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### Face Recognition with Decision Tree using SVM and SURF

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**Abstract:** Biometric technology is an emerging field for human identification now a day due to its applications in different areas. Face recognition is the one of the biometric approach in which we recognize the human being by using face special characteristics. The most important and fascinating idea about facial recognition is that it can monitor people without their interaction. This technology is more advanced than other identifying technologies because this does not need any physical interaction like scanning of finger, iris, palm print etc. Most of the researchers use NN, SVM, SURF, PCA and many more approaches separately or jointly for facial recognition. In this research paper an attempt has been made to show the technological phenomenon where decision tree based face recognition approach is proposed using SVM and SURF. In this approach, Pre-processing comes first that includes both the input image and all the images stored in the database. Secondly, the image processing operations is used to extract face feature. At last decision tree with SVM and SURF base technique is applied for training and testing purpose. The proposed approach produces better result in respect of Error Rate, Matching Time and average accuracy graph. The use of decision tree provides more accurate and better outcomes.

**Keywords:** Biometric, SVM; SURF, PCA, Decision Tree; Face Recognition

#### 1. INTRODUCTION

It is true that technology reinvents itself and this phenomenon is a healthy sign for the advancement to technology. Same is the case in biometric technology where the technical processing of earlier experiments has become more fascinating and effective with the passage of time. The adaptability of new methods in the field has opened new avenues and the present scenario has become more hyper-real. God provide a unique feature to each and every person through which we can identify them like , knuckle, thumb print, palm print, iris, ear, posture, expressions, face and many more. Biometrics methods are the methods used for identifying a person based on the physical or behavioral traits [6], [9], [12] [13]. There are two type of Biometric features; static or dynamic. Static features are used to characterize hand print; finger prints, face recognition, iris and retina scan whereas Dynamic features are used to characterize the signature, voice, typing patterns, etc. The main objective of face

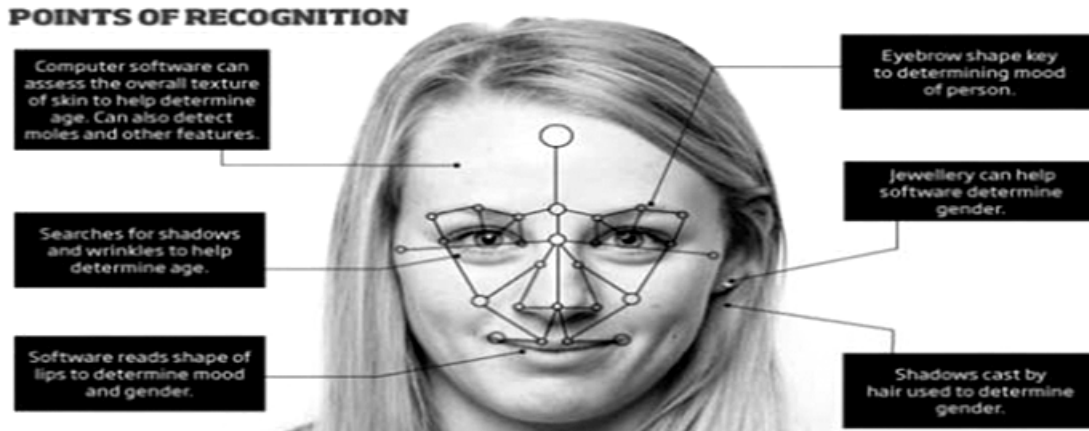


Figure 1: Points of facial recognition

recognition is to recognize a person regardless of interference from background and clothing. Advantages include the fact that it does not require subject cooperation, and the sensor may be located remotely. For instance, identifying a terrorist in a busy Airport Terminal is one of the important applications of face recognition.

Facial recognition (Figure 1) system has to recognize a human face and extract it from the rest of the scene. Then, the system measures the nodal points on the face, such as the distance between the eyes, the shape of the cheekbones and other distinguishable features. Finally, these nodal points are compared to the nodal points computed from a database of pictures in order to find a match [5].

In, [1] authors proposed “On Recognizing Face Images with Weight and Age Variations”. They proposed an algorithm which utilizes neural network and random decision forest to encode age variations across different weight categories. They prepared a database Who Is It (WIT) which contains 1109 images from 110 individuals with age and weight variations. Here in [2], an efficient approach based on PCA, EBGM and SOFT by using MORPH-II databases and in [3] “Age-invariant face recognition”. The authors proposed a technique in which 3D shapes and texture spaces from 2D images are implemented. In [4] a mixer of Gaussian mixture model and graph technique developed and a periocular biometrics in [7]. Further, [8] Biologically-inspired aging face recognition using C1 and shape features implemented and in [10] Gabor features for facial age estimation are uses. In [11] the authors proposed a Bacteria Foraging Fusion algorithm and obtain the results on two databases named FG-NET and IIIT-D.

The rest of the paper is organized as follows. Proposed approach explained in section II. Results and analysis are presented in section III and concluding in section IV.

## 2. PROPOSED APPROACH

### 2.1. Flow Chart

There are following four phases in the proposed approach (Figure 2):

*Phase 1:* Firstly, develop a code for the loading the face image in the database of the MATLAB.

*Phase 2:* After loading the input image and the database, performs pre-processing.

*Phase 3:* Apply feature extraction techniques.

*Phase 4:* After that we do code for the recognition of the loaded face image by support vector machine and develop a code for the decision on the base of the matching points by using SURF feature for the loaded face image. Recognition using SVM and Decision Tree which is basically consists of two different parts: Matching the database with the inputted data and testing the result.

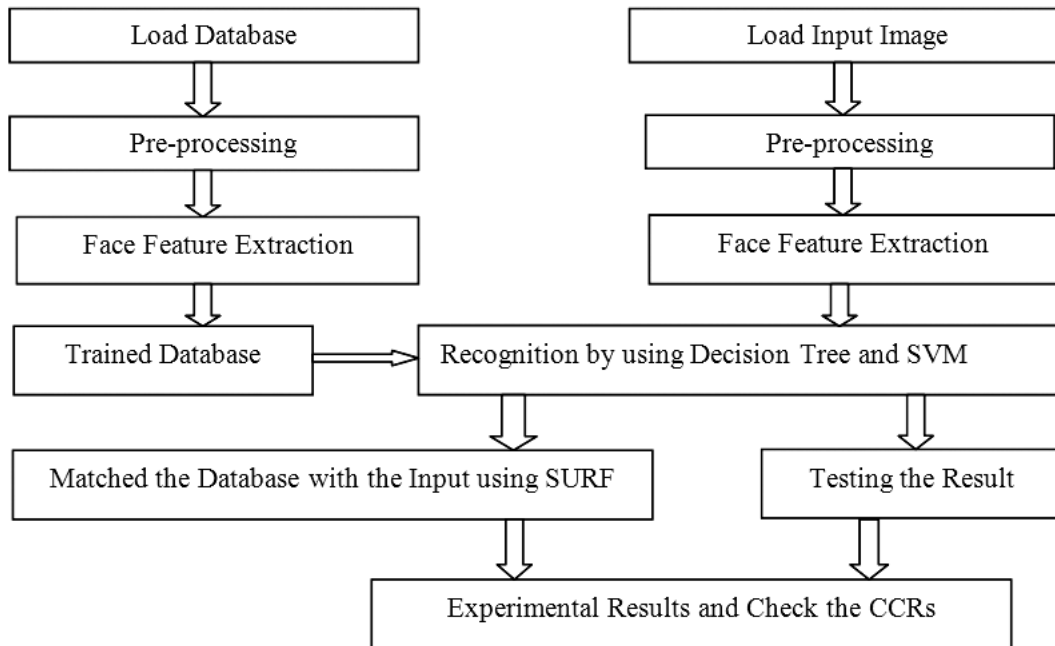


Figure 2: Flow chart of proposed approach

## 2.2. Techniques Used

There are different techniques like Neural Networks (NN), Principal Component Analysis (PCA), Speed up Robust Features (SURF) and Support Vector Machine (SVM) based algorithms are used in [5]. We are not explaining these terms widely here.

- a) *Decision Tree*: Decision trees are powerful and attractive approach for classification and prediction. The attractiveness of decision trees is due to the fact that, in contrast to neural networks. Decision trees represent set of rules that helps in decision making. These Rules are within the ambit of human intellect and they may be applied accordingly or even directly used in any computer programming languages like SQL etc. So that records pertaining to particular class may be accessed.
- b) *SURF (Speeded Up Robust Features)*: SURF having a more adaptability in real time applications, is the more appropriate version of Scale-Invariant Feature Transform. This approach is used for identifying various objects and getting to know the real position of the particular object through the feature point extraction algorithm. SURF algorithm can be bifurcated in to two parts: Feature Point Detection and Feature Invariant Point Descriptor. SURF descriptors, applications generate informative feature vectors. SURF with a lot more quickness computes distinctive and used in common image transformations like image rotation, viewpoint, change in scale, illumination changes. SURF is more technically accurate or can be comparable to other competitive tools in term of quality and performance.
- c) *SVM (Support Vector Machine)*: SVM is a classification method and its applicability ranges from bioinformatics to other area of knowledge due to its technical accuracy. It has the ability to process large volume data such as gene expression. It falls in to the general category kernel methods. A kernel method has certain dependence up on the data obtained through dot-products. SVM technique has the ability to produce non-linear decision boundaries and secondly by applying kernel functions, the user is in the position to apply classifier to input data that does not indicate at any obvious fixed dimensional vector space representation. There are some commonly used kernels includes Linear Kernel  $K(a, b) = a \cdot b$  and Polynomial Kernel  $K(a, b) = (a \cdot b + 1)^d$ .

- d) *PCA (Principal Component Analysis)*: In PCA, at first state the principal components is received and at second stage these received components are used for training set and test images to PCA space by using transformation. Every image is depicted by row in that matrix. All the pixels of an image are taken row by row from top to bottom and then they again converted to row vector which contain the intensity values or grey scale of that image. By concatenating these row vectors a single matrix is transformed.

### 3. RESULT AND DISSCUSSION

This part explains the outcome of the implemented work and discussion about the result. The outcome show the improvement through proposed SVM and Decision tree approach comparative to previous approach like SURF and NN (Figure 3 & 4) and SVM.

The proposed work produce better result in respect Error Rate, Matching Time and average accuracy graph. Hence, it has lesser Error Rate, matching time without degrade the quality of image.

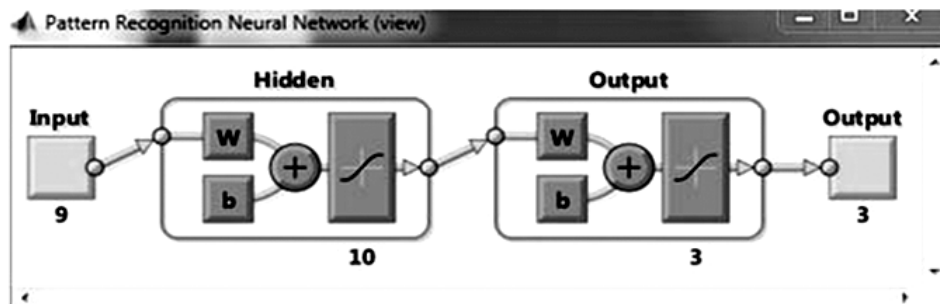


Figure 3: Pattern recognition NN

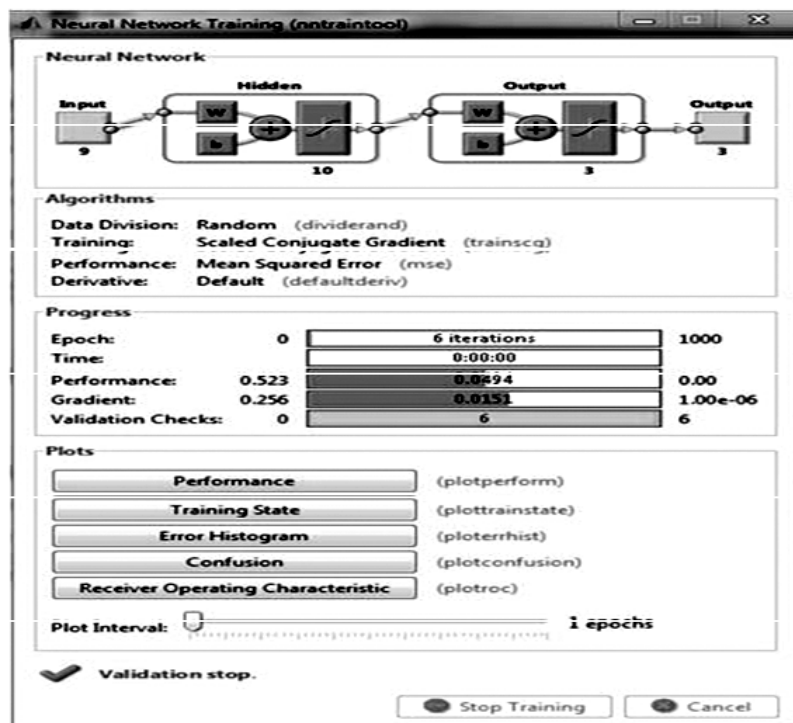
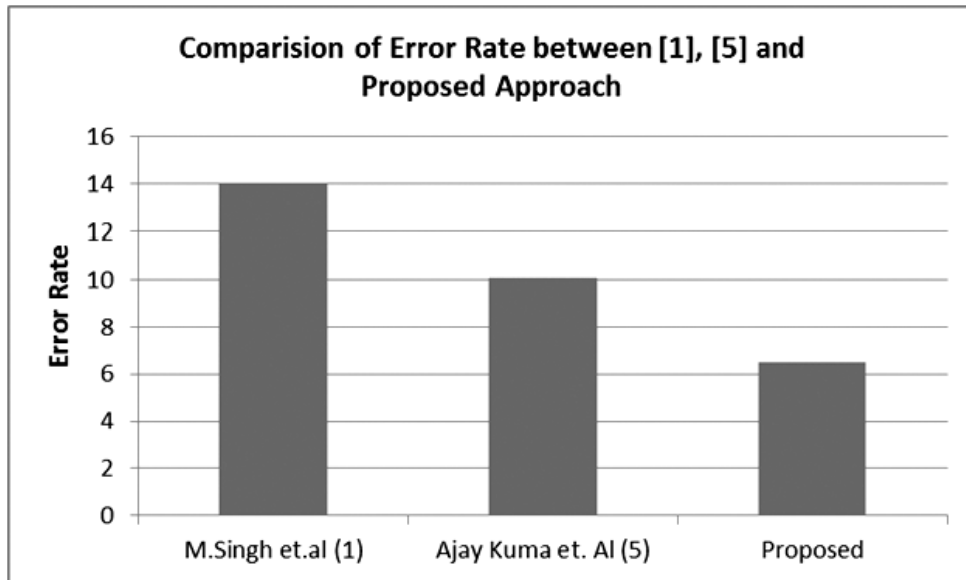


Figure 4: NN based training tool result

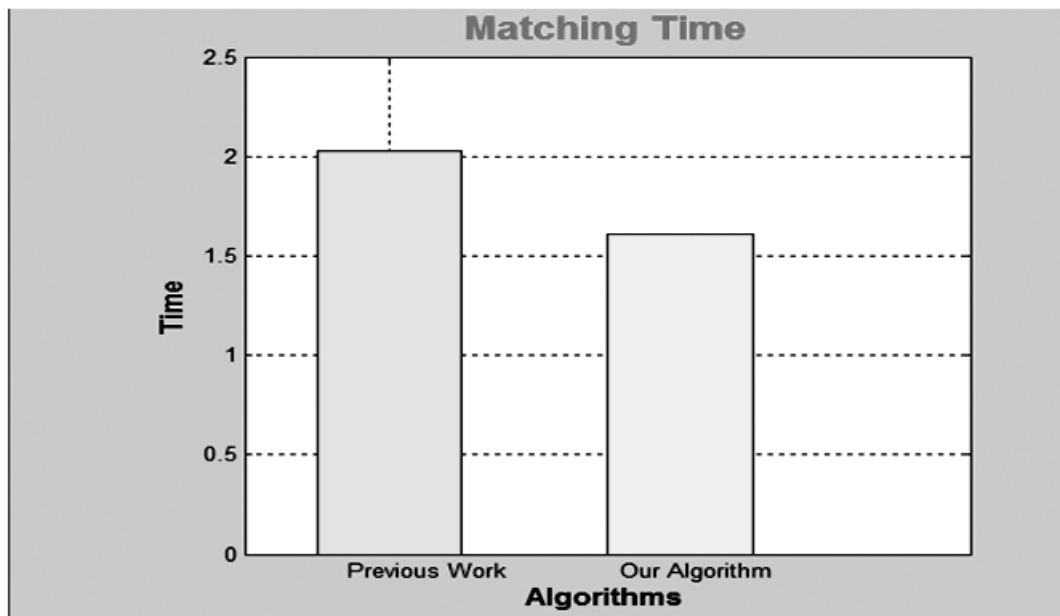
**Table 1**  
**Comparison of Error Rate between [1], [5] and proposed approach**

	<i>M.Singh et al.[1]</i>	<i>Ajay Kumar et al.[5]</i>	<i>Proposed Approach</i>
Error Rate	14	10.107	6.4929



**Figure 5: Error Rate of Comparison between [1], [5] and Proposed work**

Here, we take our base paper as [1] for which we call it as previous work. Figure 6 shows the comparative table of Error rate between [1] and our proposed approach. Further, figure 6 shows the graphical representation of figure 5. As shown error rate are reduced from 14 to 6.4.



**Figure 6: Matching Time of Previous and Proposed work**

**Comparison of Matching time between Previous and our algorithm**

	Previous Work	Proposed Work
Time	2.0300	1.6107

Figure 7: Values of Matching Time

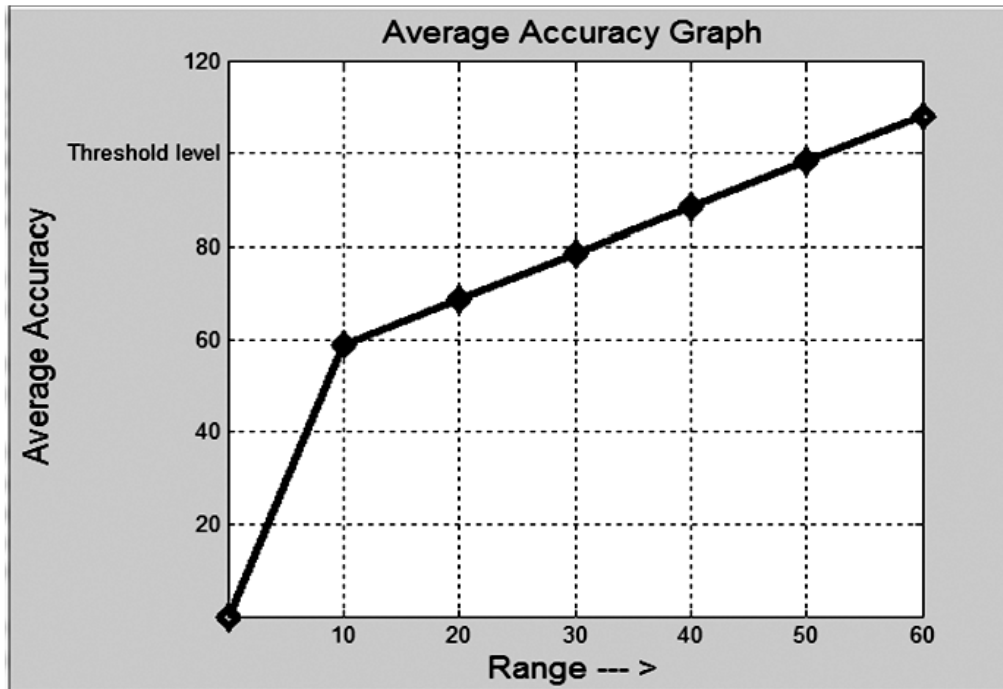


Figure 8: Average Accuracy Graph

Figure 7 shows that proposed approach takes less time during matching comparative to previous one and figure 6 shows the graphical representation of matching time. It also represents the result with high accuracy which is 98% as shown in Figure 8 and Figure 9.

Figure 10, Shows the average accuracy of proposed Decision Support System based approach with SURF and SVM comparative to SURF and SVM. Further it also shows the improvement in the results.



Figure 9: Average Accuracy

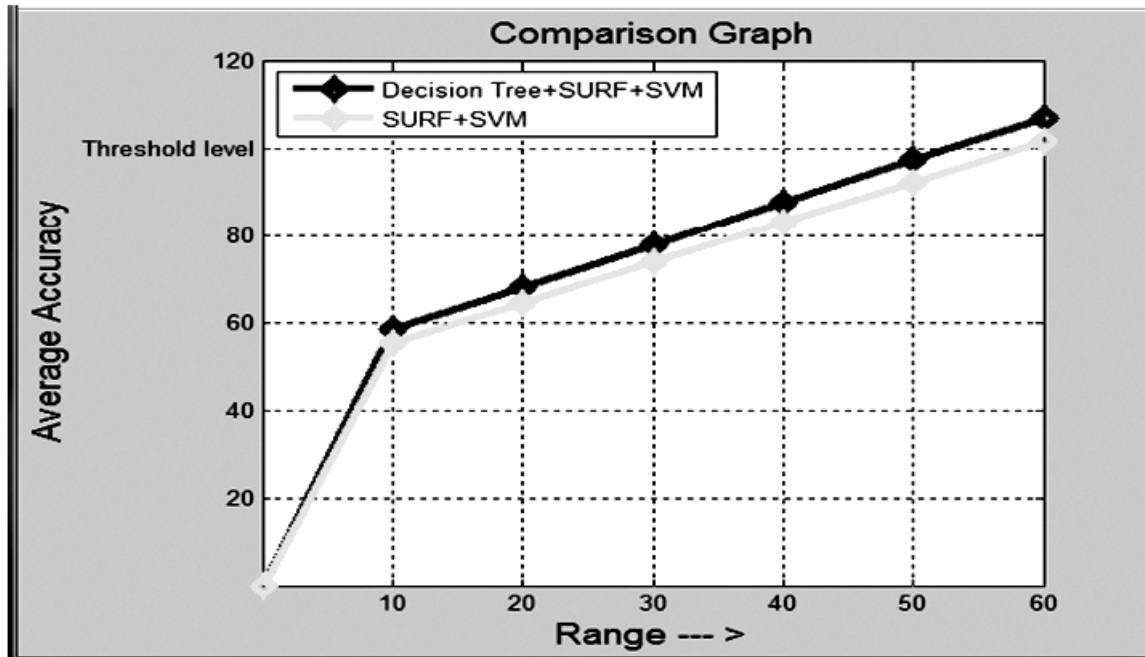


Figure 10: Average Accuracy of Previous and Proposed work

#### 4. CONCLUSION

It shows the better results in respect to reducing error rate, matching time with high accuracy. In this research paper an attempt has been made to show the technological phenomenon where decision tree based face recognition approach is proposed using SVM and SURF. In this approach, Pre-processing comes first that includes both the input image and all the images stored in the database. Secondly, the image processing operations is used to extract face feature. At last decision tree with SVM and SURF base technique is applied for training and testing purpose. The proposed approach produces better result in respect of Error Rate, Matching Time and average accuracy graph. Hence, Combining SVM and SURF with decision tree provides the more accurate and better outcomes. Further, proposed framework can be analyzed in real environment in terms of its applicability and utilization in the industry and other area. This approach can be further improved by using new methods for face recognition.

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