Unwanted Cells Detector in The Eye

Digital Image Processing

Group members:

GAHDSE23.3F 003 – DEVINDI H. M

GAHDSE23.3F 004 – SANDEEPANI G. K. N

GAHDSE23.3F 010 – NISKA A. Z. F. N

GAHDSE23.3F 008 – SANDAMALI T. D

GAHDSE23.3F 011 – VISHMINA M. G. U

ACKNOWLEDGEMENT

We would like to express our heartfelt thanks to M. W. Vadumulla for his valuable leadership and guidance during this assignment. His knowledge and his insights in digital image processing The comments were critical in shaping our project's improvements and overcoming many Challenges We are also grateful to the National Institute of Business Management for providing We have the resources and capabilities to undertake this task. Supported by our company Helps facilitate our research and development efforts. In addition, we respect Contribution of our staff contributors and contributors who played a big role inside Successful execution of this task. Their determination, difficult paintings and The spirit of cooperation is very important to reach our dreams. Finally, we would like to truly thank our families and friends for their unwavering support Encouragement. Their knowledge and perseverance was a regular inspiration.

CONTENTS

1. INTRODUCTION AND PROBLEM STATEMENT

1.1. Introduction

Digital image processing is the use of algorithms and mathematical models to process and analyze digital images. The field of digital image processing (DIP) has advanced significantly in recent years. Digital image processing products are mostly utilized in clinical field photography, agriculture, robotic vision, and video processing, among other applications. Under clinical field photography we chose to make a unwanted cell detector that can detect eye diseases using digital image processing techniques in this project. This unwanted cell detector allows users to identify disorders in their eyes such as cataracts and glaucoma.

1.2. Problem statement

Glaucoma and cataracts have blinded millions of individuals throughout the world. Millions of individuals throughout the world suffer from cataracts and glaucoma, which can lead to vision loss if not treated appropriately. To avoid this, it must be recognized, but existing diagnostic methods are costly, time-consuming, and necessitate specialized medical equipment and experience. This initiative aims to identify the undesirable cells that cause glaucoma and cataracts in the eyes. The device identifies anomalies in the lens and optic nerve and diagnoses the condition using this method.

1.3. Objectives

The primary objectives of this project are,

- To provide an overview of the system for the detection of unwanted cells and abnormalities in the eye, specifically those pertaining to cataracts and glaucoma, using digital image processing techniques and approaches in machine learning.
- Image analysis for the location and highlighting of clouding in the lens of the eye, a serious sign of the cataract.
- Early glaucoma detection through optic nerve and retinal image analysis because of damage to the optic nerve and increase in intraocular pressure.
- Design a user-friendly interface so that any medical practitioner or a general physician can upload the images of the eyes and grade them easily for preliminary diagnosis.
- The system should be such that it can also be replicated in far-off areas where resources might be scarce, thus enabling more people to make use of the early diagnosis stage.

2. LITERATURE REVIEW

2.1. Existing Solution

There are fully automated solutions for detecting unwanted cells in the eye such as glaucoma and cataracts. Some of them are Optical Coherence Tomography (OCT), fundus photography. These detection solutions reduce human errors. However, these solutions are very expensive and complex.

2.2. Relevant Digital Image Processing Techniques

1. Image acquisition:
    - Fundus photography: Capture images of the retina, optic disc and lens. Useful for detect abnormalities in the eye.
    - Optical Coherence Tomography (OCT): Provides cross-sectional images of the retina and optic nerve, allowing detailed examination of the internal structures of the eye.
2. Image preprocessing:
    - Grayscale conversion: Convert color school to gray scale image.
    - Noise reduction: Median filtering is used to reduce noise and improve image quality.
3. Image enhancement:
    - Contrast Limited Adaptive Histogram Equalization (CLAHE): Enhance the clarity of the image, useful for improving the quality of retinal image.
    - Edge detection: Highlight structures in the eye such as the optic nerve head and lens boarder.
4. Disease Detection:
    - Segmentation: Divides the image into regions of interest such as the optic nerve, retina.

3. METHODOLOGY

3.1. Tools and Libraries

- OpenCV: Open-source computer photographs and predictable library that provides whole photographs tools.
- Python: The primary programming language for production top notch gadgets, because of its splendid contribution to scientific computing and image processing.
- MySQL: The database used for storing data.

3.2. Digital Image Processing Techniques

3.2.1. Cataract detection system

1. Image acquisition:

This involves to the image is captured and imported into the system.

2. Segment retina:

Canny edge detection algorithm is applied to the image the highlight edges of the retina in the eye. It also helps to isolate the blood vessels in the eye.

3. Preprocess image:

In this step aims to reduce noise and enhance image quality.

- <u>Noise reduction:</u> Median filtering removes the noised parts and keeps the edges in the image, which is very significant to ensure that at the stage of preprocessing, the important features of the eye are not missed.
- <u>Gaussian Blurring:</u> This can also serve as an alternative form of blurring the image with the intention of suppressing noise a little more without losing the sharpness of the image itself.

4. Enhance image:

This step is aimed at improving the contrast for the better visibility.

- <u>Contrast Enhancement:</u> The CLAHE approach redistributes the intensity values of the image to enhance its contrast. This helps observe many of the subtle features of the eye, such as the retina and lens, which are very important in diagnosing cataracts.

5. Detect Cataracts:

This step detects potential cataract regions based on image analysis.

- Simple Thresholding: Simple thresholding is applied to segment the parts of the eye that are affected by cataract. It segments and marks out the darker regions that might represent cataracts for further diagnosis.

3.2.2. Glaucoma detection system

1. Image acquisition:

This involves to the image is captured and imported into the system.

2. Segment Optic Nerve:

Applies segmentation techniques to separate optic nerve from the image.

3. Preprocess Image:

Enhance the image by reducing noise and improving brightness.

- Noise Reduction: Removes noise while protect edges to ensure the optic nerve are not lost.
- Gaussian Blurring: Gaussian blur is used to reduce noise while preserving important features.

4. Enhance Image:

This step is aimed at improving the contrast for the better visibility.

- Adaptive Histogram Equalization (CLAHE): Reallocate intensity values to enhance contrast.

5. Detect Glaucoma:

Analyzes the processed image to detect signs of glaucoma.

- Cup-to-Disc Ratio Analysis: Measures the ratio of the optic cup to the optic disc.
- Retinal Nerve Fiber Layer (RNFL) Analysis: Checks for thinning of the RNFL.

3.2.3. Step-by-Step Process

Cataract detector:

1. Open image: Import the image into the system.

2. Segment Retina: Segment the retina.
3. Preprocess Image: Reduce the noise in the grayscale image.
4. Enhance Image: Improve contrast.
5. Detect Cataracts: Detect cataract regions.

Glaucoma Detector:

1. Open image: Import the image into the system.
2. Segment Optic Nerve: Separate optic nerve area from eye image.
3. Preprocess Image: Apply techniques such as grayscale conversion and noise reduction.
4. Enhance Image: Enhances the image using contrast enhancement techniques like Adaptive Histogram Equalization (CLAHE).
5. Detect Glaucoma: Analyzes the cup-to-disc ratio of the optic nerve and check for abnormalities.

5. IMPLEMENTATION

5.1. System Design

- Camera Module: Captures Eye Images
- Microcontroller: Manages Data and Workflow
- Image Processing Unit: Detects Cataracts and Glaucoma Using DIP Techniques
- Database: Stores Medical and Diagnostic Data
- Reporting System: Delivers Diagnostic Results

5.2. Software Components

- OpenCV: For visualization services.
- Database: (MySQL) for storing data.
- Programming language: For backend and Frontend, Python

5.3. DIP Techniques Implementation

1. **Image Acquisition:**

   Reason: Collect input images of the eye, it can be analyzed and processed.

   Purpose: That involves uploading existing image from device.

   Steps: upload image through the system.

2. **Image Preprocessing:**

   Reason: Unwanted disturbances such as noise or uneven contrast may occur.

   Purpose: Removes noise and enhances contrast.

   Steps: reduce noise, and adjust surveys.

3. **Image Segmentation:**

   Reason: To separate areas of interest from the image.

   Purpose: Segmentation divides the image into significant parts.

   Steps: Thresholding, edge detection.

4. **Feature Extraction:**

   Reason: Identify the specific features in image.

   Purpose: Identify and measure specific areas of disease.

   Steps: Texture analysis, shape analysis.

5. **Classification and Detection:**

   Reason: A determination must be made as to whether the owner of the eye in the imported image has symptoms of cataract or glaucoma.

   Purpose: Whether the image is healthy or diseased should be found using measurements and features.

   Steps: Cataract detection, Glaucoma detection.

6. CONCLUSION AND FUTURE IMPLEMENTATION

6.1. Conclusion

The Unwanted Cell Detector for Eye Diagnostics project will revolutionize the way cataract and glaucoma-related eye disorders are diagnosed. Equipped with the latest digital image processing techniques, this device analyzes high-resolution eye images for more accurate and timely diagnosis of abnormalities.

Imaging involves photographing the eye using sophisticated cameras or sensors that can capture high-quality images. Captured images are pre-processed to enhance image quality and detail, and noise reduction techniques such as median filtering and Gaussian blurring can be used.

After preprocessing, various segmentation techniques, such as canny edge detection, are applied to identify and segment relevant structures of the eye, such as the retina or optic nerve. This step is critical to providing accurate feature extraction that will result in a desirable analysis.

Furthermore, enhancement methods such as contrast-limited adaptive histogram equalization (CLAHE) were used to improve the visibility of the optic disc and cup to detect glaucoma or lens opacities in cataract detection.

The system finally detects the area of glaucoma or cataract using simple thresholding approaches by evaluating some algorithms of indicators, including cup-to-disc ratio.

The system is integrated with the MySQL database and serves as an integrated and time-saving tool for health professionals to efficiently manage and maintain diagnostic data. The novelty of this approach is not only to try to increase the accuracy of early diagnosis but also to improve outcomes for patients with early and early interventions.

6.2. Future implementation

Some of the key focuses toward which future development of the Unwanted Cells Detector system for eye diseases like cataracts or glaucoma may be directed are as follows. Firstly, embedding more advanced models, such as deep learning methods for feature extraction and classification, may result in even higher accuracy regarding the detection of abnormal cells in the retina and optic nerve. Furthermore, extending the system for more general types of image formats and resolutions would make it useful for different clinical settings. Another key direction involves incorporating real-time detection capabilities that would enable faster diagnostics during eye examinations. Moreover, developing a platform for mobile or cloudbased analyses would extend the capabilities of the system for areas where healthcare is limited, thus enabling early detection and treatment. The friendliness and detail of user interfaces in reporting will go a long way toward clinician usability and, therefore, better patient outcomes.

7. REFERENCES

- www.synopsys.com. (n.d.). *What is Medical Image Processing | Synopsys*. [online] Available at: https://www.synopsys.com/glossary/what-is-medical-image-processing.html.
- OpenAI (2024). ChatGPT . [online] ChatGPT

8. APPENDICES

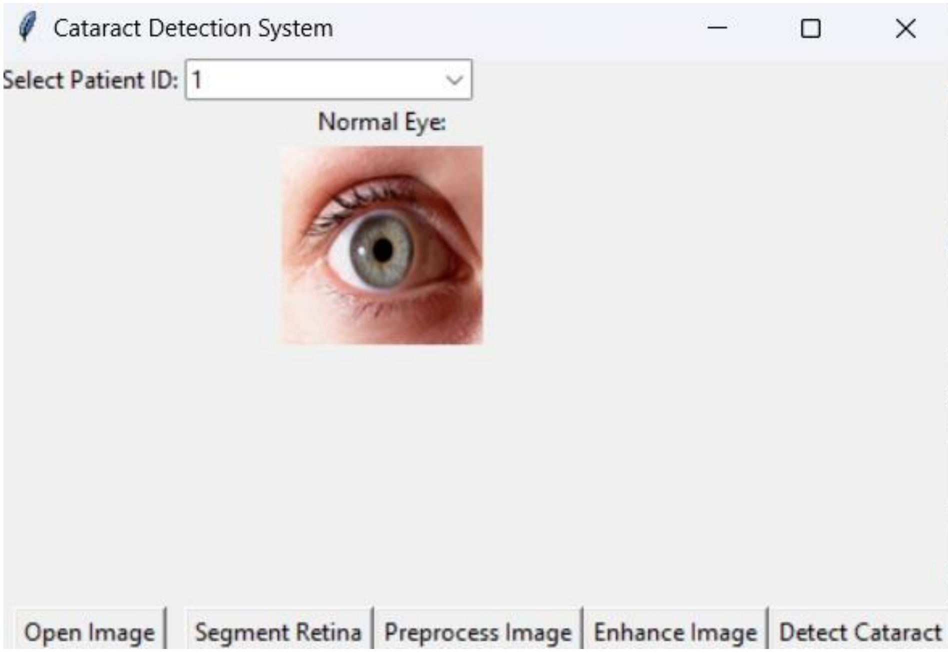

Figure 1:Normal eye

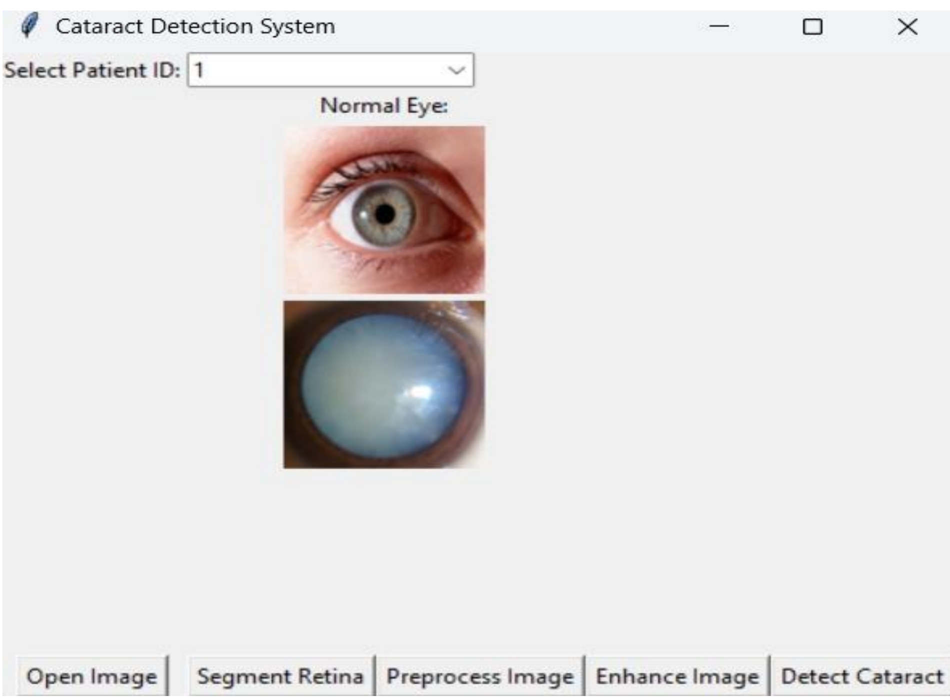

Figure 2:Segment retina

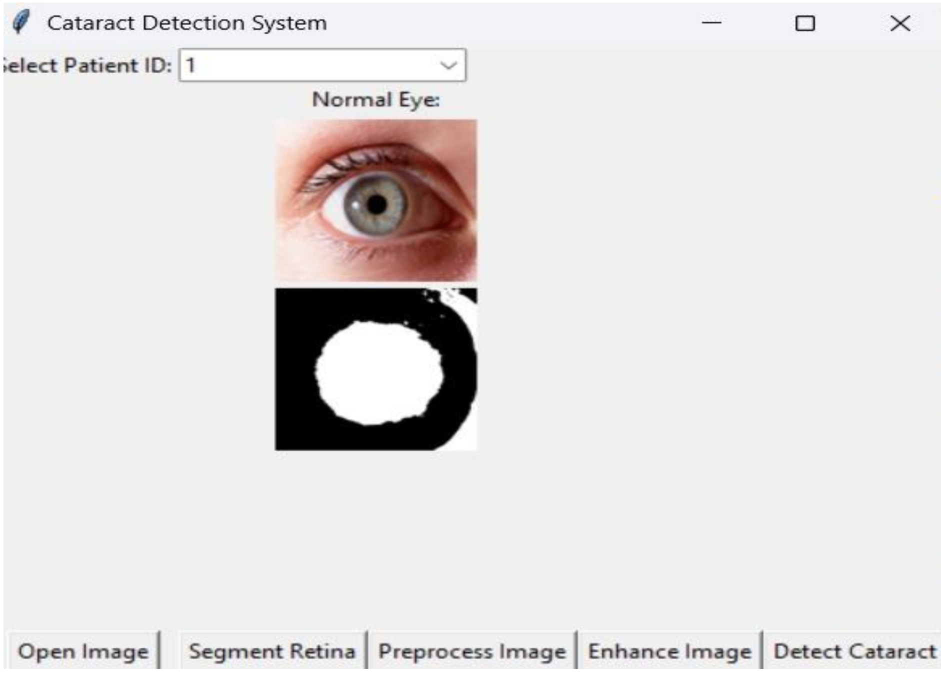

Figure 3:preprocess image

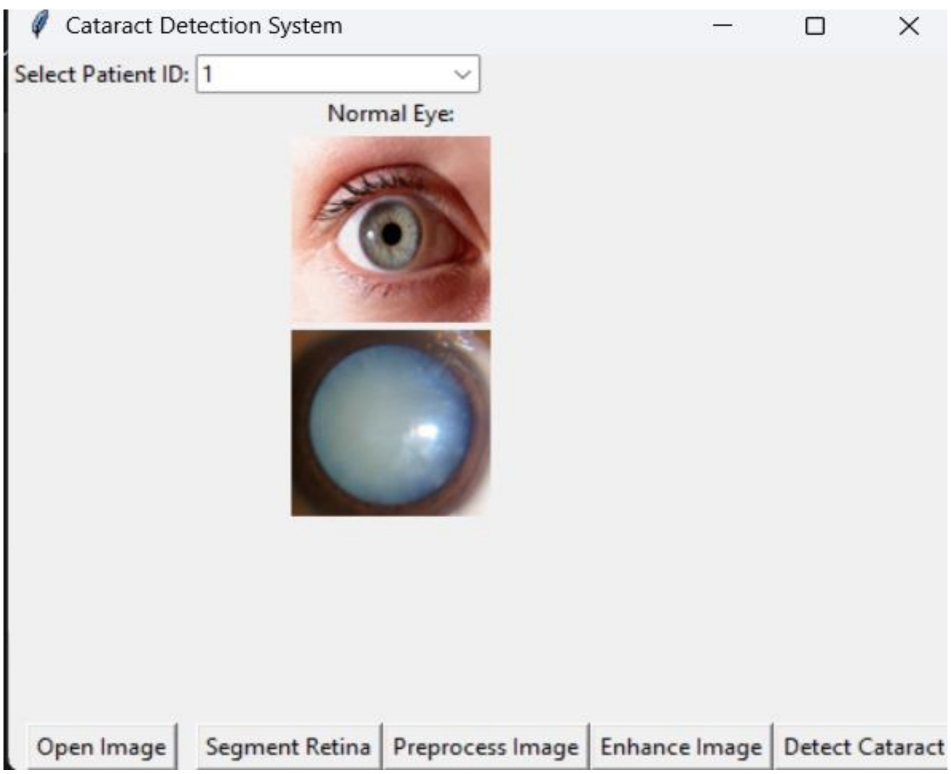

Figure 4:Enhance image

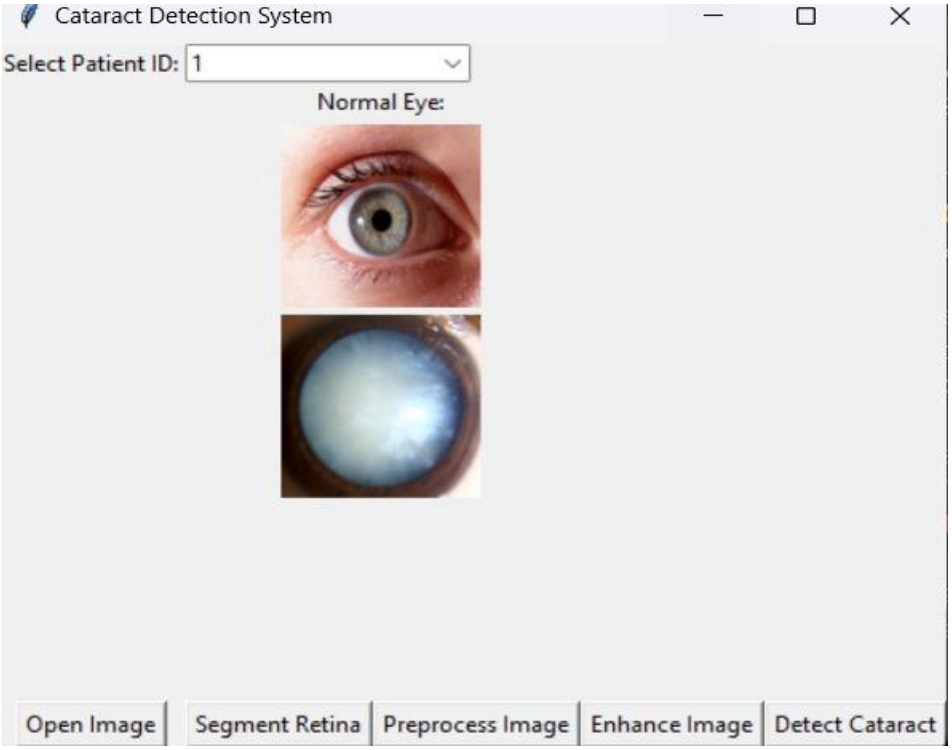

Figure 5:Detect cataract

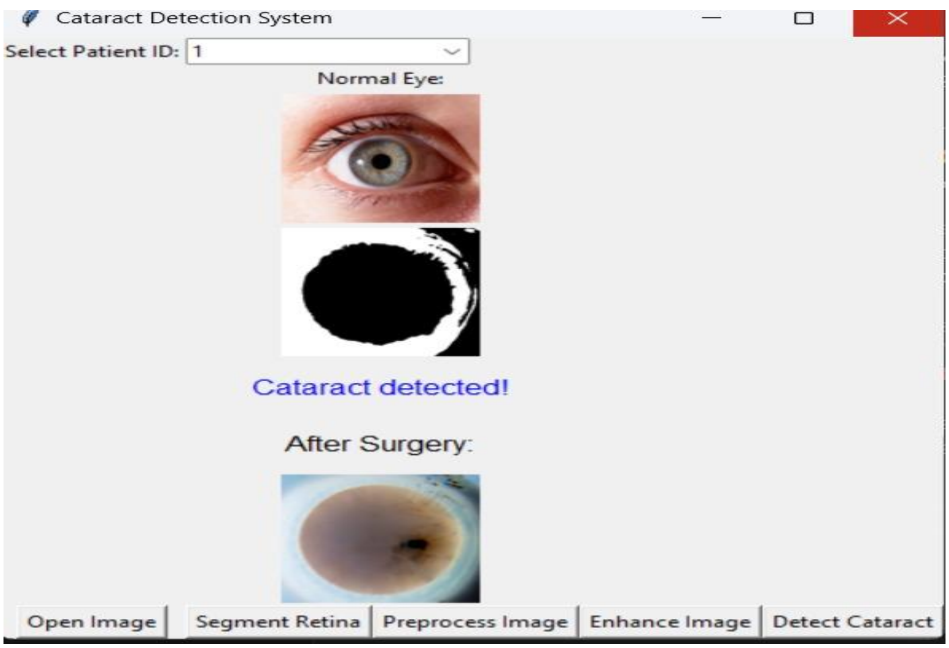

Figure 6:After surgery