Face Recognition Challenge using SIFT Algorithm

Bhumiti Gohel [1] and Supan Shah[2]

Abstract— **Face recognition is known as one of the most significant and auspicious applications of image analysis. Especially during the previous years, face recognition has gained remarkable attention.For building this application we used SIFT algorithm.**

Keywords– Face recognition,Feature extraction,Face detection,Object recognition,Computer Vision, SIFT algorithm

I. INTRODUCTION

In this computer vision era, the potential to recognize human faces is evidence of spectacular human intelligence. Psychologists concluded that holistic and feature-based approaches are two different routes of face recognition [1].The first important aspect of face recognition systems is to extract features from the face. Moreover, these features that are more stable and discriminatory are unknown. After this, the researchers started using full-face as input for facial recognition as there were difficulties in robustly extracting features. Hence, they developed a holistic face matching method.Most of the published papers in face recognition domains use holistic methods as this type of approach has a better performance when compared to that of feature-based methods. A holistic approach has poor performance if there are variations caused due to various expressions on the face. Moreover, local features that are extracted from different regions of the face are more volatile than global features. Hence, we are motivated to study the feature-based approaches and compare their performance with respect to other popular holistic approaches like null space approach(NLDA), Fisherface(FLDA), Eigenfeature Regularization Extraction(ER).In this paper, we have implemented a feature-based approach for face recognition. First, We extract the feature from the image and after that, we perform feature matching. The process of reduction in dimensionality by depletion of raw data to more manageable groups and when we have large number variables in that case without losing important or relevant information which can be used for further processing is called Feature Extraction. This process helps in reducing the number of resources that are required for processing and also retains important or relevant information. Hence, this process results in removing the redundant data for a given data. This can also help us in increasing the speed of machine learning processes like learning and generalization. There are many computer vision algorithms for finding local features and their descriptor . For example, SIFT,SURF,ORB,LBP,HOG descriptor. This algorithms extract the local features to better handle scale changes,rotationand occlusion.You can also extract features using a pretrained convolutional neural network .In this paper we implemented SIFT (Scale Invariant Feature Transform) algorithm.SIFT (Scale Invariant Feature Transform) was developed by David Lowe in 1999.It detects and describes local features in image.SIFT is invariant to scale, rotate, translation, illumination, and blur. SIFT algorithm is patented, so this algorithm is included in the Non-free module in OpenCV.

II. MOTIVATION

The main motivation for face recognition is because it is considered a passive, no intrusive system to verify and identify people. and also Increasing demand of fast and accurate authentication and identification. Many algorithm still do not work efficiently due to variation in pose,orientation,illumination,and facial expression of image. Face recognition plays vital role in our daily life.There are number of application where we used face recognition for example,Prevent re-

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tail crime,To unlock phones,Find missing persons,Help the blind,Track school attendance,In casinos, Facilitate secure transaction.

III. BACKROUND

The process of reduction in dimensionality by depletion of raw data to more manageable groups and when we have large number variables in that case without losing important or relevant information which can be used for further processing is called Feature Extraction. This process helps in reducing the number of resources that are required for processing and also retains important or relevant information. Hence, this process results in removing the redundant data for a given data. This can also help us in increasing the speed of machine learning processes like learning and generalization.

IV. DETAILED MATHEMATICAL ANALYSIS OF SIFT ALGORITHM

For Feature detection and matching using SIFT algorithm follow the below steps

(A) **Scale-Space Extrema Detection**

We use the Difference of Gaussian(DoG) function for finding unique features and first stage searches in scale space. It is also used to identify potential interest points that are not dependent to scale and orientation. The scale space of an image given as $L(x, y, \sigma)$(equation1) can be produced by convolution of variable-scale Gaussian $G(x, y, \sigma)$(equation2) from an image I(x, y)

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y) \quad (1)$$

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e \frac{-x^2 + y^2}{2\sigma^2} \quad (2)$$

Multiple DoG can be used for detecting efficient and robust key points, scale space extrema. Computation of difference of 2 nearby scales separated by constant factor k can be denoted as D(x, y, σ):

$$D(x,y,\sigma) = (G(x,y,k\sigma) - G(x,y,\sigma)) * I(x,y)$$

$$= L(x,y,k\sigma) - L(x,y,\sigma) \ldots (3)$$

(B) **Key Point Localization**

For every feature point location, we fit a detailed model for calculating location and scale. Selection of key points is based on their stability.

$$p(x, y) = (L(x + 1, y) - L(x - 1, y))^2$$

$$q(x, y) = (L(x, y + 1) - L(x, y - 1))^2$$

$$m(x, y) = \sqrt{p(x, y) + q(x, y)} \quad \ldots (4)$$

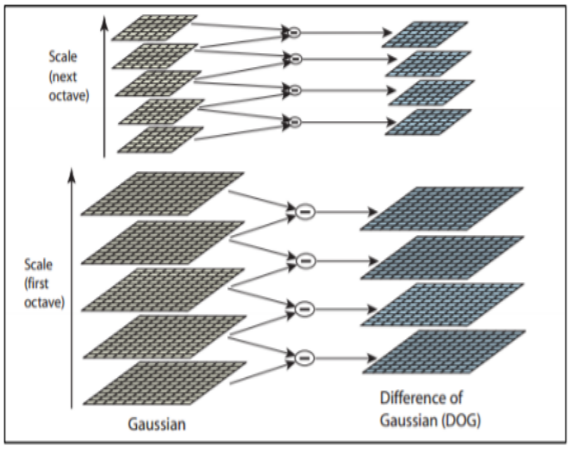


Fig. 1. Visualizing SIFT Algorithm

(C) **Key Point Descriptor**

For each key point, local image gradients are measured in that region. Then, they are transformed into a representation for significant levels of shape distortion and change in illiumination

V. EXPERIMENTS AND RESULTS

In this application, we have built our own dataset such that we first capture the data(face) using webcam.After this, we apply sift algorithm . With using SIFT algorithm we extract keypoint and descriptor. Using this keypoints and descriptor we performed FLANN based thresholding for matching that's how we trained the model. For testing purpose, we have streamed a live video and we record the stream.Following this, we detect the faces in recording and try to match it with faces that are stored in database.Upon a successful match, your name is printed above your face.This model has an accuracy of 95.71% and overall-weighted F1 score is 97.48%. as alternate method of matching we have used support vector machine (SVM) kernel method for classification. our model accuracy using FLANN based Matcher. our model accuracy using SVM based classifier.

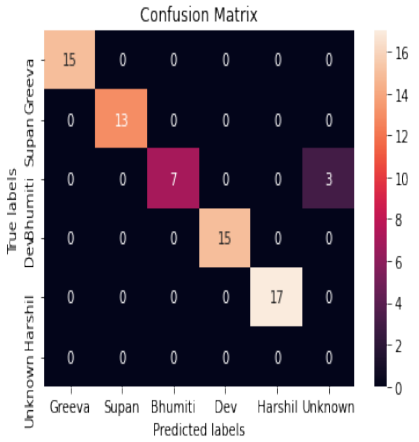


Fig. 2. Confusion Matrix for SIFT algorithm

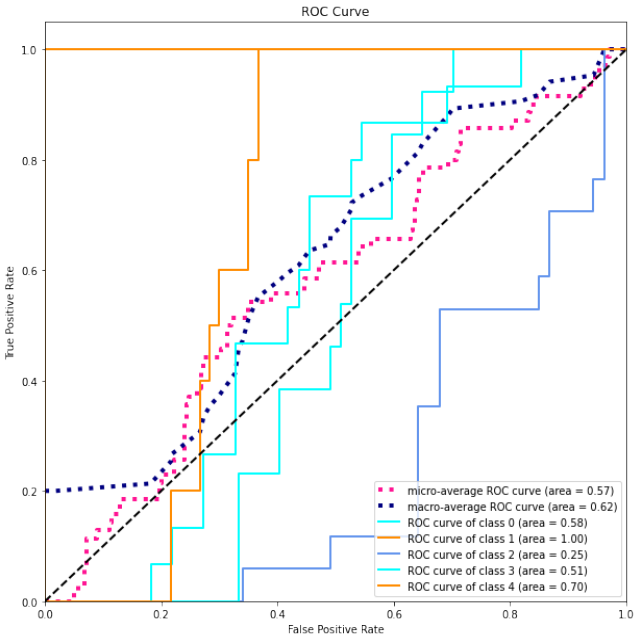
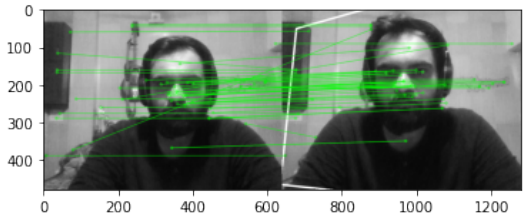


Fig. 3. ROC Curve using SVM Method

Results



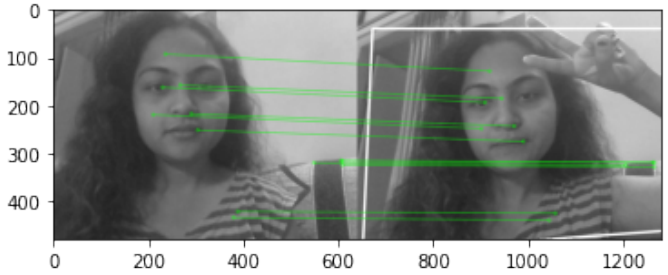


Fig. 4. Sample Output 2

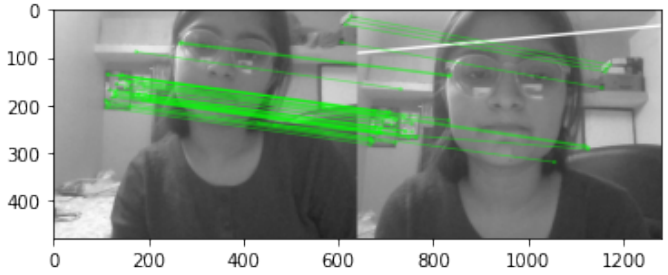


Fig. 5. Sample Output 3

VI. Comparison with other algorithm

There are number of methods used to detect (extract) and matching of features as SIFT (Scale Invariant Feature Transform), SURF (Speeded up Robust Feature), FAST, ORB etc.we comapare SIFT algorithm with SURF. SIFT and SURF both are good in illumination changes images.SURF is better than SIFT in terms of rotation invariant, blur and warp transform. SIFT is better than SURF in different scale images. SIFT is 3 times slower than SIFT because SURF using integral image and box filter methods[5]. In terms of accuracy and f1 score , SURF gives us better performance.

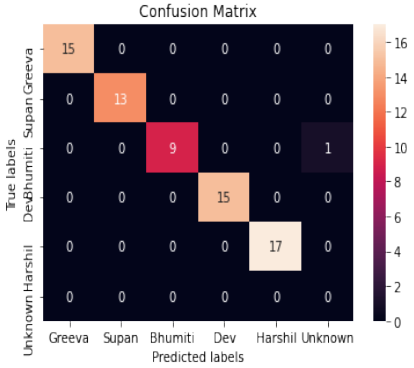


Fig. 6. Confusion Matrix for SURF algorithm

VII. Conclusion

The experiments and results obtained on our real-world dataset - our own images - show that SIFT algorithm can be efficiently used to recognise faces. While being prone to background clutter, the algorithm also exhibited a comparatively higher prediction time. The output images show Nevertheless, the SIFT algorithm can easilyThe o be used as a lightweight feature extraction algorithm to recognise faces efficiently for a non-production environment.

VIII. References

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