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Biometric retina identification based on neural network

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Abstract

In this paper the design of recognition system for retinal images using neural network is considered. Retina based recognition is perceived as the most secure method for identification of an identity used to distinguish individuals. The retina recognition stages including retina image acquisition, feature extraction and classification of the features are discussed. The structure of the neural network based retina identification is presented. Training of neural network based recognition system is performed using backpropagation algorithm. The structure of neural networks used for retina recognition and its learning algorithm are described. The implementation of recognition system has been done using MATLAB package.

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Keywords: Neural network; retina recognition; backpropagation algorithm.

1. Introduction

Biometric recognition, or biometrics, refers to the automatic identification of a person based on his/her anatomical (e.g. fingerprint, iris) or behavioural (e.g. signature) characteristics or traits. This method of identification offers several advantages over traditional methods involving ID cards (tokens) or PIN numbers (passwords) for various reasons:

- the person to be identified is required to be physically present at the point-of-identification,
- Identification based on biometric techniques obviates the need to remember a password or carry a token.

With the increased integration of computers and internet into our everyday life, it is necessary to protect sensitive and personal data. By replacing PINs (or using biometrics in addition to PINs), biometric techniques can potentially prevent unauthorized access to ATMs, cellular phones, laptops, and computer networks. Unlike biometric traits, PINs or passwords may be forgotten, and credentials like passports and driver's licenses may be forged, stolen, or lost[18]. As a result, biometric systems are being deployed to enhance security and reduce financial fraud. Various biometric traits are being used for real-time recognition; these are fingerprint recognition, facial recognition, iris recognition, hand geometry recognition, voice recognition, keystroke recognition, signature recognition, speech

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recognition and retinal recognition[3]. Nowadays these biometrics are becoming to be used to attain higher security and to handle failure and enrol situations. A biometric system is essentially a pattern recognition system that operates by acquiring biometric data from an individual, extracting a feature set from the acquired data, and comparing this feature set against the template set in the database. One of the biometric technologies used for identification of the persons is the retinal identification. Retinal identification is an automatic method that provides true identification of the person by acquiring an internal body image- the retina/choroid of a willing person who must cooperate in a way that would be difficult to counterfeit[1]. The human retina is a thin tissue composed of neural cells . Because of the complex structure of the capillaries the retina, each person's retina is unique. The network of blood vessels in the retina is not entirely genetically determined and thus even identical twins do not share a similar pattern. The blood vessels at the back of the eye have a unique pattern for each person. In blood vessel are segmented and used for recognition of retina images presents various segmentation algorithms of blood vessels are presented for identification of retinal images. Retina identification has found application in very high security environments (nuclear research and weapons sites, communications control facilities and a very large transaction-processing centre). In the paper the design of retina identification system using neural networks is presented. The design of such system will allow automating the personal identification using retina[7]. The paper is organised as follows. Sec.2. describes the structure of retina recognition system. Sec.3. describes the retina recognition system using Neural Networks. Sec.4. describes experimental results obtained for retina identification system. Sec.4. presents the conclusion of the paper.

2. Retina Identification System

Retina recognition technology captures and analyzes the patterns of blood vessels on the thin nerve on the back of the eyeball that processes light entering through the pupil. Retinal patterns are highly distinctive traits. Every eye has its own totally unique pattern of blood vessels; even the eyes of identical twins are distinct. Although each pattern normally remains stable over a person's lifetime, it can be affected by disease such as glaucoma, diabetes, high blood pressure, and autoimmune deficiency syndrome. The fact that the retina is small, internal, and difficult to measure makes capturing its image more difficult than most biometric technologies. An individual must position the eye very close to the lens of the retina-scan device, gaze directly into the lens, and remain perfectly still while focusing on a revolving light while a small camera scans the retina through the pupil. Any movement can interfere with the process and can require restarting. Enrolment can easily take more than a minute. The generated template is only 96 bytes, one of the smallest of the biometric technologies[10]. One of the most accurate and most reliable of the biometric technologies, it is used for access control in government and military environments that require very high security, such as nuclear weapons and research sites. However, the great degree of effort and cooperation required of users has made it one of the least deployed of all the biometric technologies. Newer, faster, better retina recognition technologies are being developed. The overall retinal scanning process may be broken down into three sub-processes:

i. Image acquisition,
ii. Computer based processing,
iii. Features extraction and identification.

The block diagram of the designed retina recognition system is given in Fig. 1. The retina recognition includes three phases: Image/signal acquisition, pre-processing and image classification (recognition).The image acquisition and processing phase are the most complicated. This sub-process may be completed largely depends on user cooperation. For scanning, the users' eye must be positioned very close to the lens. Moreover, glasses must be removed to avoid signal interference. On looking into the camera, the user sees a green light against a white background. Once the camera is activated, the green light moves in a complete circle with 360 degrees. The blood vessel pattern of the retina is captured during this process. The three to five images are captured at this stage. Depending on the level of user cooperation, the capturing phase can take as long as one minute. The retinal image acquisition is presented in[1]. During image acquisition, the retina images must be clear and sharply1.Image/signal acquisition and conversion (capturing an image of the retina and converting it to a digital format). Clarity of the retina's and its sharpness affect on the quality of the retina images. The next stage involves data extraction. As genetic factors do not dictate the pattern of the blood vessels, the retina contains a diversity of unique features. In pre-processing stage, the retina is extracted from an eye image and then using segmentation procedure the vascular