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Multimodal Biometric In Human Identification Of Finger Vein Patterns Using Score Level And GSA

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ABSTRACT

Biometric and multi biometric science play an important role in human authentication systems. Among many types of biometric model finger vein pattern is one of the most reliable and secure biometrics due to its invariability and safety from stealth. Since there are so much of algorithms carried out in our existing system, SVM (support vector machine) used for human authentication which has the ability to achieve maximal computational efficiency, fast spatiotemporal and has the ability to classify human motion patterns. However there are so many algorithms carried out for identification fingerprint faces some disadvantages such as sensibility to noise and spoof attack, here SVM requires large amount of training data to identify. To overcome this, thus proposing a system using heuristic method and gravitational search algorithm had advantages of solving non differentiable and multimodal problems effectively, requires less computation. The Gravitational Search Algorithm is based on Newton's law of GRAVITY and MOTION .The performance is evaluated using FAR, FRR, EER.

Keywords:Biometric, Finger Vein, MATLAB

I. INTRODUCTION

Biometric systems operate on behavioral and physiological biometric data to identify a person. The behavioral biometric parameters are signature, gait, speech and keystroke, these parameters changes with age and environment. However physiological characteristics such as face, fingerprint, palm print, and FINGER remains unchanged throughout the lifetime of a person.The biometric system operates as verification mode or identification mode depending on the requirement of an application. The verification mode validates a person's identity by comparing captured biometric datawithreadymadetemplate. Theidentification mode recognizes a person's identity by performing matches against multiple fingerprint biometric templates. Fingerprints are widely used in daily life for more than 100 years due to its feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability.

1.1 PROBLEM STATEMENT:

Among the four stages in finger recognition system that are: Acquisition, Segmentation, Feature extraction and Feature comparison, finger segmentation is one of the most significant steps in finger recognition system. Most of the existing finger segmentation algorithms rely on parametric models of the circle and ellipse to localize the finger. However, when the finger is severely occluded due to the ridges and curves, the boundary of the finger may not conform to the circular or elliptical shape. Additionally, finger segmentation is the most contested issue in the finger recognition system, since poor results of this stage will mar or break the finger recognition system effectiveness. Therefore, very careful attention has to be paid in the segmentation process if only an accurate result is expected; this depends on the accuracy of the center.

1.2 FINGERPRINT:

Skin on human fingertips contains ridges and valleys which together forms distinctive patterns. These patterns are fully developed under pregnancy and are permanent throughout whole lifetime. Prints of those patterns are called fingerprints. Injuries like cuts, burns and bruises can temporarily damage quality of fingerprints but when fully healed, patterns will be restored. Through various studies it has been observed that no two persons have the same fingerprints, hence they are unique for every individual.

Figure 1.1. A fingerprint image obtained by optical sensor

Due to the above mentioned properties, fingerprints are very popular as biometrics measurements. Especially in law enforcement where they have been used over a hundred years to help solve crime. Unfortunately fingerprint matching is a complex pattern recognition problem. Manual fingerprint matching is not only time consuming but education and training of experts takes a long time. Therefore since 1960s there have been done a lot of effort on development of automatic fingerprint recognitionsystems.Automatization of the fingerprint recognition process turned out to be success in forensic applications. Achievements made in forensic area expanded the usage of the automatic fingerprint recognition into the civilian applications. Fingerprints have remarkable permanency and individuality over the time. The observations showed that the fingerprints offer more secure and reliable person identification than keys, passwords or id-cards can provide. Examples such as mobile phones and computers equipped with fingerprint sensing devices for fingerprint based password protection are being produced to replace ordinary password protection methods. Those are only a fraction of civilian applications where fingerprints can beused.

II. SYSTEM ANALYSIS

Biometrics refers to the identification of humans by their characteristics or traits. Biometrics is used in computer science as a form of identification and access control. It is also used to identify individuals in groups that are under surveillance. Biometric identifiers are the distinctive, measurable characteristics used to label and describe individuals. Biometric identifiers are often categorized as physiological versus behavioral characteristics. A physiological biometric would identify by one's voice, DNA, hand print or behavior. Behavioral biometrics is related to the behavior of a person, including but not limited to: typing rhythm, gait, and voice. Most of the times it is an image acquisition system, but it can change according to the characteristics desired. The collection of biometric identifiers raises privacy concerns about the ultimate use of this information. More traditional means of access control include token-based identification systems.Such as a driver's license or passport and knowledge-based identification systems such as a password or personal identification number. Since biometric identifiers are unique to individuals, they are more reliable in verifying identity. A biometric system can operate in the following two modes, in verification mode the system performs a one-to-one comparison of a captured biometric with a specific template stored in a biometric database in order to verify the individual is the person they claim to be. Three steps involved in person verification in the first step, reference models for all the users are generated and stored in the model database. In the second step, some samples are matched with reference models to generate the genuine and impostor scores and calculate the threshold. Third step is the testing step.

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2.1 MULTI BIOMETRIC SYSTEM

Multi-biometric systems use multiple sensors or biometrics to overcome the limitations of modal biometric systems. For instance iris recognition systems can be compromised by aging imides and finger scanning systems by worn-out or cut fingerprints. While modal biometric systems are limited by the integrity of their identifier, it is unlikely that several modal systems will suffer from identical limitations. Multi-biometric obtain sets of information from the same marker (i.e., multiple images of an iris, or scans of the same finger) or information from different biometrics. Multi-biometric systems can integrate these modal systems sequentially, simultaneously, a combination thereof, or in series. The interested reader is pointed to Cobias for detailed tradeoffs of response time, accuracy, and costs between integration modes.

2.2 PROPOSED SYSTEM

A new multibiometric system has proposed for human authentication. The proposed method used patterns of three different finger veins and fused them using score level fusion strategy. Tuning the weights of sum score level fusion using heuristic optimization strategy – like Gravitational Search Algorithm- is the novelty of the paper. Gravitational search algorithm based on the law of gravity and the law of motion. Experimental results confirmed that using a heuristic method could lead to more accurate identification accuracy.

III. SYSTEM DESIGN

3.1 SYSTEM ARCHITECTURE

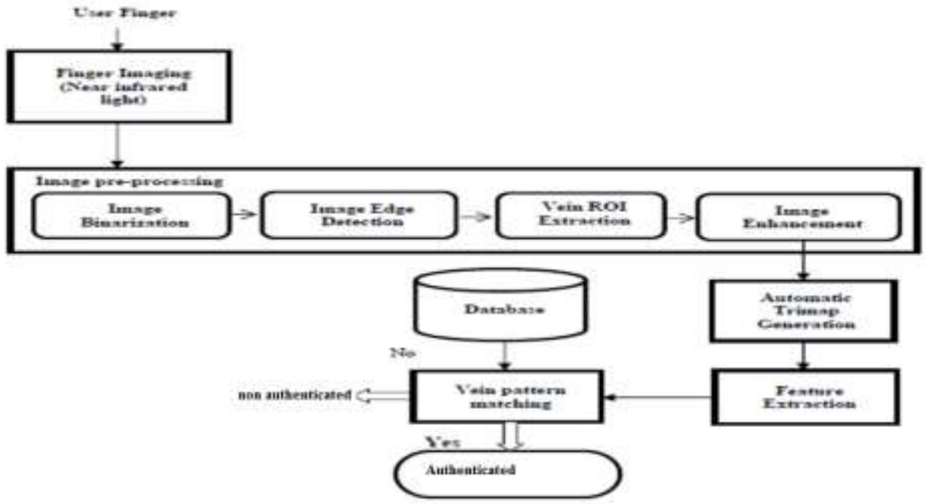

Figure 3.1: Finger Vein Recognization

3.2 IMAGE

An image is an array or a matrix of square pixels (picture elements) arranged in columns and rows. An image is an artifact, for examplea 2d picture, that has a similar appearance to some subject usually a physical object or a person.

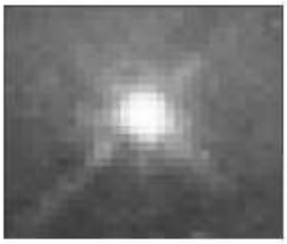

Figure 3.2: An image – an array or a matrix of pixels arranged in columns and rows

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3.3 PIXEL

Image processing is a subset of the electronic domain where in the image is converted to an array of small integers, called *pixels*, representing a physical quantity such as scene radiance, stored in a digital memory and processed by computer or other digital hardware.

Suppose we take an image, a photo, say. For the moment, let's make things easy and suppose the photo is black and white (that is, lots of shades of grey), so no colour. We may consider this image as being a two-dimensional function, where the function values give the brightness of the image at any given point, as shown in figure 1. We may assume that in such an image brightness values can be any real numbers in the range 0.0 (black) to 1.0 (white). The ranges of x and y will clearly depend on the image, but they can take all real values between their minima and maxima.

A digital image differs from a photo in that the x, y, and f(x, y)values are all discrete. Usually they take on only integer values, so the image shown in figure 1.2 will have x and y ranging from 1to 256 each, and the brightness values also ranging from 0 (black) to 255 (white). A digital image can be considered as a large array of discrete dots, each of which has a brightness associated with it. These dots are called picture elements, or more simply pixels. The pixels surrounding a given pixel constitute its neighbourhood. A neighbourhood can be characterized by its shape in the same way as a matrix: we can speak of a 3*3 neighbourhood, or of a 5*7 neighbourhood. Except in very special circumstances, neighbourhoods have odd numbers of rows and columns; this ensures that the current pixel is in the centre of the neighbourhood. An example of a neighbourhood is given. If a neighbourhood has an even number of rows or columns (or both), it may be necessary to specify which pixel in the neighbourhood is the "current pixel".

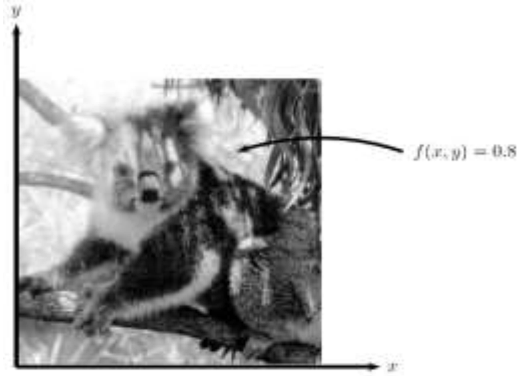

Figure 3.3: A grey scale image

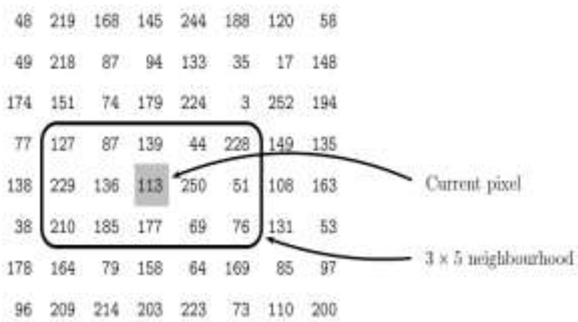

Figure 3.4: Pixel representation

3.4 EDGE DETECTION TECHNIQUES:

Sobel Operator:The operator consists of a pair of 3×3 convolution kernels as shown in Figure 1. One kernel is simply the other rotated by 90°.

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-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

These kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these *Gx* and *Gy*). These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient. The gradient magnitude is given by:

$$|G| = \sqrt{Gx^2 + Gy^2}$$

Typically, an approximate magnitude is computed using:

$$|G| = |Gx| + |Gy|$$

Which is much faster to compute?The angle of orientation of the edge (relative to the pixel grid) giving rise to the spatial gradient is given by:

$$\theta = \arctan(Gy/Gx)$$

IV. IMPLEMENTATIONS

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a dimensional signal and applying standard signal-processing techniques to it. The acquisition of images (producing the input image in the first place) is referred to as imaging. Image processing allows one to enhance image features of interest while attenuating detail irrelevant to a given application, and then extract useful information about the scene from the enhanced image. This introduction is a practical guide to the challenges, and the hardware and algorithms used to meet them. An image is digitized to convert it to a form which can be stored in a computer's memory or on some form of storage media such as a hard disk or CD-ROM. This digitization procedure can be done by a scanner, or by a video camera connected to a frame grabber board in a computer. Once the image has been digitized, it can be operated upon by various image processing operations. Image processing operations can be roughly divided into three major categories, Image Compression, Image Enhancement and Restoration, and Measurement Extraction. Image compression is familiar to most people. It involves reducing the amount of memory needed to store a digital image. Image defects which could be caused by the digitization process or by faults in the imaging set-up (for example, bad lighting) can be corrected using Image Enhancement techniques. Once the image is in good condition, the Measurement Extraction operations can be used to obtain useful information from the image. The example in figure operates on 256 gray-scale images. This means that each pixel in the image is stored as a number between 0 to 255, where 0 represents a black pixel, 255 represents a white pixel and values in-between represent shades of gray.

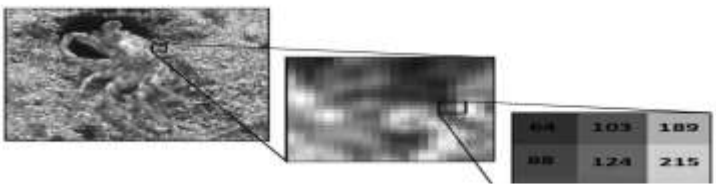

Figure 4.1: Structure of grey-scale image

In figure 2.1 each pixel represents a value from 0 to 255 verifying the level of gray. These operations can be extended to colour images too. In a (8-bit) greyscale image each picture element has an assigned intensity that ranges from 0 to 255. A grey scale image is what people normally call a black and white image, but the name emphasizes that such an image will also include many shades of grey.

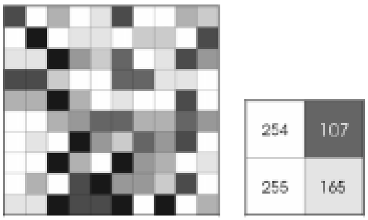

Figure:4.2 Different shades of grey scale image

A normal greyscale image has 8 bit colour depth = 256 greyscales

Figure: 4.3 Color image

A "true colour" image has 24 bit colour depth = 8 x 8 x 8 bits = 256 x 256 x 256 colours = ~16 million colours. Grey values can also be modified such that their histogram has any desired shape, e.g.flat (every grey value has the same probability). All examples assume *point processing*, viz. each output pixel is the function of one input pixel; usually, the transformation is implemented with a look-up table:

Physiological experiments have shown that very small changes in luminance are recognized by the human visual system in regions of continuous grey value, and not at all seen in regions of some discontinuities. Therefore, a design goal for image enhancement often is to smooth images in more uniform regions, but to preserve edges. On the other hand, it has also been shown that somehow degraded images with enhancement of certain features, e.g. edges, can simplify image interpretation both for a human observer and for machine recognition. A second design goal, therefore, is image sharpening. All these operations need neighbourhood processing, viz. the output pixel is a function of some neighbourhood of the input pixels.

These operations could be performed using linear operations in either the frequency or the spatial domain. We could, e.g. design, in the frequency domain, one-dimensional low or high pass filters (Filtering), and transform them according to the two-dimensional case. Unfortunately, linear filter operations do not really satisfy the above two design goals; in this book, we limit ourselves to discussing separately only (and superficially) Smoothing and Sharpening. Here is a trick that can speed up operations substantially, and serves as an example for both point and neighbourhood processing in a binary image. we number the pixels in a 3x3 neighbourhood like,

5	6	7
4	8	0
3	2	1

And denote the binary values (0,1) by b_i (i = 0,8); we then concatenate the bits into a 9-bit word, like $b_8b_7b_6b_5b_4b_3b_2b_1b_0$. This leaves us with a 9-bit grey value for each pixel, hence a new image (an 8-bit image with b_8 taken from the original binary image will also do). The new image corresponds to the result of a convolution of the binary image, with a 3 x 3 matrix containing as coefficients the powers of two. This neighbor image can then be passed through a look-up table to perform erosions, dilations, noise cleaning, skeletonization, etc.

4.1 Histogram equalization of color images:

The above describes histogram equalization on a greyscale image. However it can also be used on color images by applying the same method separately to the Red, Green and Blue components of the RGB color values of the image. However, applying the same method on the Red, Green, and Blue components of an RGB image may yield dramatic changes in the image's color balance since the relative distributions of the color channels change as a result of applying the algorithm. However, if the image is first converted to another color space, Lab color space, or HSL/HSV color space in particular, then the algorithm can be

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applied to the luminance or value channel without resulting in changes to the hue and saturation of the image. There are several histogram equalization methods in 3D space. Trahanias and Venetsanopoulos applied histogram equalization in 3D color space However, it results in "whitening" where the probability of bright pixels are higher than that of dark ones. Han et al. proposed to use a new cdf defined by the iso-luminance plane, which results in uniform gray distribution.

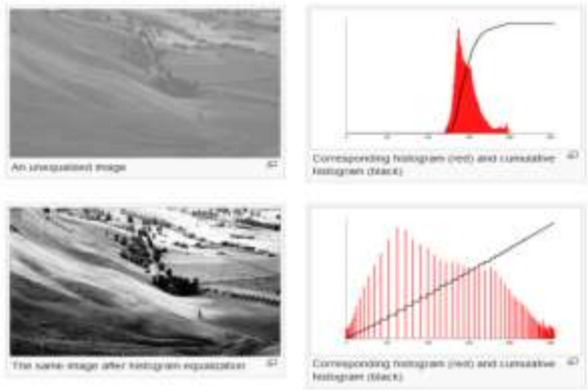

Figure 4.4: Histogram equalization

Apart from point and neighborhood processing, there are also global processing techniques, i.e. methods where every pixel depends on all pixels of the whole image. Histogram methods are usually global, but they can also be used in a neighborhood.

Figure 4.5: Image enhancement (a) original image (b) enhanced image

4.2 IMAGE RESTORATION USING GAUSIAN FILTER:

In image processing, a Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise and reduce detail. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen, distinctly different from the bokeh effect produced by an out-of-focus lens or the shadow of an object under usual illumination. Gaussian smoothing is also used as a pre-processing stage in computer vision algorithms in order to enhance image structures at different scales—see scale space representation and scale space implementation.

The purpose of image restoration is to "compensate for" or "undo" defects which degrade an image. Degradation comes in many forms such as motion blur, noise, and camera misfocus. In cases like motion blur, it is possible to come up with a very good estimate of the actual blurring function and "undo" the blur to restore the original image. In cases where the image is corrupted by noise, the best we may hope to do is to compensate for the degradation it caused. In this project, we will introduce and implement several of the methods used in the image processing world to restore images.

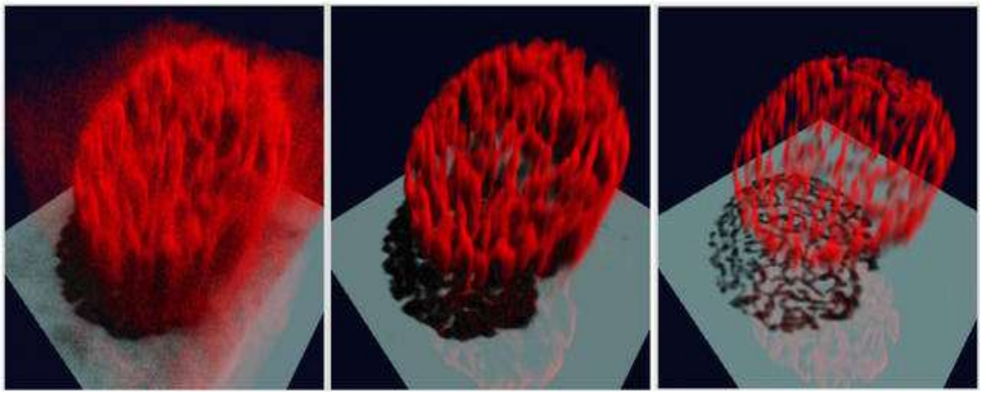

Figure 4.6: Image restoration (a) original image (b) partially restored image (c) Fully restored image

V. CONCLUSION

The reliability of any automatic fingerprint system strongly relies on the precision obtained in the minutia extraction process. A number of factors are detrimental to the correct location of minutia. Among them, poor image quality is the most serious one. In this project, a new multibiometric system has proposed for human authentication. The proposed method used patterns of three different finger veins and fused them using score level fusion strategy. Tuning the weights of sum score level fusion Using heuristic optimization strategy –like Gravitational Search Algorithm- is the novelty of the paper. Experimental results confirmed that using a heuristic method could lead to more accurate identification accuracy. The performance of the proposed heuristic score level fusion could be investigated and may improve using more advanced heuristic and metaheuristic optimization technique. There is a scope of further improvement in terms of efficiency and accuracy which can be achieved by improving the hardware to capture the image or by improving the image enhancement techniques. So that the input image to the thinning stage could be made better this could improve the future stages and the final outcome.

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