METROPOLITAN STATE UNIVERSITY[SM] OF DENVER

Digital Image Processing
Homework 2

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Overview

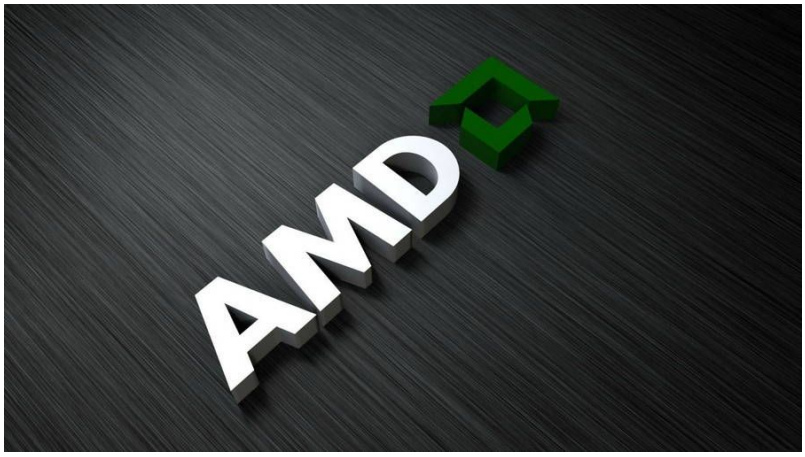
There are two requirements for this assignment:

1. Apply the following filters to an image of my choice:
    - Averaging
    - Sobel
    - Laplacian
    - Median
2. To find the boundary of the pupil in a given image

Procedure

Part I

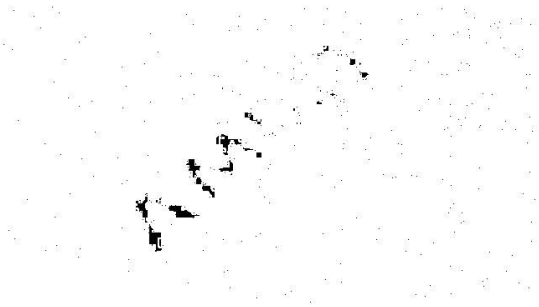
For the first part, I just needed to apply 4 basic filters to an image of my choice. Here is the image that I chose to use.



The 4 basic filters to apply were:

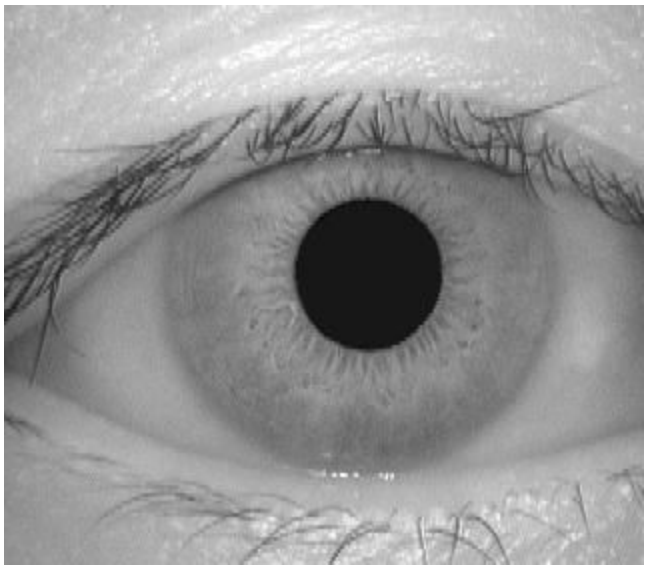
1. Averaging Filter (9x9 kernel)
2. Sobel Filter (Basic* kernel)
3. Laplacian Filter (Basic kernel)
4. Median Filter (17x17 kernel)

*It's worth mentioning that the actual basic Sobel filter's kernel produced a horrible result. The result of the original Sobel filter produced the horrible result you can see on the right. To fix this, I simply multiplied each value in the kernel by 0.005 to produce much better results. You may see the real results in the analysis section.



Part II

For the second part of this assignment, I needed to use my current knowledge of filters and processing to detect the boundary of the pupil in the following image.



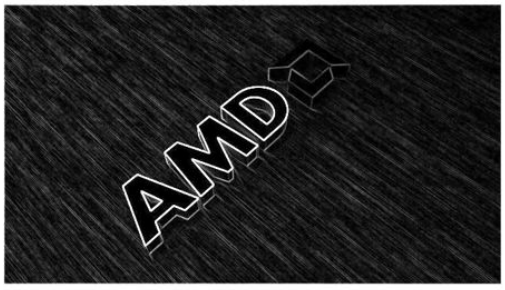
This task was to be accomplished through the following steps:

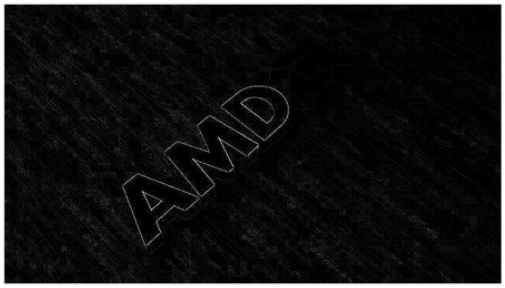
1. Apply a Sobel filter to detect edges in the image
2. Use filtering/correlation techniques to detect the center of the pupil
3. Use thresholding to remove noise outside the pupil boundary

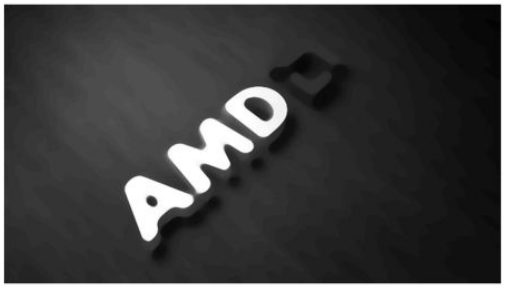
Results and Analysis

Part I

These are the results from applying the 4 basic filters.



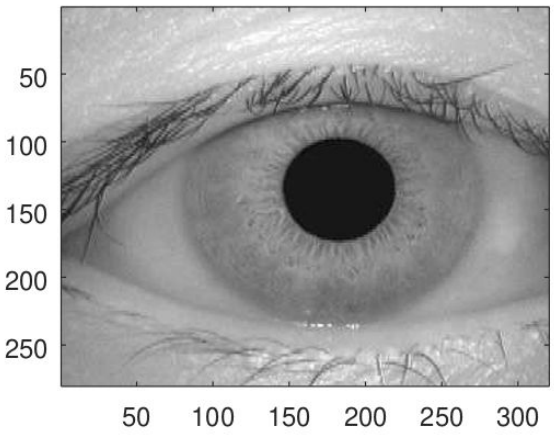


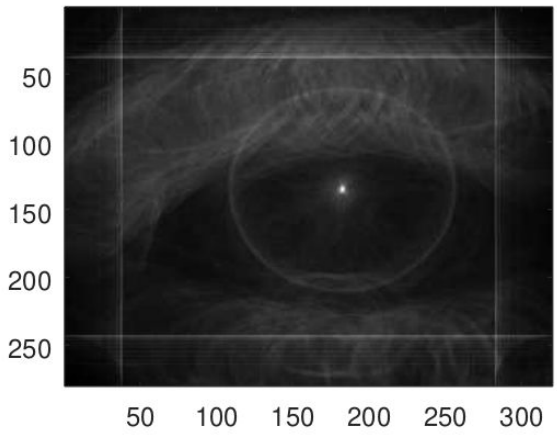


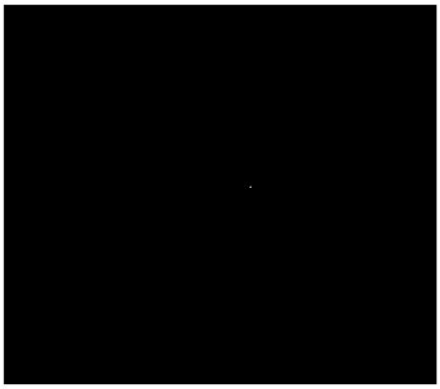
As you can see, the results of the Sobel filter turned out much better after scaling the kernel down in value.

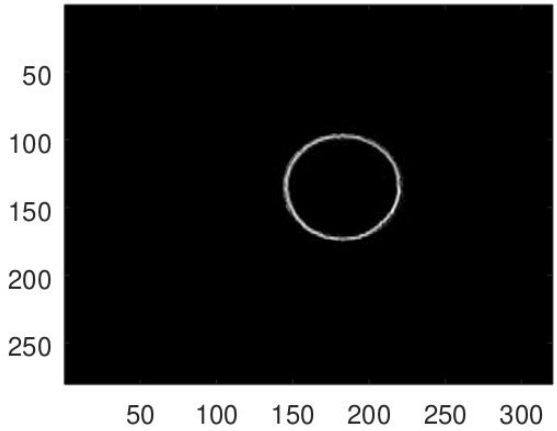
Part II

This is the result of the steps defined in the procedure.









The code works as expected.

Conclusion

This homework was a bit more challenging, but after spending enough time with it, I understand how it works. It's all in the math.

I had to spend a lot of time figuring out how different functions work, including these functions:

- mat2gray()
- imagesc() vs. imshow()
- colormap()
- normalize()

I still don't know the best way to normalize a matrix of doubles (or how the imshow() or imagesc() functions display them), but I hope that's something I can learn about in class. There must be a built-in way to do it, but if not, I could write a function to normalize a 2D matrix.

Overall, the homework was a good experience, and this will be a good foundation for the remainder of the course.