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A FACE DETECTION ALGORITHM

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Abstract-Face recognition system should be able to automatically detect a face in an image. Face Recognition system is used in security. Face recognition offers a lot of opportunities to be explored for research. Hence this study aims to address the shortcomings that deteriorate the performance of face recognition system and explore new optimized techniques. The new system is being proposed to remove limitations such as posture, light conditions and expression variations, etc. it provides an overview of different face recognition techniques such as biometric method, hybrid method, PCA, holistic technique. Various techniques introduced in each of these categories are discussed. In this work, based on point matching method suggest so work introduce geometric constraints into point-matching based on SURF features to increase the matching speed and robustness. The work shows another procedure for human Face Recognition. This work hasintroduced a novel face acknowledgment method that utilizations highlight got from SURF algorithm LDA-PCA based classifier. This analysis is vital in developing new robust algorithms. Based on the feature detection and feature extraction techniques, it has been observed that SURF algorithm is the one of the best algorithm for image matching problems. Various important techniques like block detection algorithm, Feature matching using SURF algorithm.
Keywords: face recognition, SIFT, LDA, PCA, SURF.

I. Introduction

Face Recognition (FR) is the undertaking of distinguishing the recognized face as a known face or not. It is the utilization of Digital Image Processing (DIP) and Computer Vision. PC Vision is a propel branch of Artificial Intelligence and in addition it is accomplished by Machine Learning. So, we can say that Face Recognition System is implemented with the help of Machine Learning, Computer Vision and Image processing.[1]

Face recognition is basically pattern recognition for facial cases, which can be described to classify the known face and unknown face. Since the faces are highly dynamic and pose more issues and challenges to solve, researchers in the domain of pattern recognition, computer vision and artificial intelligence have proposed many solutions to reduce such difficulties so as to improve the robustness and recognition accuracy. Basically face recognition approaches can either be classified as holistic based or feature based. The features used in holistic and feature-based approaches are fundamentally different. In holistic based approaches recognition is done based on global features from faces, whereas in feature based faces are recognized using local features from faces. Holistic approach features represent optimal variances of pixel data in facial images used to uniquely identify a person. Whereas features of feature-based approaches represent face features like the eyes, nose and mouth to uniquely identify a person.[2]

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II.FACE RECOGNITION SYSTEM

Face Recognition process can be subdivided into two main parts. The challenges in face recognition are pose, illumination, facial expression, image condition, face size and so forth. The first part is image processing and the second part is recognition techniques. The image processing part consists of face image acquisition through scanning, image enhancement, image clipping, filtering, edge detection and feature extraction. The second part consists of the artificial intelligence which is composed by genetic algorithms and there are many approaches for face recognition. Feature-based approaches first process the input image to identify and extract distinctive facial features such as the eyes, mouth, nose, etc., as well as other facial marks, and then compute the geometric relationships among those facial points, thus reducing the input facial image to a vector of geometric features. Standard statistical pattern recognition techniques are then employed to match faces using these measurements. However, if the facial features are manually extracted, it is reasonable to assume that the recognition performance would have been much lower if an automated, and hence less precise, feature extraction method had been adopted. In general, current algorithms for automatic feature extraction do not provide a high degree of accuracy and require considerable computational capacity.[3]

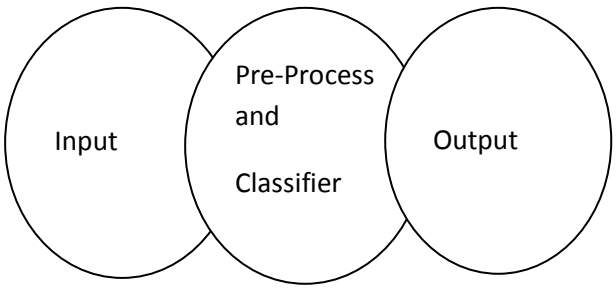


Fig. 1 Generic diagram of Face recognition process.

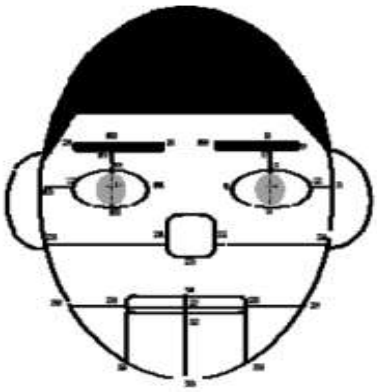


Fig. 2 Facial features recognition.

III.USING TECHNIQUES

Speeded UP Robust Features (SURF) SURF is used not only for feature detector but descriptor as well. It is used mainly for object recognition, image registration, classification and 3D reconstruction. SURF was based on another element extraction calculation, Scale invariant feature transform (SIFT), which was one of first calculations utilized as a part of the late 90's. As, SURF creators' claim, it is a few times quicker in bringing the outcomes than SIFT and furthermore exceptionally vigorous in nature. SURF utilizes a whole number guess of

the determinant of Hessian blob finder to identify the cross focuses, making it fit for registering 3 number tasks utilizing a precomputed necessary picture. The element descriptor utilized as a part of SURF depends on the aggregate of the wavelet transform the purpose of intrigue, which makes it capable to be processed with the guide of inside picture. SURF descriptors have been utilized to find and perceive questions, individuals or countenances, to recreate 3D scenes, to track protests and to remove purposes of interest.[4]

Linear Discriminant Analysis (LDA)

LDA is otherwise called Fisher's Linear Discriminant (FLD). It lessens the measurement space by utilizing the FLD strategy. FLD procedure uses inside class data, limiting variety inside each class and amplifying class partition.

Principal Component Analysis (PCA)

PCA is one of the successful techniques used to the original data with lower dimensional features vectors. This procedure transforms a number of correlated variables into a number of unrelated variables called Principal Components. PCA is a powerful tool for analysing data. The main advantages of PCA are to find the patterns in the data and reducing the number of dimensions without loss of information's. Purpose of PCA is to reduce the large dimensionality of the data space to the smaller intrinsic dimensionality of feature space.[5]

VI. LITERATUREREVIEW

Yuqian Zhou et al. [2018] Face detection is a well-explored problem. Many challenges on face detectors like extreme pose, illumination, low resolution and small scales are studied in the previous work. However, previous proposed models are mostly trained and tested on good-quality images which are not always the case for practical applications like surveillance systems. In this paper, we first review the current state-of-the-art face detectors and their performance on benchmark dataset FDDB, and compare the design protocols of the algorithms. Secondly, we investigate their performance degradation while testing on low-quality images with different levels of blur, noise, and contrast. Our results demonstrate that both hand-crafted and deep-learning based face detectors are not robust enough for low-quality images. It inspires researchers to produce more robust design for face detection in the wild.[6]

Rajat Naik et al. [2018] Face recognition has become a most popular space for research in computer vision and one in every of the foremost booming applications of image analysis and understanding. Nowadays, face recognition is used in different applications for authentication and verification. There are various ways that can be used for face recognition. Our proposed survey

work is focused on ICA based face recognition. This paper discusses the different ICA based techniques which are used in last decade. This paper reviews the comparative study of different face recognition techniques which is based on ICA. In this review paper, we discuss the comparison of different methods of ICA and their advantages.[7]

Sandeep Kumar et al. [2017] Nowadays research has explored to extracting auxiliary information from various biometric techniques such as fingerprints, face, iris, palm, voice etc. This information contains some features like gender, age, beard, mustache, scars, height, hair, skin color, glasses, weight, facial marks, tattoos etc. All this information contributes more and more to identification. The major changes that come across face recognition are to find age & gender of the person. This paper contributes a significant survey of various face recognition techniques for finding the age and gender. The existing techniques are discussed based on their performances. This paper also provides future directions for further research.[8]

Prof. K. B. Pawar et al. [2017] This paper presents a correspondence measure method based on novel method which combines a permutation of Voila Jones Face detection method and Eigen face classification (Identification) technique. In the proposed method, we come to overcome the problem of low accuracy. We propose a new system here to align the face using Voila Jones Face detection method followed by Eigen face classification technique. Compared to other face detection methods, the proposed method is very efficient for the face detection purpose. The system is built to meet real time face classification criteria.[9]

Anand Handa et al. [2016] Face Recognition is one of the most demanding problems in computer vision and image processing. Face recognition techniques can be divided into following categories: methods which are applicable on intensified images; images derived from video sequences; and images that require three-dimensional information and data. In this paper, we have compared the various Bi-Modal and Multi-Modal techniques. Speech recognition is an essential component for various applications such as building interfaces for natural human machines. Acoustic speech is used as the only input for various speech based automatic recognition system. Recognition is as a Multimodal indigenous component of the next level speech-based systems. The main objective of this review paper is to compare the various components of bimodal recognition and it aims at some important ongoing research issues in the field of image and face recognition.[10]

Roshan Jameel et al.[2016] Motion of one or more than one muscles underneath the skin is Facial Expression. These movements plays very important

role in conveying the emotional states of individual to the observer. Human face-to-face communication is important in human interaction. In recent years, different approaches have been put forward for developing methods for fully automated facial expressions analysis that is important for human computer interaction. In Facial Expression Recognition System the image is processed to extract such information from it, which can help in recognizing six universal expressions that are neutral, happy, sad, angry, disgust and surprise. This processing is done in several phases including image acquisition, features extraction and finally expressions classification. This paper surveys some of the techniques that are used for the purpose of facial expression recognition; a summary of some of the papers from 2001 to 2012 is given in tabular form. A list of few challenges in this field is given at the end along with the possible future advancements.[11]

Aryuanto Soetedjo et al. [2016] this paper presents the fusion techniques for detecting and tracking the face. The proposed method combines the Viola-Jones method, the Cam Shift tracking, and the Kalman Filter tracking. The objective is to increase the face detection rate, while reduce the computation cost. The proposed method is implemented on a low cost embedded system based-on the Raspberry Pi module. The experimental results show that the average detection rate of 98.3% is achieved, and it is superior compared to the existing techniques. The proposed system achieves the frame rate of 7.09 fps in the real-time face detection.[12]

V. Propose work

Problem statement:

In this paper The SIFT descriptor becomes unstable in the presence of variations in face pressure or differences in skin characteristics. Therefore, the gray-scale fingerprint images without pre-processing are not proper for original SIFT extraction. Filters are used to process the original face image to derive an enhanced gray image. It can be partitioned into the following major stages: high pass filter, low pass filter, ridge direction detection, and ridge enhancement. SIFT is good technique but not best technique for face recognition that's why we use another propose technique for face recognition.

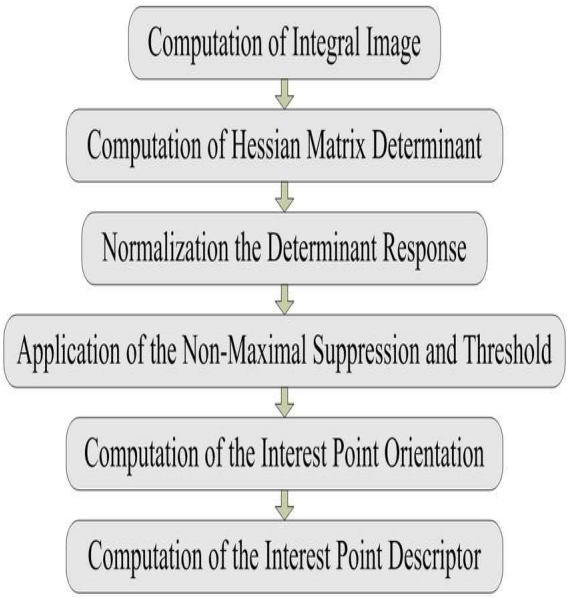
Propose Methodology:

Feature matching is commonly used in face recognition by SIFT. In this paper, based on point matching method suggest so we introduce geometric constraints into point-matching based on SURF features to increase the matching speed and robustness. Because in face recognition, face images are usually upright and normalized, the matching points in two images must have the similar locations on the two faces. The point-pair

with the minimum distance between descriptors will be considered as a candidate matching pair. If the ratio of these two distances is smaller than a pre-defined threshold, the point-pair with the minimum distance is confirmed as a matched pair. Since location information is introduced in search of the minimum-distance point-pair, and the ratio of the minimum distance and next to minimum distance measures the matching reliability of two interest points in some degree, the above method can avoid mismatching effectively. This paper shows another procedure for human FR. This paper has introduced a novel face acknowledgment method that utilizations highlight got from SURF algorithm LDA-PCA based classifier. This analysis is vital in developing new robust algorithms. Based on the feature detection and feature extraction techniques, it has been observed that SURF algorithm is the one of the best algorithm for image matching problems. Various important techniques like block detection algorithm, Feature matching using SURF algorithm.

Speeded Up Robust Features (SURF)

SURF is used not only for feature detector but descriptor as well. It is used mainly for object recognition, image registration, classification and 3D reconstruction. SURF was based on another element extraction calculation, Scale invariant feature transform (SIFT), which was one of first calculations utilized as a part of the late 90's. As, SURF creators' claim, it is a few times quicker in bringing the outcomes than SIFT and furthermore exceptionally vigorous in nature. SURF utilizes a whole number guess of the determinant of Hessian blob finder to identify the cross focuses, making it fit for registering 3 number tasks utilizing a recomputed necessary picture. The element descriptor utilized as a part of SURF depends on the aggregate of the Hair wavelet transform the purpose of intrigue, which makes it capable to be processed with the guide of inside picture. SURF descriptors have been utilized to find and perceive questions, individuals or countenances, to recreate 3D scenes, to track protests and to remove purposes of interest.



Flow chart: 3.1 Surf algorithm

The algorithm works as follow:

1. Find features/key points that are likely to be found in different images of the same object. Those features should be scale and rotation invariant if possible. Corners,

blobs etc. are good and most often searched in multiple scales.

2. Find the right "orientation" of that point so that if the image is rotated according to that orientation, both images are aligned in regard to that single key point.

Computation of a descriptor that has information of how the neighborhood of the key point looks like (after orientation) in the right scale.

Principal Component Analysis (PCA)

Many methods are using for maintaining the security like as pin numbers, credit cards, smart cards etc. But sometimes it fails. Here the present face recognition using Principal Component Analysis.The PCA has been extensively used for face recognition algorithms. It is one of the most popular representation methods for face image. PCA not only reduces the dimensionality of the image, but also retains some of the variations. It is one of the popular methods for feature selection and dimension reduction. PCA is a variable reduction procedure. It is useful when obtained data have some redundancy and this will result into reduction of variables into small number of variables which are called principal components. PCA is a mathematical procedure that performs a dimensionality reduction by extracting the principal component.

Linear Discriminant Analysis (LDA)

LDA is otherwise called Fisher's Linear Discriminant (FLD).It lessens the measurement space by utilizing the FLD strategy. FLD procedure uses inside class data, limiting variety inside each class and amplifying class partition.

Fisher Face:

The Linear Subspace algorithm takes advantage of the fact that under ideal conditions the classes are linearly separable. Yet, one can perform dimensionality reduction using linear projection and still preserve linear reparability; error free classification under any lighting conditions is still possible in the lower dimensional feature space using linear decision boundaries. This is a strong argument in favour of using linear methods for dimensionality reduction in the face recognition problem, at least when one seeks insensitivity to lighting conditions.

Pseudo code for the Key point Detection and Description

Input: Set of select band B1 and B2.

Output: A set of key points K for each selected band of both images.

Parameters: Number of sublevels **N**sub.

Key point Detection

1.Calculate the optimal number of OctavesNoctaccording to the spatial size of the images

2. Upsample the images to obtain images whose size is divisible by the number of octaves Noct

3. For each band b in images B1 and B2 do

4. Upsample the band by a factor of 2 using bilinear interpolation

5. Stage build the pyramidal scale space

6. Smooth the Upsampled band using a Gaussian filter

7. Compute the contrast factor K from the gradient histogram of the smoothed band

8. Sub stage Build the pyramid using FED scheme

9. For 0 ← 1, Noct do

10. Subsample the last sublevel image by a factor of 2

11. For S ← 1, Nsub do

12. Smooth using a Gaussian filter

13. Compute the conductivity g (Equation 3)

14. Discretized the nonlinear diffusion equation using the FED scheme

15. End for

16. End for

17. End sub-stage

18. End stage

19. Stage locate the key point in the scale space

20. Compute the determinant of the Hessian matrix

21. Detect key point by searching for point that are the maxima of their neighbourhood $\rightarrow \mathbf{K}_1^b,\ \mathbf{K}_2^b$

22. Refine the position and the scale of each key point

23. End stage

Key point description

24.for each key point in $\mathbf{K}_1^b$ and $\mathbf{K}_2^b$ do

25. Calculate the main orientation

26. Compute the M-SURF descriptor

27. Append the spectral signature

28. End for

29. End for

Propose Algorithm:

Step.1. Start

Step.1. Browse image from test dataset for recognition

Step.2. Detect face

Step.3. Apply SIFT for feature detection

Step.4. Face recognition by LDA and PCA

Step.5. Apply SURF for feature detection

Step.6. Calculate the performance evolution for accuracy

Accuracy Perform formula by SURF

```
Function accuracy=perform (ima1, output)
    [r , c] = size (ima1);
    Output = image resize (output, [200 180]);
    Adder = ima1 + output;
     TP = length (find (adder == 5));
     TN = length (find (adder == 0));
     Sub tr = ima1 - output;
     FP = length (find (sub t r == -5));
     FN = length (find (sub t r == 1));
```

Accuracy = (TP+TN) / (TP+TN+FP+FN)

A true positive would be an image that has a property (in the context of face detection maybe contains a face) and that is recognized by a program as such. A false" positive then is one that does not have the property but is recognized anyway.

These terms are validation metrics used for verifying quality of a segmented image. In a scenario where you want to compare a segmented image with ground truth, then taking the ground truth image as base of comparison you can make assumption of taking foreground as "white" pixels and background as "black" pixels in ground-truth. The terms that you referred then would mean.

1. **True positive (TP)** : pixels correctly segmented as foreground
2. **False positive (FP)** : pixels falsely segmented as foreground
3. **True negative (TN)** : pixels correctly detected as background
4. **False negative (FN)** : pixels falsely detected as background

These metrics are then used to calculate sensitivity, specificity and accuracy as:

Sensitivity: The sensitivity tells us how likely the test is come back positive in someone who has the characteristic. This is calculated as TP / (TP+FN).

Specificity: The specificity tells us how likely the test is to come back negative in someone who does not have the characteristic. This is calculated as TN / (TN+FP).

Accuracy: (TP+TN) / (TP+FP+TN+FN).

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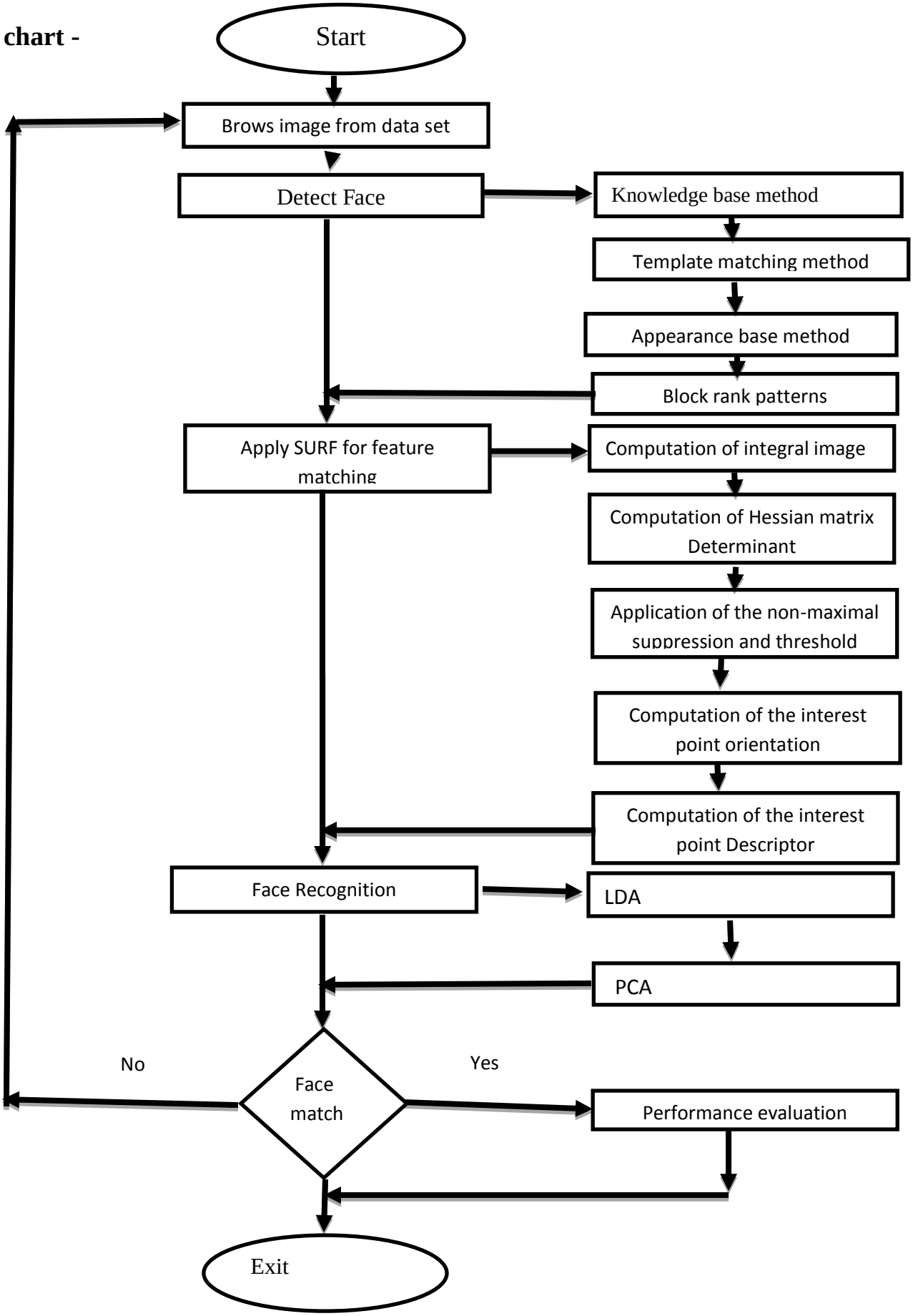
Flow chart -



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VI.result analysis

In this part, simulations &consequences of our projected system are revealed. For our experiment, the hardware environment is a personal computer with an Intel Core i5 E4600 2.4 (GHz) CPU with 4G RAM. The operating system is Windows 10 and running MATLAB 18 (A).

 (a)1.jpeg	 (b) 2.jpeg	 (c) 4.jpeg	 (d) 5.jpeg
 (e) 6.jpeg	 (f) 7.jpeg	 (g) 8.jpeg	

Fig 4. Dataset of work

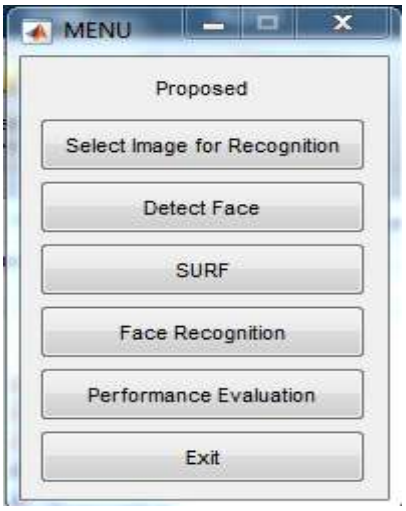

Fig. 5. First run the code obtained this of menu bar

Fig. 6. Browse image from the test dataset image.

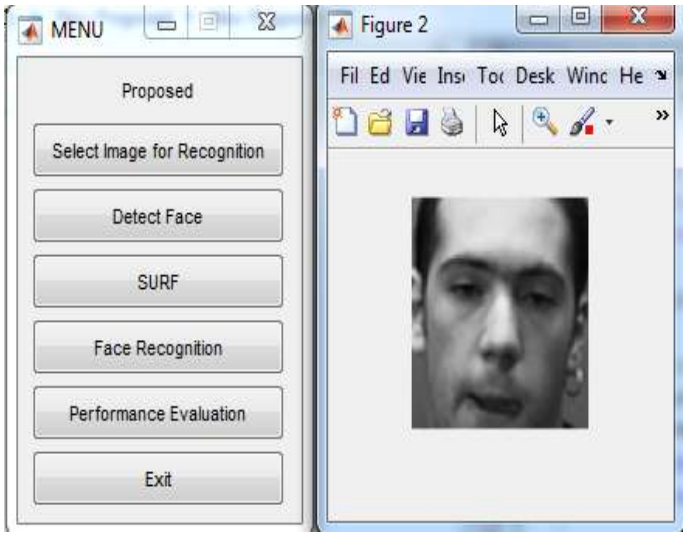

Fig.7. detect face image

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Fig. 8. Apply the SURF

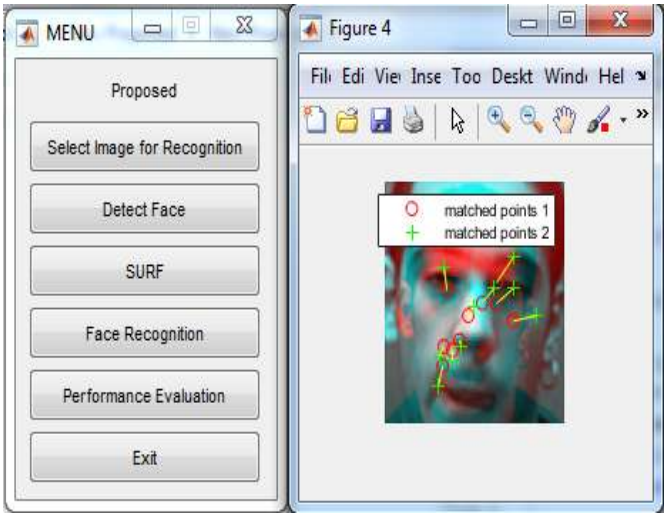

Fig. 9. Feature Matching by SURF

By following steps says that it better than existing base work:

1. Timing-In base work the time duration is greater than propose work because base code very heavy and run time process very slow.

2. **Speed and Robustness-**The speed and robustness is better than base work in base work the speed is very slow and robustness is less than propose work because nearest pixels are compute in proposed work but in base work nearest pixels are not compute.

3. Memory Storage- In base work memory storage is not good than propose work. "In base work programming code is heavy '' by this reason memory storage is less than proposed work.

4. Accuracy- In propose work accuracy is better than base work because propose work compute the nearest pixels but base work dose not compute nearest pixels.

5. Point Matching- In propose work point matching is high or better than base work because in prosed work SURF algorithm used but in base work SIFT algorithm is used. Because by SIFT calculates the face recognition and by SURF calculates point matching.

6. Technology Used-In base work the method is used which is SIFT and the method is used in propose work which is SURF. SURF is better than SIFT because by SURF uses in object recognition,Re-registration and classification. SIFT is not good because the code of SIFT is heavy it work in half feature, in this technology is needed a

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Image Name	Base (Accuracy)	Propose(Accuracy)
2.jpg	81	92
4.jpg	83	92.90
6.jpg	87	95.54

Table 1. Comparisons on base Accuracy and propose Accuracy

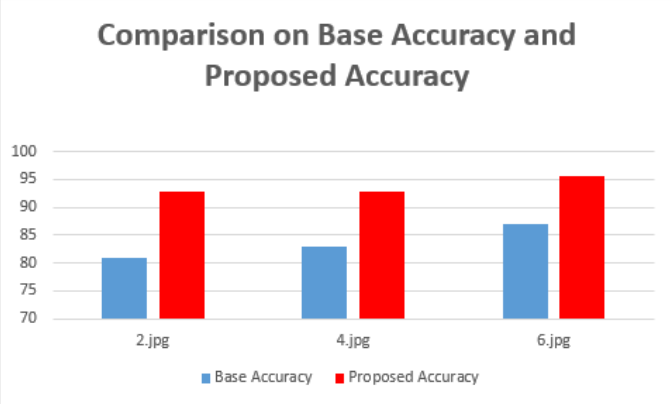

Fig. 10. Comparisons graph on base Accuracy and proposed Accuracy of three images.

network running process is slow of SIFT and it cannot work in low power devoices.

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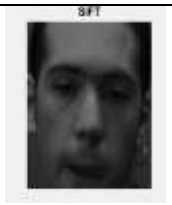
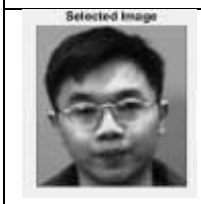
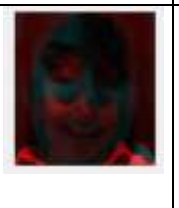
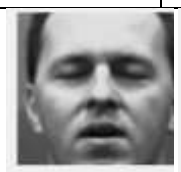
Select image for Recognition	Detect face	Sift	Feature matching	Feature recognition by SURF	Performance Evaluation of Base work	Performance Evaluation of Propose work
					90.77	92.70
					80.93	84.37
					90.90	93.42
					83.77	87.57
					89.54	92.53
					86.47	91.23
					90.22	93.44

Fig. 11: Show the seven images resulting output and comparison for Performance Evaluation of Base Work and Performance Evaluation of Propose work

Conclusion

In this paper the effort is being made to present a work of the face recognition, as it is active research area due to its several benefits. Recent progress in the field of face recognition is covered by conducting a review of a noteworthy number of researchers. Continuous efforts are some applications of face recognition technology are economical.

Reliable and highly accurate. In this work we have given ideas of face acknowledgment techniques. The present paper can provide the readers a better understanding about face recognition methods. This analysis is vital in developing new robust algorithms. Based on the feature detection and feature extraction techniques, we have seen sure algorithm is the one of the best algorithm for image matching problems. Feature extraction using SURF technique, and Face recognition using LDA, PCA. Calculate the Accuracy. In the future, 2D & 3D Face Recognition and large scale applications such as e-commerce, student ID, digital driver licenses, or even national ID is the challenging task in face recognition & the topic is open to further research.

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