SCE Tech Fest 25
Innovation Sustainability Community

EEE-A-04

Electrical and Electronics Engineering

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Advisor: Dr. Meir Yaakov

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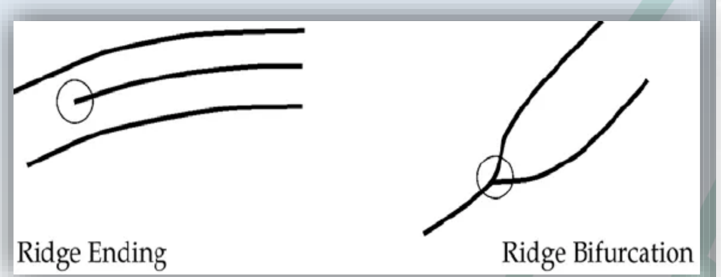
Fingerprint Identification system - Feature Extraction Algorithm

Introduction:
Fingerprint recognition is a leading method for personal identification, based on minutiae (ridge endings and bifurcations). This process involves four key steps: capturing the fingerprint with a sensor, enhancing the image, extracting features, and matching them to entries in a database.

Objectives:
Improve fingerprint image quality and extract key features such as ridge endings and bifurcations as reliable metrics for matching and identity verification.

Solutions Enabled by this Work:
Enhances fingerprint recognition accuracy, strengthening biometric identification for security, law enforcement, travel, finance, healthcare, and access control.

ZK9500 Infra-red Scanner



Minutiae feature example

Fingerprint Sample

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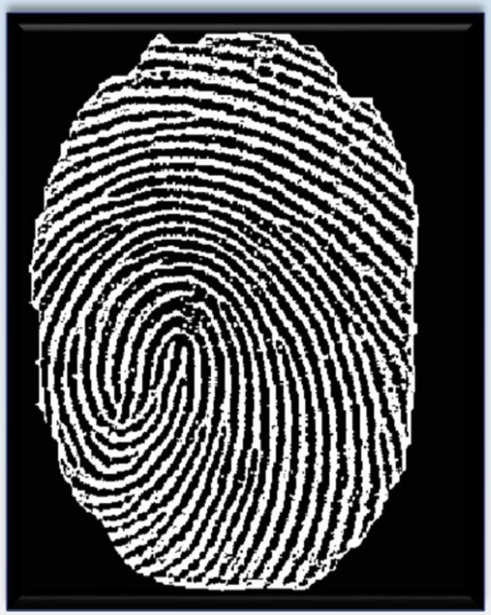
Fingerprint Identification system - Methodology main stages:

1. Preprocessing:

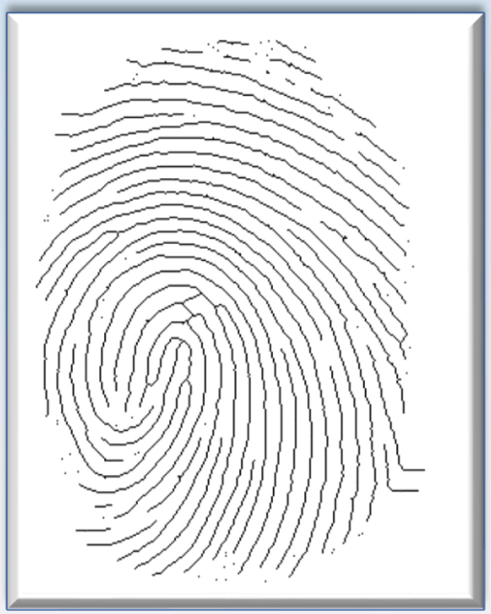
- Loading the Image
- Region Of Interest Extraction
- Average Level Subtraction
- Linear Contrast Stretch
- Binarization Thresholding



Preprocessing result

2. Processing:

- Removing Noise Pixels
- Pruning Edges
- Thinning Process
- Removing Branches
- Removing False Minutiae

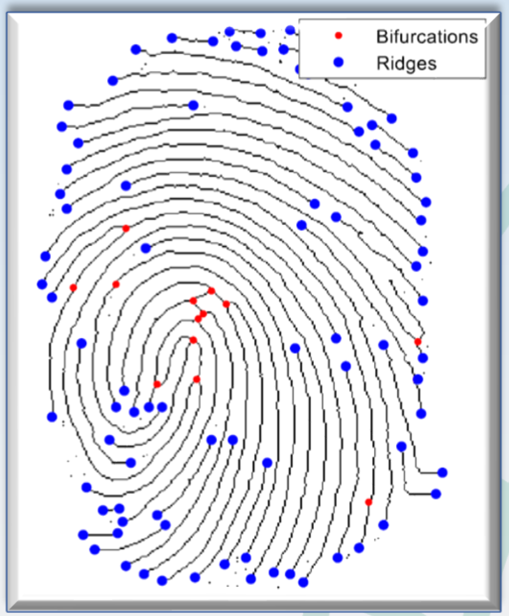


processing result

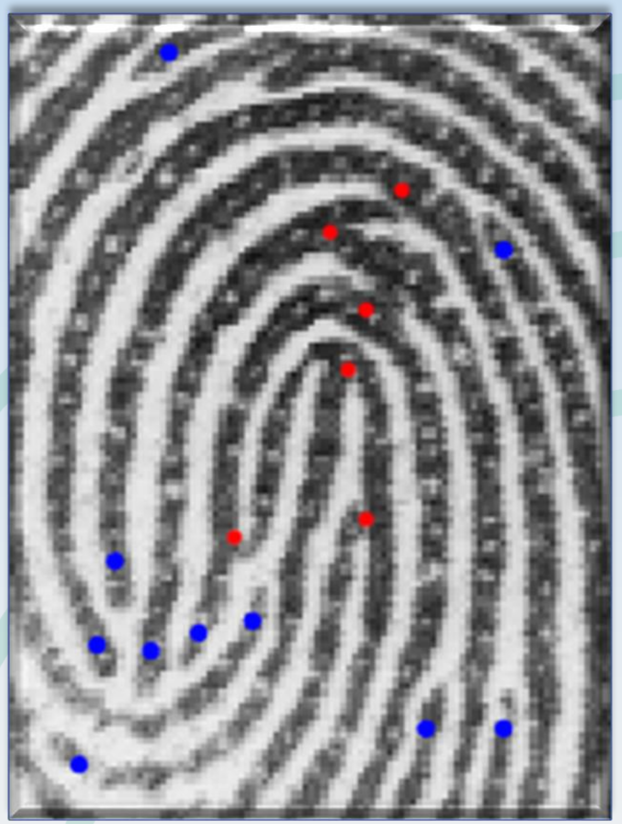
3. Feature Detection

Using Convolution masks:

- Detecting Bifurcations
- Detecting Ridges



Detection result



Detected Features on the original Sample

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Fingerprint Identification system – Information extraction & Matching:

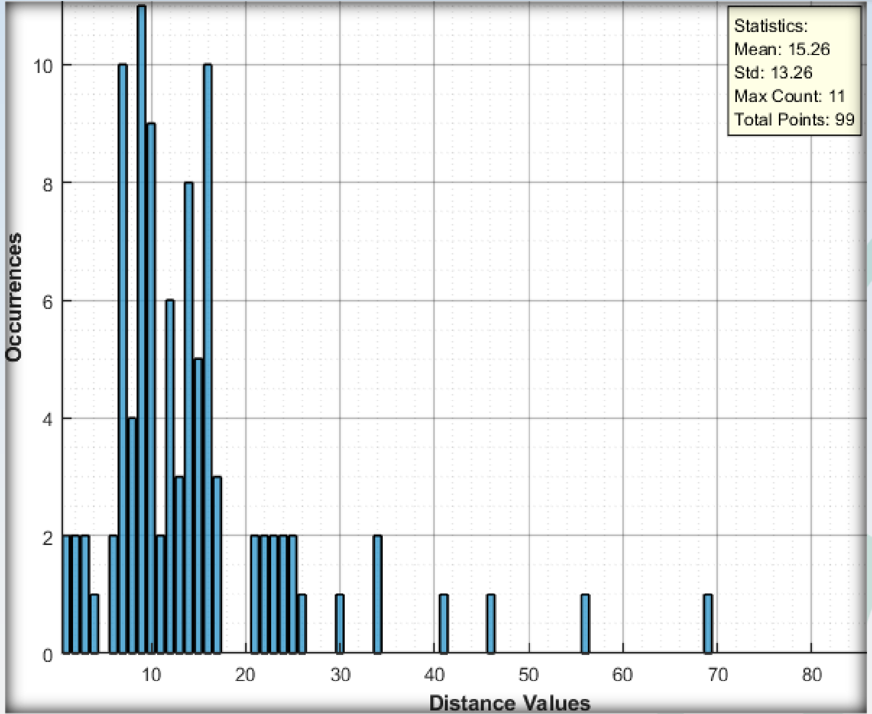
4. Feature Extraction

- Applying ''Breadth First Search'' algorithm to calculate the minimum distances between two neighboring Minutiae points.
- Exporting table to CSV File as followed:

x	y	type	Distance ridges	Distance bifurcations	Distance combined
column	row	ridge/bifurcation	distance to nearest ridge	distance to nearest bifurcation	combined distance value

5. Histogram Comparison – Proposed matching method

- Organizing the distances vector as a histogram
- Calculating Histogram Statistics
- Comparing Histograms of different samples
- Using histogram intersection percentage as the matching result



6. Future improvement:

Applying deep learning for sample matching

7. Conclusions:

Successfully developed a feature extraction algorithm using MATLAB with a true minutiae detection accuracy exceeding 95%. The extracted features were precisely converted into vectorized information, enabling effective use in both machine learning and deep learning-based matching systems.