TRJ VOL. 2 ISSUE 4 JULY-AUG 2016 ISSN: 2454-7301 (PRINT) | ISSN: 2454-4930 (ONLINE)
DOI: 10.13140/RG.2.2.22145.45922

Iris Recognition using Feature Extraction Technique (SIFT)

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***Abstract* -** Iris biometrics research is an exciting, broad, and rapidly expanding field. At the same time there are successful practical applications that illustrate the power of iris biometrics, there are also many fundamental research issues to be solved on the way to larger scale and more complex applications. In this research work, iris recognition has been done using Hough Man Circular Transform (HCT), Scale Invariant Feature Transform (SIFT) and Genetic Algorithm(GA) method. Hough Man Circular Transform(HCT) localize the retina, Scale Invariant Feature Transform (SIFT) extract the features of the iris templates and then in the end Genetic Algorithm (GA)reduce the obtained features. The whole simulation is being implement in MATLAB 2010 environment. The performance of the system is evaluated by using with False Acceptance Rate (FAR), False Rejection Rate(FRR) and Recall Rate (RR) parameters.

***Keywords* -** Iris Recognition, Security, Biometrics, Scale Invariant Feature (SIFT), Hough man Circular Transform (HCT).

I. INTRODUCTION

An extensive variety of systems require dependable individual recognition schemes to either confirm or decide the identity of an entity requesting their services. The reason of such schemes is to make sure that the render services are access only by a rightful user, and not anyone else. Example of such applications includes secure access to buildings, computer systems, laptops, cellular phones and ATMs. In the nonexistence of strong personal recognition schemes, these systems are susceptible to the wiles of an impostor [1, 2]. Biometric recognition, or just biometrics, refers to the mechanical recognition of persons based on their physiological and behavioral individuality. By using biometrics it is probable to confirm or establish an individual's identity based on "who she is", rather than by "what she possesses" (e.g., an Identity Card) or "what she remembers" (e.g., a password). In this document, give a concise impression of the field of biometrics and summarize some of its compensation, disadvantage, strengths, limitations, and linked isolation concerns [3, 4].

Substitute representations of identity such as passwords and ID cards are not sufficient for reliable identity determination because they can be easily misplaced, shared, or stolen. Biometric recognition is the science of establishing the identity of a person using his/her anatomical and behavioral traits. Commonly used biometric traits include fingerprint, face, iris, hand geometry, voice, palm print, handwritten signatures [5, 6, 7, 8]. Three features that influenced the increased interest in the biometric are as follows: 1) public acceptance; 2) new user-friendly capture devices with broad improved capabilities; and 3) a broadened range of applications. But the main issue of all authentication systems is that it must have, high accuracy rate and low error rate. So it can only be achieved by using SIFT feature extraction for Iris, then for feature reduction genetic algorithm is applied and features are reduced. That's why proposed algorithm is based on this algorithm along with some preprocessing on CASIA dataset. During feature extraction process, we employ feature extraction method to get feature vectors. In addition to this, we will be propose a local feature extraction method to reduce the amount of data using GA and improve performance.[9, 10].

II. HOUGHMANCIRCULARTRANSFORMATION (HCT)

The Hough transform can be applied to detect the presence of a circular shape in a given image. It is being utilized to discover any figure or else to find the iris in the human being's face[15]. The characteristic equation of a circle of radius r and centre (a, b) is given by:

$$(x-a)^2 + (y-b)^2 = r^2 \quad (1)$$

This particular circle could possibly be illustrated through the two of subsequent equations:

$$x = a + r \cos (Q)$$
$$y = b + r \sin (Q) \quad (2)$$

Thus, the role of the Hough transform is to search for the triplet of parameters (a, b, r) which determines the points. Two cases may be presented as described:

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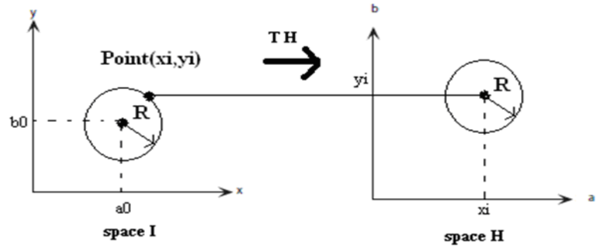

Fig. 1 Hough Transformation

A. Case of Known Radius

If we know the radius of the circle to be detected in the actual picture, the real parameter so that to search is reduced in the direction of a pair (a, b) and the H space is two-D. We deliberate a circle of radius R_1 as well as centre (a, b), the transformation for each point (x, y) in space I yields a circle in space H having a centre x, y and radius R.

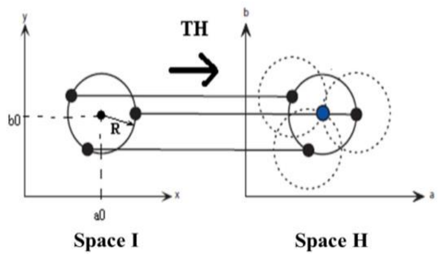

Fig. 2 Detection of Circle

Similarly, we transform all points of the circle in picture. The end result will be more circles where their intersection is the point (a, b). This point is obtained by searching the maximum of the accumulator.

A.*Case of Unknown Radius*

In this case, the work consists to find the triplet parameters (a, b, r) which define the points of the circle to discover. The space will be available in 3D.

For each point(x, y) of the space I will match a cone in space H, as the radius r varity from 0 to an actual given value. After transforming of all points of contour in the equivalent way, the intersection will able to provide a spherical surface corresponding to the maxim of accumulator. The area is characterized by a center (a,b) and the radius r searched.

III. SCALE INVARIANT FEATURE TRANSFORM (SIFT)

Scale Invariant Feature Transform (SIFT) was proposed by David Lowe [11] that has the capacity to distinguish and depict neighborhood picture elements positively. SIFT extract the so many features but some features are :

- Edges
- Intersect point
- Blobs
- Ridges

A. Edges

The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.

B. Intersect point

An interest point is a point in the image which is general can be characterized. Intersect point is a well-defined position in image space.

C. Blobs

A blob is a region of an image in which some properties are constant or approximately constant. All the points in a blob can be considered in some sense to be similar to each other.

D. Ridges

A ridge is a curved line in a finger image. Some ridges are continuous curves and some ridges terminate at specific points called ridge endings. When two ridges come together at a point called a bifurcation. Ridge endings and bifurcations are known as minutiae.

The necessary SIFT appraisal comprises of five noteworthy stages:

A. *Scale-space local extreme detection*
B. *Key-point localization*
C. *Orientation assignment*
D. *Key-point descriptor*
E. *Trimming of false matches*

The accompanying sub-segment will portray every stage.

A. Scale-space Local Extreme Detection

The first step of keypoint detection involves identification of locations that can be assigned with a change in view as well as change in scale. In such locations, which are invariant towards scale changes, are found by searching stable features across all the possible scales using scale space that is a continuous function of scale [20]. Gaussian function is the only possible scale space function. For that reason the scale space of picture is well-defined as, 2D Gaussian operator G (a_1, b_1, σ) with the i/p picture J (a_1, b_1): $L(a1, b1, \sigma) = G(a_1, b_1, \sigma) * J(a_1, b_1)$ (3)

Where $J(a_1, b_1)$ is the input image and $*$ is the convolution operation in a1 and b1. G (a_1, b_1, σ) is the variable scale Gaussian defined as

$$G(a_1, b_1, \sigma) = (1/ 2\pi\sigma^2)\, e^{(-a12 + b12)/2\sigma 2} \quad (4)$$

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Difference of Gaussian (DoG)function is convolved with the image to detect stable key-point locations. For two nearby scales of an iris image J, the Difference of Gaussian (DOG) is computed as of images are:

$$D(a1, b1, \sigma) = (G(a1, b1, k\sigma) - G(a1, b1, \sigma)) * J(a_1, b_1)$$

$$= L(a1, b1, k\sigma) - L(a1, b1, \sigma) \quad (5)$$

Where k is a constant multiplicative factor in scale space that is used for changing the scale and a1, b1 are the coordinates of a pixel in image J. Nearby extremes are then recognized by watching each image point in J (a1; b1; σ). A point is decided as a local minimum or maximum when its value is smaller or larger than all its surrounding neighboring points. This technique is scale invariant, hence is appropriate for annular iris images as the dimension of iris varies due to dilation and contraction of the pupil [42].

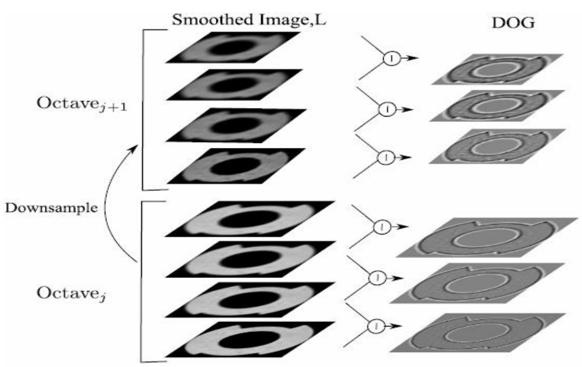

Fig. 3. Detection of scale space extreme

B. Accurate Key-point Localization

To detect the importance points, DOG pictures are utilized also local maxima as well as local minima are computed across different scales. Each pixel of a DOG image is compared to 8 neighbors in the same scale and 9 neighbors in the neighboring scales.

After keypoint detection, the next step is performing the detailed fit to the adjoining data intended for location, the proportion of principal curve as well as the scale. The basic idea behind this is to reject all those keypoints which are low in contrast. These low contrast keypoints are not considered because as stated in, such keypoint are sensitive to noise or badly limited to a small area. 3D quadratic operator is fixed in the direction of local keypoint in order to determine the interpolated location of maximum. The authors have used Taylor expansion of the scale space function, D_m (a1, b1, σ) shifted so that the origin lies at the sample point

$$D_m(z) = D + (\partial^2 D_m^{-1} / \partial z^2) * (\partial D_m / \partial z) \quad (6)$$

WhereD_m and its derivatives are calculated at the sample point and $z=(a1, b1, \sigma)^T$ is an offset from this point. The location of extremum (z) is obtained by taking the derivative of this function with respect to x and set the situation towards zero, accordingly giving

$$z = (-\partial^2 D^{-1} / \partial z^2) * (\partial D / \partial z \quad (7)$$

The offset is compared to a predefined threshold and if it is larger, then it implies that z is close to some different sample point. In this case sample point is changed and interpolation is performed about that point. The final offset is then added to the sample point to get the interpolated location of extremum.

C. Orientation Assignment

To attain invariance to picture rotations, an orientation is allocated towards each and every one of the key-point localities. The descriptor could possibly be represented comparative to this orientation. For determination of the keypoint orientation, a gradient orientation histogram is worked out in the neighborhood of the keypoint. A Gaussian smoothed image L_1 is selected using the scale of a particular key-point. On behalf of a Gaussian smoothed picture L_1 (a, b), magnitude (m(a, b)) and orientation (θ(a, b)) are calculated as

$$m(x, y) = \sqrt{\left(L_1(x+1, y) - L_1(x-1, y)\right)^2 + \left(L_1(x, y+1) - L_1(x, y-1)\right)^2} \quad (8)$$

$$\theta(x,y) = \tan^{-1}\left(\frac{(L(x,y+1) - L(x,y-1))}{(L(x+1,y) - L(x-1,y))}\right) \quad (9)$$

This is followed by formation of the orientation histogram for gradient orientation around each of the particular key-points. The actual histogram encompasses 36 bins designed for 360 orientations and before adding it to the actual histogram, each and every example is weighted by means of gradient magnitude and Gaussian weighted circular frame, by means of σ of 1.5 times the scale of actual key-point. Peaks in histogram correspond to the orientations.

D. Key-Point Descriptor

In this stage, a particular descriptor is registered at every key-point. The picture gradient magnitudes and introductions, with respect to the significant introduction of the key point, are

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inspected inside a 16X16 locale around every key-point. These specimens are then amassed into orientation histograms summarizing the contents over 4X4 sub regions.

E. Trimming of False Matches

The key-point matching procedure described may generate some erroneous coordinating focuses. We have evacuated spurious coordinating focuses using geometric limitations. We constrain ordinary geometric varieties 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 QP and length lp of the matching, and keep the matching pairs whose orientation µ and length ` are within predefined tolerances ϵQ and ϵP so that $|Q - QP| < \epsilon Q$ and $|l - lP| < \epsilon l$.

IV. GENETIC ALGORITHM

The genetic algorithm is a replica of machine learning which follows its actions as of metaphor process of development in nature. This is completed by the formation inside a machine of a population of individuals shown by chromosomes by a set of character strings which are similar to the base-4 chromosomes. The person in the inhabitants departs during an evolution process .Evolution is not considered or directed process. Mean, there is no confirmation to hold up the declaration that the objective of development is to create Mankind[16].

Genetic algorithm has mainly three operators;

1. Selection, I which selection of chromosome is done.
2. Mutation, in which two chromosomes gets mutated to generate child.
3. Crossover, to apply new changes.

Genetic Algorithm Various Phases:

Step 1:At random, produce an initial population M (0).

Step 2:Compute as well as help save the actual fitness f (m) for every specific individual m in the current population M (t);

Step 3:Specify selection probabilities p (m) for every specific individual m throughout M (t) making sure that p (m) is actually proportional to f (m).

Step 4:Crank out M (t+1) by simply probabilistically choosing individuals from M (t) to produce offspring via genetic operators.

Step 5:Repeat step 2 until satisfying solution is actually attained.

V. OBJECTIVE

1. To study the various biometrics available in the literature and characteristics related to iris for recognition.
2. To extract ROI using various segmentation techniques.
3. To extract features from iris image using Scale Invariant Feature transform (SIFT).
4. To select feature of the iris image using Genetic Algorithm.
5. Match the feature using Genetic Algorithm and evaluate the performance of the system.

VI. METHODOLOGY

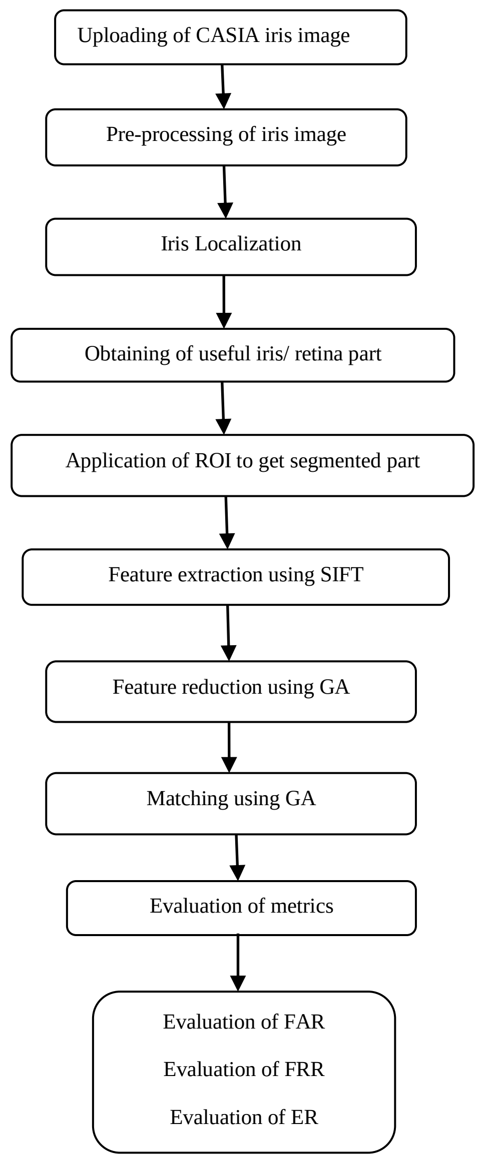

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Fig.5.1 Proposed work Flowchart

Step 1. Pre-processing of Iris Image

a) Pre-processing can convert original image into gray image. In pre-processing we use edge detection for finding the edge image to extract the iris part from the eye image.
b) For preprocessing is binarization is used. Conversion of unassigned 8 bit data into 0 and 1 form in Binarization. Black and white image appears after that. After the binarization , the image is in the form of 0 & 1. Then the edges are discovered of the image using "edge" command by canny technique. We use in this format edge (I,'canny',thresh) specifies sensitivity thresholds for the Canny method.

Step 2. Iris Localization

The acquired iris image has to be preprocessed to detect the iris, which is an annular portion between the pupil (inner boundary) and the sclera (outer boundary). The first step in iris localization is to detect pupil which is the black circular part surrounded by iris tissues. The center of pupil can be used to detect the outer radius of iris patterns. The important steps involved are:

A. Pupil detection

B. Outer iris localization

A. Pupil Detection

The iris image is converted into grayscale to remove the effect of illumination. As pupil is the largest black area in the intensity image, its edges can be detected easily from the binarized image by using suitable threshold on the intensity image. But the problem of binarization arises in case of persons having dark iris. Thus the localization of pupil fails in such cases. In order to overcome these problems Circular Hough Transformation for pupil detection can be used. The basic idea of this technique is to find curves that can be parameterized like straight lines, polynomials, circles, etc., in a suitable parameter space. The transformation is able to overcome artifacts such as shadows and noise.

B. Outer Iris Localization

External noise is removed by blurring the intensity image. But too much blurring may dilate the boundaries of the edge or may make it difficult to detect the outer iris boundary, separating the eyeball and sclera. Thus a special smoothing filter such as the median filter [8] is used on the original intensity image. This type of filtering eliminates sparse noise while preserving image boundaries. After filtering, the contrast of image is enhanced to have sharp variation at image boundaries using histogram equalization of different radii from the pupil center and the intensities lying over the perimeter of the circle are summed up. Among the candidate iris circles, the circle having a maximum change in intensity with respect to the previous drawn circle is the iris outer boundary. Figure shows an example of localized iris image.

Step 3. Obtaining Useful Iris

The iris image should be rich in iris texture as the feature extraction stage depends upon the image quality and accurate extraction of iris area from image. High resolution and good sharpness: It is necessary for the accurate detection of outer and inner circle boundaries. Good lighting condition: The system of diffused light is used to prevent spotlight effect.

Step 4.Application of ROI using Segmentation Techniques

For improvement in the recognition rate we need to extract the feature of iris but there are problem during feature extraction of iris. When segmentation of iris is not well then we cannot extract more features. So for feature extraction and improvement in recognition rate of proposed system we need to segment proper area of iris.

Step 5.Feature Extraction using SIFT

After the ROI to find the feature of segmented iris. So for feature extraction use Scale-invariant feature transform (SIFT). SIFT is an image descriptor for image-based matching and recognition developed by David Lowe. This descriptor as well as related image descriptors is used for a large number of purposes in computer vision related to point matching between different views of a 3-D scene and view-based object recognition. The SIFT descriptor is invariant to translations, rotations and scaling transformations in the image domain and robust to moderate perspective transformations and illumination variations. Experimentally, the SIFT descriptor has been proven to be very useful in practice for image matching and object recognition under real-world conditions. The SIFT descriptor was computed from the image intensities around interesting locations in the image domain which can be referred to as interest points, alternatively key points.

Step 6 Feature Reduction and Matching using GA

Firstly load all extracted feature point for the feature reduction process. Before applying Genetic Algorithm to initialize the GA basic function using 'optimset' function like population size, mutation function, crossover etc. After that we use 'ga' function for feature reduction according to the fitness function. Fitness function set according to our requirement like which type of feature we can use for classification purpose. Genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based

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on a natural selection process that mimics biological evolution. The algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm randomly selects individuals from the feature vector.

VII. RESULTSANDDISCUSSION

The whole simulation is being done in MATLAB environment to build the iris recognition system. In proposed work various techniques has been compared with recent one using FAR as well as FRR.

False Accept Rate (FAR**):**FAR is the type of error in the pattern recognition system which is measured by:

$$FAR = \frac{TotalNumberofFeatures - TotalNumberofFalselyAcceptedFeatures}{TotalNumberofFeatures}$$

False rejection rate (FRR):The percentage of times a valid user is rejected by the system. Its formula is given as:

$$FRR = \frac{TotalNumberofFeatures - TotalNumberofFalselyRejectedFeatures}{TotalNumberofFeatures}$$

Accuracy: Accuracy is a general term used to describe how accurate a biometric system performs. Its formula is given as:

$$Accuracy = 100 - (FAR + FRR)$$

Using Euclidean Distance we check the test feature data matching ratio with dataset features. After that we observed that test image features matched with 3rd number of dataset features. But some feature point different from dataset feature so we calculate FAR and FRR.

TABLE : 1 Comparison with Previous Methods

Author	FAR	FRR
Wildes [12]	2.4	2.9
Avila[13]	0.03	2.08
Tisse[14]	1.94	8.79
Proposed	0.77	0.94

VIII. CONCLUSION AND FUTURE SCOPE

In this work, we have focused on iris biometrics. The reasons for selecting this is that iris is acceptable personally, socially and legally as an identification procedure.In this work, iris biometric system is developed using GAand SIFT feature extraction method. GA was used to optimize SIFT result. The results show that the proposed biometric system leads to better security than the existing unimodal biometric identification systems as the FAR and FRR values have decreased and accuracy has increased.The efficiency of authentication system can be further increased using more modalities for fusion. In future, work can be done to remove the complexity of multimodal biometrics and to remove the errors. Other classification and optimization techniques can be opted to get the same. There is scope for further improvement in feature extraction also. Improved or advance algorithms can be adopted to get better and clear features.

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