Zagazig University - Faculty of Engineering
Department of Electronics and Communications Engineering
Image Processing Course (ECE228) - 2024/2025

Cornea Detection using MATLAB with GUI Application

PRESENTED TO

Dr / Azhar Ahmed Hamdi

CONTENT

1. Problem Definition

The aim of this project is to develop a MATLAB-based system capable of detecting the cornea in digital eye images. The system uses a custom algorithm for segmenting and identifying the cornea based on color and shape analysis. A graphical user interface (GUI) was developed to facilitate image loading, processing, and result visualization.

2. Selected Algorithm and Mathematical Foundation

This cornea detection system leverages basic image processing techniques, with the following main steps:

Color Channel Analysis:

- The RGB image is converted to double precision and separated into R, G, and B channels.
- A binary mask is created where the red channel dominates and the color falls within specific thresholds that resemble corneal appear ance.

Morphological Operations:

-Noise and small artifacts are removed using morphological opening.
-Holes are filled using morphological closing with a disk-shaped structuring element.

Region Properties Extraction:

- Connected components are labeled and their properties (centroid, area, perimeter) are computed.

3. Step-by-Step Implementation

The GUI includes four axes for displaying:

1- Original Image

2- Color Threshold Mask

3-Cleaned Mask

4-Final Detection Result

Functional Buttons:

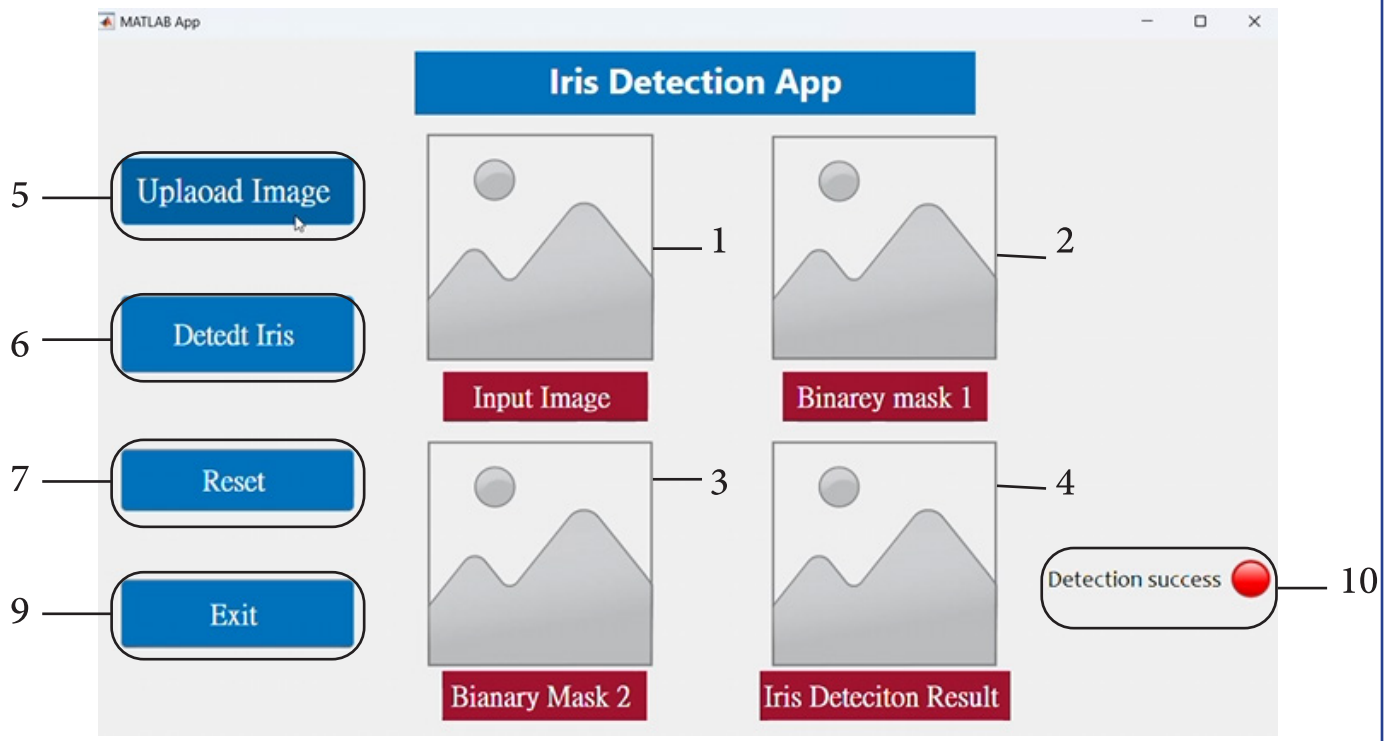
5- Load Image: Loads an eye image from the user's device.

6- Execute: Performs the cornea detection algorithm.

7- Reset: Clears all images and resets the status.

8- Exit: Closes the application.

9 - A status display box updates the user about the process stage (e.g., "Ready", "Processing", "Detection Complete").



4. Challenges and Solutions

Challenge	Solution
Varying lighting and cornea	Used color thresholding with relaxed ranges for robustness
Small or noisy regions in the	Applied morphological operations
Multiple candidate regions	Scoring system based on circularity and center proximity
Visual clarity of result	Used viscircles to display the detected cornea clearly

5. Results and Evaluation

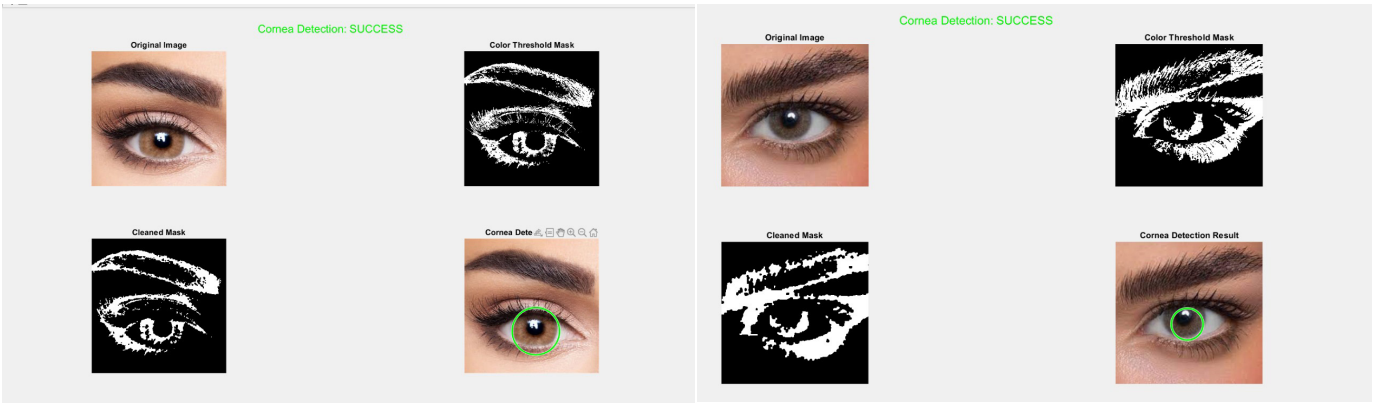
The system was tested with various eye images. It successfully detected the cornea in most cases where the color and shape were within expected parameters.

Detection Accuracy: High in frontal, close-up images with clear corneal contrast.

False Detection Rate: Low due to the scoring method.

Execution Speed: Fast, suitable for real-time GUI interaction.

6. Screenshots



7. Team Collaboration

The work was carried out collaboratively, with each member contributing:
Algorithm design and MATLAB coding
GUI development and integration.
Testing and optimization.
Documentation and report writing.

8. Conclusion

The cornea detection project effectively demonstrates the use of simple yet powerful image processing techniques in MATLAB. By leveraging color segmentation, morphological filtering, and region scoring, the system achieves accurate cornea localization in eye images. The GUI further enhances user interaction and interpretability of results.

9 - OUR TEAM

1- Abdallah Ahmed Abdelwahid

2- Abdelrahman Mohamed Saad

3- Ahmed Gamal Mahmoud Salem

4- Ahmed Osama Soliman

5- Ezzat Mohamed Abdelmohsen Mohamed

6 -Mohamed Abdo El-Sayed Attallah

7- Nada Mohamed Naguib

8- Shahd Ahmed Goda

THANKS