

Multimodel Biometric Template Authentication of Fingerprint and signature using Visual Cryptography

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Abstract:

In this paper personal verification method using fingerprint and signature is presented. Among many authentication systems fingerprint is promising as the foolproof method of automatic personal identification. Fingerprint and signature image is pre-processed and features are extracted using cross number concept and principle component analysis. Fusion technique is used to fuse the fingerprint and signature images. Then the visual cryptographic scheme is applied for the biometric template to generate the shares. The shares are stored in a separate database, and then the biometric image is revealed only when both the shares are simultaneously available. At the same time, the individual image does not reveal the identity of the biometric image. The proposed work is evaluated with evaluation metrics FAR, FRR and accuracy.

Keywords — Biometrics, Multimodal, Visual Cryptography, Fingerprint, Signature.

1. Introduction

1.1 What Is Image Processing?

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- ❖ Importing the image with optical scanner or by digital photography.
- ❖ Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- ❖ Output is the last stage in which result can be altered image or report that is based on image analysis.

Purpose of Image processing:

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

1.2 Types of Image Processing:

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing.

Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display, information extraction.

1.3 Working diagram of Image Processing:

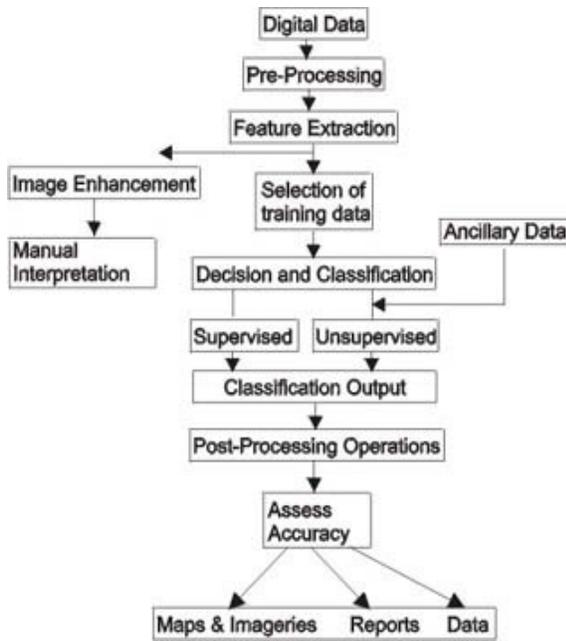


Fig 1

1.4 Characteristics of Image Processing:

Before going to processing an image, it is converted into a digital form. Digitization includes sampling of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, Image enhancement, Image restoration, and Image compression.

Image enhancement:

It refers to accentuation, or sharpening, of image features such as boundaries, or contrast to make a graphic display more useful for display & analysis. This process does not increase the inherent information content in data. It includes gray level & contrast manipulation, noise reduction, edge crispening and sharpening, filtering, interpolation and magnification, pseudo coloring, and so on.

Image restoration:

It is concerned with filtering the observed image to minimize the effect of degradations. Effectiveness of image restoration depends on the extent and accuracy of the knowledge of degradation process as well as on filter design. Image restoration differs from image enhancement in that the latter is concerned with more extraction or accentuation of image features.

Image compression:

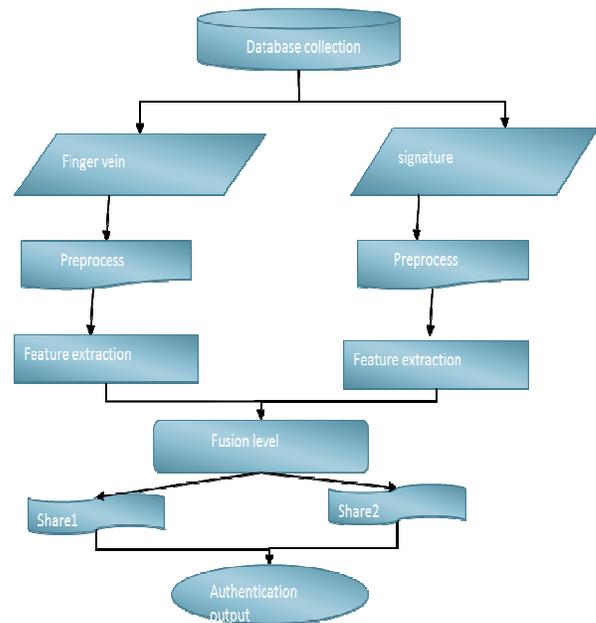
It is concerned with minimizing the number of bits required to represent an image. Application of compression are in broadcast TV, remote sensing via satellite, military communication via aircraft, radar, teleconferencing, facsimile transmission, for educational & business documents, medical images that arise in computer tomography, magnetic resonance imaging and digital radiology, motion, pictures, satellite images, weather maps, geological surveys and so on.

- Text compression – CCITT GROUP3 & GROUP4
- Still image compression – JPEG
- Video image compression - MPEG

Advantages of Image Processing:

- The processing of images is faster and more cost-effective. One needs less time for processing, as well as less film and other photographing equipment.
- It is more ecological to process images. No processing or fixing chemicals are needed to take and process digital images. However, printing inks are essential when printing digital images.
- When shooting a digital image, one can immediately see if the image is good or not.
- Copying a digital image is easy, and the quality of the image stays good unless it is compressed. For instance, saving an image as jpg format compresses the image. By resaving the image as jpg format, the compressed image will be recompressed, and the quality of the image will get worse with every saving.
- Fixing and retouching of images has become easier. In new Photoshop 7, it is possible to smoother face wrinkles with a new Healing Brush Tool in a couple of seconds.
- The expensive reproduction (compared with rastering the image with a repro camera) is faster and cheaper.
- By changing the image format and resolution, the image can be used in a number of media.

1.5 Block Diagram :



. Fig 2:Block Diagram

2 LITERATURE SURVEY

2.1 TITLE: Feature Level Fusion in Biometric Systems

AUTHOR:2004

YEAR: Arun Ross

Multibiometric systems utilize the evidence presented by multiple biometric sources (e.g., face and fingerprint, multiple fingers of a user, multiple matchers, etc.) in order to determine or verify the identity of an individual. Information from multiple sources can be consolidated in several distinct levels, including the feature extraction level, match score level and decision level. While fusion at the match score and decision levels have been extensively studied in the literature, fusion at the feature level is a relatively understudied problem. In this paper we discuss fusion at the feature level in 3 different scenarios: (i) fusion of PCA and LDA coefficients of face; (ii) fusion of LDA coefficients corresponding to the R,G,B channels of a face image; (iii) fusion of face and hand modalities. Preliminary results are encouraging and help in highlighting the pros and cons of performing fusion at this level. The primary motivation of this work is to demonstrate the viability of such a fusion and to underscore the importance of pursuing further research in this direction.

2.2 TITLE: Palm Vein Recognition with Local Binary Patterns and Local Derivative Patterns

AUTHOR: Leila Mirmohamadsadeghi

YEAR:2010

Palm vein feature extraction from near infrared images is a challenging problem in hand pattern recognition. In this paper, a promising new approach based on local texture patterns is proposed. First, operators and histograms of multi-scale Local Binary Patterns (LBPs) are investigated in order to identify new efficient descriptors for palm vein patterns. Novel higher-order local pattern descriptors based on Local Derivative Pattern (LDP) histograms are then investigated for palm vein description. Both feature extraction methods are compared and evaluated in the framework of verification and identification tasks. Extensive experiments on CASIA Multi-Spectral Palmprint Image Database V1.0 (CASIA database) identify the LBP and LDP descriptors which are better adapted to palm vein texture. Tests on the CASIA datasets also show that the best adapted LDP descriptors consistently outperform their LBP counterparts in both palm vein verification and identification

2.3 TITLE: Level of Fusion in Multimodal Biometrics: a Review

AUTHOR: Dapinder Kaur

YEAR:2013

User verification systems that use a single biometric indicator often have to contend with noisy sensor data, restricted degree of freedom, non-universality of the biometric trait and unacceptable error rates. So the need of using multimodal biometric system occurred. A multimodal biometric system combines the different biometric traits and provides better recognition performance as compared to the systems based on single biometric trait or modality. In this paper, studies of different modalities are discussed and also discuss the various techniques used in different level of fusion with the objective of improving performance & robustness at each level of fusion.

2.4 TITLE: A Review of Multibiometric System with Fusion Strategies and Weighting Factor

AUTHOR: Haryati Jaafar

YEAR:2013

Biometric is a technology for verification or identification of individuals by employing a person's physiological and behavioural

traits. Although these systems are more secured compared the traditional methods such as key, smart card or password, they also undergo with many limitations such as noise in sensed data, intra-class variations and spoof attacks. One of the solutions to these problems is by implementing multibiometric systems where in these systems, many sources of biometric information are used. This paper presents a review of multibiometric systems including its taxonomy, the fusion level schemes and toward the implementation of fixed and adaptive weighting fusion schemes so as to sustain the effectiveness of executing the multibiometric systems in real application.

2.5 TITLE: Secure Biometric Authentication using Visual Cryptography

AUTHOR: Priya Pradeep Bhirud

YEAR:2013

Protection of biometric data is gaining importance because its uniqueness and digital watermarking techniques are used to protect the biometric data from either accidental or intentional attacks. Here introduces a novel secured authentication method using wavelet decomposition and Visual Cryptography to hide an iris image. In this report gives exhaustive study on a scheme in which iris image is secured by using a technique called Visual Cryptography (VC). In this technique, iris image is embedded in cover image and then using wavelet transform this output image is decomposed into four shares. These four shares are compressed at sender site. At receiver side, to obtain original iris image inverse DWT is obtained and finally bit matching procedure has been applied. The result shows that Steganography and Visual cryptography implementation on biometrics, secures Iris and related textual information from getting identity forged. In comparison with existing approach quality of final watermarked cover images and Iris has been maintained which could be used for matching of it for authentication. Along with quality, goal of higher security and bandwidth reduction by reducing size of shares is achieved. Also technique of three least significant bits applied successfully that allows secr

3. PRE PROCESSING OF FINGERVEIN

3.1 FINGERVEIN EXTRACTION: The fingervein Extraction is done by using maximum curvature points method.

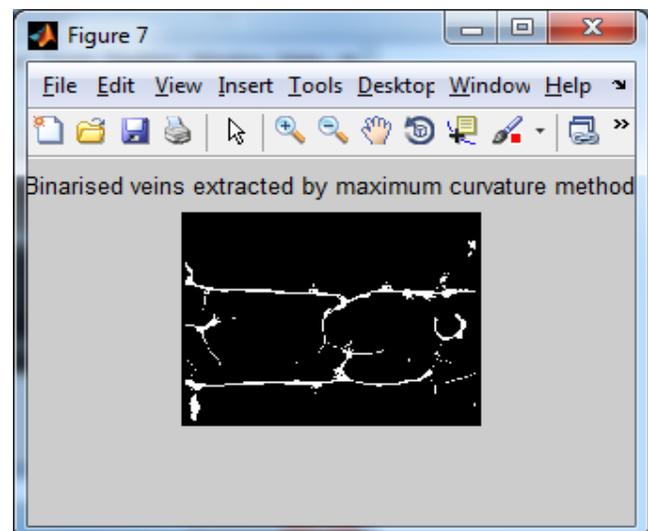


Fig 3: Fingervein Extraction

3.2 Thinning Image:

Thinning is the transformation of a digital image into a simplified, but topologically equivalent image. It is a type of topological skeleton, but computed using mathematical morphology operators. Thinning operation is calculated by translating the origin of the structuring element to each possible pixel position in the image, and at each such position comparing it with the underlying image pixels. If the foreground and background pixels in the structuring element exactly match foreground and background pixels in the image, then the image pixel underneath the origin of the structuring element is set to background (zero). Otherwise it is left unchanged. Note that the structuring element must always have a one or a blank at its origin if it is to have any effect. The choice of structuring element determines under what situations a foreground pixel will be set to background, and hence it determines the application for the thinning operation.

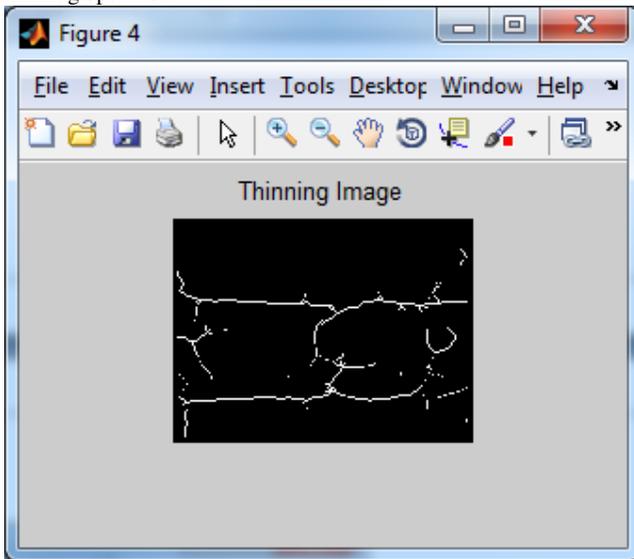


Fig 4: Thinning Image

4. MODULES :

- Input Image
- Binary Image
- Minuate Feature Extraction
- Threshold apply
- Edge detection
- PCA

MODULES DESCRIPTION:

Input Image:

To read the image from given folder select pathname and filename specified format using matlab syntax (imread). Also in this process we are selected two kind of images for the input one signature and another one fingervein.

Binary Image:

A binary image is a digital image that has only two possible values for each pixel. Typically, the two colors used for a binary image are black and white, though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering. Some input/output devices, such as laser printers, fax machines, and bilevel computer displays, can only handle bilevel images. A binary image can be stored in memory as a bitmap, a packed array of bits. A 640x480 image requires 37.5 KiB of storage. Because of the small size of the image files, fax machine and document management solutions usually use this format. Most binary images also compress well with simple run-length compression schemes. Binary images can be interpreted as subsets of the two-dimensional integer lattice Z^2 ; the field of morphological image processing was largely inspired by this view.

Minuate Feature Extraction:

The uniqueness of a fingerprint is exclusively determined by the local ridge characteristics and their relationships. The ridges and valleys in a fingerprint alternate, flowing in a local constant direction. The two most prominent local ridge characteristics are: 1) ridge ending and 2) ridge bifurcation. A ridge ending is defined as the point where a ridge ends abruptly. A ridge bifurcation is defined as the point where a ridge forks or diverges into branch ridges. Collectively, these features are called minutiae. Detailed description of fingerprint minutiae will be given in the next section. The widespread deployment of fingerprint recognition systems in various applications has caused concerns that compromised fingerprint templates may be used to make fake fingers, which could then be used to deceive all fingerprint systems the same person is enrolled in. Once compromised, the grayscale image is the most at risk. Leakage of a phase image or skeleton image is also dangerous since it is a trivial problem to reconstruct a grayscale fingerprint image from the phase image or the skeleton image. In contrast to the above three representations, leakage of minutiae templates has been considered to be less serious as it is not trivial to reconstruct a grayscale image from the minutiae.

Threshold apply:

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T (that is or a white pixel if the image intensity is greater than that constant. In the example image on the right, this results in the dark tree becoming completely black, and the white snow becoming completely white.

Edge Detection:

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond.

PCA:(PRINCIPLE COMPONENT ANALYSIS)

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of

possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the smaller of (number of original variables or number of observations). This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components. The resulting vectors are an uncorrelated orthogonal basis set. PCA is sensitive to the relative scaling of the original variables.

5. ALGORITHM:

- Morphological image processing is a collection of non-linear operations related to the shape or features in an image.
- Morphological operations can also be applied to grey scale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest.
- Canny edge detector is to detect wide range of edges and it has low error rate
- Principle Component Analysis (PCA) algorithm used to change the curves of the signature into data variables for 'n' of times to grant access to most possible way

Laplace of Gaussian:

- Laplace operator may detect edges as well as noise (isolated, out-of-range), it may be desirable to smooth the image first by a convolution with a Gaussian kernel .
- The kernel of any other sizes can be obtained by approximating the continuous expression of LoG given above.
- However, make sure that the sum (or average) of all elements of the kernel has to be zero (similar to the Laplace kernel) so that the convolution result of a homogeneous regions is always zero.
- The edges in the image can be obtained by these steps:
 - Applying LoG to the image
 - Detection of zero-crossings in the image
 - Threshold the zero-crossings to keep only those strong ones (large difference between the positive maximum and the negative minimum)

Harris and harris Laplace:

- Harris affine region detector belongs to the category of [feature detection](#).
- Feature detection is a preprocessing step of several algorithms that rely on identifying characteristic points or [interest points](#) so to make correspondences

between images, recognize textures, categorize objects or build panoramas.

- The Harris affine detector relies heavily on both the Harris measure and a [Gaussian scale space representation](#).

6. RESULTS AND CONCLUSIONS:

6.1 OUTPUT DESIGN:

A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system's relationship to help user decision-making.

1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should Identify the specific output that is needed to meet the requirements.

2. Select methods for presenting information.

3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.

- ❖ Convey information about past activities, current status or projections of the
- ❖ Future.
- ❖ Signal important events, opportunities, problems, or warnings.
- ❖ Trigger an action.
- ❖ Confirm an action.

Fingervein output:

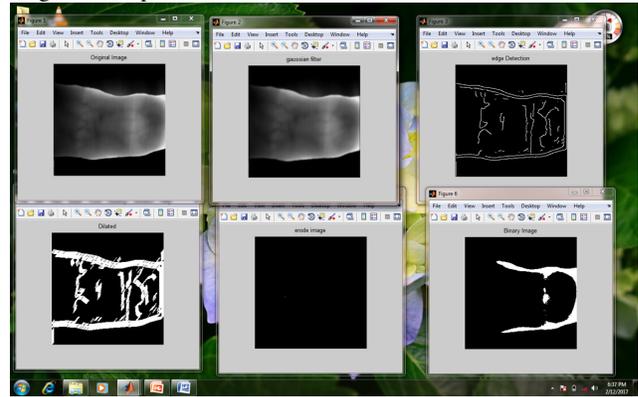


Fig 5: Fingervein output

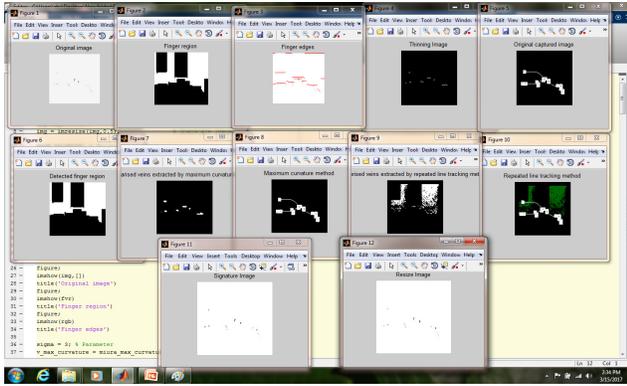


Fig 6: Signature Output

7. EXPLANATION:

7.1 SOFTWARE DESCRIPTIONS:

OVERVIEW OF MATLAB:

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

Typical uses include

- Math and computation
- Algorithm development
- Data acquisition
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including graphical user interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non interactive language such as C or Fortran. The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects. Today, MATLAB engines incorporate the LAPACK and BLAS libraries, embedding the state of the art in software for matrix computation.

MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of add-on application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others. The MATLAB System Conclusion and Future Work:

The proposed work is to improve the accuracy of the secured biometric system with finger vein and signature. The biometric images are pre-processed and features are extracted from the finger vein and signature using cross number concept and principle compound analysis simultaneously. By applying visual cryptographic technique, security level gets increased. Thus the experimental result of the proposed system achieves secure authentication result. In the future work different fusion technique can be applied to enhance the performance of the model and also the number of shares can be expanded to enhance the verification level.

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