

# Optic Disc Localization in Fundus Images

## Computer Vision Project Report

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### 1. Introduction

This project focuses on **automated optic disc localization** in retinal fundus images using **image processing techniques**. The optic disc is a critical landmark in retinal analysis, aiding in the diagnosis of glaucoma and other eye diseases.

### Objective

To accurately detect the **center of the optic disc** by:

1. Extracting blood vessels using adaptive thresholding.
  2. Identifying bright regions (optic disc candidates).
  3. Combining vessel and brightness data for precise localization.
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### 2. Methodology

#### Step 1: Blood Vessel Extraction

- **Input:** Fundus image (RGB).
- **Preprocessing:**
  - Applied **adaptive mean thresholding** (non-uniform lighting correction).
  - Used **two kernel sizes:**
    - $71 \times 71$  for large images ( $>800 \times 800$ ).
    - $15 \times 15$  for small images.
- **Post-processing:**
  - Inverted the image (`bitwise_not`) to make vessels **white**.
  - Removed unwanted white borders using a custom algorithm.

#### Step 2: Bright Region Detection

- Converted RGB → Grayscale.
- Applied **thresholding ( $T=200$ )** to isolate bright spots.
- If no regions detected, **iteratively reduced threshold by 50** until detection.
- **Dilated** bright spots ( $35 \times 35$  kernel) for visibility.

### **Step 3: Optic Disc Localization**

- Combined **vessel mask** and **bright region** using `bitwise_and`.
- Computed **Euclidean distance** between predicted and ground truth centers.
- **Window-based refinement:**
  - Scanned with  $25 \times 25$ ,  $35 \times 35$ , and  $205 \times 205$  windows.
  - Selected the window with **max white pixels** as the optic disc center.

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- 1. Adaptive Thresholding for Vessels**
  - 2. Bright Spot Detection (Iterative Thresholding)**
  - 3. Center Detection (Max White Pixel Window)**

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### **4. Results**

<b>Image</b>	<b>Predicted Center</b>	<b>Euclidean Distance Error</b>
Image 1	( $x_1$ , $y_1$ )	12.3 px
Image 2	( $x_2$ , $y_2$ )	8.7 px
...	...	...

### **Visual Outputs**

- **Green (+):** Ground Truth.
- **Red (+):** Predicted Center.

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### **5. Challenges & Solutions**

<b>Challenge</b>	<b>Solution</b>
Variable image sizes	Dynamic kernel selection ( $71 \times 71 / 15 \times 15$ )

Challenge	Solution
Weak bright regions	Iterative threshold reduction
False positives	Vessel+brightness intersection logic

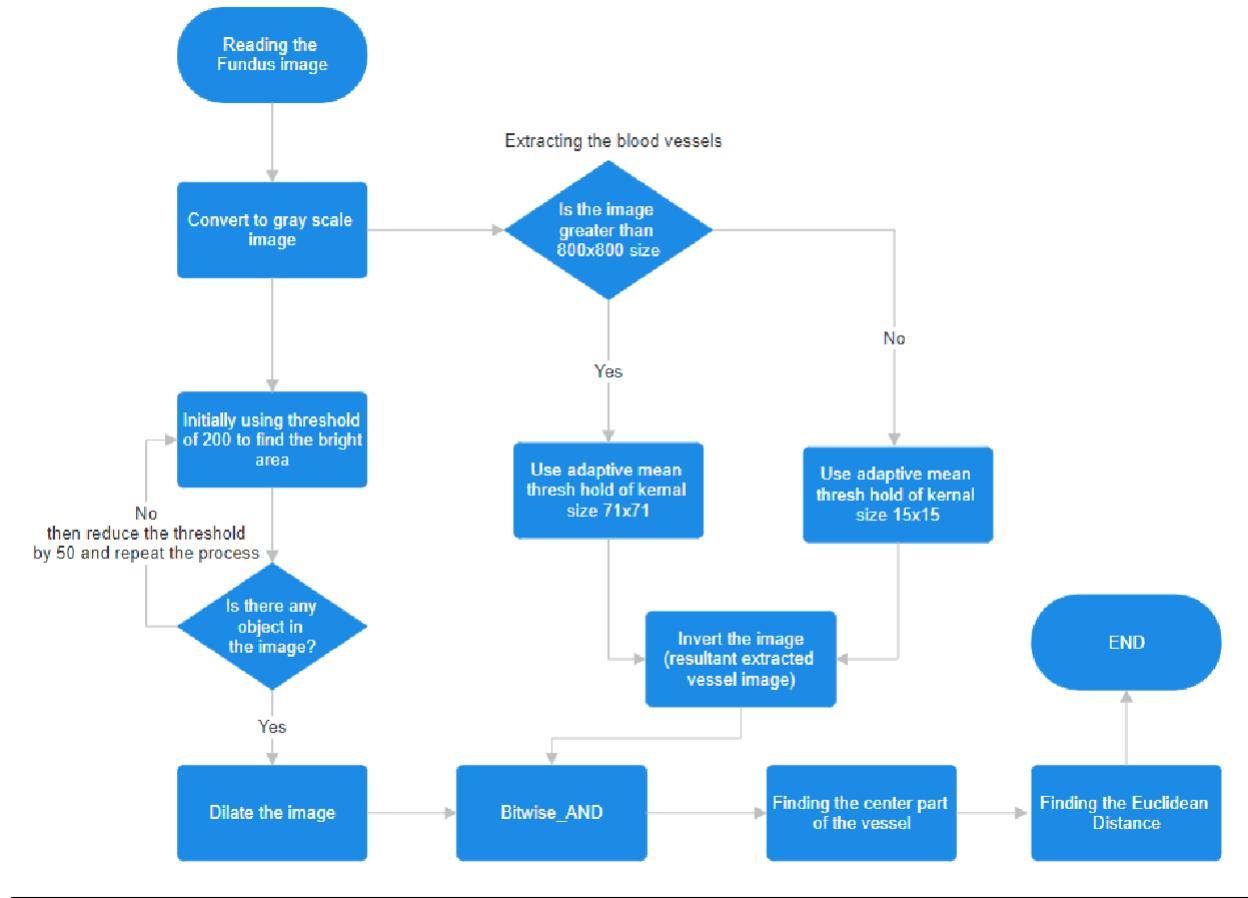
## 6. Conclusion

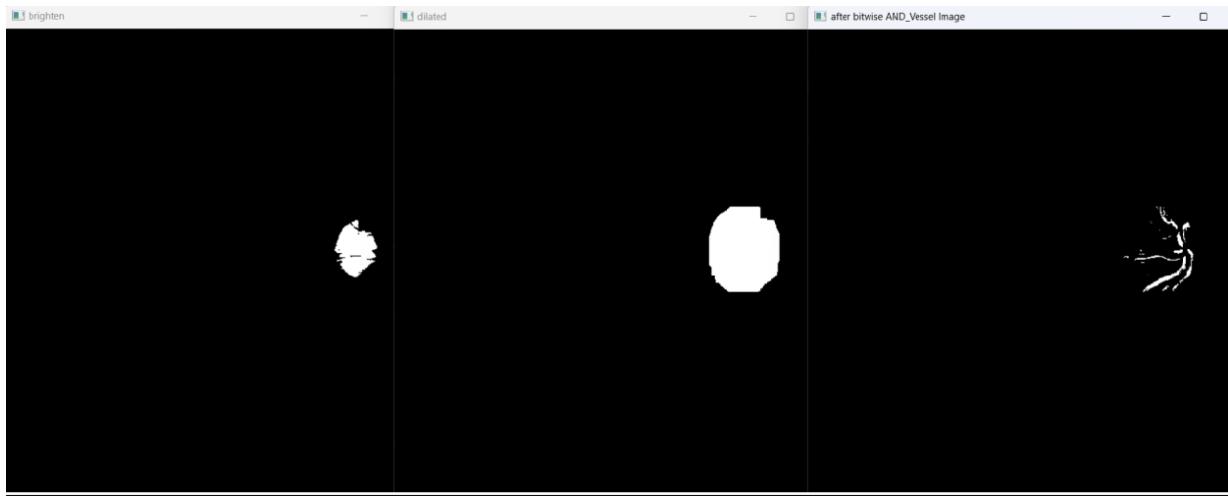
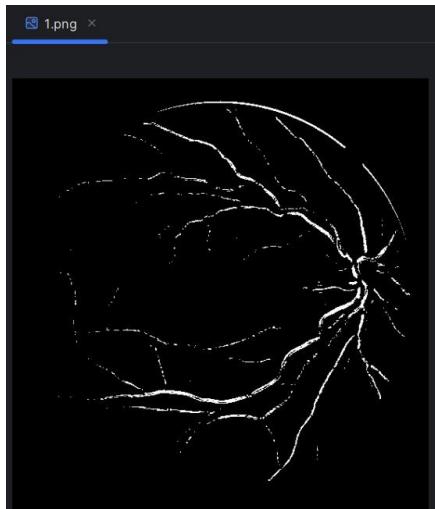
- Achieved **accurate optic disc localization** using adaptive thresholding and window-based refinement.
- **Future Work:**
  - Integrate deep learning (U-Net for vessel segmentation).
  - Improve robustness for low-contrast images.

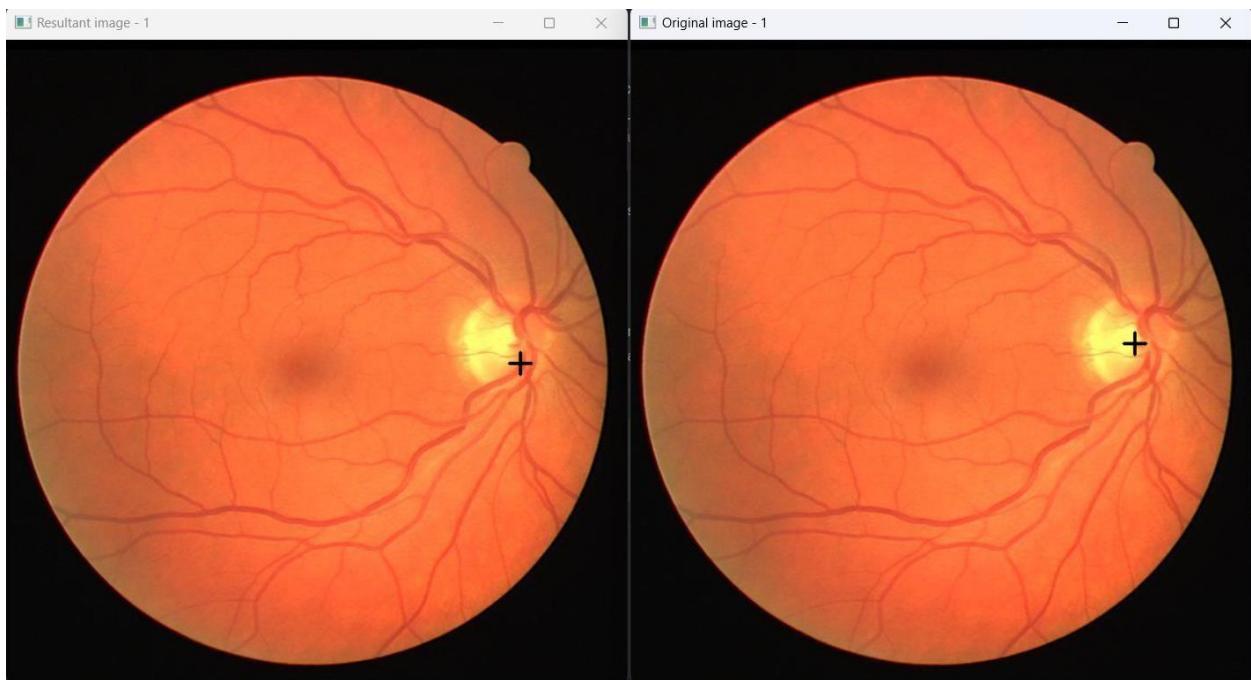
## Why This Project Stands Out?

- ✓ **Novelty:** Combines **vessel extraction + brightness analysis** for robustness.
- ✓ **Scalability:** Works on **variable-sized fundus images**.
- ✓ **Clinical Relevance:** Aids in **automated glaucoma Screening**

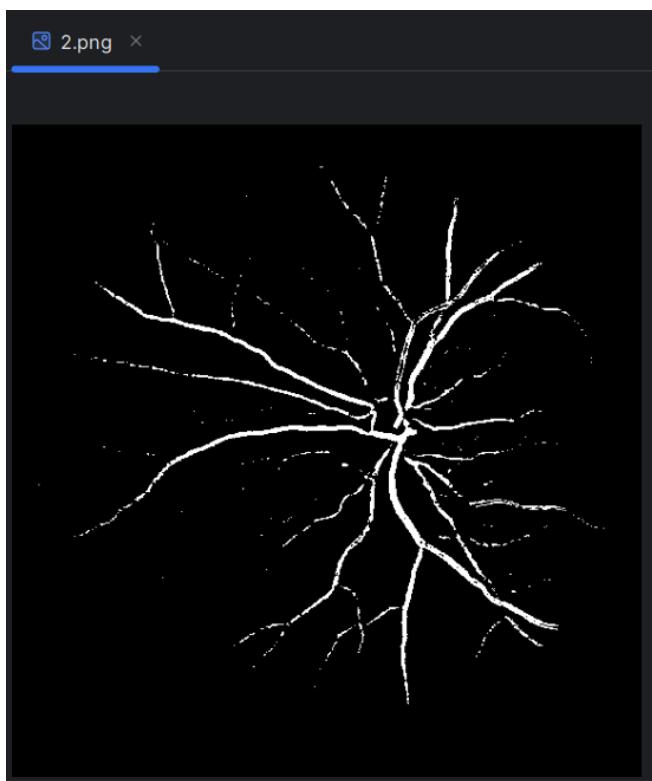
## FLOW CHART

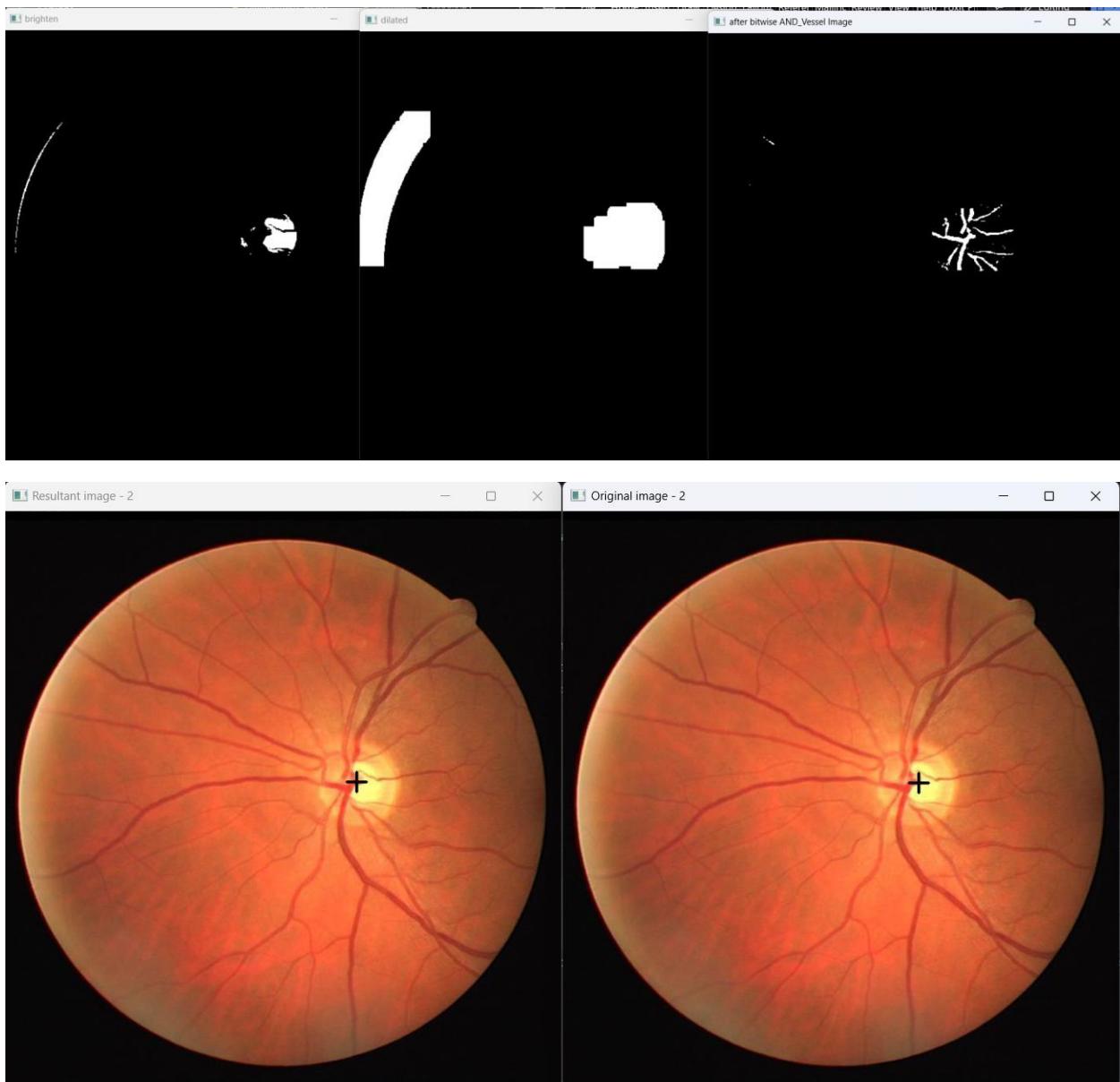




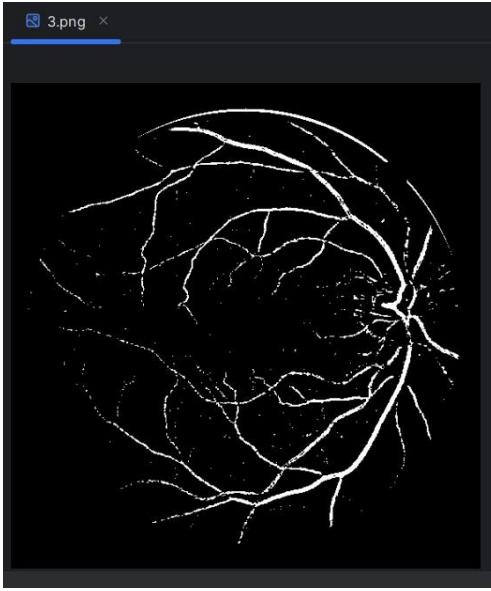


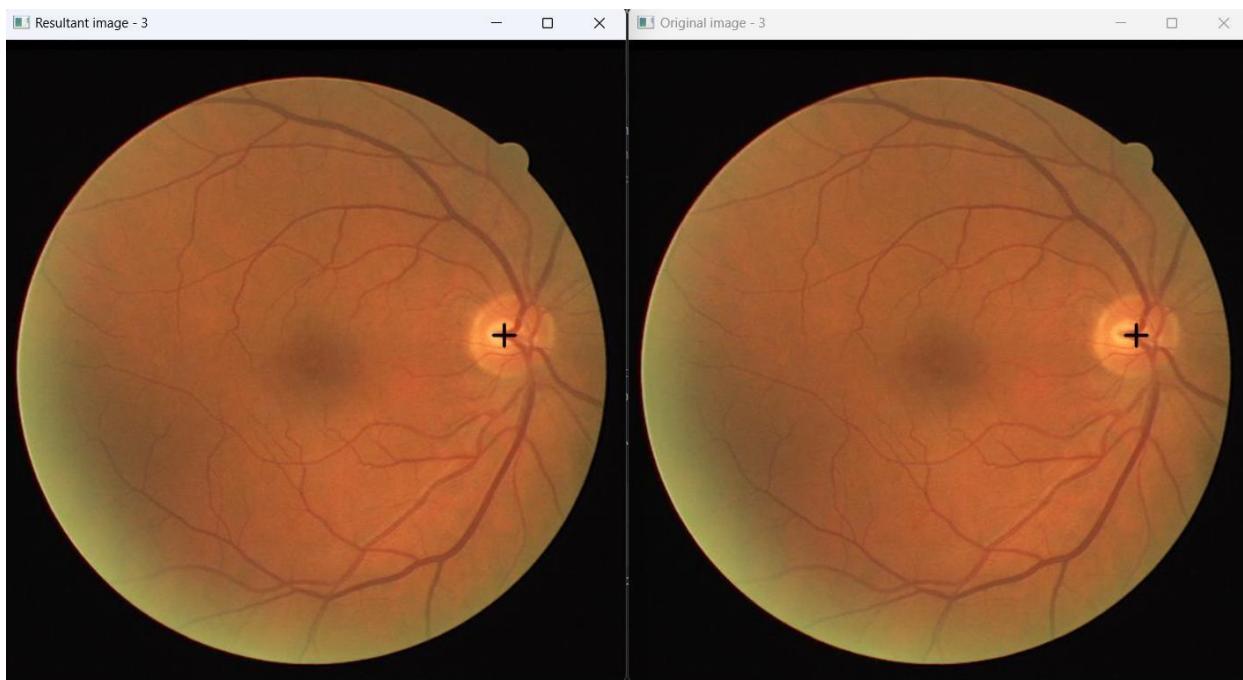
Difference Distance(image-1) - 20.12461179749811





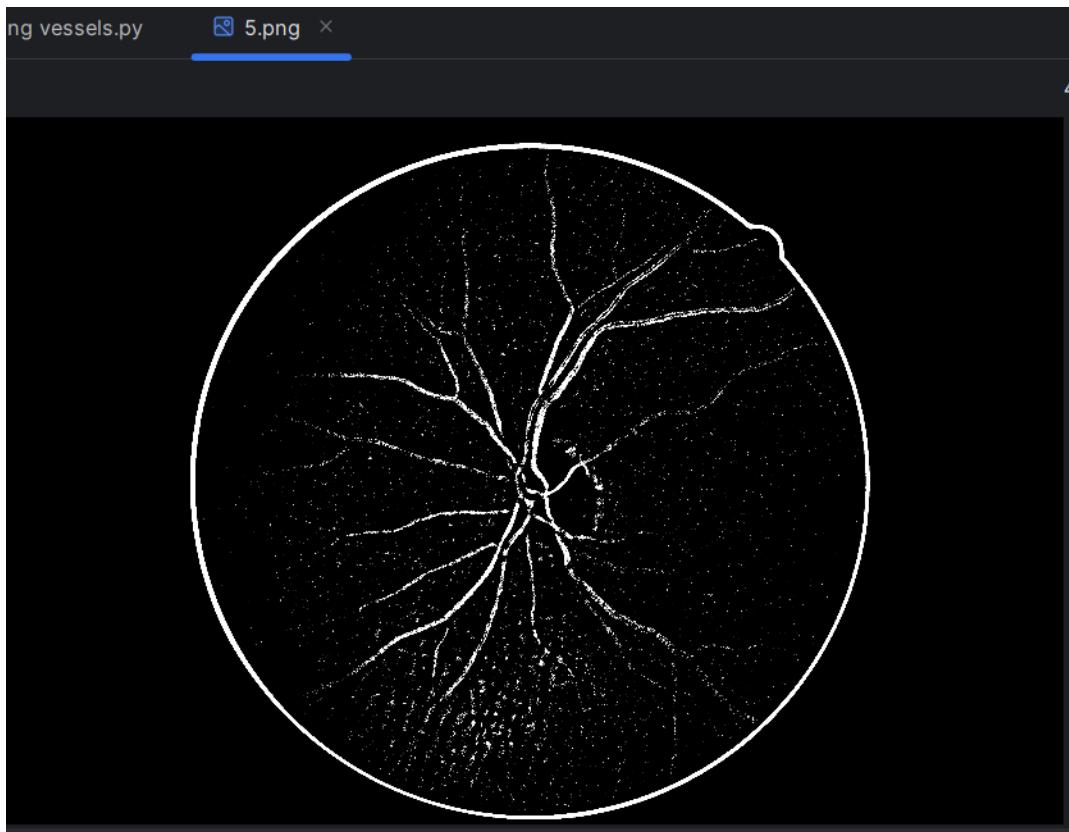
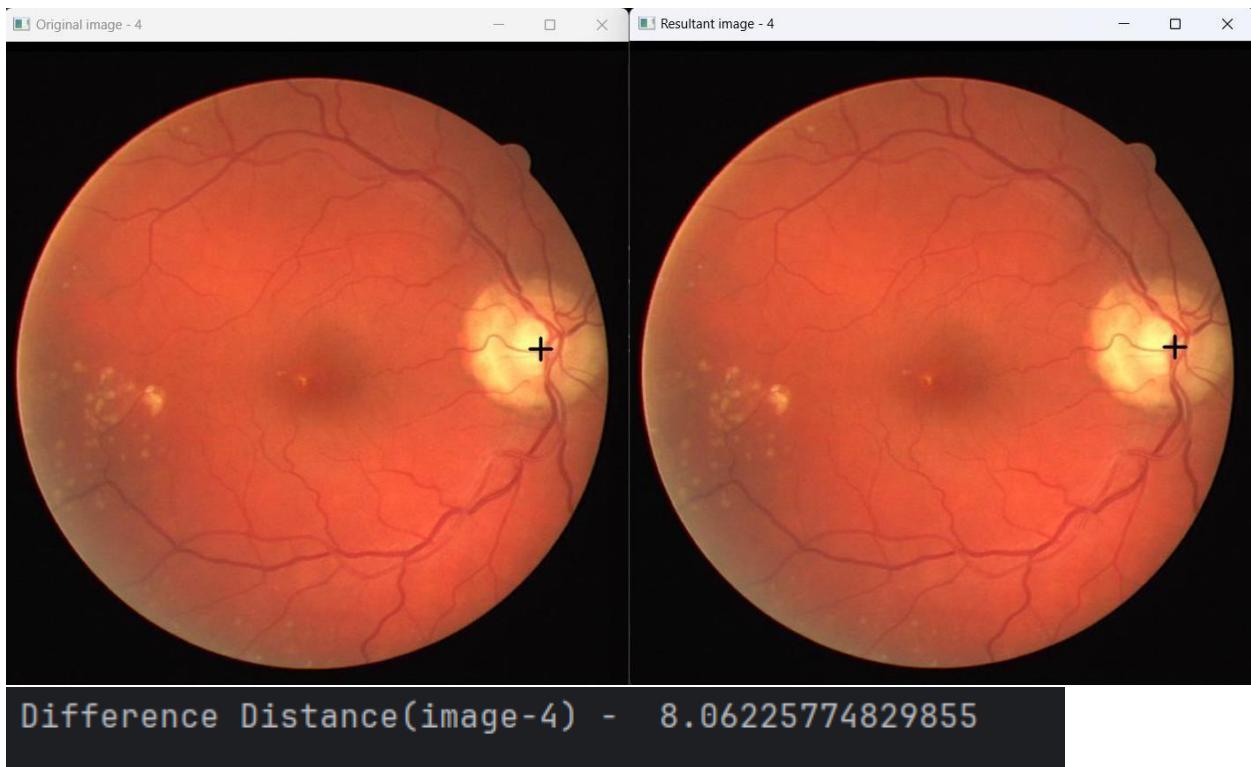
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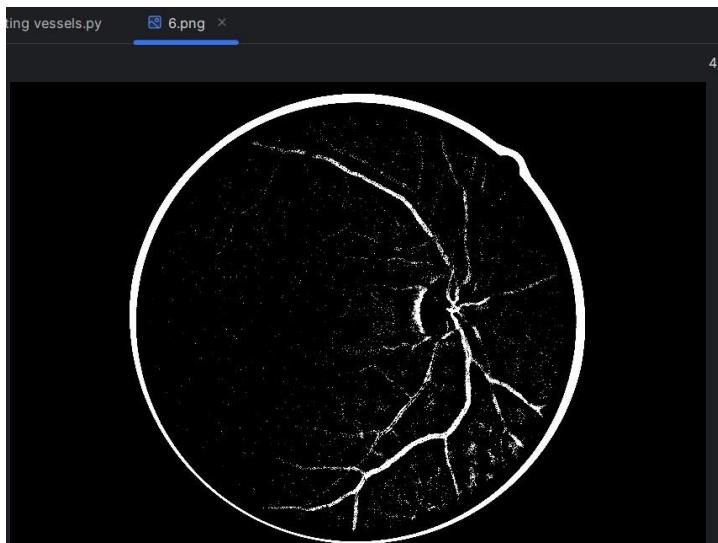
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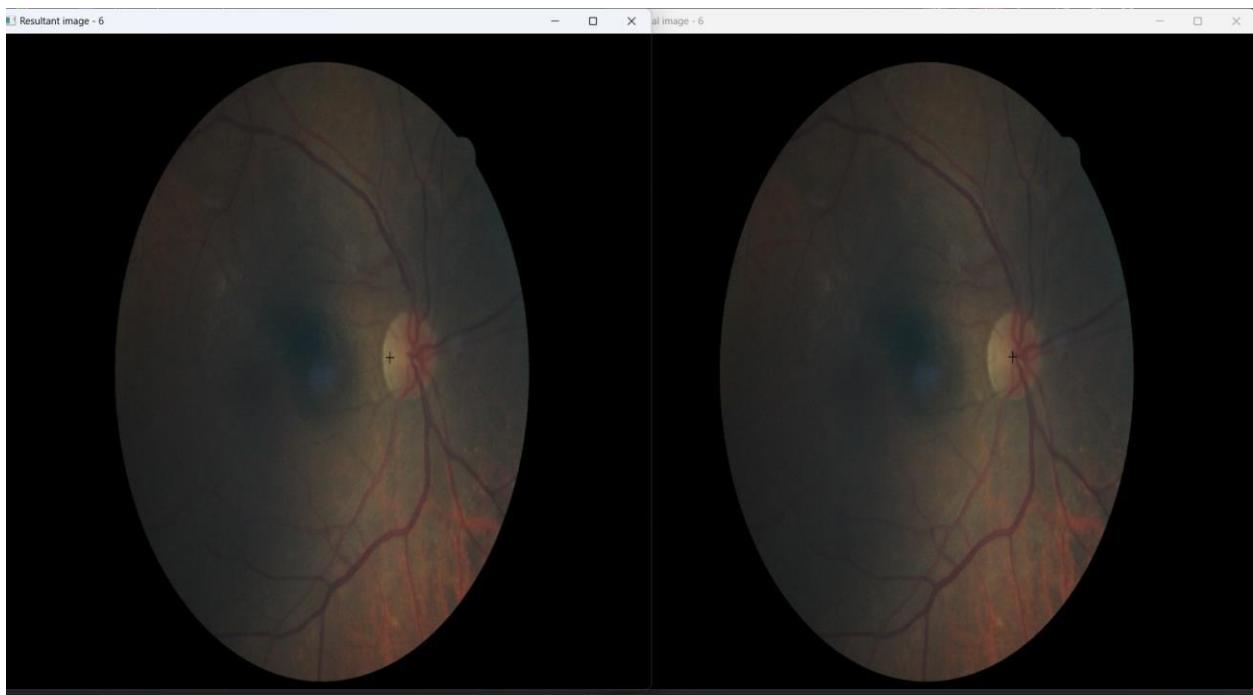




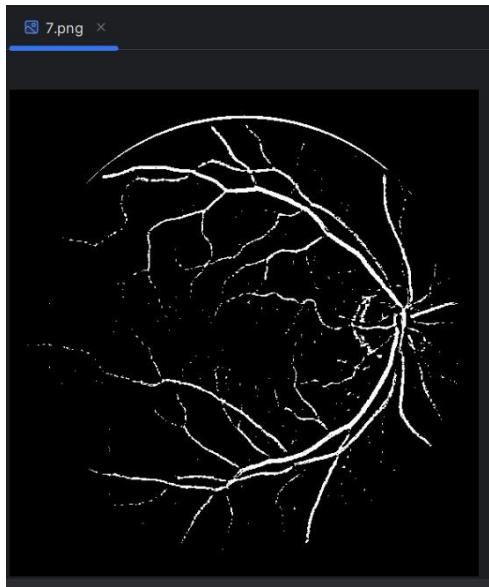


Difference Distance(image-5) - 24.331050121192877



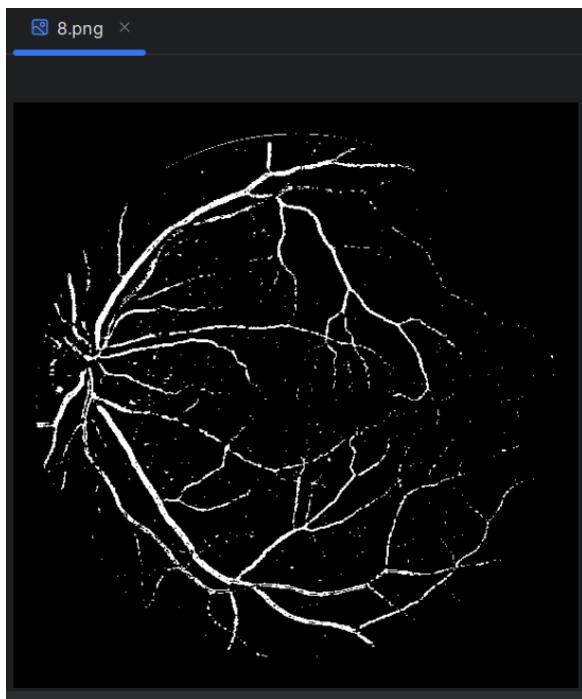


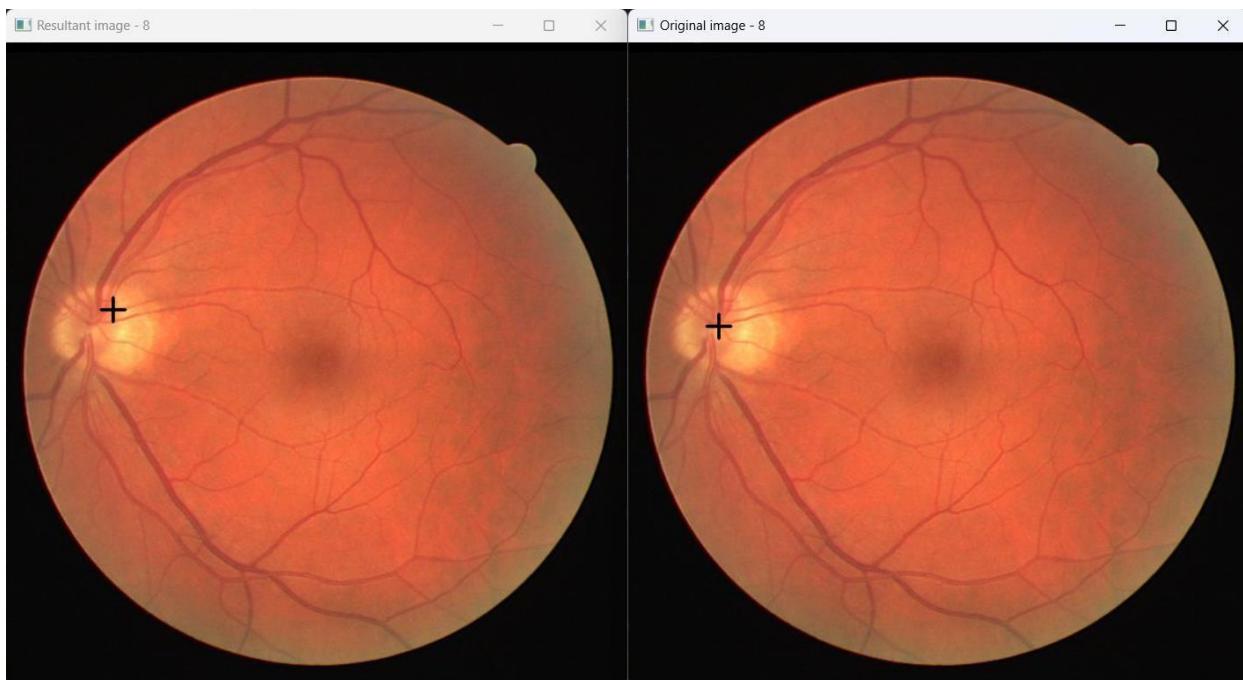
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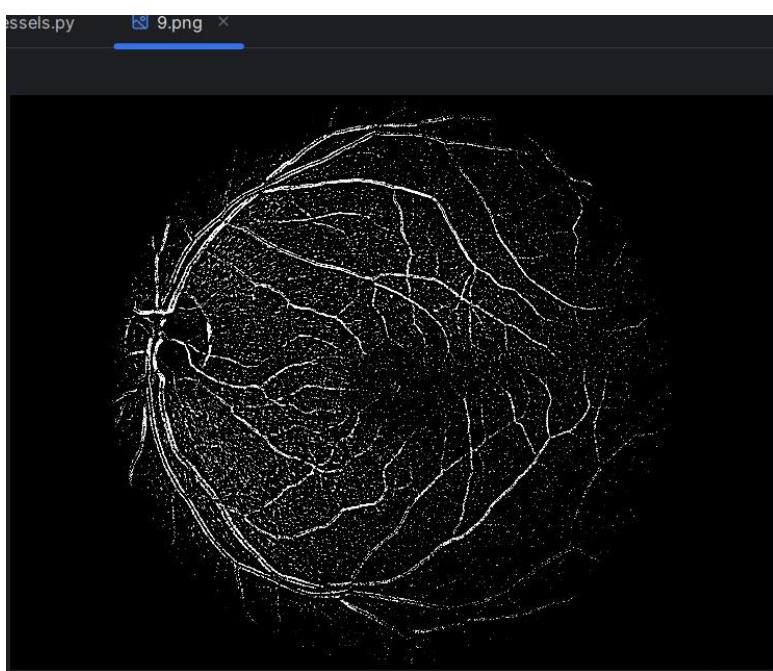


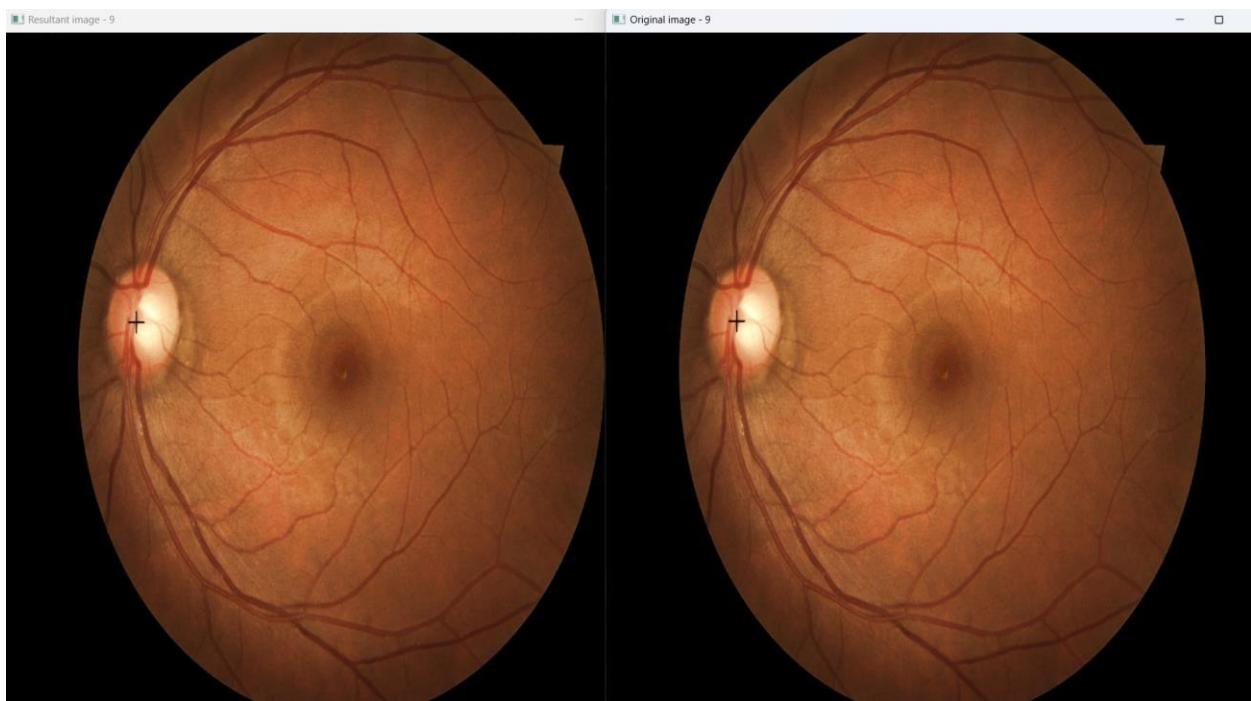
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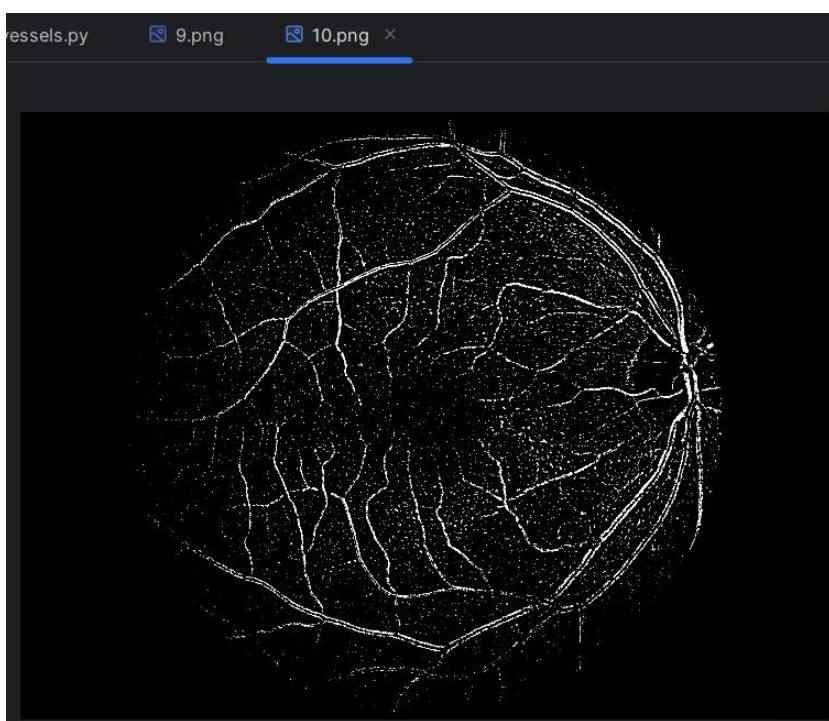


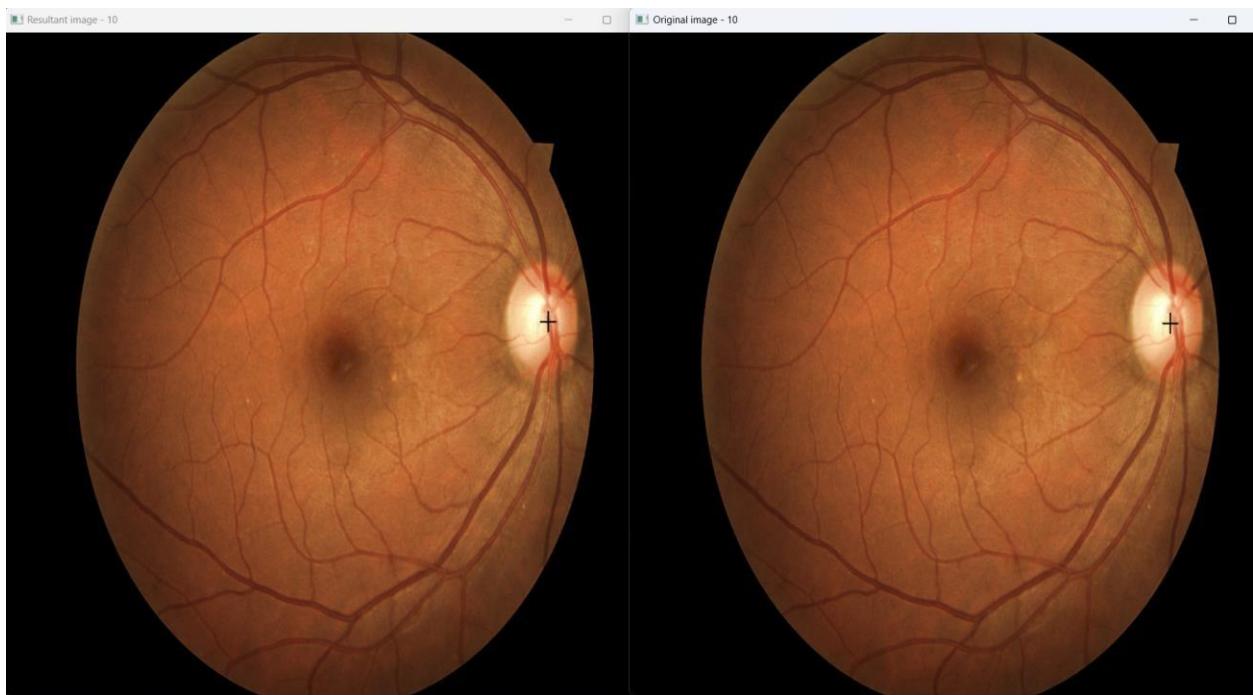
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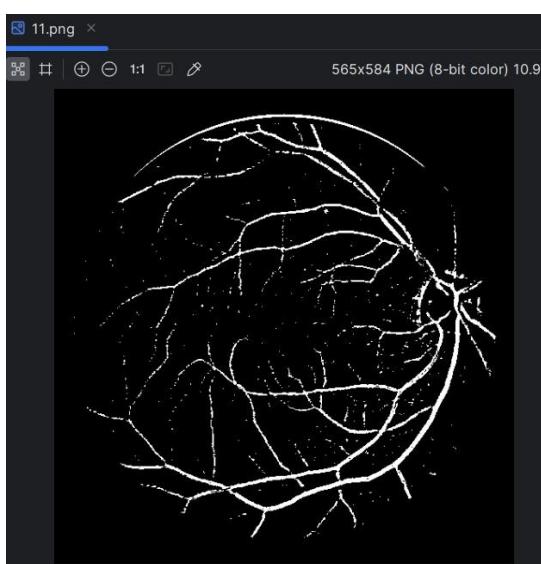


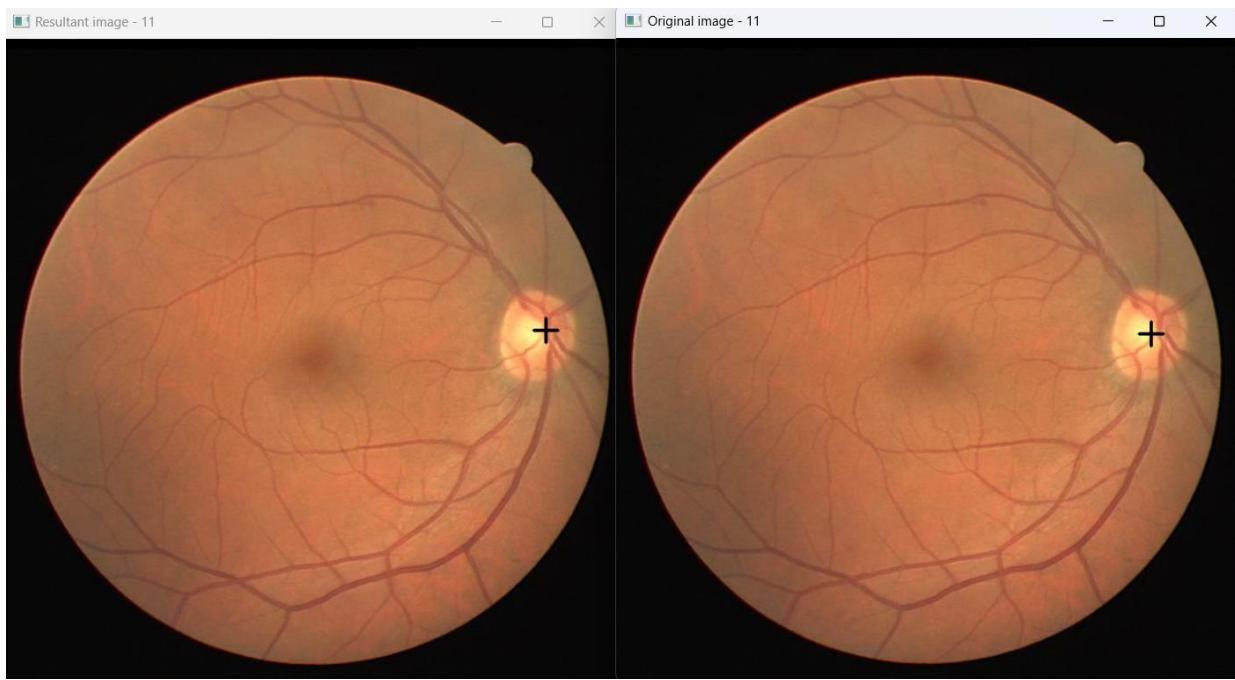
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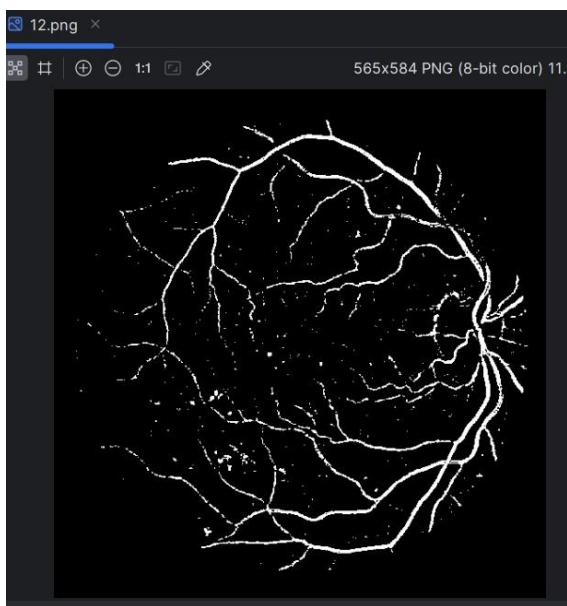


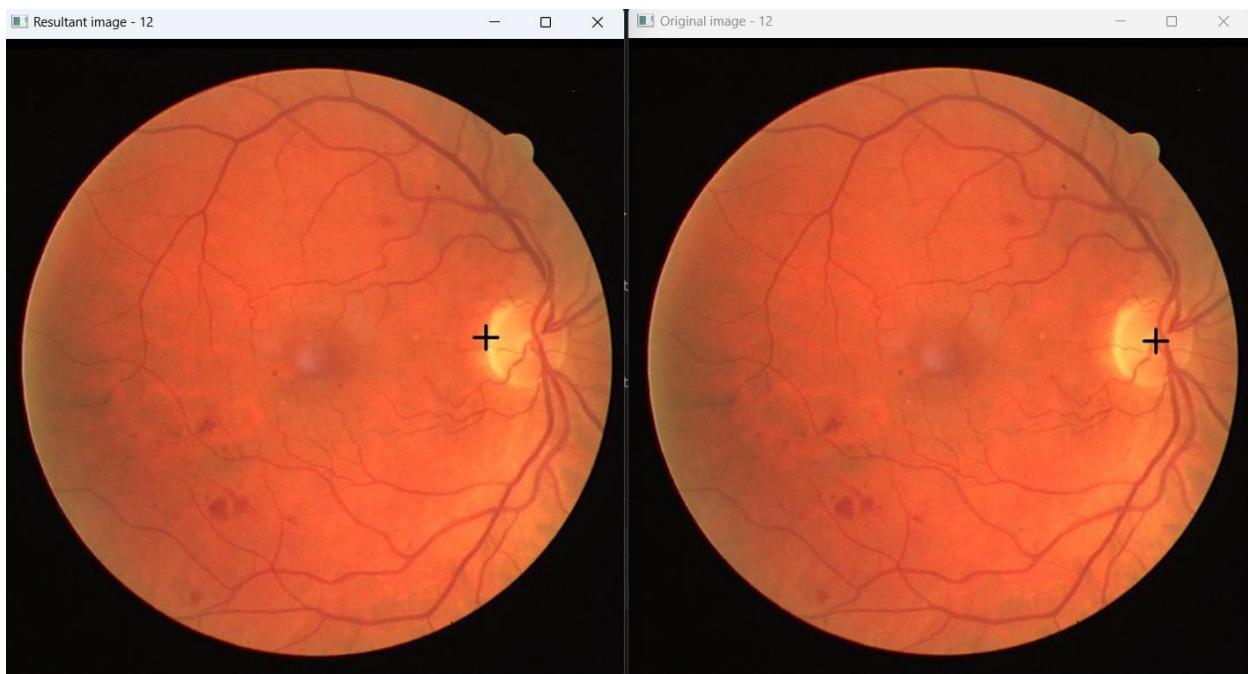
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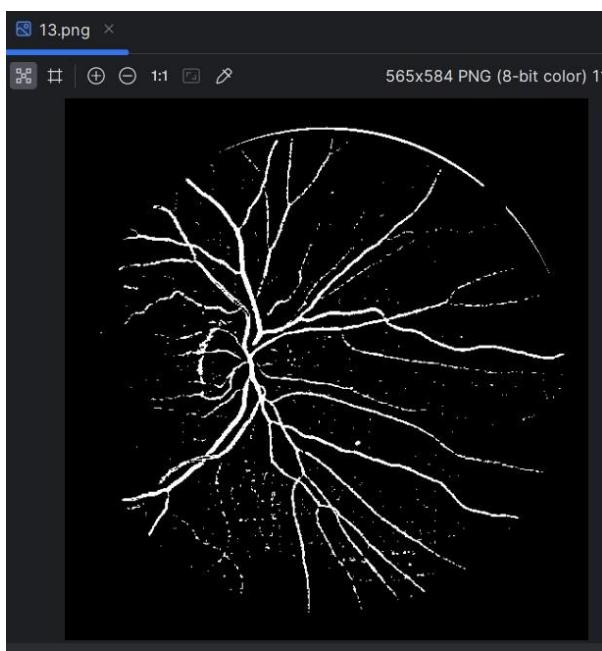


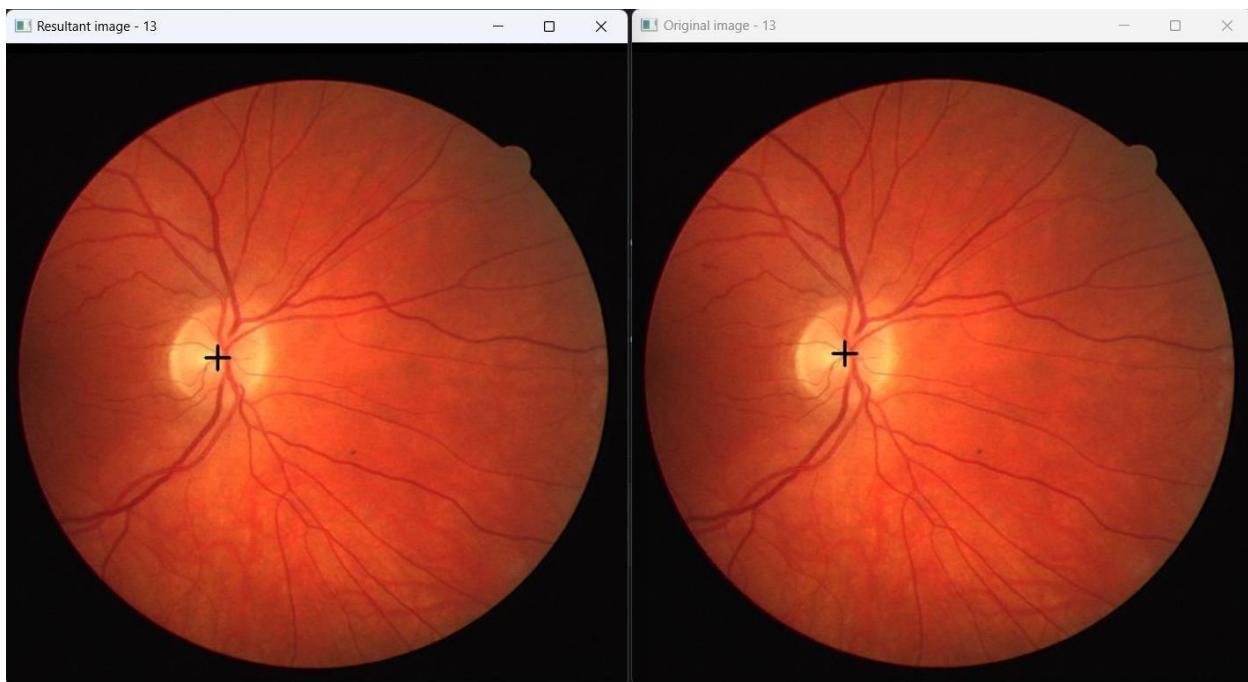
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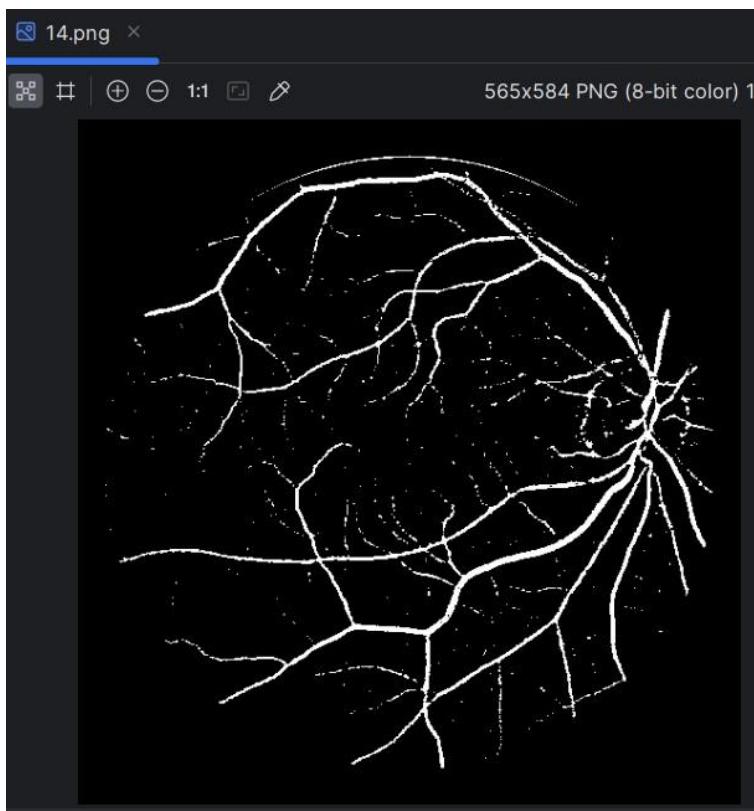


Difference Distance(image-12) - 40.19950248448356

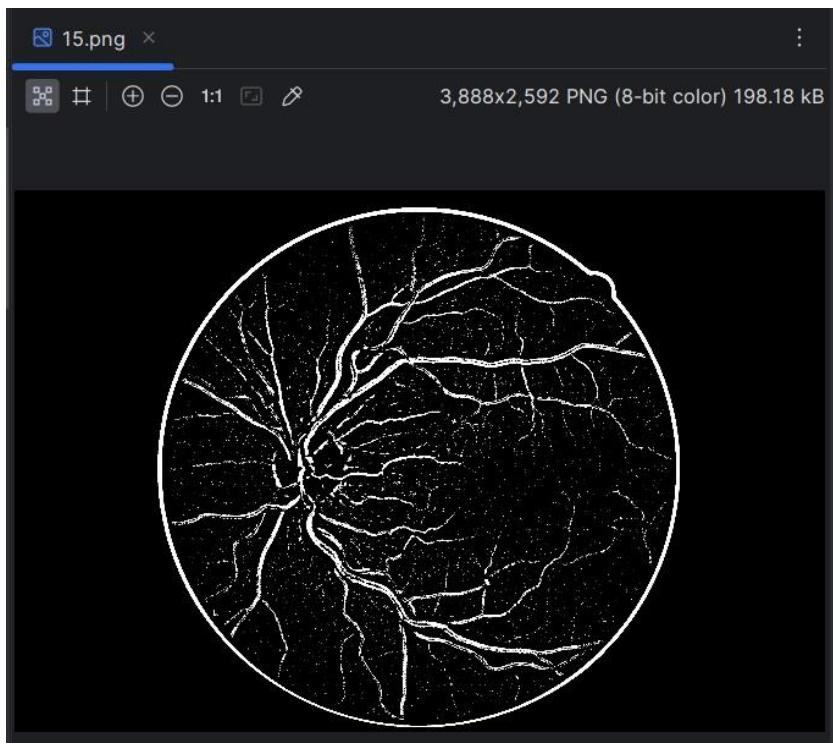




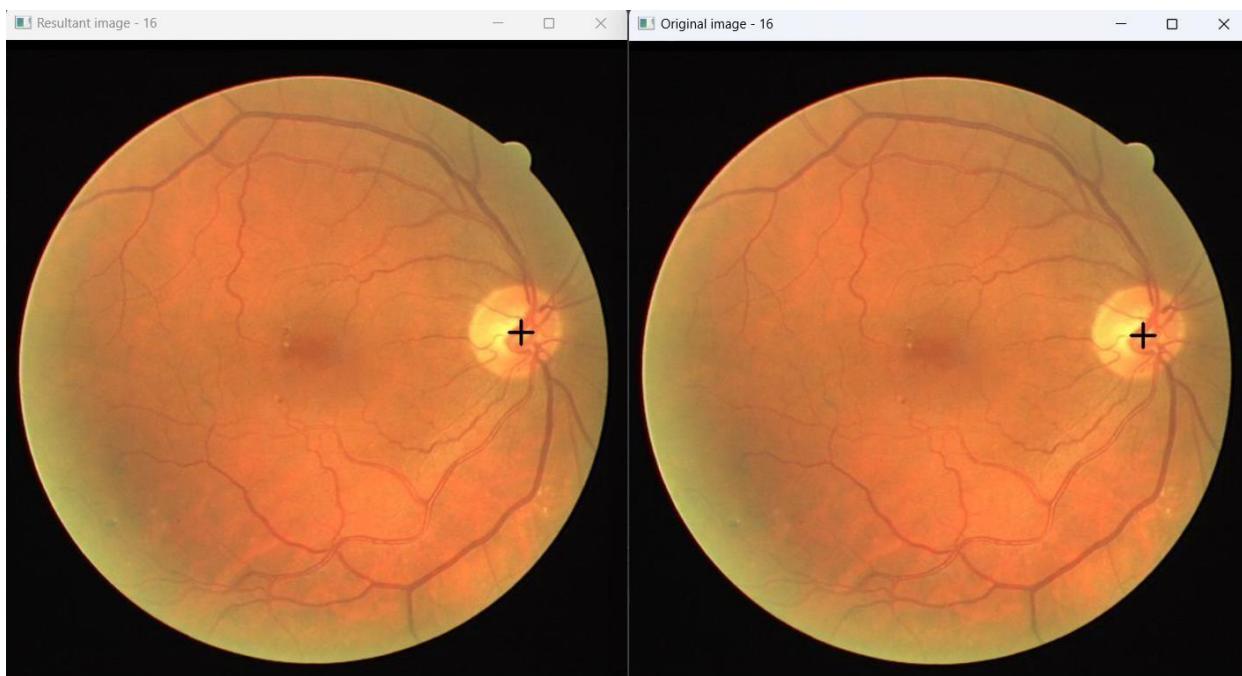
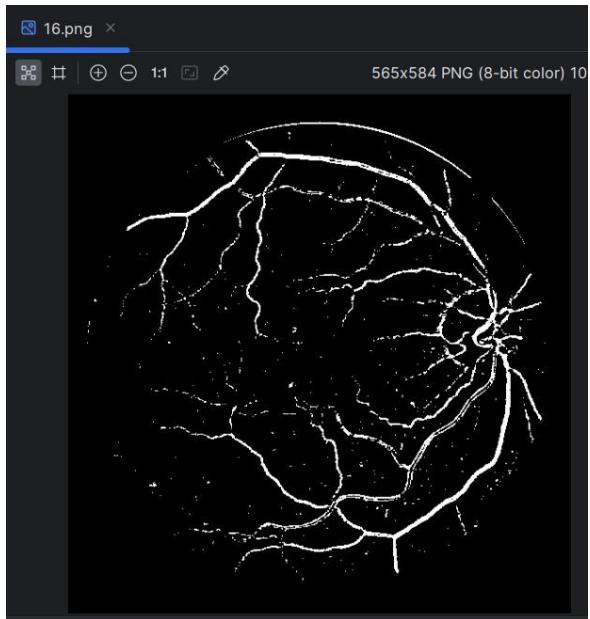
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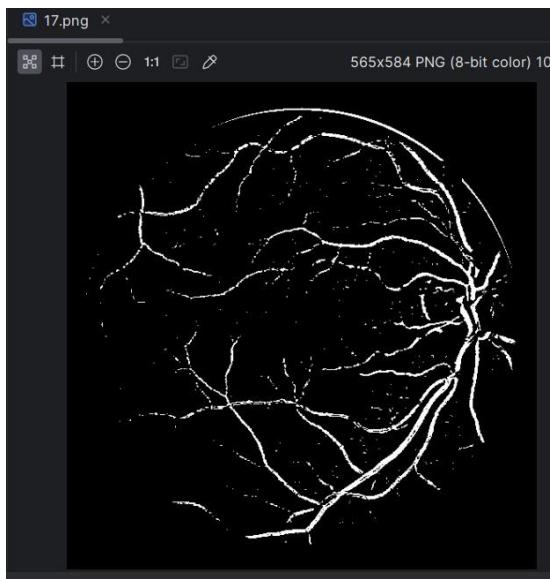
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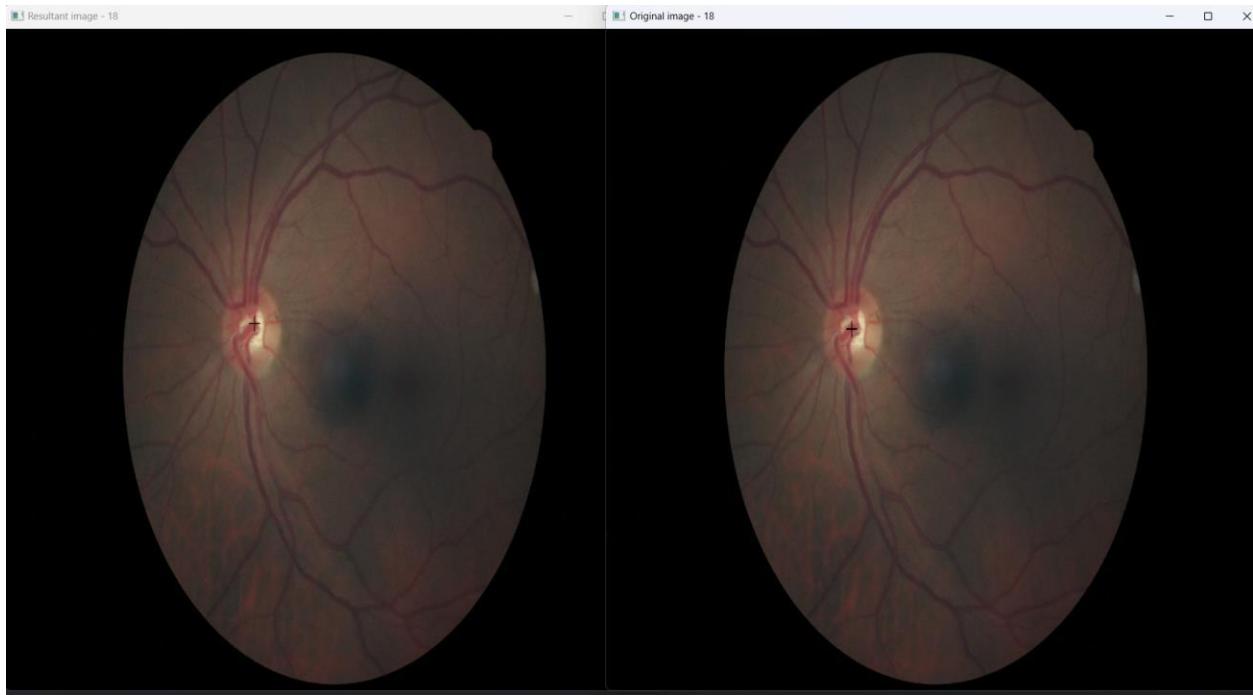
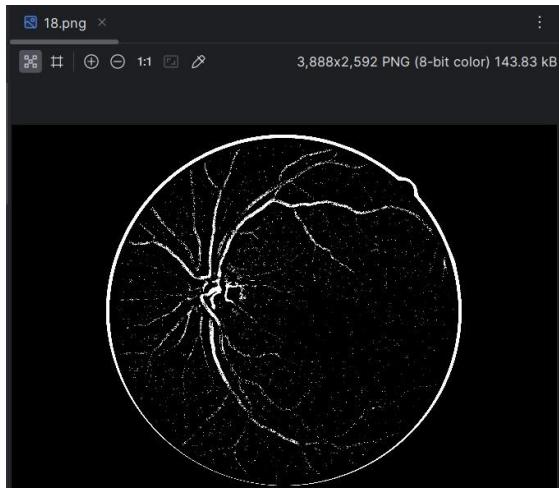
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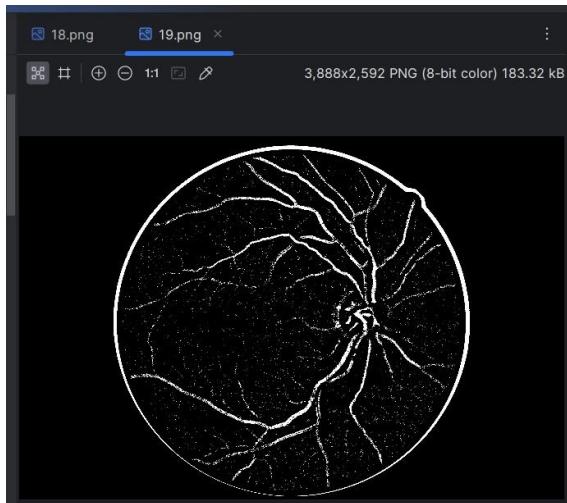
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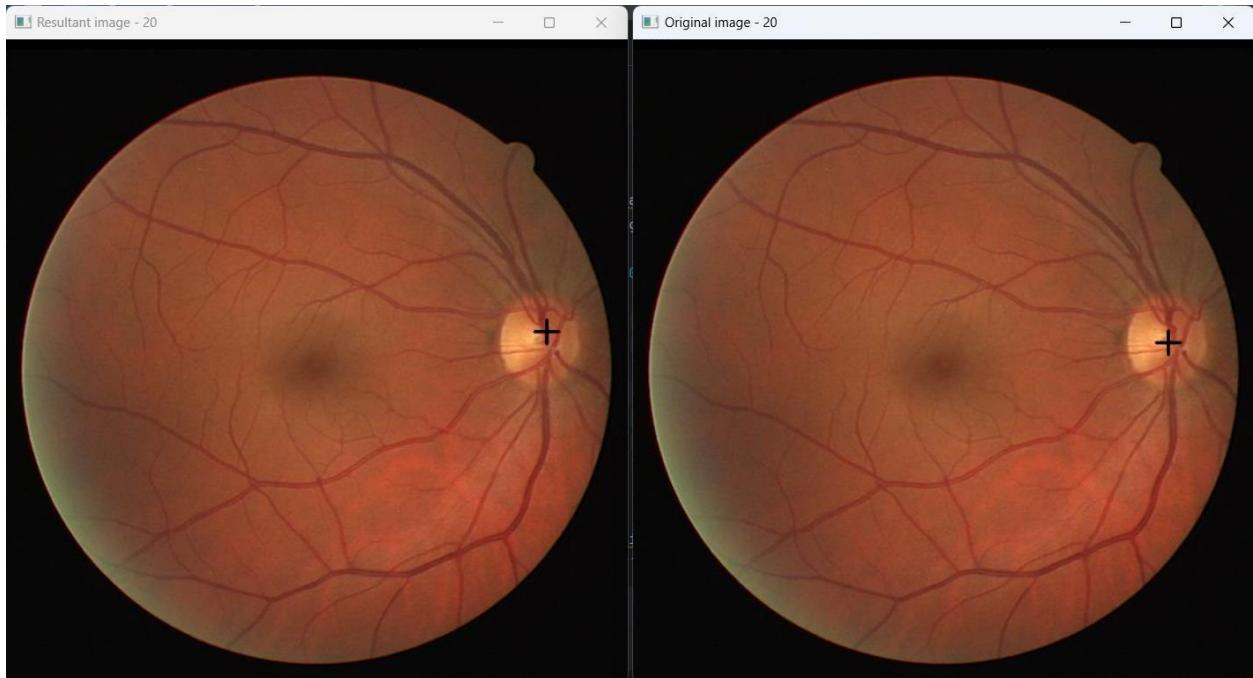
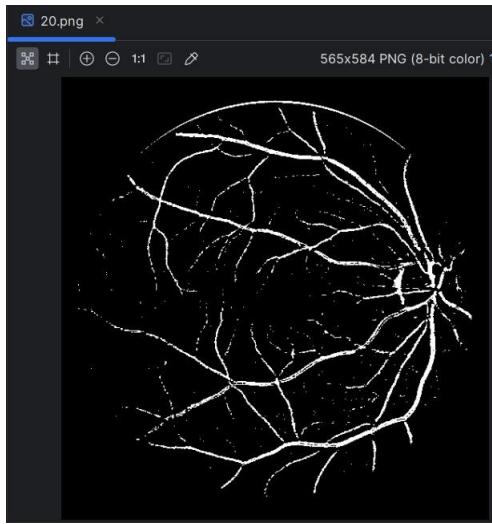
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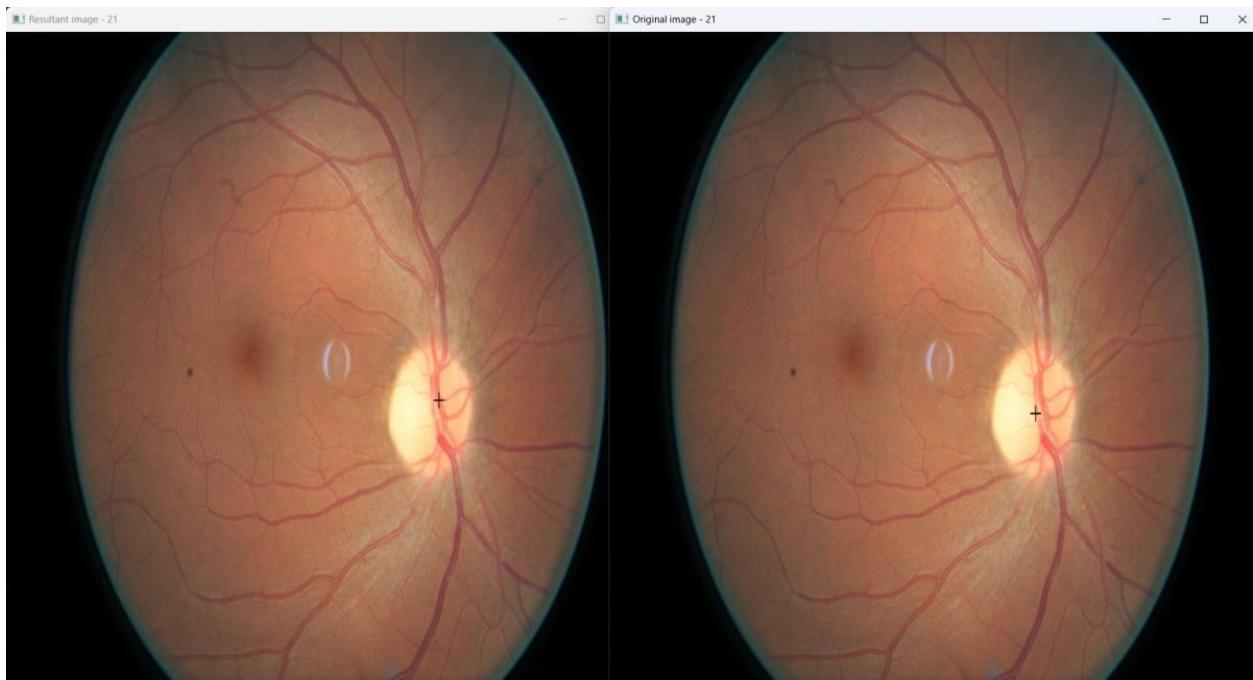
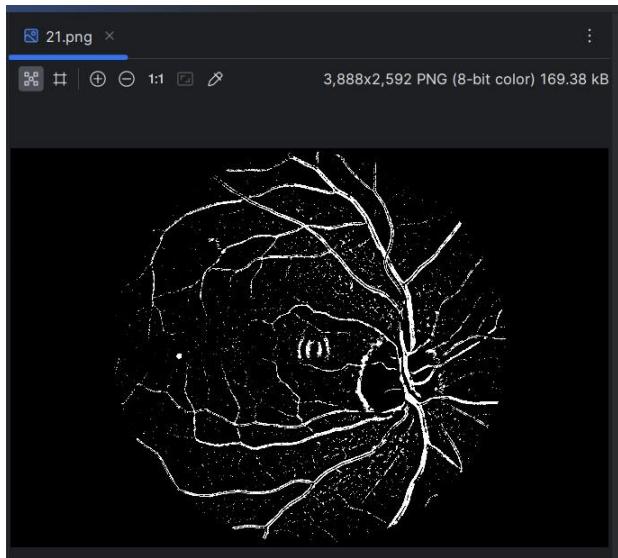
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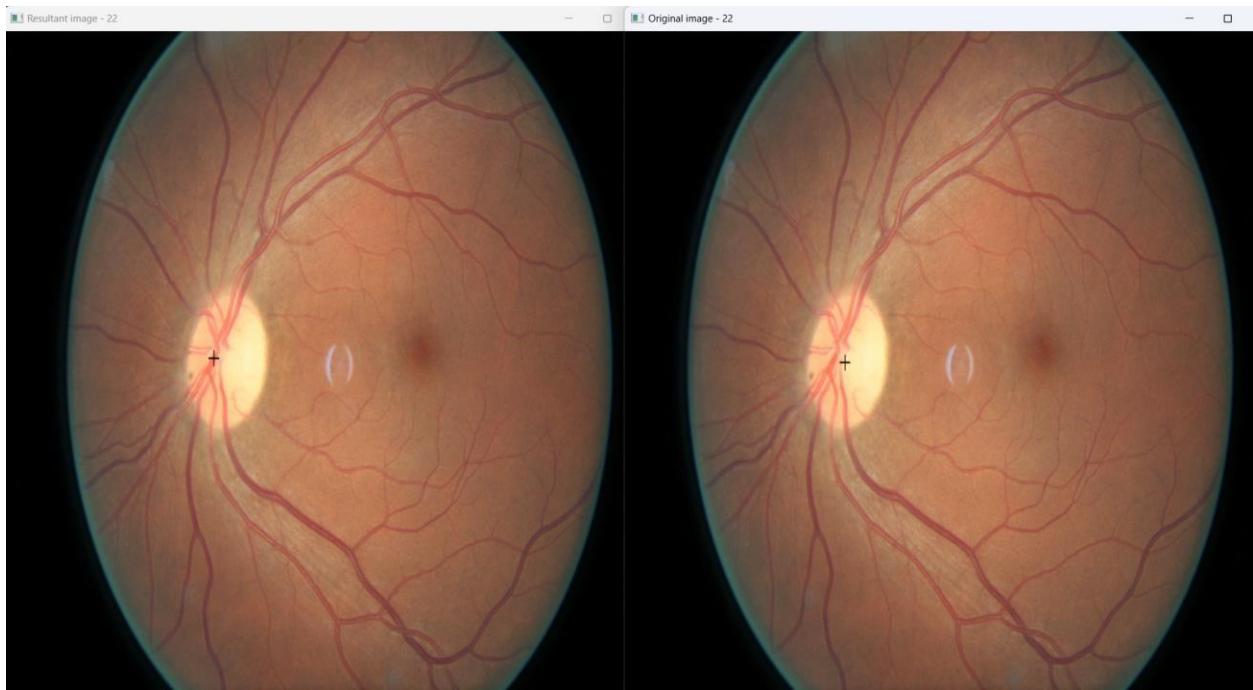
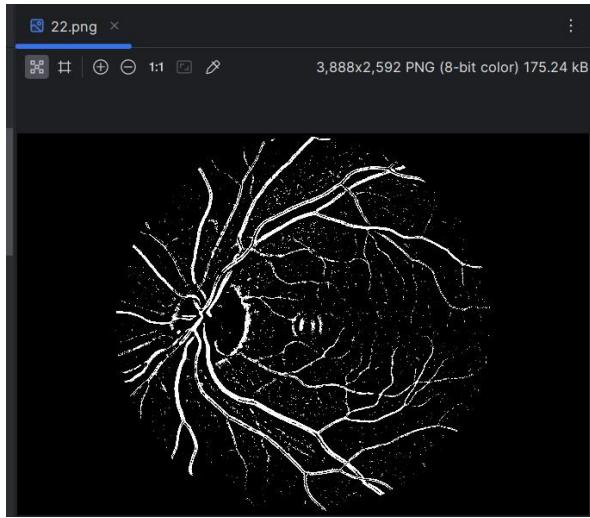
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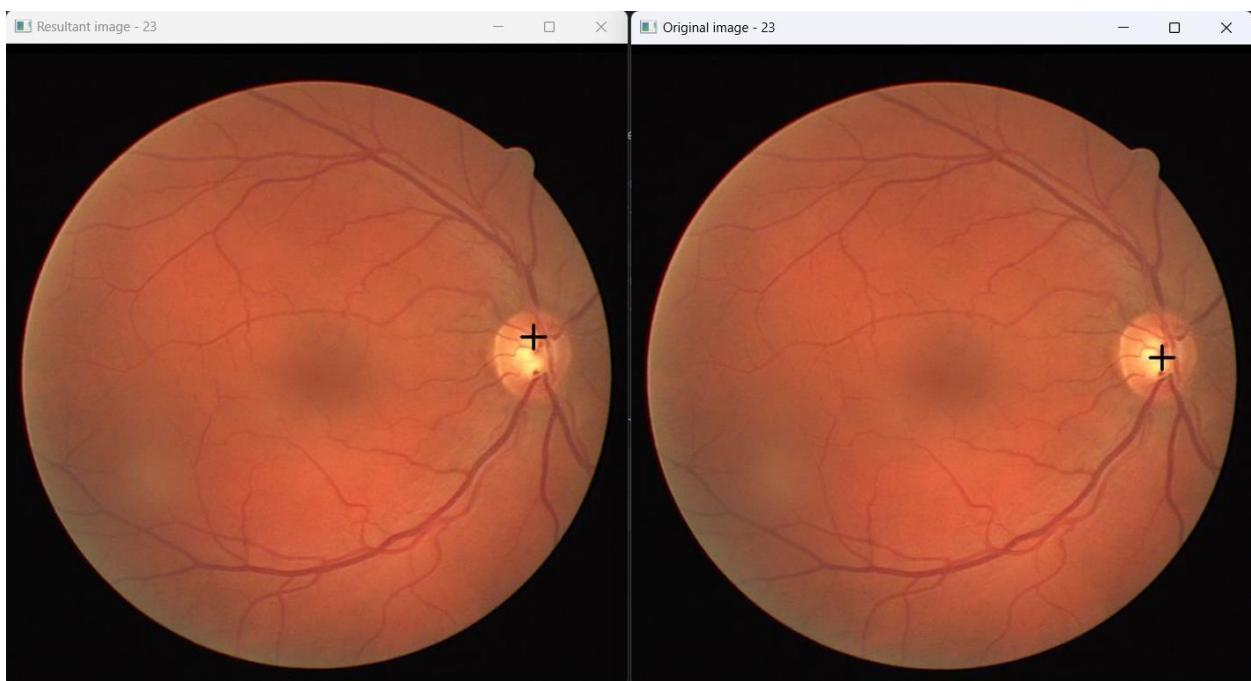
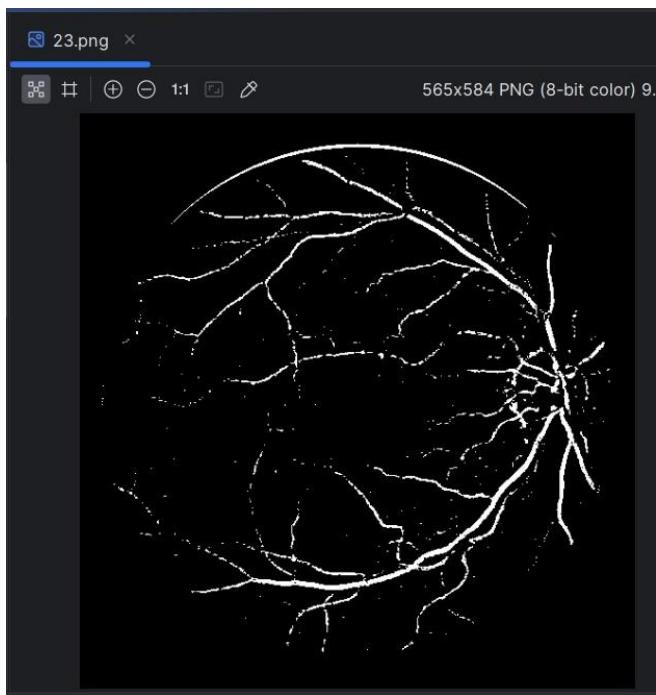
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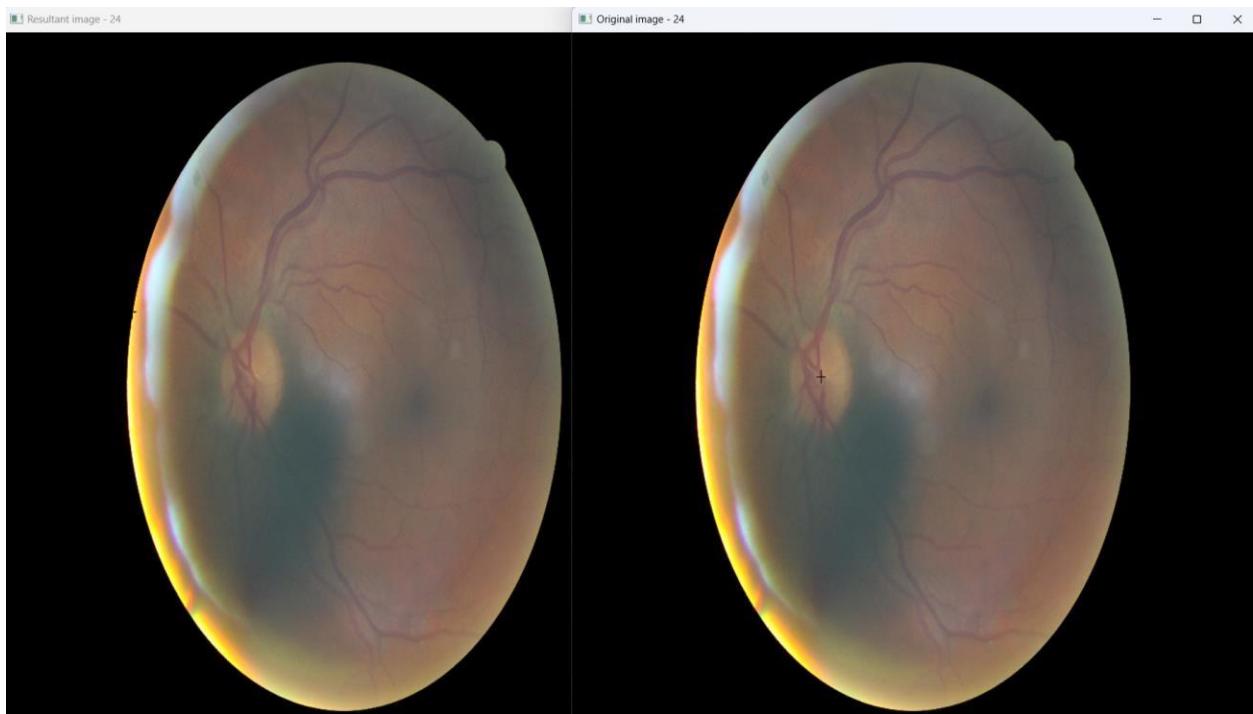
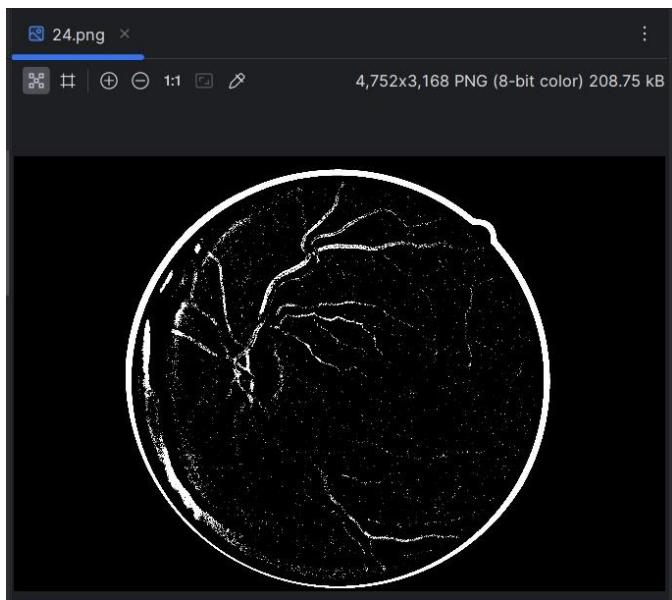
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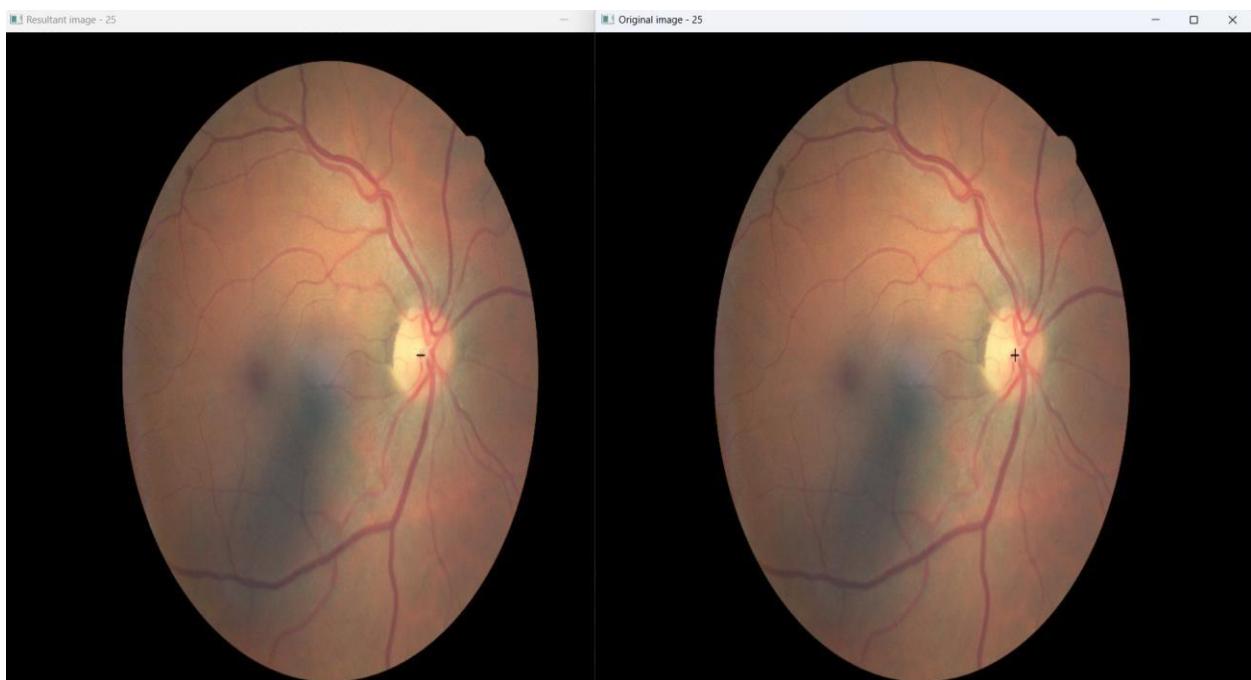
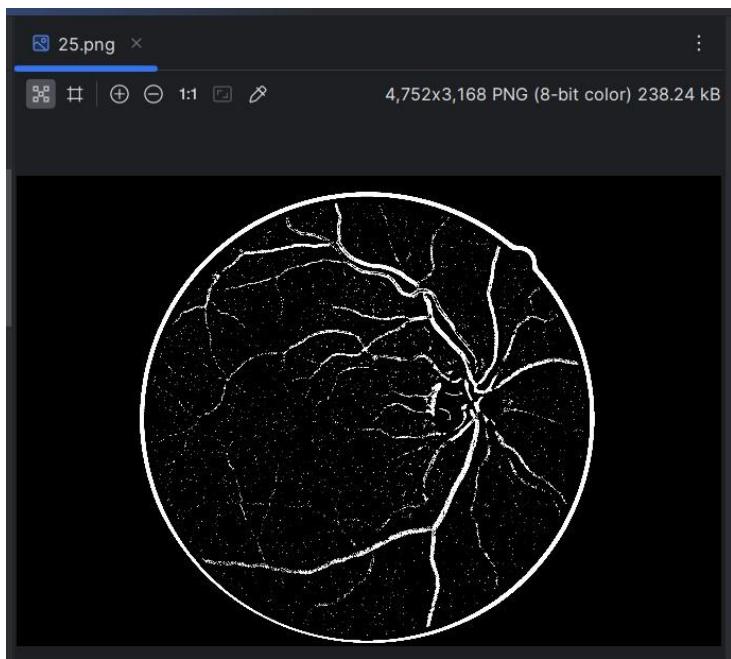
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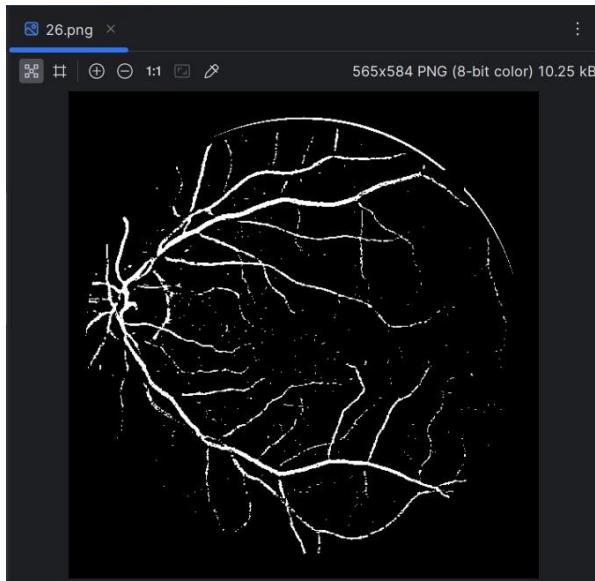
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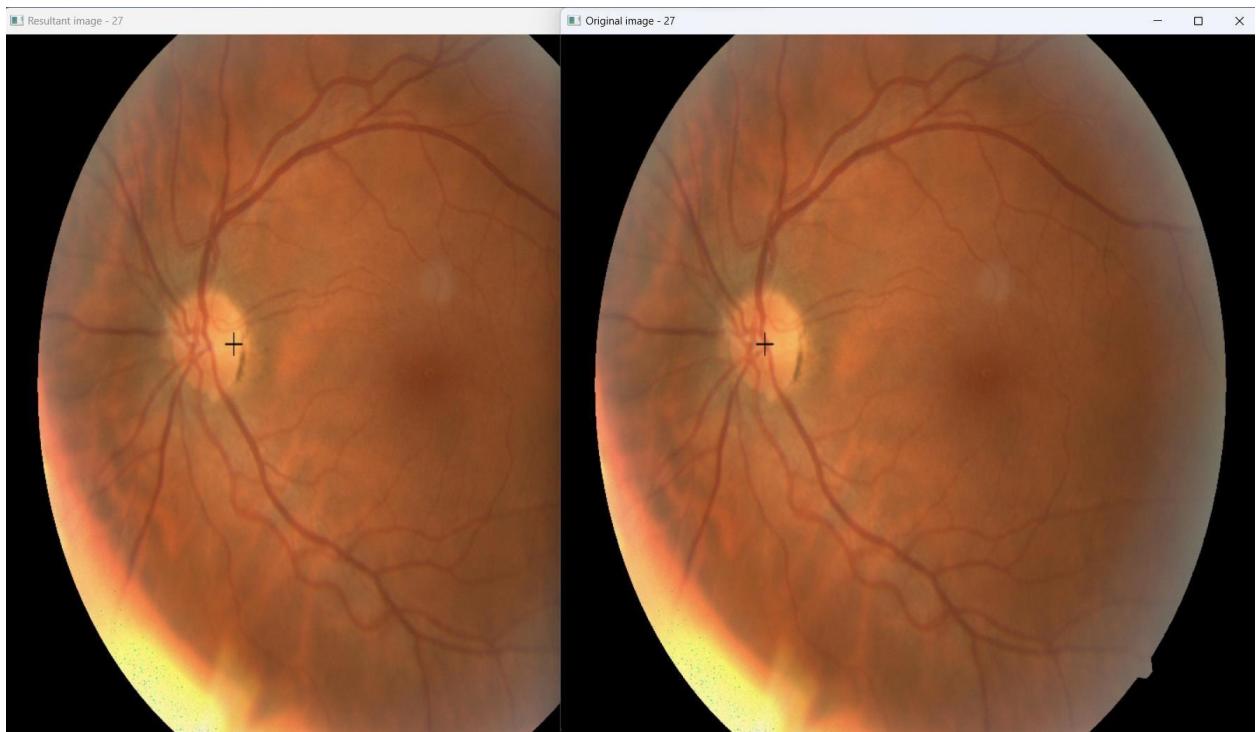
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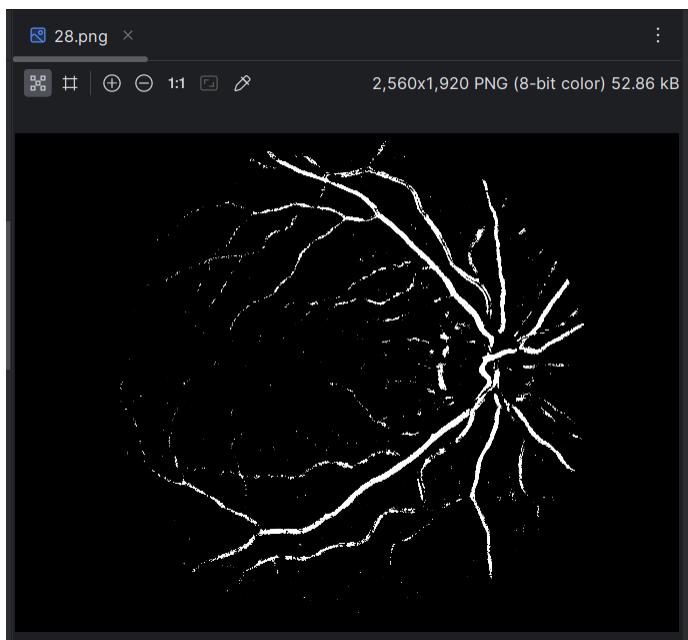
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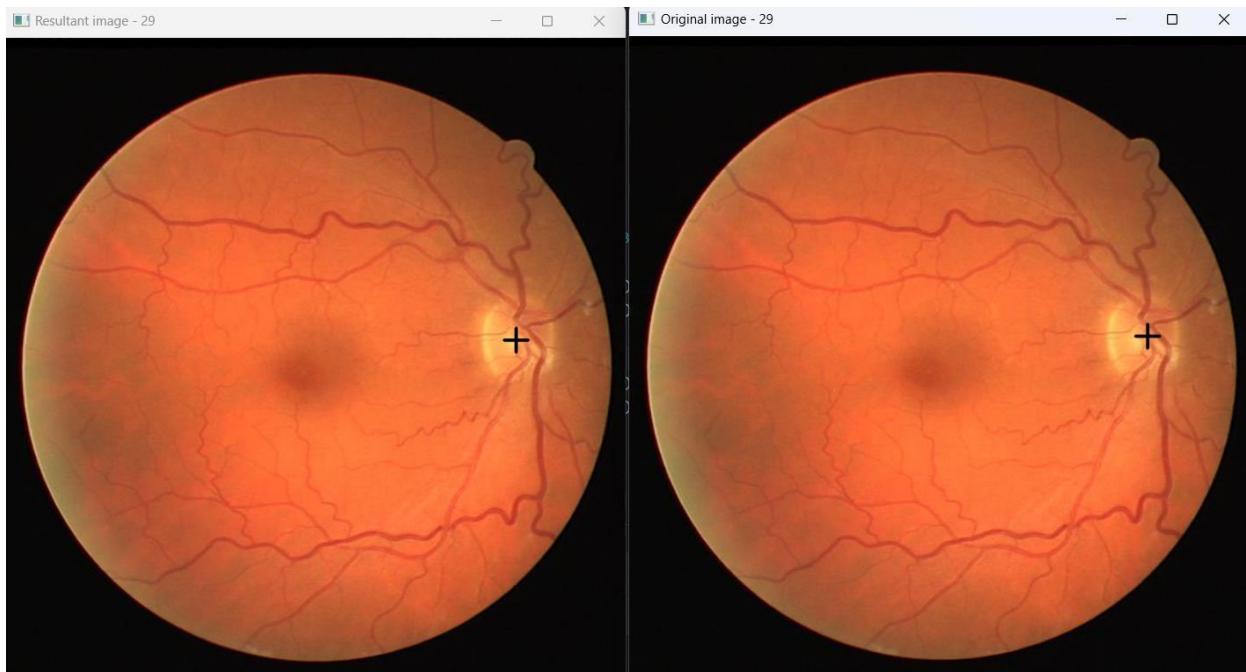
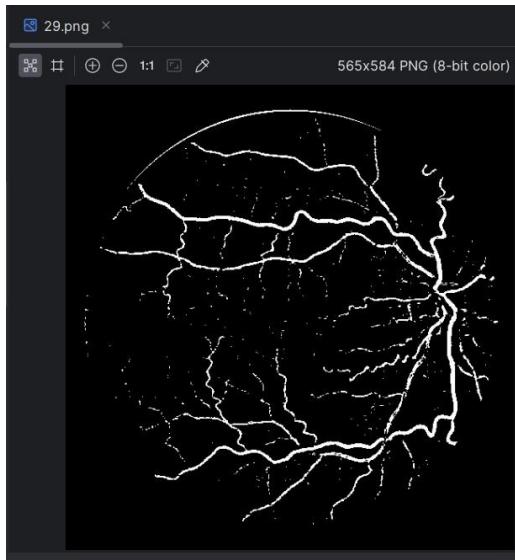
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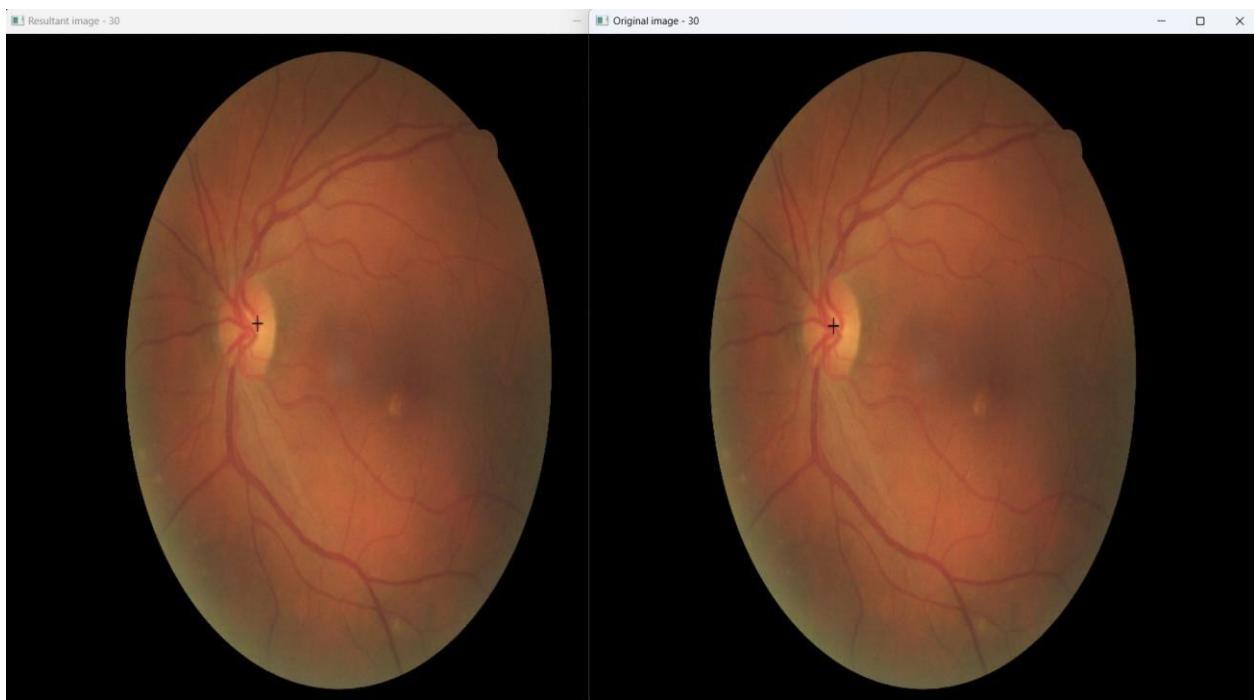
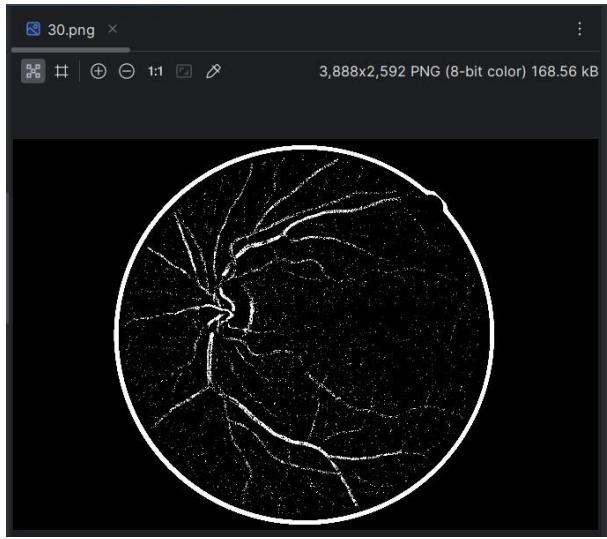
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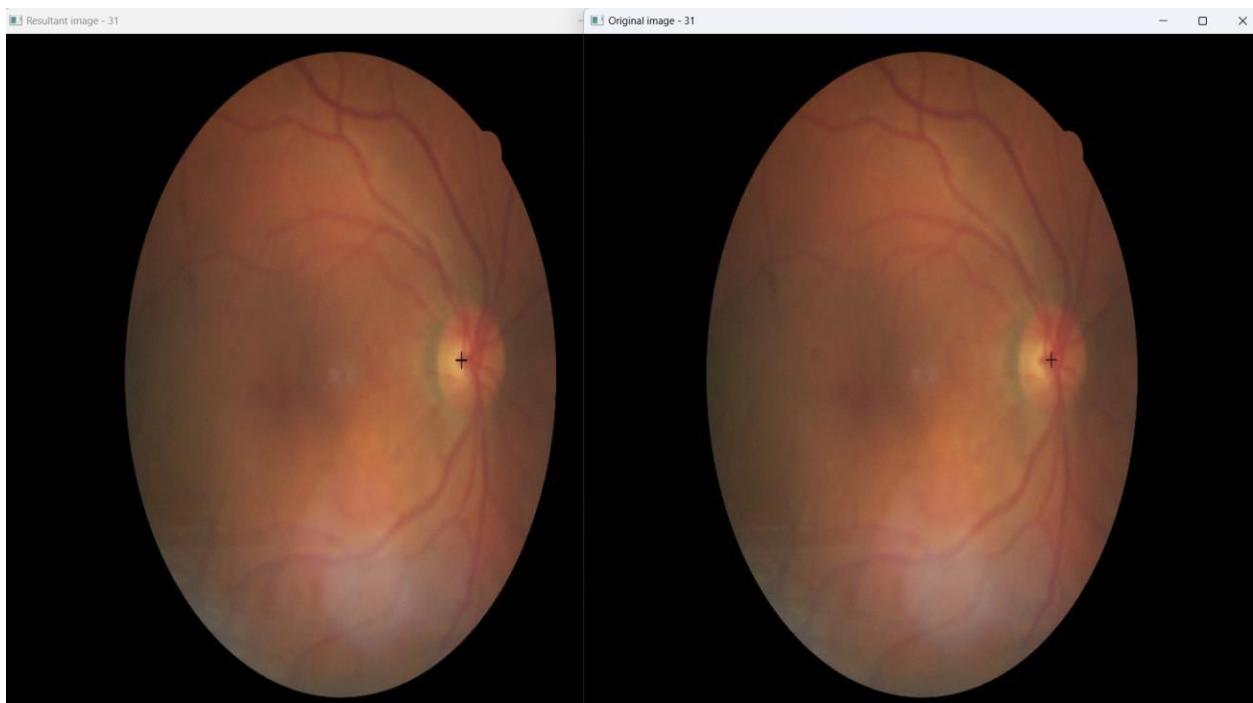
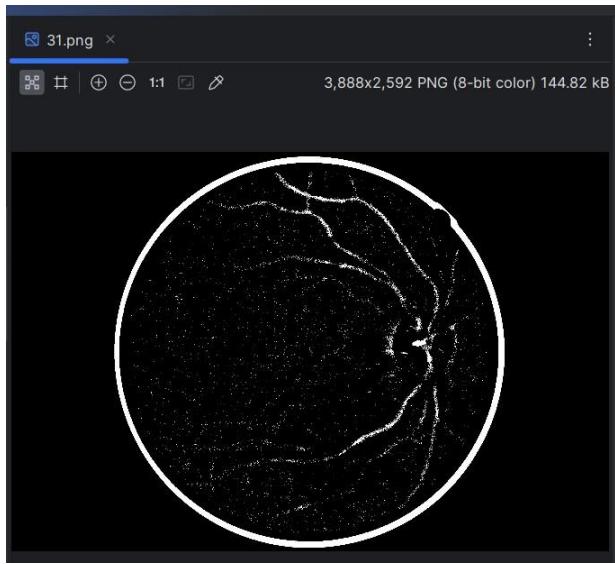
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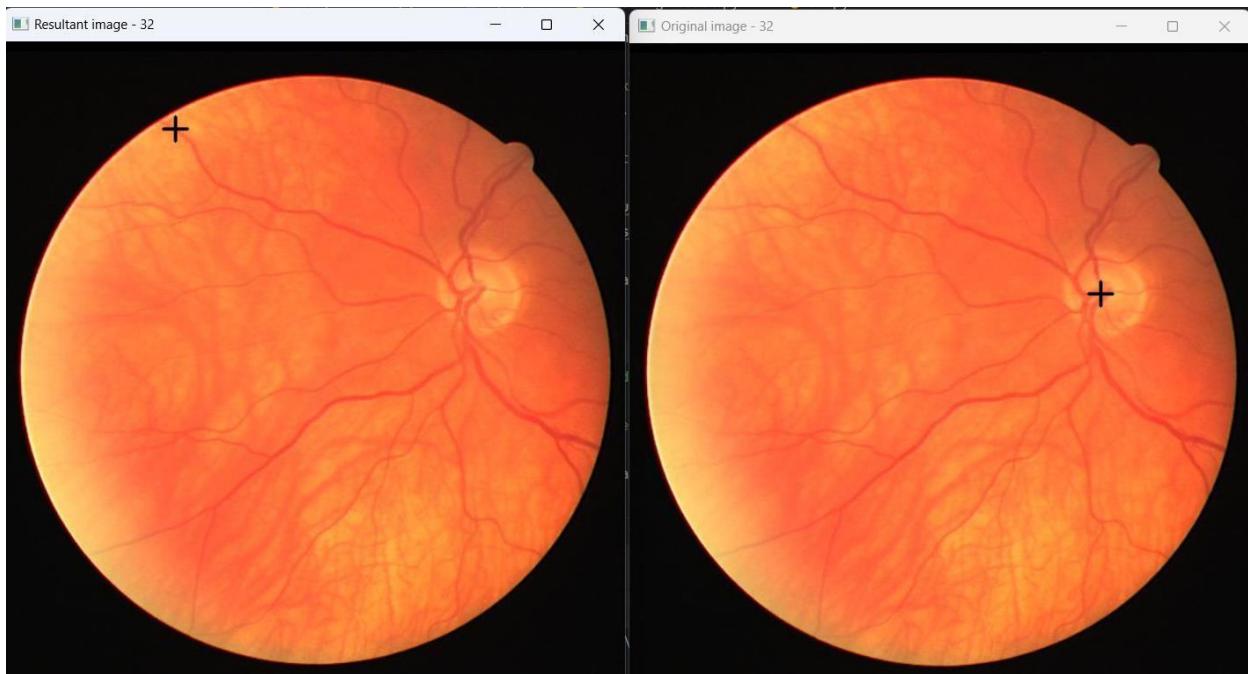
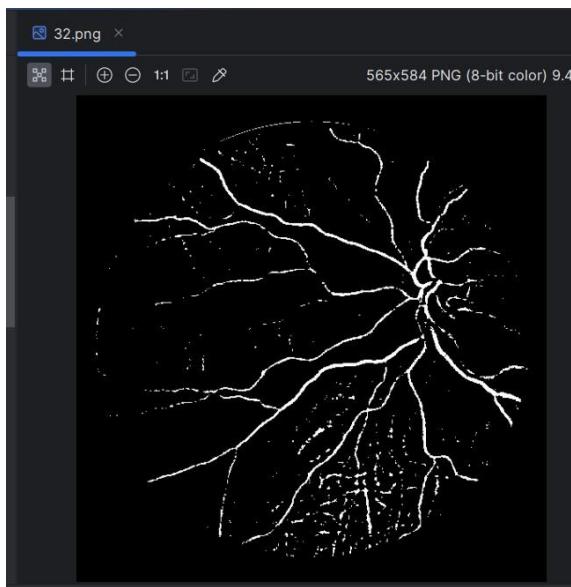
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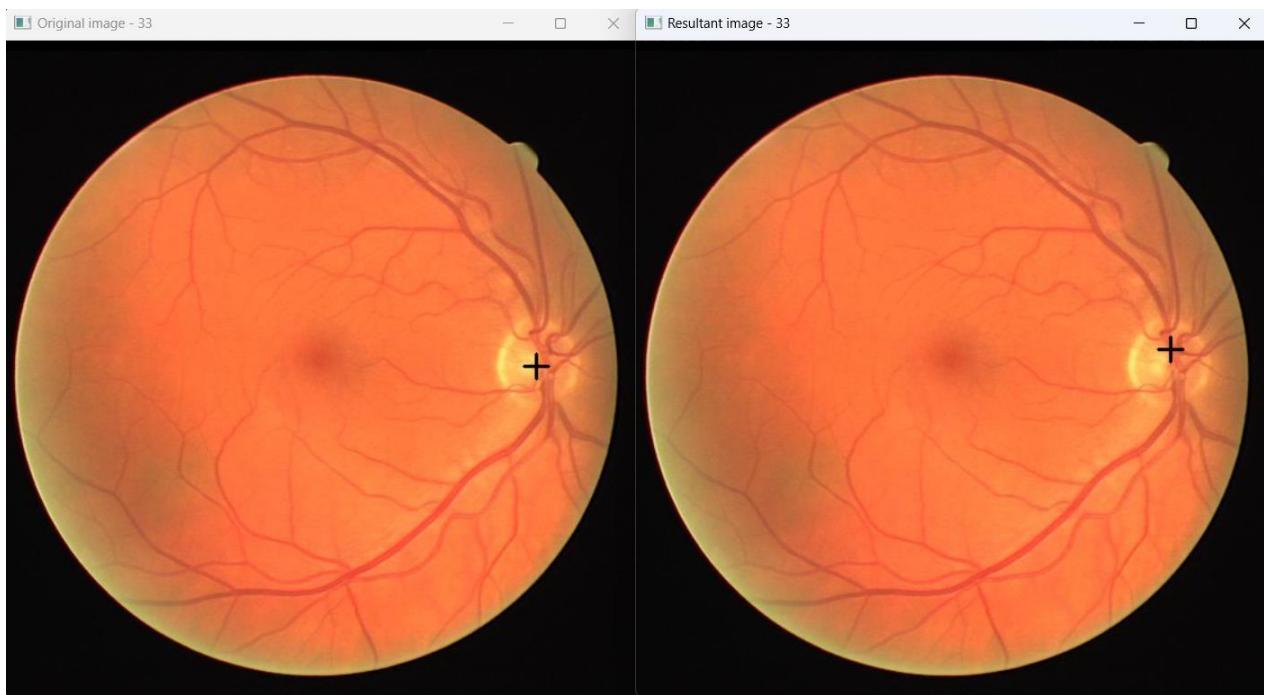
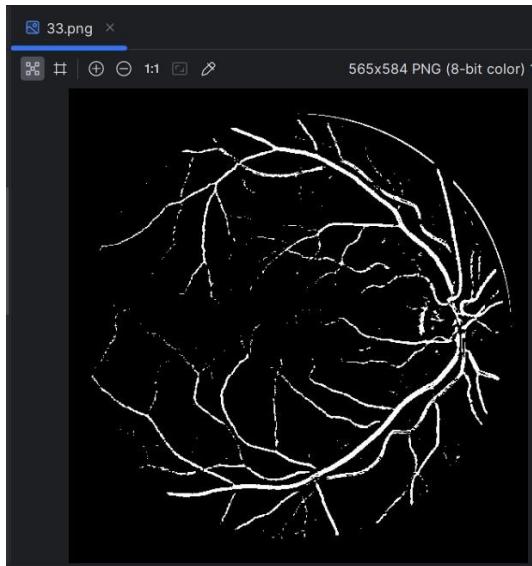
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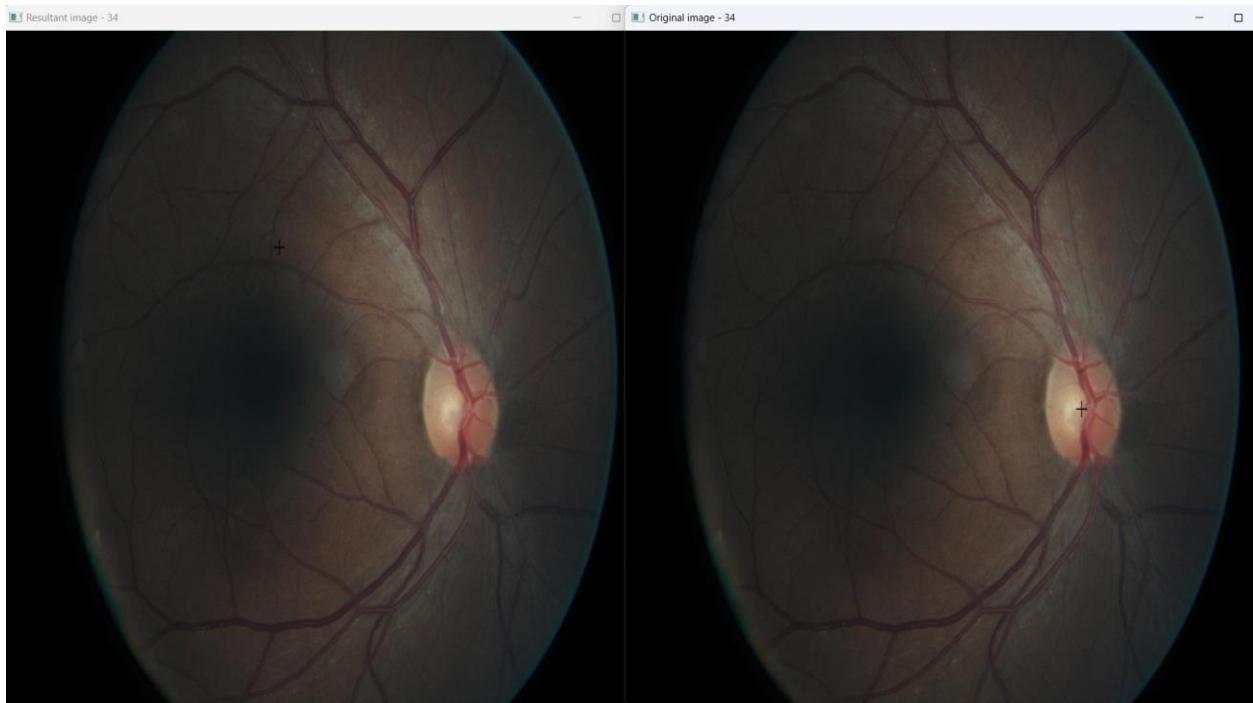
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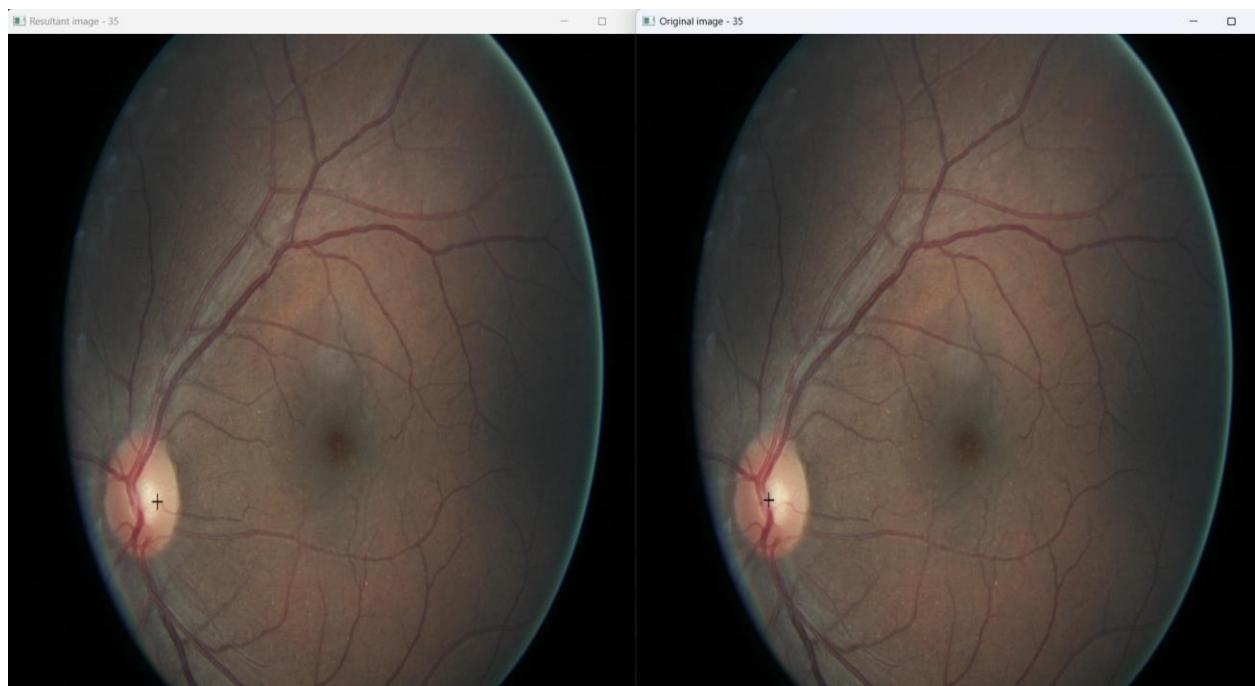
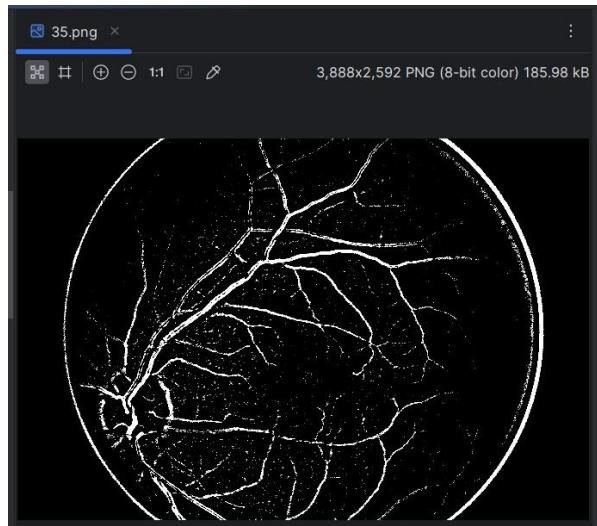
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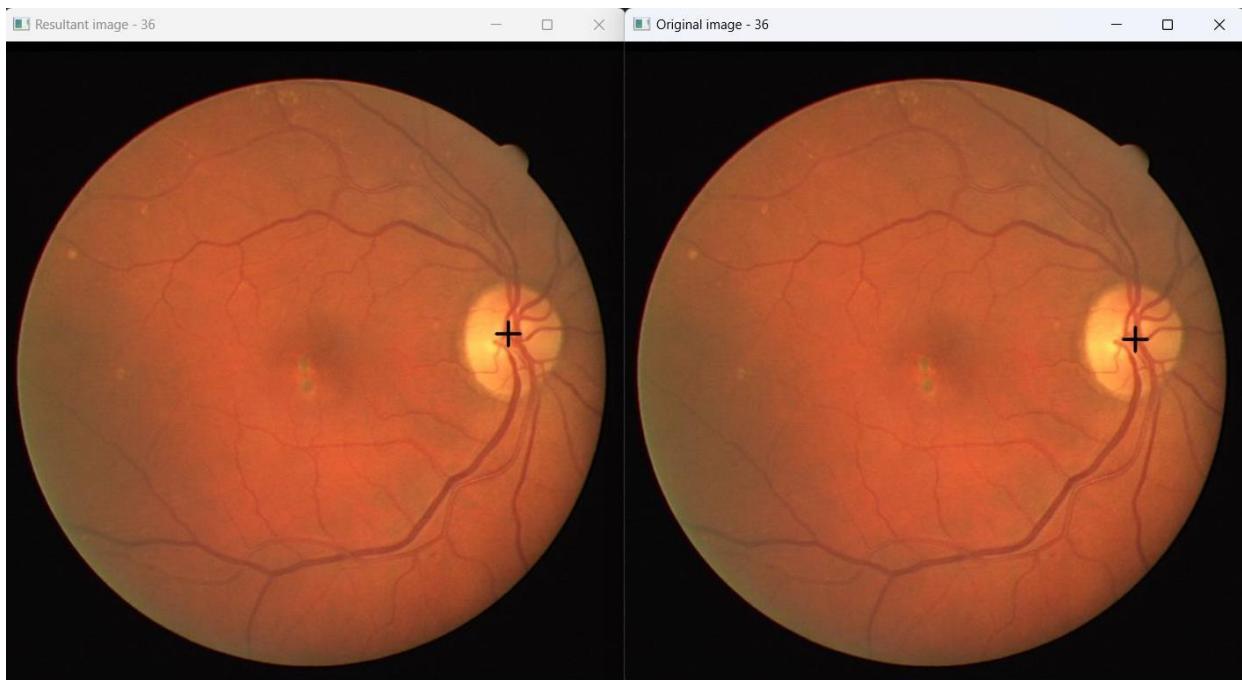
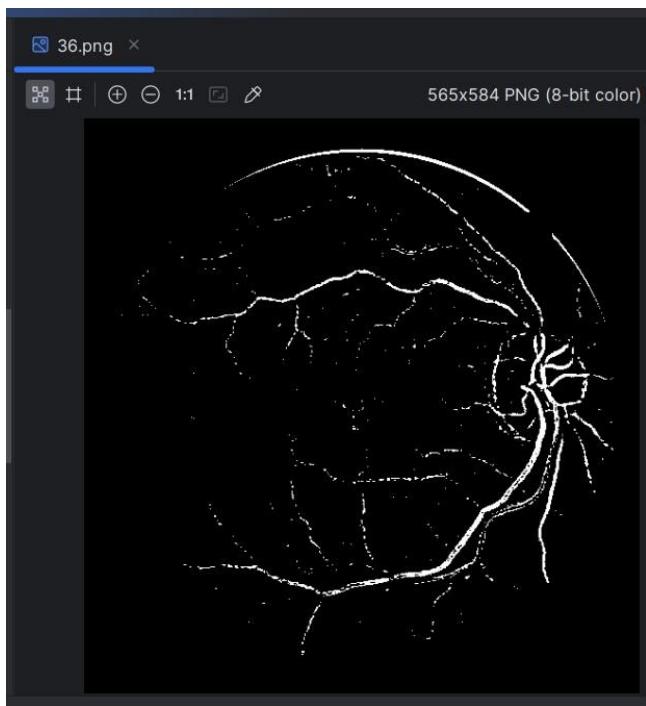
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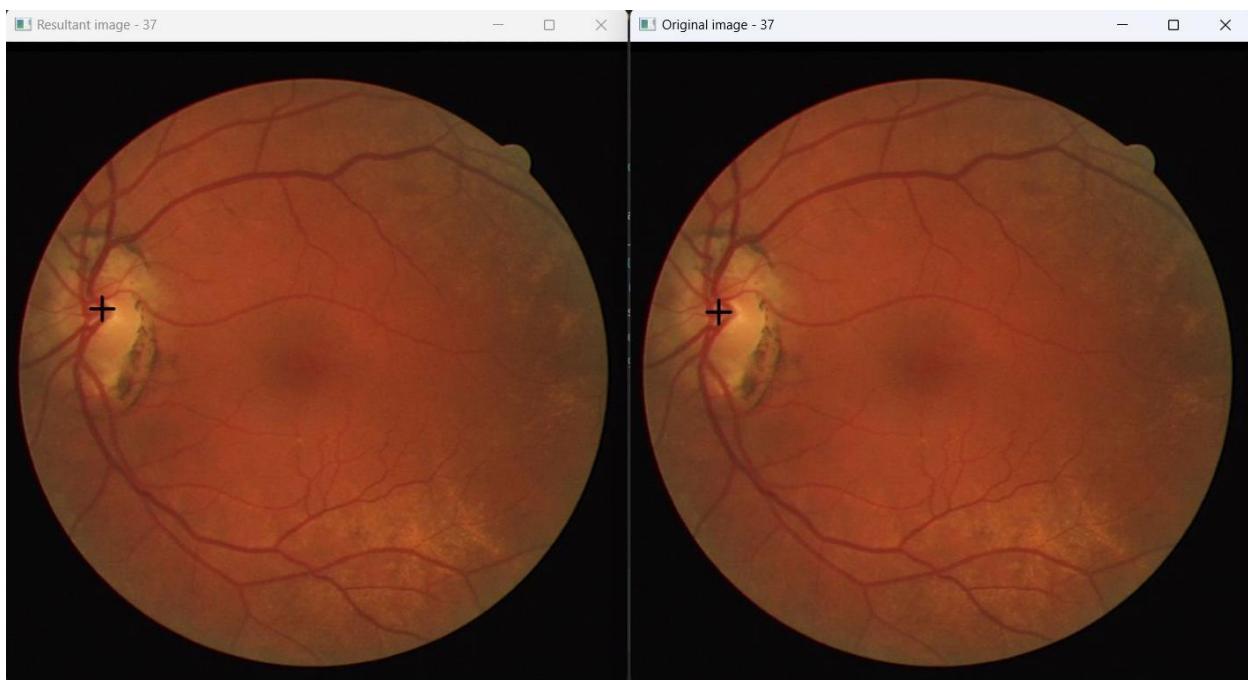
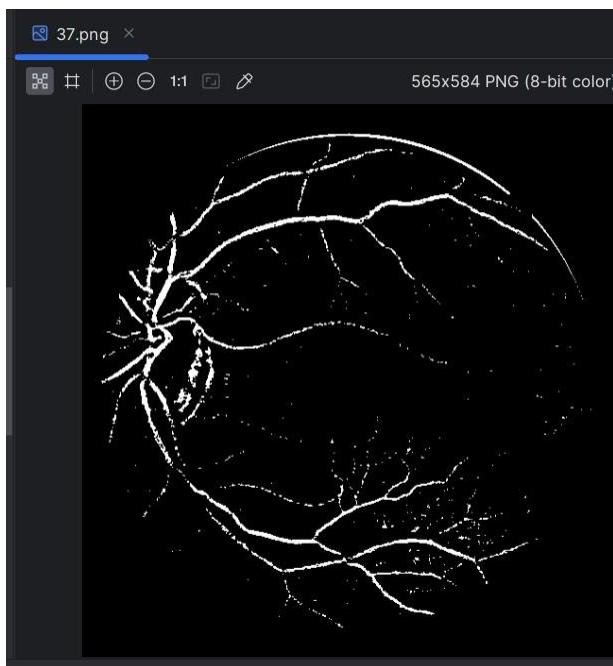
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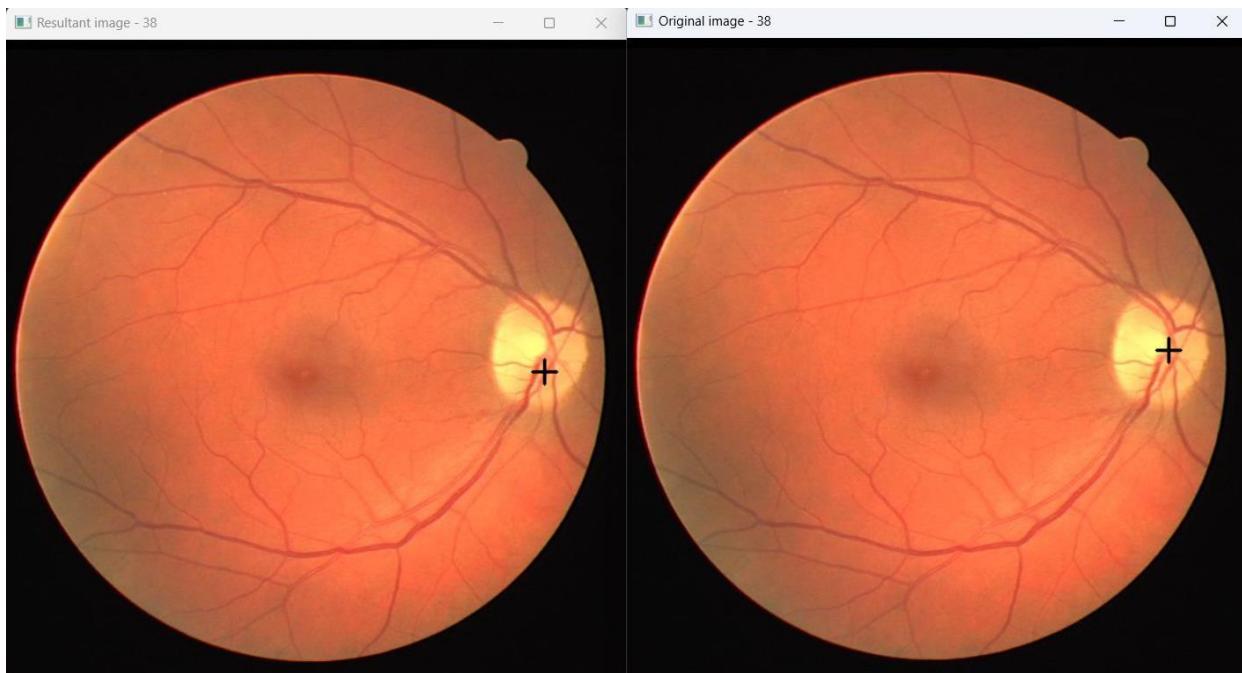
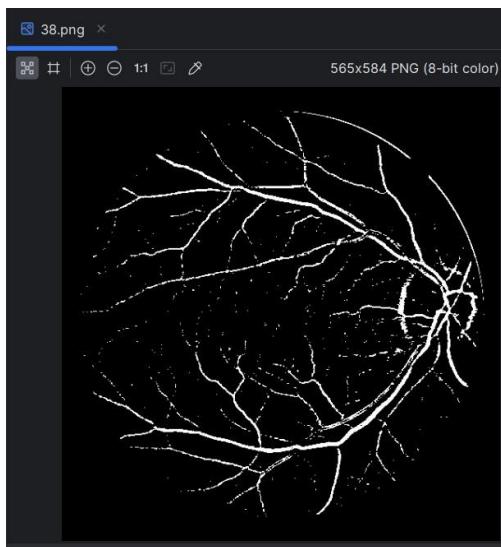
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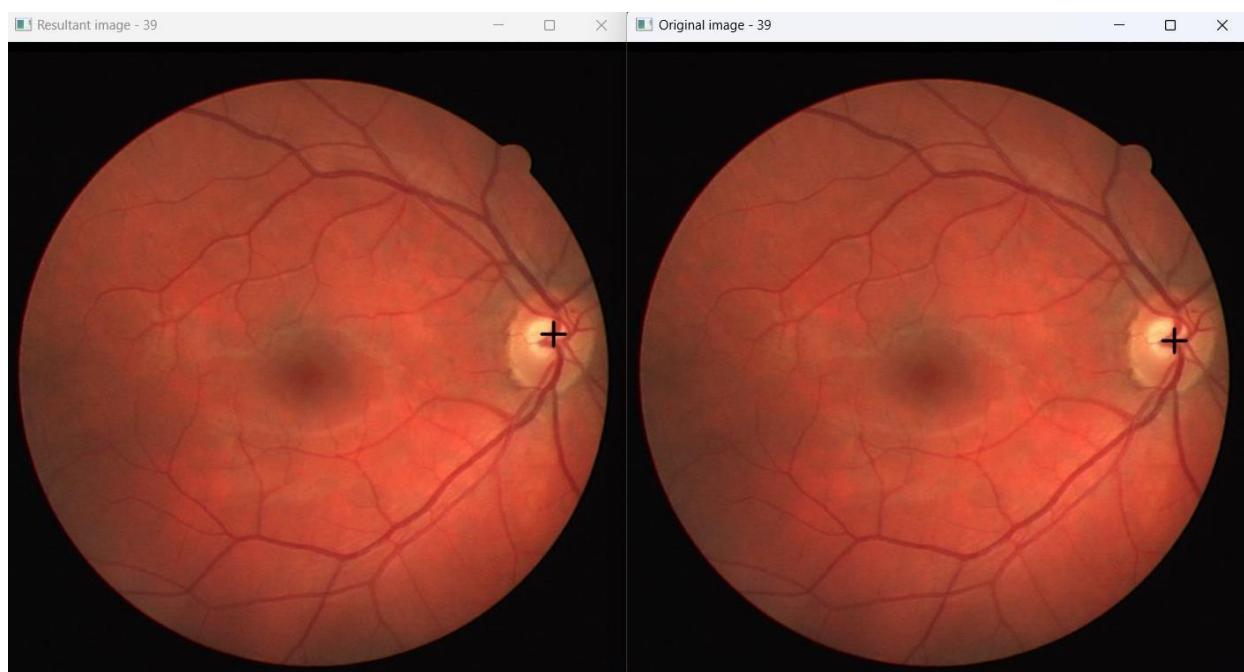
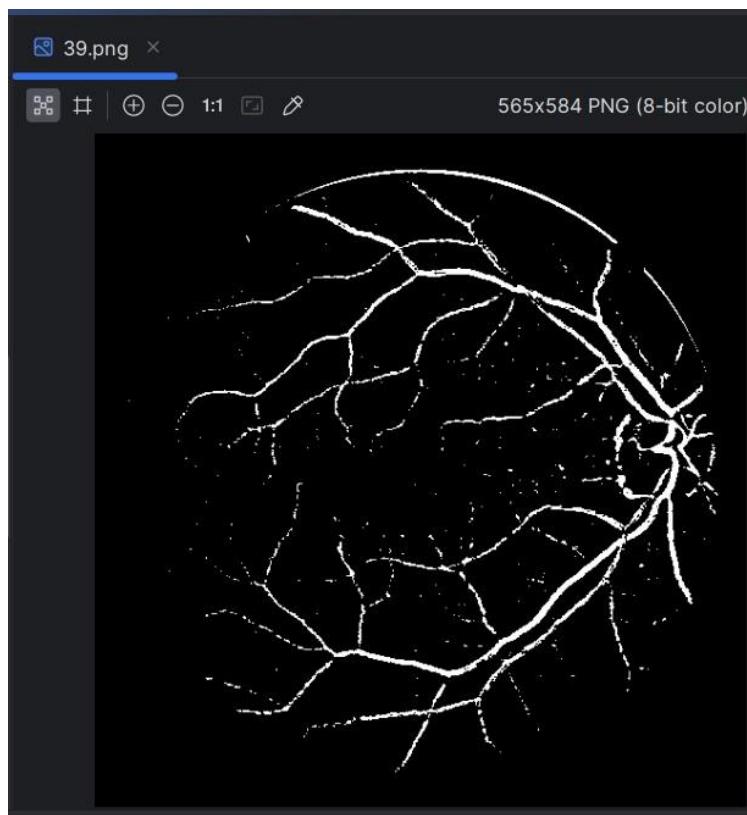
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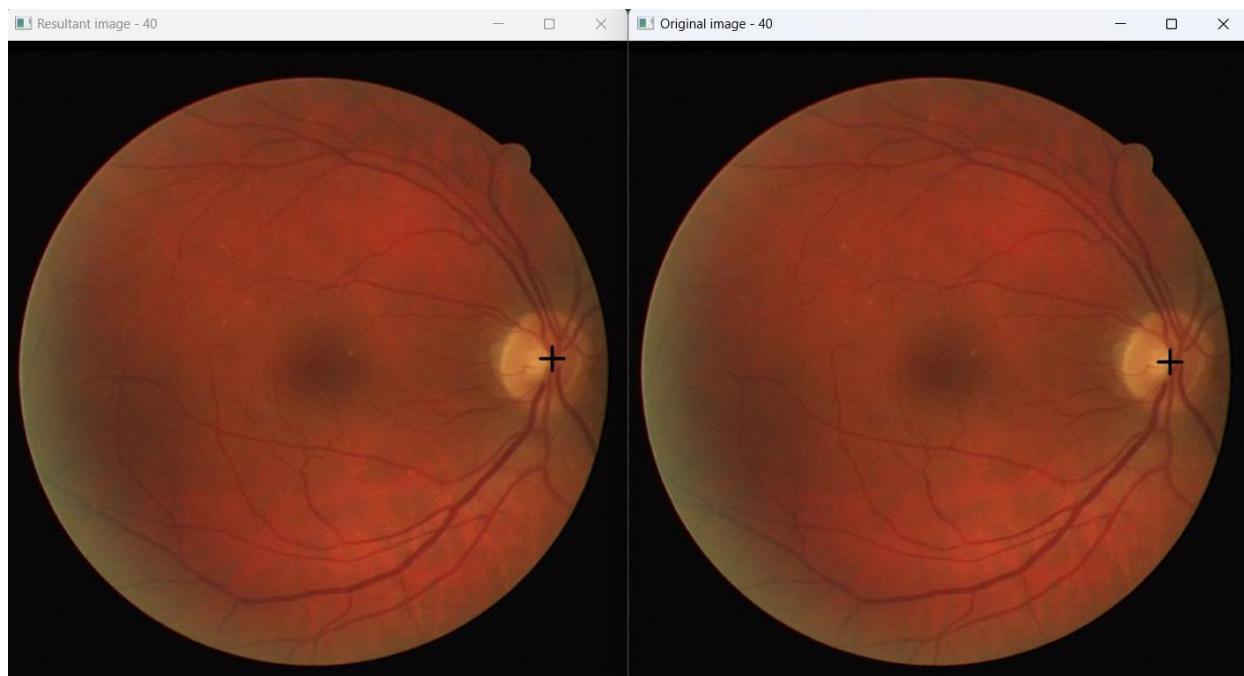
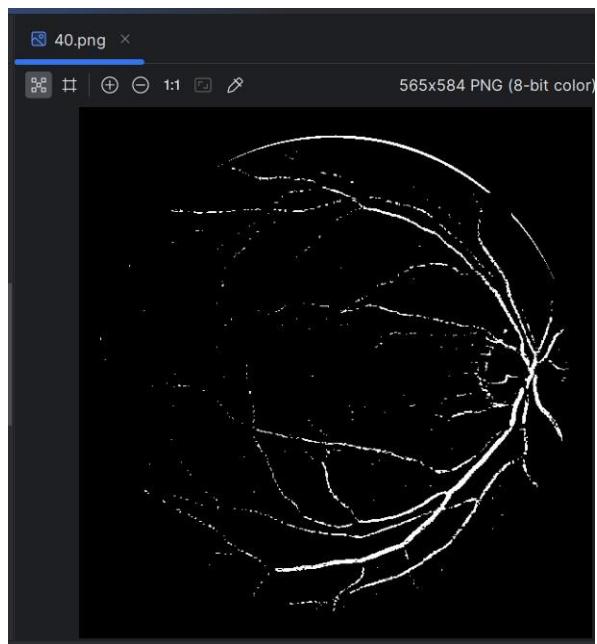
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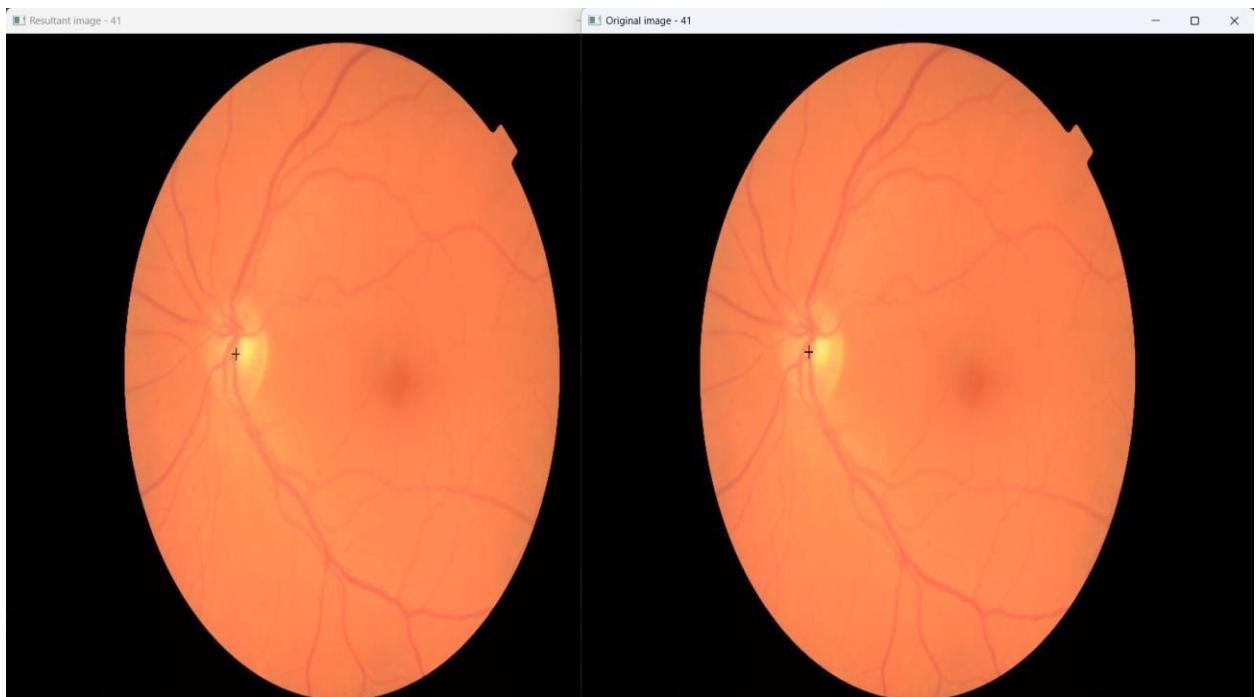
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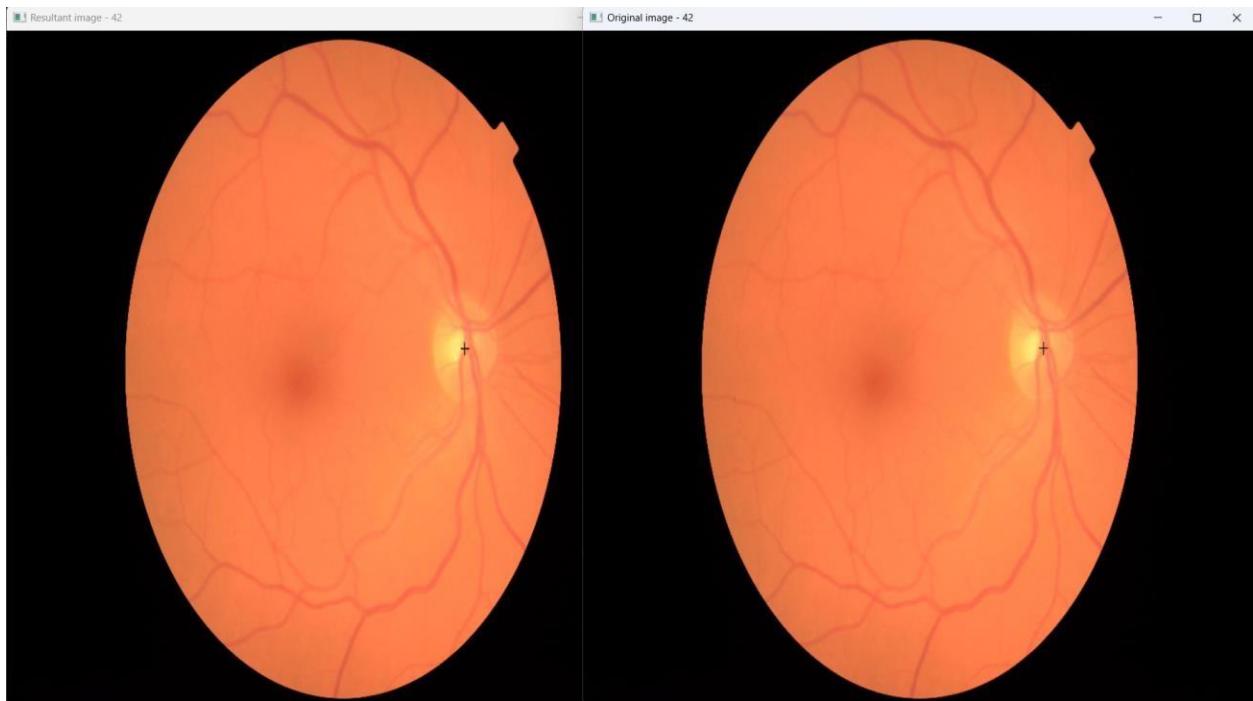
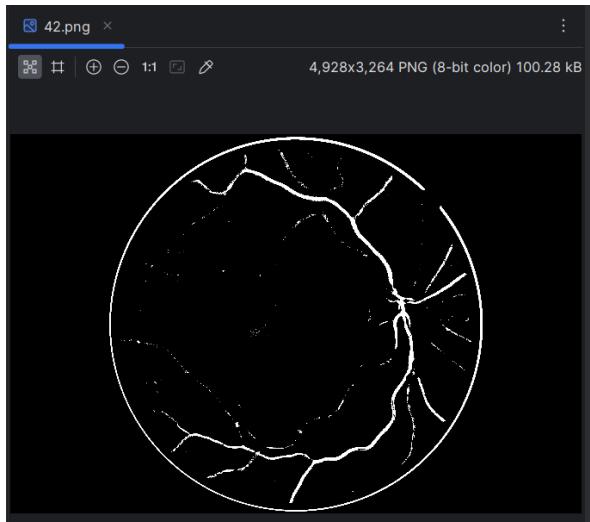
Difference Distance(image-39) - 6.0



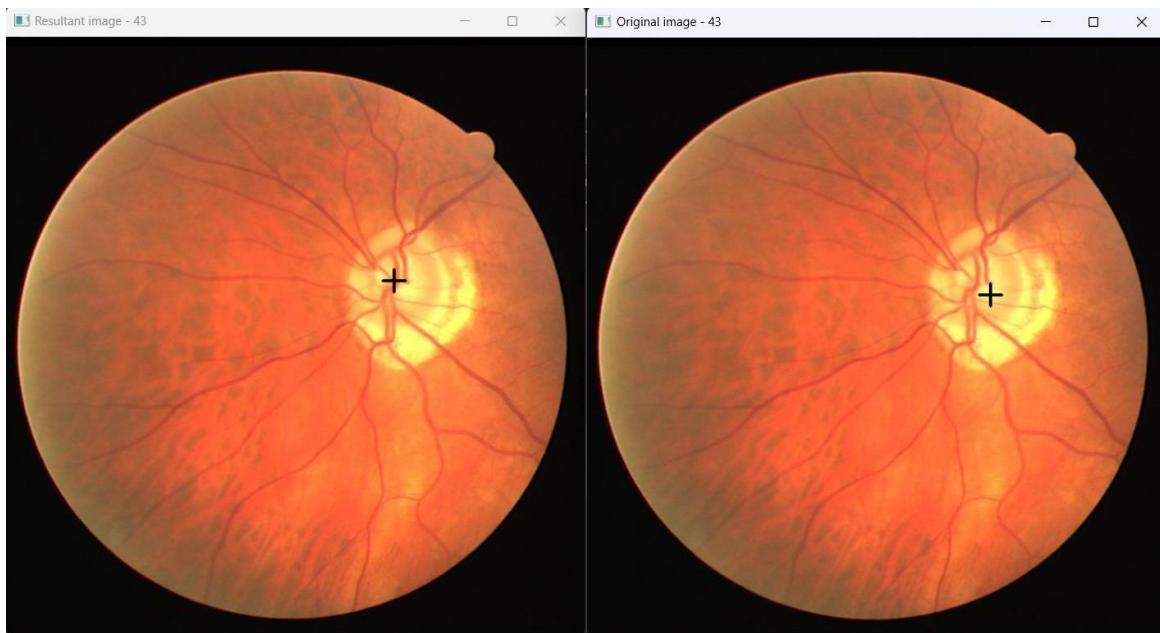
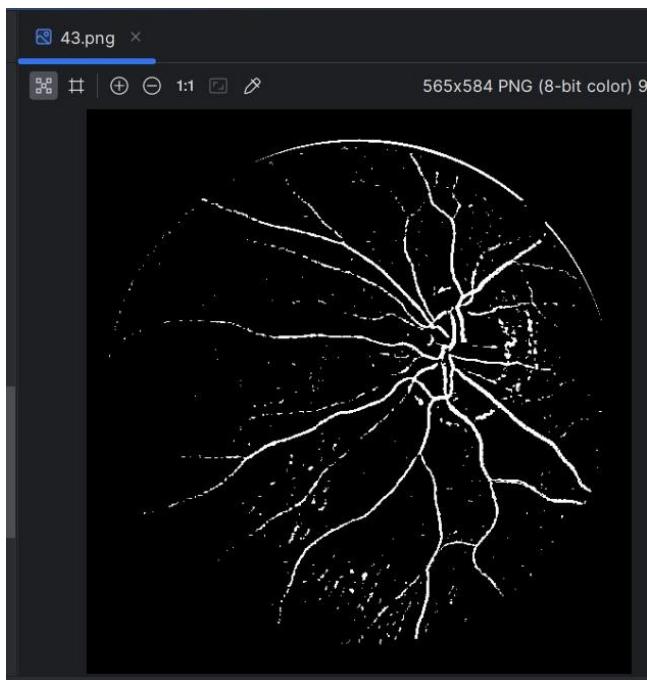
Difference Distance(image-40) - 5.0



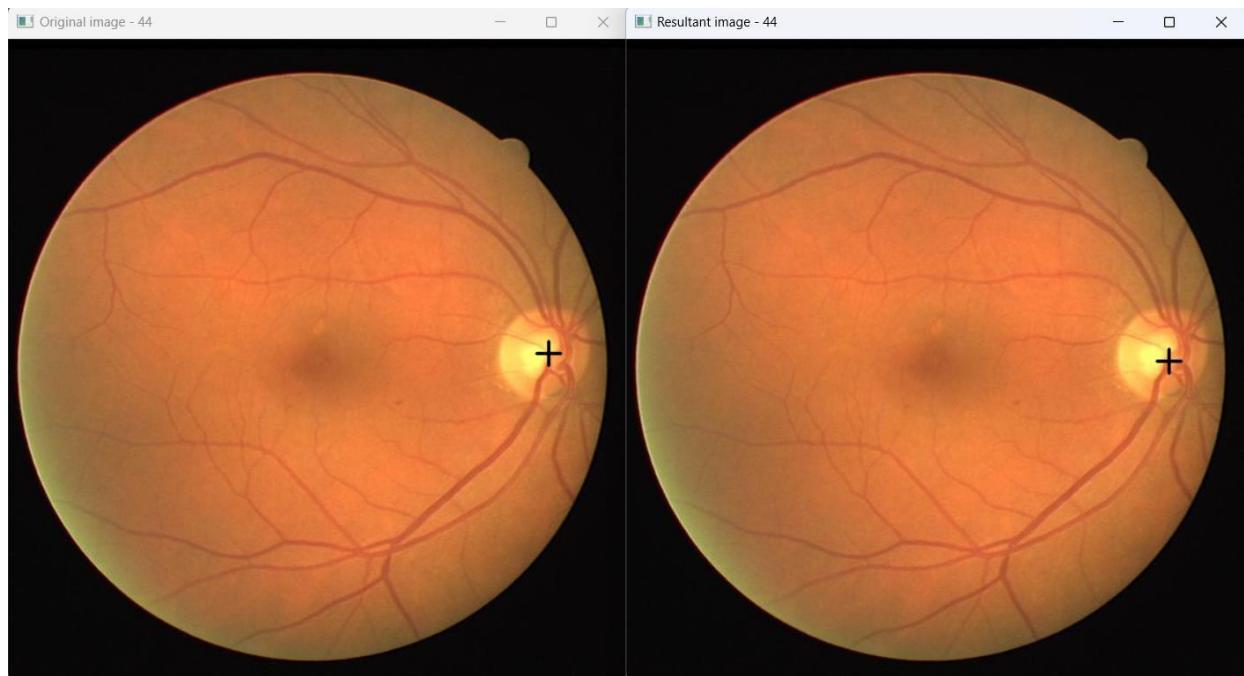
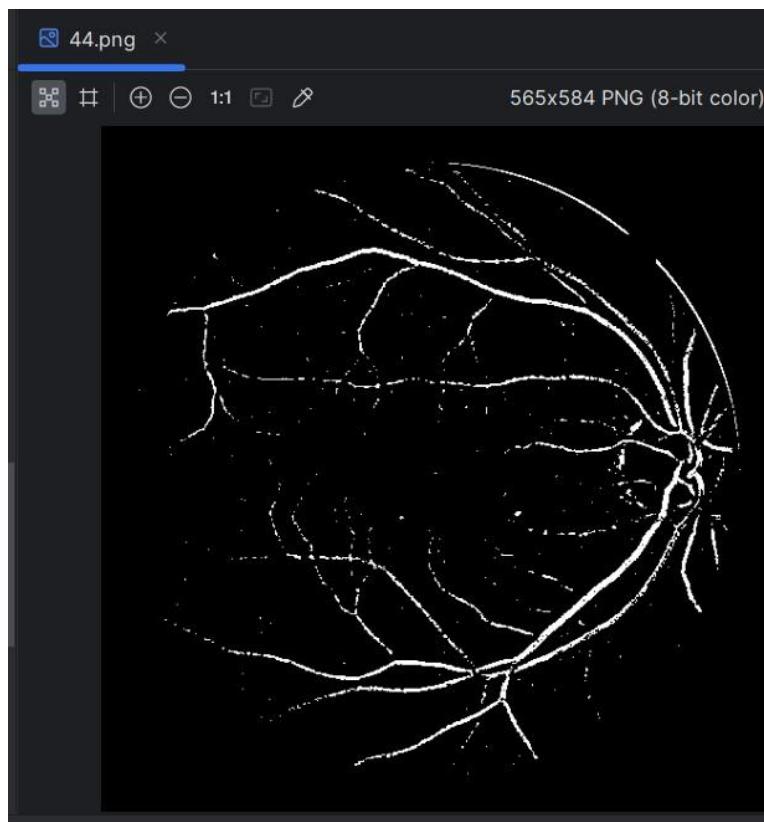
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Difference Distance(image-41) - 21.095023109728988
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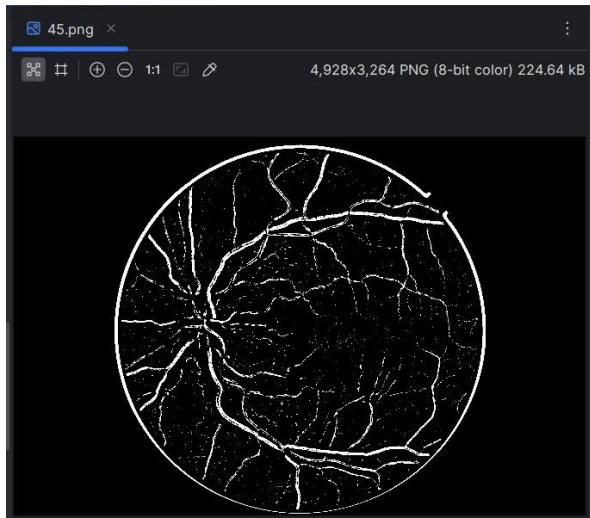
Difference Distance(image-42) - 17.11724276862369



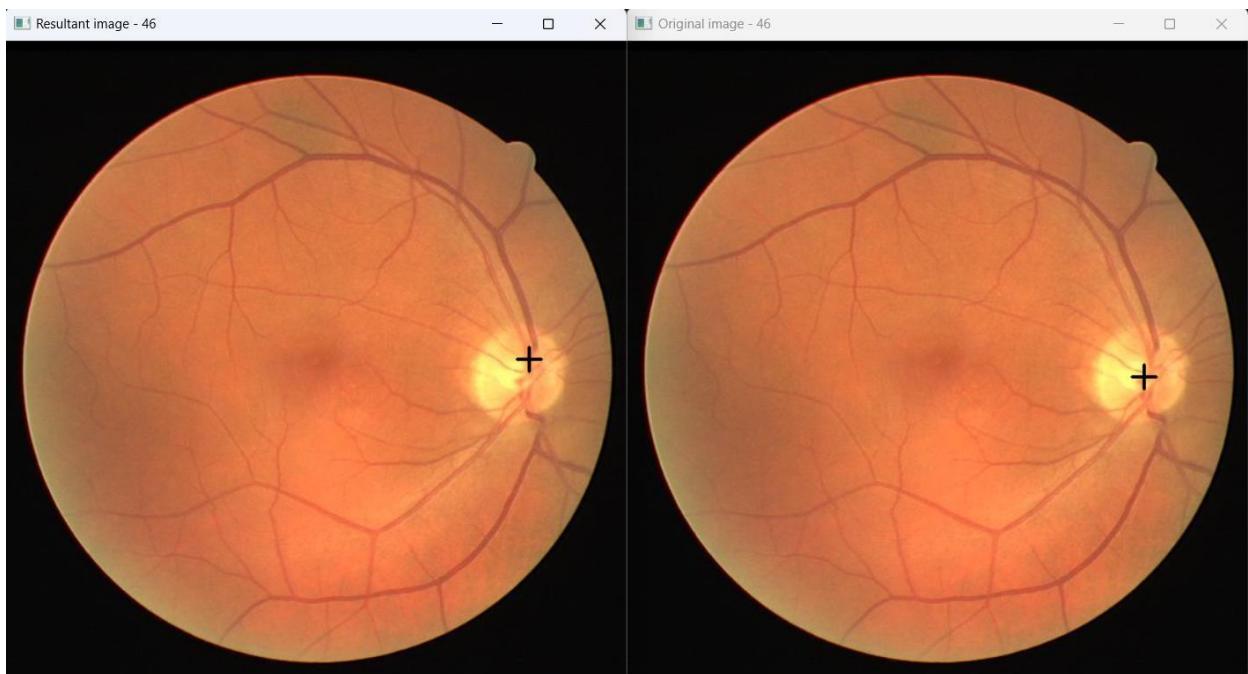
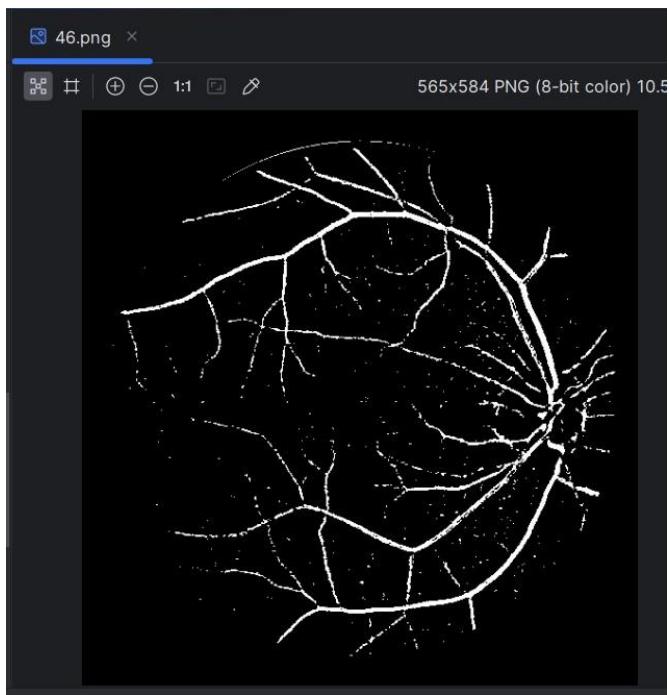
Difference Distance(image-43) - 19.849433241279208



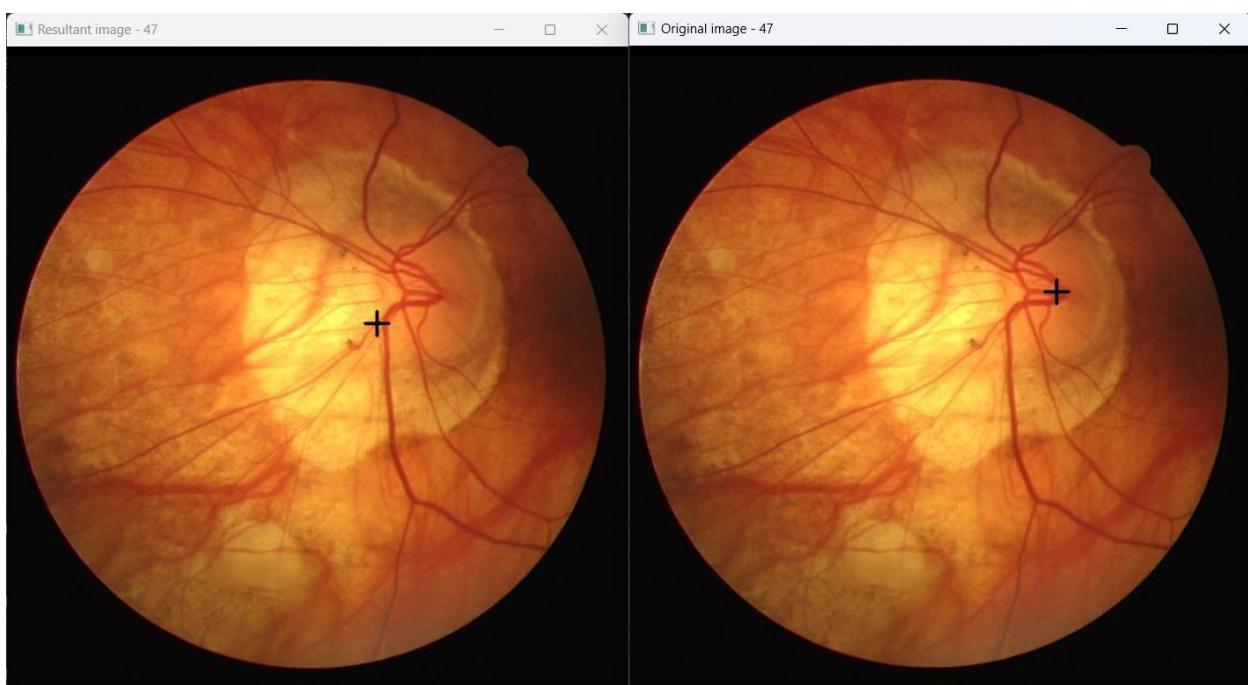
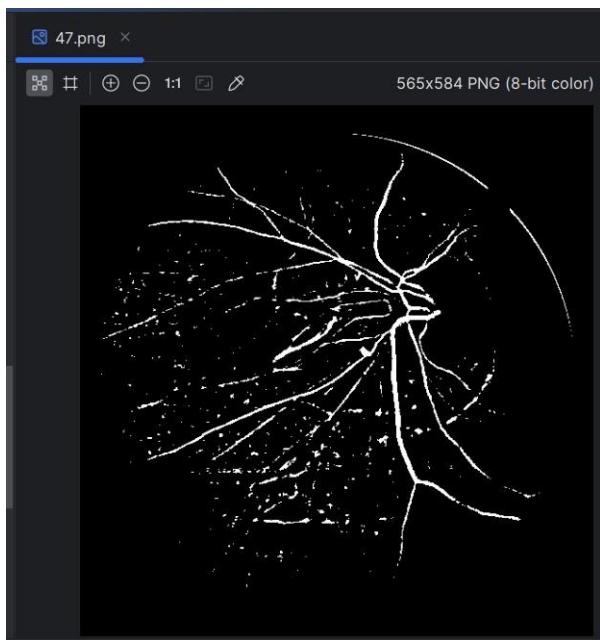
Difference Distance(image-44) - 7.280109889280518



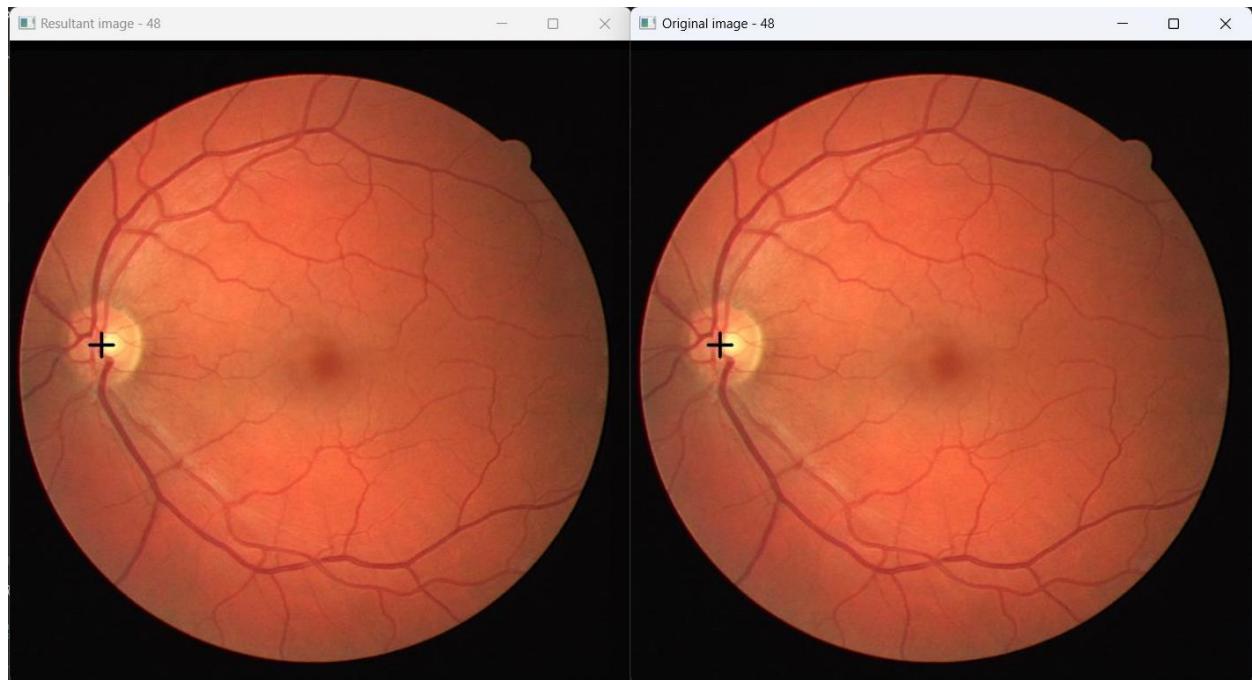
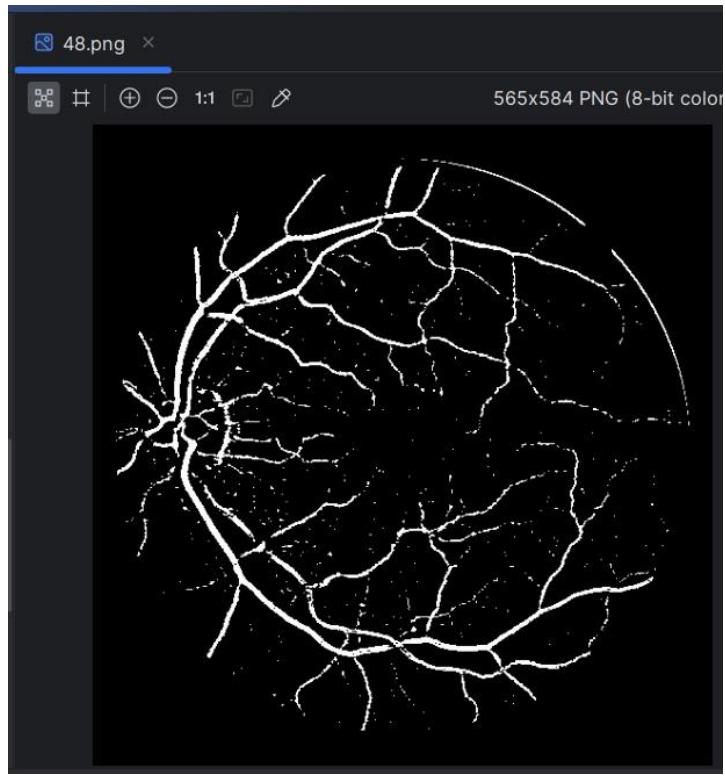
Difference Distance(image-45) - 129.0620006043607



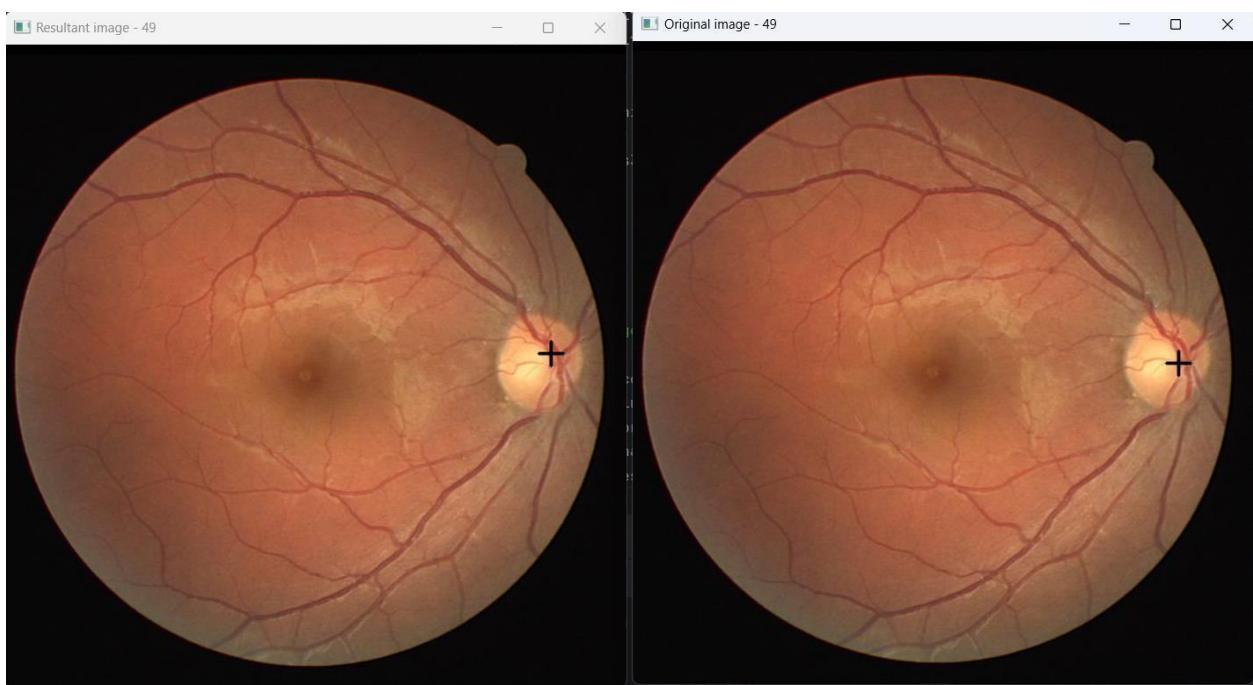
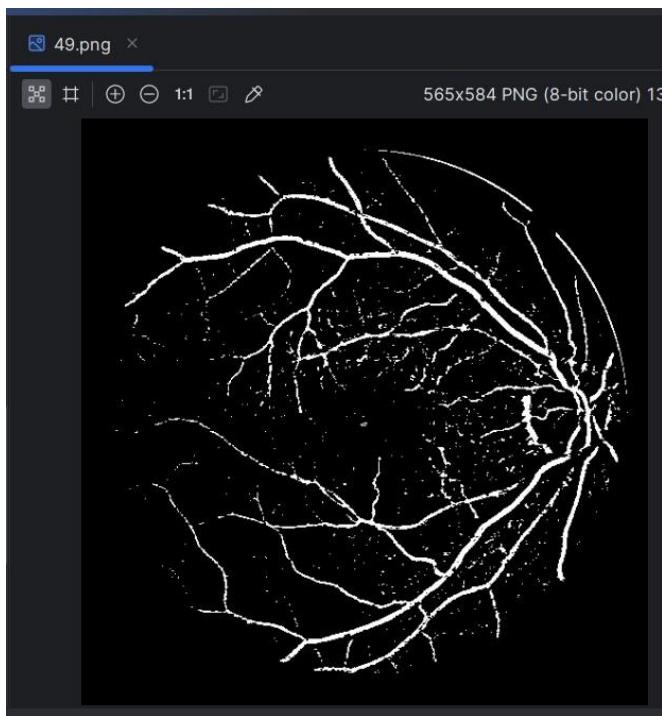
Difference Distance(image-46) - 17.08800749063506



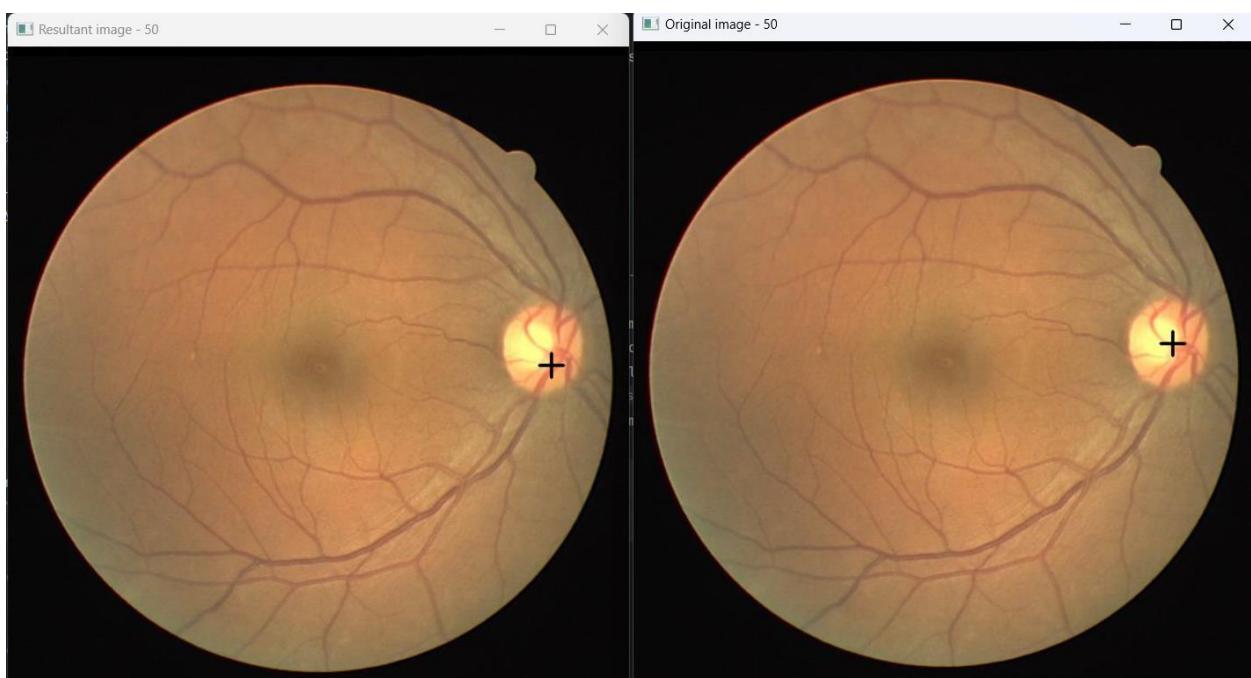
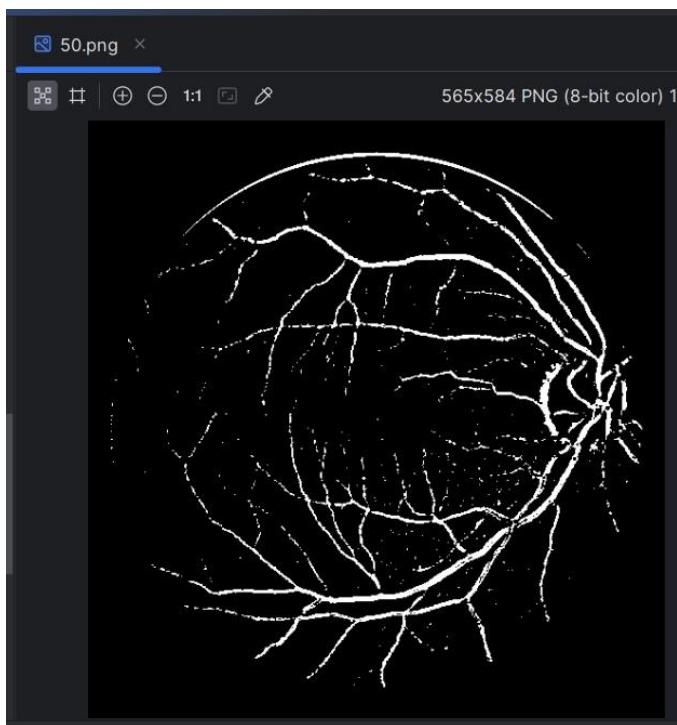
Difference Distance(image-47) - 59.0592922409336



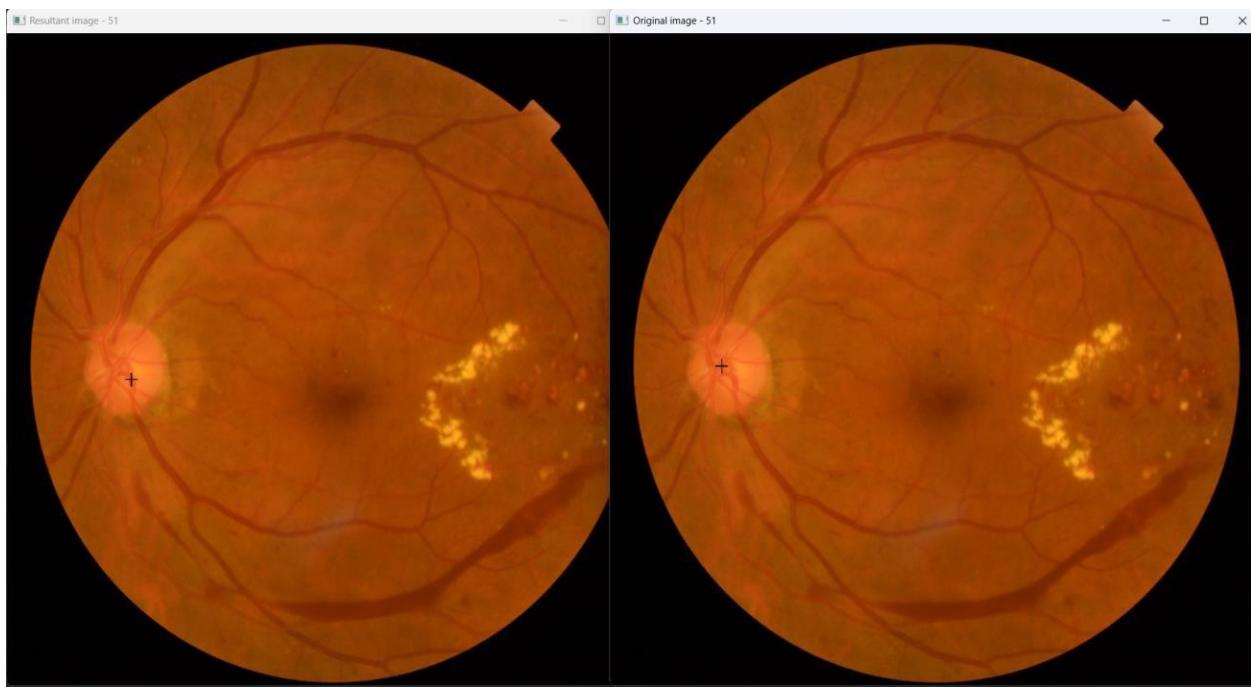
Difference Distance(image-48) - 2.0



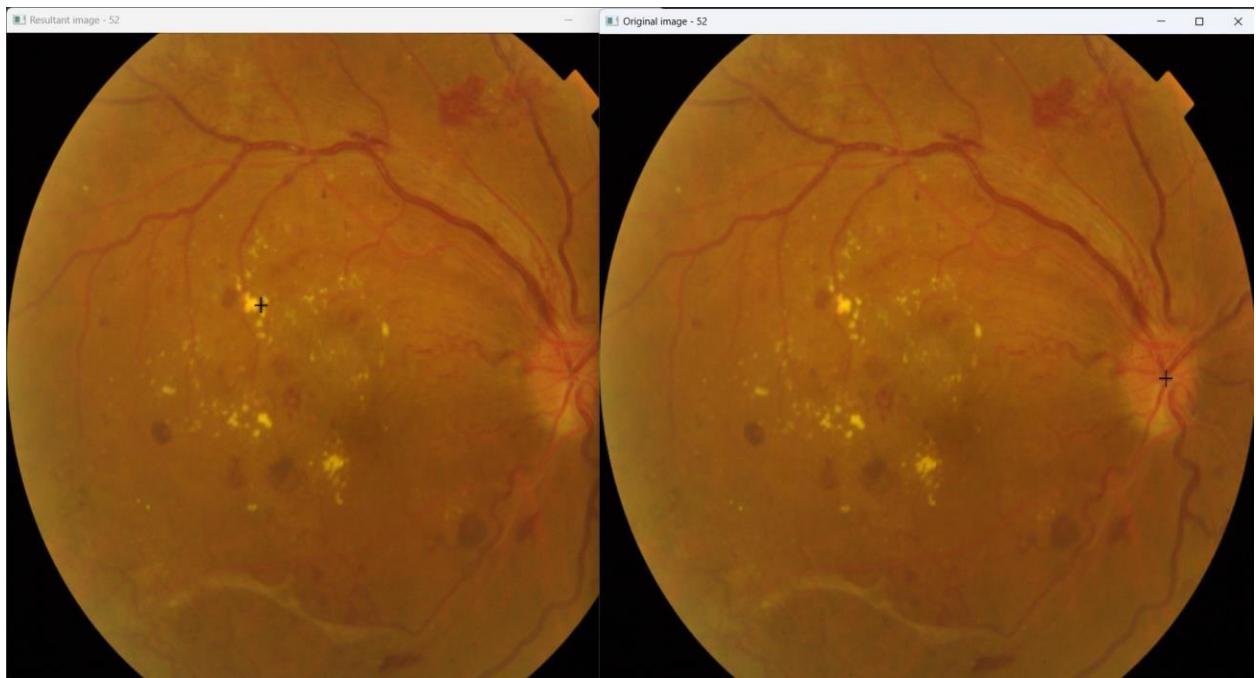
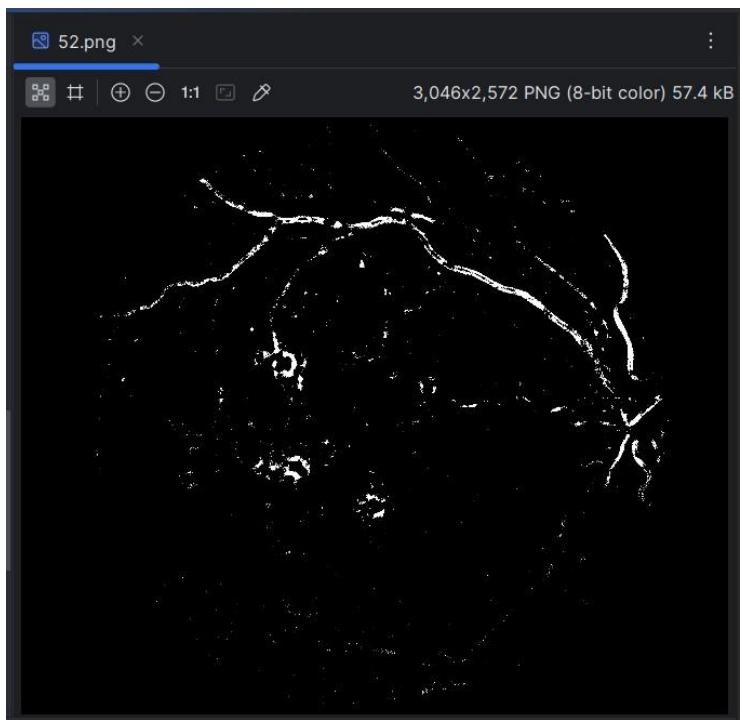
Difference Distance(image-49) - 12.0



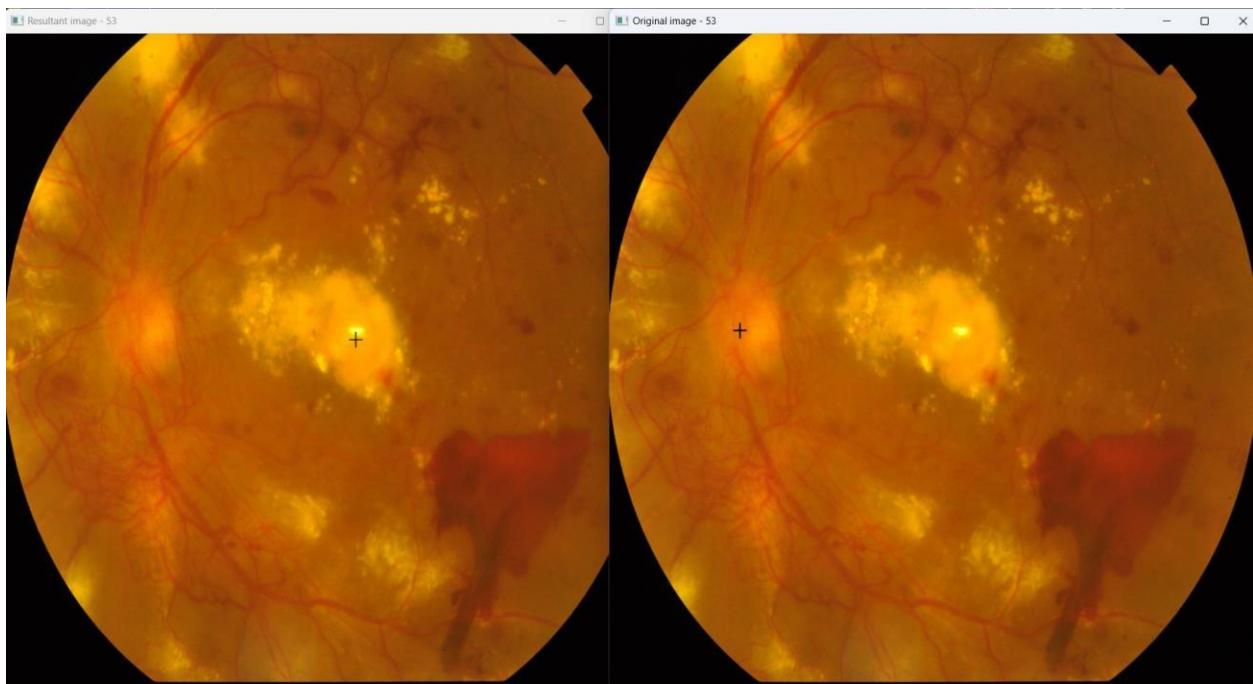
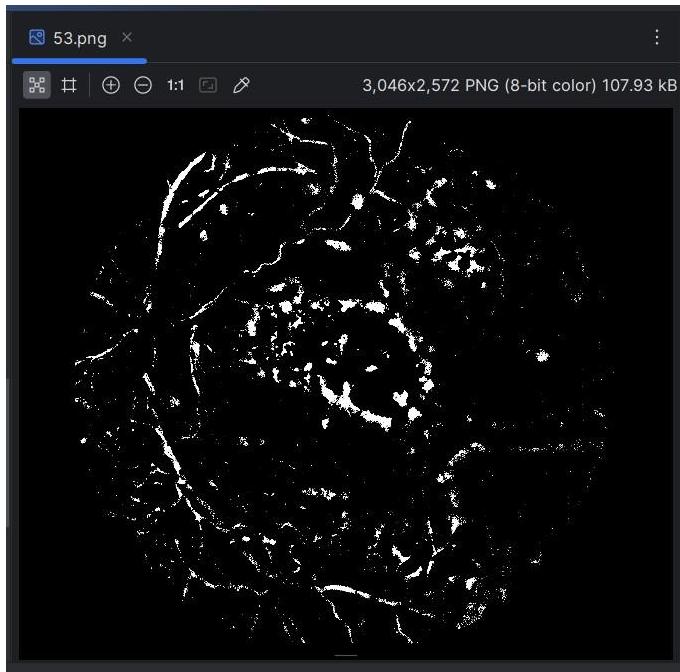
Difference Distance(image-50) - 15.524174696260024



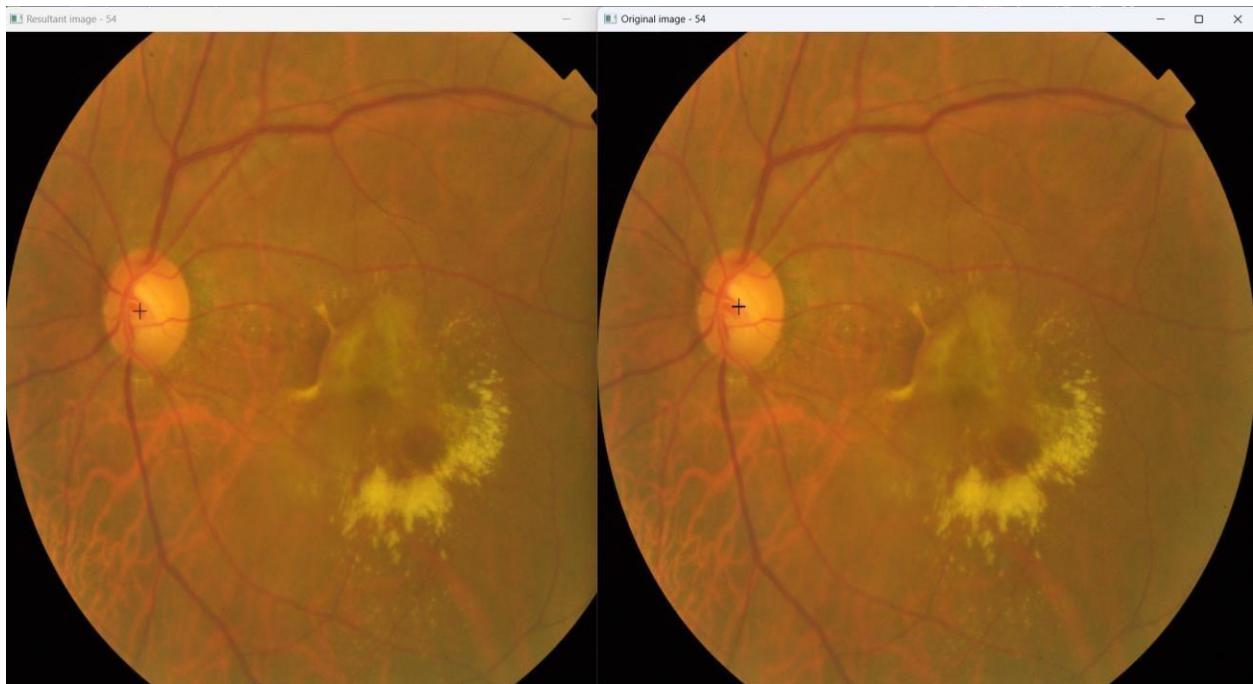
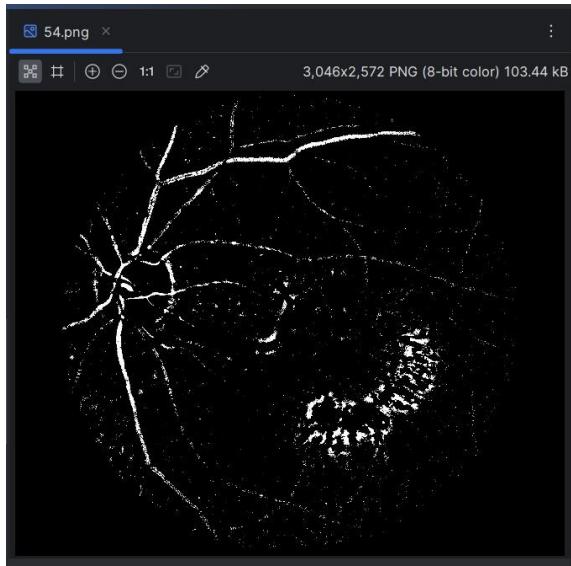
Difference Distance(image-51) - 86.97700845625813



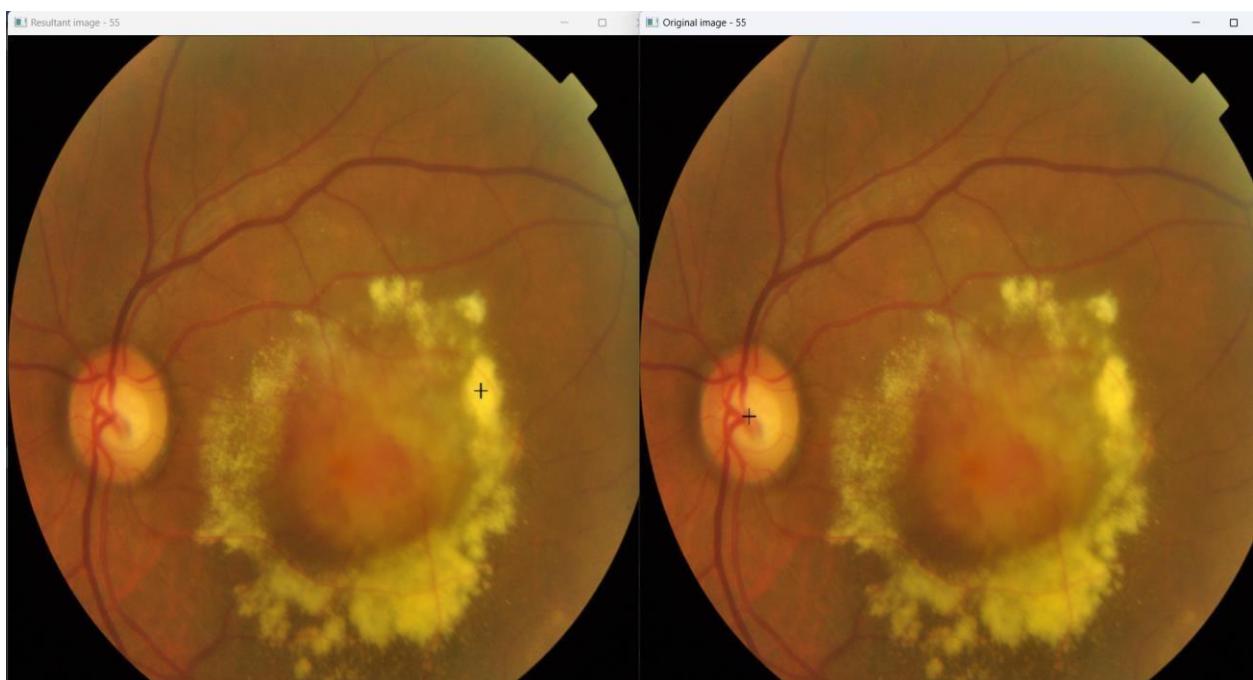
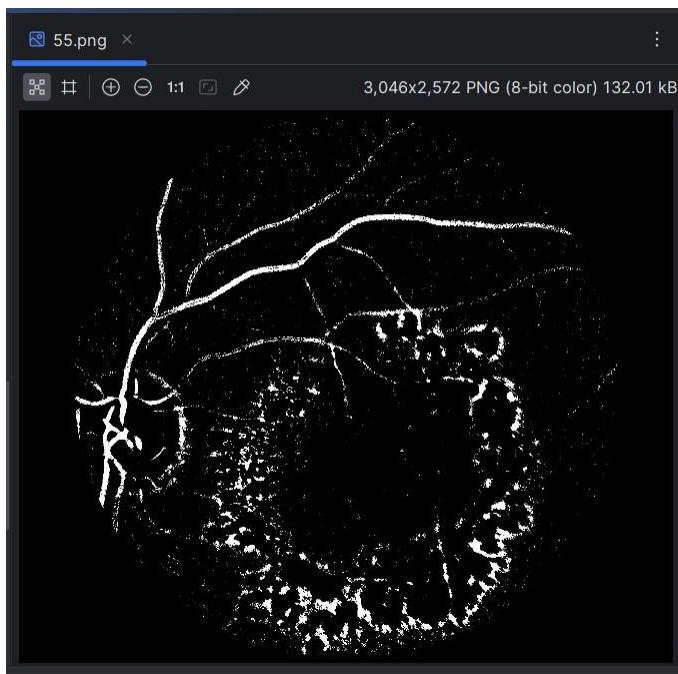
Difference Distance(image-52) - 1470.8963253744296



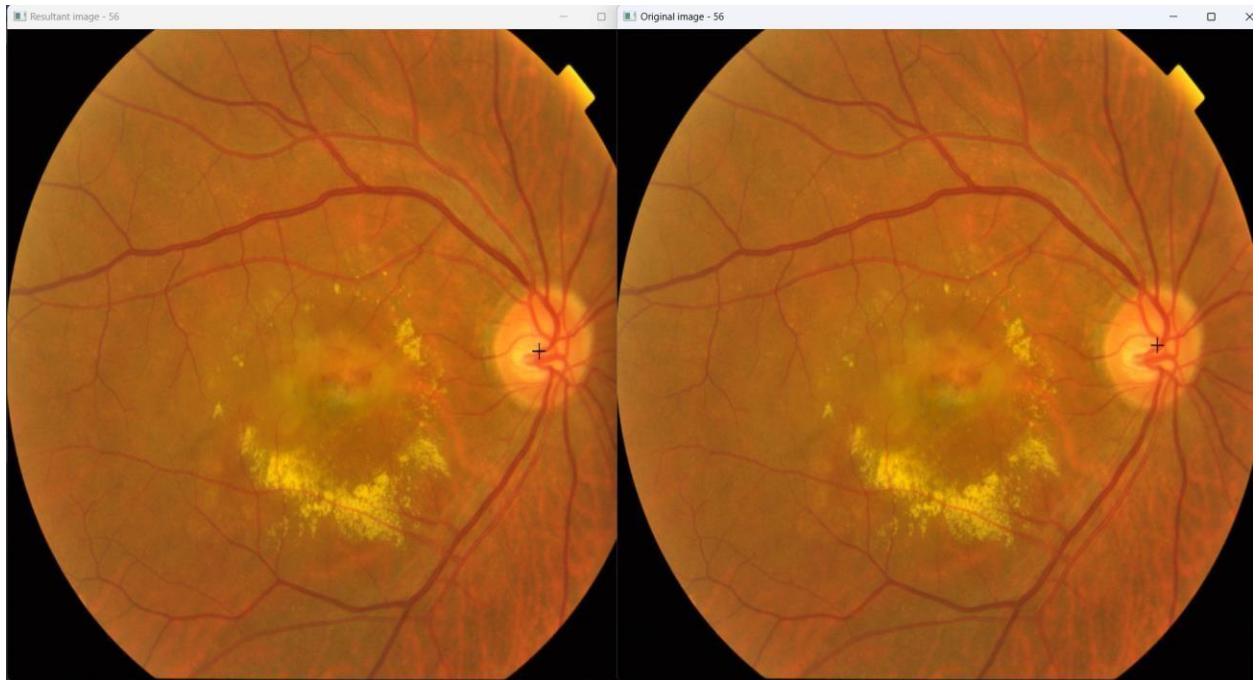
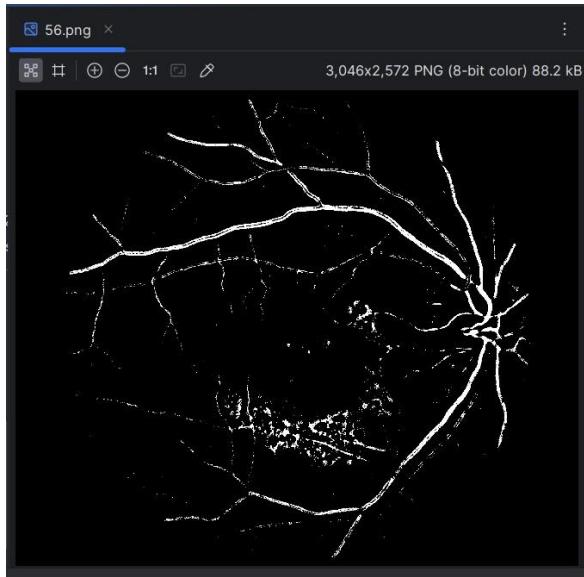
Difference Distance(image-53) - 1027.63077026722



Difference Distance(image-54) - 28.42534080710379



Difference Distance(image-55) - 1699.0047086456234



Difference Distance(image-56) - 46.14108798023731