A web application for manual expert segmentation of retinal and choroidal layers

Degree programme: BSc in Electrical Engineering and Information Technology | Specialisation: Communication Technologies
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Recognizing significant temporal changes in the thickness of the choroid and retina at an early stage is a crucial factor in the prevention and treatment of ocular diseases such as myopia or glaucoma. The goal of this project is to develop a web application to collect a huge amount of manual expert segmentations of the choroid and retina with a comfortable working environment.

Overview

In the last 25 years, Optical Coherence Tomography (OCT) Imaging has proven to be a valuable technique for detecting changes in the thickness of the choroid and retina. Unfortunately, especially in the border area separating the choroid from the sclera, OCT images suffer from low contrast. Recently, huge improvements in detecting such temporal changes were done, due to the continuous developments of machine learning techniques, such as image registration and deep learning algorithms. However, such algorithms need rich reliable datasets that can be provided by experts. In the past manual segmentation was done with markers on transparencies, which took a lot of time (especially the handling of the coordinates of the segmentation curves) and did not meet the current standards of precision. In response to this, my Django based web application provides a user-friendly online tool accessible through the internet and compatible with all internet browsers to collect segmentations from experts.

Implementation

Django is a Python web framework as an MVC (Model, View, Controller) architecture that has been used to implement this web application. The main reasons for using Django are its high security, scalability, and versatility. By supporting tons of packages especially in data science and machine learning, it is ready to host server-side computing and a perfect platform for commercial usages.
The admin page was developed to control user activity and accessibility. The administrator by using this page can easily set up a new experiment, also can monitor the processes and results. The OCT images can be imported after a preparatory process.
Inside this project, some front-end libraries were included like drawing lines on a picture and offering image filters. This means that each user can apply his favorite filter to trace an accurate line. For every B-scan picture from choroid closed to the fovea, three different segmentation such as the Inner Limiting Membrane (ILM), Bruch's Membrane/Retinal Pigment Epithelium (BM/RPE) and Choroidal Sclera Interface (CSI) must be taken into account.

Result

The result is generated as a unique JSON file which contains coordinate of user segmentation of ILM, BM, and CSI for every OCT B-scan.

Conclusion

The outcome of this bachelor thesis is a secure and smart web application that provides reliable datasets for future research in monitoring choroidal and retinal thickness changes. The results can be potentially addressed in upcoming ophthalmological research, as the training set for the development of deep learning algorithms and to validate image segmentation and registration algorithms.

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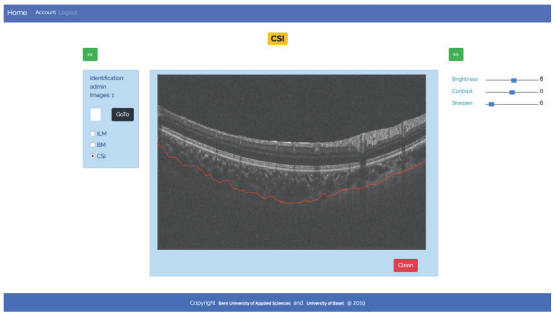
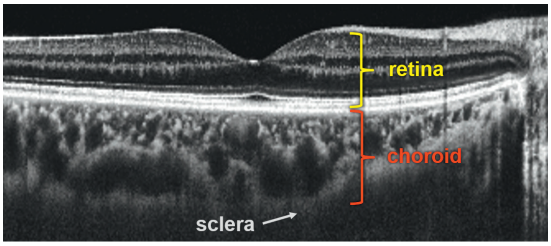


User panel



OCT B-scan of a healthy right eye