IJRSET Volume 2, Issue 3 Pages: 21-28

ISSN 2394-739X

International Journal for Research in Science Engineering and Technology

IDENTIFICATION OF THE RACE LIVELINESS AND MATCHING OF THE IRIS IMAGES

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Abstract:-

Individual recognition using Iris is most commonly employed in the entire place. This requires some special cameras to take the Iris image and the obtained iris images were classified based on the features extracted. Only identification of person is not the application of Iris recognition. It can be developed to do many processes. In this process the race of the person is identified. Also the input iris is fake or original is also identified. The iris image captured from the cameras was taken. Some Iris recognition system fails because some of the recognition systems identify the iris image in photos; also some of the recognition systems identify the fake iris images generated by some attackers. An iris recognition system that identifies the fake iris images are much needed. The proposed iris recognition system identifies the fake and original iris images. In order to identify fake and original iris image SIFT descriptors were derived from the input iris images.

Before this process the iris image is preprocessed by resizing the iris image and then filtering the iris image using median filter. The preprocessed iris image is then normalized. The normalization process identifies the iris and pupil region in the image correctly and it reshapes the identified positions. The normalization process improves the efficiency.

The SIFT descriptors identifies the corner points in the iris image and then the extracted points were used to generate the codebook. The code book generation processes is done using Hierarchical Visual Code book Generation method. As performance metrics we have taken accuracy, sensitivity and specificity.

The calculated values shows that the proposed system has better accuracy and also additional methods are also included compared to the existing methodologies.

Keywords: - Iris, Images, Hierarchical, SIFT, codebook, SVM.

1. INTRODUCTION

The proper functioning of many of our social, financial, and political structures today relies on correct identification of people. The iris pattern of a person distorts due to change of the pupil size under varying lighting conditions.

This distortion of the iris pattern can be significant when the pupil sizes are very different. This creates a problem for personal idenfication systems which use the iris as the biometric measure (i.e. iris recognition systems).

In order to understand how pupil size variations affect the performance of iris recognition systems, a fundamental background of biometrics recognition is given. This includes the basic requirement of biometrics recognition systems and how the systems work.

The review is focused on iris recognition systems, especially the iris normalization techniques which deal with the issue of variations of pupil size.

1.1. Introduction to Biometric Technology

Biometric systems work by first capturing a sample of the feature, such as recording a digital sound signal for voice recognition, or taking a digital color image for face recognition. The sample is then transformed using some sort of mathematical function into a biometric template. The biometric template will provide a normalized, efficient and highly discriminating representation of the feature, which can then be objectively compared with other templates in order to determine identity. Most biometric systems allow two modes of operation. An enrolment mode for adding templates to a database, and an identification mode, where a template is created for an individual and then a match is searched for in the database of pre-enrolled templates. A good biometric is characterized by use of a feature that is; highly unique – so that the chance of any two people having the same characteristic will be minimal, stable – so that the feature does not change over time, and be easily captured – in order to provide convenience to the user, and prevent misrepresentation of the feature.

1.2. Human Iris & Recognition

The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. A front-on view of the iris is shown in Figure 1.1. The iris is perforated close to its centre by a circular aperture known as the pupil. The function of the iris is to control the amount of light entering through the pupil, and this is done by the sphincter and the dilator muscles, which adjust the size of the pupil. The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter [2].
The iris consists of a number of layers; the lowest is the epithelium layer, which contains dense pigmentation cells. The stromal layer lies above the epithelium layer, and contains blood vessels, pigment cells and the two iris muscles. The density of stromal pigmentation determines the color of the iris. The externally visible surface of the multi-layered iris contains two zones, which often differ in color [3]. An outer ciliary zone and an inner papillary zone, and these two zones are divided by the collarette – which appears as a zigzag pattern.
Formation of the iris begins during the third month of embryonic life [3]. The unique pattern on the surface of the iris is formed during the first year of life, and pigmentation of the stroma takes place for the first few years. Formation of the unique patterns of the iris is random and not related to any genetic factors [4].

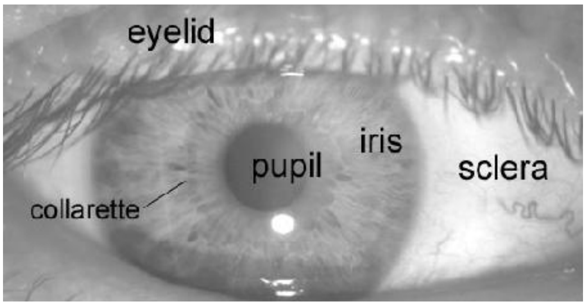


Figure 1.1: A front-on view of the human eye.

The only characteristic that is dependent on genetics is the pigmentation of the iris, which determines its color. Due to the epigenetic nature of iris patterns, the two eyes of an individual contain completely independent iris patterns, and identical twins possess uncorrelated iris patterns. For further details on the anatomy of the human eye consult the book by Wolff [3].
The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitised image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wishes to be identified by an iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified, or no match is found and the subject remains unidentified.Compared with other biometric technologies, such as face, speech and finger recognition, iris recognition can easily be considered as the most reliable form of biometric technology [1]. However, there have been no independent trials of the technology, and source code for systems is not available. Also, there is a lack of publicly available datasets for testing and research, and the test results published have usually

been produced using carefully imaged irises under favorable conditions.

2. STEPS FOR IRIS RECOGNITION

The human iris is rich in features which can be used to quantitatively and distinguish one eye from another. The iris contains many collagenous fibers, contraction furrows, coronas, crypts, color, serpentine vasculature, striations, freckles, rifts, and pits. Measuring the patterns of these features and their spatial relationships to each other provides other quantifiable parameters useful to the identification process.

Image processing techniques are employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which is stored in a database. The steps in processing are shown in Fig. 2.1.

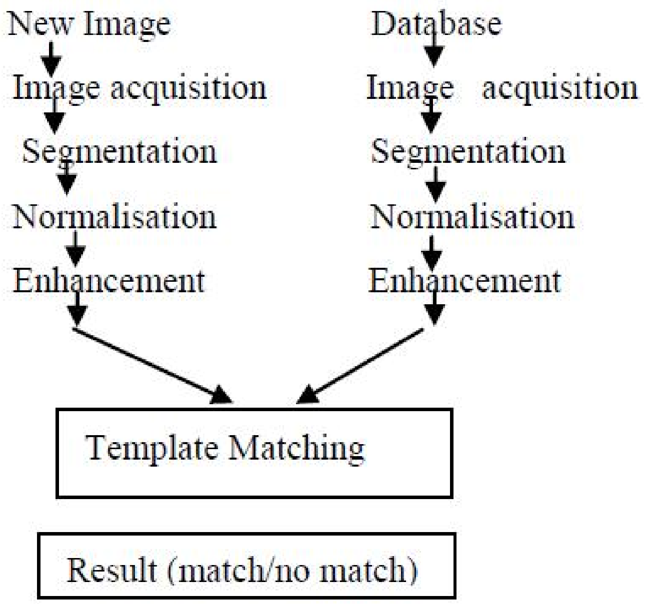


Figure 2.1: Processing Steps

The first stage of iris recognition is to isolate the actual iris region in a digital eye image. The iris region, shown in Figure 1.1, can be approximated by two circles, one for the iris/sclera boundary and another, interior to the first, for the iris/pupil boundary.

The eyelids and eyelashes normally occlude the upper and lower parts of the iris region. Also, specular 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.

2.1. Image Acquisition

Image is acquired with following parameters taken into consideration:

- Brightness of surroundings
- Head tilt and distance

Database is composed of 200 images collected from 40 persons in two distinct sessions. Session 1: The enrollment noise factors are minimized in the first image capture session, Session 2: The second session changed the capture location in order to introduce natural luminosity factor. This enabled the appearance of heterogeneous images with respect to reflections, contrast, luminosity and focus problems. All images from both sessions are classified with respect to three parameters [1]Focus [2] Reflections and [3] Visible Iris, in a three value scale 'Good', 'Average' and 'Bad'.

2.2. Segmentation & Boundary Detection

Segmentation and boundary detection is implemented in two stages. The first stage is to isolate the actual iris region in a digital eye image. The eyelids and eyelashes normally occlude the upper and lower parts of the iris region. Also, specular reflections can occur within the iris region which may corrupt the iris pattern. Hence second stage of segmentation technique is required to isolate eyelids and exclude these artifacts as well as locate the circular iris region.

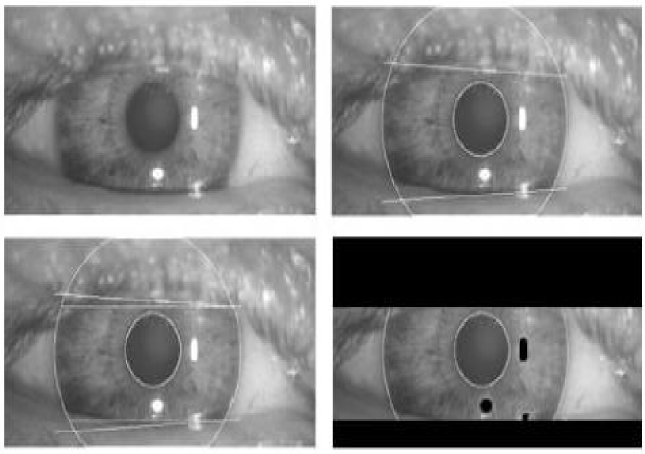


Figure 2.2: Stages of segmentation with eye image

An automatic segmentation algorithm based on the Hough Transform is used for creating templates. 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. Circular Hough Transform is used for detecting the iris and pupil boundaries and linear Hough Transform is used to isolate eyelids.

2.3. Normalization of Extracted Iris

Once the iris region is successfully segmented from an eye image, the next stage is to normalize the iris region in rectangular block so that it has fixed dimensions in order to allow comparisons. The normalization process produces iris regions, which have the same constant dimensions, so that two photographs of the same iris under different conditions will have characteristic features at the same spatial location.

2.4. Template Matching

For Template matching, the Hamming distance is chosen as a metric for recognition, since bit-wise comparisons is necessary. 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. 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 to **0.5.** This occurs because independence implies the two bit patterns will be totally random, 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 patterns. If two patterns are derived from the same iris, the Hamming distance between them will be close to **0.0**, since they are highly correlated and the bits should agree between the two iris codes.

3. EXISTING SYSTEM WORK

Iris liveliness detection is done by using Frequency analysis and then image quality analysis. Texture classification methods were used to detect the liveliness of the Iris image. Texture classification process involves two phases: the learning phase and the recognition phase. In the learning phase, the target is to build a model for the texture content of each texture class present in the training data, which generally comprises of images with known class labels. The texture content of the training images is captured with the chosen texture analysis method, which yields a set of textural features for each image. The texture based classification can be divided into statistical, geometrical and model based. Statistical methods analyze the spatial distribution of gray values, by computing local features at each point in the image, and deriving a set of statistics from the distributions of the local features. Geometrical methods consider texture to be composed of texture primitives. Model-based methods hypothesize the underlying texture process, constructing a parametric generative model, which could have created the observed intensity distribution. Based on the identification and classification of similar patterns the liveliness of the input iris is identified. Then texture based features such as Gray Level Co-occurrence Matrix, Statistical distribution of Iris textures, Local Binary Patterns, weighted Local Binary Patterns were used as features to identify the liveliness of the input iris image. The GLCM algorithm gives the texture distribution all over the image. Race classification is done using the face images based on Gabour Wavelets and Adaboost classification. Matching of the Iris image is done based on template matching. The Gabour wavelets give the grey level orientations all over the image. These features give the texture related information's in the iris image. The shape based matching of the iris images compares the input iris pattern with the pattern in the dataset and identifies the closest matching pattern. The patterns of the iris were identified based on the texture based information's.

4. PROPOSED SYSTEM STRUCTURE

Iris images were collected from dataset. Iris images were trained by extracting the codebook generated from the SIFT descriptors of the images. The input Iris image is first resized and it is preprocessed using median filter. The noises in the image reduces the performance of the process to a greater extend. There is different type of noises commonly present in images. The most commonly occurring noise is the salt and pepper noise. It presents itself as sparsely occurring white and black pixels. For denoising we can employ any of the filters to remove the noises from the Images. Median filter splits the image into the particular window size that we have specified. The noisy pixel in the particular window is identified. The noisy pixel is replaced by calculating the median of the neighboring pixels in the particular region. The normalization of Iris is done by detecting the Iris and Pupil in the input image and then resizing the detected iris region to a particular size. The normalization process converts the image from Cartesian to polar co-ordinates and then the pupil and the iris regions were rescaled inorder to obtain the normalized image. Then SIFT descriptors were extracted from the normalized image. The Scale Invariant feature extraction algorithm extracts the feature values from the Iris image. The algorithm identifies the clearly visible edges from the Iris image and marks them and gets the values from them. These values were used to generate the codebook for the images. Applications of SIFT features include object recognition, robotic mapping and navigation, image stitching, 3D modeling, gesture recognition, etc. From the SIFT descriptors codebook is generated using the Hierarchical Visual Codebook. Hierarchical Visual Codebook is based on Vocabulary Tree and Locality Constrained Linear Codebook. The SIFT features obtained were initially clustered using any of the clustering algorithm. The parent node will be the initial clusters obtained. The roots are obtained by further clustering of the parent. The process continues till the end. At each node level the generated values were saved as features. The obtained features were used for the classification of the Iris image. The values of the codebook were taken as features. The extracted features were then classified using Support Vector Machine classifier and the race, liveliness were detected and the Iris is matched. The extracted feature values were then classified based on the label given by the user. The classifier gives the label to which the input image belongs. Three different labels were given in order to find the liveliness, Race and matching of iris. The input image is classified to any one of the two categories that we have specified (i.e.) fake or Real, Asian or Non-Asian. The category of the Iris is also identified using Multi SVM. It categorizes the images into more number of categories. The performance of our process is measured by calculating the accuracy, sensitivity and specificity of the classifier for the three process. The accuracy of the classifier represents to which extend the classifier classifies the images based on the given label. The sensitivity of the classifier represents how exactly the classifier correctly classifies the data to each category. The specificity of the classifier represents how exactly the classifier correctly rejects the data to each category. The ROC curve and confusion matrices were got. The ROC curve is a plot between the existing and the proposed system. Confusion matrix describes the True Positive and the false positive values of the classifier that we use for each type of category that we have specified.

4.1. Proposed System Modules

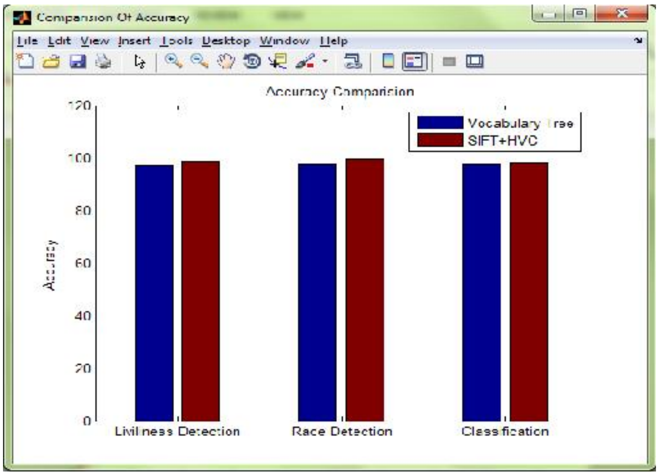
The proposed method produces high accuracy in most of the cases since it used SIFT descriptors that are more reliable. The proposed Iris recognition method is more secure since the accuracy of liveliness detection is high even though there are many difficulties in the dataset (i.e.) high illumination difference, Fake iris more similar to the original iris. The proposed method is trained with a large amount of training set and tested. The proposed system modules are,

- Preprocessing.
- Normalization.
- SIFT Descriptors Extraction.
- Codebook Generation.
- Iris Classification.
- Performance Analysis.

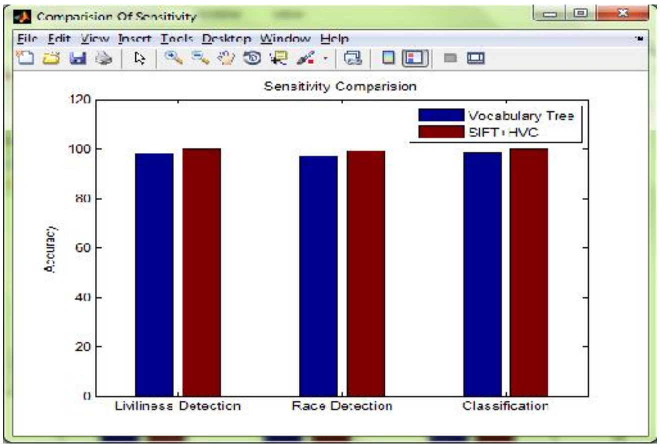
The iris image is first resized to a particular size. The noises in the frames reduce the quality of the frames. Each frame is considered as images. In order to improve the quality of the images we normally employ some filtering operations. Median filter is used for filtering. The median filter considers each pixel in the image in turn and looks at its nearby neighbors to decide whether or not it is representative of its surroundings. Instead of simply replacing the pixel value with the median of neighboring pixel values. The median is calculated by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value. In image processing, it is often desirable to be able to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, often used to remove noise. The Iris region and the pupil region were segmented. The pixels inside the iris and the pupil were converted from Cartesian coordinates to polar coordinates. The normalization process stretches the contrast in the particular place to the whole image. The normalization process reshapes the segmented portions to a particular range. The ring-shape iris regions into a unified coordinates (i.e.) polar coordinates. Preprocessing and normalization are most common measures used in all the Iris recognition systems. The first stage of iris recognition is to isolate the actual iris region in a digital eye image. The segmentation of iris localizes the iris's spatial extent in the eye image by isolating it from other structures in its vicinity, such as the sclera, pupil, eyelids, and eyelashes. The normalization if iris invokes a geometric normalization scheme to transform the segmented iris image from Cartesian coordinates to polar coordinates. The Scale Invariant feature extraction algorithm extracts the feature values from the Iris image. The algorithms identify the clearly visible edges from the Iris image and mark them and get the values from them. These values were used to generate the codebook for the images. Applications of SIFT features include object recognition, robotic mapping and navigation, image stitching, 3D modeling, gesture recognition; etc. It is an algorithm in computer vision to detect and describe local features in images. For any object in an image, interesting points on the object can be extracted to provide a "feature description" of the object. Codebook is generated from the extracted SIFT Descriptors. The extracted SIFT descriptors were clustered and the cluster center and id is identified. The parent node will be the initial clusters obtained. The roots are obtained by further clustering of the parent. The process continues till the end. At each node level the generated values were saved as features. The obtained features were used for the classification of the Iris image. The iris database is trained by extracting the feature values for all the images in the dataset. The obtained feature values were saved. Vocabulary Tree (VT) was originally proposed to improve quality and efficiency of image retrieval. The basic idea of VT is to hierarchically represent a large set of representative visual words through recursive applications of K-means clustering. Support vector machines are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. The basic SVM takes a set of input data and predicts, for each given input, which of two possible classes forms the output. After training the SVM model is created. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible.

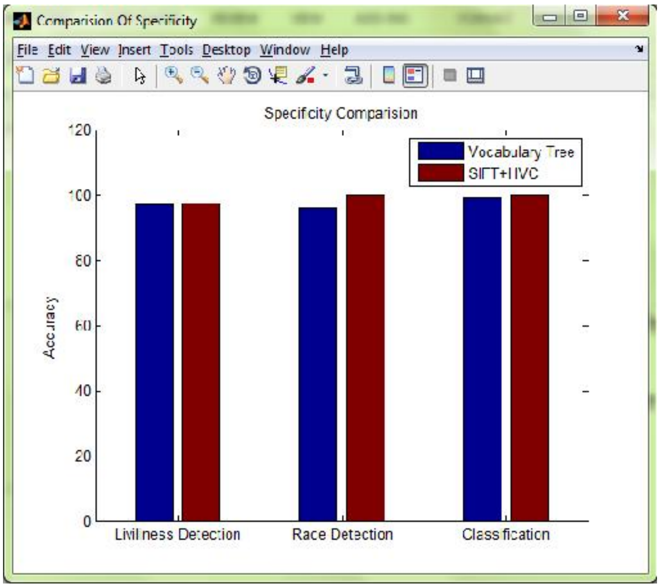
5. IMPLEMENTATION & RESULTS

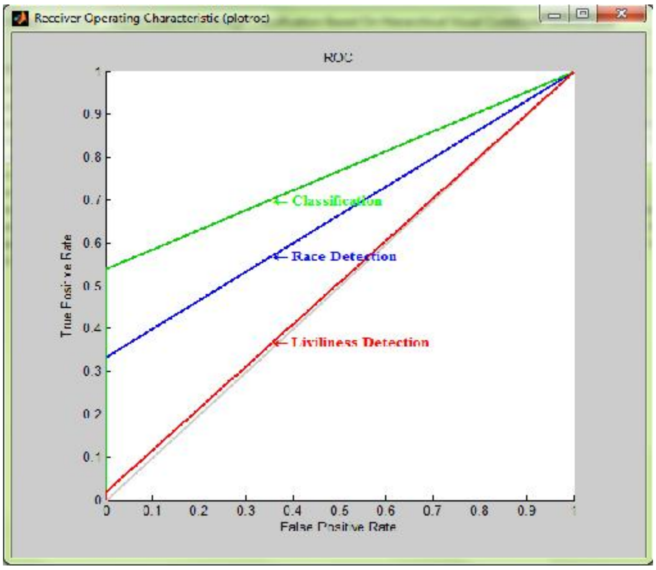
The accuracy of recognition with these distributions can be determined by calculating their false accept and false reject rates with different separation points.



Contrary to some conventional wisdom in the iris biometrics field, we find no significant difference in the value of the inner rings of the iris versus the outer rings. Perhaps, surprisingly, our results indicate that the middle bands may be slightly better than either the inner or the outer bands.







The complete iris recognition system consists of an automatic segmentation system 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 is then normalized into a rectangular block with constant dimensions to account for imaging inconsistencies.

CONCLUSION & FUTURE WORK

The system presented in this paper is able to perform accurately, however there are still a number of issues which need to be addressed. First of all, the automatic segmentation was not perfect, since it could not successfully segment the iris regions for all of the eye images in the two databases. In order to improve the automatic segmentation algorithm, a more elaborate eyelid and eyelash detection system could be implemented. An improvement could also be made in the speed of the system. The most computation intensive stages include performing the Hough Transform, and calculating Hamming distance values between templates to search for a match. Since the system is implemented in MATLAB®, which is an interpreted language, speed benefits could be made by implementing computationally intensive parts in C or C++.

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