3️⃣

A3 - Jay Vora - Student # - 203321900

Class Name	CP467

Your Approach And The Algorithms

- I have taken classes approach in the given problem of detecting the iris and pupil circles. To accomplish this, two primary classes `PupilDetection` and `IrisDetection` were created, each class responsible for detecting pupil and iris respectively.

1. Preprocessing ⇒ Each image was first preprocessed using CLAHE (Contrast Limited Adaptive Histogram Equalization) to improve contrast, followed by median blurring to reduce noise without affecting edges significantly.
2. Edge Detection ⇒ Canny edge detection was applied to the preprocessed image to highlight the boundaries within the eye.
3. Pupil Detection ⇒ Hough Circle Transform was used on the image to identify circle matching the pupil's expected size. Parameters were tuned to prioritize smaller circles.
4. Iris Detection ⇒ Previously detected pupil was used as a reference point to detect the iris radius range. Hough Circle Transform was reapplied for that specific range to detect large iris circle.

Challenges and Solutions

- Parameter selection for Hough Circle Transform was the most crucial part of my algorithm that I have used, selecting the right parameters was for reliable detection and a generalized solution. Due to not having a separate

class for iris initially my algorithm was not able to detect the iris correctly and mixing the iris and pupil circles. But after separating them, I was able to identify both the circles respectively with their radius.

Insights and Observations

- Using a sequential detection strategy - detecting the pupil first and then using its information for iris detection - helped improve the accuracy and robustness of the algorithm.
- The algorithm worked well with most of the images and with minimal parameter adjustments, this shows the potential of the generalized method.

Potential Improvements

- After reviewing few research paper one could get the pupil and iris ratio's mean would give the right amount of the radius for both and figure out the radius to get the right iris circle because it would not be different from the actual iris in any given image.
- Using different and better noise reduction and edge detection method could enhance present algorithm proposed by myself. Also, more precise parameters and adaptive parameters could help detect the circles in Hough Circle Transform.

References:

The `pupil_detection` class structure is based on this sample code from _ esmitt/iris_detection.py Although the techniques used to derive to the solution was my own but the initialization and structure of the class was used from here.