Artificial Intelligence in diagnosis of Diabetic Retinopathy

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Abstract:
Diabetic Retinopathy (DR) is the lead cause of blindness in the developed world. In clinical practice, OCT data is used to measure the retinal layer depth which is used as a biomarker for the diagnosis of multiple related eye conditions and diseases. The goal of the project is to utilize deep learning techniques to predict a spatially resolved retinal depth directly from an infrared fundus image (IR) of the retina, potentially supporting or replacing OCT measurements and additional algorithmic feature extraction methods.

Data and context:
The TUM Eye clinic extensive database contains data from patients visiting the clinic for medical care. This project considers data from patients receiving OCT scans of type Volume containing the depth information of each patient's retinal layers. The data has been gathered from 2001-10-10 until today's date and contains 7575 data records arising from 4807 different visits, 1014 female, and 1150 male patients. Each record represents a visit to the clinic where one IR image and on average 49 OCT images were taken from the left and right eye on one patient. The 49 OCT slices are used to create a Volume map of the eye containing the retinal layer depth information. The retinal layer depth serves as an important biological marker for DRD and clinicians use the IR and OCT together for diagnosis. The OCT is a complex measurement and the process of retaining it from every patient can be costly and inconvenient.

Goals:
The aim of this study is to investigate the possibility of supporting or replacing OCT measurements for determining the depth of patients retinal layers by training Deep Convolutional Neural Networks to directly predict the 3D depth information from the 2D IR image data. Automating this costly process could potentially improve efficiency and enable successful treatment of more patients.

Methods:
We will use the existing OCT measurements to calculate thickness grids which will be spatially coregistered with the IR measurements. Therefore we will build algorithms to automatically segment the retinal layer in each individual OCT slice and interpolate between neighboring slices to obtain a spatially resolved 2D thickness grid. We will use this data to train a neural network which predicts the pixel-wise retinal thickness (== thickness grid) from the IR image. We will evaluate the usefulness of our method by measuring pixelwise depth deviations as well as differences in the predictability of multiple diagnostic outcomes between real and predicted thickness grids.