THE APPLICATION OF DIFFERETIAL BOX-COUNTING METHOD FOR IRIS RECOGNITION

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Tajuk Projek : The Application of Differential Box-Counting Method for Iris Recognition

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ABSTRACT

Biometrics technology is a part of technology which controlling the personal identification and verification systems, which use to secure any important informations. One of the biometrics technology is the iris recognition system. Iris recognition system is technology that recognize the human eye as the person identification in the verification system. The uniqueness of the iris, makes this iris recognition system is one of the most secure verification system. The possibilities of human having the same irises pattern is almost to zero. It is also non-hackable system if compares with PIN based identification. Therefore, in this project the Differential Box-Counting Method was introduced in feature extraction process in order to evaluate the performance of this method in iris recognition system. A neural network tool in MATLAB is used to evaluate the performance of the system. The performance of this method is expected to achieve 80% of recognizable.

ABSTRAK

Teknologi biometrik adalah sebahagian daripada teknologi yang mengawal identiti dan pengesahan untuk sistem peribadi, dan ia juga digunakan untuk melindung segala maklumat yang penting. Salah satu teknologi biometrik adalah sistem pengesan mata. Sistem ini menggunakan keunikan mata sebagai pengecam identiti manusia. Keunikan mata menjadikan sistem ini salah satu sistem pengesahan yang paling selamat diantara system lain yang sedia ada. Kebarangkalian manusia mempunyai corak mata yang sama hampir kepada sifar, menjadikan sistem ini antara system yang selamat untuk digunakan. Ia juga merupakan sistem yang tidak boleh digodam dengan mudah, jika dibandingkan dengan sistem yang berasaskan nombor PIN. Oleh itu, dalam projek ini teknik Differential Box-Counting digunakan dalam proses pengekstrakan ciri untuk menilai prestasi teknik ini dalam sistem pengesanan mata. Alat rangkaian neural dalam MATLAB digunakan untuk menilai prestasi system ini. Prestasi kaedah ini dijangka mencapai 80 % dapat dikenali.

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CHAPTER 1

INTRODUCTION

1.1 Project Introduction

Private information is normally provided by using passwords or Personal Identification Numbers (PINs) for authentication, which are easy to implement, but it is exposed to probability that user forgotten their password. Biometric technology, which is uses human physiological character for personal identification, is a more effective alternative to replace the PIN based authentication techniques [1]. In biometrics nowadays, iris recognition is a type of physical identification that is based on the personal and unique characteristics of the iris, the colored ring around the pupil of an eye. Similar to the more common fingerprint recognition, iris recognition is based on scanning a person's iris and comparing the scan to a stored photograph or template to make an identification match [2].

Current iris recognition systems perform the iris identification matching with high computational complexity. This new iris recognition system is very effective because it can reduce the searching time and computational complexity, and it is also can increase the accuracy of the recognition system [3]. However, the potential requirement of obtaining high accuracy is that users supply iris images of good quality. Current iris recognition systems require only frontal view images of good quality and remove poor quality images by evaluating qualities of images [4].

The iris image database will be computed in order to find the estimation fractal dimension of the image. The methods that can be used for image fractal dimension estimation are such as Hausdorff dimension, box-counting dimension, differential box-counting method and many more. The box-counting method is widely used because of it's computability and conveniently. In those methods based on box-counting dimension estimation, the main methods are the differential box-counting method (DBCM) and probability method (PM), while differential box-counting method is more widely applied [5].

1.2 Objectives of this project

The main goal of this project is to use the differential box-counting method in the iris recognition system. Specifically, the main objectives of this project are:

a) To apply the application of differential box-counting method in iris recognition
b) To evaluate the performance and the accuracy of the differential box-counting method by using neural network.

1.3 Problem Statement

There are several problems that occur in iris recognition such as inaccurate in capturing the image pattern, texture analysis and segmentation, and shape measurement. This differential box-counting method is the easiest method to use in image recognition because of its simplicity, automatic computability and more accurate in image processing [5]. The normal box-counting method has the disabilities in capturing or measuring the gray scale image because it is mainly measuring the binary image rather than gray scale image. So, the differential box-counting method offers the solution in measuring a grayscale image and it is also more effective than the box-counting method [6].

1.4 Scope of Project

The scope of this project is to perform the neural network classification and measure the performance of the classification. The neural network classification should result an 80% of accuracy. The iris image database will be obtained at CASIA website. The MATLAB software will be used to program the algorithm to compute the fractal dimension for iris image. To compute the fractal dimension of iris images, the differential box-counting method will be used. About 50-100 iris image database will be computed and also about 10 of humans irises will involve in this research.

1.5 Project Limitation

This project has a limitation of the study. In this project, only about 50-100 iris images and about 10 human irises will be used to perform the neural network classification and fractal dimension. Only MATLAB software will use to perform the neural network classification. For the fractal dimension estimation, only differential box-counting method will be used.

1.6 Report Structure

This thesis is a combination of five chapters that contain the introduction, literature review, methodology, result and discussion and the last chapter is the conclusion and recommendation of the project.

Chapter 1 is an introduction to the project. In this chapter, we will explain the background and objectives of the project. The concept behind the project and an overall overview of the project also will be discussed within this chapter. Chapter 2 tells about the literature review of the application of differential box-counting method based upon previous research done.

Chapter 3 will explain about the project methodologies of the project. This chapter will show the steps and flow for problem solving in such a specific method used to estimate the fractal dimension or feature extraction using the differential box-counting method and the neural network classification in order to find the 80% of accuracy will be focused on.

Chapters 4 describe the expected result from this project and justify its performance to make sure it meets the objectives of the research. Finally, Chapter 5 concludes the whole research and proposes the future progress of the project.

CHAPTER 2

LITERATURE REVIEW

This chapter will explain and discuss about the literature which is related to iris recognition and the implementation method that has been studied from different resources to perform this project.

2.1 Introduction

Biometric identification or verification of identity is currently a very effective system for recognition. Many applications that require the personal identification for authentication, such as banking, computer network access, or physical access to a private facility, are replacing the current system such as a PIN number or access card. These PIN numbers and card access are easy to exploit or hackable [1]. A higher degree of confidence can be achieved by using unique physical or behavioral characteristics to identify a person, this is biometrics. A physical characteristics such as iris pattern, fingerprint, facial feature, is a very stable characteristics and very suitable to use for identification system because the probability of having the same physical characteristic is almost to zero [8].

Figure 2.1: Example of iris pattern

As a vital and different trademark for status, the iris has numerous focal points, for example, uniqueness, steadiness, and many more. Non-contacting biometrics are the unavoidable pattern of the examination and the advancement of status identification. The error rate of iris distinguish is the most minimal in all the biometrics as indicated by the statistic [7].

To enhance the accuracy, the vast majority of the biometric verification system store numerous templates for every user to record for varieties in biometric information. Consequently, these systems may experience the problem of not enough storage room and computational overheads. With a specific end goal to address these issues, the system must be monitored and upgrade if needed and optimize the computational by making a solid example, an iris format for every user instead of keeping up numerous templates [9].

Thus, there are many methods that have been produced and proposed by researchers in order to increase the performance iris recognition system. Those methods are believed to be the most effective methods to be approachable in the iris recognition system.

2.2 Iris Recognition System

The iris recognition process consists of 5 major steps. The first step is the image acquisition of a person's eye at enrollment time or check the time. The second step is to segment the iris out of the image containing the eye and part of the face, which localizes the iris pattern. Step three is the normalization; here the iris pattern will be extracted and scaled to a predefined size. Step four is the template generation, here the details of the iris are filtered, extracted and represented in an iris code. The last step is the matching phase, where two iris codes will be compared and a similarity score are computed [9] [10]. These steps are shown schematically in Figure 2.2.

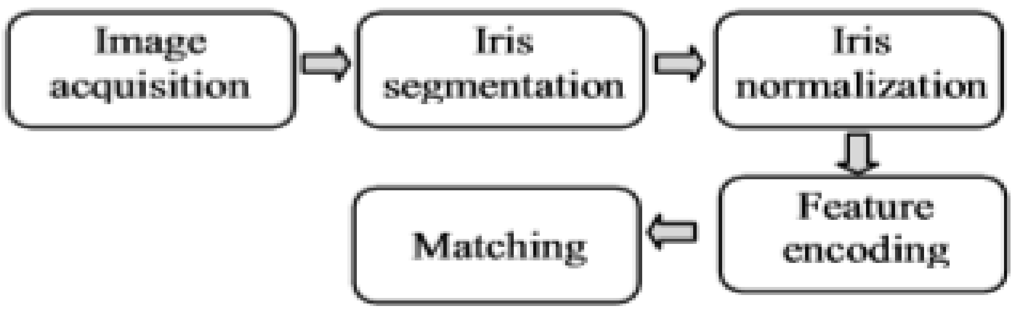

Figure 2.2: Iris recognition system

2.2.1. Image acquisition

Acquisition of the eye image includes the lighting system, positioning system and the physical capture system. During this process, the iris image in the input sequence must be clear and sharp. A high quality image must be selected for iris recognition [13]. This image database can be downloaded from the internet such as CASIA website. The sample of the iris images is shown as figure below.

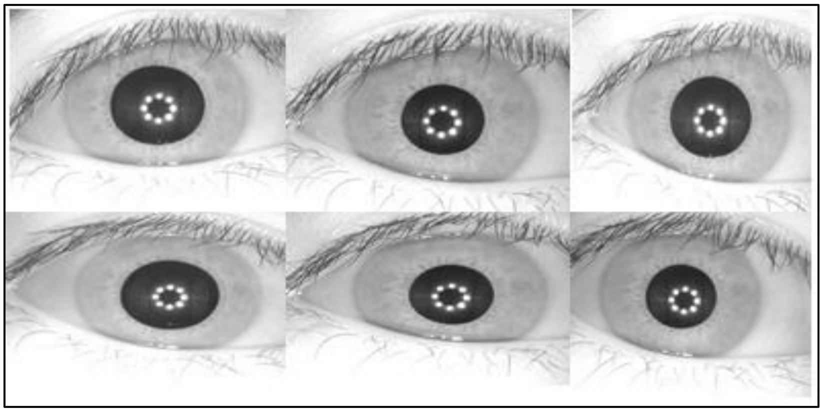

Figure 2.3: Sample of iris images from CASIA

2.2.2. Segmentation

A good segmentation algorithm should involve two procedures, iris localization and noise reduction. The iris localization processes take the acquired image and find both the boundary between the pupil and iris, and the boundary between the iris and the sclera. The noise reduction process refers to localizing the iris from the noise (non-iris parts) in the image. These noises include the pupil, sclera, eyelids, eyelashes, and artifacts. Figure 2.4 shows the iris segmentation step [9] [10].

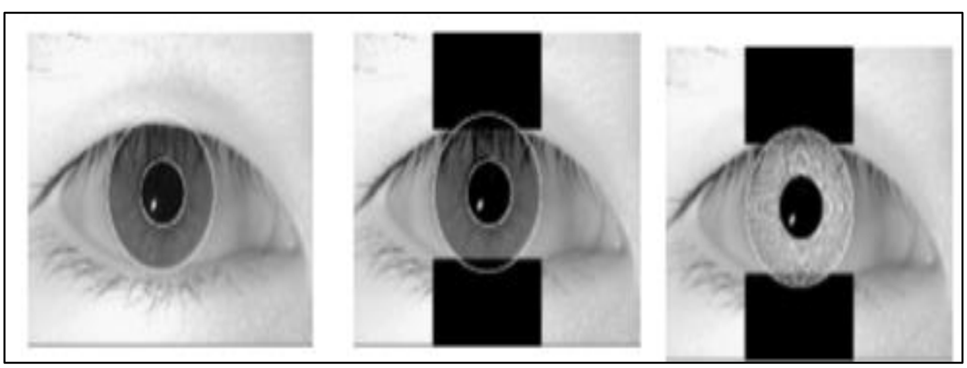

Figure 2.4: Iris segmentation

2.2.3. Normalization

Once the iris region has been duly segmented from a given image, it becomes important to organize its information to enable future comparisons. For the processing of an accurate match, it is essential to have in one database, images which contain the same dimensions. However, some factors contribute to dimensional inconsistencies such as varying imaging distance and also the stretching of the iris caused by pupil dilatation from varying levels of illumination. Other sources of inconsistency include a possible rotation of the camera, head tilt, and rotation of the eye within the eye socket. Another point to note is that the pupil region is not always concentric within the iris. Normally the pupil presents a slightly nasal position, that is, the pupil's center is at a lower position than that of the iris' center and closer to the nose. The normalization process is responsible for the generation of images with fixed dimensions, and so, images of the same iris captured under different conditions will have characteristic features at the same spatial location. John Daugman has proposed a method to generate a rectangular representation of the ring shaped iris region through a dimensional polar coordinates. This representation shows in the figure 2.5 [9] [10].

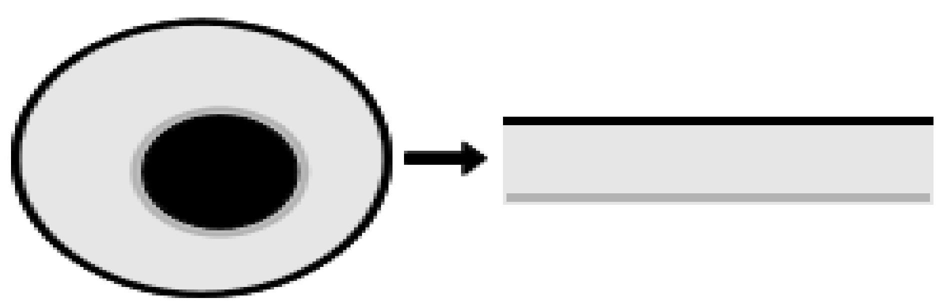

Figure 2.5: Rectangular representation of an iris

The center of the pupil is considered as the reference point, and radial vectors pass through the iris region. A number of data points are selected along each radial line. This number of points represent the radial resolution and defines the vertical dimension of the rectangular representation. The number of radial lines represents the angular resolution and defines the horizontal dimension of the rectangular representation. This method takes into account pupil dilatation, imaging distance and non-concentric pupil displacement [9] [10].

2.2.4. Feature Encoding

In the feature encoding step, a template representing iris pattern information is created using a Gabor filter, log Gabor filter or zero-crossing of the wavelet transform. The differences in lighting between two different images cause error when directly comparing the pixel intensity of two different iris images. To alleviate this difficulty, Duagman extracted the features from the normalized iris image by using convolution with 2-D Gabor filters. In that system, the filters are multiplied by the raw image pixel data and integrated over their domain of support to generate coefficients which describe, extract, and encode image texture information. A noise mask associated with the feature template is generated to mark the corrupted bits in the template, Figure 2.6 [9] [10].

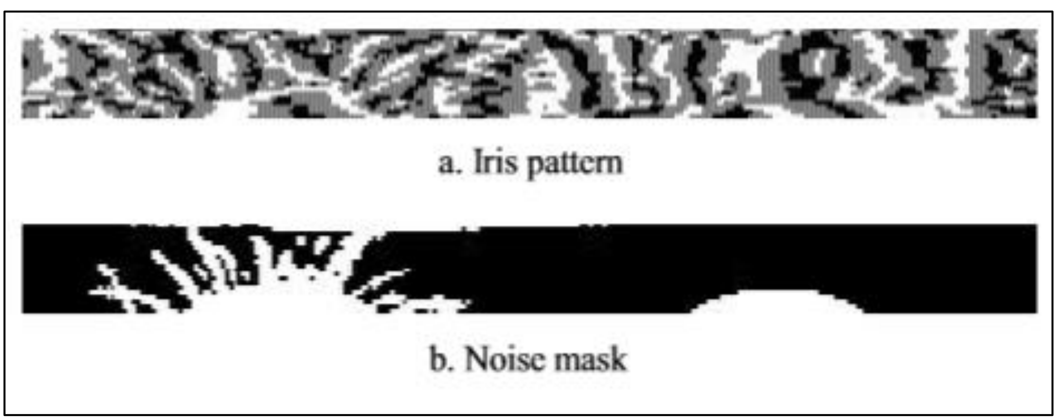

Figure 2.6: Feature encoding

2.2.5. Matching

The goal of matching is to evaluate the similarity of two iris representations. Created templates are compared using the Hamming distance or Euclidean distance. The normalized Hamming distance used by Daugman measures the fraction of bits in which two iris codes disagree. A low normalized Hamming distance implies strong similarity of the iris codes. If parts of the irises are occluded, the normalized Hamming distance is the fraction of bits that disagree in the areas that are not occluded on either image. To account for rotation, a comparison between a pair of images involves computing the normalized Hamming distance for several different orientations that correspond to circular permutations of the code in the angular coordinate. The minimum computed normalized Hamming distance is assumed to correspond to the correct alignment of the two images [9] [10].

2.3 Fractal Dimension

Fractal Dimension is an index that uses for texture segmentation, shape classification and graphic analysis. One of the frequent technique that use to estimate the fractal dimension and to improve the accuracy is a differential box-counting method [5]. The differential box-counting dimension is the most frequently used for measurements in various application fields. The reason for its dominance lies in its simplicity and automatic computability. Precisely, the fractal dimension offers the ability to describe and to characterize the complexity of the images or more precisely of their texture composition. Fractal dimension index represented in non-integer value, unlike the Euclidean dimension which it represents the index in in the integer value depends on the shape. The shape represents the index value is given in figure 2.8 below.

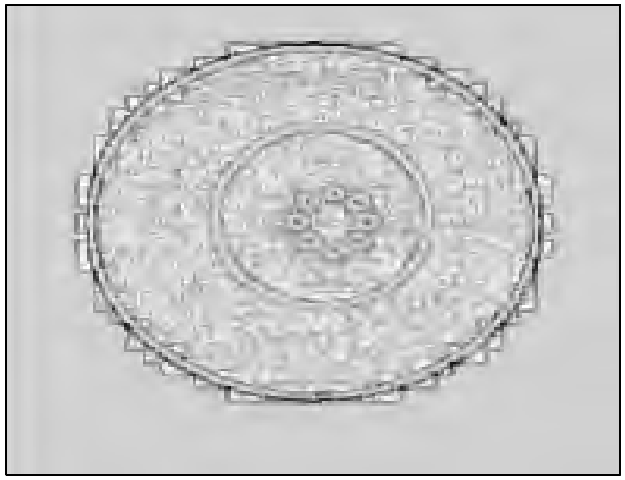

Figure 2.7: Example of iris images has been transformed into fractal image

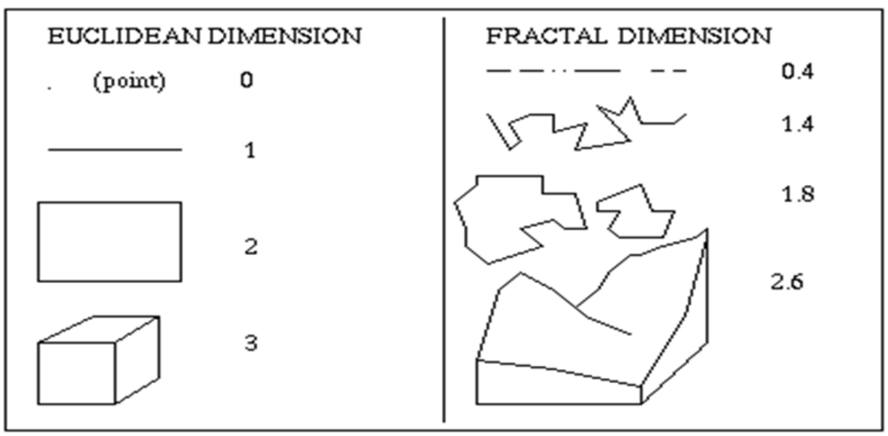

Figure 2.8: Index value between Euclidean and fractal dimension

In Euclidean dimension, index 0 describing the points (0-dimensional sets), index 1 is for sets describing lines (1-dimensional sets having length only), index 2 for sets describing the surfaces (2-dimensional sets having length and width), and index 3 for sets describing the volumes (3-dimensional sets having length, width, and height). But this change for fractal sets. If the theoretical fractal dimension of a set exceeds its topological dimension, the set is considered to have fractal geometry.