



INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Finger Vein Recognition and Authentication System

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Abstract

The protection for private information has steadily increased with the demand that the authentication has to be done in a highly secured method it is also simple and convenient. With this consideration and requirements for the emerging devices has to been done by the human physiological and biometric structures and behavior. One such biometrical identity is used in this paper is the finger vein. This is used as a biometric identity and authenticated also is experimented. The paper reveals about the high security system in our society to protect the personal information that is being theft. The main objective of this work is to implement a low cost budget system for protection purposes. This system is very simple and convenient not so complex like other biometric identification systems Finger print, palm size, hand shape, face recognition, iris identification and so on. Based on the application the component requirements can be increased or decreased which will constantly reflect on the cost of implementation of this project. Here the finger vein recognition system is implemented using MATLAB which is highly helpful in image processing applications. In this the real time finger is captured on and the image is processed using this software before the image is used. A novel finger vein algorithm is equipped in this system.

Keywords: finger image, vein extraction, image matching.

Introduction

The biometric systems, like finger print, face recognitions, voice, iris identifications, gait, hand shape, gesture identification, palm print, signature are no longer exist because of its easy foolproof, hacking, and spoofing attacks. The other way round the password, Pin numbers can also be used for the essential purposes, whereas those lead to the effect of forgetting the number or to the risk of exposure. By these means the data can be easily read by the people and they can make use of that to collect your private information which describes the most important personal data where you need to maintain your secrecy. This may cause the system collapse. For instance, let us take a banking security system, where the ATM cards are often used, for wide variety of applications like banking, online shopping, online billing, etc. which means that losing the PIN number will lead to different consequences. Even the PIN number can also be forgotten where wrong entry of PIN may lock the account, so there are several other problems also.

But here the physiological behavior is used where there is no vulnerability for the risk of exposure or being forgotten. The finger vein cannot be easily read by anybody since it is inside the body, that it is

internally connected with a person's finger. The basic advantage of this system is cannot be forged easily that the finger vein varies independently for each and every person. This cannot be read by a person whereas without the knowledge of his own.

The finger vein has lot of advantages comparatively with other biometric systems. Those can be listed and are as follows:

Finger vein is unique biometric physiological feature hidden inside and mostly it is invisible to our human eye it varies from person to person.

Vein can be obtained only from alive people and not from dead ones.

Since vein is hidden it has no contact with the image acquisition device which reduces the falsification of data.

The vein characteristics and attributes remain unchanged for years which are everlasting.

Overview of the System

The Basic outline of the system can be described with this structure shown below.

The system has two different stages where the main problem of the system lies. One is the registration stage other is the comparison stage.

Registration stage is also called as enrollment stage.
Comparison stage is also called as verification stage.

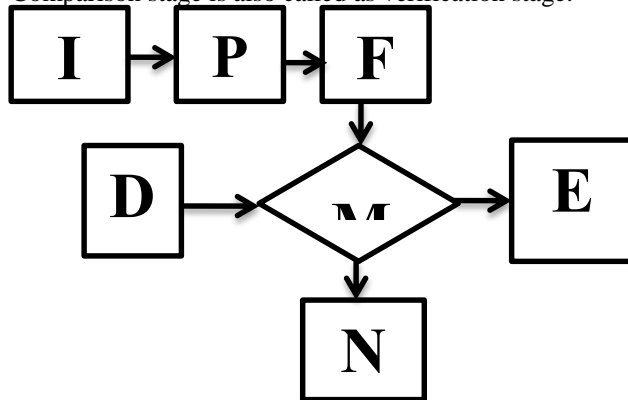


Fig 1. Overview of the System

Whenever the system is implicated this undergoes the above two stages where the real time finger vein identification also has to undergo those. The Registration stage is nothing but the image or the template storage stage. Before the image could be matched the image has to undergo pre-processing where the image will be captured and feature extracted and then stored for the comparative purpose. Every time when the image is given in real time implementation, the image undergoes the pre-processing, feature extraction and the matched with the template that is stored in the database of the system. So if the system matches image in database then the output of an equivalent image will be displayed else no image will be displayed.

Image Acquisition Device

The image acquisition device has the following components such as a camera, IR LEDs, and a human finger. The device can uphold the structure that is shown below.

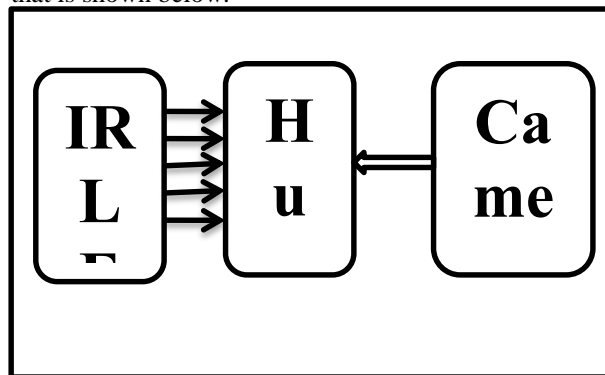


Fig 2. Image Acquisition device

The image Acquisition can be done by using the camera, and IR LEDs. The image of the finger is captured with the help of the camera. The idea of our project is to capture the finger vein image, but with the camera only the finger can be capture since we need

the vein image and also the vein is inside the human body it cannot be easily captured, so IR LEDs can be used. When the image is captured in night mode, the IR light is passed through the finger where in this captures the finger vein which is dark and the image is stored in location.

Camera

The image is captured using an ordinary camera, which is used in common applications, with an medium resolution of pixel rate. Here an IR camera also can be used to get effective result. The infrared camera can be used to read an image with the infrared radiation which is also very similar to a common camera with the visible light. The infrared cameras are used in the wavelength of 14µm, this camera works in total darkness because of the level of ambient light that does not matter. The Infrared camera has a very complex construction, to differentiate wavelength and color. The camera construction can be varied based on the application we develop and here we need to remove the outer cover of the camera to rebuild the camera setup in such a way that, the camera body fits into the case which we designed.

The camera is fixed in a supportive position based on this the total system is designed. The camera will be in top and the LEDs will be fixed in the bottom, whereas there will a little space provided to place the finger. The LEDs will be arranged in a form that wherein the finger can be placed on it. The spatial arrangement will be constant for all.

The IR LEDs are used here, because of the infrared radiations provided by them. A common LED will be similar to this, but the infrared illumination makes the difference, in this IR LEDs. These LED number can be increased or decreased based on the light illumination for the image. If there is low intensity in the image, then the number of LEDs has to be increased and if intensity is high then the number can be decreased. The main advantage of these IR LEDs is that they can be used in night vision and the infrared radiations passed by this cannot be seen by naked eye. This becomes the major disadvantage of the system that, whether the IR LED circuit is working or not. So this can first experimented in the night vision and then it can be applied in the system. For instance in real time the system can be used by the camera in cell phone, now the camera emanates the IR rays from the IR LED circuit.

Some of the main features in this IR LED are:

These LEDs will have high reliability and radiant intensity.

The device can also be matched spectrally with other circuits like phototransistor, photodiode and infrared receiver module.

These IR LEDs are seen commonly in remote controls, wherein they will have a beam width and this IR LED will act as an IR transmitter, and the one in the opponent device will act as the receiver. The IR LEDs are special purpose LED that transmits infrared rays of range 760nm wavelength.

The arrangement of LED can be designed based on the approximation of the system with normal finger layout. The outline of the fore finger can be considered for this outline sketch and develop an IR LED structure.

Image Processing

The image processing is the process of determining the vein originality from the captured image. The finger image is first captured and image processing is done in MATLAB to obtain the vein image alone. Here the basic processes like segmentation, enhancement, alignment and other pre-processing stages are executed. The basic processes are implemented and then the image undergoes some of the following steps:

The new image has to be loaded with the help of the capturing device, the camera.

The image captured should undergo the basic test in the field and store it in the database, which is known as train database or register.

When the image is taken in real time the image will have to be first tested based on the input, finger.

The captured image should be tested these techniques and it is called as test database.

The path or location where the two databases are stored should be copied and used in the program.

The image that is captured using the camera will be in the below displayed form.

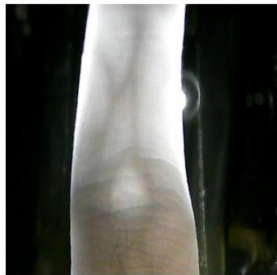


Fig 5. Finger image captured using camera

The image is thus captured using the camera, and there is no proper vein detection, in this above shown image. This is because of the radiation of the light because the vein is not detected properly there are some process to detect the vein region in the finger, edge detection and also to find the maximum curvature of the finger vein image.



Fig 6. Finger region and edge detection

Finger edge detection is shown in Fig 6. and the detected region can be used in finger vein tracking method. The vein has to be obtained from the above image and then the finalized image is used for enhancement and equalization. The figure shows that once when the image is captured the finger image refines itself to a stage that is the maximum enhancement should be obtained as a result. This will also be used in image registration process.

The finger edge detection is thus performed and utilized for the maximum curvature tracking and line tracking. These operations are performed in the system with the help of the binarised veins that are extracted by maximum curvature method and also by repeated line tracking method.

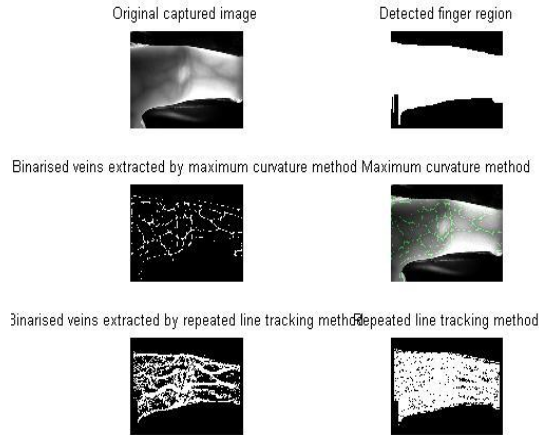


Fig 7. Vein extraction and line tracking

The image has been binarised and detected by repeated line tracking method. The image has to be enhanced and normalized to obtain the perfect vein structure that has to be applied in matching the real time image with the registered image.

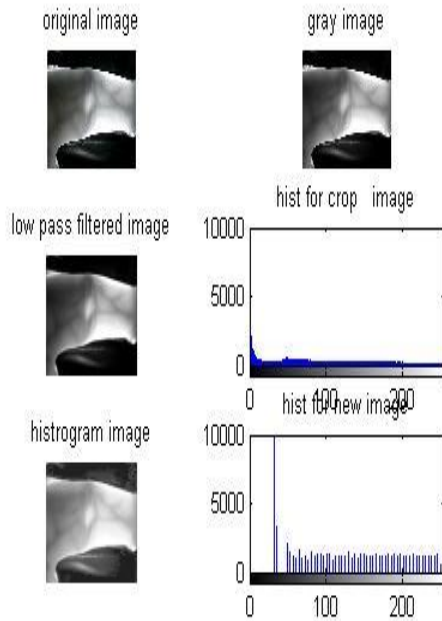


Fig 8. Histogram equalization of finger vein

The image is captured and then that is converted to a gray scale image for which the binarised images are helped and then the maximum curvature and detection is done by repeated line tracking, then the normalization is performed and the image enhancement stage is accessed. The image enhancement is done by histogram equalization, the image is cropped and filtered and then histogram has

to be achieved for the crop image and again the image after cropping a new image will be obtained, again using the histogram equalization, the enhancement for the finger vein is done and equalized, and is plotted for new image. Then the new image can be stored.

The image is stored in the system is for training database, when it comes to real time image, a new image is captured an all the image processing functions are performed and then compared with the whole database and the output is displayed.

Matching

The real time image has to be matched with the database images, by means of finding a threshold for the registered image. The threshold value for those images can be found by trial and error method. The threshold level should not be varied and should be fixed constant for all. Whenever the new image is captured the image will undergo all the test and finally matched with the images in the database also with the threshold and produce a matching score percentage of the new image with the registered image. Only if there is 100% matched the verification will be accepted else the equivalent image will not be displayed.

Conclusion

The development of this paper for high security system can be implemented in many applications like home security systems, banking security, mobile devices, ATMs, passport verifications, etc. The memory is one of the important constraints here, so based on the requirement the implementation can be varied.

Future Work

The image storing and memory allocation plays the vital role in this system, so in order to improve the memory the system can be further implemented in any processor, whereas the code can be first converted from MATLAB source to any other platform and then it can be implemented.

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