Universidade de São Paulo

Fingerprint Recognition

Student

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Introduction

What is a fingerprint?

Introduction

- **Fingerprints have unique features;**

Introduction

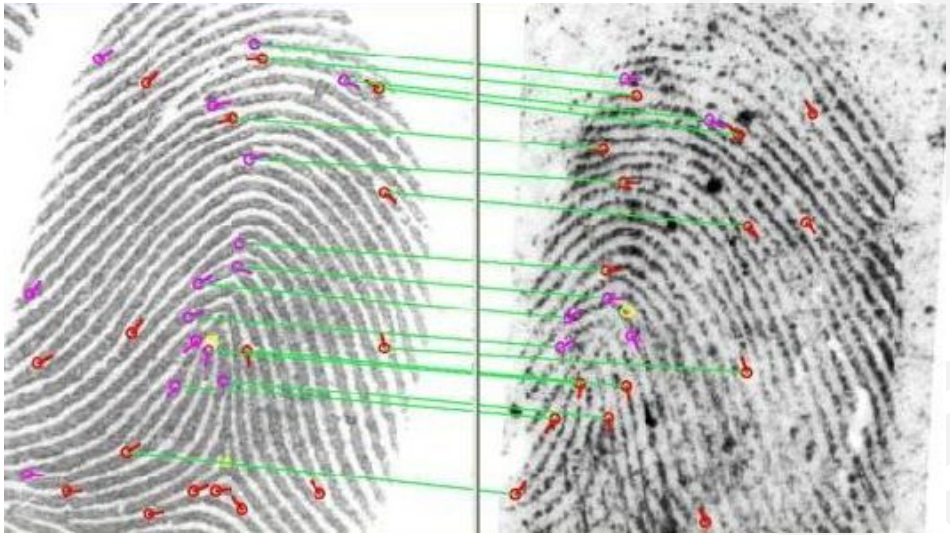
- Fingerprints have unique features;
- Common Applications:
  - Access Control:
  - Police investigations;

Introduction

- Fingerprints have unique features;
- Common Applications:
  - Access Control:
  - Police investigations;
- Features:
  - Ridge bifurcation;
  - Ridge ending;

Objectives

- **Given 2 fingerprints, the algorithm must verify the similarity between them.**



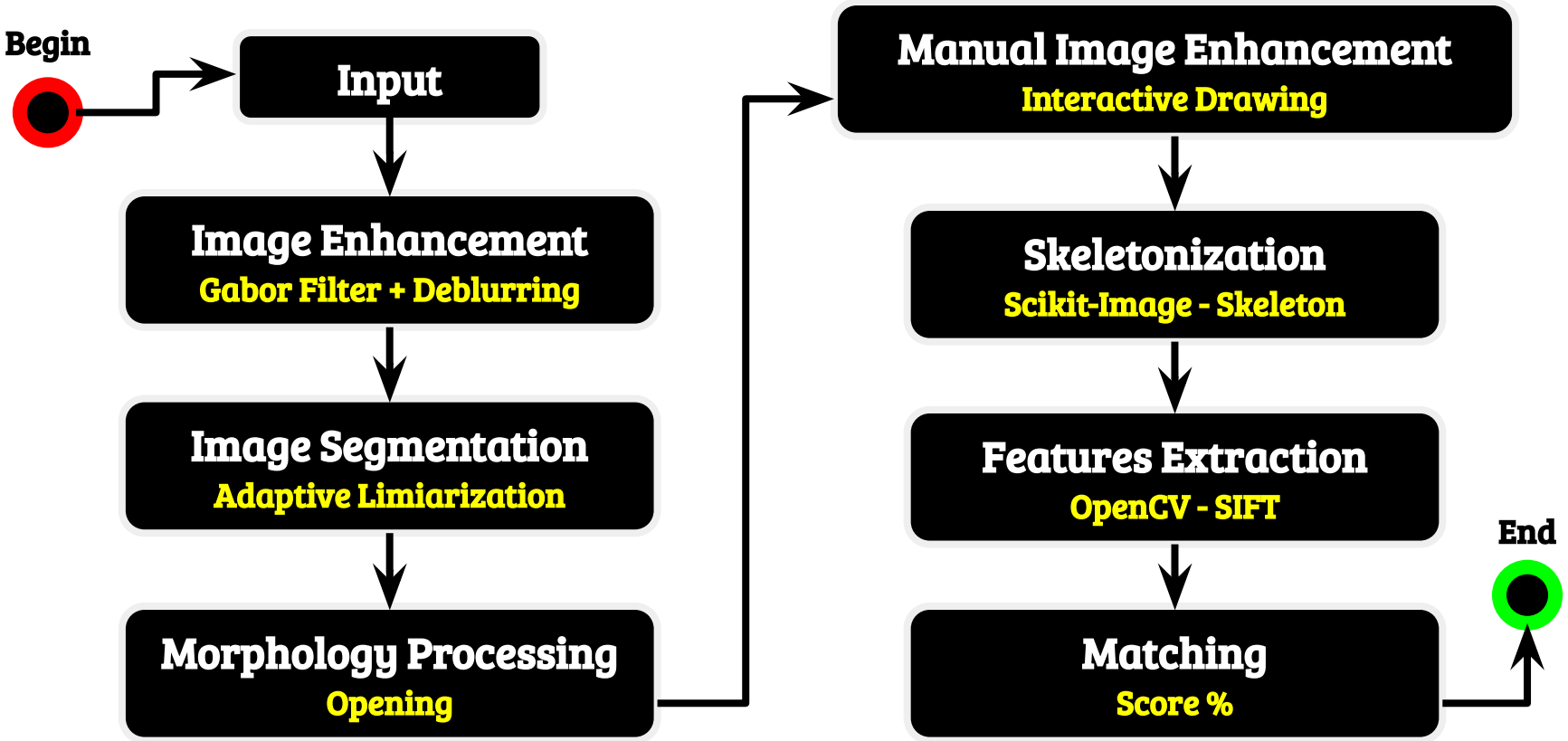
https://biometrics.mainguet.org/types/fingerprint/algo/matching_card_latent.jpg

Objectives

- Given 2 fingerprints, the algorithm must verify the similarity between them.

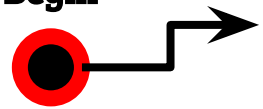
- Image Processing Tasks Involved:
  - Image Enhancement;
  - Image Segmentation;
  - Morphology Processing;

Project Steps



Project Steps

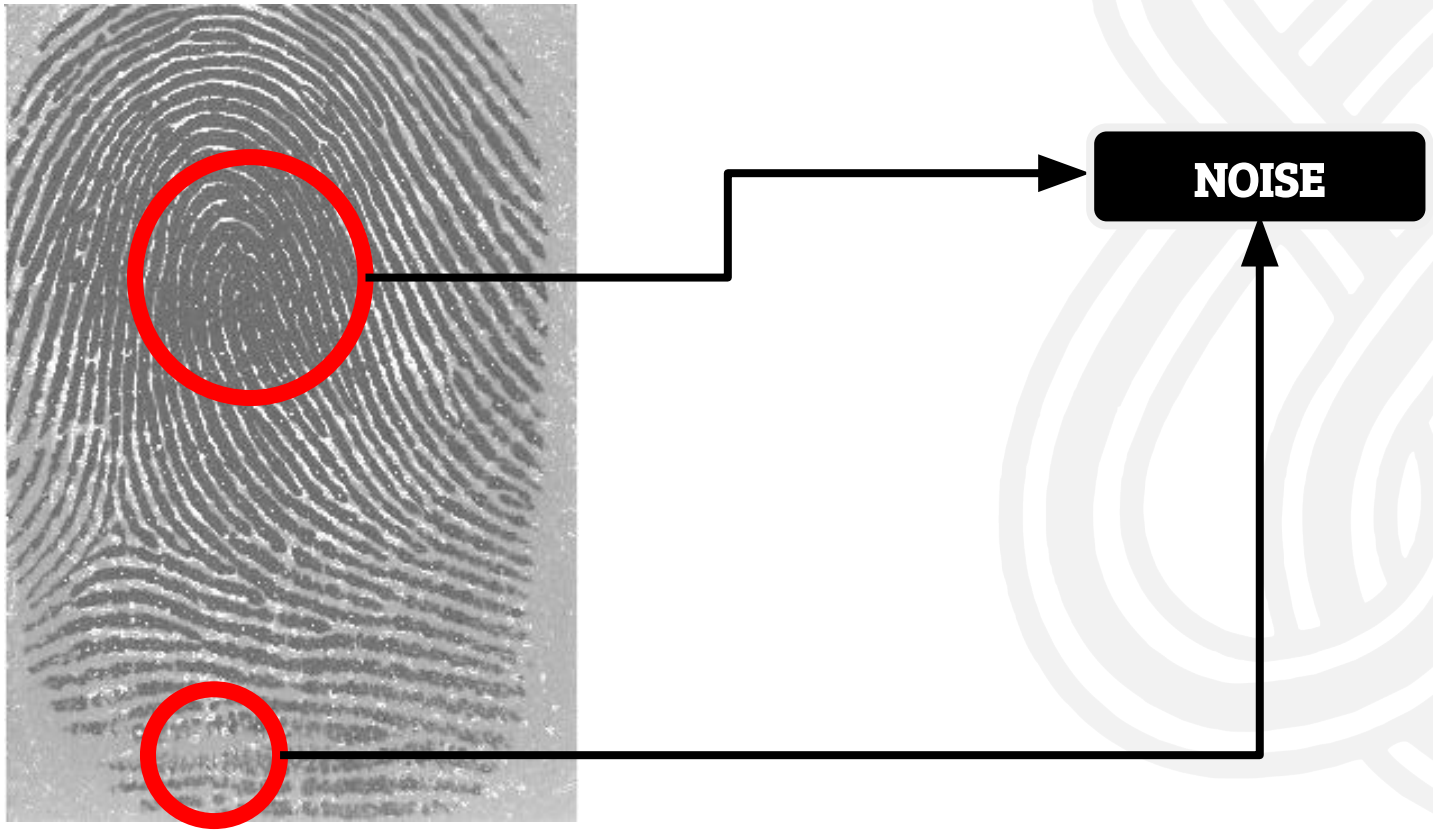
Begin



Project Steps

Input Examples

Input Examples: NOISE



Project Steps

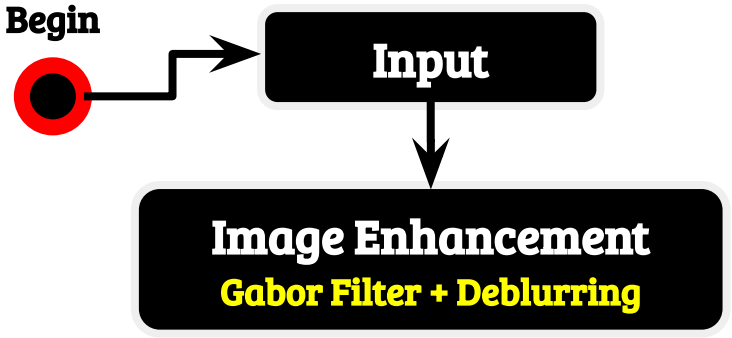


Image Enhancement: Gabor Filter Spatial Domain

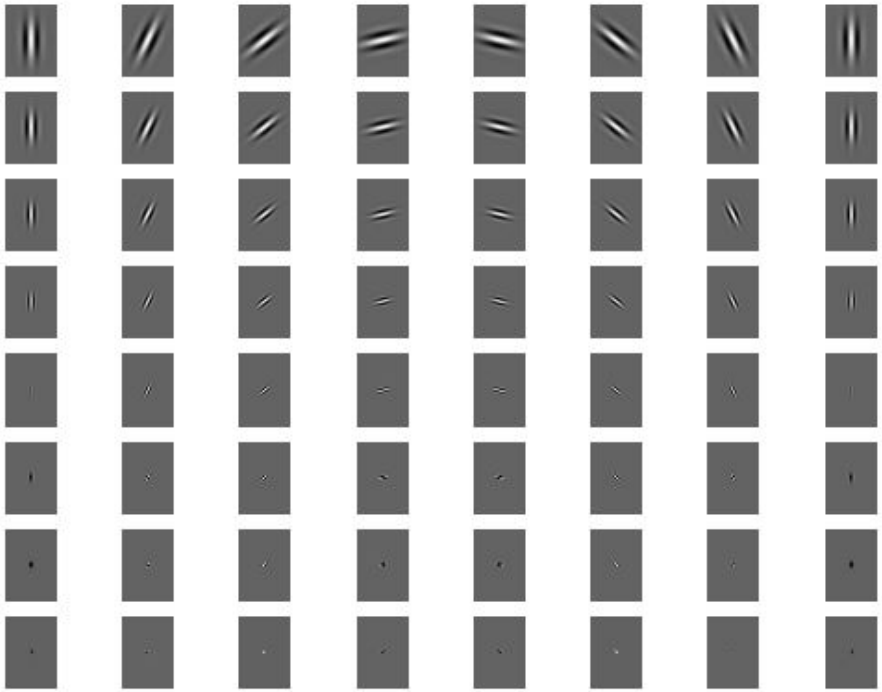


Image Enhancement: Gabor Filter Frequency Domain

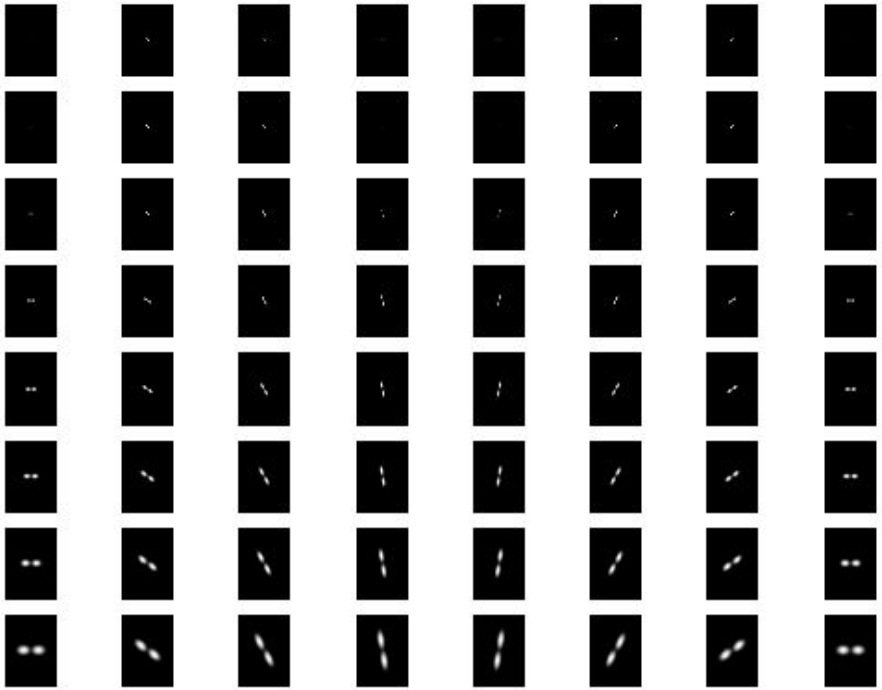
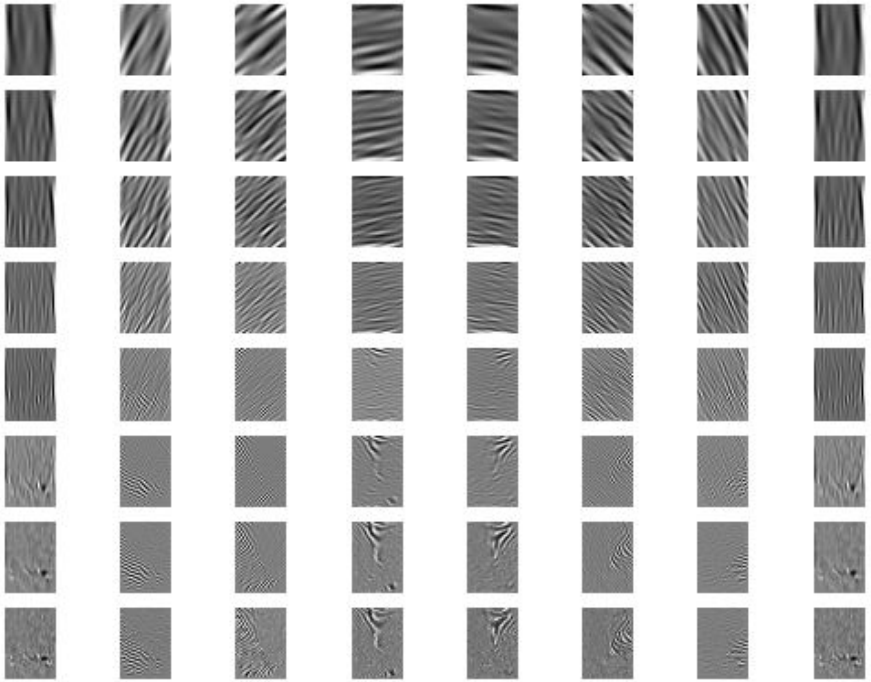
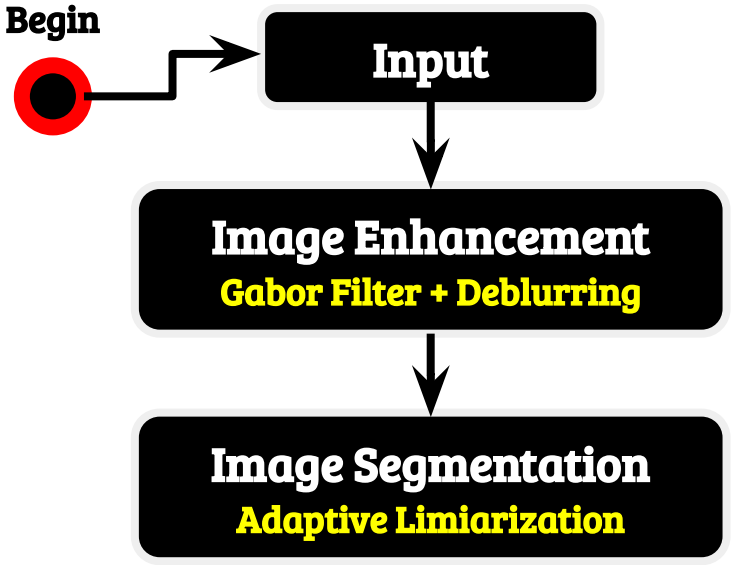


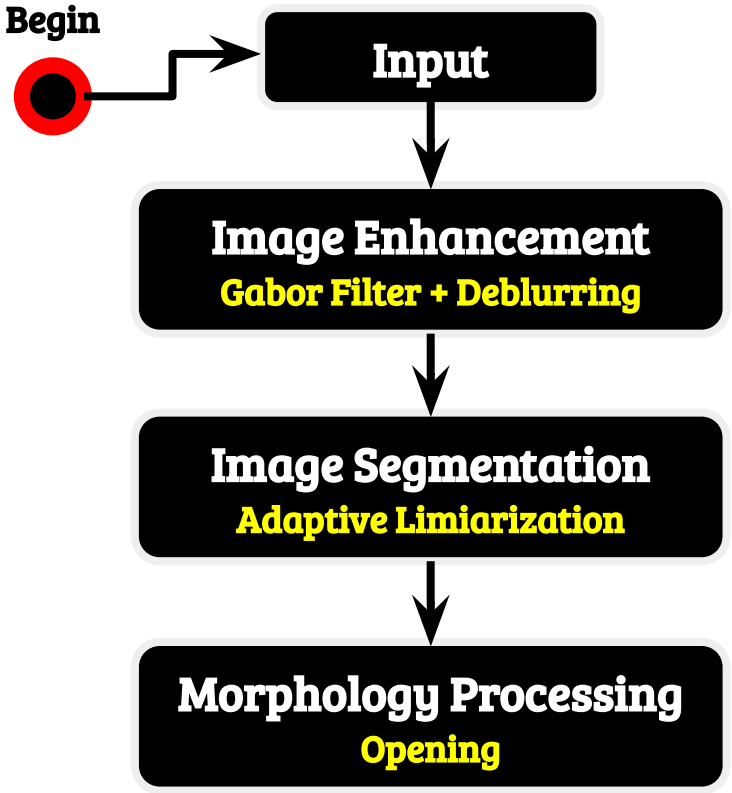
Image Enhancement: Gabor Filter Features Map



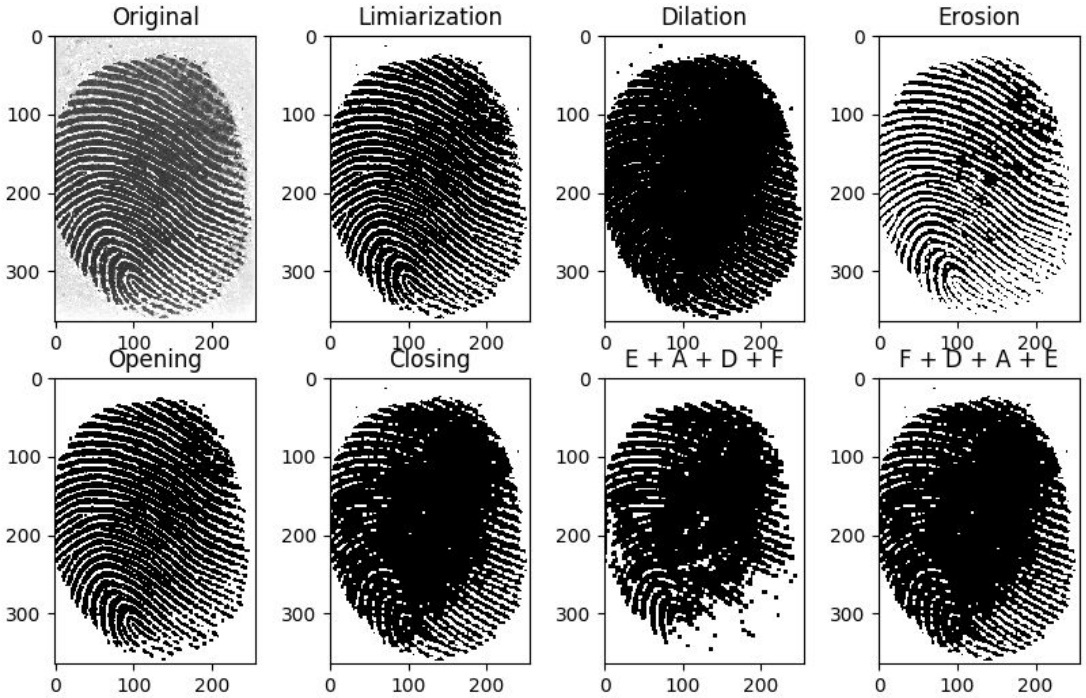
Project Steps



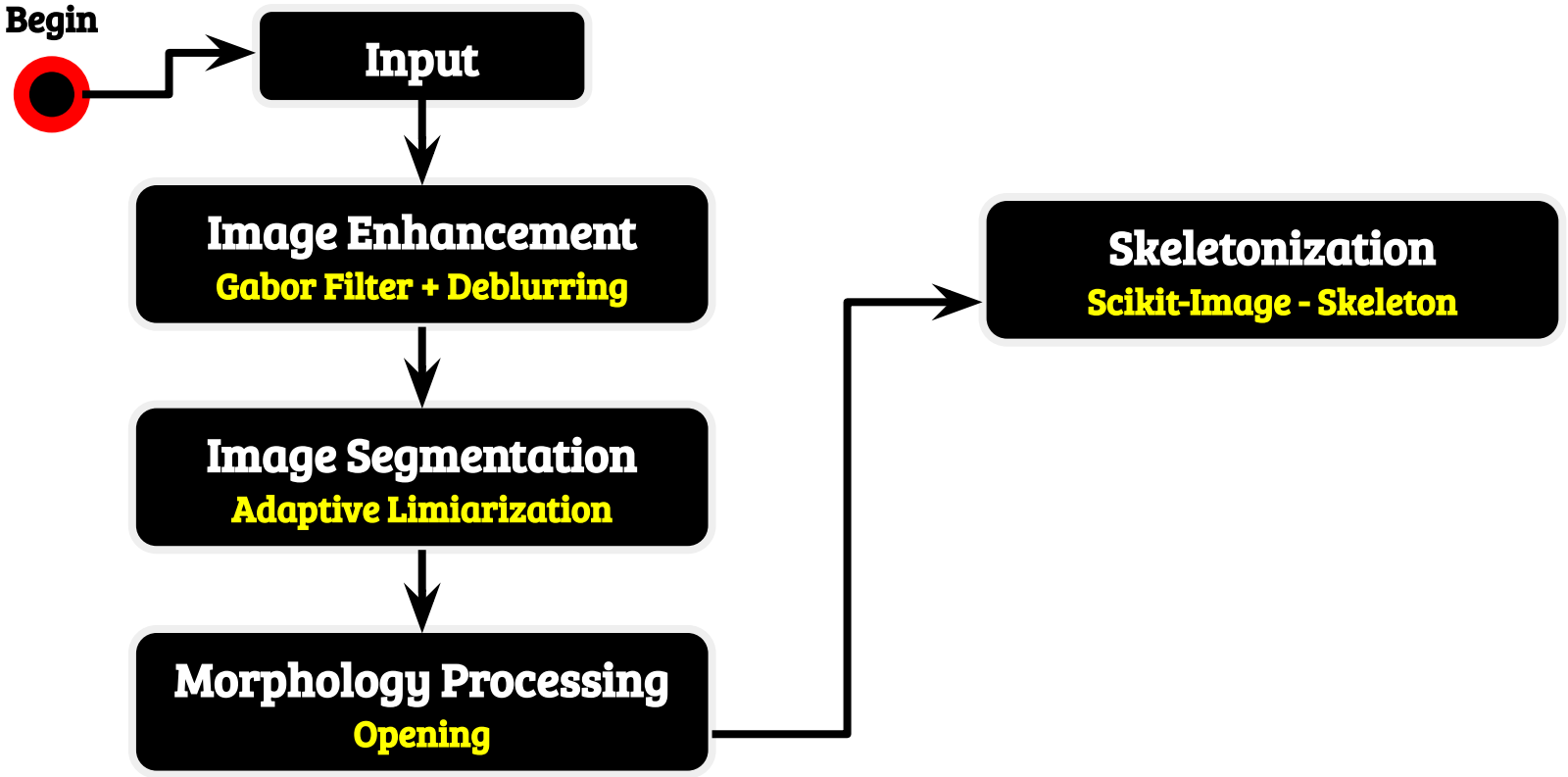
Project Steps



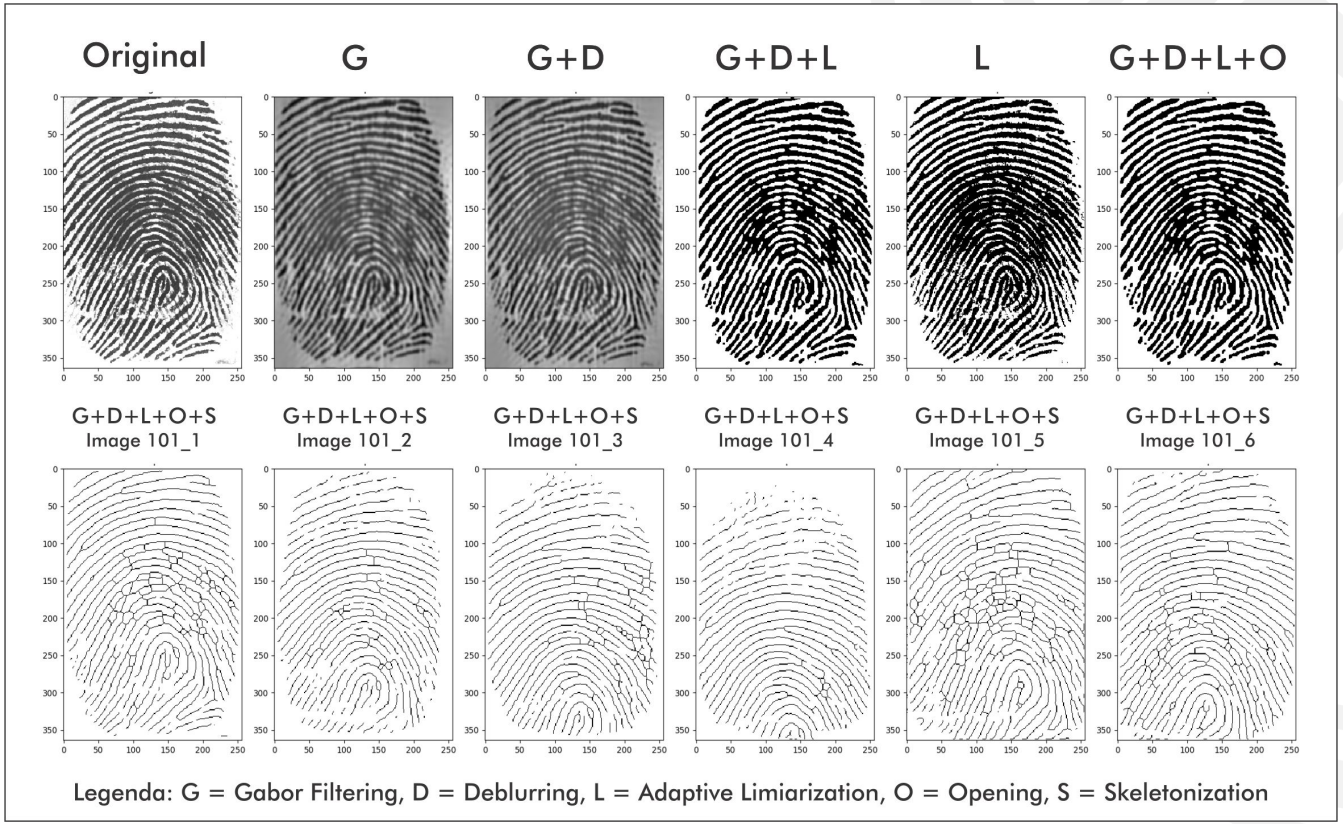
1st Results


Original
Limiarization
Dilation
Erosion
Opening
Closing
E + A + D + F
F + D + A + E
0
100
200
300

Project Steps

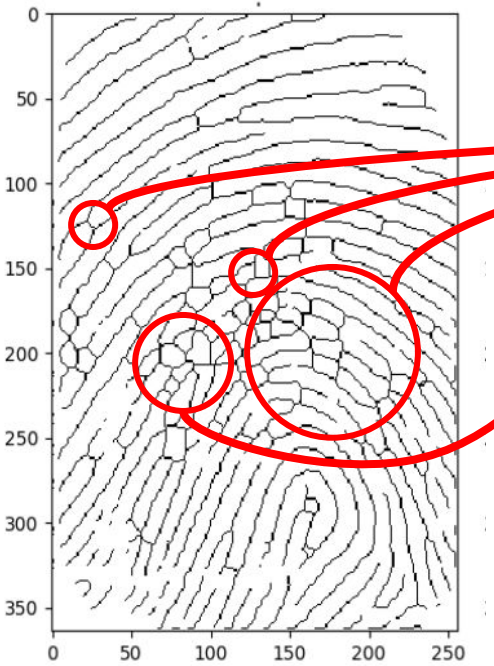


2nd Results


Original
G
G+D
G+D+L
L
G+D+L+O
G+D+L+O+S
Image 101_1
G+D+L+O+S
Image 101_2
G+D+L+O+S
Image 101_3
G+D+L+O+S
Image 101_4
G+D+L+O+S
Image 101_5
G+D+L+O+S
Image 101_6
Legenda: G = Gabor Filtering, D = Deblurring, L = Adaptive Limiarization, O = Opening, S = Skeletonization

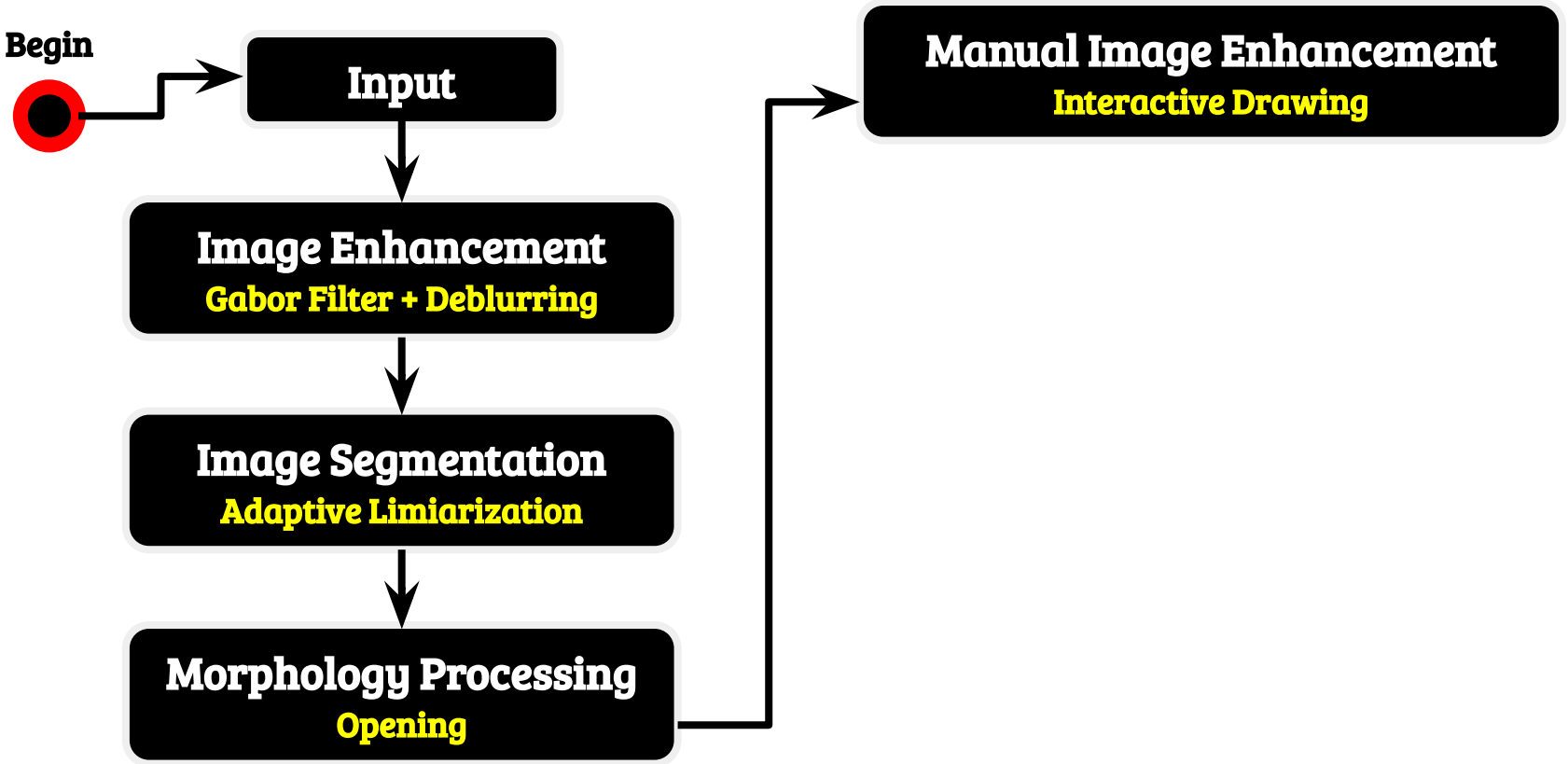
2nd Results

G+D+L+O+S
Image 101_5

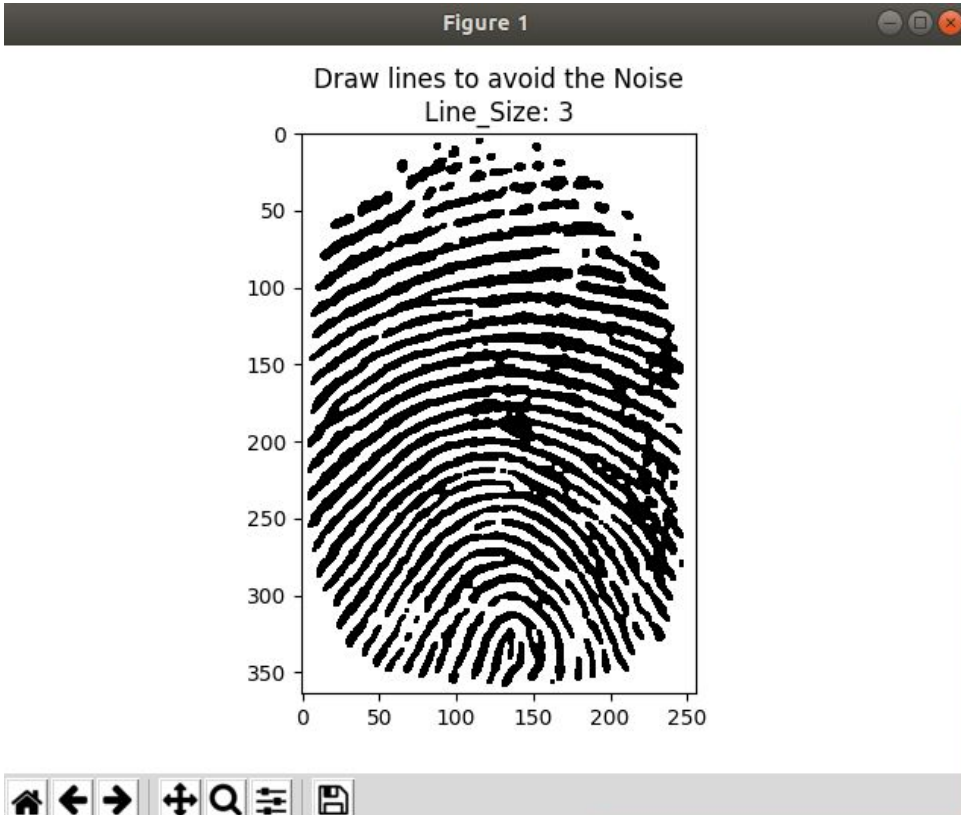


NOISE

Project Steps



Manual Enhancement: Interactive Drawing



Commands

Black Line
Left Button

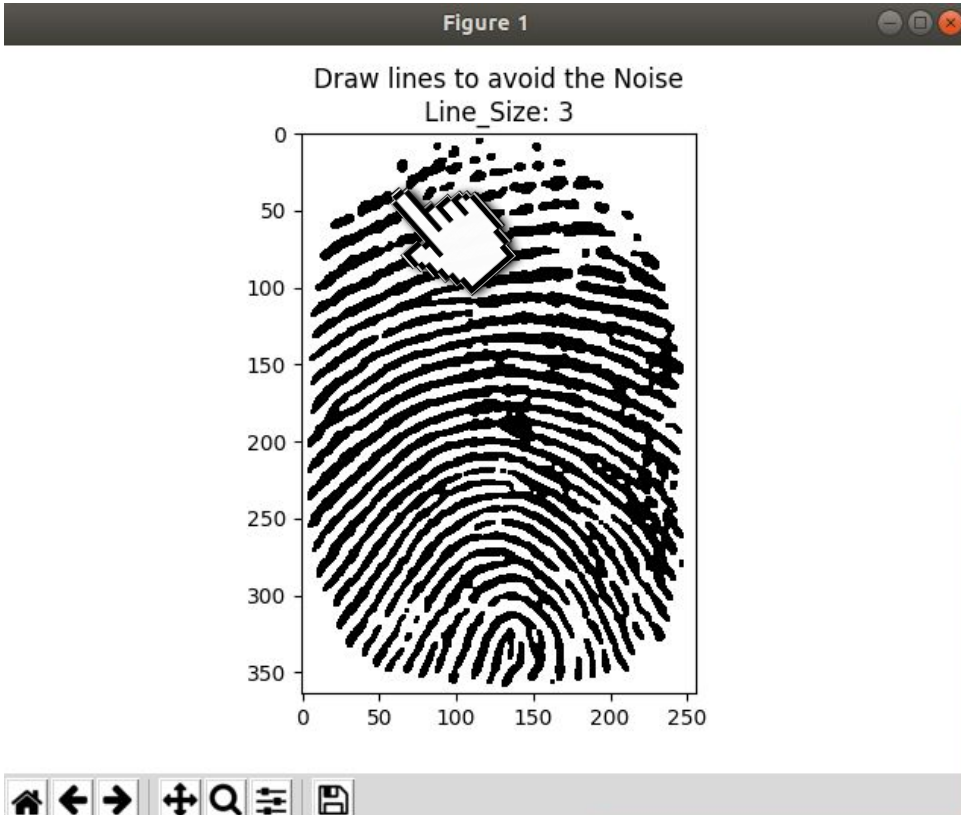
White Line
Right Button

+ Line Size

- Line Size

Backspace — Last step

Manual Enhancement: Interactive Drawing



Commands

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Right Button

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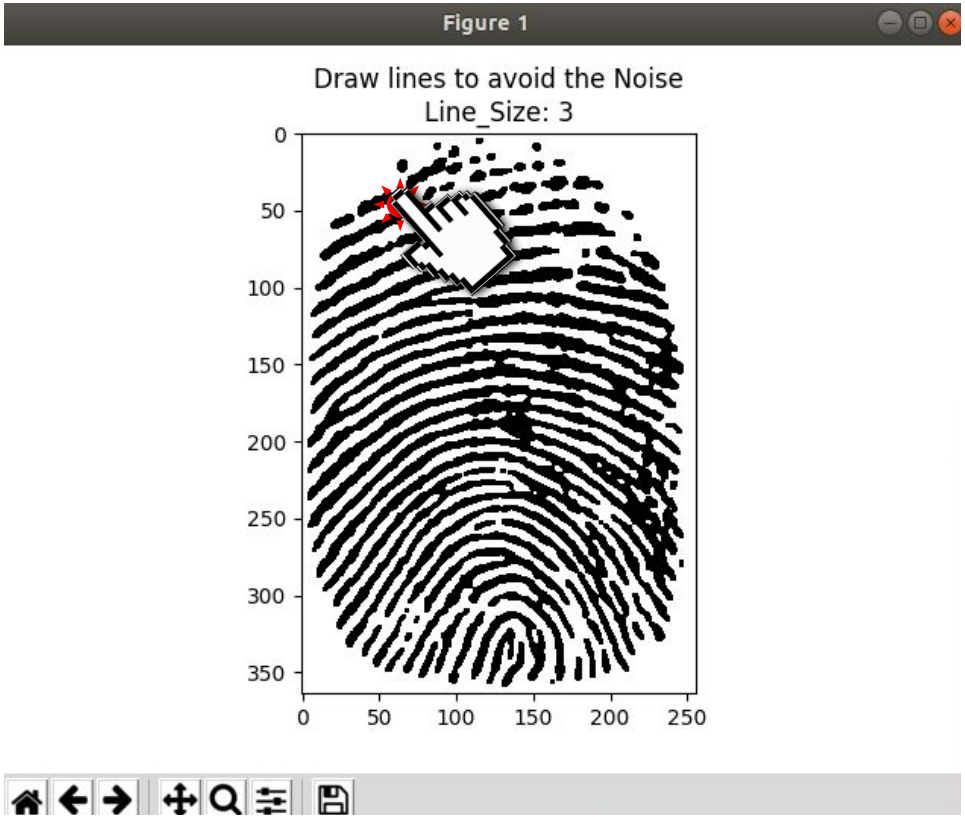
- Line Size

Backspace Last step

Manual Enhancement: Interactive Drawing



Commands

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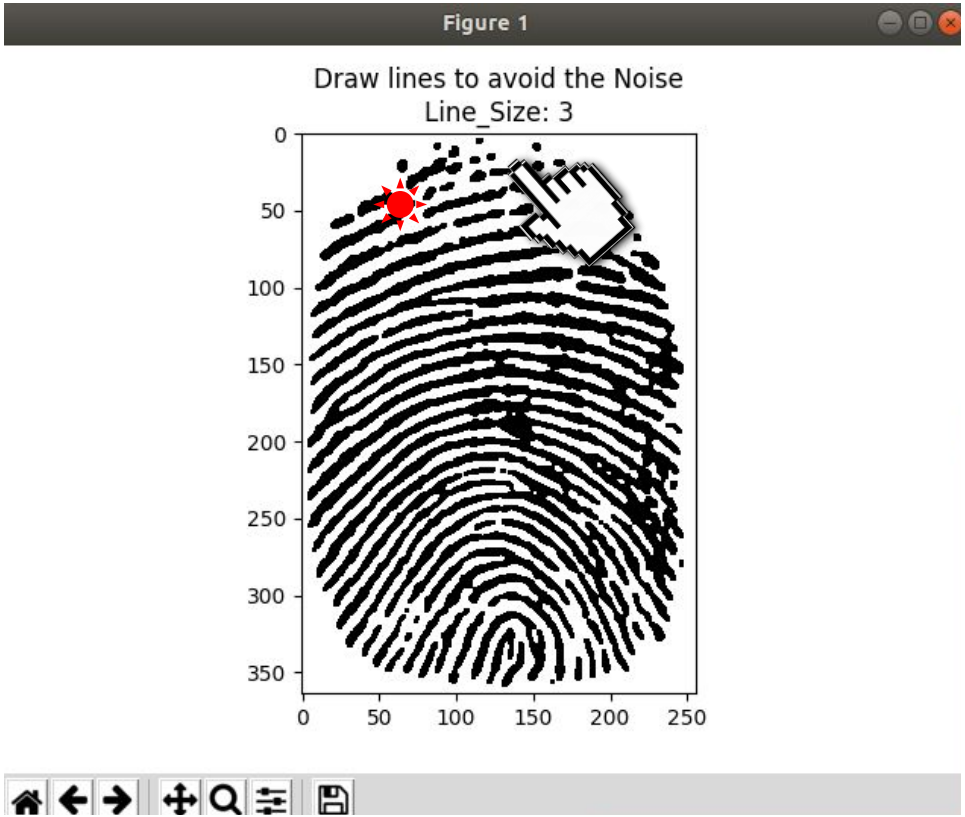
Backspace Last step

Manual Enhancement: Interactive Drawing



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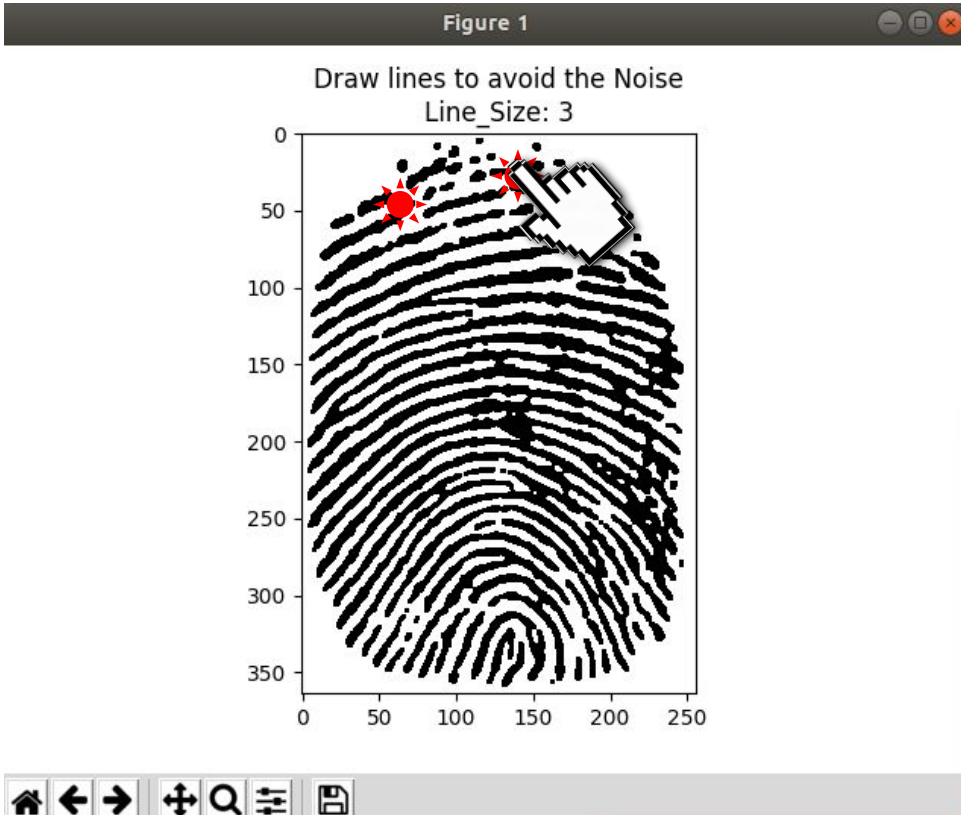
Backspace Last step

Manual Enhancement: Interactive Drawing



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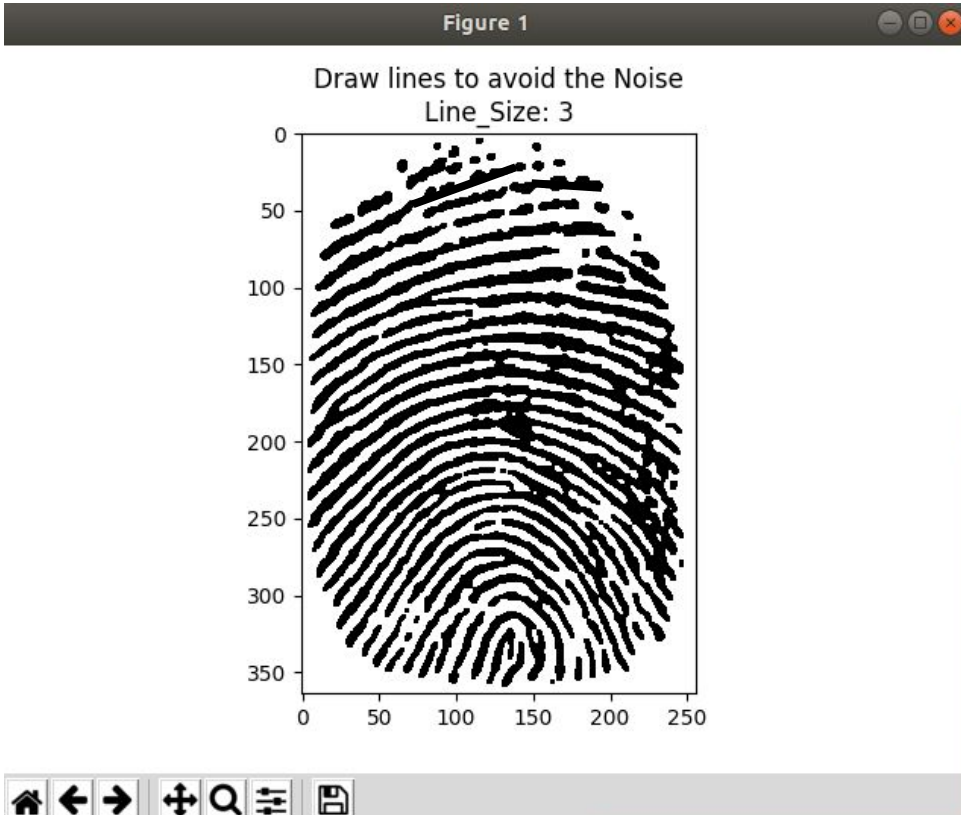

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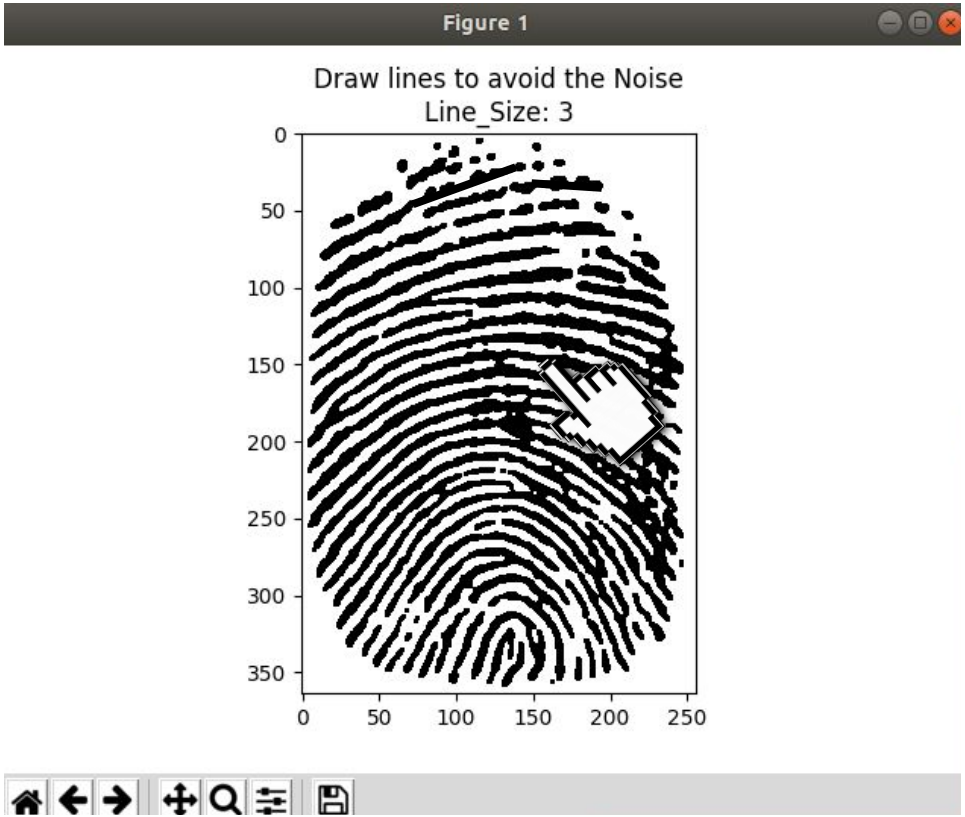
Manual Enhancement: Interactive Drawing



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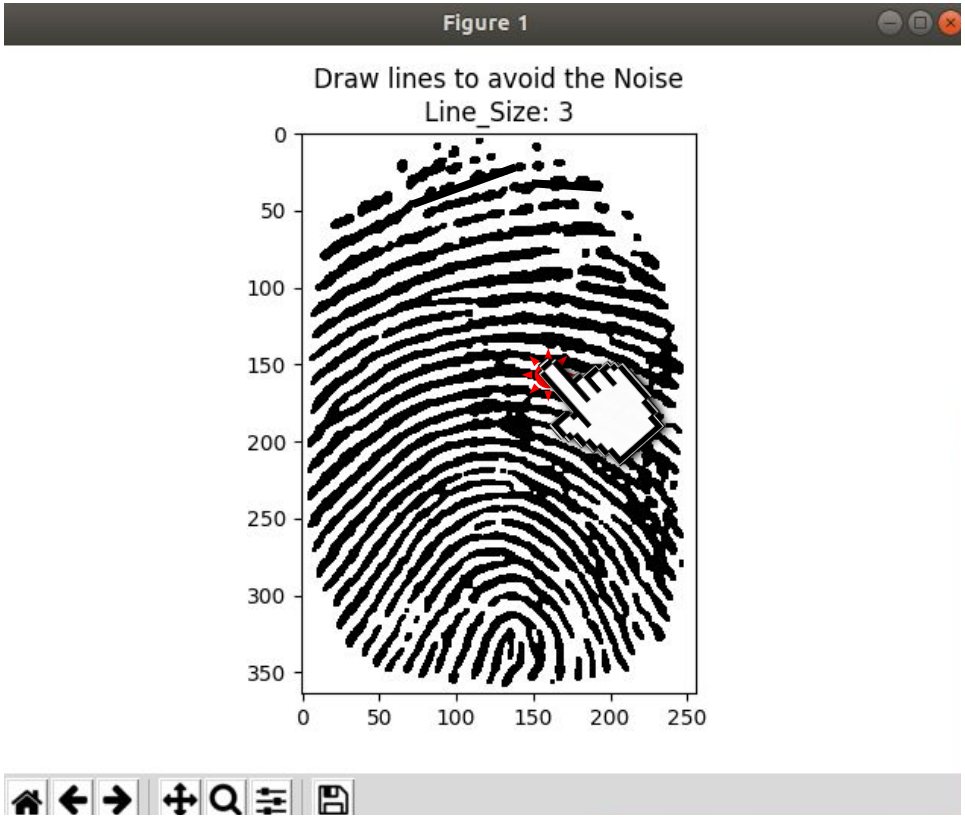
- Line Size

Backspace Last step

Manual Enhancement: Interactive Drawing



Commands

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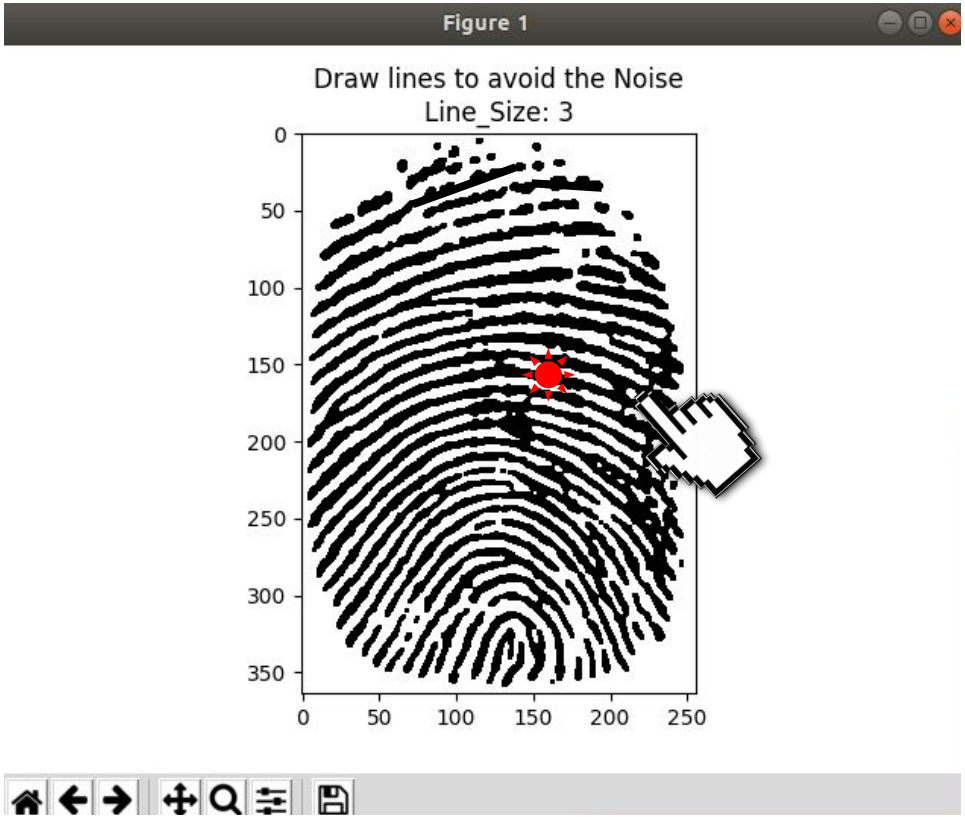
- Line Size

Backspace Last step

Manual Enhancement: Interactive Drawing



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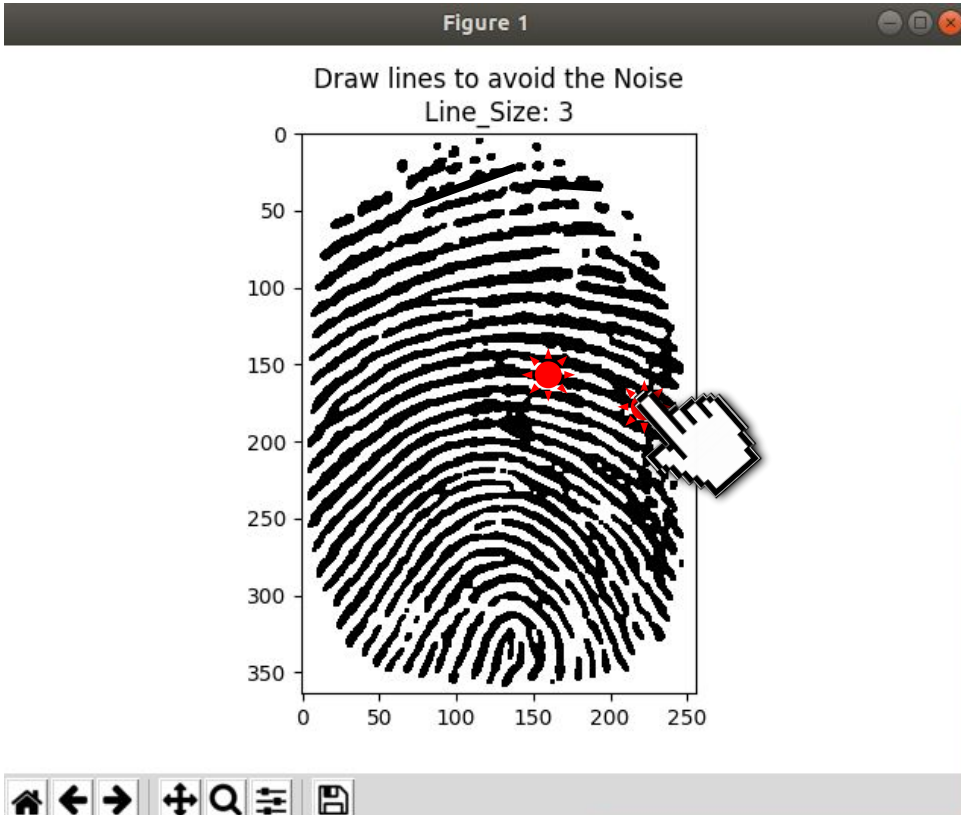
Backspace Last step

Manual Enhancement: Interactive Drawing



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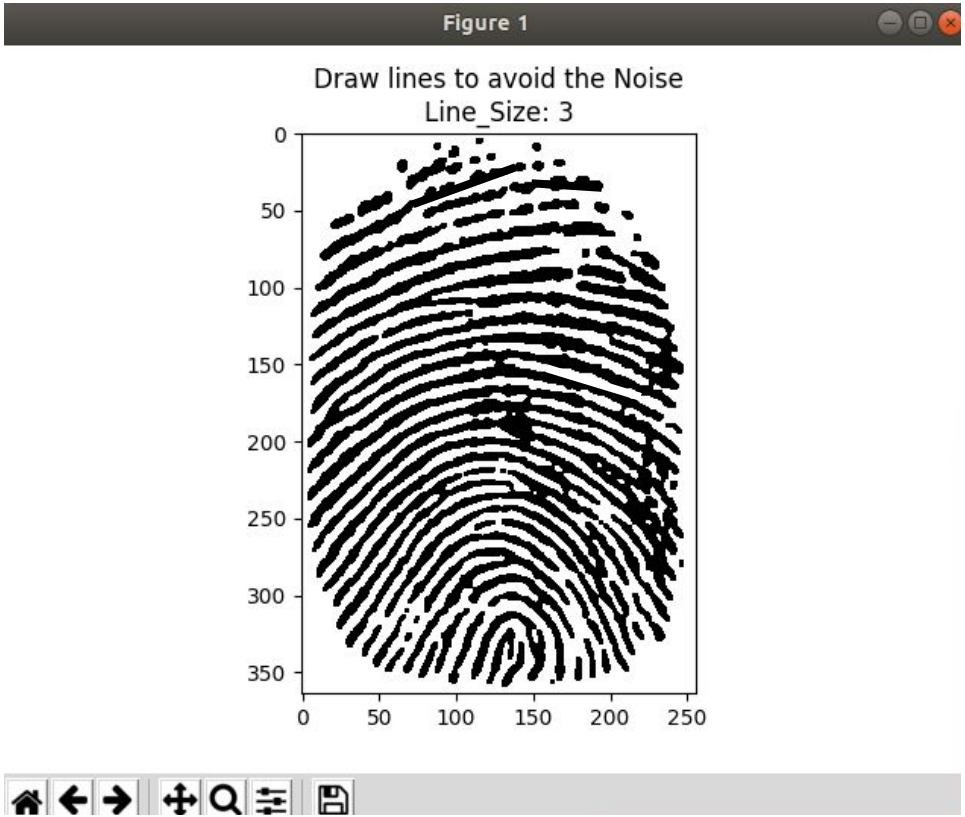
Backspace Last step

Manual Enhancement: Interactive Drawing



Commands

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Right Button

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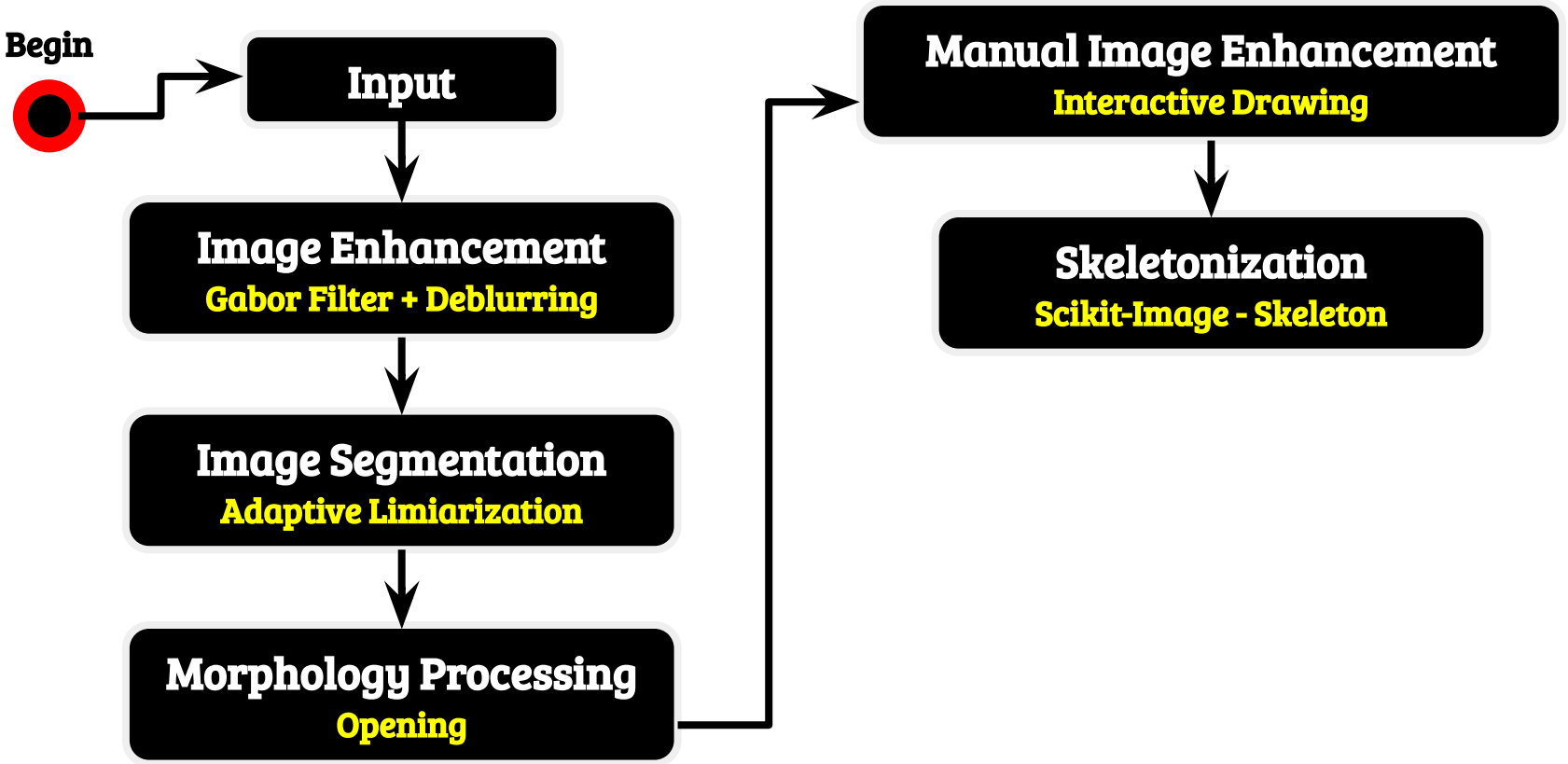
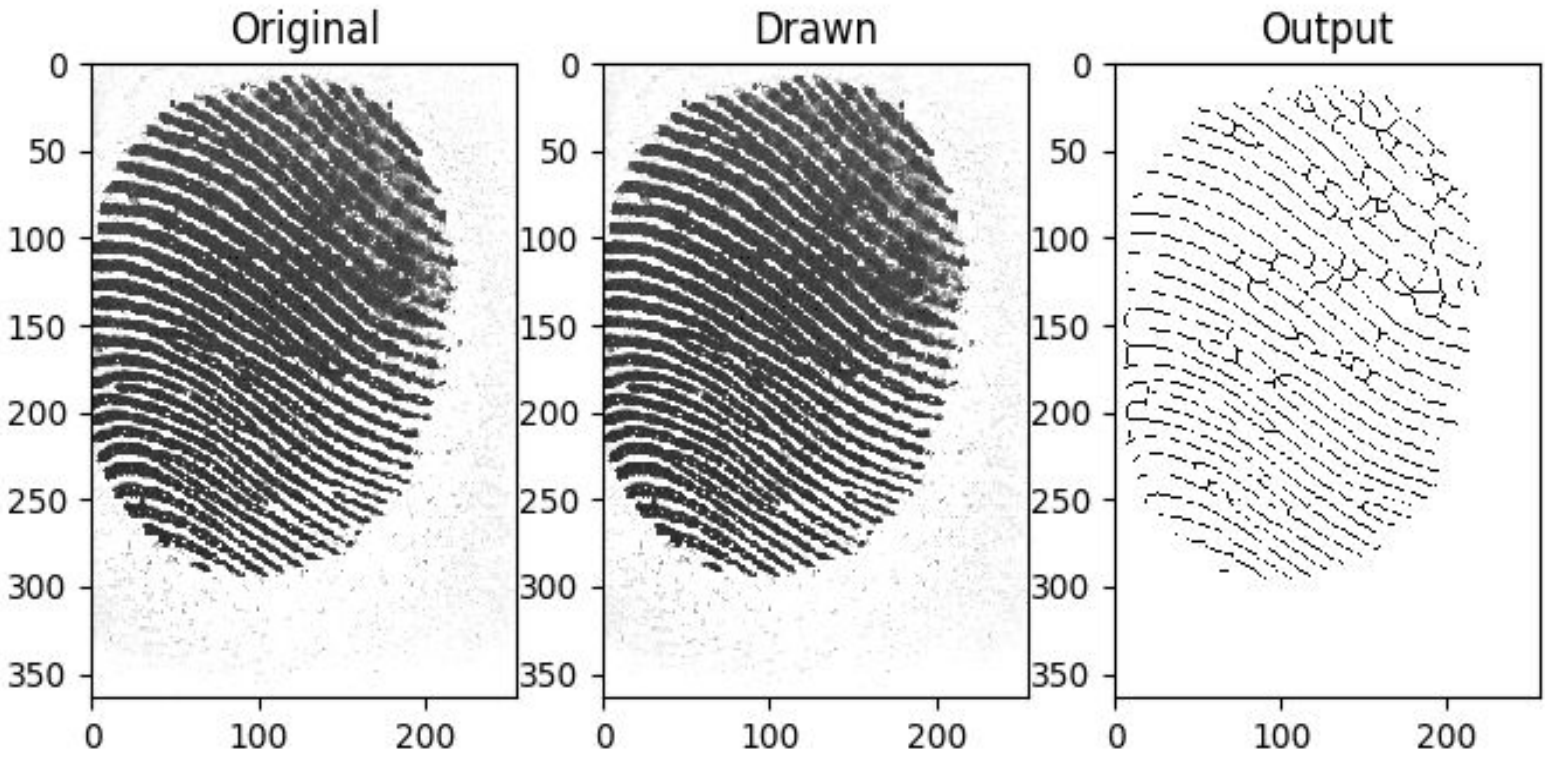
- Line Size

Backspace Last step

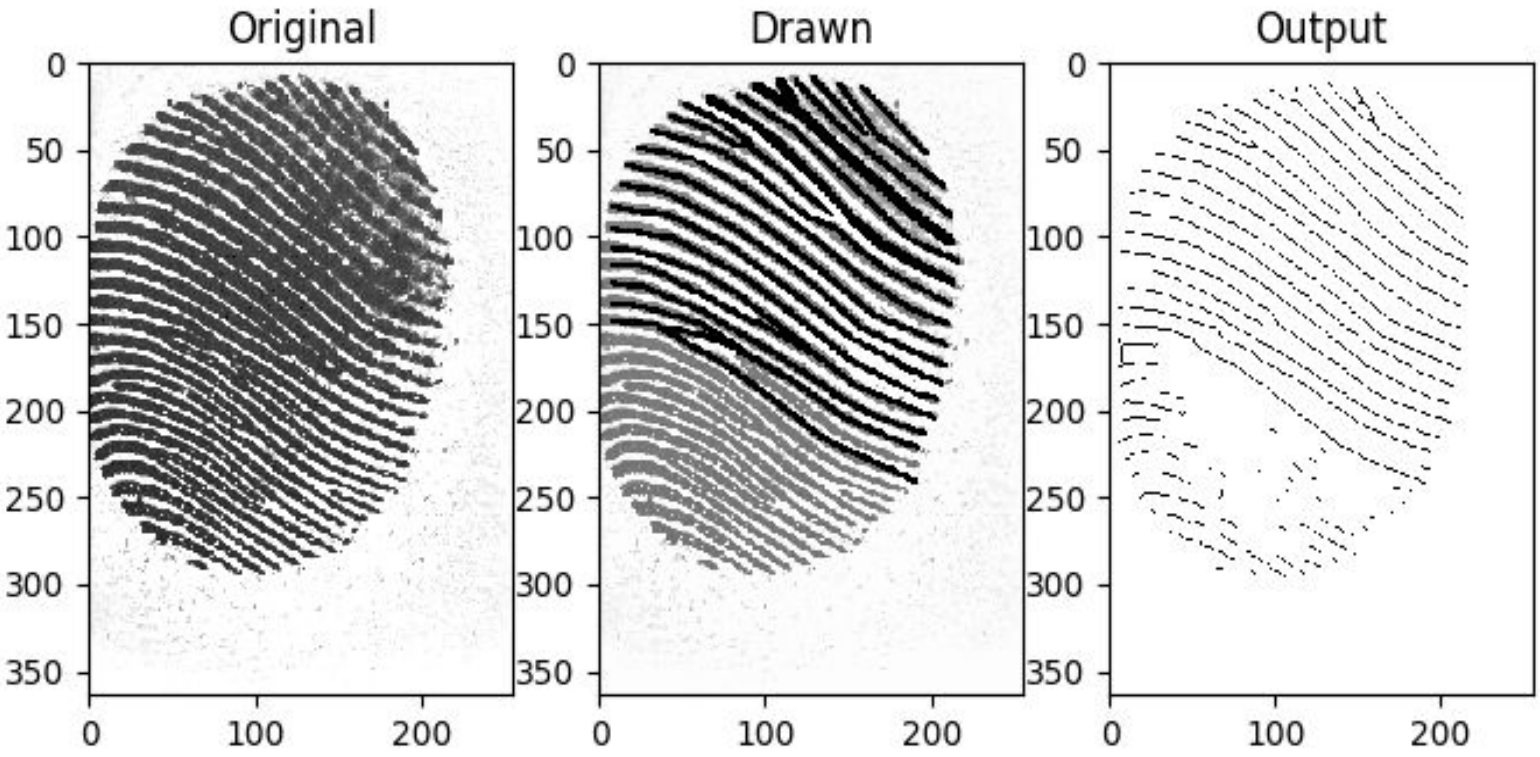
Project Steps



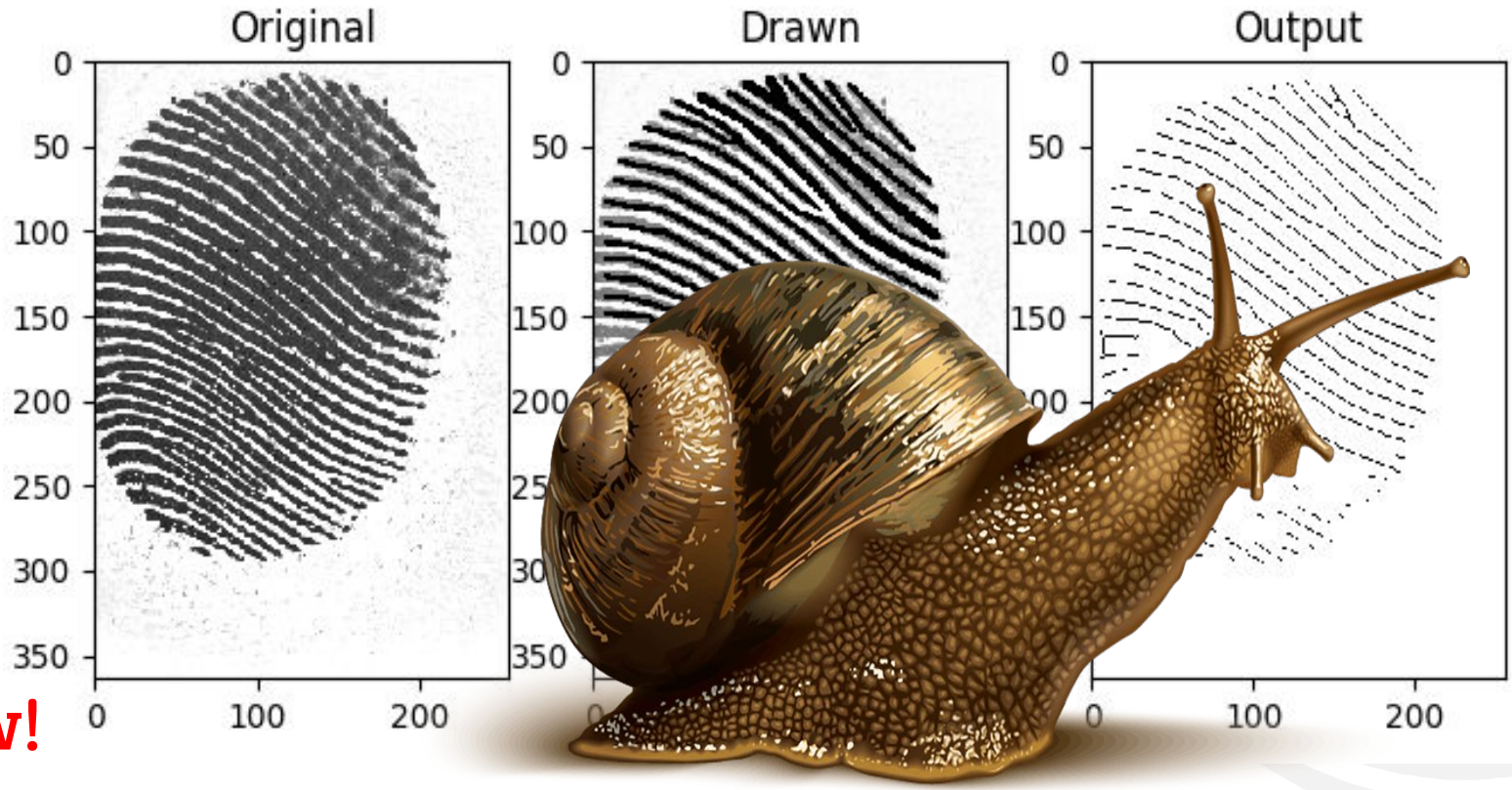
3rd Results: Without modifications



3rd Results: With interactive drawing over the input image

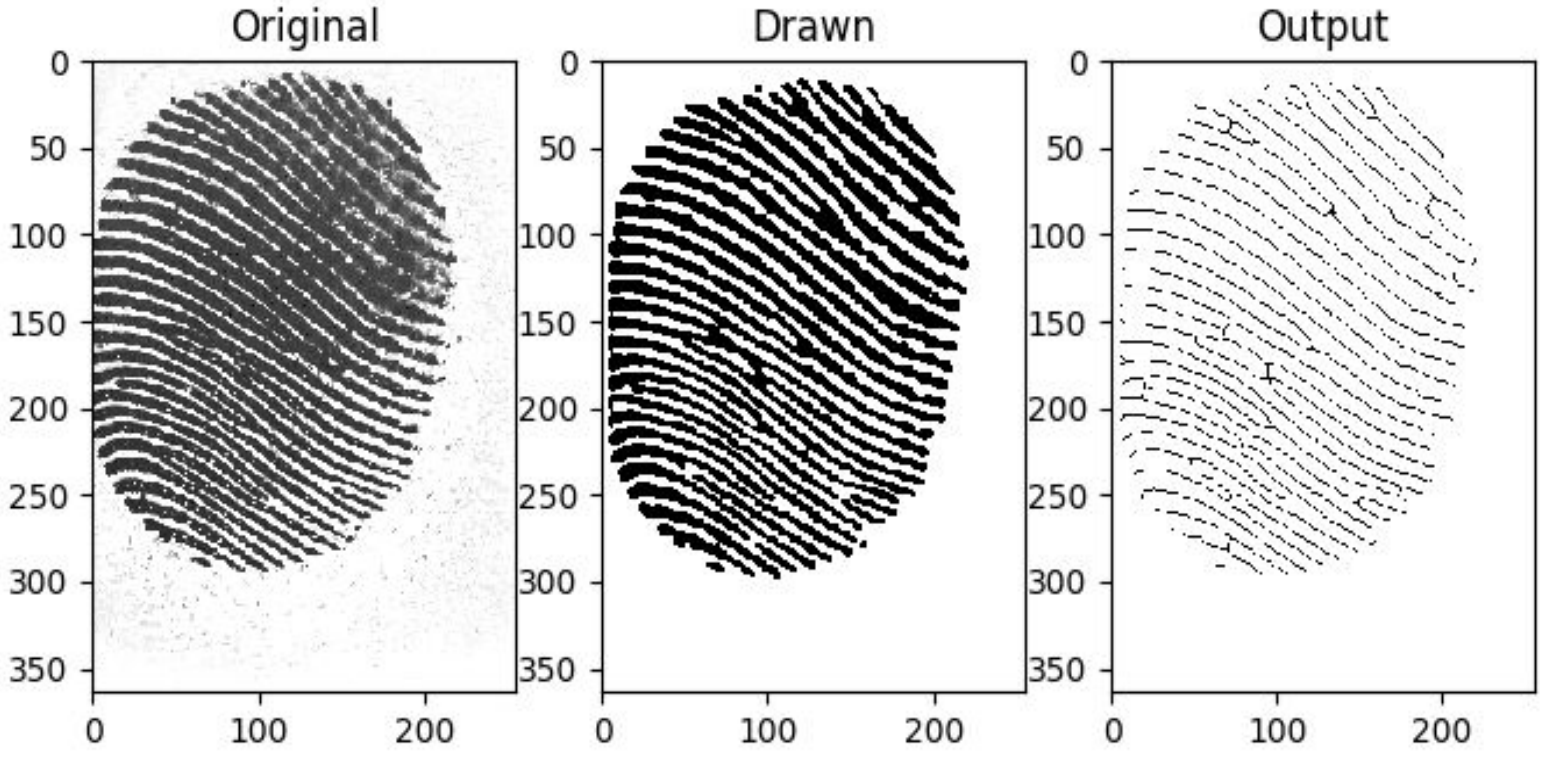


3rd Results: With interactive drawing over the input image

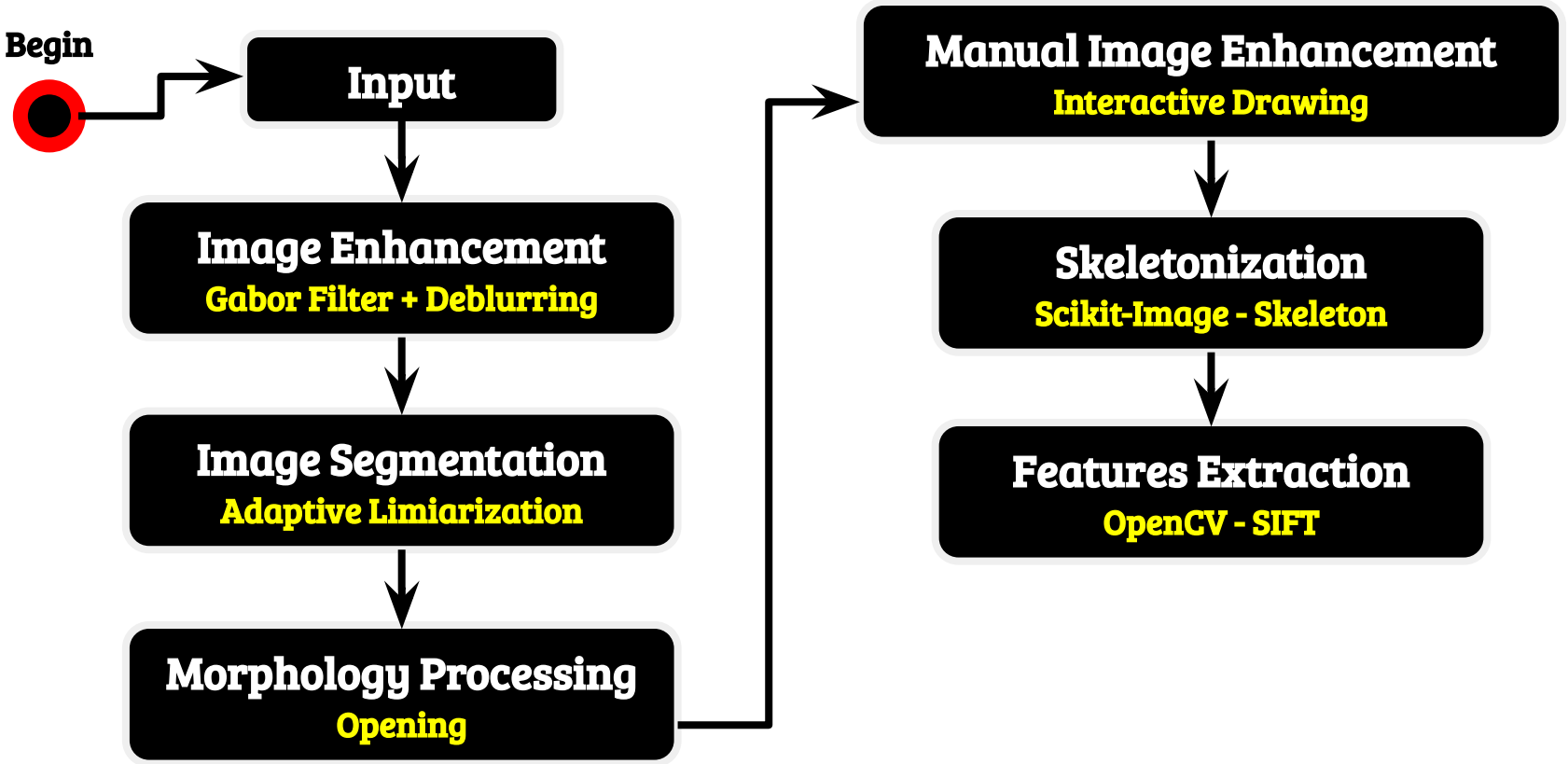


Slow!

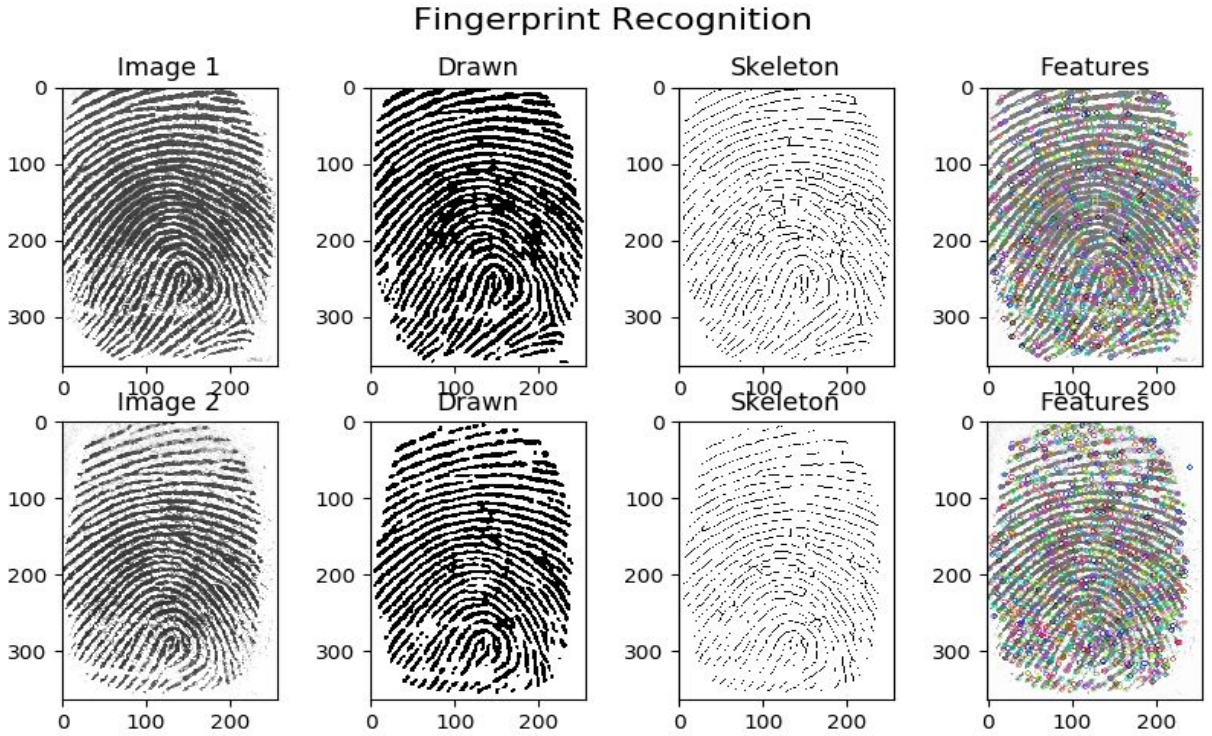
3rd Results: With interactive drawing after Opening



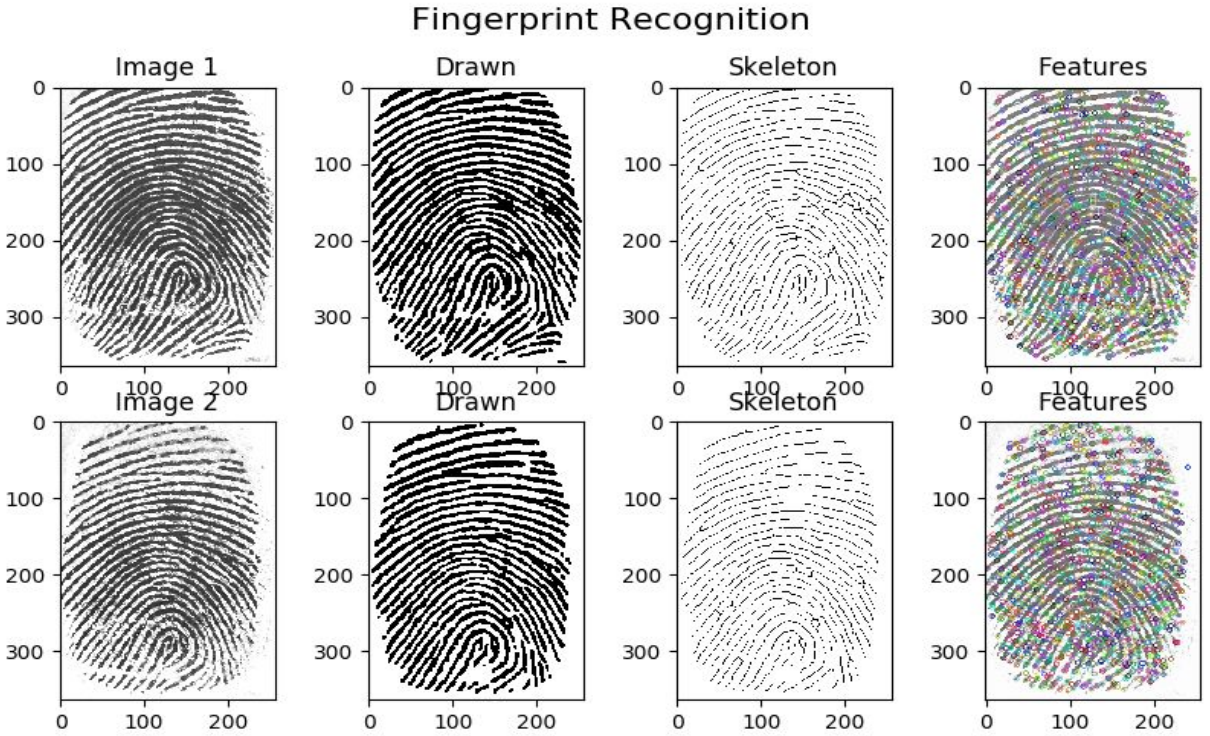
Project Steps



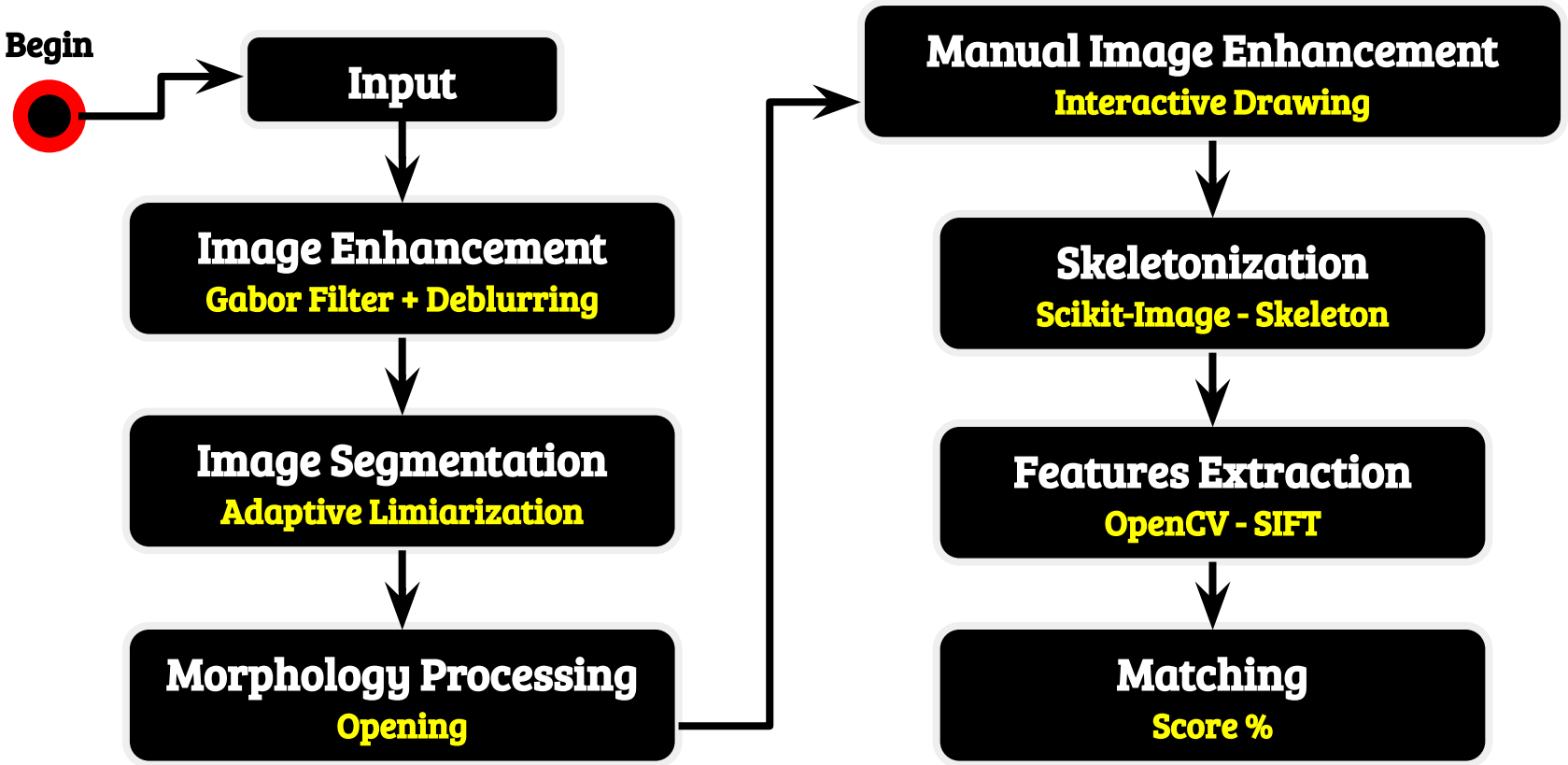
4th Results: Without Interactive Drawing



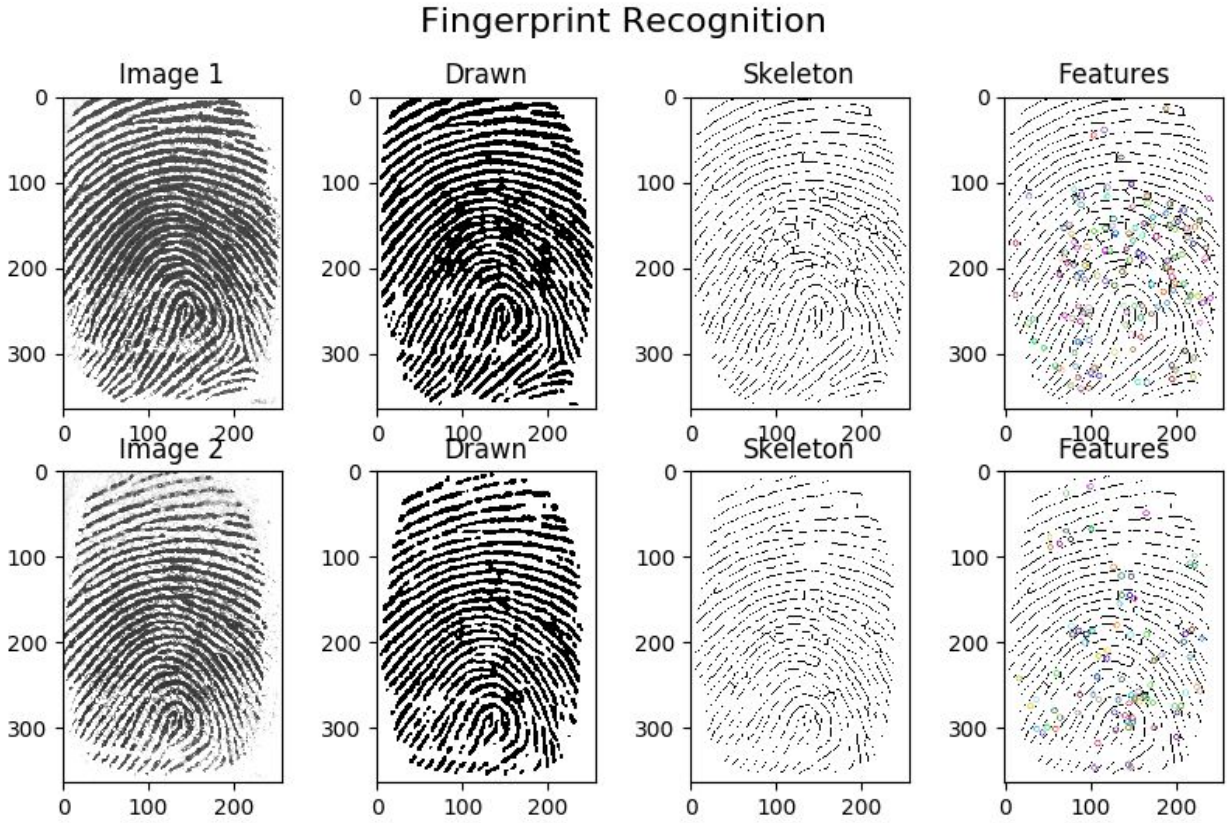
4th Results: With Interactive Drawing



Project Steps



4th Results: (101_1.tif x 101_2.tif)

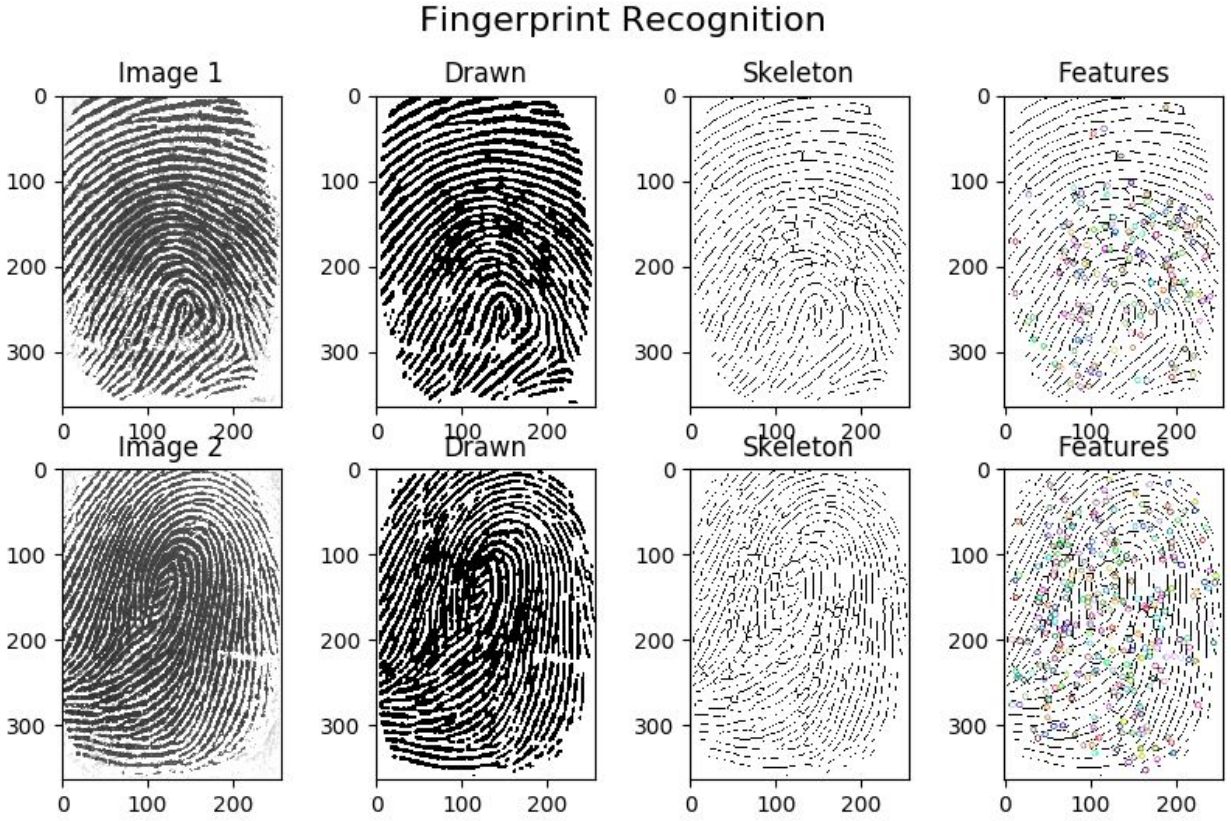


Same Class

Similarity:

74.4%

4th Results: (101_1.tif x 102_4.tif)

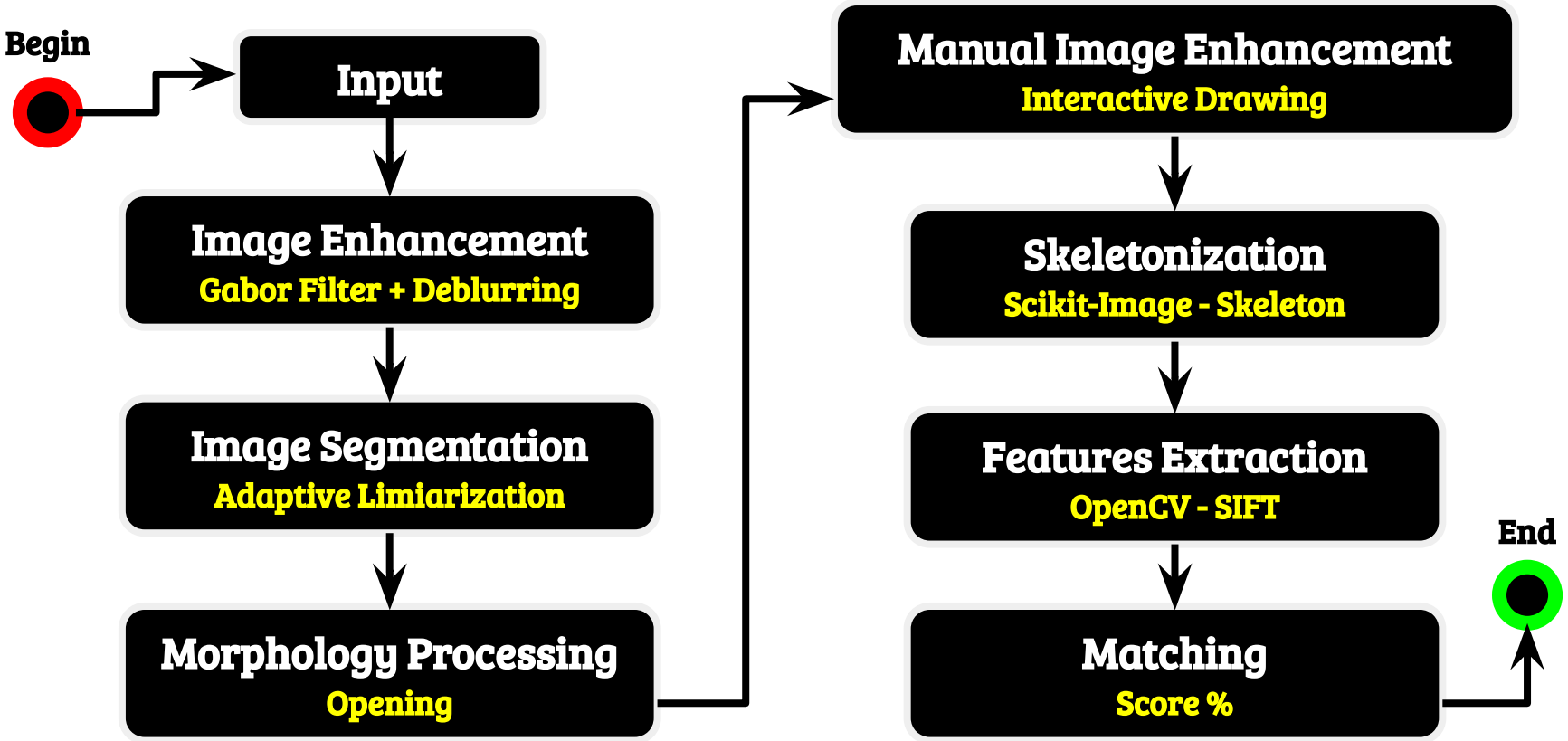


Other Class

Similarity:

34.5%

Project Steps



Conclusion

What did i learn?

Conclusion

- Preprocessing fingerprints is necessary!
- SIFT Features are not good for Fingerprint Recognition.
- Interactive Drawing Technique is good to avoid noise.

- Project: https://github.com/SherlonAlmeida/Fingerprint_Recognition

DEMO

How to use the program?

Universidade de São Paulo

Fingerprint Recognition

Student

Sherlon Almeida da Silva

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Thank you!