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Robust Sclera Recognition with Novel Hough Transform Technique

Dhanusha G. R[1], Bharati C. Belagali[2], B. P. Likhitha[3], Harshitha M[4], Manjula G[5]

Department of ISE, SJB Institute of Technology, Bengaluru, India.

ABSTRACT: In biometric authentication sclera pattern based human verification is gaining more importance. The sclera pattern of each human is unique, so analysis sclera pattern for individual gave an effective human identification. In the proposed paper a smart effective human authentication using sclera pattern is designed by using efficient machine learning algorithm. Circular Hough Transform (CHT) segmentation with feature extraction techniques with Support Vector Machine (SVM) presents an effective output in person identification. Result section briefly summarize proposed system presents accurate result in person identification.

KEYWORDS: Sclera, Circular Hough Transform (CHT), Wavelet Transform, Harries Detector, Support Vector Machine (SVM), Person Identification.

I. INTRODUCTION

Increase in the technology presents a numerous method in human identification but biometric based human authentication is globally accepted. Here person's physical and evident attributes are figure out. Further research work is extended to achieve to higher level of system accuracy by covering the larger population. Numerous biometric human authentication models are designed such as finger print based, iris based and face based etc. Each designed model and the considered physical parameter has its own influence and defect. The essence of biometric applications is to achieve superior system accuracy, system stability, user satisfaction and scalability to large community [01].

Face based human recognition is one of the most widely used application method, but the cons of this method as person aged his face structure becomes changed. Finger print based human authentication presents more accuracy but it has more medical issues. To boost a system accuracy level, the research work has been moved to sclera based human identification. Sclera based person authentication is a most advanced and unique techniques. In sclera each human being has unique vessel patterns; even twins also have different blood vessel patterns. Hence where face based person identification fails there sclera based verification works. This sclera vessel pattern will not alter till the end of human life, due these unique characteristics it prefers worldwide. In below section II survey on different modules which are designed sclera based bio metric authentication is summarized. Section III describes the proposed model, where Experimental results are depicted in Section IV.

II. LITERATURE SURVEY

Sreelekshmi et.al [02] has proposed a sclera pattern based human identification system. The designed system includes five sub function blocks. Initially a glare area of the eye is detected by applying the soble filter. Compared to other region glare area is entirely different in an eye. The sobel filter output is further passed to ostu's thresholding to separate the sclera region. Once sclera region get separated vein pattern are enhanced by Gabor filter. The enhanced image is passed to feature extraction algorithms to assemble the numerical data for the respective vein patterns. These extracted numerical features are compared with other samples for human validation. Result section briefly summarizes the intermediated results.

Rohan Parab et.al [03] designed a human recognition system. The given input is comparatively larger in size, so it is necessary to localize the eye section. To normalize the given test image a 2D Gabor filter is used. Further an advanced features extraction algorithm is applied for numerical features collection. These features are passed for next

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step human recognition. The intermediate results are briefly depicted in results section. The author concluded that proposed system can be used for color as well as gray plane of the query image.

Vanitha Patil et.al [04] has proposed histogram equalization based sclera extraction and human recognition system. The designed system performance is tested by using the standard database. MATLAB tool is used for system implementation. Initially the RGB image is get converted into a gray plane, to separate the sclera part given RGB image is spited into an R, G, B plane separately. As per the survey the intensity of sclera region is very high as related to the other parts. Using Gabor filter the sclera is enhanced and morphological operations are applied to get the veins patterns. The application of line descriptor can effectively the sclera features of further matching algorithms. The application of sclera registration and matching algorithm can effectively validate the human.

Priti S. Tayade et.al [05] has proposed feature extraction techniques for sclera region. Every human has a unique sclera pattern hence it is necessary to assemble the numerical features during human recognition. In a referred model 2D DWT algorithm is used to gather the numerical patterns of sclera region. Before application of DWT, there must be necessary to segment the sclera region from the given image. In the referred system threshold based canny edge detection and Gabor filter are used to assemble the strong sclera edge. Morphological methods preferred to analyze the veins pattern and the application ANN classifier can efficiently the match the trained features with test features during human recognition.

Parth Nagarkar et.al [06] has proposed sclera based biometric security system. The referred system includes multiple intermediated functions to segment the sclera region. Application gray conversion techniques can effectively convert the three plane image into a single plane. Gabor filter is used improve the appearance of gray plane. A SURF algorithm is used for feature extraction. Image matching technique is used to match the test feature with trained features. Using intermediate result the author concludes designed system presents the effective results.

III. METHODOLOGY

Figure 1 depicts the designed system architecture. The entire work flow is sectored in training and testing part. Training section plays a major role in knowledge base creation. In which a numerous sclera segmented patterns are already kept for analysis. A Contrast-Limited Adaptive Histogram Equalization (CLAHE) is used to strengthen the aspect of the segmented images. Further wavelet transform and harris detectors are used extract the respective numerical features are pre-processed images. A Support Vector Machine (SVM) is trained by using extracted features.

In testing cases a real time image is taken as input, a Circular Hough Transform (CHT) is applied to extract or eliminate the unwanted eye (i.e. iris) section. Further application of advanced image processing algorithm can effectively detect the sclera region. The application of CLAHE enhances the appearance of a segmented sclera image. The respective features extraction which is used at training section is used to gather the numerical features. These extracted test features are passed to the SVM classifier for human authentication. Used classifier effectively creates the hyperplane for effective feature analysis. The mathematical representation of each intermediate algorithm is briefly presented in below section.

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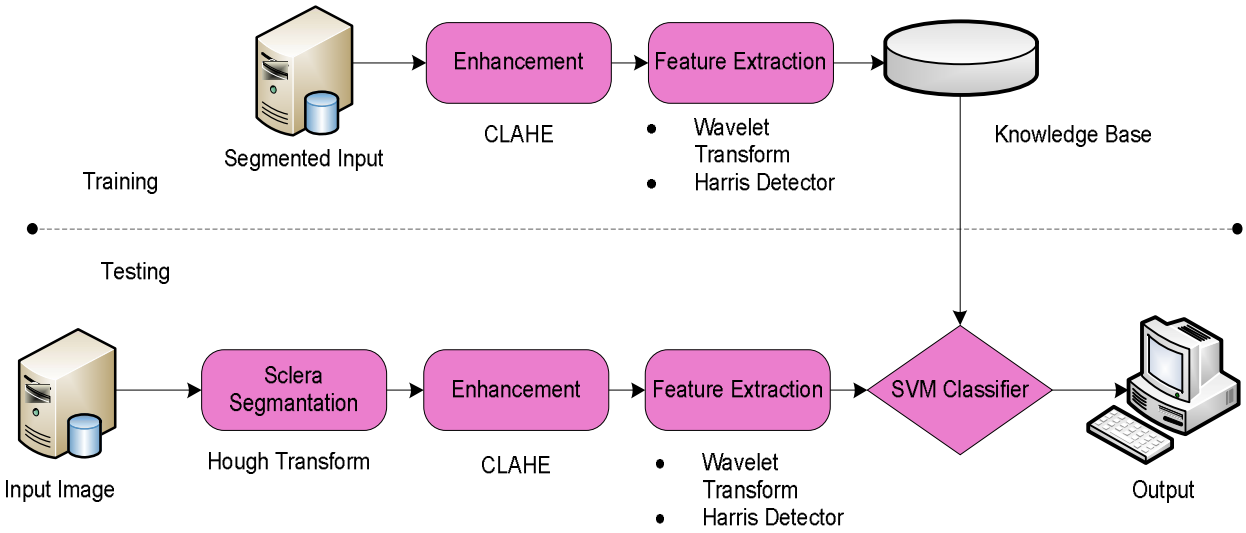

Figure 1: Block Diagram of Proposed System

2.1 Sclera Segmentation

The appearance of the sclera in the eye is entirely different compared to other element. This change in is used for the sclera identification. Before to separate the sclera it is necessary to eliminate or separate other element of the eye. Optic disk (OD) is the major element of human eye, so before to separate the sclera it must significant separate the OD region. To achieve this Circular Hough Transform (CHT) is used. To use CHT there must necessity to defined specification of shape parameter the given object like line or circle. In our case, it is a circle its mathematical equation is given as

$$p^2 = (x - c)^2 + (y - d)^2 \quad (1)$$

c and d denotes coordinates of circle centre which passes the x, y plane with variable limited radius r. Form above equation it is cleared that CHT is a 3D space in circle object recognition. Edge detection is the initial step of CHT, where it identifies the connected component of the input image. After edge detection an accumulator matrix is generated to update the number of circle formed in edges with centre radius r, these process is repeated for all the data elements of the image. Finally input image scaled such that is value come under 0 and 1 and applying a thresholding value to leave only highly probable circles. A ring shape circle mask is created of the input image [07]. Once OD gets separated using advanced image processing algorithms a sclera region is separated. This extracted region is passed to enhancement block to strengthen its appearance level.

2.2 Contrast Limited Adaptive Histogram Equalization (CLAHE)

To enhance the pictorial appearance CLAHE is used. It function is sector in a three sub function block. A number of non overlapping image regions are generated by dividing the input image. Further histogram of each region is computed. By using desired contrast expansion a clipping histogram is obtained. Based on clip limit the each region histogram is redistributed [08]. This redistribution of contrast presents the effective output. This enhanced output is passed for feature extraction techniques.

2.3 Feature Extraction

In computer vision the quality of the object, its characteristics and appearance property are measured using multiple algorithm and its features are presented in a numerical or pictorial forms. This representation of object property is defined as features and the algorithms used for features generation are defined as features extraction techniques. Features to be extract is depend on the application. In a proposed model a Wavelet transform and corner based features extraction techniques are used.

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- *Wavelet Transform*

It is frequency based signal analysis techniques. In digital communication an image is behave as a signal, the application wavelet transform analyze given image by dividing into various frequency components i.e. as high pass filters and low pass filters. A multiple techniques are available in wavelet transform, in proposed method a Discrete Wavelet Transform (DWT) is used, which decompose the input image into multiple sub bands i.e., LH, HL and HH. The DWT data is analyzed in two ways i.e. coarse and detailed information. Whereas L and H denote the high and low frequency components, LL sub band presents the coarse information and LH and HL presents the detailed information. Each sub bands deals with unique features i.e. vertical image features are extracted from LH sub bands, HL and HH sub bands are used to gather horizontal and diagonal features[09][10].

- **Harris Detector**

Harris is one of the corner features extraction algorithm. In image abrupt change in intensity has significant features. This information is gathered by using corner based feature techniques. This feature extraction method divided into two section i.e. edge based corner detection and corner detection based on gray level [11]. The application proposed techniques effectively presents the sensitive features involved in vessel pattern recognition.

2.4 SVM Classification

In computer vision, machine learning classifiers gaining more significance during data analysis.

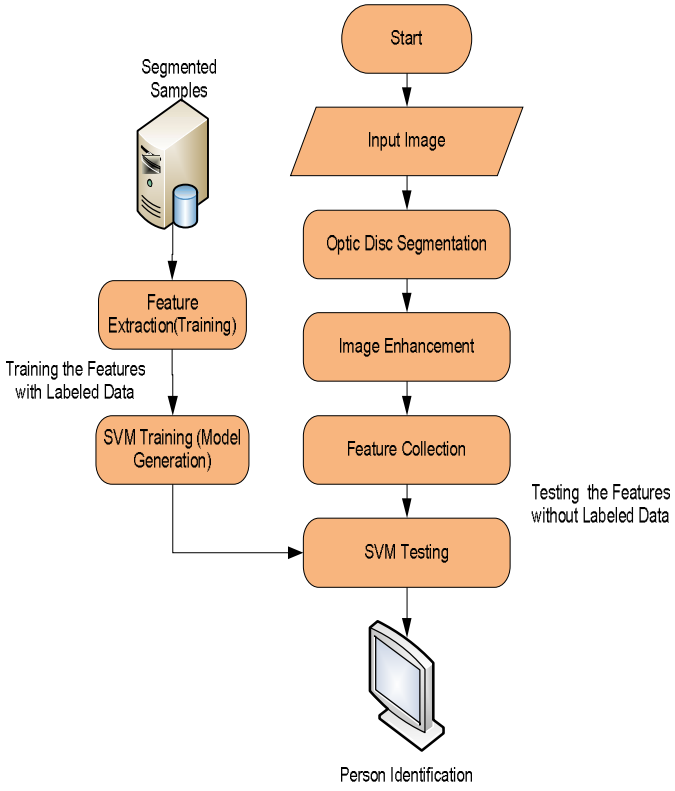

Figure 2: Flow Chart of Proposed System

A numerous machine learning classifiers are available in image processing to use, in which each algorithm has its own influence over the corresponding applications. In proposed a Support Vector Machine (SVM) is used for the human authentication. SVM classify the given data and label it by creating the hyperplane. Based on complexity of application area SVM classifier is divided into a two parts i.e. Linear SVM and Non Linear SVM. In Linear SVM creation of

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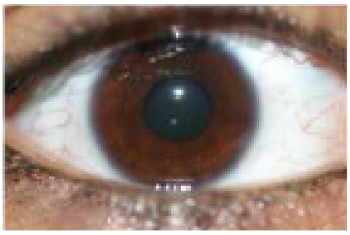
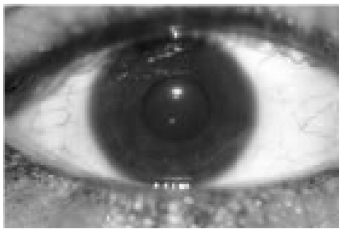
hyperplane is linear with respect to the training dataset, where as in non linera SVM the hyperplane is non linear with respect to the label data [12]. The application of SVM to proposed system effectively classifies tested features and authenticates the respective human. The overall working flow of the designed model is depicted in below Figure 2.

IV. EXPERIMENTAL RESULT

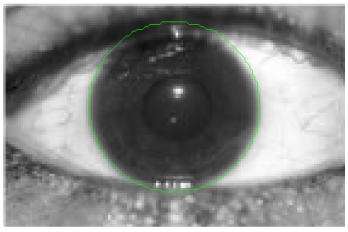
The proposed model performance is analyzed by using standard UTIRIS V.1database. This database includes set eye samples of multiple humans. Along with the RGB planes it includes infrared eye samples (i.e. both right eye and left eye). Instead of using infrared samples RGB samples are used for performance analysis. The input image, pre processed image and segmented output of the proposed system is depicted in below Figure`3.



(a)



(b)



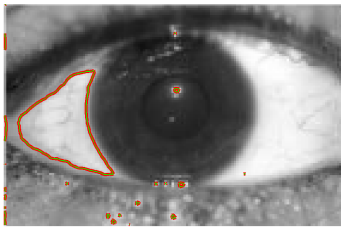
(c)

Figure 3: (a) Input Image ;(b) Gray Plane of Input Image ;(c) Optic Disk Recognition using CHT;

Before sclera region extraction there must be significance to eliminate unwanted region of eye. Application of Circular Hough Transform efficiently recognize optic disc region, this is get separated for further analysis. The separated optic disc region is shown in Figure 4 (a). The pattern of sclera region is entirely different compared to other eye region. A color based region extraction is used for sclera region extraction. The intermediate result involved in sclera region extraction is shown in Figure 4(b) and 4(c).

Once Sclera region detected, it get separated from input image, the segmented output is shown in below Figure 5(a) and the respective classified output is shown in Figure 5(b).

(a)



(b)

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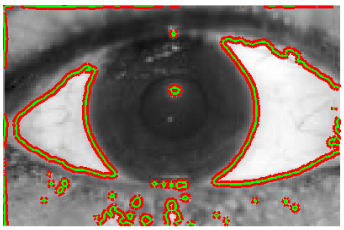
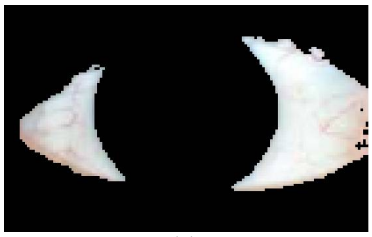


(c)

Figure 4: (a) Extracted Optic Disc; (b) Sclera Region Recognition; (c) Sclera Identification



(a)

(b)

Figure 5: (a) Extracted Sclera Region ;(b) Classifier Output

V. CONCLUSION

The proposed system present a sclera based biometric approach. The performance of the proposed system is analyzed with respect to the given database. Application features extraction method can effective identify test image sclera pattern with trained set of samples. Using SVM the respective person can be authenticated. As compared to the existing system proposed model is simple effective and reduce in the computation time and system complexity. Further the proposed approach can also extended by using other machine learning classifier to improve the performance level.

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