

RETINA RECOGNITION SYSTEM USING ARTIFICIAL INTELLIGENCE TECHNIQUES

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Introduction

Biometric identification is one of the most popular and secure person identification techniques. There are many categories of biometric identification systems and the basic concept is to identify a unique feature such as finger print, hand geometry, iris, retina, etc from a human. Retina identification is considered to be the most accurate and reliable biometric system among existing systems. This paper presents an artificial intelligence based retina recognition system.

A recognition system has two parts; feature extraction and identification. The main objective of this study is to assess the accuracy of biometric retina technology for personal identification on higher security basis.

Materials and Methods

Drive retina image database (Drive 2009) was used for testing the methods. It contains 40 retinal images of size 564 x 584. Basic architecture of the system is shown in Fig. 1.

Image pre-processing and feature extraction

A sample image from the database is shown in Fig. 2 a. To enhance the contrast of the images, histogram equalization was performed and using the highest 1 percent of the intensity image pixels, a binary image that mainly contains pixels of the optic disc was created (Fig. 2 b). After binarization a threshold value of 500 pixels is applied to area of the pixels to remove the unnecessary regions.

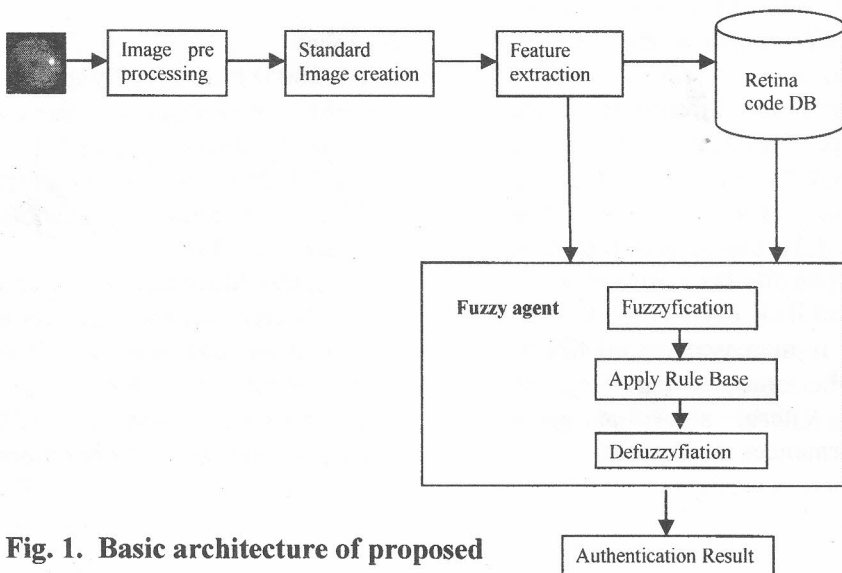


Fig. 1. Basic architecture of proposed system

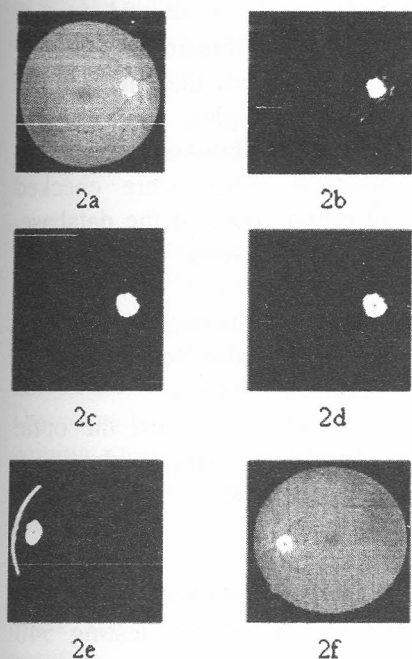


Fig. 2. Image processing steps

Dilation on the threshold image gives the result in Fig. 2 c. Although for some images this method identifies the optic disc only, there are some situations where more than one area is identified as optic disc. To find the optic disc correctly, the regions that have standard deviation between 15 and 40 were identified. (Fig. 2 d and Fig. 2e).

The location of the optic disc is not in a unique position for all the images in the database. So a standard for the whole database was generated by positioning the images so that the optic disc centroid is placed in left half of the image (Fig. 2f).

In the RGB images, the green channel which shows the best vessel/background contrast was used to extract the features.

The 2-D Gabor wavelet has been extensively used within computer vision (source-forge visit retina project 2010). The important property

is its capability of detecting and analyzing directional structures. The MATLAB tool *mlvessel2* (source-forge visit retina project 2010) based on the wavelet-domain was used to enhance vessel contrast while filtering out noise (Fig. 3b). The Retina vessel pattern was extracted by applying a threshold value of 0.6. To eliminate the non - vessel pixels an area threshold value of 20 pixels was applied (Fig. 3c).

The region with the radius 50 and 75 pixels from the vessel image is selected for the recognition (Fig. 3c). Then Cartesian to polar co-ordinate transformation (Ferzin et al. 2008) was applied to unroll the radial image of ROI (512X64 pixel size, Fig. 4). Then using an averaging sliding window the image was reduced to size of 126X16. This image, known as “retina code” (Fuhrman 2009) was used to identify each person uniquely.

Identity of person

The crisp input of the fuzzy system is the magnitude of the difference between the retina code values corresponding to a particular segment of the matching retina and the retina code from the database. The crisp input was multiplied by 100 so that the input will range from -100 to +100.

All the crisp outputs which are greater than 5.0 were added together. Finally this added value was divided by the number of segments checked. This added and divided value is called Fuzzy Humming Distance (FHD).

The rule base used for the proposed system can be altered depending on the location and the security level used the rules and the values (Kodituwakku and Fazeen 2008).

FHD is the factor that used to match persons.

- If the FHD is less than 1.5 then the checked retina images are “Perfect Match”
- If the FHD is less than 2.5 then the checked retina images are “Normal Match”
- If the FHD is less than 2.75 then the checked retina images are “Low Match”
- If the FHD is greater than 2.75 then the checked retina images are “No Match”

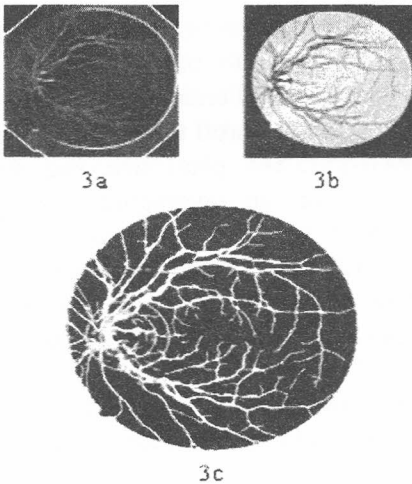


Fig. 3. Vessel extraction



Fig. 4. Unrolled retina

bases/DRIVE/ (Accessed November 2009).

Farzin H., Abrishami-Moghaddam H., and Moin M.S. (2008), A Novel retinal identification System by Journal on Advances in Signal Processing,(Article ID - 280635).

Fuhrman T. (2009) Usefulness of Retina code in biometrics. Advances in Image and Video Technology (LNCS-5414,624-632).

Results

540 images were created by rotating the 36 images from the database (by different 15 angles, +7 to -7) considering the rotational variant as it was practical. They were checked with 40 retina codes in the database. The entire test took 15 hours to complete.

True positive + True negative = 532

False positive + False Negative = 8

ROC Accuracy = 98.5%

For 39 out of 40 images, the optic disc centroid was correctly identified. (Accuracy = 97.5%).

Discussion

The tests of the method showed an accuracy of 98.50% by testing 540 images. The final system showed successful results in person identification but the main drawback is the computation time. This can be overcome by reducing the number of pixels that are being used in calculation by the fuzzy logic system. Further improvements to the method can be done by using the whole image and extracting the branch point patterns of the vessels for identification purpose.

References

Drive Retina image database. <http://www.isi.uu.nl/Research/Data>

Kodituwakku S.R. and Fazeen M.I.M (2008), An Offline Fuzzy Based Approach for Iris Recognition with Enhanced Feature Detection. Advanced Techniques in Computing Sciences and Software Engineering, 2008, 39-44.

Source forge visit retina project. http://sourceforge.net/apps/mediawiki/retinal/index.php?title=Main_Page (Accessed January 2010)