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FINGER VEINAUTHENTICATION SYSTEM USING DEEPLEARNING IN ALEXNET ALGORITHM

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Abstract

Vascular-based biometrics is increasing in importance due to their accuracy and security. Finger vein- basedbiometric systems elegantly solve the problems associated with fingerprint systems. The vein-based authentication system is a promising biometric model for personal identification in terms ofits security and ease of use. Vein patterns can only be taken from a living body. Therefore, it is natural and conclusive evidence that a subject whose veins have been successfully struck is alive. The finger vein detection technique was improved using a neighborhood elimination technique to reduce repetitive features in the removed finger vein-specific image. The neighborhood elimination technique is used to remove redundant data while retaining effective raw data for subsequent processing.

Keywords—Finger vein image authentication, deep learning, Convolutional neural network, Vein-based authentication

INTRODUCTION

The interest in modern societies has increased as Internet and network technologies are developed and implemented for remote user authentication or identity detection methods. The modernization also includes traditional security systems such as key locks or ID cards, which can improve the security of critical locations such as ATMs, banks, nuclear power plants, etc. These and other different scenarios drive more complex systems based on biometric data, because it is impossible for a malicious person to produce the data. These systems are commonly known as biometric identification systems. Pattern this goal, it is necessary to combine hardware design and programming procedures. With the help of hardware design, the system can instruct the user to act correctly so that the pattern is easily recognized. Software interventions allow the system to correct pattern acquisition problems by relying on algorithms to resolve irregularities. In addition, the algorithm is able to generate a biometric token similarity score based on the extracted fingerprints, the result of which is assumed to be accurate to aninfinite number of decimal places.

DEEP LEARNING TECHNIQUES

Image Acquisition

It's understood as data acquisition for finger identification the process that targets the process that starts from the camera input to the final extracted information that the system requires. Thisdata has to be representative of the individual finger and needs to be able to deliver similar results between captures in order to be able to define a proper identification system. The procedure for which the information is captured,transformed, extracted information about the user and finally compared with a database samples is the finger vein identification process.

High-quality finger vein datasets available for the research community are still relatively scarce; therefore, we collected a set of finger vein images of high resolution and a known pixel density recognition systems can identify a person based on a unique biometric feature. In theory, an ideal biometric trait should be: easy to isolate from an individual, difficult for the general public to obtain, and difficult for anyone else to duplicate. The acquisition of biometric parameters is a very complex operation, because it requires that the conditions surrounding the obtained parameter are as similar as possible. To achieve this goal, it is necessary to combine hardware design and programming procedures. With the help of hardware design, the system can instruct the user to act correctly so that the pattern is easily recognized. Software interventions allow the system to correct pattern acquisition problems by relying on algorithms to resolve irregularities. In addition, the algorithm is able to generate a biometric token similarity score based on the extracted fingerprints, theresult of which is assumed to be accurate to an infinite number of decimal places.

Convolutional Neural Network

Convolutional Neural Networks (ConvNets) are widely used tools for deep learning. They are especially useful for image input, but are also used for other applications such as text, signals, and other continuous responses. AlexNet is a type of ConvNets which is used in this project.

AlexNet: AlexNet is a convolutional neural network that is 8 layers deep. You can load a pre trained version of the network trained on more than a million images from the Image Net database. The pre trained network can classify images into 1000 object categories.

A spatial pyramid pooling mode network structure was introduced to address the limited image size and adaptability issues of the AlexNet network model. AlexNet's convolutional core size, network depth, and full link layer are tuned to accelerate network training speed and reduce network model complexity. The results show that the improved network model shows significant improvements in detection accuracy and training time compared to the AlexNet model on both public and private fingervein datasets.

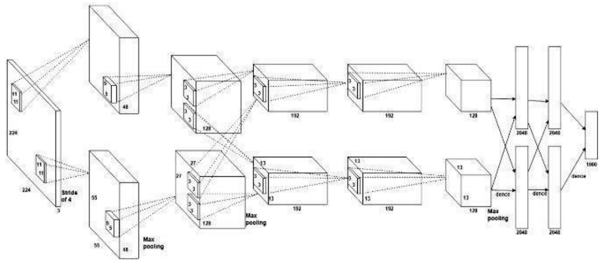

Fig 1: AlexNet Architecture

The next step that comes in our process is of equalizing the histogram. Histogram equalization is a technique for adjusting image intensities. The images acquired from the database have a very low contrast value, and it would be very difficult to extract the vein patterns before enhancing it. To achieve a good contrast tone and stretching out the intensity range of the image, histogram equalizationis performed.

Pre-Processing

The cycle of image processing begins with the conversion of the finger vein image to grayscale. The reason for converting an image to its grayscale structure is that a lesser amount of light can every pixel will need to accommodate a certain quantity of data. The depth of the image's digitization determines the maximum grey level.

The next step is to set up the histogram after the image has been converted to grayscale. A graphic representation of the tonal distribution in a digital image is called an image histogram. Each tonal value's number of pixels is plotted.

Each column in the histogram denotes the number of pixels in the image that correspond to each column's pixel value.

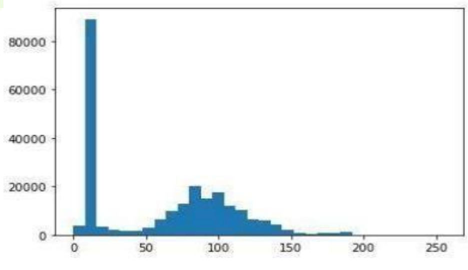

Fig 2: Histogram of the Image

Generally, images captured by the acquisition process itself introduce noise. This noise must be removed from the image. The process of opening is proposed for this purpose. The opening is a process in which erosion is followed by dilation. Erosion and Dilation are morphological image processing operations. Both operations are defined for binary images, but these operations can also be used on a grayscale image. These operations are used for removing noise, identifying intensity bumps or holes in the picture and isolating the individual elements, and joining disparate elements in the image. Erosion means stripping away the layer of pixels from inner boundaries and outer boundaries, which help in the elimination of small and unimportant details.

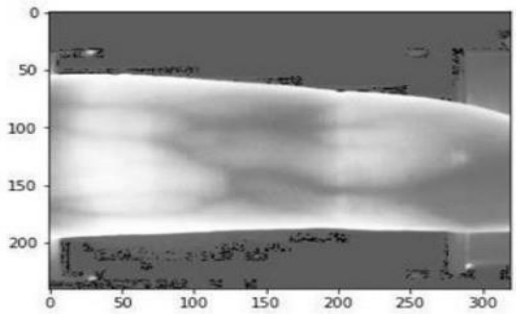

Fig 3: Image after equalizing the histogram

Dilation in this proposed system helps fill the gap between the veins, which can be caused by erosion during the removal of layers in the boundaries. Thus, erosion and dilation together help form a visible continuous vein pattern from which ROI can be extracted. Erosion is applied before dilation because it helps eliminate unimportant details from the image, and further application of dilation causes the enhancement of vein patterns. Dilation is almost similar to erosion in calculation. The difference is that the pixel value of erosion is calculated as a minimum rather than the maximum in dilation. The image is replaced under the anchor point with that calculated minimum pixel. Unlike dilation, the regions of darker shades increase. At the same time, it decreases in the white shade or brighter side.

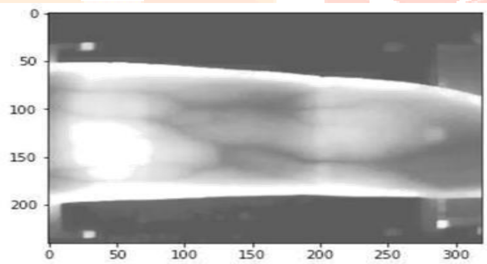

Fig 4: After noise removal

Segmentation

Usually the acquisition of the vein pattern is limited to an area inside the finger. However, the experimentation during this project showed that including the finger shape as one more finger vein,

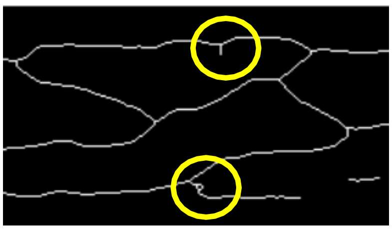

Fig 5 : Segmentation

Fusing it with the closer to the border of the finger, improved the end user experience,increasing the probability that a genuine user was identified

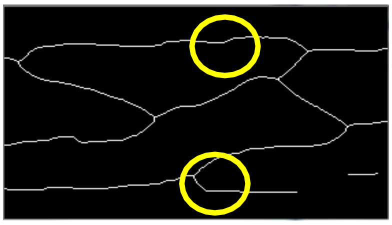

Fig 6: Thinned vein pattern

Fig 7 : Smoothed vein pattern

As you can notice in the smoothed vein pattern, the introduction of the finger side as one more vein fused with the top and bottom finger vein increases the number of lines detected and the complexity of the final vein pattern. This aiding the identification of a given vein pattern and at the same time decreases the correlation between finger vein patterns from different fingers. It also helps to avoid the problem related with fingers with almost un-detectable vein patterns. In this case, the finger geometry becomes the finger vein pattern used for identification proposes. It also has the advantage that the rotation of the finger commonly hides the vein closer to the finger side. Fusing the side and the closest finger vein helps to decrease the differentiability between both finger vein patterns.

Feature Extraction

Once the finger vein pattern is acquired the next step in an identification system is to choose, design the implementation of the pattern recognition algorithm and features that will be used for identification. Multiple kinds of data and pattern recognition algorithms can be used in a single final score. Those systems are usually known as multimodal systems since they use different features to perform a single identification. In this project three different kinds of data from the finger vein pattern were selected as feature points and the fusion between them in order to obtain a final result, such features are:

The finger vein pattern as it is will be recorded as a feature.

The maximum and minimum distance found between two finger veins in a cross-section scan of the finger vein pattern as geometric feature.

The end and cross points of that can be found in the final picture after the image acquisition

Procedure.

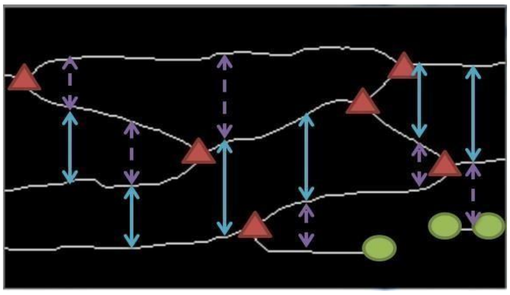

Fig 8: Feature Extraction

CONCLUSION

This project study the possibilities and performance of different methods and setup of a finger vein identification system and propose a networked implementation of a finger vein identification system. It has been explained the process to extract the finger vein pattern from an input Near Infrared camera and the required steps to make it something reliable for a finger vein identification system. This project has shown how it is possible to improve the problems related to a non- homogenous illumination of the finger from an array of illuminators. However, it would be recommendable for future device designs to avoid such design faults.

During the experimentation with the finger vein segmentation and extraction, as well as matching process, was possible to identify the effects related to rotations and different curvature levels of the finger. It would be recommendable for future designs to reduce the distance between the illuminators and the camera and consequently, reduce the height of the device, reducing the degrees of freedom of a given user at the time to introduce the finger. It has studied and defined the properties of different methods and scoring setups in order to define the final parameters of our proposed solution. It is also shown that methods with low levels of accuracy can be used to define a multimodal system with an increased accuracy but, at the same time, it has been proved that the minimum FAR required by the system can suffer a great penalty if one of the combined systems and the combination of more than one sample per user can greatly improve the performance of the system. It has also been proposed a distributed setup using networked solution to provide the authentication information to different devices at remote locations.

FUTURE ENHANCEMENT

The proposed system implements the software part used for matching the vein images for personal identification.

In the future, besides embedded applications for portable IT devices such as cellular phones, finger vein authentication will take full advantage of its unique use of the finger to expand into applications such as opening doors with a simple grip of the handle.

Grip-type technology embeds personal authentication in the natural motion of opening a door, ensuring the highest security without forcing the user to learn complicated new procedures.

This technology will be applicable to home, office or car doors and will usher in a future without keys that nevertheless allows one to protect personal property with the utmost security.

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