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Research Paper

Next-Generation Finger Vein Recognition Technology

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ABSTRACT: *This paper proposed a lightweight real-time finger vein segmentation method based on deep learning technique because the existing finger vein segmentation networks are too large and not suitable for implementation in mobile terminals, Finger vein recognition is a method of biometric authentication that uses patterns-recognition techniques based on images of human finger vein patterns beneath the skin's surface. Finger Vein ID is a biometric authentication system that matches the vascular pattern in an individual's finger to previously obtained data. Finger vein authentication removes the possibility of fraud because finger veins are distinct even in identical twins, exist beneath the skin, and last a person their entire life. recognition of finger vein patterns has greatly improved. The data is substantially increased by randomly choosing the center to acquire sub-blocks on each image from the training set during the preprocessing stage of the algorithm. A repeated line tracking method is used in this finger vein authentication, pixels such as horizontal, vertical, and diagonals of 256 pixels are covered and the efficiency is improved. Our suggested solution, which has a database recognition rate 99.56%, can compete with cutting edge techniques.*

KEYWORDS: *Machine learning, Artificial neural networks (ANN), MATLAB, feature extraction, U-Net.*

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I. INTRODUCTION

Due to the growing requirement to guarantee the security and accuracy of biometric systems, biometric technology has recently been attracting more and more attention from the general public. Many biological characteristics, including fingerprints, palm prints, finger veins, hand veins, palm veins, faces, iris, voices, gaits, and signatures, are currently used in recognition and verification applications. Due to its benefits of difficulties in forging, and relatively inexpensive compared to various other biometric recognition technologies, finger vein recognition has been receiving a lot of attention in the research community. Even if earlier finger vein segmentation networks including FCN, SegNet, RefineNet, U-Net, etc. have generated better performances, it is essential to keep in mind that these techniques need a considerable amount of storage resources on. It produced results that were quite excellent, and in the end, it was the best paper of ICLR 2016. After then, analysis of model compression techniques revealed that the primary branches of DL are as follows: I The model's design has been improved device. The suggested solution combines feature extraction with repeated line tracking, which covers all 256 pixels multidimensionally and yields greater accuracy.

The study of computer algorithms that automatically get better as you acquire experience is known as machine learning (ML). Machine learning (ML) is used in deep learning (DL), which is used with big data sets. Due to the extensive learning required for intelligent. ML is used in the majority of AI projects. Since the commencement of AI research, machine learning (ML) has served as a key concept. It is the study of computer algorithms that get better on their own with practice.

Deep learning methods are designed to examine the functional hierarchy with higher-level functions, which are compound. The table format has several values, but images contain pixel data, documents contain text data, or files contain audio data. Deep learning enables computer models with the non-contact collection, live detection, of processing to learn data representations with multiple levels of abstraction sed of lower-level functions.

The median filter is the filtering technique used for noise removal from images and signals. The median filter is very crucial in the image processing field as it is well known for the preservation of edges during noise removal. Median filtering often involves a horizontal window with 3 taps; occasionally, 5 or even 7 taps are used.

Gaussian Process is a machine learning technique. You can use it to do regression, and classification, among many other things. A Gaussian filter is a linear filter. It's usually used to blur the image or to reduce noise. If you use two of them and subtract them, you can use them for "unsharp masking" (edge detection). The Gaussian filter alone will blur edges and reduce contrast. A Gaussian filter is a linear filter that is typically used to reduce noise or blur the image — Gaussian Blur or Gaussian Smoothening.

Fig. 1: Gaussian Filter

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It was developed by John F. Canny in 1986. Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. This method is, therefore, less likely to be affected by noise, and more likely to detect true weak edges. This method is therefore less likely than the others to be affected by noise, and more likely to detect true weak edges.

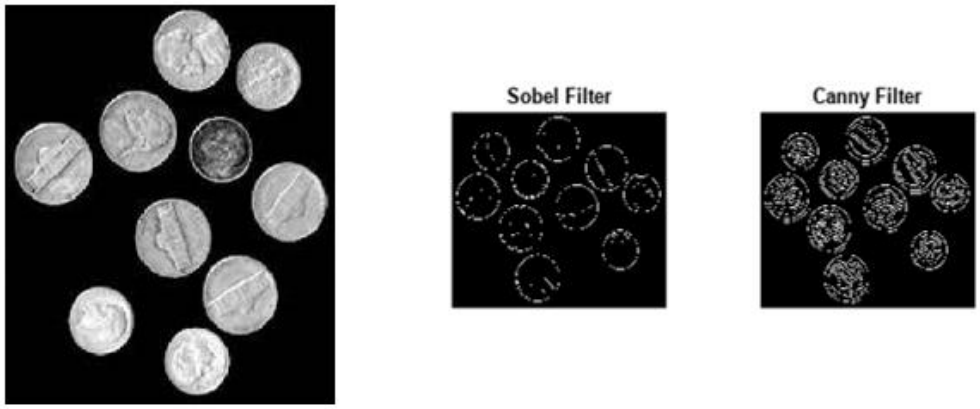


Fig. 2: Filter output

MATLAB is a proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. MATLAB is the easiest and most productive computing environment for engineers and scientists. It includes the MATLAB language, the only top programming language dedicated to mathematical and technical computing. In contrast, Python is a general-purpose programming language.

II. LITERATURE REVIEW

1) TITLE: Vascular Patter Of The Finger Bio, Etric Of The Finger

AUTHORS: B. Ton (2020)

The usage of the vascular pattern of the finger is emerging as a new form of biometrics. This new biometrics is already commercially exploited but the scientific research done is still lacking behind. The goal of this research is to bridge this gap between research and commerce. In order to do so this research focuses on three main

aspects. The dataset collected comprises 59 volunteers which had their ring, middle and index fingers captured from both hands during two sessions. These sessions were separated by two weeks and during each session each finger was captured.

2) TITLE: Robust ROI Localization Based on Image Segmentation and Outlier Detection In Finger Vein Recognition

Finger vein is deemed to be a promising biological trait for individual identification. However, partially due to non-uniform collection devices and non-standard collection process, original images are polluted by lots of unfavorable factors. These negative effects increase the burden on image matching. Therefore, Region of Interest (ROI) localization plays an important role in finger vein recognition Next, in order to ensure the edge be qualified and further correct the skew angle, the novel Directional Linkage the previous work, the number of thresholds used during the whole process is reduced to only four. The identification EER in experiments is reduced to 0.0476 on all the images in three public databases, which indicates Compared methods.

3) TITLE: Finger vein recognition based on lightweight CNN combining centre loss and dynamic regularization.

AUTHOR: Dingdong Zhao, Hui Ma, Zedong Yang, Jianlian Li, Weberian (2020)

Finger vein recognition is one of a new biometric recognition technology, which has a wide range of applications in daily life. However, the quality of finger vein images is less than satisfactory because of the disappointing sensor conditions based on infrared light.

4) TITLE: Finger Vein Identification Using Deeply-Fused Convolutional Neural Network.

AUTHORS: Ismail Boucherit, Mohamed Oldsmar, Hamza Rentable, Bakhtiar Affendi Rosdi. (2022)

Finger vein identification is a recently developed biometric technology and has become an essential field in biometrics, garnering increasing attention in recent years. As a biometric trait, using vein patterns allows for personal recognition with high security Our proposed scheme can compete with state-of-the-art methods with recognition rate of 99.56% for the THU-FVFDT2 database.

5) TITLE: A Joint Bayesian Framework Based on Partial Least Squares Discriminant Analysis for Finger Vein Recognition.

AUTHORS: Liping Zhang, Linjun, Sun, WeijunLi, Jianming Zhang, Weiwei Cai, Chuantong Cheng, Xin Ning.(2022)

Finger vein recognition has attracted considerable attention from the biometric identification technology community owing to its convenience and security. Unlike most previous works only pay attention to one part of finger vein recognition, we propose a joint Bayesian framework in this paper, which is proposed method to most state-of-the-art finger vein recognition methods.

6) TTITLE : Finger Vein Recognition Algorithm Based on Lightweight Deep Convolutional Neural Network.

AUTHORS: JiaquanShen, NingzhongLiu, Chenglu Xu, Han Sun, Yushun Xiao, Deguang Li, YongxinZhang.(2021)

Even though the deep neural networks have strong feature representation capability and high recognition accuracy in finger vein recognition, the deep models are computationally intensive and poor in timeliness. To address these issues, this article proposes a lightweight algorithm for finger vein image recognition and matching. The results show that the finger vein recognition and matching algorithm proposed in this article achieves 99.3% and 99.6% in recognition accuracy and 14.2 and 16.5 ms in matching time for the dataset Shandong University Machine Learning and Applications Laboratory-Homologous Multimodal Biometric Traits (SDUMLA-HMT) and Peking University Finger Vein Dataset (PKU-FVD), respectively. These metrics show that our approach is time-saving and more effective than previous algorithms. Compared with the state-of-the-art finger vein recognition algorithm, the proposed algorithm improves 1.45% in recognition accuracy while saving 45.7% in recognition time.

III. EXISTING SYSTEM

Private information is traditionally provided by using passwords or Personal Identification Numbers (PINs), which are easy to implement but is vulnerable to the risk of exposure and being forgotten. Biometrics, which uses human physiological or behavioral features for personal identification, has attracted more and more attention and is becoming one of the most popular and promising alternatives to the traditional password or PIN based authentication techniques.

IV. PROPOSED SYSTEM

The finger vein is a promising biometric pattern for personal identification in terms of its security and convenience. The vein is hidden inside the body and is mostly invisible to human eyes, so it is difficult to forge or steal. The non-invasive and contactless capture of finger veins ensures both convenience and hygiene for the user and is thus more acceptable. The finger-vein pattern can only be taken from a finger. Therefore, it is natural and convincing proof that the subject whose finger vein is successfully captured is alive. We use the ANN algorithm based on Neural Network. To get the Voice notes.

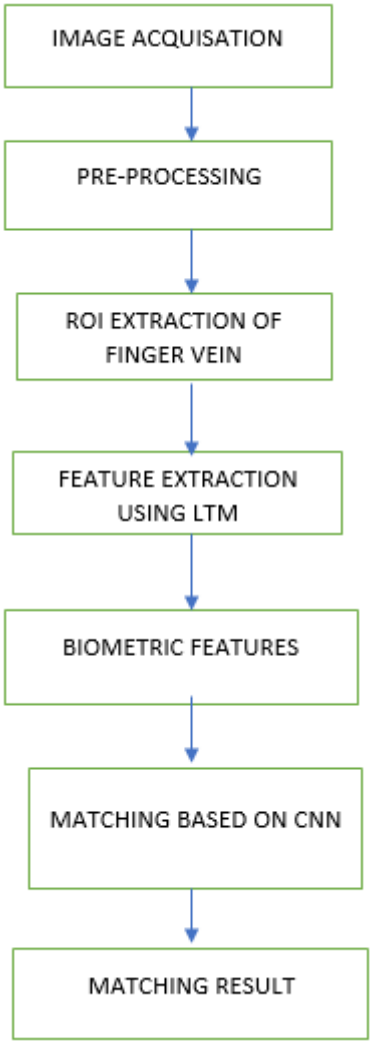


Fig. 3: Proposed Block diagram

4.1 Advantages

1.Safety: vein pattern is an internal feature and not easy to replicate

2.Living body identification: only the vein in a living finger can be captured and further used in identification

4.2 Disadvantages

1.The Existing System is not robust.

2.Finger vein recognition outperforms fingerprint recognition in terms of accuracy.

3.Non-contact: the aging and wear of the skin surface can be ignored because finger veins are located in the subcutaneous layer of the skin.

4.Not with standing this great and increasing variety of biometrics patterns, no biometric has yet been developed that is perfectly reliable or secure.

5. Fingerprints and palm prints are usually frayed; voice, signatures, and hand shapes are easily forged.

V. SOFTWARE AND HARDWARE REQUIREMENT

5.1 Hardware requirement

- Windows 7 (or) higher
- 64-bit operating system
- Processor – Intel Core i5 10th Gen
- RAM – 8GB & Above (DDR4)
- SSD Capacity – 512GB
- Keyboard – Standard 104 Enhanced Key
- Mouse- No DPI or DPI sufficient

5.2 Software requirement

MATLAB

MATLAB 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
•Modelling, simulation, and prototyping
•Data analysis, exploration, and visualization
•Scientific and engineering graphics
•Application development, including graphical user interface building

Toolboxes

Toolboxes are a kind of application-specific solutions available in MATLAB. Toolboxes are essential for the majority of MATLAB users since they let you study and use specific technologies. Toolboxes are thorough sets of MATLAB functions (M-files) that enhance the MATLAB environment to address specific problem types.

The MATLAB System

The MATLAB system consists of five main parts.

Development Environment

You can use MATLAB functions and files with the help of this group of tools and resources. The user interfaces for many of these programmes are graphical. It has browsers for reading help, the workspace, files, and the search path in addition to the MATLAB desktop and Command Window, a command history, and these features.

The MATLAB Mathematical Function Library

This is a sizable collection of computation-related algorithms, ranging from simple ones like sum, sine, and cosine to more difficult ones like matrix inverse, matrix eigenvalues, Bessel functions, and rapid Fourier transforms.

The MATLAB language.

This is a high-level matrix/array language with features for object-oriented programming, control flow statements, functions, data structures, input/output, and input/output.

Handle Graphics

The MATLAB graphics system is seen here. It has high-level instructions for image processing, animation, two- and three-dimensional data visualisation, and presentation graphics.

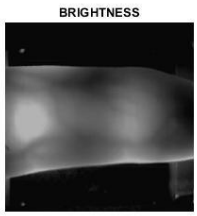
The MATLAB Application Program Interface (API).

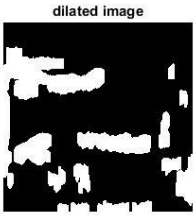
With the help of this library, you can create C and Fortran applications that communicate with MATLAB. It features tools for reading and writing MAT files, calling MATLAB as a computational engine, and dynamically connecting to MATLAB procedures.

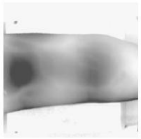
VI. RESULTS AND DISCUSSION

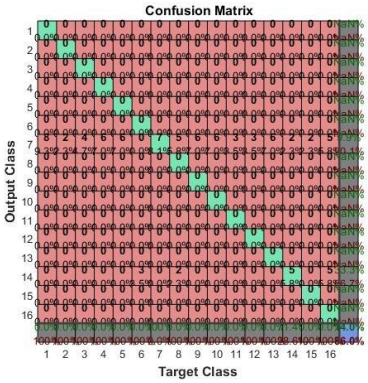
The finger vein recognition system project aimed to assess how well the technology works in real-world scenarios. We looked at its accuracy in recognizing finger vein patterns, how fast it processes data, and how reliable it is under different conditions like lighting or temperature changes. We also tested its security against fake attempts to fool the system. Additionally, we gathered feedback from users to see how easy and comfortable it is to use. Integration with existing systems and the overall cost-effectiveness were also

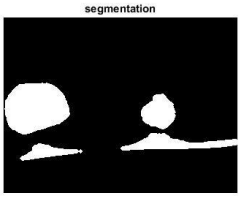
considered. Our goal was to determine if the system is practical, secure, and worth implementing in various settings.

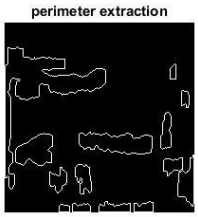


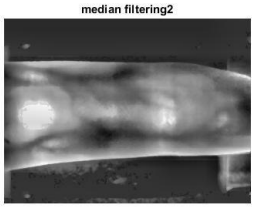


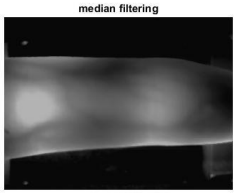


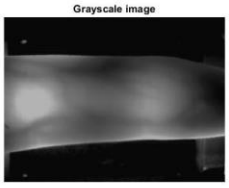


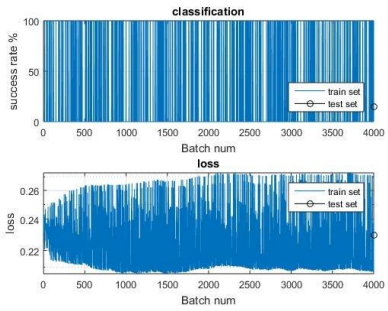


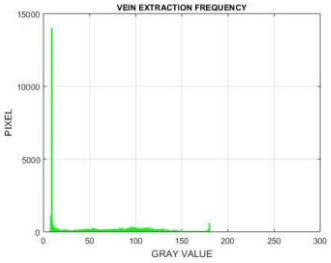


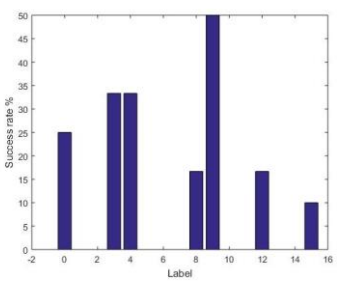


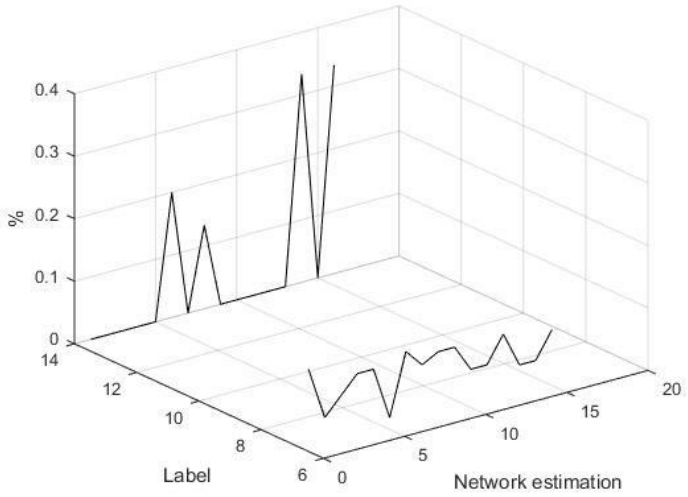












VII. CONCLUSION

The next generation of finger vein recognition technology holds great promise for enhancing security and authentication systems. With advancements in image processing algorithms, hardware miniaturization, and improved accuracy rates, finger vein recognition is poised to become a more reliable and widespread biometric authentication method. Its advantages, such as resistance to spoofing, high accuracy, and non-intrusive nature, make it suitable for various application ranging from personal device authentication to access control in high-security environments. In conclusion, the future of finger vein recognition technology looks bright, with continued research and development likely to further improve its performance, reliability, and usability, thereby cementing its position as a key player in the biometric authentication landscape.

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