A New Hybrid Technique for Iris Recognition

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ABSTRACT
Iris recognition is considered as the most accurate biometric method. In this paper, we have developed a system that can recognize human iris patterns and an analysis of the results is done. A novel mechanism has been used for implementation of the system. Feature encoding has been used to extract the most discriminating features of the iris and is done using SIFT scheme. And finally the biometric templates are classified using SVM and Neural Network which tells us whether the two iris images are same or not and on the basis of that performance metric are evaluated Accuracy, precision and false positive rate using MATLAB environment.

Keywords
SIFT (Scale invariant feature transform), Iris authentication, Support Vector Machine (SVM), Neural network (NN), Hough circle transform (HCT),least mean square(LMS)

1. INTRODUCTION
In human recognizable proof, the developing late research is fundamentally on the biometric applications. The biometric applications are mostly utilized for security purposes. The biometric applications make utilization of numerous components of human they incorporate palm print, voice, face, and finger impression, knuckle print, Iris. Every one of these elements are one of a kind for each individual human. The biometrics is principally used to keep away from the false like faking ID. Government likewise subsidizing for security and wellbeing stages in view of biometrics to supplant the conventional systems like pin and secret key.

The national ID cards supplied by the administration, chiefly concentrates on the biometrics so they can consummately recognize the people and no different persons can ready to fake them or utilization them. Iris has some focal points that can't be replaced by another human so it is most accurate biometric.

Iris acknowledgment started by Flom and safir [1]. Later Daugman built up the Iris acknowledgment utilizing Gabor 1-D wavelets [2].Wildes et al. Utilized the four level Laplacian pyramid to concentrate the elements of iris, utilized ordinary relationship for classification[3].Boles and Boashash [4] utilized zero intersections for grouping. Mama et al. [5] utilized the bank of spatial channels.

Sun et al. [6] built up the Gaussian channels to gauge the nearby heading. Sanchez [7] utilized numerous zero intersections based marks of Iris. Geodesic dynamic shape (GAG) is utilized to portion Iris from the surroundings [12].

Miyazawa et al. [8] built up the stage segments of the iris picture utilizing 2-D discrete Fourier change. Brigle [9] diminishes the season of execution by keeping the time intensive standardization. Zhu et al. [10] adjusted the Scale Invariant Feature Transform (SIFT) for the component extraction, yet the classifier utilized is to match the components are not all that impeccable, so the bolster vector machine (SVM) [13] is utilized as classifier to deliver the precise order.

2. SYSTEM FRAMEWORK
Iris is a standout amongst the most solid biometric attributes because of its steadiness and haphazardness. Iris is changed to polar arranges by the routine acknowledgment frameworks. They perform well for the agreeable databases, yet the execution disintegrates for the non-helpful irises.

Notwithstanding this, associating impact is presented as an aftereffect of changing iris to polar space. In this proposition, these issues are tended to by considering annular iris free from clamor because of eyelids. This proposition shows a few SIFT based systems for separating particular invariant highlights from iris that can be utilized to perform dependable coordinating between diverse perspectives of an item or scene. After limitation of the iris, Scale Invariant Feature Transform (SIFT) is utilized to concentrate the neighborhood highlights. The SIFT descriptor is a broadly utilized technique for coordinating picture highlights. Then that features are saved to database that are used in the future for recognition.

At that point order of iris layouts will be done utilizing neural system and SVM classifier.

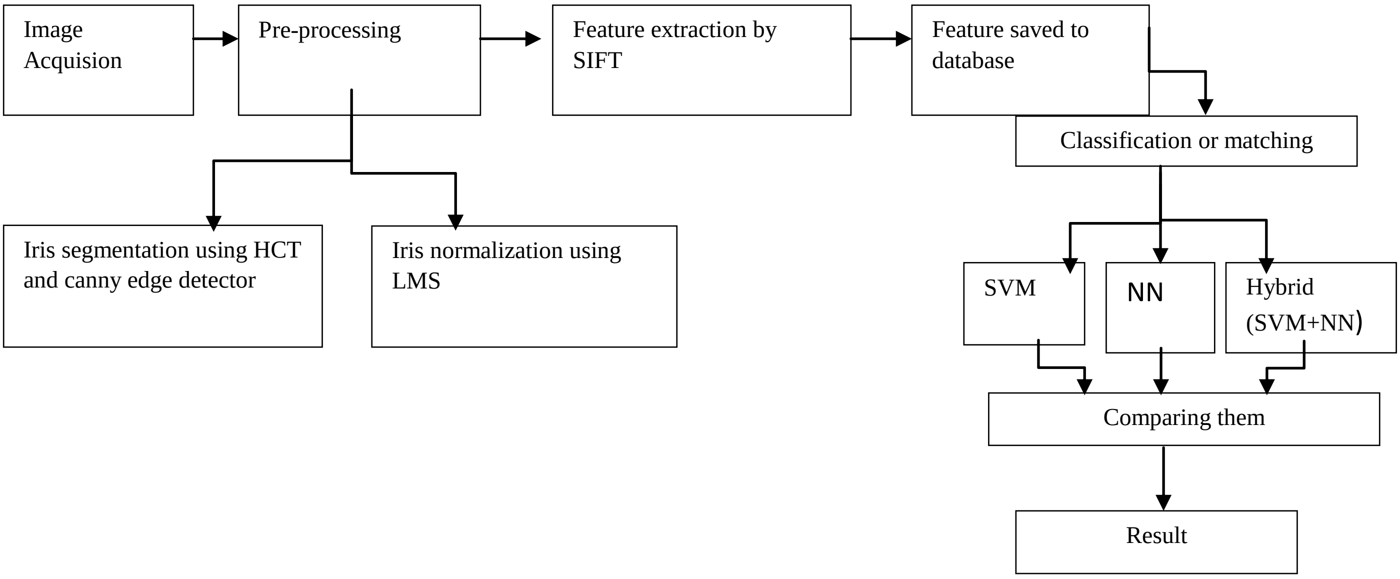

Figure.1 Proposed System framework

2.1 Image Acquision

It manages with capturing of a high quality image of the iris. The iris image ought to be rich in iris texture as the feature extraction stage relies on the picture quality. Take total 286 number of iris sample. For iris recognition firstly upload the iris image as shown below in MATLAB environment.

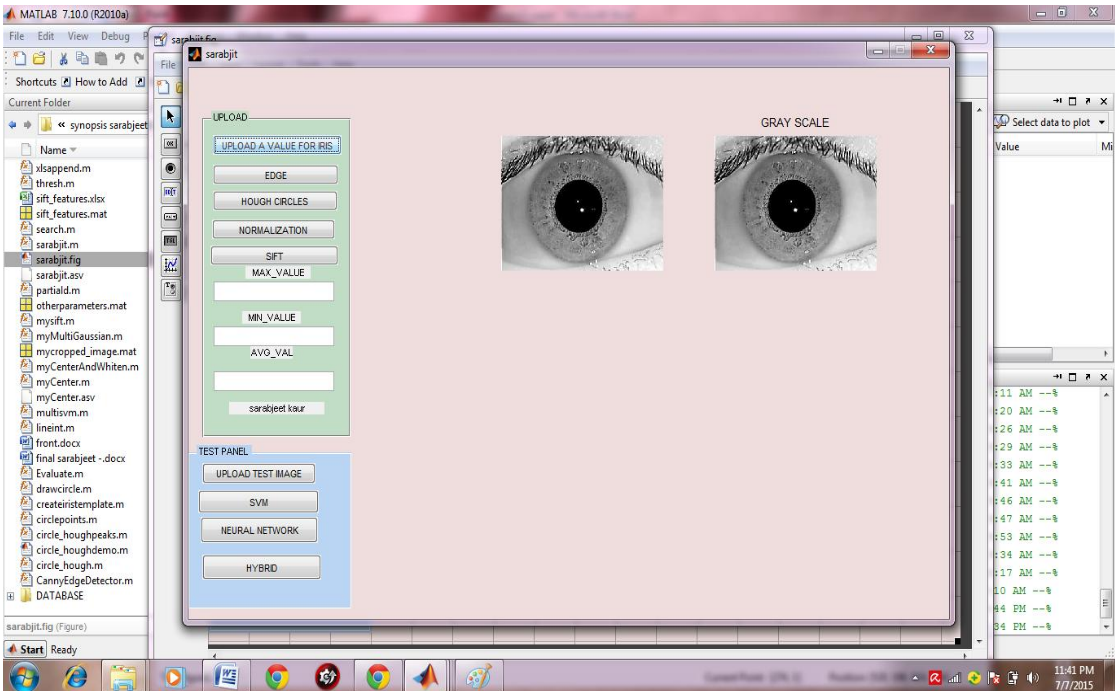

Figure 1 Iris image is uploaded successfully

2.2 Preprocessing

In preprocessing mainly segmentation and normalization is done of iris is done.

2.2.1 *Iris segmentation*

A method is obliged to seclude and prohibit the curios and in addition finding the round iris district.The inward and the external limits of the iris are figured. In segmentation firstly edges are detected by using canny edge detector [15] and the iris is localized by hough circle transform. [15]

Iris Segmentation firstly by using Canny Edge Detector is shown below-

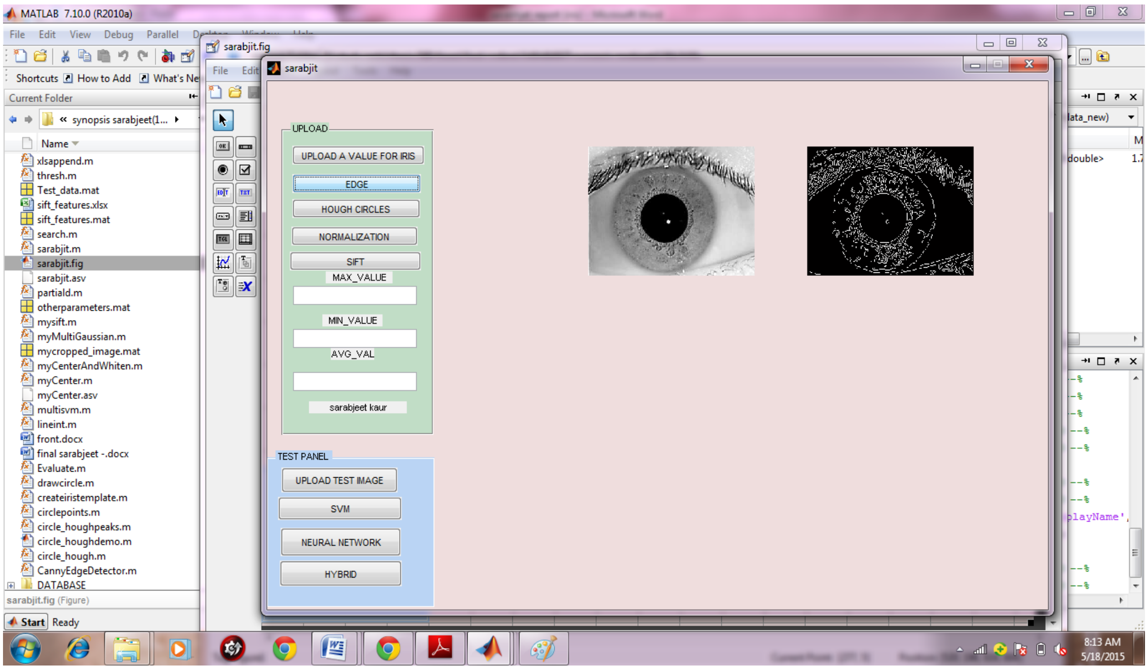

Figure 3 Canny Edge Detector successfully detect the edge

Secondly iris is localized by Hough circle transform is shown below-

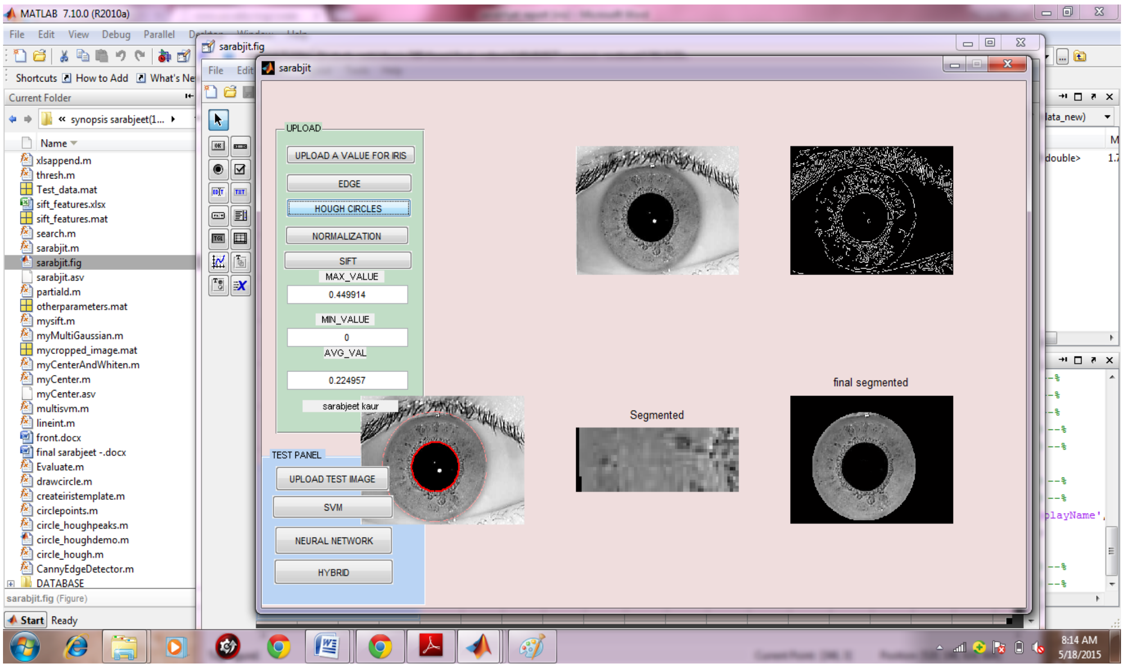

Figure 4 Iris is fully segmented here.

2.2.2 Iris Normalization-

Iris of distinctive individuals may be caught in diverse size, for the same individual additionally size may shift in light of the variety in enlightenment and different variables. The standardization procedure will create iris districts, which have the same steady measurements, so two photos of the same iris under distinctive conditions will have Characteristic highlights at the same spatial area. Below normalization is done by least mean square algorithm.

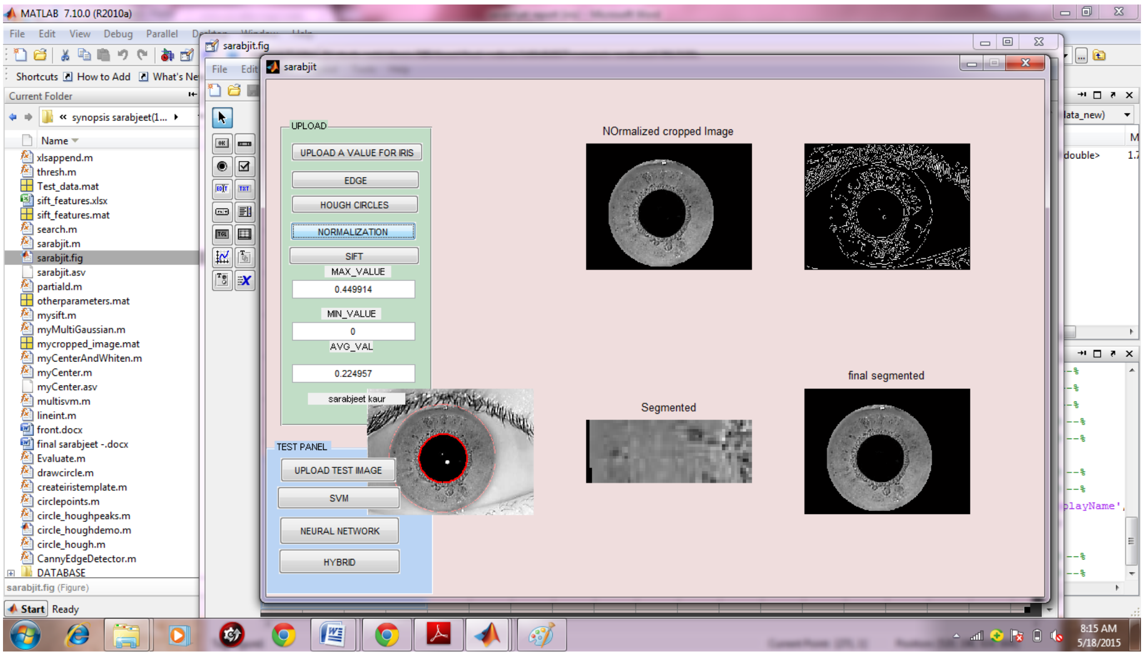

Figure 5 Iris is fully normalized here.

2.3 Feature Extraction Using SIFT Model

The feature extraction of iris is done by using SIFT algorithm. The process of feature extraction includes following steps [14].

a) **Scale-space local extrema detection** : The first step is to build a Gaussian scale space, which is completed by convolving a variable scale 2D Gaussian operator $G(x_1, y_1, \sigma)$ with the input picture $J(y_1, z_1)$:
$M(y_1, z_1, \sigma) = H(y_1, z_1, \sigma) * J(y_1, z_1)$ …..(1)
Difference of Gaussian (DoG) images $E(y_1, z_1, \sigma)$ are then obtained by subtracting subsequent scales in each octave:
$E(y_1, z_1, \sigma) = M(y_1, z_1, k\sigma) - M(y_1, z_1, \sigma)$……………….(2)
where k is a constant multiplicative factor in scale space. Local extrema are then detected by observing each image point in $E(y; z; \sigma)$. A point is decided as a local minimum or maximum when its value is smaller or larger than all its surrounding neighboring points.

b) **Accurate Keypoint Localization:** Once a key point competitor has been found, in the event that it saw to have low contrast (and is along these lines delicate to noise) or on the off chance that it is localized along an edge, it is uprooted because it cannot be dependably recognized again with little variety of perspective or lighting changes. Two thresholds are utilized, one to prohibit low contrast points and other to exclude edge points.

c) **Orientation assignment:** An introduction histogram is shaped from the gradient orientations inside a 16X16 locale around every keypoint. The introduction histogram has 36 bins covering the 360 degree range of orientations. Every specimen added to the histogram is weighted by its gradient magnitude and by a Gaussian weighted circular window centered at the key point. The significant introductions of the histogram are then appointed to the keypoint, so the keypoint descriptor can be spoken to with respect to them, in this way accomplishing invariance to picture rotation.

d) **Keypoint descriptor:** In this stage, a particular descriptor is registered at every keypoint. The picture gradient magnitudes and introductions, with respect to the significant introduction of the key point, are examined inside a 16X16 district around every keypoint. These specimens are then amassed into orientation histograms summarizing the contents over 4X4 sub regions.

e) **Keypoint matching:** Matching between two images I_1 and I_2 is performed by comparing each local extrema based on the associated descriptors. Given a feature point p_{11} in I_1, its closest point p_{21}, second closest point p_{22}, and their Euclidean distances d_1 and d_2 are calculated from feature points in I_2. If the ratio d_1/d_2 is sufficiently small, then point's p_{11} and p_{21} are considered to match. Then, the matching score between two images can be decided based on the number of matched points. According to [7], we have chosen a threshold of 0.76 for the ratio d_1/d_2.

f) **Trimming of false matches:** The keypoint matching procedure described may generate some erroneous matching points. We have removed spurious matching points using geometric constraints [10]. We limit typical geometric variations to small rotations and displacements. Therefore, if we place two iris images side by side and draw matching lines true matches must appear as parallel lines with similar lengths. According to this observation, we compute the predominant orientation Q_P and length l_p of the matching, and keep the matching pairs whose orientation μ and length ` are within predefined tolerances ϵ_Q and ϵ_P so that $|Q - Q_P| < \epsilon_Q$ and $|l - l_P| < \epsilon_l$.

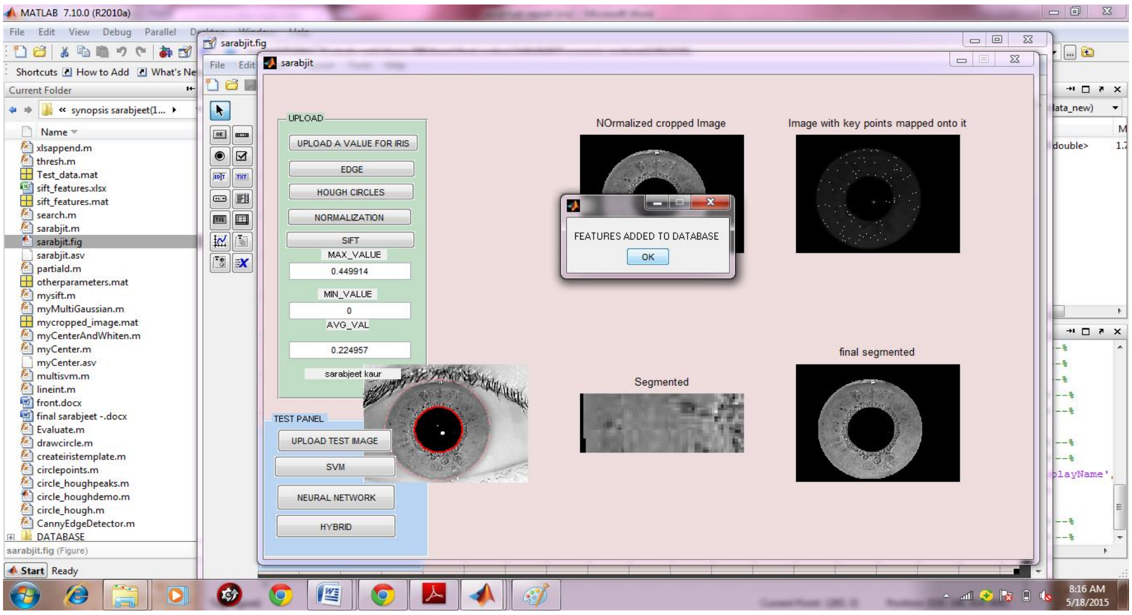

Figure 6 Feature extracted by SIFT

In above figure features are successfully extracted and various key points have been mapped from eye and features are saved to database.

2.4 Classification or matching

Classification of iris template is based on their texture pattern and classifier is used to recognize the given images from database and to authenticate via identification matching (one-to many template matching) or verification (one to- one template matching).To a stored value template in a database a and a template created by imaging the iris is compared

2.4.1 Firstly using SVM

Support Vector Machine (SVM) also called Support Vector Networks are supervised learning models that analyze data and recognize patterns [13]. SVM models represent examples as point in space mapped in manner that separate categories examples are divided by a gap thereby performing linear classification. Apart from this SVMs can also perform nonlinear classification using Kernel trick. The main idea of SVM is that; it finds the optimal separating hyper plane such that error for unseen patterns is minimized. Consider the problem of separating the set of training vectors belonging to two separate classes $x_{1,2} \ldots x_n$ Which are vectors in $\mathbb{R}D$.The features which are obtained from the SIFT algorithm are classified by using this support vector machine (SVM).This algorithm perfectly classifies the features and give the output.

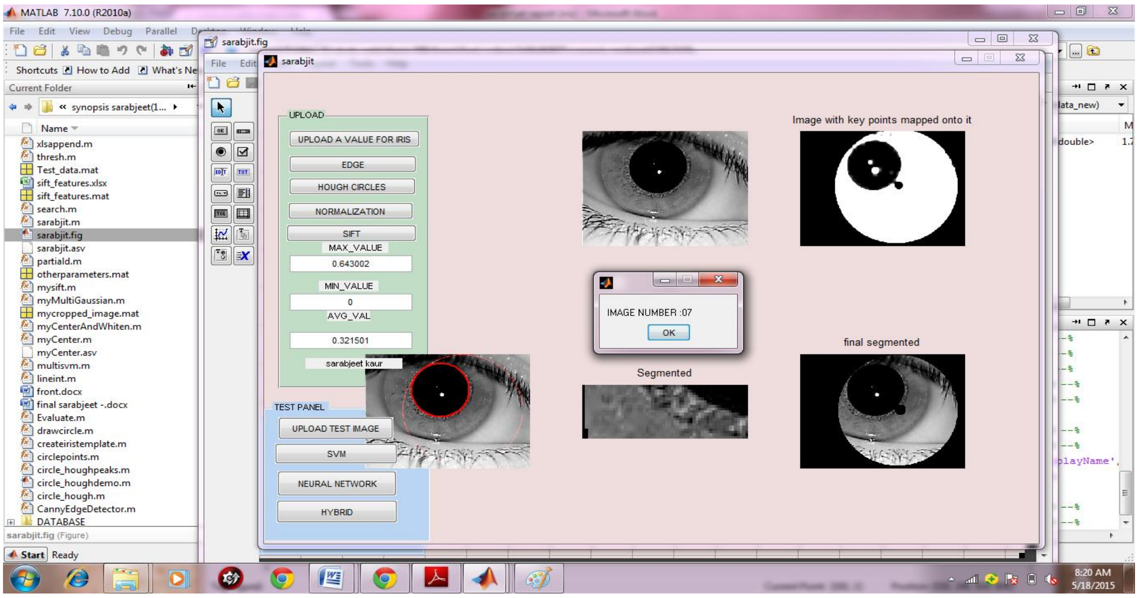

Figure 7 Iris Image matched by SVM

In above figure by clicking on SVM it will display the row number as image number of the iris image with which its features are matched that are stored in the database by sift algorithm.

2.4.2 Secondly Using NN

After classification using SVM then, the classification of the feature vectors will be performed to generate the final matching decision. Neural Network classifier is employed. This is a relatively simple, yet effective, classifier.

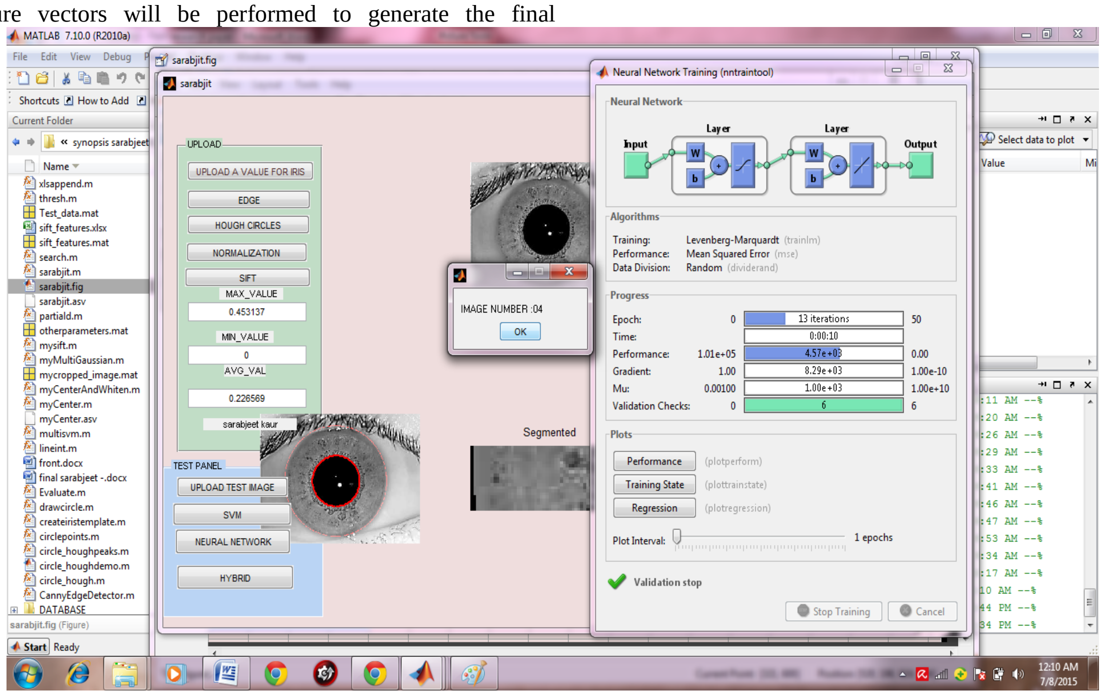

Figure 8 Iris Image matched by NN

In above figure by clicking on Neural network it will display the row number as image number of the iris image with which its features are matched that are stored in the database by sift algorithm

2.4.3 Using both SVM and NN

Both SVM and NN used for classification or matching as hybrid.

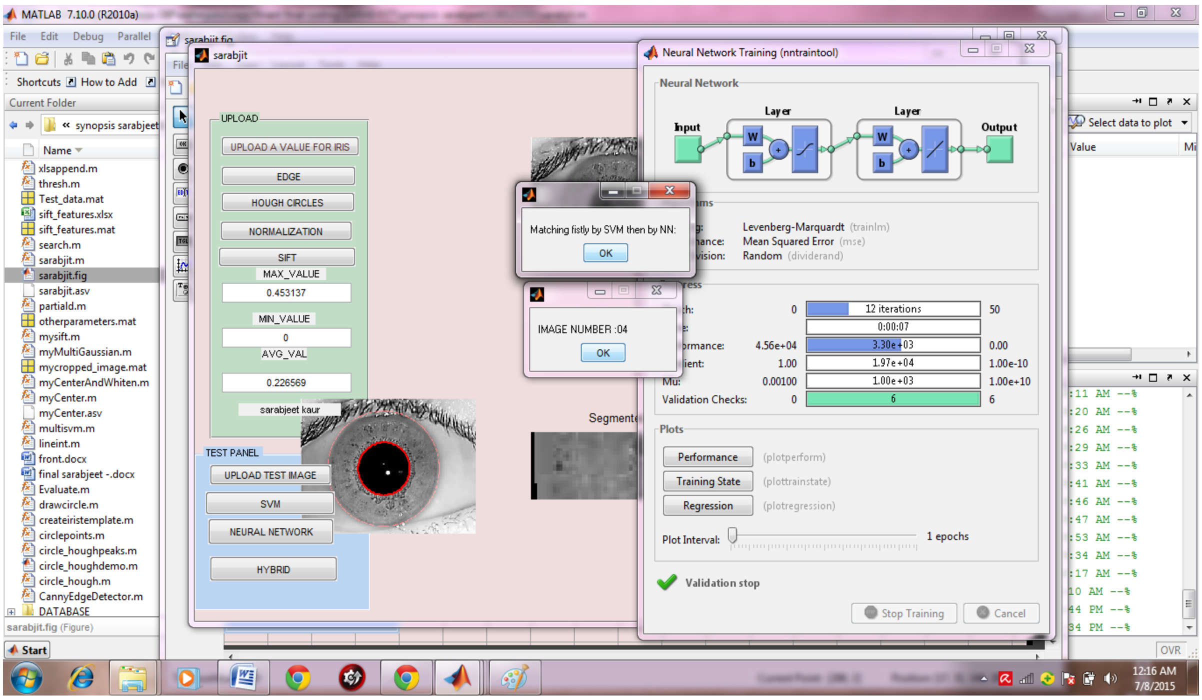

Figure 9 Iris Image matched by HYBRID

In above figure by clicking on HYBRID button it will display the row number as image number of the iris image with which its features are matched that are stored in the database by sift algorithm**.**

3. EXPERIMENTAL RESULTS

3.1 Accuracy

Accuracy mainly measured the performance of the system. How close a measured value is to the actual (true) value is check by accuracy. Or it is the proportion of the total number of predictions that were correct. The measured values are exactly the same as the given values if accuracy is 100%.

Let us discuss the accuracy of the system. There is only the small difference between the accuracy of SVM, NN, HYBRID (SVM+NN).Take randomly the 5 images from images matching from the database of 286 images .Do all the necessary steps and evaluate the accuracy.

TABLE 1- Respective value of accuracy for SVM, NN and HYBRID (SVM+NN)

IMAGE NO.	SVM	NN	HYBRID(SVM+NN)
Image 1	99.94%	99.9%	99.95%
Image 2	99%	99.95%	99.99%
Image 3	27.71%	99.93%	99.97%
Image 4	99.95%	94.9%	99.9%
Image 5	99%	27.47%	99.91%

Above table 1 shows the respective accuracy of images by SVM, NN, and HYBRID. In some cases accuracy is low by SVM, NN but it shows that accuracy of the hybrid is the highest for all the images.

Based on the above comparative values of accuracy in table 1, the graph is generated as follows-

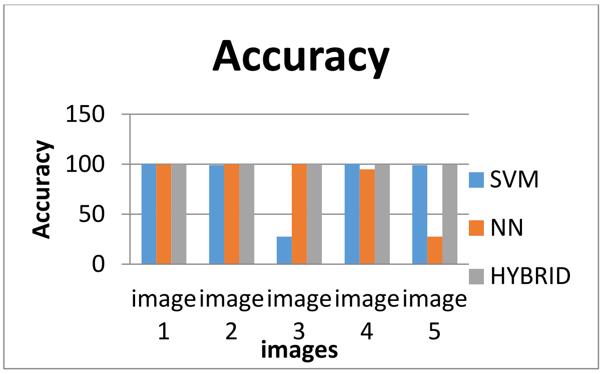

Figure 10 Comparing accuracy of images by SVM, NN and HYBRID (SVM+NN)

Above figure show accuracy comparision of image matching in iris recognition by SVM, NN and HYBRID (SVM+NN). HYBRID (SVM+NN) achieves higher level of accuracy in each case.

3.2 Precision

Precision (P) is the proportion of the predicted positive cases that were correct (also called positive predictive value) or it is the fraction of retrieved instances that are relevant. High precision means that an algorithm returned substantially more relevant results than irrelevant. Let us take randomly 5 images from database and check the precision values

TABLE 2 Respective value of precision for SVM, NN and HYBRID (SVM+NN)

Above table 2 shows the precision values by SVM, NN, HYBRID (SVM+NN) of 5 images after matching. Based on above values now plot the chart.

Image no.	SVM	NN	HYBRID(SVM+NN)
Image 1	1.0015	1.5038	1.7092
Image 2	1.2503	0.9022	1.3536
Image 3	0.2686	0.44067	0.4473
Image 4	1.0311	0.5245	1.2033
Image 5	0.5998	0.8511	1.2147

Based on the above comparative values of precision in table 2, the graph is generated as follows-

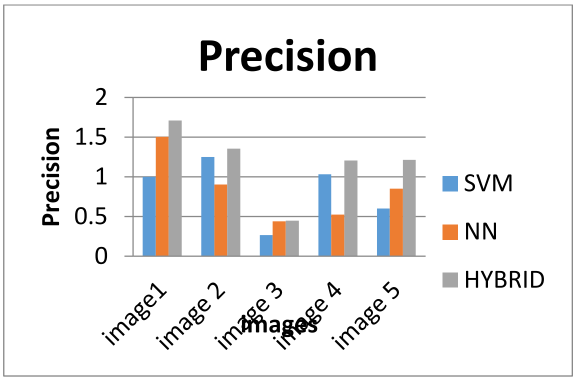

Figure 11 Comparing Precision of images by SVM, NN and HYBRID (SVM+NN)

Above figure shows the precision value of the images by SVM, NN, and HYBRID. Almost HYBRID gives the high value for precision and it will show the predicted positive cases that were correct that are more in HYBRID. A measurement system is valid if it is accurate as well as precisied.As HYBRID will give the high accurate result i.e. it also give précised value high that means it give more relevant result. As a result, the Precision value of HYBRID (SVM+NN) is higher than SVM, NN. Finally the proposed algorithm of the HYBRID (SVM+NN) achieves a higher level of the Precision value rather than the other algorithm.

3.3 False Positive Rate

The false positive rate (or "false alarm rate") usually refers to the expectancy of the false positive ratio. A false positive is an error in which a test result improperly indicates presence of a condition (the result is *positive*), it is not in reality.

Let us discuss the false positive rate by taking 5 images from the database

TABLE 3 Respective value of false positive for SVM, NN and HYBRID (SVM+NN)

Image no.	SVM	NN	HYBRID(SVM+NN)
Image 1	0.7085	0.8553	0.4795
Image 2	0.9136	0.81422	0.7149
Image 3	0.7955	0.5671	0.1252
Image 4	0.9085	0.5728	0.4125
Image 5	0.6542	0.9277	0.5631

Above table shows the respective false positive values of images for the SVM, NN and HYBRID

Based on the above comparative values of false positive rate in table 3, the graph is generated as follows-

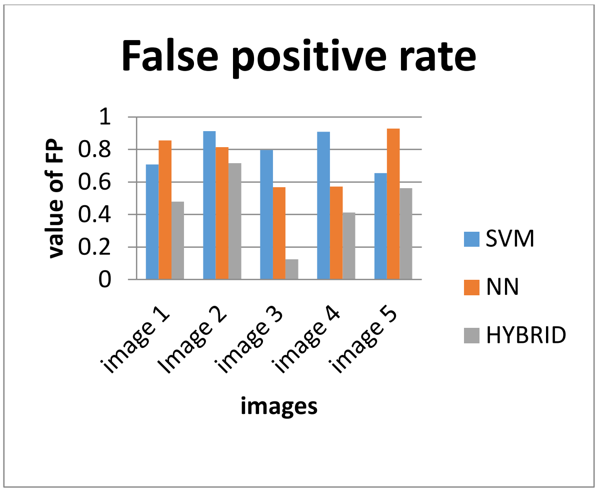

Figure 12 Comparison false positive rate of images by SVM, NN, HYBRID (SVM+NN)

Above fig shows that Hybrid has less false positive rate due to its high accuracy. It shows that hybrid will give high accuracy having low error rate. HYBRID (SVM+NN) achieves lower level of error rate.

4. CONCLUSION AND FUTURE SCOPE

In the proposed system a new technique is generated at feature level for feature extraction and iris verification system to increase the accuracy of the authentication systems i.e 99% accuracy by HYBRID (SVM+NN). In this SIFT features are extracted for iris, then classification of iris templates are done using Neural network and SVM. This proposed method has increases the system performance on the given data set having accuracy 99% and decrease the error rate.

Future works could go in the direction of using more robust modeling techniques against forgeries and hybrid fusion level can be used. Multimodal modalities can be used together to make forgeries more difficult. Also, the system should be tested on a larger database to validate the robustness of the model. In biometrics we have a integer of description which we are using in our acknowledgment technology as fingerprint, palm print, signature, face, iris recognition, thumb sense and so on but among these irises acknowledgment is best technology for recognition of a person.

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