

I approached this assignment by first finding the pupil, which was typically quite easy to find using the OpenCv `HoughCircles()` function. The code will iterate over the image, finding circles using different thresholds, until a threshold is found that results in one circle, which is the pupil.

To find a circle around the iris, we first find a pixel value outside of the pupil, which would be a pixel inside the iris. If we use this pixel value to threshold the image, using OpenCv `threshold()` function, then it makes it easier to find where the iris and sclera are separated. Using this thresholded image, I run the `HoughCircles()` function again, this time checking if the detected circle overlaps with the pupil, and only allowing it as a potential circle if it fully overlaps the pupil circle and is bigger.

A challenge I faced was finding a circle around the iris. Many of the images had very faint differences between the iris and sclera, and this made it hard to detect circles. To combat this challenge, I added in code to preview circles around the iris, and the ability to manually edit the threshold values while the code was running, in order to get better circles around the iris.

There are a few potential improvements I could make. One would be to consider the fact that a pupil is typically in the center of the eye, which means it is in the center of an iris. Using this fact you could filter out detected circles where the center of the circle does not fall within the pupil, and if there is more than one circle detected, then only use the circle with the center closest to the center of the pupil. This would allow the threshold to be lowered when locating circles, while still only getting circles that are potentially valid.

Another improvement idea could be related to the thresholding that is done after pupil detection. Currently, the image will be thresholded with a random pixel value in the iris, adjacent to the pupil. What could work better would be looking at every single pixel around the pupil, and thresholding the image based on the range of pixel values that are found. So anything lighter than the lightest pixel in the iris would be set to 255, and anything darker than the darkest pixel in the iris would be set to 0. This would make the difference between the iris and the sclera more noticeable.