**Finger Vein Recognition System using Maximum curvature Points**

**A Project Work Synopsis**

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# Abstract

This project presents a novel approach to enhance the accuracy and efficiency of finger vein recognition by leveraging maximum curvature points. The proposed system utilizes the distinctive patterns formed by the veins beneath the skin's surface, which are unique to each individual, and focuses on extracting maximum curvature points from finger vein images. Maximum curvature points are selected for their ability to capture the subtle variations in the vein structure and provide robust and reliable feature vectors for recognition. Preprocessing techniques are applied to enhance the quality of the captured images and improve the accuracy of vein segmentation.

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# INTRODUCTION

## 1.1 Problem Definition

The problem addressed by the "Finger Vein Recognition System Using Maximum Curvature Points" project revolves around the imperative need for a robust, secure, and efficient biometric authentication system. Traditional authentication methods, like passwords and PINs, are vulnerable to breaches, leading to unauthorized access to sensitive data. Moreover, existing biometric methods, such as fingerprints or facial recognition, have limitations.

This project centers on the development of a Finger Vein Recognition System to resolve these issues. It aims to harness the unique patterns of veins within an individual's fingers, which are exceedingly challenging to replicate or steal. The core problems addressed are security, accuracy, robustness, user comfort, and computational efficiency.

## 1.2 Problem Overview

In an era characterized by the increasing digitization of personal and sensitive information, ensuring robust and secure authentication methods is paramount. Traditional authentication mechanisms like passwords and PINs are plagued by vulnerabilities such as hacking, identity theft, and unauthorized access. Even conventional biometric systems like fingerprints and facial recognition are not immune to security breaches and privacy concerns.

To address these issues, the Finger Vein Recognition System Using Maximum Curvature Points project presents a cutting-edge solution. The central problem this project tackles is the need for a highly secure, accurate, and efficient biometric authentication system that goes beyond the limitations of existing methods.

## 1.2.1 Key Challenges and Aspects of the Problem

**Security:** The primary challenge is to develop a system that offers an extremely high level of security. Finger vein patterns are unique to each individual and are virtually impossible to replicate, making them an ideal biometric modality to thwart identity theft and unauthorized access.

**Accuracy and Robustness:** Achieving precision and consistency in recognizing individuals under various conditions is another crucial aspect. The system must perform reliably in different lighting environments, with varying finger poses, and across different skin tones to minimize the risks of false positives and false negatives.

**User Comfort:** Ensuring that the authentication process is comfortable and non-intrusive for users is paramount. By employing non-intrusive near-infrared (NIR) imaging technology, the project addresses this concern, making authentication more user-friendly.

**Computational Efficiency:** Real-time applications, such as access control and secure financial transactions, demand rapid processing. Therefore, the system needs to efficiently extract features from finger vein images and classify them swiftly without compromising accuracy.

**Environmental Variability:** Recognizing individuals reliably under changing environmental conditions is challenging. This project aims to adapt the system to diverse environments, ensuring consistent recognition accuracy.

**Data Preprocessing:** High-quality input data is vital for accurate recognition. Preprocessing techniques are applied to enhance image quality, remove noise, and standardize images for optimal system performance.

**Feature Extraction:** The project introduces an innovative approach using maximum curvature points for feature extraction. This novel method aims to enhance recognition precision and efficiency.

The Finger Vein Recognition System Using Maximum Curvature Points project addresses the pressing need for an advanced biometric authentication system that offers unparalleled security, accuracy, and efficiency while prioritizing user comfort and adaptability to real-world conditions.

## 1.3 Hardware Specification

* Working Windows system
* Ram over 8gb | Processor over 1.1 Ghz | Storage over 256 gb
* Java compiler
* Figner vein Scanner

## 1.4 Software Specification

* Matlab
* Dev Enviornment
* Python

# 2. LITERATURE SURVEY

## 2.1 Existing System

1. **Fujitsu PalmSecure:** Fujitsu's PalmSecure technology is one of the well-known commercial systems based on palm vein recognition. While it primarily focuses on palm veins, which are similar to finger veins, it uses near-infrared light to capture vein patterns, ensuring high accuracy and security. The system has been deployed in various applications, including secure access control and financial transactions.
2. **Academic Research:** Many research institutions and universities have developed finger vein recognition systems as part of academic research projects. These systems often explore innovative algorithms for feature extraction, matching, and robustness under different conditions. They contribute to the advancement of the field and may serve as a basis for future commercial systems.
3. **Open-Source Projects:** There are open-source finger vein recognition projects and libraries available to the research community. These projects often provide tools, algorithms, and datasets for researchers and developers to experiment with and build upon. Open-source initiatives promote collaboration and innovation in the field.
4. **Commercial Solutions**: Beyond Fujitsu, other companies have also developed finger vein recognition solutions for various applications. These systems are often designed for specific industries, such as healthcare, banking, and access control, and may offer different features and levels of security.
5. **Biometric Conferences and Journals:** The field of biometrics, including finger vein recognition, is actively discussed in academic conferences and journals. Researchers regularly publish their findings, which may include insights into novel algorithms, datasets, and evaluation methodologies.

## 2.2 Proposed System

We are in the process of developing a software interface that will revolutionize biometric authentication by leveraging the cutting-edge technique of Finger Vein Recognition, specifically utilizing the Maximum Curvature Point method. Our objective is to provide an innovative and highly secure means of identity verification.

The core of our approach lies in the utilization of Maximum Curvature Points, a unique approach to analyzing and extracting intricate finger vein data from individuals. These Maximum Curvature Points serve as the fundamental basis for recognizing and verifying the identity of users.

What sets our project apart is our commitment to refining the mathematical formulas at the heart of the Maximum Curvature Point method. By delving deep into the mathematics, we aim to optimize the feature extraction process. Our goal is to enhance both the accuracy and efficiency of the recognition system, resulting in more favorable outcomes for users.

The advantages of Finger Vein Recognition are numerous. Firstly, it offers a remarkably high level of security. Finger vein patterns are unique to each individual, making them virtually impossible to replicate or forge. Secondly, our software emphasizes user comfort and privacy by employing non-intrusive near-infrared (NIR) imaging technology, ensuring that the authentication process is both secure and user-friendly.

Moreover, computational efficiency is a key consideration. We are committed to designing a system that can efficiently process and analyze data, making it suitable for real-time applications like access control and secure financial transactions. By optimizing the mathematical underpinnings of the Maximum Curvature Point method, we aim to provide rapid and reliable authentication results.

In summary, our project represents an exciting frontier in biometric authentication. By harnessing the power of Finger Vein Recognition, fine-tuning the mathematical foundations of the Maximum Curvature Point method, and prioritizing security, user comfort, and efficiency, we aim to provide a state-of-the-art authentication solution that will set new standards in the field. Our software interface promises to redefine the way we approach identity verification, opening up a world of secure possibilities across various domains.

# 3. PROBLEM FORMULATION

### This project centers on the development of an advanced Finger Vein Recognition System that leverages the Maximum Curvature Point method to enhance biometric authentication. The primary objectives encompass security enhancement, mathematical refinement, a user-centric approach, computational efficiency, adaptability to varying environments, data quality enhancement, and feature extraction innovation.

### Security enhancement is a fundamental goal, capitalizing on the unique and challenging-to-replicate finger vein patterns to bolster biometric authentication security. Mathematical refinement plays a crucial role in optimizing feature extraction, ultimately leading to higher accuracy and efficiency in identifying individuals.A user-centric approach is emphasized to ensure user comfort and privacy. The adoption of non-intrusive NIR imaging technology enhances the system's user-friendliness, addressing concerns related to privacy and intrusiveness.

### Computational efficiency is vital for real-time applications like access control and secure financial transactions. The project strives to optimize the mathematical foundations of the system, enabling rapid data processing without compromising accuracy.

### Adaptability to varying environmental conditions, including changes in lighting and skin tones, is a recognized challenge. The system is designed to adapt to these variables while maintaining consistent recognition accuracy.

# OBJECTIVES

The project aims to develop a Finger Vein Recognition System that addresses the aforementioned challenges. The specific objectives include:

* Designing a system that offers exceptional security through finger vein recognition.
* Achieving high accuracy and robustness under varying conditions.
* Prioritizing user comfort and privacy by utilizing non-intrusive imaging technology.
* Optimizing computational efficiency for real-time applications.
* Adapting the system to diverse environmental scenarios.
* Implementing effective data preprocessing techniques.
* Introducing a novel feature extraction approach using maximum curvature points.

In project centers on the development of an innovative Finger Vein Recognition System that advances the state-of-the-art in biometric authentication. The project's success will contribute to enhancing security and privacy in various domains, including access control, financial transactions, and healthcare.

# METHODOLOGY

Developing a Finger Vein Recognition System using Maximum Curvature Points (MCP) involves several steps and methodologies. Here's a comprehensive methodology with ways to improve the project

Collecting a diverse dataset of finger vein images, including variations in lighting, pose, and finger conditions. Ensure a balance between positive (matched) and negative (unmatched) samples. Normalising and enhance the input images to reduce noise and improve consistency.Segmenting and isolate the region of interest (ROI), which contains the finger veins.

Applying MCP detection to extract curvature points and Computing the curvature at each pixel by analyzing local gradients. Selection maximum curvature points as distinctive feature points. And the feature extraction and comparing extracted features directly for matching.

## 5.1 Improvement Strategies:

1. Increase the diversity of the training dataset by applying techniques like rotation, scaling, and adding synthetic noise.
2. Experiment with different feature extraction techniques to improve recognition accuracy.
3. Combine multiple feature descriptors for better discrimination.
4. If feasible, improve the hardware used for vein image acquisition, such as higher-resolution cameras and better lighting.
5. Incorporate encryption and secure storage for biometric templates to prevent unauthorized access.
6. Optimize the user interface for a seamless and user-friendly experience.
7. tweaking the core mathematical formula for the method to yield more favorable results.

# CONCLUSION

In conclusion, the development of a Finger Vein Recognition System utilizing Maximum Curvature Points (MCPs) represents a sophisticated and promising solution for biometric authentication. This methodology provides a systematic approach to address the complex challenges associated with vein-based recognition, offering both security and user convenience.

A Finger Vein Recognition System based on MCPs has the potential to provide a secure and reliable means of authentication, particularly in applications where user identity verification is critical. However, it is essential to acknowledge that no system is entirely foolproof, and ongoing research and development are necessary to stay ahead of potential security threats.

As technology continues to advance, this project's methodologies and strategies can serve as a solid foundation for the ongoing exploration and enhancement of Finger Vein Recognition Systems, contributing to the broader field of biometric authentication and cybersecurity.

## 7. TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK

**Check Point - 1**

Literature Phase Deadline: Aug 21-26, 2023

1. Definition of Scope
2. Identifying the problem statement
3. Submit introduction for their research article

**Check Point – 2**

Design Phase Deadline: Sep 20-27, 2023

1. Preliminary Design
2. Methodology Used
3. Analysis of features (What update they have to include in the project)
4. Submit literature survey and proposed system for their research article

**Check Point – 3**

Analysis Phase Deadline: Oct 17-22, 2023

1. Result Analysis
2. Submit results, abstract and conclusion for their research article

**Check Point – 4**

Conclusion Phase Deadline: Nov 01-06, 2023

1. Submission of research article in IEEE format

**Check Point – 5**

Evaluation Phase – II Deadline: May 15-17, 2023

1. Supervisor Evaluation (Collect research Articles, Project Report, PPT, implementation (Github Link)

**Check Point – 6**

Evaluation Phase – II Final End Term Evaluation

## REFERENCES

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