A Survey: Iris Recognition Techniques & Predict Gender from Iris Images

[1]Rehana Parwin, [2]Swati Verma
[1]M.E. Scholar SSGI, [2]Assistant Professor SSGI
Bhilai (C.G.) India

***Abstract* - This paper employs machine learning techniques to develop models that predict gender based on the iris texture features. While there is a large body of research that explores biometrics as a means of verifying identity, there has been very little work done to determine if biometric measures can be used to determine specific human attributes. If it is possible to discover such attributes, they would be useful in situations where a biometric system fails to identify an individual that has not been enrolled, yet still needs to be identified. The iris was selected as the biometric to analyze for two major reasons: (1) quality methods have already been developed to segment and encode an iris image; (2) current iris encoding methods are conducive to selecting and extracting attributes from an iris texture and creating a meaningful feature vector. Among various biometric authentication systems iris recognition system is considered to be more accurate and reliable. The main objective of these systems is to identify the user as an authentic or an imposter. These systems does not reveal about imposter's gender or ethnicity. Majority of practices for gender classification utilize facial information. Very few references in the literature reported the identification of human attributes such as gender with the help of iris images. In this paper gender has been identified using iris images.**

***Index Terms* - gender classification, iris, biometric**

---

1. INTRODUCTION

Traditionally, every subject that would need to be identified in a biometric system must be enrolled. This means that the subject's biometric data is gathered and stored in the system. Whenever a user attempts to be identified by the system, it matches the user's biometric data with all of the enrolled data and will identify the user if a successful match is made. However, this method does not account for subjects who are not enrolled in the system. Supposing a system attempts to identify a subject that is not enrolled, the only information the system can provide is that there is no matching enrolled subject. However, a system capable of analyzing biometric data could provide enough information about an unknown subject that alternative identity methods could be pursued. It can also enable impostor identification, that is disguised genders. The focus of this paper is to predict gender based on iris image data. Unlike properties such as ethnicity, the distribution of gender does not vary based on external constraints. Thus, we can be assured that any gender-related patterns discovered in the iris will not be subject to the various biases that may afflict other properties. Moreover, gender allows us to eliminate various biases of ethnicities, procurement environment, etc. We can run a controlled group within each ethnicity, demographic, and procurement environment to weed out the variations in gender predictions and presence of biases, if any. To the best of our knowledge, we are not aware of any other study that attempts to predict gender from irises.

Human beings can recognize gender very easily as compared to a machine. Gender classification is an important problem of computer vision. Gender recognition is useful in the area of forensic sciences, security systems, and many more. In recent years many researchers have made the most of facial images to classify gender whereas a few studies of this nature have utilized the properties of iris images to predict gender. Iris recognition an accurate and reliable biometric authentication system identifies an individual that has been enrolled. The user is identified as an authentic or an imposter. These days for security, it is equally important to determine the gender of an imposter. Iris images possess distinct phase information which spans more than 200 degrees of freedom. Human attributes such as ethnicity and gender can be determined using these distinct features.

2. RELATED WORK

Currently, few studies of this nature have been made, but none, to the best of our knowledge, have used the properties of an iris image to predict gender. Qiu, Sun, and Tan developed a model to predict ethnicity using iris data using the AdaBoost algorithm and achieved an accuracy of 85.95%. Their model attempts to predict if a subject is either Asian or non-Asian. While the accuracy is quite high, one concern that must be addressed is potential bias associated with the iris databases they use for each class. All of the Asian images come from the CASIA dataset, while non-Asian images come from the UPOL and UBIRIS datasets. Naturally, this forms a very strong sample selection bias in the paper given different databases of ethnicities. In this paper, it is never addressed whether there is any concern over the prediction models learning on subtle differences in the iris databases. However, simply looking at sample images from each dataset suggests that there may be potential for bias since images from one dataset appear significantly darker than images from the others.Some biometric work has been done on gender classification, but all existing work involves the analysis of face image data. Moghaddam and Yang used Support Vector Machines to achieve an accuracy of 96.6% using low resolution "thumbnails" of face images. Gutta et al. employ an ensemble of RBF networks and inductive decision trees to obtain an accuracy of 96%. Sun et al. also use face images for gender identification. Jain et al approach gender classification from the frontal facial images using a combination of ICA and Support Vector Machines.

3. TECHNIQUES USED FOR IRIS SEGMENTATIONS

3.1 Integrodifferential operator

This approach is resembled as one of the most cited approaches in the survey of iris recognition. Daugman used an integrodifferential operator for segmenting the iris. It finds both inner and the outer boundaries of the iris region. The outer as well as the inner boundaries are referred to as limbic and pupil boundaries. The parameters such as the center and radius of the circular boundaries are being searched in the three dimensional parametric space in order to maximize the evaluation functions involved in the model. This algorithm achieves high performance in iris recognition. It is having a drawback that, it suffers from heavy computation.

3.2 Hough Transform

The Hough Transform is an algorithm presented by Paul Hough in 1962 for the detection of features of a particular shape like lines or circles in digitalized images. The classic Hough Transform is a standard algorithm for line and circle detection. It can be applied to many computer vision problems as most images contain feature boundaries which can be described by regular curves. The main advantage of the Hough transform technique is that it is tolerant to gaps in feature boundary descriptions and is relatively unaffected by image noise, unlike edge detectors.

The edge detection has been performed through the gradient-based Canny edge detector, which is followed by the circular Hough transform, which is used for iris localization. The advantage of this method is that it provides segmentation accuracy up to an extent.

The drawback of this approach is that, it does not provide any attention to eyelid localization (EL), reflections, eyelashes, and shadows which is more important in the iris segmentation.

3.3 Masek Method

Masek introduced an open iris recognition system for the verification of human iris uniqueness and also its performance as the biometrics. The iris recognition system consists of an automated segmentation system, which localize the iris region from an eye image and also isolate the eyelid, eyelash as well as the reflection regions. This Automatic segmentation was achieved through the utilization of the circular Hough transform in order to localize the iris as well as the pupil regions, and the linear Hough transform has been used for localizing the eyelid occlusion. Thresholding has been employed for isolating the eyelashes as well as the reflections. Now, the segmented iris region has got normalized in order to eliminate the dimensional inconsistencies between the iris regions. This was achieved by applying a version of Daugman's rubber sheet model, in which the iris is modeled as a flexible rubber sheet, which is unpacked into a rectangular block with constant polar dimensions. Ultimately, the iris features were encoded by convolving the normalized iris region with the 1D LogGabor filters and phase quantizing the output to produce a bit-wise biometric template. The drawback of this approach is that the iris segmentation is not that much accurate and also the speed of the system is low.

3.4 Fuzzy clustering algorithm

A new iris segmentation approach, which has a robust performance in the attendance of heterogeneous as well as noisy images, has been developed in this. The process starts with the image-feature extraction where three discrete i.e., (x, y) which corresponds to the pixel position, and z which corresponds to its intensity values has got extracted for each and every image pixel, which is followed by the application of a clustering algorithm which is the fuzzy K-means algorithm. The main advantage of this method is that, it provides a better segmentation for non cooperative iris recognition. The major drawback in this method is that thorough (extensive) search is needed in order to recognize the circle parameters of both the pupil as well as the iris boundaries.

3.5 Pulling and Pushing (PP) Method

A perfect (accurate) as well as a rapid iris segmentation algorithm for iris biometrics has been developed in this. There are mainly five major contributions in this. Firstly, a novel reflection removal method has been developed in order to exclude the specularities involved in the input images, also an Adaboost-cascade iris detector has been used in order to detect the iris in them and also to exclude the non iris image parts before further processing such that redundant computations can be avoided. In addition to this, a rough iris center has been extracted in the iris images. Second contribution is that, beginning from the rough iris center, a novel puling and pushing (PP) procedure has been developed in order to accurately localize the circular iris boundaries. The PP method directly finds the shortest path to the valid parameters. Third is that, a cubic smoothing spline has been adopted in order to deal with the noncircular iris boundaries. Fourth contribution is that, an efficient method for the localization of the eyelids has been developed.. The advantage of PP method is the accuracy and speed. The drawback of this method is that the occurrence of the segmentation error.

3.6 Eight-neighbor connection based clustering

An efficient as well as robust algorithm for noisy iris image segmentation in the background of non cooperative and less-cooperative iris recognition has been developed in this. The major contributions involved in this are as follows. Firstly, a novel region growing scheme known as the eight-neighbor connection based clustering has been proposed in order to cluster the whole iris image into different parts. Then, genuine iris region has been extracted with the aid of several semantic priors, and also the non-iris regions such as eyelashes, eyebrow, glass frame, hair, etc are identified and also excluded as well, which intensely reduces the possibility of mis localizations occurring on the non-iris regions. Secondly, an integrodifferential constellation has been introduced inorder to accelerate the traditional integrodifferential operator, and then, enhance its global convergence ability for pupillary as well as the limbic boundary localization. Thirdly, a 1-D horizontal rank filter as well as an eyelid curvature model has been adopted in order to tackle the eyelashes as well as the shape irregularity, during eyelid localization. Finally, the eyelash as well as the shadow occlusions has been detected with the aid of learned prediction model which is based on the intensity statistics between different iris regions.

All these techniques acquire segmentation accuracy in many areas such as boundary detection, iris detection, pupil and limbic boundary detection etc. But none of these papers provide a solution for attaining overall segmentation accuracy.

Name Approach Performance Disadvantages High confidence visual recognition of persons by a test of statistical independence Integrodifferential operator Very high performance in iris recognition Computational time is very high Iris Recognition: An emerging biometric technology Hough transform Segmentation accuracy achieved up to an extent Does not provide attention to EL as well as reflections etc Recognition of Human Iris Patterns for Biometric Identification Liber Masek's encoding algorithm Localization of circular iris region as well as eyelids, eyelashes and also the reflections occurs Speed of the system is low Iris segmentation methodology for non-cooperative recognition Fuzzy clustering algorithm Better segmentation for non-co-operative iris recognition Thorough search is needed to recognize the circle parameters of both pupil and iris boundaries Toward Accurate and Fast Iris Segmentation for Iris Biometrics Pushing and pulling (PP) method Possess accuracy and speedOccurrence of segmentation error Efficient and robust segmentation of noisy iris images for non-cooperative iris recognition Eight-neighbor connection based clustering iris segmentation accuracy has been attained to an extent segmentation of noisy iris images should be improved.

Table: 1

Name	Approach	Performance	Disadvantages
High confidence visual recognition of persons by a test of statistical independence	Integrodifferential operator	Very high performance In iris recognition	Computational time is very high
Iris Recognition: An emerging biometric technology	Hough transform	Segmentation accuracy achieved up to an extent	Does not provide attention to EL as well as reflections etc
Recognition of Human Iris Patterns for Biometric Identification	Liber Masek's encoding algorithm	Localization of circular iris region as well as eyelids, eyelashes and also the reflections occurs	Speed of the system is low
Iris segmentation methodology for non cooperative recognition	Fuzzy clustering algorithm	Better segmentation for non co-operative iris recognition	Thorough search is needed to recognize the circle parameters of both pupil and iris boundaries
Toward Accurate and Fast Iris Segmentation for Iris Biometrics	Pushing and pulling (PP) method	Possess accuracy and speed	Occurrence of segmentation error
Efficient and robust segmentation of noisy iris images for non cooperative iris recognition	Eight-neighbor connection based clustering	iris segmentation accuracy has been attained to an extent	segmentation of noisy iris images should be improved

4. IRIS IMAGE DATASETS

The accuracy of the iris recognition system depends on the image quality of the iris images. Noisy and low quality images degrade the performance of the system. UBIRIS database is the publicly available database. It consists of images with noise, with and without cooperation from subjects. The UBIRIS database has two versions with images collected in two distinct sessions corresponding to enrolment and recognition stages. The second version images were captured with more realistic noise factors on non-constrained conditions such as at-a-distance, on-the-move and visible wavelength. CASIA iris image database images are captured in two sessions. CASIA-IrisV3 contains a total of 22,051 iris images from more than 700 subjects. It also consists of twins' iris image dataset. ND 2004-2005 database is the superset of Iris Challenge Evaluation (ICE) dataset, uses an Iridian iris imaging system for capturing the images. The system provides voice feedback to guide the user to the correct position. The images are acquired in groups of three called as shot. For each shot, the system automatically selects the best image of the three and reports values of quality metrics and segmentation results for that image. For each person, the left eye and right eye are enrolled separately.

5. IRIS IMAGE CLASSIFICATION

Iris Image Classification Both iris image classification and iris recognition can be globally regarded as the same problem of pattern recognition. It mean classification of iris images into some pre-defined categories. The class labels in the traditional iris recognition is the individual identity and iris images taken from a human eye are defined as the same class so that the dissimilarity between iris images of different subjects should be identified. The main difference between both is the class labels at macro or micro scale. In classification, the class label corresponds to a group of subjects with similar properties of iris images. Therefore the solution of iris image classification is considerably different to iris recognition. Since each subject has unique pattern for

every subject and individually specific features to distinguish different subject's helps to classify the iris images. Local binary patterns (LBP), weighted-LBP, gray level co-occurrence matrix etc. are few of the texture features useful for liveness detection.
Iris has sole characteristics like steadiness of iris patterns during one's life era and is not surgically changeable. Iris recognition consist of diverse tasks like 1) Iris image acquisition; 2) Iris segmentation and normalization; 3) Feature extraction The iris recognition process is essentially separated into four steps:
Iris Localization --> Normalization --> Feature Extraction --> Matching

Localization: Inner and outer boundaries of the iris are extracted.

Normalization: Iris of different people may be of distinct size. The same person may have the varying size because of variations in illumination and additional factors. So normalization is performed to acquire all the images in a usual form appropriate for processing.

Feature extraction: Iris serves ample of texture information, a feature vector is created which consists of the structured sequence of features extracted from a variety of representations of the iris images.

Matching: Feature vectors are classified over different threshold techniques like weight vector and winner selection, Hamming Distance, dissimilarity function, etc.

Once the localization is done then Eyelids and eyelashes that may cover iris are removed. The live-wire is one of the techniques which have been utilized to localize eyelid boundaries based on the intersection points between the eyelid and outer iris boundary. Then iris normalization converts iris image from Cartesian coordinates to Polar coordinators. An alternative method of feature extraction is to apply histogram equalization and binarization to the unwrapped iris image and use a self-organizing map neural network to divide the binary image into nodes, integrodifferential operator, Hough transform, active counter method etc.

6. CONCLUSION

This paper presents a literature survey on the various segmentation techniques involved in iris recognition. There are various techniques that can be used for this purpose. Overall segmentation accuracy of all these techniques has been analyzed. Higher the segmentation rate, thus higher is its performance. Integrodifferential operator has high performance in iris recognition.
The physiological characteristics are relatively unique to an individual. An approach to reliable visual recognition of persons is achieved by iris patterns. The other approaches are based on discrete cosine transforms, corner detection and parametric template methods. The future work in real applications utilization to support generation of compact iris codes for mobile phones and PDAs. In this paper, an attempt has been made to present an insight of different iris recognition methods. The survey of the techniques provides a platform for the development of the novel techniques in this area as future work.

7. REFERENCES

[1] Yung-Hui Li and MariosSavvides, "An Automatic Iris Occlusion Estimation Method Based on High Dimensional Density Estimation", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 35, No. 4, pp. 784-796, 2013.
[2] UpasanaTiwari, DeepaliKelkar and AbhishekTiwari, "IRIS recognition based on PCA based Dimensionality reduction and SVM", International Journal of Computer Applications, Vol. 49, No. 3, pp. 28-31, 2012.
[3] V. V. S. Tallapragada and E. G. Rajan, "Improved kernelbased IRIS recognition system in the framework of support vector machine and hidden Markov model", IET Image Processing, Vol. 6, No. 6, pp. 661-667, 2012.
[4] GU Hong-ying, ZhuangYue-ting and Pan Yun-he, "An Iris Recognition Method based on Multi-orientation features and Non-Symmetrical SVM", Jounal of Zhejiang University science, Vol. 6A, No. 5, pp. 428-432, 2005.
[5] J. Daugman, "High confidence visual recognition of persons by a test of statistical independence", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 15, No. 11, pp. 1148-1161, 1993.
[6] J. Daugman, "Statistical richness of visual phase information: update on recognizing persons by iris patterns", International Journal of Computer Vision, Vol. 45, No. 1, pp. 25-38, 2001.
[7] Richard P. Wildes, "Iris recognition: An emerging biometric technology", Proceedings of the IEEE, Vol. 85, No. 9, pp. 1348-1363, 1997.
[8] L. Ma, T. Tan, Y. Wang and D. Zhang, "Personal Identification Based on Texture Analysis", IEEE Transaction on Pattern Analysis and Machine Intelligence, Vol. 25, No. 12, pp. 1519-1533, 2003.
[9] L. Ma, T. Tan, Y. Wang, and D. Zhang, "Efficient iris recognition by characterizing key local variations", IEEE Transactions on Image Processing, Vol. 13, pp. 739-750, 2004.
[10] Wageeh Boles and BoualemBoashash, "A human identification technique using images of the iris and wavelet transform", IEEE Transactions on Signal Processing, Vol. 46, No. 4, pp. 1185-1188, 1998.
[11] Fadi N. Sibai.Hafsa I. Hosani, raja M. Naqbi, SalimaDhanhani, ShaikhaShehhi, "Iris Recognition Using Artificial Neural Networks", Elsevier, Expert Systems with Applications, Vol. 38, No. 5, pp. 5940-5946, 2011.