya Lata., et.Al., 2009 refers to different face recognition approaches and chiefly focuses on principal component analysis, for the analysis and the implementation. A. Conci, E. Nunes., et.Al., 2008 analyzed and compared a proposed color-based skin detection algorithm (using RGB, HSV and YCbCr representation spaces) with a texture-based skin location algorithm which used a measure Spectral Variation Coefficient (SVC) to assess region features.

Felix Juefei-Xu., et.Al., 2011 present a novel framework of utilize periocular region for age invariant face recognition. To get hold of age invariant features, first perform preprocessing schemes, such as pose correction, enlightenment and periocular region normalization. And then we relate robust Walsh-Hadamard transform prearranged local binary patterns (WLBP) on preprocessed periocular region.

A novel face segmentation algorithm is proposed by Hongliang Li., and King N. Ngan., 2008 based on facial saliency map (FSM) for head-and-shoulder type video application. This method consists of three stages. The first stage is to produce the saliency map of input video image by our proposed facial attention model. In the second stage, a geometric model and an eye-map built from chrominance components are engaged to localize the face region according to the saliency map. The third stage involves the adaptive boundary correction and the final face contour extraction. Based on the segmented result, an effective boundary saliency map (BSM)

For feature extraction, John Wright., et.Al., 2008 show that if sparsity in the recognition problem is correctly harnessed, the choice of features is no longer dangerous. Unconventional features such as down sampled images and random projections perform just as well as conventional features such as Eigen faces and Laplacian faces. Zahid Riaz.,et.AL., 2009 describes an thought of recognizing the human face in the presence of strong facial expressions using model based approach. The features extracted for the face image sequences can be professionally used for face recognition. Caifeng Shan .,et.Al., 2009 empirically assess facial representation based on statistical local features, Local Binary Patterns, for person-independent facial expression recognition.

Xiaogang Wang,. and Xiaoou Tang., 2008 propose a novel face photo-sketch mixture and recognition method using a multiscale Markov Random Fields (MRF) model. Xiaoxing Li.,et.Al., 2009 design a feature pooling and ranking scheme to gather various types of low-level geometric features and rank them according to their sensitivities to facial expressions. By merely applying the sparse representation framework to the composed low-level features, this proposed method previously achieves acceptable recognition rates, which demonstrates the efficacy of the framework for 3D face recognition.

Shufu Xie.,et.Al., 2010 propose local Gabor XOR patterns (LGXP), which encodes the Gabor phase by using the local XOR pattern (LXP) operator. Adapting to particular aspect of face recognition with inimal cost developed a technique named Color Component Feature Identification using the Bayes Classifier associated with RGB and HSV color bands.

3. HYBRID FACIAL COLOR COMPONENT FEATURE IDENTIFICATION USING BAYES CLASSIFIER

Research in habitual face recognition has grown rapidly in the past few decades, with a primary focus towards tranquil image-based recognition. A wide variety of current state of-art methods have been reported to be effective in recognizing human faces.

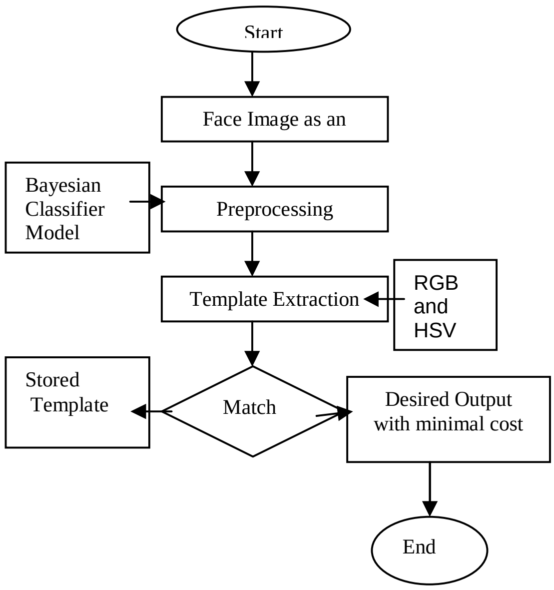

Fig 3.1 Face Recognition Steps using Bayesian Classifier

The hybrid facial color component feature identification using the Bayesian Classifier is described in the above diagram. It fetches the face images as the input and performs the preprocessing operation in Fig 3.1. The features are extracted with the help of the Bayesian Classifier model and face templates which are extracted are stored in the database. The RGB and HSV color image templates are compared with the stored face image and obtains the desired output with minimal cost.

3.1 Face Color Recognition using Bayesian Classifier

The Bayesian Classifier models in face recognition framework are dignified to provide a better overview of the area attributes that will be used in our model. We also briefly explain some steps taken to prepare both training and investigation data for categorization.

3.1.1 Domain environs

The large quantity of face images poses a procedural challenge. While conservative image-based face recognition is an uncomplicated matching of a test image to a gallery of training images. The accessibility of numerous image frames requires hybrid facial color component for further simplification. It formulates a feasible categorization methodology.

Assuming each subject represent a set of patterns. For general notation, a sequence of face images extracted from a set is given as,

$Y_f = \{y_{f,1}, y_{f,2}, . . . , yf, M_f\}$ ……………… Eqn (1)

Where M_f is the number of face images in the set.

Assuming that each set contains the faces of the same person and f is the subject matter identity of an F- division problem, $f \in \{1, 2, . . . ,F\}$, the associated pattern set is denoted by

$Pf = \{pf, 1, pf, 2, . . . , pf, N\}$ ……………… Eqn (2)

Thus, the overall pattern-division set CCFI can be concisely summarized as

$P = \{pf,n|f = 1, . . . ,F;n = 1, . . . ,N\}$………… Eqn (3)

in which $pf,n \subseteq Yf$ and there are a total of F ×N unique pattern division.

In cases where more than one training set of a particular class is used in feature identification, image frames from all analogous division set are aggregated before the patterns are extracted.

3.1.2 Data training

Consider the huge amount of face variations in each training video sequence, by applying the nonlinear dimensionality decline method. Then, faces of different colors in each training set sequence are partitioned into RGB and HSV clusters. Following that, the face pattern set is constructed by selecting the face images that are nearest to the mean of each cluster.

RGB color space in face recognition is the most normally used color space in digital images. It encodes colors as an additive combination of three primary colors: red(R), green (G) and blue (B) to recognize the face. RGB Color space is often visualized as a 3D cube where R, G and B are the three vertical axes. One main benefit of the RGB gap of face recognition is its effortlessness. Nonetheless, it is not uniform where means distances of RGB space do not linearly match to human face observation. In addition, RGB color space does not divide luminance and chrominance but

R, G, and B components are extremely correlated. The luminance of a given RGB pixel is a linear mixture of the R, G, and B values in facial color recognition.

Therefore, altering the luminance of a given face patch affects all the R, G, and B components. The location of a given face patch in the RGB color cube will change based on the intensity of the enlightenment under which such patch was imaged. This results in a much stretched face color cluster in the RGB color cube.

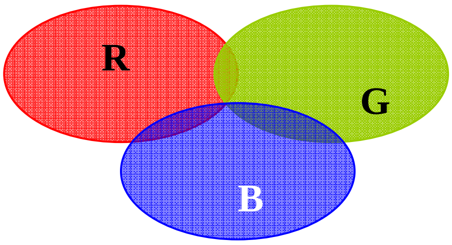

Fig 3.2 RGB color model

The above Fig 3.2 of the RGB color model is for the sensing, representation, and display of images in electronic systems such as televisions and computers. RGB is primary color which may be the most commonly used to describe the color information of the faces. It has the negative aspect that each of the coordinates (red, green, and blue) is subjected to luminance effects from the illumination intensity of the environment.

 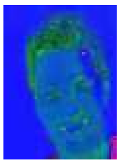

Fig 3.3 RGB Color Image HSV Image

The HSV color space in the face is much more natural and provides color information in a manner more precise. It describes how humans face think of colors and how artists typically mix colors. HSV have cylindrical coordinate to represent a RGB color model at a point of hybrid the facial color component. Basically when adjusting a hue component it gets a desired color. If wanted color component of dark red color to pink then adjusts a saturation value, and if want darker or brighter component then we adjust intensity component and get desired result. One of the compensation of these color spaces in face color detection is that they allow users to intuitively specify the boundary of the face color division in terms of the hue and saturation.

3.2. Proposed Bayesian Classifier Model

In a Bayesian inference model, the subject identity of a set Y can be found by estimating the Utmost Posteriori (UP) probability rule,

$$f^* = \arg\max_{F} E(f|y1,...,M_f) \quad .... \text{ Eqn (4)}$$

Where, the subscript notation of y concisely represents a sequence of M_f images.

3.2.1. Naive Bayesian Classifier

$$E(f|y1,...,Mf) = E(f)E(y1,...,Mf|f)\ E(y1,...,Mf)$$
$$= E(f)E(y1,...,Mf|f)\ Ec\ E(y1,...,Mf|f)E(f) \quad .. \text{ Eqn (5)}$$

Where, E (f) is the preceding probability of each division, E(y1,...,Mf |f) is the likelihood probability of 'y' given division 'f' and the denominator is a normalization factor to ensure that the sum of the likelihoods over all possible classes equals to 1. Assuming conditional independence between all observations i.e. yi $\perp\!\!\!\perp$ yj |f where i $\neq$ j,

Equation (5) can be rewritten as,

$$E(f|y1,., Mf) = \prod_{i=1}^{M_f} E(f)E(Y_i/f)/E(y_i) \text{. Eqn (6)}$$

3.2.2 Pattern based Bayesian Classifier

We propose a Pattern based Bayesian classifier (PBC) by introducing a mutual probability function in face recognition,

$$E(f,P,Y) = E(Y|P)E(P|f)E(f) \quad .... \text{ Eqn (7)}$$

Where, the pattern -division set P is a new latent variable. Thus, the UP classifier in Equation 4 is redefined by maximizing the mutual posterior probability of the division f and pattern - division P given observation Y as,

$$\max_F E(f, P|Y) = \max_F E(f,P,Y)/F(Y)$$

$$= \max_F \sum_{j=1}^{N} E(y|P_{f.j})E(P_{f,j}|f)E(f)/E(y)$$

$$= \max_F \sum_{j=1}^{N}\prod_{i=1}^{M_f} E(Yi|P_{f,j})E(P_{f,j}|F)E(f)/E(Y_i)$$

Intuitively, the conditional probability E (pf,j |f) acts as an pattern reputation weight for the division likelihood E(yi|pf,j) in feature identification in face. The insignificant probability E (yi) does not depend on both f and P, thus functioning only as normalization constant in face recognition. Since the division prior probability E (f) is assumed to be non-informative at the start of observation sequence Y, fitting uniform priors is a realistic estimation.

The below diagram describes the graphical model of the PBC system. In which f represents the division (i.e.) preprocessing of the given each facial expression image depending on color texture. The divided sets of facial image are classified based on the pattern based Bayesian Classifier model. In expected Bayesian classifiers, a multivariate probability density function is used to guesstimate data distribution.

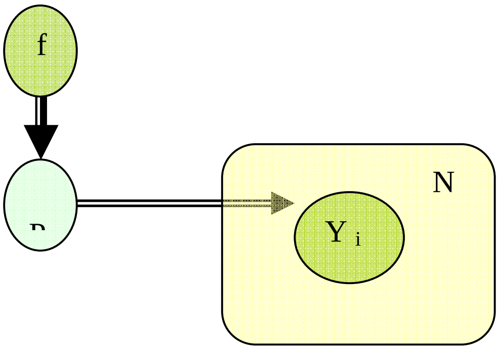

Fig 3.4 Graphical model of Pattern based Bayesian Classifier

Conversely with the limited sample size are used from the dataset for our problem. Accurate estimation of distribution is done by providing the exact result in fitting of hybrid facial color component and feature identification with less expensive.

3.3 Algorithm for (CCFI-BC) technique:

Generic Steps of the Color Component Feature Identification using the Bayesian Classifier algorithms:

Step 1: Start
Step 2: Input: Face Image using RGB and HSV color mapping
Step 3: For each pixels of the face image
  Step 3.1: Latest Pixel: E_i
  Step 3.2: If E_i matches variety of pixels
  Step 3.2.1: Pixel Face Image E_i lies inside region
  Step 3.3: Else
  Step 3.3.1: E_i lies outside the region
  Step 3.4: End If
Step 4: End for each
Step 5: Repeat for each face image map from Step 2.
Step 6: Output: Desired face image with minimal cost
Step 7: End

The algorithm above uses the RGB and HSV image color code. For the source of image, we have created the small SQL database for storage of various image from where fetching the images and applying Bayesian classifier in various color models. For the study purpose, created an algorithm named CCFI-BC to extracts the face regions color component. The outcome of the system is an optimum image with minimal impact of noise and cost.

4. EXPERIMENTAL EVALUATION

Color Component Feature Identification using the Bayesian Classifier technique for face recognition is implemented using JAVA. In addition to noise removal and minimal cost, the proposed model also present qualitative results of the face images. We have analyzed the performance of proposed CCFI-BC, using FERET database, UMIST database and Purdue AR database.

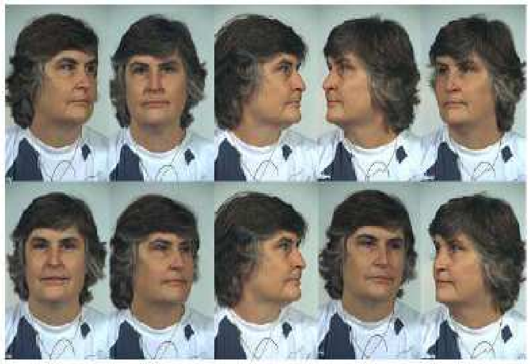

Fig 4.1 Faces of FERET Database

This FERET database contains 1564 sets of images for a total of 14,126 images that includes 1199 individuals. All the images are of size 290x240. UMIST database uses the 564 images of 20 subjects. Purdue AR database contains the 3276 face images with different facial expressions. The performance of the Color Component Feature Identification using the Bayesian Classifier technique (CCFI-BC) is measured in terms of

- Recognition Rate
- Cost Consumption
- True Positive Rate

5 RESULTS AND DISCUSSION

In this work, we efficiently evaluated the Color Component Feature Identification using the Bayesian Classifier model. The below table and graph describes the performance of the Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) compared with an Meta Analysis of Facial Action Coding System (FACS) with AU detection and Classification method.

Recognition rate: Face Recognition Rate is a ratio in which total number of faces that are correctly detected under random corruption in Bayesian Classifier model.

Size of feature Extraction	Recognition rate	
	Proposed CCFI-BC	FACS method
5	0.98	0.75
10	0.97	0.78
15	0.95	0.79
20	0.95	0.79
25	0.94	0.80
30	0.92	0.82
35	0.93	0.83
40	0.91	0.85
45	0.91	0.87
50	0.90	0.88

Table 5.1 Size of feature extraction vs. Recognition rate

The faces are portioned based on the size the feature extraction. The Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) compared with a Meta Analysis of Facial Action Coding System (FACS) with AU detection and Classification method for recognition rate.

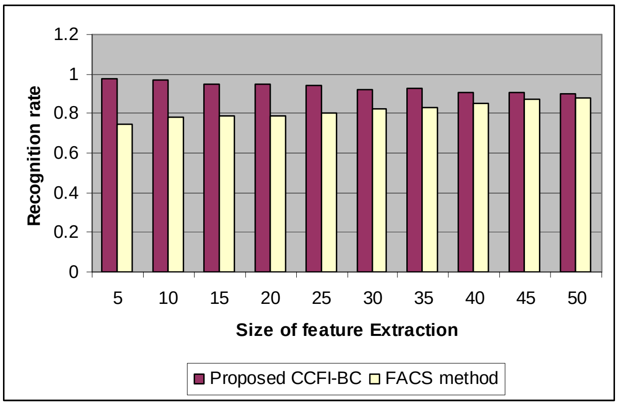

Fig 5.1 Size of feature extraction vs. Recognition rate

Fig 5.1 describes the recognition rate based on the feature extraction. The Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) efiiciently recognizes the faces with the hybrid of RGB and HSV in the FERET database. In the proposed CCFI-BC scheme the texture variance are normalized based on the probability density methodology. The outcome of the CCFI – BC is approximately 25 – 35 % higher than present Meta Analysis of Facial Action Coding System (FACS) with AU detection and Classification method.

Cost Consumption: It is defined as an amount of rate taken to perform the face recognition process using Bayesian classifier.

Frame Index (i)	Cost Consumption	
	Proposed CCFI-BC	FACS method
10	5	10
20	10	22
30	16	30
40	18	35
50	22	44
60	28	49
70	33	55
80	38	60
90	42	62
100	47	65

Table 5.2 Frame Index vs. Cost Consumption

Fig 5.2 described the cost consumption while storing the face image in the database and extracting it. In the Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) are compared with a Meta Analysis of Facial Action Coding System (FACS) with AU detection and Classification method for cost consumption.

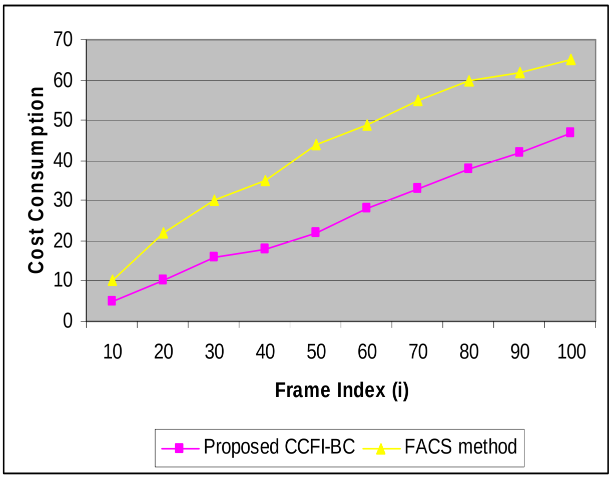

Fig 5.2 Frame Index vs. Cost Consumption

Fig 5.2 describes the cost consumption from the frame index of the set. As it is experimental using the Purdue AR database contains the various facial expression images. The observed performance from the Bayesian classification on Purdue AR dataset is higher, with the minimal cost consumption. So, the existing model accepts the more cost from the set of classes, thus showing that the quality less face recognition. The variance in cost consumption is approximately 45-50% less in the Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC).

True Positive rate: A result that is erroneously positive when a situation is normal. An example of a true positive: rate is a particular test designed to detect faces. The detector output is positive with true value (there is actually face).

No. of faces	True positive rate (%)	
	Proposed CCFI-BC	FACS method
100	93	66
200	94	68
300	95	69
400	96	70
500	96	67
600	96	67
700	97	69
800	95	71
900	95	72
1000	95	72

Table 5.3 No. of faces vs. True positive rate

Fig 5.3, described the true acceptance rate while storing the face image in the database and extracting it. In the Color

Component Feature Identification using the Bayesian Classifier model (CCFI – BC) are compared with a Meta Analysis of Facial Action Coding System (FACS) with AU detection and Classification method for true acceptance rate is noticed.

The performance graph of the Component Feature Identification using the Bayesian Classifier model (CCFI – BC) on the true positive rate based on number of faces are shown in Fig 5.3. It is examined using the UMIST database and FERET database by producing the excellent result with RGB and HSV color space. This may be due to the fact that it does focus on extracting and matching the textured information, and produce strong mechanism to accommodate potentially large variations which are more likely to exist in the contact less database.

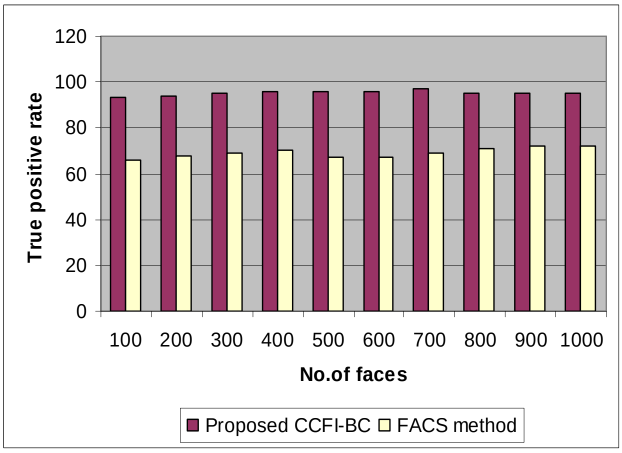

Fig 5.3 No. of faces vs. True positive rate

The variance in the error rate in the both dataset evaluation would be approximately 15-20% higher in Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) when compared with a Meta Analysis of Facial Action Coding System (FACS) with AU detection and Classification method

Finally, it is being observed that the Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) eradicates the noise occurring in the face recognition and suitably adapt to the texture variance with minimal cost. The Color Component Feature Identification using the Bayesian Classifier model (CCFI – BC) is analyzed through FERET, UMIST and Purdue AR database.

6 CONCLUSION

In this work, we efficiently performed the biometric face recognition by introducing the Color Component Feature Identification using the Bayesian Classifier (CCFI-BC) technique. It explains causally the relationships between extracted patterns and their respective pattern-set division with RGB and HSV color space. Incorporates the temporal continuity and simplify the density judgment by utilizing probabilistic distance measures which are comparably lightweight. The model is associated with RGB and HSV color bands along with its corresponding facial feature components to obtain the better performance. Performance of Color Component Feature Identification using the Bayesian Classifier (CCFI-BC) technique reliably segments the facial color depending on the texture and identifies the features. These regions are further combined with RGB and HSV bands for robust pixel detection and with better visibility. CCFI-BC improves the performance measure and evaluated in terms of recognition rate, cost efficiency and true positive rate. A systematic and experiential result shows a minimal cost in restricting the participant's choice of classifiers.

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