Master Thesis Summary

Image Quality Control of Multispectral Imaging in the human eye

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The aim of this master thesis was to develop and test a multispectral retinal imaging device that can capture high-quality images of the retina in multiple spectral bands.

The mobile embedded vision system for multispectral imaging of the retina is based on XIMEA camera and Raspberry Pi computer. A software complex was developed for the system with the possibility of retinal image assessment for algorithm-based diagnostics. The system is controlled through two applications; the first one is responsible for communication with the camera and starting the acquisition of frames. The second one allows for flexible control of the intensity, duration, and sequencing of flashes from the 13 light emitting diodes of visible and infrared spectra.

Additionally, an image quality assessment algorithm was implemented and found to be effective in the current task. The purpose of such an algorithm is to detect low quality images and outliers, as these automatic tools can lead to an incorrect prediction and thus an incorrect diagnosis. A gradient boosting algorithm was applied to differentiate between outliers or low quality retinal images and those acceptable for further medical application. The model presented successful results with high accuracy of quality prediction (98%, binary classification between "good" or "rejected" classes). Moreover, anatomical landmarks such as the blood vessel network and optic disc were extracted using various algorithms inspired by previous researchers, with attempts made to locate the macula and fovea.

Overall, the testing of the multispectral retinal imaging device with promising results provides a foundation for future work in the field of portable medical screening devices. This device and its image quality assessment algorithm can be used in remote areas or places without medical facilities by users with no education or previous experience in ophthalmology. The extraction of anatomical landmarks provides valuable information for further diagnostic applications.