Improving Efficiency of Classification Based on Contact Lenses in Iris

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Abstract- Iris based authentication system is a pattern recognition technique that makes the use of iris patterns, which are statistically unique. The richness and apparent stability of the iris texture make it a robust biometric trait for personal authentication. Iris is a unique part which does not change with respect to time and also every individual has unique and different pattern of iris for both the eyes. Though iris patterns are unique, they may be affected by external factors such as illumination, camera-eye angle, and sensor interoperability. The presence of contact lens, particularly color cosmetic lens, may also pose a challenge to iris biometrics as it obfuscates the iris patterns and changes the inter and intraclass distributions. This helps to identify the person very accurately. This work presents results of improved classification method based on contact lens types. Results show that it is possible to identify with high accuracy, in which a textured cosmetic contact lens is present and it also distinguish soft lenses and without lenses iris.

I. INTRODUCTION

The ability to easily and accurately identify an individual is of great importance for security purposes. Most people have to authenticate their unique identity on a daily basis, such as to obtain secure access to a building, the bank, ATM's, etc. A biometric identification system provides a more secure solution to traditional procedures such as access cards and passwords used for identification of the user. The term biometrics alludes to programmed acknowledgment of an individual in view of behavioral and/or physiological qualities (e.g. fingerprints, face, iris, voice, signature, and so forth.), which can't be stolen, lost, or duplicated. Though iris patterns are uncommon, they may be affected by external factors such as illumination, camera-eye angle and the presence of contact lenses. Basically Iris can be classified into three categories: (1) textured contact lenses, (2) soft or non-textured cosmetic lenses, and (3) no contact lens. So, the classification of these three types of contact lenses is very important step in iris recognition system. A general iris recognition system is composed of four steps which are image acquisition, pre-processing, feature extraction and classification.

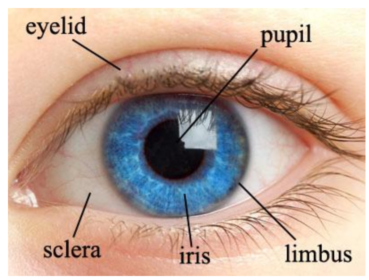

Fig-1: Iris Image

II. RELATED WORK

Since the first iris recognition system pioneered by Daugman[1,3], research has grown with immense interest in making iris recognition systems 100% accurate in both ideal and unconstrained environments Daugman who was approached by two eye scientists (Ophthalmologists) implemented and documented the first working iris recognition system, which has been patented and deployed in many countries. In this method, monochrome CCD iris capturing camera (480 * 640) was used to capture the rich iris features because Near Infra-red (NIR) illumination in the range of 700nm-900nm was required to capture an iris image which will be visible also to a human vision. To locate the region of interest from the acquired eye image, the parameters for capturing the center of iris and pupil were determined by using an integro-differential operator, which locates and segments the pupil and the iris regions with their varying centre coordinates.

To centralize the iris wildes utilized edge detection and hough transform. Edge detector is applied to generate the edge map on the gray scale iris image. For smoothening of the image Gaussian filter is applied on it.[3]

It has long been believed that clear prescription contacts do not affect the accuracy of iris recognition. For
example, an article appearing in IEEE Computer in 2000 stated, "Successful identification can be made through
eyeglasses and contact lenses [9]. As recently as 2010, sources such as Wikipedia contained claims such as,
"Iris recognition efficacy is rarely impeded by glasses or contact lenses [10]. Even currently, India's UIDAI site contains the statement, "Iris recognition is rarely impeded by glasses or contact lenses." [11].

Kohli et al. [7] perform an analysis of the effects of various types of contact lenses on the performance in a commercial iris biometrics system. They investigate four techniques for contact lens detection and present ROC curves demonstrating an improvement when lens detection is used to filter probe images.

III. PROBLEM DEFINITION

The existence of contact lens, particularly color cosmetic lens, may also pose a challenge to iris biometrics. Iris recognition systems need the capability to automatically determine if a person is (a) wearing no contact lens, (b) wearing a clear prescription lens, or (c), wearing a textured cosmetic lens. Textured contact lenses are designed to alter the appearance of the wearer's eye, giving it a different color and/or texture. Unfortunately, they also greatly reduce the amount of genuine iris texture visible to iris recognition systems. So, first of all three-class classification problem is solved and then iris recognition algorithms for different classes will be implemented.

IV. EXPERIMENTAL SETUP

4.1 Dataset Description:

We are utilizing publically distracted iris image database. Notre Dame Cosmetic Contact Lenses 2012 dataset, is the only iris image dataset that supports research in detection of contact lenses. The dataset contains a training set of 3, 000 images and a verification set of 1, 200 images. All images were captured with a LG 4000 iris camera. Both the training set and the verification set are separated similarly into three classes: (1) no contact lenses, (2) soft or non-cosmetic contact lenses, and (3) textured or colored contact lenses.

4.2 Tools and Technologies:

In this system, proposed method is implemented in java using eclipse platform. One of the key advantages of the Eclipse Platform is acknowledged by its utilization as an incorporation point. Building an apparatus or application on top of Eclipse Platform empowers the instrument or application to incorporate with different devices and applications additionally composed utilizing the Eclipse Platform.

V. METHODOLOGY

5.1 Flow of Proposed Work:

Flow of proposed work is basically divided into two parts: (1) Iris Recognition System and (2) Contact lenses types iris Classification.

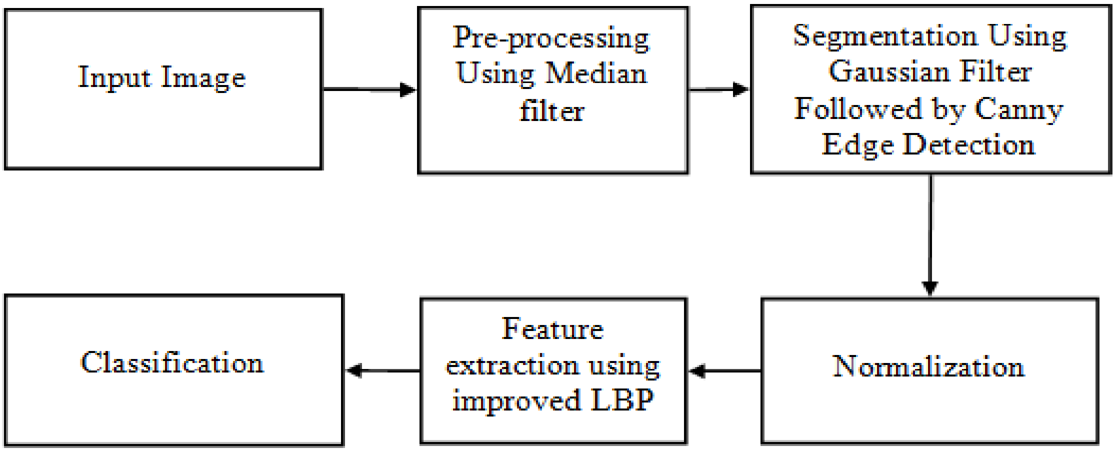

Fig-2 Flow of iris recognition system

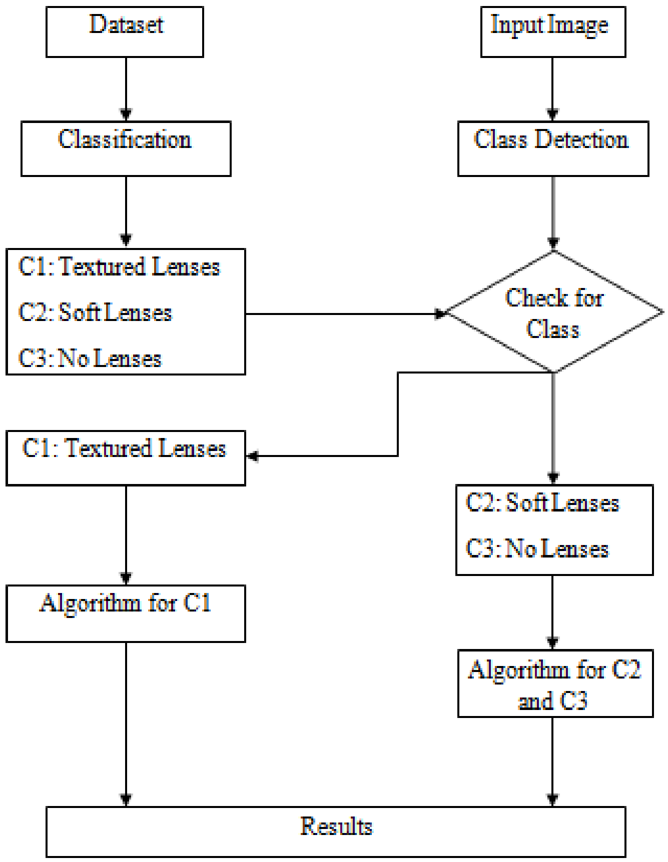

Fig-3 Flow of iris classification system

5.2 Iris Segmentation:

A segmentation method generally recommended by different researchers is to use Circular Hough Transform.

It is a good method but takes a lot of time and memory for processing. Instead, a simple method to obtain the segmented iris images is to apply the Gaussian filter followed by canny In this technique Gaussian filter, with window size 30 and sigma = 5, is applied to the image. This results in a smoothed or blurred eye image. Canny edge detection technique is then applied to the obtained smoothed image. As a result we get the major boundaries/edges of the image (Fig. 4). The biggest connected component in the obtained image is the outer boundary of the IRIS.

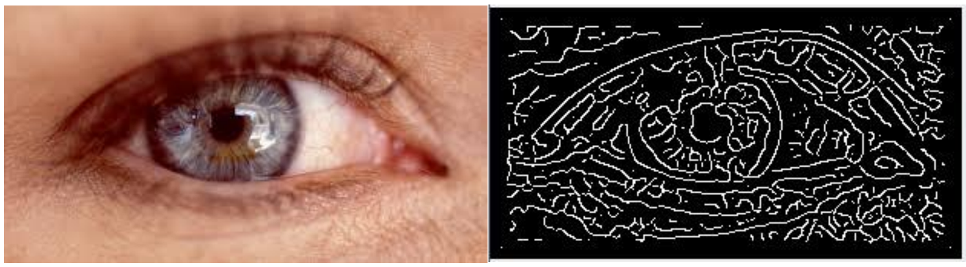

Fig-4: Edge Detection using canny (a) input image (b) Output after edge detection

5.3 Feature Extraction:

Modified Local Binary Pattern analysis (shown in fig-5) is applied to each region of each image at multiple scales to produce feature values. The pupil, iris, and sclera all have significantly different appearances, and as such the binary pattern analysis is performed separately for each region. Unlike traditional LBP, this method does not decompose the image into blocks and independently analyze each block to construct a large feature vector. The kernel size for the binary pattern analysis is scaled from 1 to 15 in increments of 1 for a total of 15 different feature sets for each of three regions and 45 features sets overall.

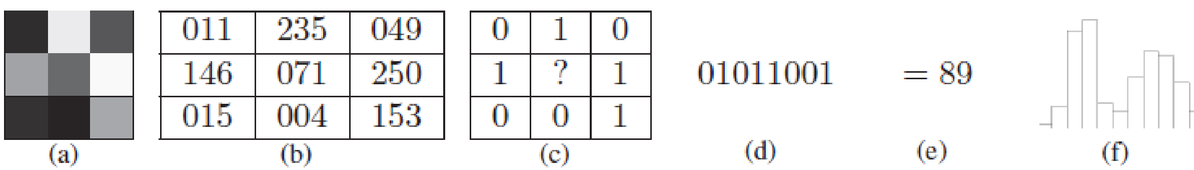

Fig-5: A 3*x*3 neighborhood of pixels (a) with values (b) can be converted into a Binary Pattern by comparing perimeter values against the center value. A larger perimeter value gets replaced with a 1 and a smaller or equal perimeter value is replaced with a 0 in (c). Starting with the upper left neighbor and working clockwise, a binary number (d) is formed. The binary value is converted to decimal for a final scalar value (e) and added into the histogram of values for the entire image (f).

5.4 Classification:

To improve overall efficiency of classification, an exhaustive combination of two classifiers is performed. Naïve bayes [8] have exhibited high accuracy and speed when applied to large datasets. And for categorical data like color is classified with the use of k-nearest neighbor [8] classifiers. For categorical attributes, a simple method is to compare the corresponding value of attributes in tuple A with that in tuple B. If two are identical, then the difference between two is taken 0, otherwise the different is taken 1. Thus, this method is best to classify different lenses in iris.

5.5 Results

Lens category	Relevant images out of 400 relevant images	
	Base paper algo	Proposed algo
None	262	299
Soft	201	274
Texture	386	384

VI. CONCLUSION

Person authentication has always been an important goal in computer world. The ability to easily and accurately identify an individual is of great importance for security purposes. To achieve high protection needs and dependable person identification iris segmentation and recognition method is used. In this system segmentation and feature extraction are the main modules for the purpose of classification. Because if the segmented iris image is not clear then there will be possibility for the false recognition. Furthermore, in the same way, if the system will not extract feature correctly then also iris cannot be recognized correctly. Different methods for each module are used for better accuracy and execution. Although iris patterns are uncommon, they may be pretended by external factors. Recognition of the contact lenses is the first step to enhance the system for contact lens wearer. Notre Dame Cosmetic Contact Lenses 2012 dataset is used for this work. Segmentation provided by the NDCLD12 dataset is utilized to divide each iris into three regions: (1) pupil, (2) iris and (3) sclera. Local Binary Pattern (LBP) and improved Local Binary Pattern are used for the feature extraction. After that classification is done with the use of naïve bayes and k-nearest neighbor classifiers. In future, we can also try another combinations of classifiers for classification of iris.

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