Detection of Obstructions in Vessels in Fundus Images

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Abstract

We developed a software enabling ophthalmologist to detect emboli occurrences in retinal images more easily.
This project's main purpose is to find emboli occurrences inside vessels in eye angiographic images therefore, our primary objective is to reduce the effort spent by the doctor to detect eye diseases.
The main motivation for the ophthalmologist to use this software is to allow the software to interpret the image much more quickly with above average accuracy and precision to reduce the time spent on a single patient so that the doctor can deal with more patients at the same time.

Introduction

The length of time that doctors are able to deal with a patient is significantly reduced in the early hours of the day, especially when the hospital is crowded with waiting patients. Due to lack of time for diagnosis, doctors often miss important details. Our aim is designing and developing a user-friendly software that utilizes image processing techniques to reduce the amount of time required to detect emboli occurrences.

Solution

Our solution is based on two processes which are vessel segmentation and emboli detection. Vessel segmentation is already known as a tremendously challenging task however, it is required to accurately detect emboli occurrences since emboli can only occur inside vessels. In detail, we accomplish this task by using neural networks and deep learning. Training is performed using adaptive learning method rmsprop. Our network is trained to do a pixel classification to determine if a pixel corresponds to the part of a vessel or the background which in final, produces a smoother binary output. Finally, with a simple threshold technique we detect emboli occurrences. All image processing operations are developed using Matlab to segment vessels and find emboli. Also, the GUI part of the system is developed in Visual Studio with C#.

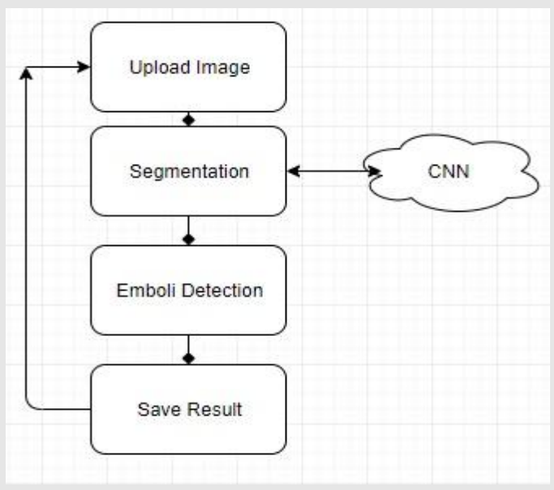


Figure 1 - Flowchart

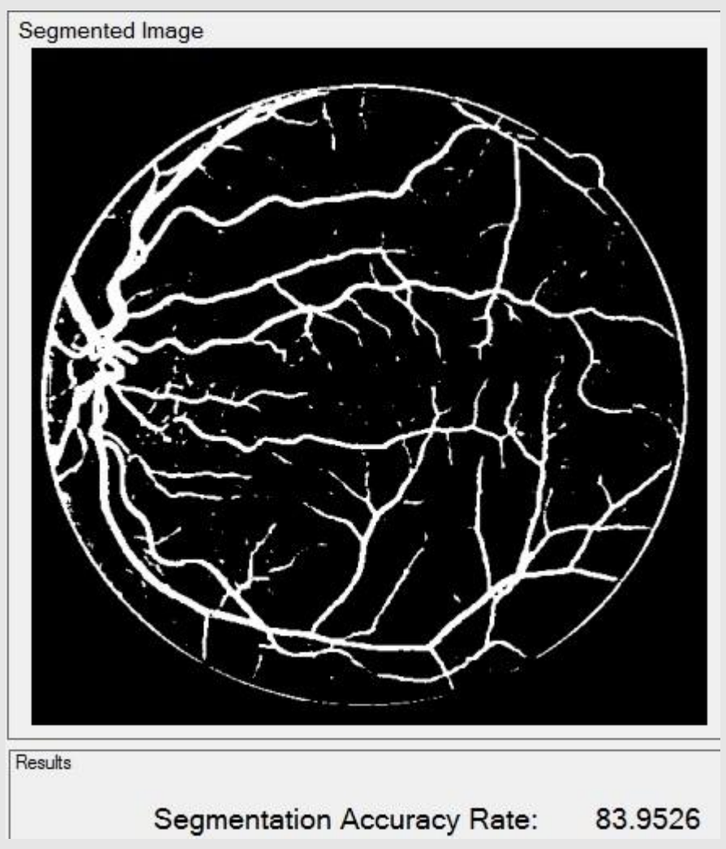


Figure 2 – Segmentation Process

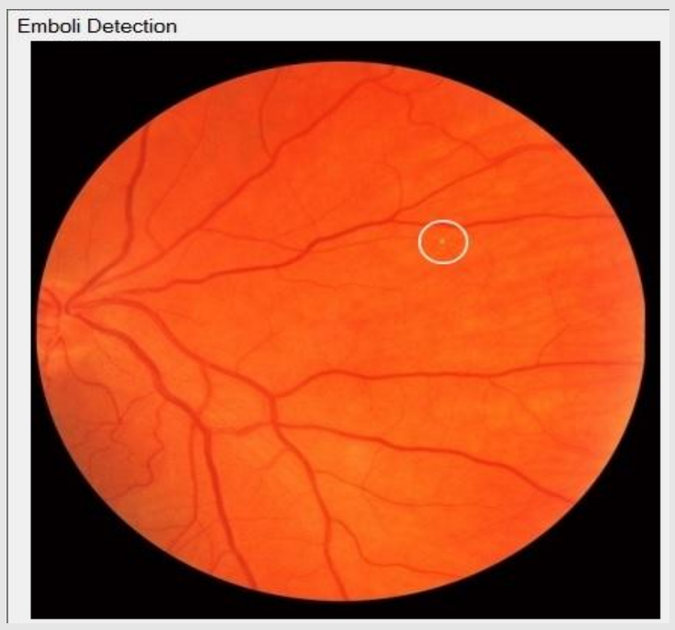
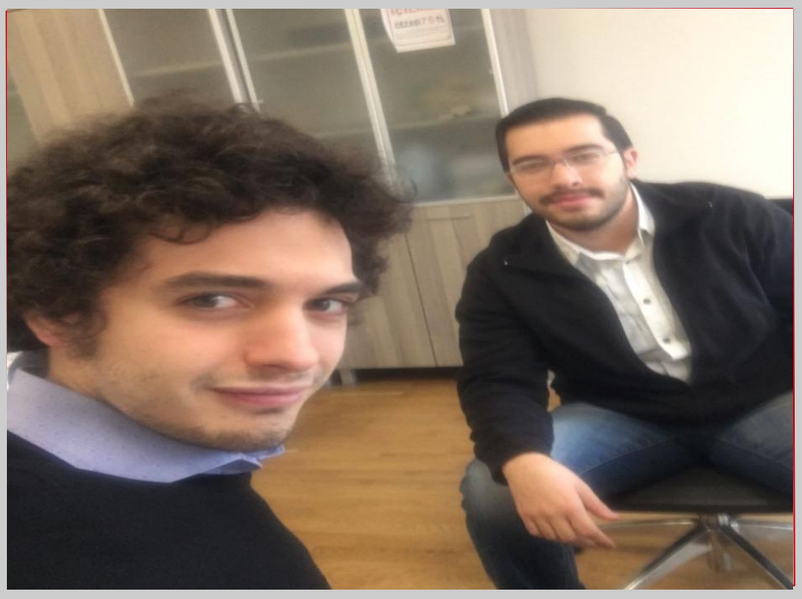


Figure 3 – Emboli Detection



Future Work

We are planning to add a feedback mechanism to allow ophthalmologist to finalize the result with more accuracy.

We are also going to use more powerful hardware for neural network training in order to increase learning accuracy and use deep learning concepts for the emboli detection.

Results & Conclusion

In this project, we have used different technologies, and certainly lots of different methods in order to accomplish segmentation task.
Among the threshold and image matting techniques we have tried, deep learning became our final decision as it is much more accurate compared to previous two methods. We have learned a lot about fundamentals of image processing and software development. Ability to manage time efficiently, handling constantly changing requirements and especially knowledge about neural network concept are valuable lessons gathered from this year's project.
Finally we end up with at max 84 percent and average 75 percent segmentation accuracy due to technological limitations as the training process for the network requires lots of GPU power. For the future, we're planning to increase our segmentation accuracy by using better hardware.

Acknowledgement

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