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An Improved Authentication System Using Finger Vein Imaging

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ABSTRACT: The main objective of this system is to Enhance security through vein based on imaging for personal authentication. Presented the design of a personal identification system based on Near Infrared (NIR) finger vein image. Propose an observation model of finger vein imaging, upon which a self-adaptive bilateral filter based illuminance control algorithm, is used. Algorithm could automatically adjust the illuminance distribution of lighting. Increase the illuminance of lighting, under which the thicker part of finger body is presented and decrease the illuminance of lighting, under which the thinner part of finger body is presented. The whole finger body could be illuminated appropriately according to its thickness distribution, and the overexposure and underexposure are avoided effectively.

KEYWORDS: Learning Analytics, Learning Management Systems, Portability, Predictive Modeling, Student Performance

I. INTRODUCTION

Recognizes a person based on physiological or behavioral characteristic. Nowadays, security has been important for privacy protection and country in many situations. The biometric technology is becoming the base approach to solve the increasing crime. Vein pattern is the network of blood vessels beneath person's skin. Vein authentication is not only interested in lab researchers but also in industries. The products perform well in tests of the International Biometric Group.

A reliable biometric system, which is essentially a pattern-recognition that recognizes a person based on physiological or behavioral characteristic, is an indispensable element in several areas, including ecommerce(e.g. online banking) various forms of access control security(e.g. PC login), and so on. Nowadays, security has been important for privacy protection and country in many situations, and the biometric technology is becoming the base approach to solve the increasing crime. As the significant advances in computer processing, the automated authentication techniques using various biometric features have become available over the last few decades.

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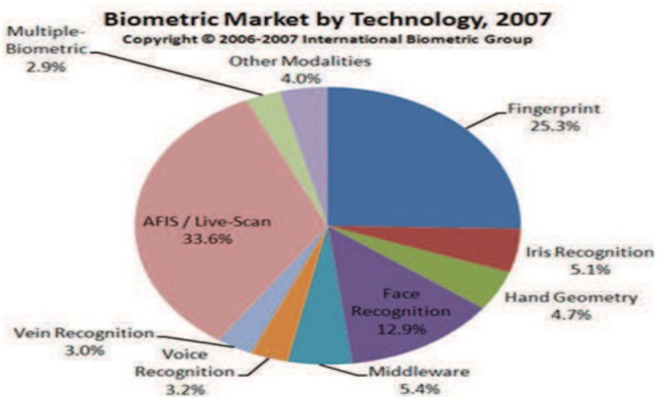

Fig.1 IBG Biometric Market by Technology

Biometric characteristics include fingerprint, face, hand/finger geometry, iris, retina, signature, gait, voice, hand vein, odor or the DNA information, while fingerprint, face, iris and signature are considered as traditional ones. Due to each biometric technology has its merits and shortcoming, it is difficult to make a comparison directly. Jain et al. have identified seven factors, which are (1) universality, (2) uniqueness, (3) permanence, (4) measurability, (5) performance, (6) acceptability, (7) circumvention, to determine the suitability of a trait to be used in a biometric application. Vein pattern is the network of blood vessels beneath person's skin. The idea using vein patterns as a form of biometric technology was first proposed in 1992, while researches only paid attentions to vein authentication in last ten years. Vein patterns are sufficiently different across individuals, and they are stable unaffected by ageing and no significant changed in adults by observing. It is believed that the patterns of blood vein are unique to every individual, even among twins. Contrasting with other biometric traits, such as face or fingerprint, vein patterns provide a really specific that they are hidden inside of human body distinguishing them from other forms, which are captured externally. Veins are internal, thus this characteristic makes the systems highly secure, and they are not been affected by the situation of the outer skin (e.g. dirty hand). At the same time, vein patterns can be acquired by infrared devices by two ways, non-contact type and contact type. In the case of non-contact method, there is no need to touch the device, and therefore it is friendly to individuals in the target population who utilize the systems. In the contact type, the collection type is the same as fingerprint which has already been accepted by most people. From the customer's point of view, the authentication system is not only high accuracy level for security but also easy to enroll. Vein patterns serve as a high secure form of personal authentication as iris recognition (Iris is known for high accurate rates of authentication, but it is regarded unfriendly by users due to the direct application of light into their eyes), and serve as a convenient form as fingerprint recognition. On account of the several advantages, vein authentication is not only interested in lab researchers but also in industries, and the products perform well in tests of the International Biometric Group (IBG) . Recently, vein recognition appears to be making real headway in the market, and considered as one of the more 'novel' biometric, which is called the Fourth Biometric.

II. SYSTEM IMPLEMENTATION

A. IMAGE FILE DETECTION

Image file formats are standardized means of organizing and storing digital images. Image files are composed of either pixel or vector (geometric) data that are rasterized to pixels when displayed (with few exceptions) in a vector graphic display. The pixels that constitute an image are ordered as a grid (columns and rows). Each pixel consists of numbers representing magnitudes of brightness and color.

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B. IMAGE FILE SIZES

Image file size expressed as the number of bytes increases with the number of pixels composing an image, and the colour depth of the pixels. The greater the number of rows and columns, which is greater than the image resolution and larger than the file. Also, each pixel of an image increases in size when its colour depth increases an 8-bit pixel (1 byte) stores 256 colors, a 24-bit pixel (3 bytes) stores 16 million colors, the latter known as truecolor. Image compression uses algorithms to decrease the size of a file. High resolution cameras produce large image files, ranging from hundreds of kilobytes to megabytes, per the camera's resolution and the image-storage format capacity. High resolution digital cameras record 12 megapixel (1MP = 1,000,000 pixels / 1 million) images, or more, in truecolor. For example, an image recorded by a 12 MP camera; since each pixel uses 3 bytes to record truecolor, the uncompressed image. would occupy 36,000,000 bytes of memory—a great amount of digital storage for one image, given that cameras must record and store many images to be practical. Faced with large file sizes, both within the camera and a storage disc, image file formats were developed to store such large images.

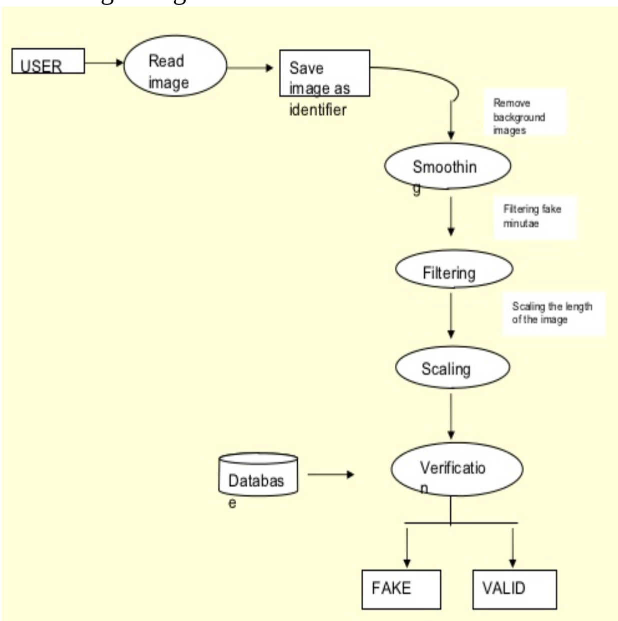

Fig.2 Proposed System Flow Diagram

C. IMAGE FILES COMPRESSION

There are two types of image file compression algorithms: lossless and lossy.
(a) Lossless compression algorithms reduce file size without losing image quality, though they are not compressed into as small a file as a lossy compression file. When image quality is valued above file size, lossless algorithms are typically chosen.
(b) Lossy compression algorithms take advantage of the inherent limitations of the human eye and discard invisible information. Most lossy compression algorithms allow for variable quality levels (compression) and as these levels are increased, file size is reduced. At the highest compression levels, image deterioration becomes noticeable as "compression artifacting". The images below demonstrate the noticeable artifacting of lossy compression algorithms; select the thumbnail image to view the full size version.

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D. EDGE-DETECTION AND IMAGE SEGMENTATION ALGORITHMS

The object identifies boundaries in an image. These algorithms include the Sobel, Prewitt, Roberts, Canny, and Laplacian of Gaussian methods. The powerful Canny method can detect true weak edges without being "fooled" by noise. Determine region boundaries in an image. You can explore many different approaches to image segmentation, including automatic thresholding, edge-based methods, and morphology-based methods such as the watershed transform, often used to segment touching objects. Instead of defining an object on its own based on the strength of connectedness (as in absolute fuzzy connectedness), all other objects (co-objects) of importance that are present in the scene are also considered, and all objects are let to compete among themselves in having voxels as their members in relative fuzzy connectedness. In this competition, every pair of voxels in the scene will have a strength of connectedness in each object. The object in which this strength is highest will claim membership of the voxels. This approach of fuzzy object definition using relative strengths of connectedness eliminates the need for a threshold of strength of connectedness that is part of the previous definition described. It is more natural since it relies on the fact that an object gets defined in a scene by the presence of other objects that coexist in the scene

E. IMPORTING AND EXPORTING IMAGES

Image Processing Toolbox supports images generated by a wide range of devices, including digital cameras, satellite and airborne sensors, medical imaging devices, microscopes, telescopes, and other scientific instruments. You can visualize, analyze, and process these images in many data types, including single- and double precision floating-point and signed and unsigned 8-, 16-, and 32-bit integers. There are several ways to import and export images into and out of the MATLAB environment for processing. You can use Image Acquisition Toolbox™ to acquire live images from Web cameras, frame grabbers, DCAM-compatible cameras, and other devices. Using Database Toolbox™, you can access images stored in ODBC/JDBC-compliant databases. MATLAB supports standard data and image formats, including JPEG, JPEG-2000, TIFF, PNG, HDF, HDF-EOS, FITS, Microsoft® Excel®, ASCII, and binary files. It also supports the multiband image formats BIP and BIL, as used by LANDSAT for example. Low-level I/O and memory mapping functions enable you to develop custom routines for working with any data format. Image Processing Toolbox supports a number of specialized image file formats. For medical images, it supports the DICOM file format, including associated metadata, as well as the Analyze and Interfile formats. The toolbox can also read geospatial images in the NITF format and high dynamic range images in the HDR format.

F. DISPLAYING AND EXPLORING IMAGES

Image Processing Toolbox extends MATLAB graphics to provide image display capabilities that are highly customizable. You can create displays with multiple images in a single window, annotate displays with text and graphics, and create specialized displays such as histograms, profiles, and contour plots.In addition to display functions, the toolbox provides a suite of interactive tools for exploring images and building GUIs. It can view image information, zoom and pan around the image, and closely examine a region of pixels. You can interactively place and manipulate ROIs, including points, lines, rectangles, polygons, ellipses, and freehand shapes. You can also interactively crop, adjust the contrast, and measure distances. The suite of tools is available within Image Tool or from individual functions that can be used to create customized GUIs.
(a) A typical interactive session using Image Tool. The Overview window (left) is used to navigate when looking at magnified views in the Image Tool. The Pixel Region window (right) superimposes pixel values on a highly magnified view. LANDSAT image of Paris courtesy of Space Imaging, LLC.
(b) Using region-of-interest tools to create a mask. Items in the original image (top) are selected to create the mask (bottom).
(c) The toolbox includes tools for displaying video and sequences in either a time-lapsed video viewer or an image montage. Volume visualization tools in MATLAB let you create is surface displays of multidimensional image data sets.

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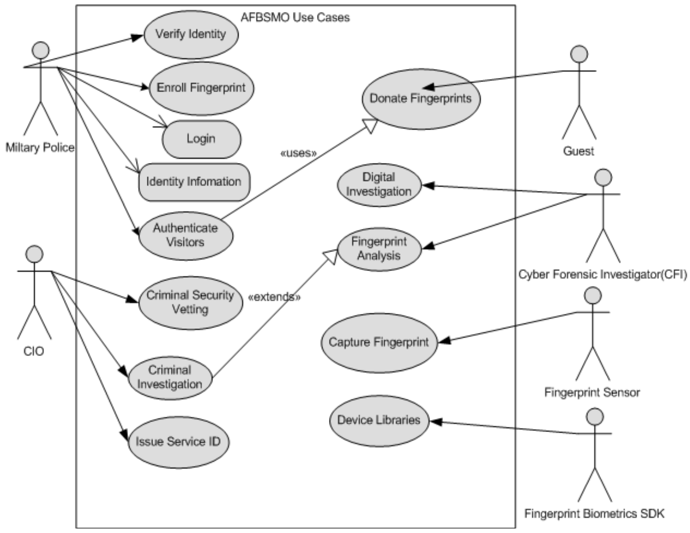

Fig.3 Proposed System Usecase Diagram

G. PREPROCESSING AND POSTPROCESSING IMAGES

Image Processing Toolbox provides reference-standard algorithms for pre-processing and post-processing tasks that solve frequent system problems, such asinterfering noise, low dynamic range, out-of-focus optics, and the difference in color representation between input and output devices. Image enhancement techniques in Image Processing Toolbox enable you to increase the signal-to-noise ratio and accentuate image features by modifying the colors or intensities of an image.
(a) Perform histogram equalization
(b) Perform decorrelation stretching
(c) Remap the dynamic range
(d) Adjust the gamma value
(e) Perform linear, median, or adaptive filtering

The toolbox includes specialized filtering routines and a generalized multidimensional filtering function that handles integer image types, offers multiple boundary-padding options, and performs convolution and correlation. Predefined filters and functions for designing and implementing your own linear filters are also provided. Performing connected components analysis on an image with non-uniform background intensity using MATLAB and Image Processing Toolbox. Image deblurring algorithms in Image Processing Toolbox include blind, Lucy-Richardson, Wiener, and regularized filter deconvolution, as well as conversions between point spread and optical transfer functions.

These functions help correct blurring caused by out-of-focus optics, movement by the camera or the subject during image capture, atmospheric conditions, short exposure time, and other factors. All deblurring functions work with multidimensional images. Device-independent color management in Image Processing Toolbox enables you to accurately represent color independently from input and output devices. This is useful when analyzing the characteristics of a device, quantitatively measuring color accuracy, or developing algorithms for several different devices. With specialized functions in the toolbox, you can convert images between device-independent color spaces, such as sRGB, XYZ, xyY, L*a*b*, uvL, and L*ch.

For more flexibility and control, the toolbox supports profile-based color space conversions using a color management system based on ICC version 4. For example, you can import n-dimensional ICC color profiles, create new or modify existing ICC color profiles for specific input and output devices, specify the rendering intent, and find all compliant profiles on your machine.

Image transforms such as FFT and DCT play a critical role in many image processing tasks, including image enhancement, analysis, restoration, and compression. Image Processing Toolbox provides several image transforms, including Radon and fan-beam projections. You can reconstruct images from parallel-beam and fan-beam projection data (common in tomography applications). Image transforms are also available in MATLAB and Wavelet Toolbox.

Image conversions between data classes and image types are a common requirement for imaging applications. Image Processing Toolbox provides a variety of utilities for conversion between data classes, including single- and double-precision floating-point and signed or unsigned 8-, 16-, and 32-bit integers. The toolbox includes algorithms for conversion between image types, including binary, grayscale, indexed color, and truecolor. Specifically for color images, the toolbox supports a variety of color spaces (such as YIQ, HSV, and YCrCb) as well as Bayer pattern encoded and high dynamic range images.

III. LITERATURE SURVEY

Shigang Cui et al (2017) [1] used digital image processing technology. Firstly the collected image of leaves was smoothed in HSI space, and then using the threshold segmentation method to divide the main vein. After that, the image of main vein extracted by the method of refinement algorithm and morphological processing. Finally, the length of the main vein was calculated by using the relationship between the image pixels and the actual length, so that the length of the main vein can be preliminarily measured. The test results shown that determination of leaf length using image processing technology, more accurate and efficient than manual measurement. It realized the non-destructive detection of leaf length, which provided technical support for plant research and agricultural management.

Tianhu Leiet al (2001) [2] proposed a separation process utilizes fuzzy connected object delineation principles and algorithms. The first step of this separation process is the segmentation of the entire vessel structure from the background and other clutter via absolute fuzzy connectedness. The second step is to separate artery from vein within this entire vessel structure via iterative relative fuzzy connectedness. After seed voxels are specified inside the artery and vein in the CE-MRA image, the small regions of the bigger aspects of artery and vein are separated in the initial iterations, and further detailed aspects of artery and vein are included in later iterations. At each iteration, the artery and vein compete among themselves to grab membership of each voxel in the vessel structure based on the relative strength of connectedness of the voxel in the artery and veinn via MRA-An image processing approach At each iteration, the artery and vein compete among themselves to grab membership of each voxel in the vessel structure based on the relative strength of connectedness of the voxel in the artery and vein.

N. Lalithamani et al (2016) [3] proposed different algorithms to be confronted by security of biometric systems. Two major ways are, (1) Encryption, and (2) watermarking by securing biometric images and templates. In this paper, we utilise a watermarking technology to improve the template security in biometric authentication. According to, two modalities such as, iris and hand vein is taken to preserve the characteristics of liveliness and permanency. Our proposed technique for embedding of iris data to hand vein images using watermarking technology to improve template protection in biometric recognition is done based on the following steps: i) pre-processing of iris and hand vein images, ii) iris template extraction, iii) Vein extraction, iv) Embedding of iris pattern to vein images based on region of interest and v) Storing embedded images. In the recognition phase, iris pattern is extracted from the embeddedimage and then, matching is done with query images. The final decision of authentication is done based on the product rule-based score level fusion. The implementation is done using MATLAB and the performance of the technique is analysed with FAR, FRR and accuracy.

Mihails Pudzset al (2014) [4] demonstrated how to implement Complex Matched Filter in FPGA based systems for real-time palmprint and palm vein image processing. CMF approach is based on matched filtering with rotated line

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extraction kernels, however, CMF requires less computational resources and it obtains additional angular information about the extracted biometric features. This information is valuable in feature description and recognition process. Topics that are covered in this paper include optimization of used multipliers and real-time data processing without use of external RAM resources.

Wenhai Wu et al (2012) [5] reviews the concepts and types of biometrics, then discusses VBB and vein image processing. According to the study of existing algorithms and techniques, a hand vein image segmentation and refinement algorithm is introduced in this section, a normalized image of the hand veins is processed by the Gaussian filtering and median filtering, in order to remove certain amount of speckle noise. By using local dynamic threshold segmentation NiBlack algorithm, a coarse vein image is produced. An image of veins lines with smaller distortion is obtained by refinement algorithm. It is also show some experimental results of VBB. The last section of this paper is about some new developments of biometrics.

Xiangping Zeng Weidong Jin (2012) [6] introduce the principles and workflows of vein recognition. At the same time, algorithms of vein recognition were researched. This paper focuses on the vein image preprocessing and relative algorithms. And a series of simulation results of vein image processing were given in the paper.

Kazi Istiaque Ahmedet al (2017) [7] proposes an easy guiding method for nurse and doctors to be integrated into the procedure. A vision-based imaging technique, that gives a practitioner a new perspective for the needle infusion procedure, is introduced. The idea behind of this process is to use the IR camera to capture video sequences of the arm and then compute the effect of electromagnetic wave imprint on each pixel. Then trace the vein location by locating the NIR illumination that is absorbed by the blood in the vein and highlighting it in comparison to the surrounding tissue. Interestingly, this can lead to other applications for the developed system like locating abdominal bleeding, stroke inducing clots in veins near the skin surface and body part vein map-based individual identification biometric to name a few.

IV. SYSTEM ANALYSIS

A. Existing System

In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for texture analysis, which means that it basically analyses whether there are any specific frequency content in the image in specific directions in a localized region around the point or region of analysis. Frequency and orientation representations of Gabor filters are claimed by many contemporary vision scientists to be similar to those of the human visual system, though there is no empirical evidence and no functional rationale to support the idea. They have been found to be particularly appropriate for texture representation and discrimination.

In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. Some authors claim that simple cells in the visual cortex of mammalian brains can be modeled by Gabor functions. Thus, image analysis with Gabor filters is thought by some to be similar to perception in the human visual system. Its impulse response is defined by a sinusoidal wave (a plane wave for 2D Gabor filters) multiplied by a Gaussian function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function (sinusoidal function) and the Fourier transform of the Gaussian function.

The filter has a real and an imaginary component representing orthogonal directions. The two components may be formed into a complex number or used individually. Demonstration of a Gabor filter applied to Chinese OCR. Four orientations are shown on the right 0°, 45°, 90° and 135°. The original character picture and the superposition of all four orientations are shown on the left. Gabor filters are directly related to Gabor wavelets, since they can be designed

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for a number of dilations and rotations. However, in general, expansion is not applied for Gabor wavelets, since this requires computation of bi-orthogonal wavelets, which may be very time-consuming.

Therefore, usually, a filter bank consisting of Gabor filters with various scales and rotations is created. The filters are convolved with the signal, resulting in a so-called Gabor space. This process is closely related to processes in the primary visual cortex.Jones and Palmer showed that the real part of the complex Gabor function is a good fit to the receptive field weight functions found in simple cells in a cat's striate cortex.

DISADVANTAGES OF EXISTING SYSTEM

(a) Time consuming.
(b) The consistency of the image quality could not be guaranteed.

B. Proposed System

A bilateral filter is a non-linear, edge-preserving, and noise-reducing smoothing filter for images. It replaces the intensity of each pixel with a weighted average of intensity values from nearby pixels.

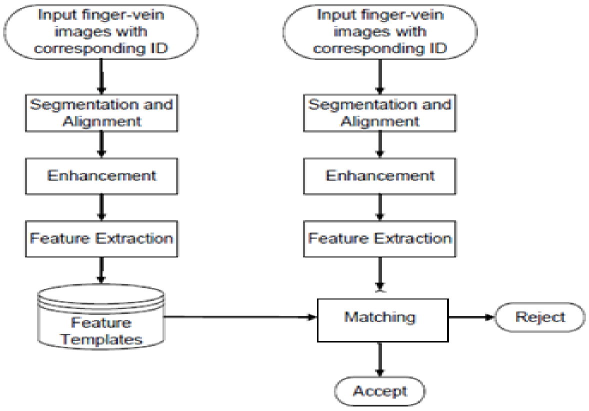

Fig.4 System Architecture Design

This weight can be based on a Gaussian distribution. Crucially, the weights depend not only on Euclidean distance of pixels, but also on the radiometric differences (e.g., range differences, such as color intensity, depth distance, etc.). This preserves sharp edges. The bilateral filter is defined as the filtered image. As the range parameter or increases, the bilateral filter gradually approaches Gaussian convolution more closely because the range Gaussian widens and flattens, which means that it becomes nearly constant over the intensity interval of the image.

ADVANTAGES OF PROPOSED SYSTEM

(a) The better account for changing legal behavior
(b) Different frequencies and with orientations in different directions have been used to localize and extract text-only regions from complex document images (both gray and colour).
(c) It has been used to study the directionality distribution inside the porous spongy trabecular bone in the spine.

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V. RESULTS AND DISCUSSION

In this section, we provided the simulated results of entire project with its practical proofs. The following figure shows the Finger Vein Identification perspective of the Proposed System.

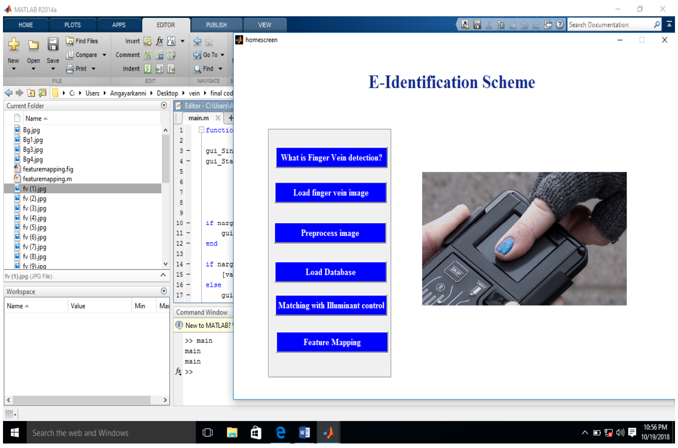

Fig.5 Finger Vein Identification

The following figure illustrates the Pre-Processing Stage of the proposed system.

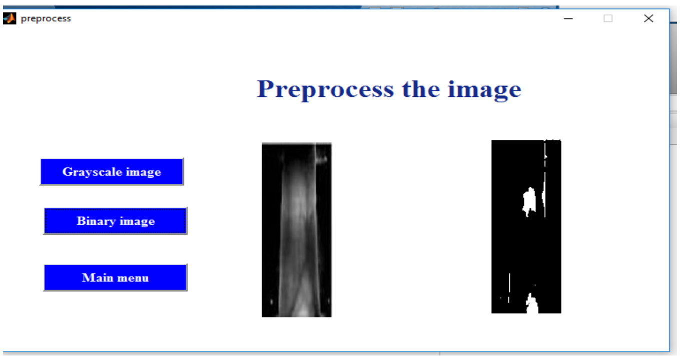

Fig.6 Pre-Processing Stage View

The following figure illustrates the view of Matching with Illuminanace Control of the proposed system.

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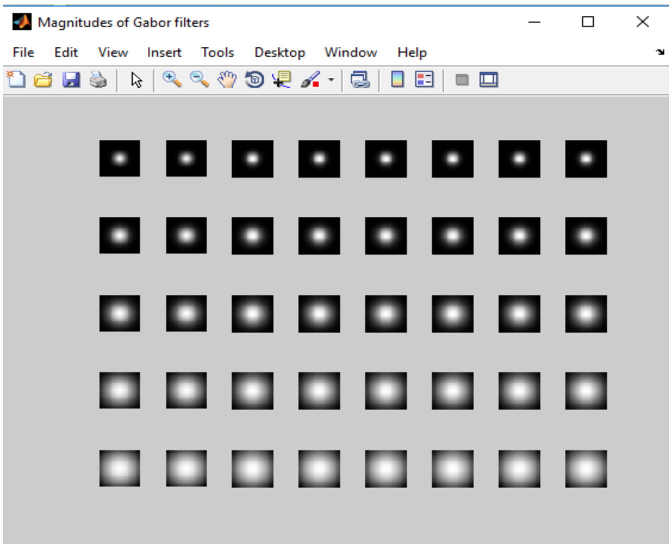

Fig.7 Matching With Illuminanace Control

The following figure illustrates the Feature Mapping View of the proposed system.

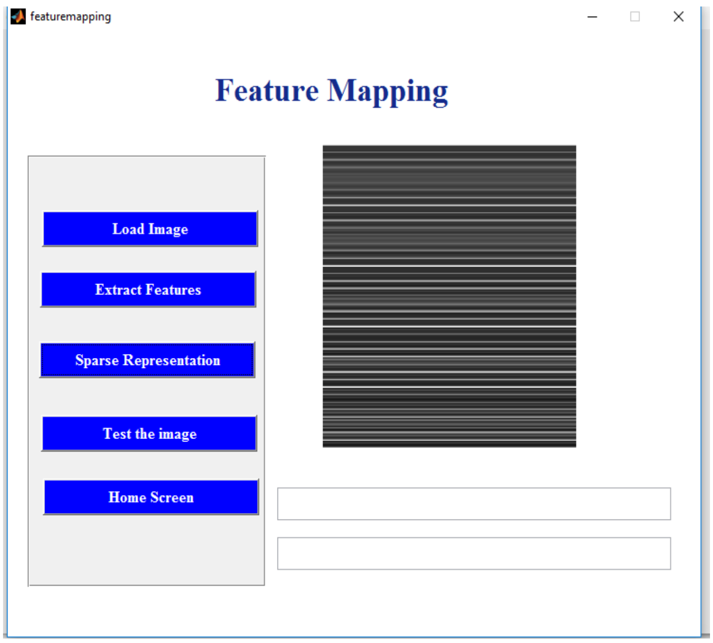

Fig.8 Feature Mapping

VI. CONCLUSION AND FUTURE SCOPE

Finger- vein based identification technology has high security and reliability compared to the traditional authentication mode. It also can be applied in public or private equipments such as entrance control systems, home or office door

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entry control systems, and ATM systems. The system provides effective and efficient feature using bilateral algorithm which is been implemented on MATLAB platform. The accuracy can be further improved by considering the light exposure factor in the implemented hardware.

In future, the proposed work is further extended by means of some intensive algorithms such as Deep Convolution Neural Network (DCNN) with powerful authentication strategies and has a plan to improve the accuracy range higher than the proposed system.

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