Ghulam Ishaq Khan Institute of Engineering Sciences and Technology
Faculty of Computer Science and Engineering

AI-319 Computer Vision
Semester Project
Project Proposal

GROUP MEMBERS:

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Project Title

Finger Vein Biometric Authentication Using OPENCV & Deep Learning

Problem Statement

Finger vein patterns are distinct to each individual, even among identical twins, making them ideal for personal identification purposes. The authentication process involves comparing a previously captured vein pattern, obtained during enrollment, with the pattern captured during authentication to determine if they match. Achieving this goal requires a combination of hardware design and software procedures.

Through hardware design, the system guides users to ensure proper positioning and capture of their vein patterns, facilitating easier recognition. Meanwhile, software procedures address acquisition-related issues by employing algorithms to rectify irregularities in the captured patterns.

Moreover, the algorithm calculates a similarity score based on extracted fingerprints, providing a highly precise measure of biometric similarity. This score is assumed to be accurate to an infinite decimal level.

Structure and Techniques

Finger vein recognition has become a reliable biometric procedure due to the unique patterns of veins that can be captured using near-infrared spectrum technology. Large-scale implementations of finger vein-based biometric solutions require efficient searching of probe finger vein samples within extensive galleries of stored samples.

To enhance reliability in searching for suitable identities within large-scale finger vein databases, it is crucial to introduce a finger vein indexing and retrieval scheme. This proposal presents a biometric system designed to identify individuals based on their finger vein patterns. The system utilizes a database containing infrared images of human index fingers.

The proposed system employs a combination of the Sobel detector, enhancement filters, and binarization processes to extract vein patterns from captured images. A novel finger vein recognition algorithm is implemented, incorporating dimension reduction and Gabor filtering techniques for feature extraction. Matching of extracted features is performed using a distance classifier.

In summary, this proposal outlines a comprehensive approach to finger vein recognition, employing advanced algorithms for vein pattern extraction and matching to enhance accuracy and efficiency in large-scale biometric identification systems.

Methodology

The Proposed System consists of the following Modules:

- Module 1: Exploratory Data Evaluation
- Module 2: Pre-processing
- Module 3: Feature Engineering
- Module 4: Prediction

Convolution Neural Network (CNN)

- The input layer which is a gray scale image.
- The output layer is a binary or multi-class label.
- Hidden layers consisting of convolution layers, ReLU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network.

The proposed method is subject to change during implementation.

Expected Outcomes & Results

Expected Outcomes

Improved Accuracy: Through the implementation of advanced algorithms for vein pattern extraction and matching, we anticipate achieving higher accuracy rates in identifying individuals based on their finger vein patterns. The combination of Sobel detection, enhancement filters,

and binarization processes will enhance the clarity and distinctiveness of vein patterns, leading to more reliable authentication results.

Enhanced Efficiency: The introduction of finger vein indexing and retrieval schemes will streamline the process of searching for identities within large-scale databases. By efficiently indexing vein patterns and employing feature extraction techniques such as dimension reduction and Gabor filtering, we expect to reduce the computational complexity and time required for matching.

Robustness to Variability: The proposed system will be evaluated for its robustness to variations in finger vein patterns caused by factors such as lighting conditions, finger positioning, and image quality. By incorporating adaptive thresholding methods and sophisticated matching algorithms, we aim to ensure consistent performance across diverse environments and user scenarios.

Evaluation of Success

The success of our approach will be evaluated through rigorous testing and validation processes. Key performance metrics will include:

Identification Accuracy: We will measure the system's accuracy in correctly identifying individuals based on their finger vein patterns, using established evaluation protocols and benchmark datasets.

False Acceptance Rate (FAR) and False Rejection Rate (FRR): We will assess the system's error rates to evaluate its reliability and security in authentication tasks.

Efficiency Metrics: We will evaluate the computational efficiency of our approach, including processing time for enrollment, authentication, and database searches, to ensure scalability and real-time performance.

We will also utilize confusion matrices to provide a comprehensive assessment of the system's performance.

Dataset Link

https://drive.google.com/drive/folders/1HE-j2ILB9muRaIG5M0i57J8Orjlbx7Tq?usp=sharing

TIMELINE OF THE PROJECT

Date	***Tasks***
Apr 17, 2024	Code Completion EDA & Feature Extraction
Apr 24, 2024	Complete Code with Predictions and Model
Apr 28, 2024	Paper write-up (Introduction & Literature Review)
May 5, 2024	Paper write-up (Methodology & Results)
May 8, 2024	Complete Code and Paper Submission
May 12, 2024	IOT Implementation Demo

References

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