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Research Paper

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Smart Voting System through Facial Recognition

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***Abstract*—** Facial recognition is a category of biometric software which works by matching the facial features. We will be studying the implementation of various algorithms in the field of secure voting methodology. There are three levels of verification which were used for the voters in our proposed system. The first is UID verification, second is for the voter card number, and the third level of verification includes the use of various algorithms for facial recognition. In this paper, we will provide a comparative study between these algorithms, namely: Eigenface, FisherFace & SURF.

Keywords— Smart Voting; Facial Recognition; EigenFace ; FisherFace; SURF

I. INTRODUCTION

In India, currently we are having two kinds of voting mechanisms first the secret Ballet paper and the second one is Electronic Voting Machines (EVM), but the process of voting has some demerits and drawbacks, that is, why is the present ongoing system not so much safe & secure. In our chosen study of the system, we are proposing three levels of verification which is very effective in reducing the false voting scenarios. The first includes the unique id generate at the of registration which would be given to the voter. After which, in the second level of security when given id to the Election Commission Officer where it would be cross-checked by the officer and now the new tier of verification through which the voter needs to go, will greatly enhance the security, here we would be matching the current facial features of voter with the one present in database, this would reduce the chances of false casting of voting and make the system safer and accurate. In this paper, we will discuss the different types of algorithms used in the field of facial recognition. Along with this, we will also make a comparison between these algorithms. We have also measured the accuracy of these algorithms by practically implementing it and evaluating it on the test set.

The paper is organized in IV sections. Section I contains the introduction to the different types of voting mechanisms. Section II contains the Literature Survey which shows the recent work done in this domain. Section III contains the Data Analysis section for our proposed method. It consists of a comparative study of different types of algorithms used for facial recognition. Section IV contains the main conclusion part of our complete research.

II. LITERATURE SURVEY

The past work done in this domain involves reviewing the already present algorithms and comparison for these algorithms based on various features and conditions such as the kind of database used, and neural network-based image processing system used for the identification of the facial features [1,6]. The amount of distortion and attenuation plays a big role in generating a clear and transparent image in a localized area of the image frequency as it would be important aspect while capturing the image and processing of it to accurately match it with one that is present in the database [3].

III. DATA ANALYSIS

A. EIGENFACES

Eigenfaces, as its name suggests, involves the use of Eigenvectors for performing facial recognition. The Eigenface technique is commonly used for recognition of faces from the images. The base segments for the recognition process involve the creation of Eigenface basis and recognition of a new face. The Eigenface technique classifies faces based on general facial patterns [2]. These patterns involve various features of the face [shown in figure 1.] based on the training set images. Eigenface system involves training on a dataset of known faces where all images are of the same size and pixels, along with other properties like grayscale, with values ranging from 0 to 255.

Algorithm steps are as follows [4]:

1. For every new individual, the training data set is formed by capturing images from the different perspective of viewing angles to completely recognize every facial feature.
2. After which the images in the training set is recompiled and reconstructed to so that they are having the same dimensions and size in pixels using the grayscale property using openCV.
3. In order to enhance the features, we increase the contrast of the image, which becomes another step of feature enhancement.
4. These then are used together to form an Eigenvector

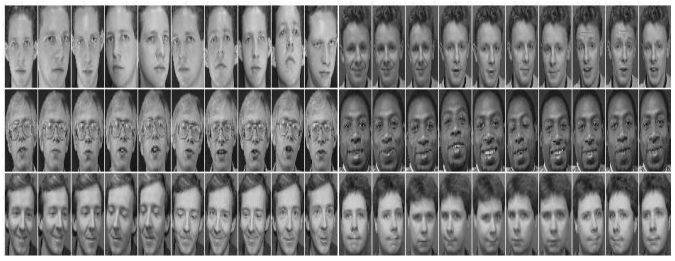

Figure 1. Sample Database for faces

Eigenfaces technique uses Principal Component Analysis (PCA) for finding Eigen values. Principal Component Analysis is a method for dimensionality reduction and creates Eigen space from the data by the means of removal and merging of its common attributes. This Eigen space then consists of the Eigenvectors which help in the mathematical representation of the various pattern. These patterns are a result of the feature matrix that has been developed from the images in the training dataset. So, as a result, the Principal Component Analysis forms the Eigen space that consists of Eigen values, which helps in maximizing the variance. The output of Eigenface system is the first point extracted result of the individual's face which can be used to match the voter's identity. The voter will be asked to enter their ID number which will be used to fetch their image from database [5].

Eigenface has some of the demerits which are described as follows:

- Scale-sensitive means it requires some pre-processing of an image before identification.
- Its throughput decreases under varying pose and illumination conditions.
- It cannot be used in cases of extreme pose variations as well in expressions.
- It cannot maximize the ratio between class scatter to within-class scatter.

Figure 2. Reveals the procedure of the algorithm to demonstrate completely.

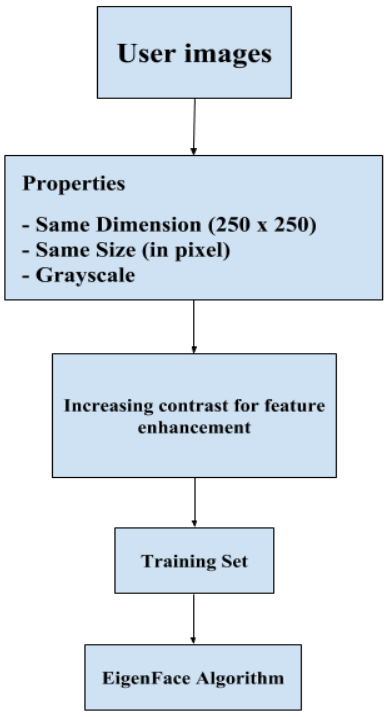

Figure 2. The training process for Eigenface technique

B. FISHERFACES

The Fisherface technique is an extension to the Eigenface technique. The main key difference between Fisherface and Eigenface technique is that Fisherface instead of only Principal Component Analysis (PCA) as dimensionality reduction technique uses a merger of both Principal Component Analysis (PCA) along with Linear Discriminant Analysis (LDA) for dimensionality reduction.

The Fisherface [Figure 3] is especially used when the images have large variations in illuminations and facial expression. Using LDA for dimensionality reduction maximizes the ratio of between class-scatter to within class scatter and for this reason it works better than PCA.

Algorithm steps are as follows:

- Formation of the training dataset. The Training dataset is created in a similar way as created in Eigenface technique.
- The Fisherface technique then follows its feature extraction process using PCA and LDA.
- PCA extracts Eigenvector from the training image data.
- LDA helps in finding the directions that are used for classification.

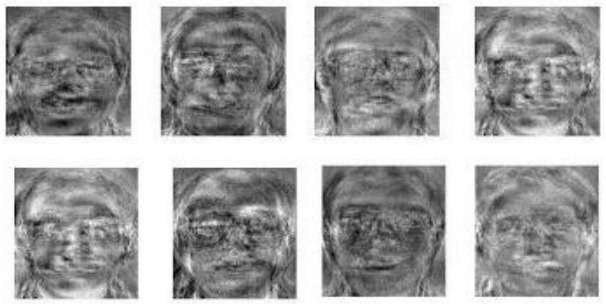

Figure 3. Fisherface feature sets

With the use of both, PCA and LDA [Figure 4], time complexity reduces. This means that the processing of images becomes fast, and this results in increases in the speed of facial recognition in images with more efficiency and better results. Fisherfaces makes the use of Fisher Linear Discriminant (FLD) to reduce dimensionality. FLD maximizes between class scatter and minimizes within class scatter. So, FLD is a good way to reduce dimensionality keeping classes separate from each other.

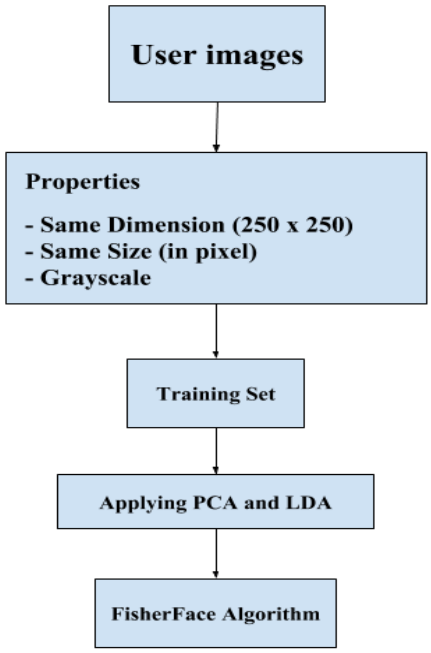

Figure 4. The training process for Fisherface technique

C. SURF

Speeded Up Robust Features or SURF is an algorithm which helps in similarity invariant representation and rapid comparison of images. SURF also helps in detecting objects based on its scale and angle properties and for this reason, it is a scale and in-place rotation invariant detector.

SURF method follows mainly three stages; these are shown in figure 5:

- Feature Detection- In this step, the SURF feature detector applies a Gaussian mask to an image at different scale and rotation invariant if possible.
- Finding correct orientation- It involves a check for image alignment based on the rotation of the image. It helps in finding the right orientation in regard to
- that single key point so that if the image is rotated then the image becomes aligned.
- Feature Descriptor- In this step, the SURF feature descriptor checks the information of the neighbourhood of the key points.

After step 3, Euclidean distance is then computed on the descriptors. The main steps involved with SURF are step 2 and step 3. SURF uses integral images to speed things up, so it must be computed only once.

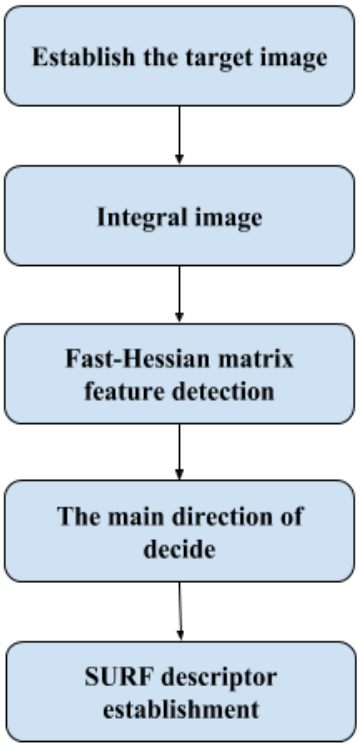

Figure 5. The training process for SURF technique

SURF Technique has many advantages, few are as follows:-

- SURF uses box filters for interest point detection and then computes gradient statistics to encode local information.
- SURF is faster to run since the computation time complexity is smaller for feature detection.

- SURF uses integral images because of which makes the calculation for box filters easy.

SURF or Speeded Up Robust Features is a robust algorithm which is mostly used for detection of objects in images based on the feature descriptors. It is also used for tasks such as image registration, 3D reconstruction and

IV. CONCLUSION

Face recognition has been since its advent a more secure and trustworthy form of authentication by including this feature with our present voting system we could enhance the capabilities of the system and can make it more secure and free from false voting. In this paper, we have provided a comparative study based on the properties of the three types of algorithms, that is, Eigenfaces, Fisherfaces, and SURF (Speeded Up Robust Features). Along with this, we have also compared their performance based on how they classify faces in the images. Our training set consisted of 2316 images. The images in the training set were augmented for further enhancement of their features. Each augments set constituted of 4 more samples per image. So the complete set constituted of 2316*4, that is, 9264 images. On the basis of our research, we observed that the accuracy of the algorithms based on the training data came out to be, 77% for Eigenface algorithm, 80% for Fisherface algorithm and 88% for SURF algorithm. The training data consisted of 2316 labeled image. Apart from this, we observed another conclusion that the SURF algorithm only gives higher accuracy when the image has some similar features in comparison to the training data. In future work, we plan on increasing the training dataset and applying other important techniques like SIFT, deep learning neural network, etc.

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