Using Machine Learning and Image Segmentation to Analyze Retinal Blood Vessel Densities

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Abnormal growth of the blood vessels in the retina of the eye is associated with vision loss; therefore, methods to identify or measure abnormal blood vessels is important in research. One such measurement to identify diseases is the retinal blood vascular density. Yet, current methods to measure retinal vascular density are time-consuming and labor-intensive. This project created a method that can automatically measure retinal vascular density in retinal flat mount images and use this information to identify whether a flat mount is diseased or not. The method used the open-source software FIJI and multiple algorithms including machine learning algorithms. Each retinal flat mount image was automatically segmented to remove unnecessary image components and background noise. The method was run on multiple normal and diseased retinal flat mount images, resulting in an average accuracy rate of 94.3%. An innovative approach was also created to automatically find the specific areas of low vascular density in a retinal flat mount. This approach could potentially be used as another method to identify diseased retinal flat mounts. Sources of error came from algorithms that did not remove all the unnecessary parts of each image, or the images not being perfectly segmented. Future research includes finding more accurate methods of segmentation and removal of unnecessary components, and implementing algorithms to recognize patterns or region of interest in a diseased retina.