EFFECTIVE APPROACH FOR SECURE IDENTIFICATION USING IRIS RECOGNITION SYSTEM

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Abstract – Iris pattern recognition is one of the most trustworthy biometric identification technologies and it is a biometric identification and authentication approach that employs recognition algorithms on pictures of a person's eyes. In this research, an iris recognition system is used to provide secure authentication (M Patil and Gowda, 2017). Iris texture is a natural password with several benefits, including variability, stability, and unique characteristics for each individual, as well as its impact in the field of security. It puts an iris recognition technology ahead of various biometric human identification systems. The development of intelligent systems capable of identifying people on the basis of texture of their iris has recently piqued the interest of scientists. Using local and directional texture information, we suggested a new feature extraction method. The suggested feature extraction approach obtains local and global pertinent data while being faster than other methods. Using the CASIA iris dataset, the system is compared with various well-known and newer iris recognition systems in the experimental sections. Experiments show that the suggested system outperforms previous systems in terms of recognition rate (99.96%). (Hamouchene and Aouat, 2016)

Keywords: *Iris authentication; secure identification; biometric recognition;* Image processing; Iris recognition

Introduction

Security for systems is becoming increasingly important in today's statistical technology. A considerable number of structures that have been breached is growing all the time, and authentication is a critical initial line of protection against invaders. As financial losses from computer-based fraud, such as computer hacking and identity theft, rise year after year, modern e-safety is in desperate need of finding accurate, comfortable, and cost-effective replacements to passwords and personal identifying numbers. Biometric solutions address these basic issues since individual's biometric information is unique and cannot be transmitted. (M Patil and Gowda, 2017).

In many crucial domains, traditional identifying techniques including keys, ID cards and passwords are insufficient. All of these traditional methods have significant security flaws. These techniques could be forgotten, stolen, imitated, broken, or even hacked. In today's e-security study, disparities in humans, like shape and behavior, are used to automatically distinguish between individuals. The main issue in this field is identifying and controlling access to restricted areas. As a result, recent advances in security sciences have piqued interest in biometric-based automatic identification and authentication systems. (Hamouchene and Aouat, 2016)

Biometrics has recently brought solutions to the authentication dilemma. Indeed, biometric data gathered from a person is one-of-a-kind and cannot be duplicated or stolen. Biometric authentication is a means of identifying people that is automated. Physiological and behavioral characteristics are separated into two categories in this technique. Physical features include aspects of a individual's appearance, such as the face, recognition of the iris and finger image. The person's behavior is referred to as behavioral traits. (Hamouchene and Aouat, 2016) Signatures, voice verification, and keystroke dynamics are all included in this section. For nearly 25 years, the finger identification system is in operation. For identification, face and voice recognition have been used as well. Iris identification is the most reliable system among numerous physical traits. The iris has several features that put it ahead of other biometrics systems. (Hamouchene and Aouat, 2016). It offers the advantages of being contactless, having a low mis-identification rate, and requiring no prior information from the user to begin using this approach. Iris is highly shielded from the surrounding environment since it is a part of the eye's inner a portion of the eye, and its patterns are strong through the lifespan. The iris is a thin circular anatomical structure in the eye that is an annular component between the black pupil and the white sclera. The iris contains a variable sized hole known as the pupil. It has a visual function, which is expressed by the texture of the iris. (M Patil and Gowda, 2017).

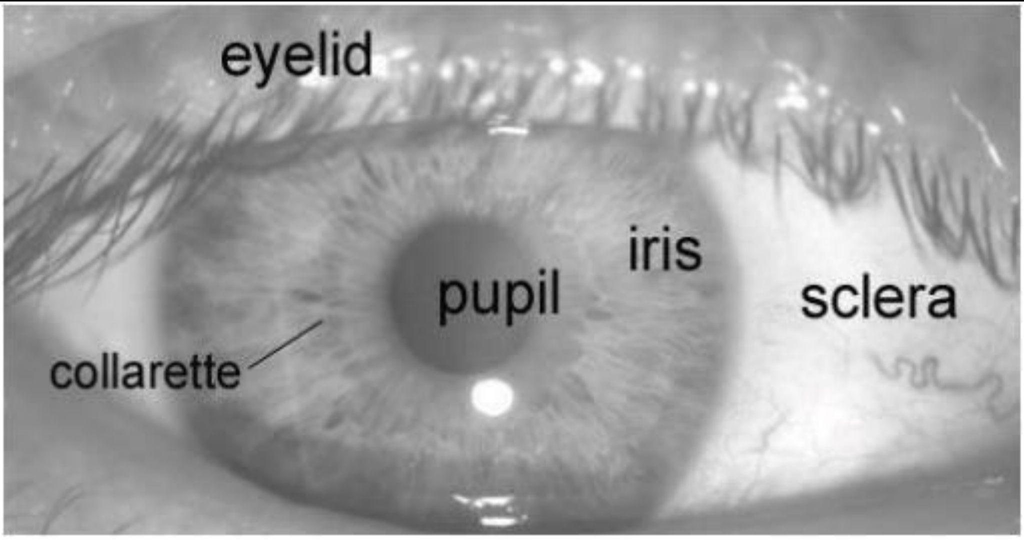


Figure 1. Front view of iris

Figure 1 depicts the iris from the front. To control the quantity of light entering the eye, the iris's muscle tissues (sphincter and dilator) either expand or contract the pupil, the center opening of the iris. (M Patil and Gowda, 2017).
Iris is a component of the body that is seldom injured, unlike other body parts like fingers and hands. As a result, an iris identification system may be noninvasive to its users, which is a critical feature in the real world. Iris has a texture that is both stable and invariant across time. Another benefit is that each person's iris is distinct, even amongst siblings or twins. (Hamouchene and Aouat, 2016)

Iris datasets

In the last thirty years, biometric recognition has grown in popularity. Over the years, a lot of work has gone into developing accurate iris recognition algorithms. Iris recognition systems now in use analyze the iris for traits that can be used to identify a person. A complete test on an iris dataset consisting of a range of iris photos is required to analyze and evaluate the performance of these systems. As a result, a variety of iris databases have been developed to help with these tasks. Here are the several publicly available iris datasets: (Ghaffari, Hosseinian-Far and Sheikh-Akbari, 2017)

- CASIA dataset which is from Chinese Academy of Science with four editions in 2010
- BATH dataset by Smart Sensor Limited in Bath University in 2007
- MMU dataset created by Multimedia University in 2010 and it has two editions
- ICE dataset discovered by National Institute of Standards and Technology in 2011
- WVU dataset by West Virginia University in 2007
- UBIRIS dataset by SOCIA lab in 2010 and it includes noisy iris images.

Iris recognition system

Image acquisition with preprocessing including feature extraction, and matching are the primary phases in an iris recognition system.
The image acquisition stage involves a number of systems. The camera, namely, the lighting system (to acquire an illuminated and clear image), the position system (to acquire the exact iris picture for each repeat), and the lighting system (to produce an illuminated and clear image) (to obtain good-quality image). Several factors have a direct influence on the system's recognition rate at this level. To begin, the camera or sensor quality has a considerable influence on the iris picture quality. Second, the iris picture must be crisp and clear during the capture of the sequence of iris images. For identification, the clarity and sharpness of the boundary between the pupil and the iris is crucial. The identification of the iris is also influenced by three factors: brightness, distance, and acquisition angle.
The preprocessing procedure is the second stage. Variations in the size of the same iris can be caused by changes in the distance between the camera and the eye. The brightness is not evenly distributed due to the

nonuniform light, and the size of the iris may change. Furthermore, the resulting eye image incorporates not only the iris region, but also non-essential information such as lid and eyelash disruption in the iris image. These steps result in a rectangular iris with a smooth texture.

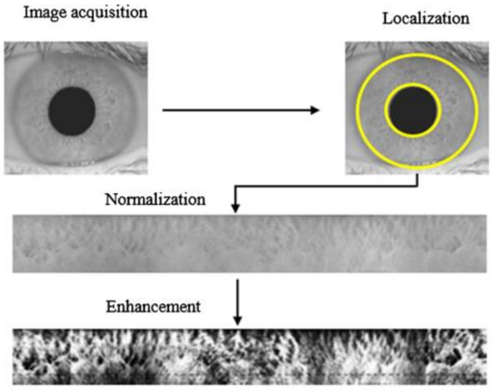


Figure 2. Preprocessing steps

The human iris is a fascinating and complicated structure that holds a great deal of information. As a result, the goal was to use a representation approach to extract relevant patterns from iris texture. The primary step in an iris recognition system is this one. Frequency and oriented unique patterns make up the majority of the iris texture. To define iris texture, several research have been proposed [17,26]. Daugman proposed in 1994 that the texture be described with a frequency domain 2D Gabor filter. On the normalized iris, he used the two-dimensional Gabor filter with the multiscale quadrate technique. The real and imaginary parts of the Gabor coefficient's signs are encoded with this approach. The number 1 denotes a positive Gabor coefficient, whereas 0 denotes a negative one. Each pixel has two bits of information embedded in it.

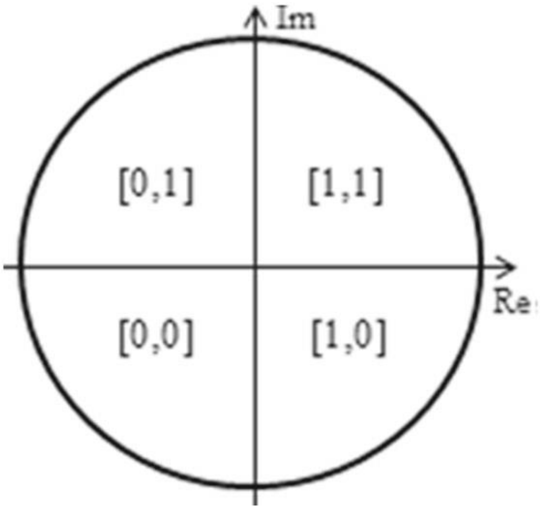


Figure 3. Method of Multiscale quadrate

At the completion of the encoding procedure, a binary template is obtained. As a result, from the acquired iris picture, which serves as its template, a binary code is formed. As seen in Fig.4, the binary code obtained is referred to as "iris code." After the creation of the iris template, the matching method is used to identify the iris' identification.

Limitations

Iris is modest and cannot be seen from a distance of more than a few meters. To be correctly enrolled on the system, a person must be within close proximity to the iris scanning gadget. As a result, a correct setup is required to begin the iris recognition process. (Mehedi, 2018)

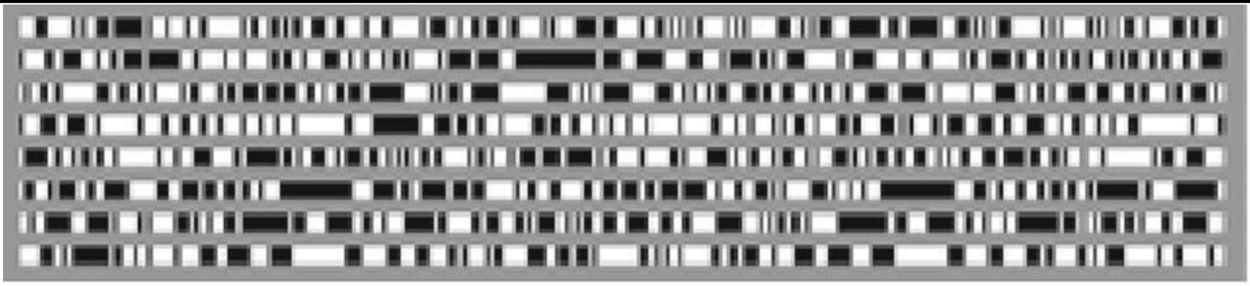


Figure 4. Proposed Iris code by Daughman

To be enrolled by iris scanners, a person must be still in front of the equipment. It means that this gadget cannot be used to scan anyone, independent of their actions, in the same way that face recognition systems can. It can be tough to maintain enough control to complete the scanning process on the first try. (Mehedi, 2018)

Reflection: The presence of reflections can make iris scanning difficult in some instances. It could happen if you have eyelashes, contact lenses, or anything else that reflects light. Because these are not uncommon in contemporary society, people may encounter difficulties throughout the iris scanning process. (Mehedi, 2018)

Cost

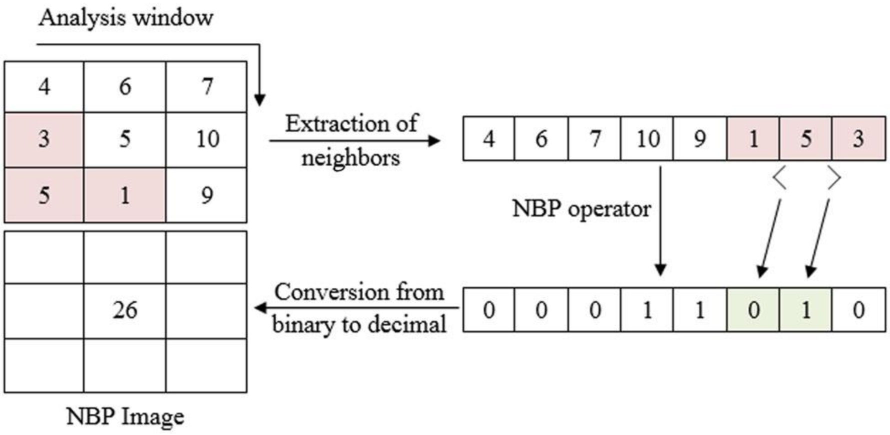
Biometrics	Accuracy	Cost	Size of template	Stability	Security level
Finger print	Medium	Low	small	Low	Low
Facial recognition	Low	High	Large	Low	Low
Voice recognition	Low	Medium	Small	Low	Low
Iris scan	High	High	Small	High	Medium
Finger vein	High	Medium	Medium	High	High
Hand Geometry	High	Medium	small	Medium	Medium
Retina	High	High	small	Low	medium
Signature	Medium	Low	Medium	Low	Low

Price is another limitation for iris recognition. Although it is costly, it can provide better security and exceptional accuracy with splendid stability. Since corporations and bigger companies and organizations are concerned about those issues, iris will be superior choice for the to implement.

Methodology

The proposed feature extraction approach will be explained below. Local variation and neighbor-to-neighbor interactions are the foundations of the neighborhood-based binary pattern (NBP) approach. The entire iris image is first subjected to a three-pixel processing window. Each of the neighbors of the center pixel is given a threshold by the following neighbor. If the gray value of one neighbor (of the central pixel) is greater than the gray value of the next neighbor, this neighbor is encoded as 1 and 0 otherwise. The top left and top center neighbors are compared, and vice versa. Finally, the binary code is converted to a decimal number, which is then utilized to replace the value of the central pixel. The relative information between pixels' neighbors is represented by this value. Figure 5 depicts the encoding procedure.

Figure 5. Encoding process of NBP



The NBP encoding procedure is depicted in Figure 5. The encoding method for the three red pixels (in Fig.5), for example, is as follows: The pixel with the gray value 1 is smaller than its neighbor (5). As a result, the integer 0 is used to represent this transition (first green pixel). The pixel 5 is, on the other hand, greater than 3. As a result, the integer 1 is used to represent this transition (second green pixel). Finally, as shown in the NBP graphic, the resulting binary code is translated into a decimal number (26). Figure 6 shows the application of the NBP approach to an iris picture and the resulting NBP picture.

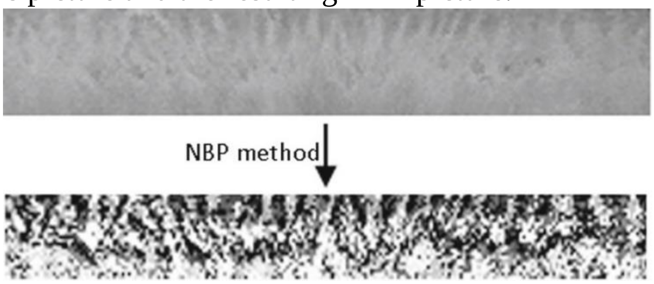


Figure 6. NBP Iris image

In order to describe the texture features, the NBP image acquired (Fig.6) is then approached using a two-dimensional discreet normalized pattern histogram. The NBP histogram collects the incidents of each pattern, as shown in Fig.7.

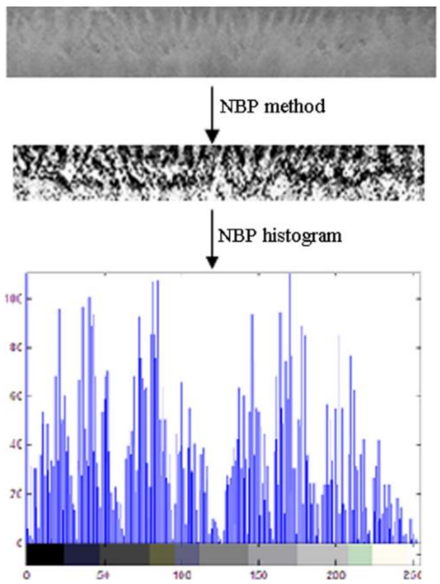


Figure 7. NBP descriptor

The computing time is one concern that still needs to be resolved. In fact, 256 bins in the NBP histogram takes longer to extract and compare. We have implemented an invariant NBP approach to tackle this vulnerability. The NBPmethod is the foundation for the rotation invariant NBP technique (RINBP). The encoding procedure is the emphasis of this method.

The encoding procedure begins with the topmost neighbor, not the top left neighbor. As a result, even if the pattern is rotated, the binary code recovered will remain the same. Figure 8 depicts this procedure. The RINBP technique is depicted in Figure 8. The two-analysis windows are rotated, which is visible. The two extracted binary codes are the same in this rotation as well. The encoding process, in fact, begins with the greatest value (9). As a result, the encoding process for the first window begins with the middle right neighbor, whereas the encoding process for the second picture begins with the top middle neighbor.

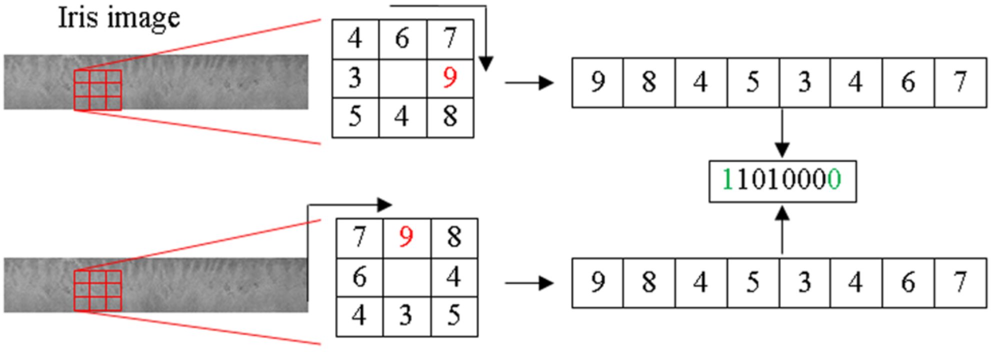


Figure 8. RINBP method

In-depth analysis

The suggested iris recognition system is depicted in detail in Figure 9, beginning with the preprocessing processes. The RINBP image is then extracted using the proposed feature extraction method (RINBP). The resultant RINBP picture is then split into eight identical chunks. Each block's RINBP normalized histograms are extracted. The related histograms have the same color, as can be seen. Finally, the model grid is calculated using the mean histogram of each group. The input iris image will be described using the model grid. The proposed approach is employed in order to compare two irises. The two model grids obtained are calculated. The distance between each histogram in the first grid and all of the histograms in the second grid is compared. The highest possible degree of similarity is saved. Finally, the global similarity between the two irises is determined by taking the mean of the stored similarity values.

The phases in the assessment process are as follows: First, each person's iris is photographed. To get the model grid, the suggested approach is applied to an iris picture. This individual is given the extracted model grid. Finally, each person's reference database is created. The evaluation procedure is begun after extracting each person's model grid. Each iris picture is subjected to the suggested system. All iris pictures' model grids are retrieved. Each model grid is compared to the reference database and assigned to the individual who is the most similar. Figure 10 depicts the assessment procedure.

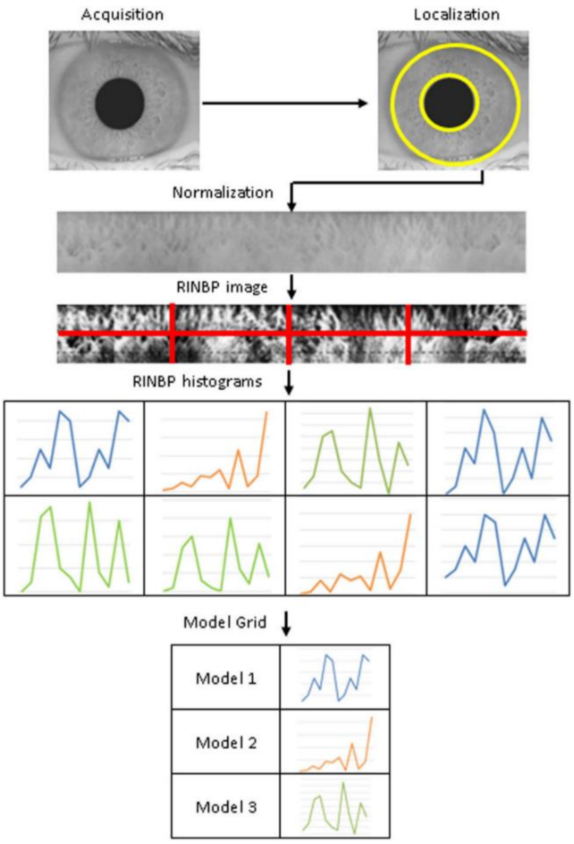


Figure 9. Suggested iris recognition system

The evaluation method is depicted in Figure 10. From the input iris picture, the rotation invariant NBP picture is extracted.

Then, the model grid is computed (Fig.9). The extracted model grid is then compared to all of the reference database's model grid. Finally, the most comparable individual is assigned to the provided iris picture.

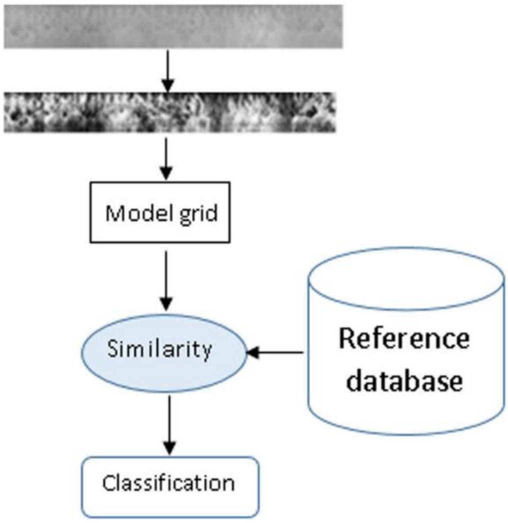


Figure 10. Process of evaluation

Here is a comparison table with some well-known systems. Masek and Wildes have 94.82 percent and 86.49 percent, respectively. Using Izem et al., the RR is 97.59 percent. The RRs for Han et al and Rai et al systems are quite good, with 98.25 and 99.91 percent, respectively. Finally, our suggested system had the highest identification rate of 99.96%. The experimental findings reveal that the suggested system outperforms competing systems in terms of recognition rates. The suggested system's major advantage is the extraction of histogram models from the iris picture and the use of the RINBP approach, which is faster than other methods.

Table 2. Recognition rate of every person

Iris recognition system	Recognition rate (%)
Masek	94.82
Wildes	86.49
Izem et al.	97.59
Han et al.	98.25
Rai et al.	99.91
Proposed system	99.96

Conclusion

We suggested a novel iris recognition technique in this assignment. The feature extraction process is the emphasis of the proposed system. To extract robust information, we used a recent feature extraction approach (NBP) and its rotation invariant version (RINBP). Then, in order to explain the iris texture, we derive a histogram model from the RINBP iris picture. Finally, the categorization and the model grid are compared. We put our suggested system to the test in the experimental section. CASIA, a public iris picture library, is utilized to assess the suggested iris recognition system's performance. When compared to other contemporary and well-known systems, our suggested system performed well (99.96%). The suggested system's advantages account for this improvement. The suggested system's key benefits are the use of the RINBP approach and the use of only one iris picture as a reference.

Finally, it can be stated that iris is highly secure, strongly protected contactless recognition system which is worth to implement it. Deep research has been done in terms of its advantages, cost, limitations, recognition rates and at the end of the day successful recognition method with splendid recognition rate has been discovered.

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