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VIDEO BASED PROCESS FOR IRIS RECOGNITION AND IMPROVING ACCURACY FOR THE SYSTEM

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Abstract- **Iris recognition is one of the most promising biometric procedures with business scope in government and industrial areas. It presents more effective performance, which is reliable than other methods such as speech, facial or fingerprint recognition. Iris recognition uses iris patterns for personnel identification. It is characterized by stability and discrimination power. Each human have unique iris pattern and its unchanging texture provides a reliable status for analyzing and increasing the pattern identification of a specific individual. In this paper, a video based project is being done in which the segmentation and normalization process is carried out for improving accuracy in iris recognition system. The noises like eyelids, eyelashes, reflections are being removed for getting more accuracy. MATLAB® is used for system implementation and validation. The images database digitized in grayscale CASIA v.2.0 is used, where coding and processing through segmentation algorithms is implemented using Gabor filters and Hough Transform. With reference algorithms such as Hough Transform and model approaches such as Daugman's Rubber sheet model, contributes correct operation to the system. This system provides 99.87% accuracy compare to existing system.**

Keywords –*Codification, Daugman's Rubber sheet model, Eyelash detection, Image processing, Iris Recognition, Normalization, Segmentation.*

1. INTRODUCTION

Iris recognition is to isolate the actual iris region in a digital eye image. The iris region can be approximated by two circles, one for the iris/sclera boundary and other for the iris/pupil boundary. The eyelids and eyelashes normally occlude the upper and lower parts of the iris region. Also, specula reflections can occur within the iris region corrupting the iris pattern. A technique is required to isolate and exclude these artifacts as well as locating the circular iris region. Biometrics was developed with the aim of improving the overall level security in all society contexts. Iris recognition is one of the most promising procedures with business scope in government and industry areas. Iris Biometrics is characterized by high stability and discrimination power, since iris is dissimilar for each human. Its texture provides a reliable status for analysis, increases the pattern identification of a specific individual.

A biometric system describes a set of techniques to analyze certain individual's iris features, store and then using those patterns to identify or verify the identity of a person. The objective will be to implement an open-source iris recognition system in order to verify the claimed performance of the technology. The development tool used will be MATLAB®, and emphasis will be only on the software for performing recognition. MATLAB® provides an excellent RAD environment, with its image processing toolbox, and high level programming methodology. This system is to be composed of a number of sub-systems, which correspond to each stage of iris recognition. These stages undergo segmentation, in which the image is being given as input and gray scale conversion gives gray scaled image. The set of pixels containing only the iris, normalized by a rubber-sheet model to compensate for pupil dilation or constriction, is then analyzed to extract a bit pattern encoding the information needed to compare two iris images. Iris images are selected from the CASIA (Chinese Academy of Sciences - Institute of Automation) Database, for detecting the iris and pupil boundary from rest of the eye image by removing the noises. Here mainly the eyelashes, eyelids, reflections are the noises which is being removed. The segmented iris region was normalized to minimize the dimensional inconsistencies between iris regions by using Daugman's Rubber Sheet Model. The features of the iris were encoded by convolving the normalized iris region with 1D Log-Gabor filters and phases quantizing the output in order to produce a bit-wise biometric template. The Hamming distance was used as a matching metric, which gives the measure of how many bits disagreed between the templates of the iris image**.**

2. RELATED WORKS

2.1 Iris recognition using circular symmetric filters.

The Hough transform is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects, such as lines and circles, present in an image. The circular Hough transform can be employed to deduce the radius and centre coordinates of the pupil and iris regions. An automatic segmentation algorithm based on the circular Hough transform is employed by Wildes et al. [19], First of all, an edge map is generated by calculating the first derivatives of intensity values in an eye image and then thresholding the result. From the edge map, votes are cast in Hough space for the parameters of circles passing through each edge point [12]. A maximum point in the Hough space will correspond to the radius and centre coordinates of the circle best defined by the edge points. The motivation for this is that the eyelids are usually horizontally aligned, and also the eyelid edge map will corrupt the circular iris boundary edge map if using all gradient data.

2.2 Location of the pupil-iris border in slit-lamp images of the cornea

Ritter et al. [17] make use of active contour models for localizing the pupil in eye images. Active contours respond to pre-set internal and external forces by deforming internally or moving across an image until equilibrium is reached. The contour contains a number of vertices, whose positions are changed by two opposing forces, an internal force, which is dependent on the desired characteristics, and an external force, which is dependent on the image [4]. Each vertex is moved between time t and t + 1. In order to improve accuracy Ritter et al. use the variance image, rather than the edge image. In Nicola Ritter [17], A point interior to the pupil is located from a variance image and then a discrete circular active contour (DCAC) is created with this point as its centre.

2.3 Accurate iris segmentation based on novel reflection and eyelash detection model.

Kong and Zhang [23] present a method for eyelash detection, where eyelashes are treated as belonging to two types. They are separable eyelashes and multiple eyelashes. Separable eyelashes are isolated in the image. Multiple eyelashes are bunched together and overlap in the eye image. Separable eyelashes are detected using 1D Gabor filters, since the convolution of a separable eyelash with the Gaussian smoothing function results in a low output value. Thus, if a resultant point is smaller than a threshold, then it is noted that this point belongs to an eyelash.

2.4 Authentication for secure environments based on iris scanning technology

The homogenous rubber sheet model devised by Daugman [20] remaps each point within the iris region to a pair of polar coordinates (r,θ) where r is on the interval [0,1] and θ is angle $[0,2\pi]$. The remapping of the iris region from (x,y) Cartesian coordinates to the normalized non-concentric polar representation. The rubber sheet model takes pupil dilation and size inconsistencies in order to produce a normalized representation with constant dimensions. Modeling is being done in iris recognition as a flexible rubber sheet anchored at the iris boundary with the pupil centre as the reference point.

2.5 Recognition of Human Iris Patterns for Biometric Identification

The Hamming distance gives a measure of how many bits are the same between two bit patterns. Using the Hamming distance of two bit patterns, a decision can be made as to whether the two patterns were generated from different irises or from the same one[13]. In comparing the bit patterns X and Y, the Hamming distance, HD, is defined as the sum of disagreeing bits (sum of the exclusive-OR between X and Y) over N, the total number of bits in the bit pattern. Since an individual iris region contains features with high degrees of freedom, each iris region will produce a bit-pattern which is independent to that produced by another iris, on the other hand, two iris codes produced from the same iris will be highly correlated. If two bits patterns are completely independent, such as iris templates generated from different irises, the Hamming distance between the two patterns should equal 0.5.

3. OBJECTIVE AND OVERVIEW OF THE PROPOSED MECHANISM

A) OBJECTIVE

The mainstay of the project is to the segmentation and normalization process for automatic biometric iris recognition system. The system is to be composed of a number of sub-systems, which correspond to each stage of iris recognition. These stages undergoes segmentation in which image is being given as input. The gray scale conversion gives gray scaled image has a set of pixels containing only the iris, normalized by a Daugman‘s rubber-sheet model to compensate for pupil dilation or constriction. Image is to be analyzed to extract a bit pattern encoding the information which is compared with two iris images. The phase data from 1D Log-Gabor filters was extracted and quantized to four levels to encode the unique pattern of the iris into a bit-wise biometric template. The Hamming distance was employed for classification of iris templates.

B) OVERVIEW OF THE PROPOSED MECHANISM

The system is to be composed of a number of sub-systems, which have each stage of iris recognition. These stages undergoes segmentation and the image is being given as input - gray scale conversion gives gray scaled image – The set of pixels containing only the iris, normalized by a rubber-sheet model to compensate for pupil dilation or constriction, is then analyzed to extract a bit pattern encoding the information needed to compare two iris images. The work presented in this paper involved developing an 'open-source' iris recognition system in order to verify both the uniqueness of the human iris and also its performance as a biometric. For determining the recognition performance of the system two databases of digitized grayscale eye images were used. The iris recognition system consists of an automatic segmentation system that is based on the Hough transform, and is able to localize the circular iris and pupil region, occluding eyelids and eyelashes, and reflections. The extracted iris region was then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies. 1D Log-Gabor filters was extracted and quantized to four levels to encode the unique pattern of the iris into a bit-wise biometric template. The development tool used will be MATLAB®, and emphasis will be only on the software for performing recognition. MATLAB® provides an excellent RAD environment, with its image processing toolbox, and high level programming methodology.

4. IRIS SEGMENTATION

The segmentation stage is the effective region in which features are extracted. Segmentation techniques are done by different algorithms or other various methods of objects in a digital image to form recognition. In this process the iris region is isolated in digital image and the circles are being approximated on the edges or borders of both the iris and pupil region. The first step of iris recognition system is to isolate the actual iris region from the captured digital eye image. The eyelids and eyelashes normally obstruct the upper and lower parts of the iris region, light reflections occur within the iris region which can corrupt the iris pattern and hence a technique is required to isolate or to exclude these artifacts as well as for locating the circular iris region. So in proposed system, the eyelashes and eyelids are removed by circular Hough transform technique. For iris and pupil parameters detection, binarized image is created by applying an edges detector to the original image and later the detection method of circles is being used [4].

A. Edge Detection

The edge detection involves in edge mapping .These involves four phases, the first phase is the image enhancement, the second phase is done by using the *Canny* algorithm based on the first derivative operators theory, which extracts the edges and close the image contours to avoid possible breaches, the third phase is the elimination of the non maximums and the last phase is Thresholding Edges.

Phase 1:

The image enhancement is done by an intensity functions that acts independently pixel by pixel, changing its intensity value. This can be done by gamma correction to compensate the pronounced intensity variations of the image quality and facilitating its further analysis and processing. Since the intensity curve slope is close to zero (absolute black) for pixels is much less than the slope value for pixels near 255 (absolute white).In fig(1) the gray scaled image is being obtained.

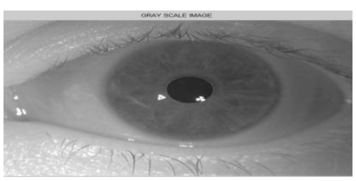

Fig 1: Gray scaled image

Pixels at pupil boundary should be strong edged pixels; hence in order to obtain strong edged pixels, Sobel filters is used in horizontal as well as vertical directions, which are applied in eq.1 on giving the gradient images Igh and Igv respectively. Gradient images Igh and Igv are combined to generate gradient magnitude image Ig as in eq.1,

$$I_g(x,y)=(I^2_{gh}(x,y)+I^2_{gv}(x,y))^{½} \quad - (1)$$

B. Canny Edge Detection

Histogram-stretching is done so that the image is being used in the entire gray-scale. This step may not be necessary, but it is included to compensate for automatic light adjustment in web camera [1,24]. The Canny Edge Detection Algorithm is an important algorithm which runs in 5 separate steps as follows:

1. **Smoothing**: Done to remove the noise by blurring the image.
2. **Finding gradients**: Wherever the gradients of the image have large magnitudes, there the edges should be marked.
3. **Non-maximum suppression**: Local maxima should be marked as edges.
4. **Double thresholding**: Potential edges are determined by thresholding.
5. **Edge tracking by hysteresis**: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

Phase 2:

By using the canny algorithm, based on the first derivative of operator's theory, the edges are extracted and the image contours are being closed to avoid possible breaches.

Smoothing

It is inevitable that all images which are taken from a camera will contain some amount of noise. It may cause mistaken for edges so those noise must be reduced. Therefore the image is first smoothed by applying a Gaussian filter in Fig 2

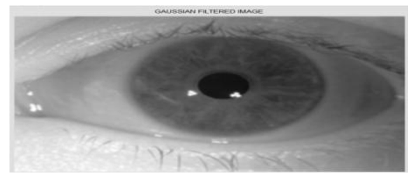

Fig 2: Gaussian filtered image

B) Finding gradients

The Canny algorithm finds edges, where the grayscale intensity of the image changes the most. These areas are being founded by determining gradients of the image. Gradients at each pixel in the smoothed image are determined by applying the Sobel-operator. The gradient magnitudes (also known as the edge strengths) can then be determined as an Euclidean distance measure by applying the law of Pythagoras. The Euclidean distance measure is applied to the test image in eq.2,

$$G(i,j) = e^{-(i2+j2)/2\sigma 2} \quad -(2)$$

Fig 3: X-gradient image

Phase 3:

Elimination of non maximums. Here the magnitude image and the gradient direction is given as a new output image I_N, in which four directions are being considered. They are d1, d2, d3 and d4 corresponding to the orientations of 0°, 45°, 90° and 135° with respect to horizontal axis, whereby it is necessary for each pixel as shown in Fig 3 and 4.

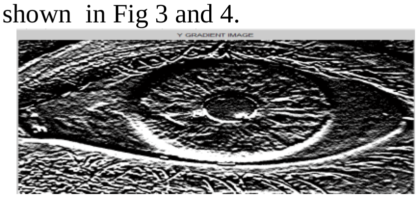

Fig 4: Y-gradient image

C. Non-maximum suppression

The purpose of non-maximum suppression is to convert the blurred edges in the image of the gradient magnitudes to sharp edges. This is done by preserving all local maxima in the gradient image, and deleting everything else. The algorithm is for each pixel in the gradient image:

1. Firstly round the gradient direction to nearest 45◦, with corresponding to the use of an 8-connected neighborhood.

2. Then compare the edge strength of the current pixel with the edge strength of the pixel in the positive and negative gradient direction. i.e. if the gradient direction is north (θ=90◦), thereby comparing with the pixels to the north and south.

3. If the edge strength of the current pixel is large, then preserve the value of the edge strength.

If not, suppress (i.e. remove) the value. Almost all pixels have gradient directions pointing to north. Therefore they are compared with the pixels which are above and below. The pixels that turn out to be maximal value in this comparison are marked with white borders in Fig 5. All other pixels will be suppressed.

First of all each element of the gradient angle array approaches to 0°, 45°, 90° or 135°. The provided value are kept in the intervals as follows: 0° (0° – 23.5° and 158.5° – 180°), 45° (23.5° – 68.5°), 90° (68.5° – 113.5°), 135° (113.5° –158.5°). If the nearby neighbors are present then, the matrix gradient magnitude will be greater than the pixel *A(i,j)* which implies that the position will be a maximum in that point, so it is being assigned to zero value of the pixel *A (i, j) = 0*, if the value is greater or equal than the gradient, the value of the pixel will remain equal and the response will be obtained[4].

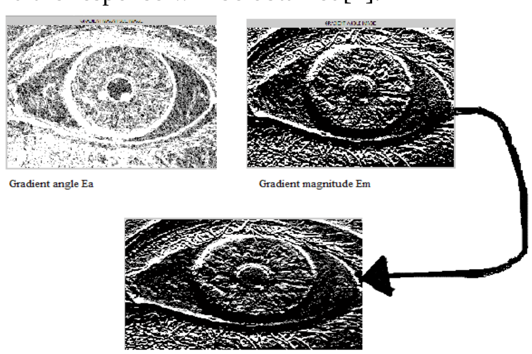

Fig 5: Non maximum removal

Phase 4:

Thresholding Edge - In the Canny filter, threshold allocation is the most important step in the segmentation process as it is essential to avoid some kind of noise at the edges. Thresholding is used in the canny operator to know hysteresis. This involves the application of two possible thresholds, i.e. if there is a value that is above the upper threshold then it is accepted. Otherwise it is rejected. I_N image normally contains local maxima, which is created by the noises to eliminate these maxima.

Implementation of Canny Edge Detection

1. The image and the thresholds can be chosen arbitrarily.
2. Smoothing filter with a standard deviation of σ = 1.4 is only supported.
3. The implementation used here will be the correct Euclidean measure for the edge strength.
4. For edge pixels different filters cannot be applied. This can cause the output image to be 8 pixels smaller in all direction.

First step is to scan all weak edges of neighbor edges and joined into groups and at the same time groups which are adjacent is also marked. Then all of these markings are examined to determine which groups of weak edges are directly or indirectly connected to strong edges. The weak edges that are connected to strong edges are marked as strong edges. The rest of the weak edges are being suppressed in fig.6. This is being interpreted as BLOB(Binary Large OBject) analysis. In this process only BLOB's containing strong edges are preserved, which are considered as one BLOB[3].

a) Taking I_N as input, the edge points orientation and two thresholds $t_1$and t_2; [when $t_1 < t_2$].

b) Then browse all points of I_N in a fixed order:

b.1) the next point should be previously should be unexplored edge, i.e. I_N (i, j) = 0; [such that I_N (i, j) > t_2].

b.2) Follow local maxima chains from I_N (i, j) connected in perpendicular directions, both to the normal of the edge; [to provided that I_N (i, j) > t_1]. Next all points examined, marked, and the list of all connected contour points found and saved.

c) A set of connected edges of image contours, the magnitude and orientation properties describing edge sets are in the output image.

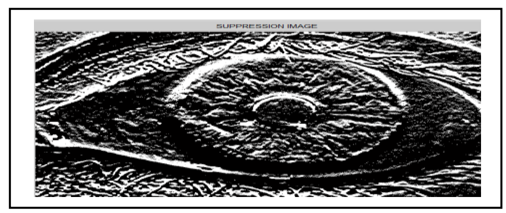

Fig 6: Suppressed image

D. Linear Transformations

A grayscale image has 28 intensity levels, [13] the intensity values of the pixels are maximum and minimum. They are not usually varying from 255 to 0. By increasing the image contrast facilitates, and significantly differentiating the regions, the segmentation process is done, as seen in Fig. 7.

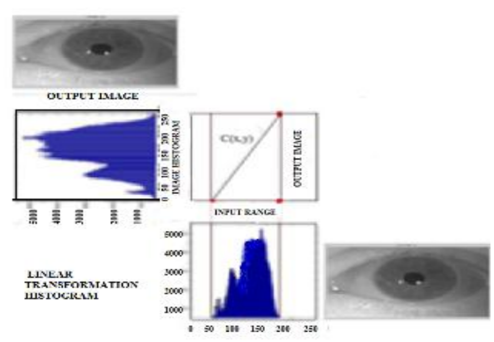

Fig 7: **Linear transformation Histograms**

Hough transformation

The Hough transformation is a standardized computer vision algorithm that can be used in determining the parameters of simple geometric objects, such as lines and circles, present in an image. The circular Hough transform is employed to deduce the radius and centre coordinates of the pupil and iris regions. An automatic segmentation algorithm based on the circular Hough transform is employed by Wildes et al. [19], First of all, an edge map is generated by calculating the first derivatives of intensity values in an eye image and then thresholding the result is being carried out. From the edge map, votes are casted in Hough space for the parameters of circles passing through each edge point [2]. A maximum point in the Hough space will be corresponded with the radius and centre of coordinates of the circle's best defined by the edge point. A three-dimensional parameter space which is included in a circle with center (c_x,c_y) and radius r according to Eq. (3):

$$(x-c_x)^2+(y-c_y)^2 = r^2 \quad -(3)$$

The circles with center (c_x', c_y') and radius r' was being traced in each edges of pixels, although by keeping the coordinates of the circles drawn, found the most recurrent breakpoint between them and the coordinates of this point as the center of the circle that describes the iris outline is taken.

5. NORMALIZATION

Normalization techniques are based on transformation of the iris, in polar coordinates, which are commonly referred to as iris development process. The iris region is segmented from a captured eye image; the next process is to fix the dimensions of the segmented eye image in order to allow for comparisons. There are various inconsistencies between eye images .Some of them are due to pupil dilation, rotation of the camera, head tilt, and rotation of the eye within the eyeball and changing of the image distance. The most are affected inconsistently due to the variation in the light intensities. Thereby illumination causes pupil dilation resulting in stretching of the iris. In order to remove these inconsistencies, segmented image is being normalized.

The normalization process will produce iris regions, which have the same constant dimensions. The two eye images of the same iris under different conditions will have the same characteristic features of Pupil displacement relative to the iris center and Schematic of the normalization process, with 10 pixels of radial resolution and 40 pixels of angular resolution. The homogenous rubber sheet model devised by Daugman remaps the each point within the iris region to a pair of polar coordinates (r,θ) where r is on the interval [0,1] and θ is angle [0,2π]. The remapping of the iris region from *(x,y)* Cartesian coordinates to the normalized non-concentric polar representation is carried out. The coordinates of the pupil and iris boundaries along the θ direction is corrected. The daugman rubber sheet model takes pupil dilation and size inconsistencies in order to produce a normalized representation with constant dimensions. Modeling is being carried out in iris recognition as a flexible rubber sheet anchored at the iris boundary with the pupil centre as the reference point. The Integra-differential operator, which behaves as a circular edge detector searches for the gradient maxima over a 3D parameter space, so that there are no threshold parameters required as in the canny edge detector. Daugman simply excludes the upper and lower most portions of the image where eyelids are occluded is expected to occur.[2]

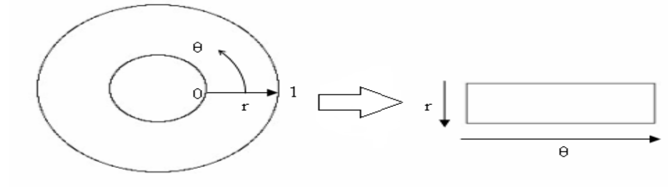

Fig 8: Daugman's rubber sheet model

The homogenous rubber sheet models i.e. the Daugman rubber sheet model accounts for the pupil dilation, imaging distance and non-concentric pupil displacement as shown in Fig 8. It will not compensate for rotational inconsistencies. In the Daugman's system, rotation is accounted during matching by shifting the iris templates in the θ direction until two iris templates are aligned. The pupil center is taken as a reference point, and similarly the radial vectors in the region of iris radial resolution. Radial resolution defines the vertical dimensions of the normalized representation. It can also be said in other words is that the number of points selected through a radial line and Angular resolution is based on the number of radial lines going around the iris, the concentrically constant value 240 was obtained by simulation. In iris region, normalization produces a *2D* array with horizontal dimensions for angular resolution and vertical dimensions for radial resolution is being taken. Wildes[19] had proposed an iris recognition system in which iris localization is completed by detecting edges in iris images followed by use of a circular Hough transform to localize the iris boundaries [9]. In a circular Hough transform, images are analyzed to estimate the three parameters of one circle (x,,) using the equation:

$$H(x_0,y_0,r) = \sum \text{I h}(x_i,y_i,x_0,y_0,r) \quad .-(4)$$

The location ($x_{0,0}$,r) with the maximum value of $H(x_0,y_0,r)$ is chosen as the parameter vector for the strongest circular boundary. Wildes' system models the eyelids as parabolic arcs. The upper and lower eyelids are detected by using a Hough transform based approach [2]. The only difference is that it votes for parabolic arcs instead of circles. One weak point of the edge detection, the Hough transform approach is used for thresholds in edge detection. Different settings of threshold values may result in different edges that in turn affect the Hough transform result significantly. Camus and Wildes (2004) described an algorithm for finding a subject's iris in a closed-up image. In eq 5 a way similar to Daugman's methodology, their algorithm searches in an space for the three circumference parameters (center(x,y), radius(r)) by maximizing the function.

$$C=\sum_{\theta=1}^{n} ((n-1)\, \|g\theta,\| - \sum_{\emptyset=\theta+1}^{n} \|g\theta,r-g\theta,r\| - I\theta,r/\, n) \quad -(5)$$

This method is very accurate on images where the pupil and iris regions' intensities are clearly separated from the sclera, and on the images that contain no reflections or other noise factors. When dealing with noisy data, the algorithm's accuracy deteriorates significantly [1].

6. CODING PROCESS

Coding process is done with the help of Log-Gabor filter. This is extracted by the image frequency information, estimated by the power frequency in certain bands, and their orientation in each location. By giving a result in the spatial domain, Gabor filters are a traditionally made as choice for obtaining localized frequency information. They will offer the best simultaneous localization of spatial and frequency information. They have two main limitations they are, The maximum bandwidth of a Gabor filter is limited to approximately one octave and other one is Gabor filters are not optimal, when one is seeking broad spectral information with maximal spatial localization. An alternative to the Gabor function is the Log-Gabor function proposed by Field in 1987. Log-Gabor filters are constructed with arbitrary bandwidth and the bandwidth can be optimized to produce a filter with minimal spatial extent. Field suggests that the natural images are better coded by filters which have Gaussian transfer functions when viewed on the *logarithmic* frequency scale [10]. On the linear frequency scale the log-Gabor function has a transfer function of the form,

$$G(w) = e^{(-\log(w/w_o)2) / (2 (\log(k/w_o)2} \qquad -(6)$$

Where w_o is said to be filter's centre frequency. Mainly to obtain constant shape ratio filters the term k/w_o must also be held as constant for varying w_o. There are two important characteristics for log-Gabor functions they are: log-Gabor functions by definition, they always have no DC component. Secondly, the transfer function of this log Gabor function has an extended tail at the high frequency end. In field's studies of the statistics of natural images, they indicate that images have amplitude spectra that fall off at approximately 1/w. To encode these images having such spectral characteristics values. One should use filters having spectra that are similar. Fields usually suggests that log Gabor functions, having extended tails, should be able to encode natural images more efficiently than ordinary Gabor functions, which would over-represent the low frequency components and under-represent the high frequency components in any encoding methods [9,10].

In the frequency domain the even symmetric filter is represented in two real-valued log-Gaussian curves i.e. 'bumps' which are symmetrically placed on each side of the origin. The odd-symmetric filter represents in two imaginary valued log-Gaussian 'bumps' and they are anti-symmetrically placed on each side of the origin. One of them will combine with the convolution of the even and odd symmetric filters into the one operation. Exploiting the linearity of the Fourier Transform where,

$$FFT(A+B) = FFT(A) + FFT(B). \qquad –(7)$$

Multiply the FFT of the odd-symmetric filter by i and add it to the FFT of the even-symmetric filter. The anti-symmetric 'bump' from the odd-symmetric filter will get cancelled out by the corresponding symmetric bump from the even-symmetric filter [9]. This leaves a single 'bump' which is multiplied by 2 on the positive side of the frequency spectrum. The design of log Gabor filter constitutes that, A log-Gabor filter bank does not form an orthogonal basis set and hence there is no ideal arrangement of the filters.

7. COMPARISION PROCESS

The hamming distance is used for comparison process. An individual iris region contains features with high degrees of freedom, i.e. each iris region will produce some bit-pattern which is independent to that produced by another iris, on the other hand, two iris codes are produced from the same iris will be correlated highly. If both the bits patterns are completely independent, then iris templates which are generated from different irises, has the Hamming distance between the two patterns should be equal to 0.5. This occurs, since the two bit patterns will be totally random as independence implies, so there is 0.5 chance of setting any bit to 1, and vice versa. Therefore, half of the bits will agree and half will disagree between the two iris patterns. If both the patterns are derived from the same iris, the Hamming distance between them will be close to 0.0, therefore they are highly correlated and the bits will agree between the two iris codes in Fig 9.

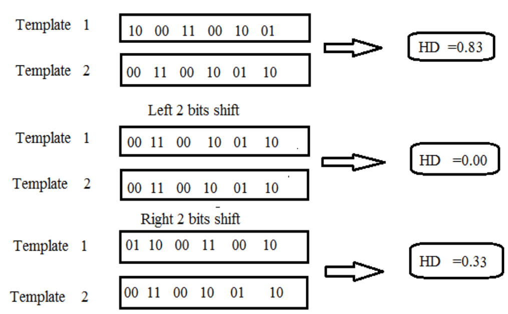

Fig 9: Bit wise template pattern for two iris

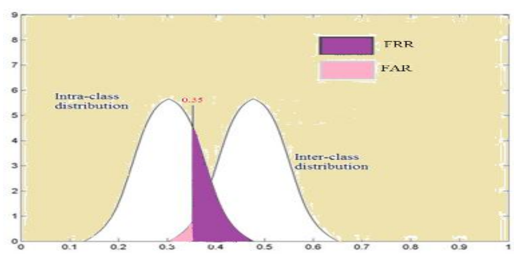

Fig 10: False Accept rate and False Rejection rate for two distributions with a separation Hamming distance of 0.35.

The distance between the minimum Hamming distance value for inter-class comparisons and maximum Hamming distance value for intra-class comparisons is used as a metric to measure separation between irises in Fig 9 and Fig 10. The shifting also causes a reduction in the number of degrees of freedom (DOF). This reduction in *DOF* is caused by a smaller standard deviation, which is caused by taking the lowest Hamming distance from 10 calculated values. Here, it shows that, due to shifting, the characteristics of the distribution are changed but the distribution is not shifted towards the left. By using the Hamming distance of two bit patterns, a decision can be made as to whether the two patterns were generated from different irises or from the same one. By comparing the bit patterns X and Y, the Hamming distance(HD), is defined as the sum of disagreeing bits i.e.sum of the exclusive-OR between X and Y over N, i.e.the total number of bits in the bit pattern.

8. PERFORMANCE EVALUVATION

Normalization results have proved satisfactory results as shown in Fig 11and Fig 12. It has several process, including the size of the polar rectangular plane, i.e. the normalized image depends directly on the pupil dilation with the pupil size varying from *20%* to *80%* the pixilated is greatly modified accordingly with respect to the case, but always remains constant at the dimensions of the image with relation to the angular positions and they are framed in the horizontal direction in representation [18, 5]. Comparison is carried out in Fig13 and Fig 14

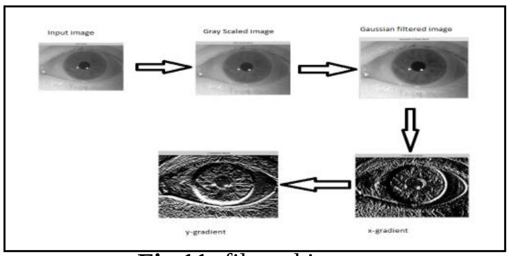

Fig 11: filtered image

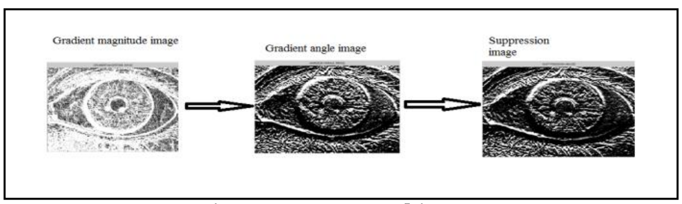

Fig 12: Suppressed image

Threshold parameter (t) value				
Sub-Category	**Mean**	**Minimum**	**Maximum**	**Standard Deviation**
Eyelid	0.40	0.37	0.42	0.023
Eyelash	0.40	0.4	0.44	0.041
Specular Reection	0.45	0.37	0.5	0.066
Pupil Boundary Noise	0.4	0.27	0.5	0.057
Bright image	0.47	0.36	0.53	0.07
Dark image	0.37	0.26	0.52	0.053

Table 1: Variation in threshold parameter needed for correct segmentation

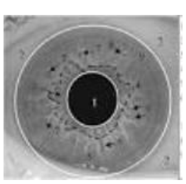

Fig 13: Normalization of Iris image

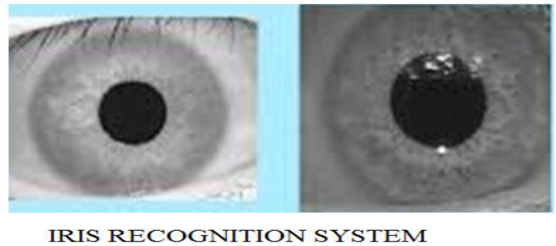

Fig 14: Comparison in Iris Recognition

9. CONCLUSION

This paper has presented an iris recognition system, which was tested using two databases of grayscale eye images in order to verify the claimed performance of iris recognition technology. An automatic segmentation algorithm presented, which would localize the iris region from an eye image and isolate eyelid, eyelash and reflection areas. Automatic segmentation was achieved through the use of the circular Hough transform for localizing the iris and pupil regions, and the linear Hough transform for localizing and occluding eyelids[7]. Thresholding was also employed for isolating eyelashes and reflections. The segmented iris region was normalized to eliminate dimensional inconsistencies between iris regions. This was achieved by implementing a version of Daugman's rubber sheet model, where the iris is kept as model to a flexible rubber sheet, which is unwrapped into a rectangular block with constant polar dimensions. The Hamming distance was chosen as a matching metric technique. The Euclidean distance is used in measuring test images. There by more accuracy in iris recognition system is achieved.

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