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Image Enhancement and Iris Recognition using SIFT Feature Extraction

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Abstract— **Human recognition through iris has gained allot of attention. This paper presents an efficient approach for recognition which includes segmentation, enhancement, feature extraction and recognition. Before feature extraction the image is enhanced using Contrast Limited Adaptive Histogram Equalization (CLAHE). Iris features are extracted using Scale Invariant Feature Transform (SIFT) which is invariant to scale and somewhat invariant to rotation and shown robustness to affine distortion .The advantage of proposed method is accuracy and simplicity. The system is tested using CASIA database version-4 for experimental results.**

Index Terms— **Iris segmentation, SIFT, Contrast Limited Adaptive Histogram Equalization, Euclidean distance.**

I. Introduction

The authentication of person based on biometrics is rapidly increasing these days as compare to conventional system which includes physical key, ID card, password, pin, token. Identification based on biometric technology includes fingerprints, face, retina, palm-print, hand geometry, voice, handwriting and iris. Among the various biometric recognition the iris is one of the most stable, reliable and has high uniqueness which means the probability of finding two iris exactly similar is almost zero and even the iris texture of left and right eye of same human is different. The idea of using iris for personal identification was first proposed in 1936 by Frank Burch, an ophthalmologist. The annular region between sclera and pupil is defined as iris as shown in fig 1.The steps to be performed generally in iris recognition systems are as follows: 1) Iris segmentation. 2) Iris normalization. 3) Image enhancement. 4) Feature extraction. 5) Matching algorithm.

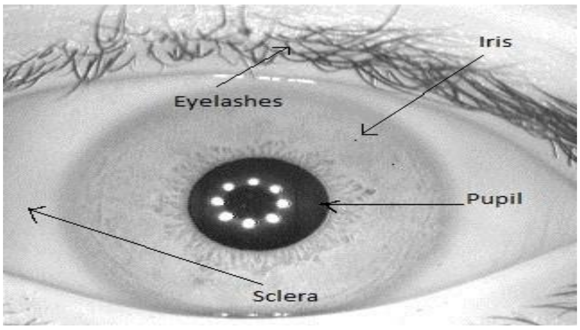

Fig. 1. Human eye

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The paper is organized as follows: Section II gives the brief idea of previous literature survey. Section III defines the SIFT principle. Section IV presents the proposed iris recognition system. Section V proposed matching algorithm. Section VI gives the conclusion of the paper.

II. Related Work

In [1], the iris segmentation was carried out by using pupil circle region growing using binary integrated edge curves, iris normalization by rubber-sheet model, Haar wavelet for feature extraction and matching of two iris codes was done with Hamming distance method. Khin [13] proposed a model in 2009 in which gradient values are estimated by Sobel edge detector, feature were extracted using statistical method and matching of feature vector was done using hamming distance, root-mean square, entropy and neural network. It was concluded that neural network had better accuracy among all above. In [18] features were extracted using bidimentional empirical mode decomposition and fractal dimension. Asheer [3] presented a model for eyelash segmentation using Grey Level Co-Occurrence Matrix(GLCM) features. The K-means and fuzzy C-means were both implemented on each image comparison and it was concluded that the accuracy of fuzzy C-Means was greater. Li Ma [9] focused on image quality assessment and selection and image enhancement was performed histogram equalization and using spatial filters the features were extracted. L.Masek [18] used linear Hough transform for eyelids detection. In [5] the Gabor wavelet is introduced for texture feature extraction. In [16] SURF was used for iris feature extraction and fusion rules was used in matching algorithm.

In this paper we use a novel method for human identification. We use circular hough transform for segmentation. Features are extracted by SIFT descriptor defined by David G.Lowe[12]. The method is invariant from scaling rotation and partially invariant to change in illumination. In [19] a preprocessing stage is applied at SIFT algorithm for image contrast enhancement using CLAHE.

In this paper we present a technique for human identification. We segment the iris region on which the SIFT algorithm is applied defined by David G.Lowe after image enhancement.

III. Scale Invariant Feature Transform

Calculating the correspondence between two iris images i.e stored image and the extracted image is the task performed by SIFT. SIFT produces the highly distinctive features[12]. The keypoint selection is performed by

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extrema detection is performed by comparing the eight neighbors around sample point and nine neighbors in difference- of-Gaussian (DOG) images above and below of it. The DOG is calculated as:

$$D(x, y, \sigma) = (G(x, y, k\sigma) - G(x, y, \sigma))*I(x, y) \quad (1)$$
$$=L(x, y, k\sigma) - L(x, y, \sigma) \quad (2)$$

Where * is the convolution, G(x, y, σ) is the variable scale Gaussian, I(x, y) is input image and L(x, y, σ) is the scale space of an image which is given as:

$$L(x, y, \sigma) = G(x, y, \sigma)*I(x, y) \quad (4)$$

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e^{-(x^2+y^2)/2\sigma^2} \quad (5)$$

Eigen values of Hessian matrix (H) are computed to eliminate the edge responses and H is given as:

$$H= \begin{bmatrix} Dxx & Dxy \\ Dyx & Dyy \end{bmatrix} \quad (6)$$

To obtain rotation invariance the dominant orientation is founded around the keypoint and the neighborhood points are aligned according to it

IV. Proposed Iris Recognition System

The system proposed has the following steps to be proposed are as follows:

A. *Iris Segmentation*

It is a process of partitioning an images into set of pixels. In iris segmentation the iris region is extracted from the image. It is the most important step which will determine the accuracy of next steps. Various methods of segmentations are integro-differential operator, Circular Hough transform (CHT) , Morphological operations[1]. Among these methods we will use CHT after edge map which is performed using Sobel edge detector. The CHT will perform outer iris localization (the bigger circle) and inner pupil localization (the smaller circle) as shown in fig 2. The region between two circles is extracted which is the iris region. The thresholding operation is performed for elimination of eyelashes.

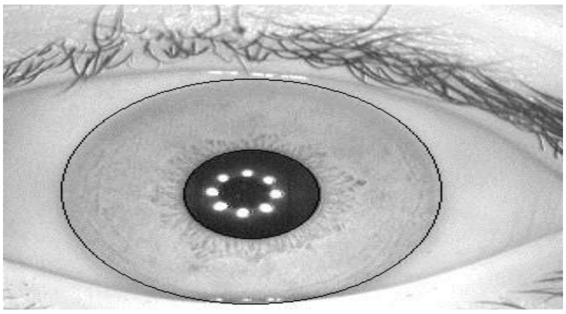

Fig. 2. Iris localization

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B. *Normalization*

Once the image is successfully segmented next step is normalization which convert image into fixed dimensions for comparison. The angular region variation occurs because of head tilt, rotation, rotation of eye, varying image distance and pupil dilation because of variation of illumination. The Daugman's rubber sheet model [18], [16] is used for normalization which remap the Cartesian coordinate to polar coordinate

C. *Image Enhancement*

Before feature extraction the image is enhanced by using Contrast Limited Adaptive Histogram Equalization (CLAHE) which is enhancement of Adaptive Histogram Equalization, as it overcome the over amplification of noise in homogeneous regions of an image thus providing limited amplification [16], [19].

This step is necessary to reduce the noise and to overcome low contrast and illumination problems. It operates in small regions called tiles and for smooth combining of neighboring areas bilinear interpolation is used.

D. *Feature Extraction*

The feature extraction is performed using SIFT. The descriptor vector is formed for each keypoint to extract the local features of the iris image. SIFT descriptor features are highly distinctive with high correct match probability with respect to large database.

Around the keypoint the gradient magnitude and orientation are computed for creating keypoint descriptor. The assignment of weights to the magnitude is done by Gaussian weighting function which is half the width of the descriptor window.

For each keypoint 128 (4×4×8) element feature vector is computed by gradient magnitude and orientation for each of its neighboring point. The final modification is done to reduce illumination effects for that normalization is performed to make it unit vector and the contrast changes are cancelled.

E. *Matching Algorithm*

The fusion rule is applied for matching of feature vectors at different levels shown in table I :

TABLE I. PROPOSED MATCHING ALGORIHM

NO.	STEPS
1.	Calculate the Euclidean distance between the tested and database image. For all keypoints the Euclidean distance is calculated and the keypoints with minimum distance is chosen as best match.
2.	The score is obtained for the first image stored in database against tested image with minimum rule.
3.	Five training images are stored for each person in database and the above procedure is applied to all of them. The mean rule is applied to obtain a matching score of a vector with five score values.
4.	The left and right images score are fused with minimum rule.

V. Conclusion

This paper presents a novel the iris recognition system using SIFT through which the keypoints are extracted. The fusion rule is applied to increase the accuracy of the system. The

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image is enhanced by dividing the image into tiles and applying the histogram equalization at each tile known as CLAHE.

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