ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

Feature Extraction in Face Recognition using SVM, Skin Fusion and Edge Detection Technique

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ABSTRACT: Face detection is a challenging computer vision problem. A reliable human skin detection method that is adaptable to different human skin colours and illumination conditions is essential for better human skin segmentation. Even though different human skin colour detection solutions have been successfully applied, they are prone to false skin detection and are not able to cope with the variety of human skin colours across different ethnic. Given a still image or an image sequence, the goal of face detection is to locate all regions that contain a face regardless of any three dimensional transformation and lighting condition. Human face detection and recognition play important roles in many applications such as video surveillance and face image database management. There are two main categories that may serve as a solution for this problem: feature-based and image-based approaches. In this thesis, three different feature-based oriented solutions are compared. In our, as studied worked on both face detection and recognition techniques to develop an algorithms for them. There are conditions where we define face detection and recognition methods that is Edge based, Skin fusion based and template matching SVM-LBP method in which we recognize an unknown test image by comparing it with the known training images stored in the database as well as give information regarding the person recognized. These techniques works well under robust conditions like complex background, different face positions. These algorithms give different rates of accuracy under different conditions as experimentally observed. In face detection, we have developed an algorithm that can detect human faces from an image. We have taken skin color as a tool for detection. This technique works well for Indian faces which have a specific complexion varying under certain range. We have taken real life examples and simulated the algorithms in MATLAB successfully.

KEYWORDS: Face Detection, SVM-LBP, feature-based, Image based.

I. INTRODUCTION

The face is our primary focus of attention in social life playing an important role in conveying identity and emotions. We can recognize a number of faces learned throughout our lifespan and identify faces at a glance even after years of separation. This skill is quite robust despite of large variations in visual stimulus due to changing condition, aging and distractions such as beard, glasses or changes in hairstyle.

Computer vision, in general, aims to duplicate (or in some cases compensate) human vision, and traditionally, have been used in performing routine, repetitive tasks, such as classification in massive assembly lines. Today, research on computer vision is spreading enormously so that it is almost impossible to itemize all of its subtopics. Despite of this fact, one can list relevant several applications, such as face processing (i.e. face, expression, and gesture recognition), computer human interaction, crowd surveillance, and content-based image retrieval. All of these applications, stated above, require face detection, which can be simply viewed as a preprocessing step, for obtaining the “object”. In other words, many of the techniques that are proposed for these applications assume that the location of the face is pre-identified and available for the next step.

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Computational models of face recognition are interesting because they can contribute not only to theoretical knowledge but also to practical applications. Computers that detect and recognize faces could be applied to a wide variety of tasks including criminal identification, security system, image and film processing, identity verification, tagging purposes and human-computer interaction. Unfortunately, developing a computational model of face detection and recognition is quite difficult because faces are complex, multidimensional and meaningful visual stimuli.

Face detection is used in many places now a day especially the websites hosting images like picassa, photo bucket and facebook. The automatically tagging feature adds a new dimension to sharing pictures among the people who are in the picture and also gives the idea to other people about who the person is in the image. In our work, we have studied and implemented a pretty simple but very effective face detection algorithm which takes human skin color into account.

Face detection is one of the tasks which human vision can do effortlessly. However, for computer vision, this task is not that easy. A general definition of the problem can be stated as follows: Identify all of the regions that contain a face, in a still image or image sequence, independent of any three dimensional transformation of the face and lighting condition of the scene. There are several methods issued for this problem and they can be broadly classified in two main classes, which are feature-based, and image-based approaches. Previous research has shown that both feature-based, and image-based approaches perform effectively while detecting upright frontal faces, whereas feature-based approaches show a better performance for the detection scenarios especially in simple scenes.

Our aim, which we believe we have reached, was to develop a method of face recognition that is fast, robust, reasonably simple and accurate with a relatively simple and easy to understand algorithms and techniques. The examples provided in this thesis are real-time and taken from our own surroundings.

II. LITERATURE SURVEY

Kiran D. Kadam (2014), in this paper the author combining the two techniques of face recognition to increase in recognition rate or increase the accuracy of face recognition system. But there are many methods that work on face recognition. These methods can be divided into three categorization: feature-based matching method, holistic matching method and hybrid methods. The PCA, LDA, ICA methods are belongs to the holistic method which used whole face as input. The two techniques that are used in this paper are Principal Component Analysis (PCA) method which can exactly express every face image via linear operation of Eigen vector and also solve the compression and Discrete Cosine Transform (DCT) method that is used to transform a signal domain in to frequency domain and eliminate the redundancies in an image. The author used the hybrid method of Principal Component Analysis (PCA) and Discrete Cosine Transform (DCT) to reduce the dimension of data on number of images. To evaluate the performance of these two algorithms PCA and DCT, a code for each algorithm has been generated using this hybrid technique gives the better result than by using the single Principal Component Analysis (PCA) method. The author achieved the accuracy 99.90% on FACES 94 and 94.70% on ORL. And the recognition rate of single PCA algorithm is less than the combination of PCA and DCT algorithms [23]. P. Dhoke, et al. (2014), the author proposed a method by using Principal Component Analysis (PCA) with Back Propagation Neural Networks (BPNN) method for identification and verification of a person for face recognition system in this paper. The PCA algorithm is used for the reduction of dimensionality of face mage and the recognition is done by the BPNN. The method that is proposed by the author is applied on a database that consists of a set of facial patterns. The PCA method is used to reduce dimensionality of an image and each face image may be represented as a feature vector of the eigen faces, which are stored in a 1D array. By using this feature vector of Eigen faces, the test image can be constructed. The distance between the feature vectors of the test image and that of the database images are then compared. Thus one can reconstruct original image with the help of Eigen faces so that it matches the desired image. The back-propagation algorithm is a multi-layer network and it is a fully feed-forward network connection. There are main two layers in this first is input layer and second is output layer. Each layer is connected with another layer and the activation travels from input layer to output layer. Back-propagation algorithm consists of two sweeps of the network which are the forward sweep and the backward sweeps. Forward sweep defines the network from the input layer to the output layer and the backward sweep defines network from the output layer to the input layer. The author through this paper shows that the PCA for feature extraction and BPNN for image classification and recognition provide the fast computation and high accuracy rate in face recognition system.

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International Journal of Innovative Research in Computer and Communication Engineering

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The execution time of this is only few seconds and acceptance ration s more than 90% [32]. D. N. Parmar, el at. (2013), Face recognition is a process of identify or verify any person from an image [1] and it presents a challenging problem in the field of image analysis and computer vision. By using this system, it can increase the security in any field as like; cameras are commonly used in airports, Offices, University, ATM, Bank and in any locations for security. Through this, the author gives the overview of Face recognition system that detects a face in an image automatically. It extracts features from the image and then recognize it, regardless of lighting, expression, illumination, ageing, transformations (translate, rotate and scale image) and pose, which is a difficult task. In this paper, author describes the face recognition technique in three sections. In these sections the author describes the methods of it as like holistic matching method, feature extraction method and hybrid methods and the applications of it [8]. F. Bellakhdhar, et al. (2013), in this paper author conveyed that Face recognition is an important research field that is used in pattern recognition. It is necessary for us to give attention to feature extractor and classifier. Because the performance of face recognition system is depend on how to extract feature vector and to classify them into a class correctly. In this paper, the author propose a methodological improvement to raise face recognition rate by fusing the phase and magnitude of Gabor's representations of the face as a new representation, by using the face recognition algorithm, the principal component Analysis approach and Support Vector Machine(SVM) that are used in this paper as a new classifier for pattern recognition. The algorithms that are proposed in by the author are tested on the public and largely used databases of FRGCv2 face and ORL databases. The algorithm PCA is a global method that is used to implement contrasts with a strong sensitivity to changes in lighting, poses and facial expression (by using the number of poses for each person). The author combines the magnitude and the phase of Gabor is used to extract the characteristic vector, the algorithm PCA used for recognition and SVM used to classify faces. Through this approach, it makes the PCA an algorithm effective and commonly used in reducing dimensionality where it can then be used to upstream other algorithms to improve the results of our application [10]. V.Pali, et al. (2013), this paper proposes a method of genetic algorithm (GA) that is on based neural network for feature and in this paper, there are four stages or algorithms are used to get the best results. PCA is used for dimensionality reduction that is Eigen face approach; LDA is used for feature extraction. LDA and PCA methods used for dimensionality reduction and feature extraction which overcomes the small sample size (SSS) problem of LDA. Genetic Algorithm based feature selection and last is Back propagation Neural Network (BPNN) is used for the classification of face images to a particular class. The author do this experiment on database of 80 images and a test database of 40 images and achieved a recognition rate of 97.5% with a small execution time of 10 ms to 20 ms. These methods increase the rate of execution of the system [29].

III. METHDOLOGY

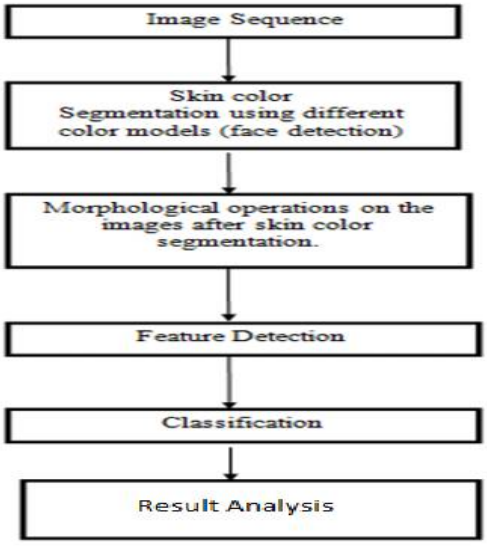

Figure 1.1: Flowchart of methododlogy of skin detection

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

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IV. RESULTS

In this chapter, experimental results concerning training and evaluation will be introduced. In training experiments, SVM with LBP of the learning methods provide several features enabling a control for learning efficiency. For testing, besides using some different constants, both of the methods share the same testing setup. Here three techniques have been worked out having different results on the base of parameters.
Some of the faces were not detected properly and one non-face area was also detected as face. The experiment was conducted again after coloring the background which provided a 100% result. Also the experiment was conducted on other images. Images having high ranges of color (most of them falling under skin color category) showed false results. After adjusting the filter coefficients and changing the color range, a better result was obtained. The results are shown below with graphical regions and as well as through parameters.

A. IMPLEMENTATION USING EDGE FACE DETECTION

Graphical representation is shown below for edge detecting used for face identifying. In this, various parts of face is also detected. In this, four buttons are shown. First button is used for loading the original image. Second button is used for extracting all features such as rotating, Gray scale, Black and white, Edge using canny and Prewitt image and at last Extracted feature of face image. Third button is for exiting from graphical window. At last, fourth button extract feature shows the various parts of faces to be recognized or identified.
Various parameters such as color space, time and accuracy are used for result calculation and comparing which technique has better response for detecting various parts of the face with skin identification.

Figure 1.2: Window for detecting face using Canny and Prewitt Edge technique

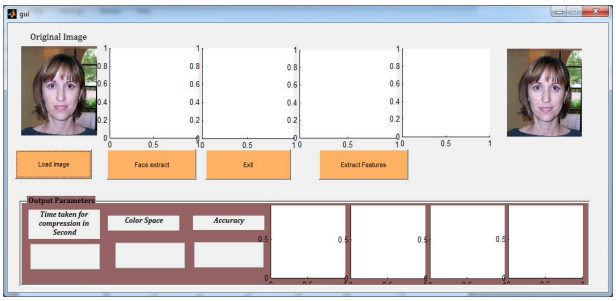

Figure 1.3: Window with Loading Image using Canny and Prewitt Edge technique

Above Figure 1.2, shows the original window. Figure 1.3, shows the window with loading or selecting image for dataset.

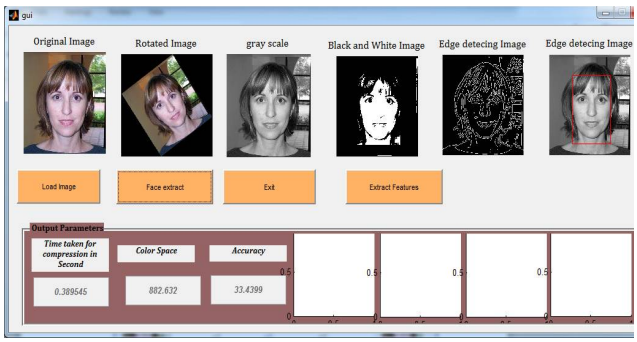

Figure 1.4: Window showing different Image using Canny and Prewitt Edge technique

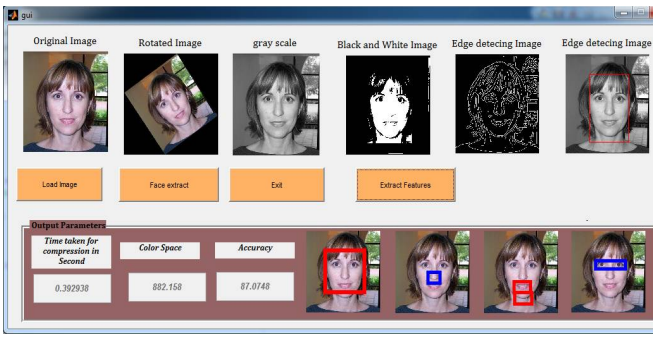

Figure 1.5: Window showing various parts of faces using Canny and Prewitt Edge technique

Above Figure 1.4, shows the different images after applying technique as second image on the top row rotated image, third images as gray scale, fourth image as black and white, fifth image as edge detecting using canny and prewitt and

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

last image as face detecting in rectangular box of red color. Figure 1.5, shows the window showing all parts of face as detected in second row with parameters such as first as face, second as nose, third as mouth and fourth as eyes.

i. IMPLEMENTATION USING FUSION SKIN FACE DETECTION

Graphical representation is shown below for fusion skin detecting used for face identifying. In this, various parts of face is also detected. In this, five buttons are shown. First button is used for loading the original image. Second button is used for image fusion with skin color and extracting all features such as rotating, Black and white, at last Extracted feature of face image. Third button is used for clearing all the contents shown in graphical window. Fourth button is for exiting from graphical window. At last, fifth button extract feature shows the various parts of faces to be recognized or identified.

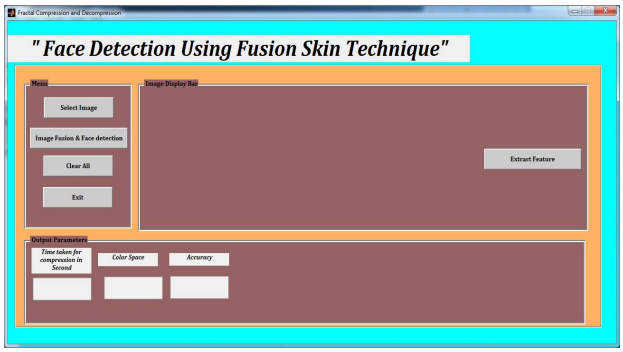

Figure 1.6: Window for detecting face parts using Fusion Skin Technique

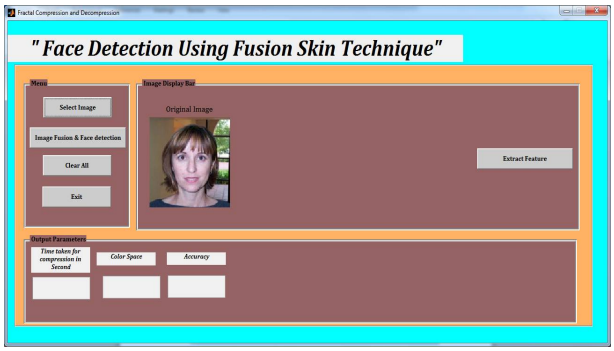

Figure 1.7: Window with Loading Image using Fusion Skin Technique

Above Figure 1.6, shows the original window. Figure 1.7, shows the window with loading or selecting image for dataset.

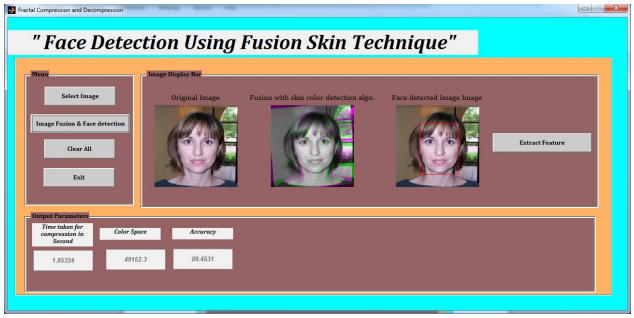

Figure 1.8: Window showing different Image using Fusion Skin Technique

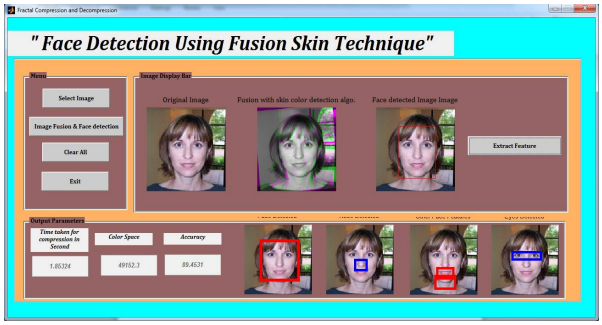

Figure 1.9: Window showing various parts of faces using Fusion Skin technique

Above Figure 1.8, shows the different images after applying technique as second image on the top row shows fusion image with skin color detection and last image as face detecting in rectangular box of red color. Figure 1.9, shows the window showing all parts of face as detected in second row with parameters such as first as face, second as nose, third as mouth and fourth as eyes.

ISSN(Online): 2320-9801
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International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

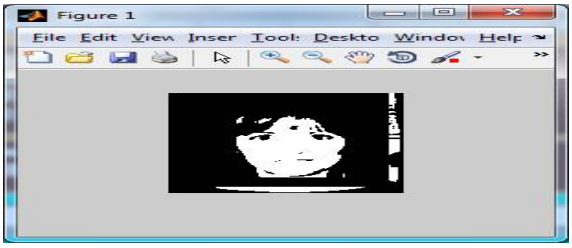

Figure 1.10: Window showing black and white image using Fusion Skin technique

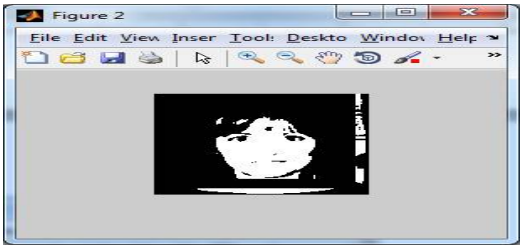

Figure 1.11 Window showing black and white image after minimization using Fusion Skin technique

Figure 1.10, shows the window with black and white image after rotating. Figure 1.11, shows the window with black and white image after fusion and minimizing again the portion.

ii. IMPLEMENTATION USING SVM- LBP FACE DETECTION

Graphical representation is shown below using SVM- LBP detecting used for face identifying. In this, various parts of face is also detected. In this, five buttons are shown. First button is used for loading the original image. Second button is used for Gray scale conversion. Third button is used for showing filtered image as filtering through median filter. Fourth button is for extraction of face only. At last, fifth button extract feature shows the various parts of faces to be recognized or identified.

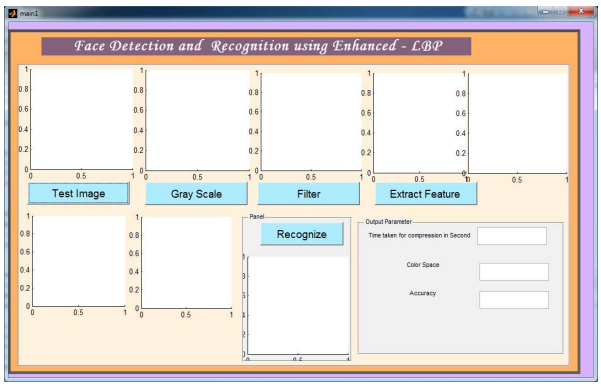

Figure 1.12: Window for detecting face parts using SVM- LBP Technique

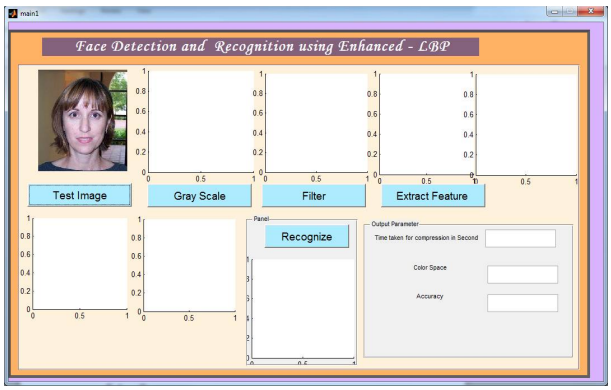

Figure 1.13: Window with Loading Image using SVM- LBP Technique

Above Figure 1.12, shows the original window. Figure 1.13, shows the window with loading or selecting image for dataset.

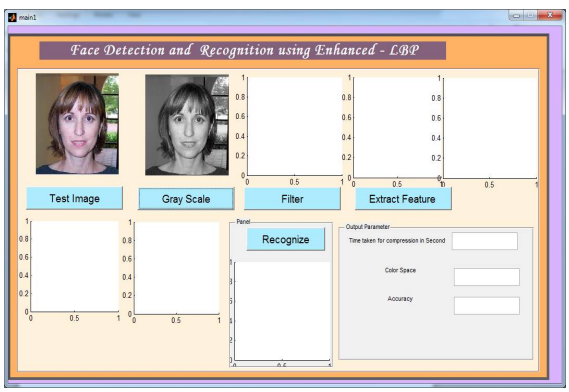

Figure 1.14: Window with Gray Scale Image using SVM- LBP Technique

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

Below Figure 1.14, shows the Gray Scale image. Figure 1.15, shows the window with Filtered image after removing noise form it.

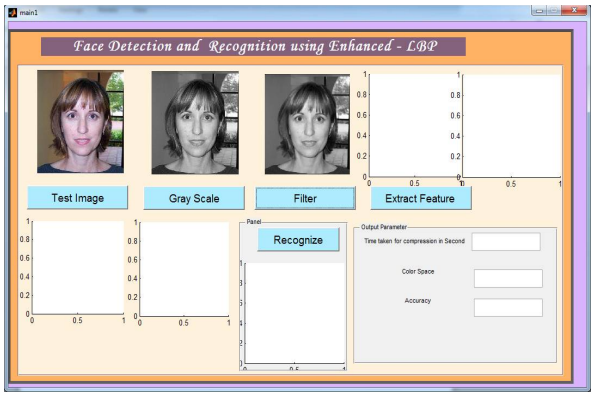

Figure 1.15: Window with Filtered Image using SVM-LBP Technique

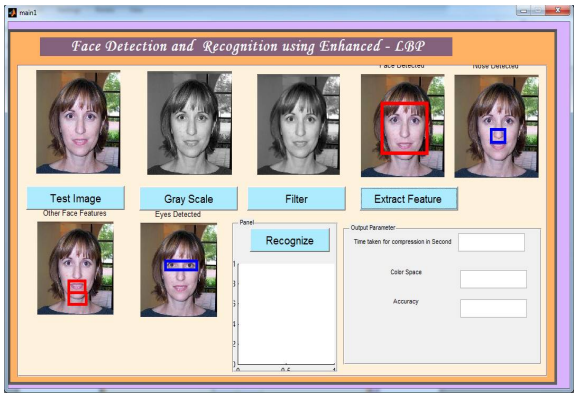

Figure 1.16: Window showing various parts of faces using SVM-LBP technique

Figure 1.16, shows the window showing all parts of face as detected in first row with face and nose. Second row with image detecting as mouth and eyes.

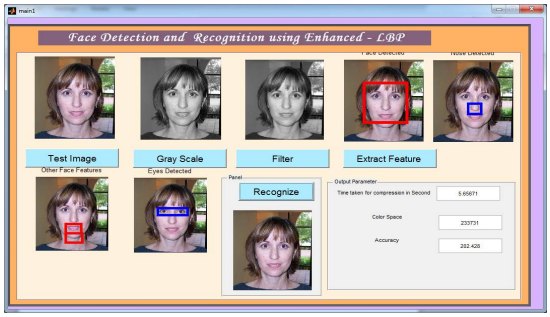

Figure 1.17: Window recognizing exact faces using SVM-LBP technique

B. DISCUSSION

As above shown, graphical results of three techniques. Now, parameters such as true color space, time and accuracy will evaluate the exact result that which technique is best for detecting face from an image and also their parts. Table below shows the comparison of techniques through various parameters.

Figure 1.18: Original Images d Dataset

Figure 1.18, shows the original images dataset for detection of face appearance as feature extraction.

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ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

Table 1.1: Performance comparison of techniques through parameters

Sr. No	Color space			Accuracy			Time		
Images Name/ Technique	Edge	Fusion Skin	SVM-LBP	Edge	Fusion Skin	SVM-LBP	Edge	Fusion Skin	SVM-LBP
Image 1	972.9	49152.7	26244	79.01	89.82	91.63	0.46	1.818	5.43
Image 2	882.9	49152.7	23373	87.07	89.96	91.28	0.33	1.810	3.23
Image 3	1059.4	49152.3	56656	47.85	89.95	90.87	0.44	1.816	3.05
Image 4	954.8	49152.1	24040	80.50	89.17	91.17	0.34	1.848	3.27
Image 7	870.1	49152.7	38280	58.18	89.68	91.02	0.42	1.880	3.22

This thesis is mainly focused on face detection using SVM-LBP, Edge and fusion skin methods which simply take face detection as a pattern recognition problem. Prior face knowledge and any other knowledge-based heuristics are ignored and a prediction is only made according to the learned characteristics from training images. Additionally, theoretic and common practical adaptations of learning field for face detection task are studied and main steps for a face detection learning scheme are outlined ranging from training through testing.

In order to make a comprehensive study, Edge, SVM-LBP and Fusion Skin based face detection systems are implemented, and experimented in training and evaluation phases with a comparative insight. The first Edge detection techniques, shows the better results according to the performance of parameters such as time taken and color space. Second SVM-LBP techniques, shows best results in accuracy as high. Color space means the different colors form representation of RGB as numerically. It specifies the color percentages of red, green, and blue hues mixed together. It should be Low as to have accurate color specification. Time compared to be taken less is shown by edge technique. Accuracy means what is true percentage for accurate to detect objects which referred.

V. CONCLUSION

Experimental results in the training phase showed that both Edge and SVM- LBP face classifiers are able separate examples included in face and non-face training data from each other. Thus, both applied an implicit surface division with the help of adjustments for internal weights. Experiments concerning efficiency of these divisions, showed trained tested images have similar generalization (true detection rate over total number of false detections) abilities. While Accuracy in generalization value of SVM-LBP is slightly higher than other techniques as counterpart. Hence, it is possible to state SVM-LBP and Edge detection techniques is best than Fusion skin technique.

The face recognition and detection algorithms were thoroughly studied taking a number of test images and varying the conditions and variables. All the work mentioned above involved real time data. The Edge and SVM-LBP success rates were given while for face detection, the success rate was different for different images depending on the external factors. The overall success rate was 91% with edge detection method.

VI. FUTURE SCOPE

There exist several directions for researches in the future. Further improvements can be made in terms of training examples for achieving a better generalization. Additionally, more informative features can be used instead of intensity values. For example, a simple quantization for gray levels may also achieve better evaluation results. Moreover, utilization of color values instead of gray levels may also improve learning mechanism, but in that case lighting variations must be sufficient large in the training sets.

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International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

The internal parameters for all three techniques can be further optimized to improve generalization abilities. The training and evaluation complexities can also be worked for neural network for improvement and can be used to reduce the optimization in network topology. Internal dynamics may be further studied in order to achieve improvements, and to design different adaptations for other visual tasks.

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ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 10, October 2016

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