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The Application of Cellular Learning Automata in Individuals' Identification on the Basis of iris Image

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ABSTRACT

Using biometric methods is one of the methods widely used for individuals' identification. In this system, unique characteristics of individuals are used such as fingerprint, face recpgnition, image detection of iris or retinal, the form of ears and complex tissue, and the part nearer to pupil is called crinkle part. This area has an intensive tissue placed near to each other. An identification system on the basis of iris involves four steps as follows: step 1: getting the image and pre-processing, step 2: Segmentation, step 3: Normalization, step 4: features and characteristics extraction, and step 5: adaptation and Classification. Pre-processing step involves three steps such as zoning, normalization and recovery. In this study, the application of cellular learning automata is studied in image pre-processing constituted of simple components, and the behavior of each element and component is determined and improved on the basis of neighbors behavior and previous experiences. In this method, cells show a complex behavior by interacting with each other. Image features involving edges, lines, borders and etc can be extracted in machine sight and image processing by using some mathematics operations sight and image processing by using mathematics operations such as edge detection by gradient or by through applying suitable filters. By extracting these features, processing area can be segmented with higher precision. Cellular learning automata can be applied in terms of edge and border detection.

Keywords: *Cellular Learning Automata, Identification, iris, Moor Neighborhood, Canny.*

1 INTRODUCTION

Due to increasing security problems, most companies and governments use biometric methods for individuals' identification Biometric detection methods such as face recognition, fingerprint, and iris detection are used for applications having more importance. Among various methods of biometrics, iris detection is considered as the most precise and reliable method. In this method, the patterns of iris tissue are analyzed [1, 2]. Iris of human has a complex structure that is completed during embryogen periods, and iris does not change during life. This tissue has been placed inside the eye, and it is a protected organ so environment does not affect it. In addition, it is accessible, and imaging can be easily used for iris [1]. Due to these features and characteristics, iris tissue is taken into account as an ideal detection method [11].

2 LITERATURE

Various methods have been proposed to detect iris. Some of these methods have been introduced in this section. Ragman [1, 3, 5, 10] has considered differential integral operator in his method to detect iris, and upper and lower eyelid is separated by two arcs. This method can be considered as Hough transform changes because the first deviation of image is used to search. If initial image has noise such as the noise resulting from reflections, then an incorrect reply may be obtained. Also, more time is required to find the borders. Wildz [1, 3, 4] considered segmentation by using filtering, and modeled them with horizontal parts. The noises resulting from pupils and eyelashes have not been taken into account in this method. Tisse [3, 5] presented a method for iris segmentation on the basis of differential and integral operators. He decreased computation time of Dogman method, and he removed the possibility of placing the center outside eyes image. In this method, noises resulting from pupils and eyelashes have not been also considered [6, 7]. [6, 7] have used filtering to find edge points and Hough conversion for segmentation. In this method, noises resulting from pupils and eyelashes have been considered. Kang and Zhang [6,8] presented a method to identify eyelashes. In this method, separate eyelashes are indentified by using Gabor one-dimensional filters, and eyelashes stuck together are indentified by using the variance of light intensity. Then, the borders are obtained by using edge finder and linear Hough transformation.

3 THE STRUCTURE OF IRIS IDENTIFICATION SYSTEMS

An identification system based on iris image has four steps involving getting image, pre-processing, features extraction and adaptation.

3.1 Getting the Image

In this case, imaging is performed by using relative strong cameras via indirect light so that light reflection in iris is avoided, and next steps are easily performed. Image obtained from iris does not only involve iris area, and pupils, eyelids, eyelashes and reflections are observed. A sample of these images has been shown in figure 1. In next processing, iris images are firstly segmented. In this section, we study the application of cellular learning automata and its immediate effect on speed and quality of iris image segmentation.

3.1.1 Pre Processing

Identification is considered by using the patterns available in iris tissue. The image must have desirable quality in terms of contrast. With regard to imaging conditions and the location of light source, light may not be uniformly distributed in all iris surfaces. Therefore, pre-processing is used in this case, and this step involves segmentation, normalization and recovery. In this step, the image of gray phase is processed through using cellular learning automata so that the image noise is deleted, and other steps involving segmentation and normalization are considered.

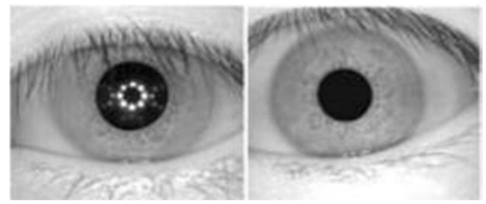

Fig. 1. Captured image from eye

3.2 Segmentation

Some of the pixels of an image have special features and characteristics, and distinguishes them from neighbors. These pixels are called feature pixels. The purpose of cellular learning automata is to find and determine these pixels so that borders and features of iris image are specified with higher precision and quality. A pixel is determined as a feature pixel by cellular learning automata and through applying the local law in neighboring considered for each pixel, and each automaton involves two actions. One action is related to search feature, and another action is related to lack of search feature in that pixel. Each automaton selects one of its own actions, and compares it with its neighbors. In this case, it performs its action or changes it. The neighboring space of each cellular learning automaton is like circle space in each pixel such as P. Its center is P, and its radius is K. In fact, pixels of this space are neighbor pixels of automata located in the pixel. The neighboring one with radius of 1 has been shown in figure 2, and I1-I8 and central automata are its eight neighbors. Each pixel is connected to eight neighbors in a two-dimensional network. Local law to consider record or fine is explained as follows. At first, the number of pixels that have gray surface and are near to central pixel is determined. If their number is more than one threshold, reward is resigned to the selected action; otherwise, it will be fined. Determining the number of threshold depends on the considered feature. For example, as it has been shown in figure 3, fifty automata of cell neighbor with the value of 53 and gray surface are close to it. In this section, the efficiency of cellular learning automata in feature extraction of this image is investigated.

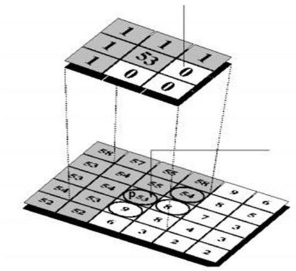

Fig. 2. 30 automata

At the beginning, we consider the number of automata that have selected the first action lesser than automata that have selected the second action. In each repetition step, each automaton compares its own status and position with the neighbors position, and in this way, it improves its own behavior. The way of evaluation of decision making of each automaton in each step is as follows. If a cell selects its own action in cellular learning automata; in other words, it detects the corresponding pixel as the edge, then the selected actions is appropriate, and reward is assigned to it when the number of automata in hexagonal neighbor is between 2 and 4. In other words, a pixel is considered as the edge if it is between two and four. If a cell of automata is one or more than four in hexagonal neighbor of the cell selected that action, then the selected action is appropriate, and reward is assigned to it; otherwise, the selected action is inappropriate, and it will be fined. Therefore, we repeat the above mentioned operations until all automata reach a stable status, and no automata changes its own status and position. The performance of the promised method in edge extractions of various images has been shown in figures 4-6. In this step, inner and outer borders of iris are specified, and eyelid border is extracted [4].

3.3 Normalization

After separating iris from other parts, normalization step is performed. Due to some factors such as camera or changing the size of pupil resulting from changes of environment light and moving the head, some changes occur in iris, and they cause some disorders in iris [5]. In order to prevent the effects of these factors, iris is normalized. In normalization step, iris is changed to a rectangular area with uniform and fixed dimensions. In this step, Daugman taping model is used [8]. According to figure 7, this method transfers each point of iris to a point located in polar coordinates (r, θ).

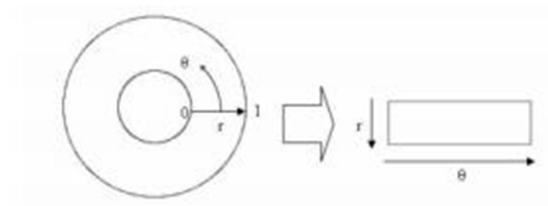

Fig. 3. John Daugman Method for Normalization

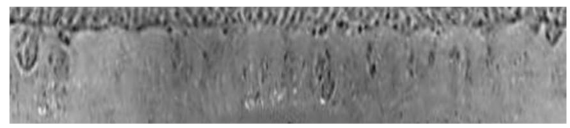

Fig. 4. iris rectangle extracted by Daugman Method

3.4 Features extraction

Features extraction reduces the iris complexity, and it increases detection precision. In this step, some algorithms such as Gabor filter are used to extract feature vectors and we use Cellular learning automata to detect features on image, features covering properties like edges and boundary that detect by CLA.

Fig. 5. feature extraction by CLA from extracted iris

3.5 Adaptation or Classification

In this step, the features and characteristics extracted from iris are investigated. Usually, Haming distance computation is used to compare the features extracted from iris [10]. Haming distance shows difference percent between two iris codes. If it is close to Zero, then it will have more differences but Recently, the use of statistical methods to increase, These methods are based on the statistical properties of the features extracted from the images and variance of extracted features, more variance gives better results. We use Knn, SVM and NB methods in classification or recognition.

Table 1: svm, k-nn and NB methods on feature exteracted by CLA and data by various Variance V meaning Variance

method	V>3	V>2.5	V>2	V>1	Total samples
SVM	82(0.3 sec)	91(0.37 sec)	95(0.43 sec)	99(0.5 sec)	100(1.2 sec)
K-NN (k=2)	92(0.4 sec)	97(0.52 sec)	97(0.65sec)	100(0.89 sec)	100(1.5 sec)
NB	91(0.35 sec)	97(0.4sec)	98(0.7sec)	99(0.92 sec)	100(1.87 sec)

4 CONCLUSION

In this study, the application of cellular learning automata to extract image features and characteristics has been studied in order to be used in identification systems on the basis of iris image. One of the most important characteristics of the proposed methods is efficiency of image feature extraction operations when the image is noisy. cellular automata approach to salt pepper noise due to low sensitivity of neighboring patterns. The width of a point to detect edges and thin edges are produced. we have a few toys. Also, iris borders and eyelid lines are easily detected. Another characteristic of the proposed method is distribution, and its parallelism is possible. In addition, this method relies on local operations in each pixel neighboring, and in this way, implementation can be simply performed, feature extracted from a data set that include 100 iris image from 10 various persons we use 90% of data for train system and 10% of data for test, in continue show some of images that process by Canny and morphology method and feature extraction variance diagram.

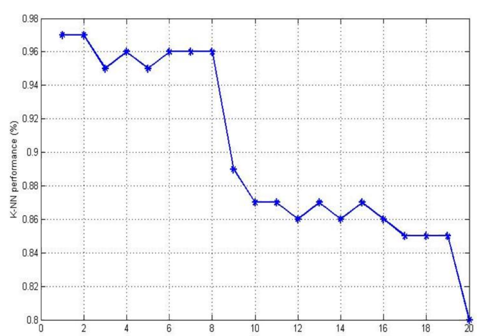

Fig. 6. K-nn method performance for various neighbor and Variance 2

Fig. 7. feature extracted by canny method

Fig. 8. feature extracted by morphology method

Table 2: Time of feature extraction and classification on different methods on 10 image

Time of classification for 10 image	Feature extraction time	K-NN	NB	SVM
CLA	1.018081e+02	6.088128e-01	3.712208e-01	1.863205e-01
Canny	9.216701e+01	3.238029e-02	1.905971e-02	1.021154e-02
Morphology	9.110258e+01	3.098101e-02	1.884973e-02	4.624229e-03

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