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Segmentation of Retinal Blood Vessels from Fundus Images Using U-Net Model

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Abstract: *Abnormal blood flow within the retinal vessels is a key factor behind many optical disorders, including partial vision impairment and blindness. Precise segmentation of blood vessels in retinal images is crucial for applications such as biometric identification, computer-aided laser surgery, automated screening, and the diagnosis of eye conditions like diabetic retinopathy, age-related macular degeneration, and hypertensive retinopathy. Early and accurate detection of retinal blood vessels aids medical professionals in implementing effective treatment strategies to minimize vision loss. Automated retinal vessel segmentation plays a significant role in addressing a variety of optical diseases, especially with the rising number of patients requiring such analysis.*

The manual segmentation process can be time- consuming and labor-intensive, making automated systems a practical alternative. Retinal blood vessels are critical in diagnosing and treating numerous retinal disorders, highlighting the importance of extracting vasculature for medical assessments. Various machine learning methods, such as Support Vector Machines (SVM), are employed for segmentation tasks; however, deep learning models surpass traditional approaches like SVM in performance and accuracy. Presently, deep learning architectures like fully convolutional networks and encoder-decoder models are widely used. Among these, U-Net and V-Net are notable frameworks for biomedical image segmentation. Among these U-Net and V-Net are notable frameworks for biomedical image segemenation.

To enhance the accuracy of retinal blood vessel segmentation, this project explores the use of transfer learning techniques. The U-Net model employs VGG-19 as a pre-trained encoder. The study focuses on evaluating the impact of transfer learning by freezing encoder layers incrementally, training the model after each step, and recording the results. These statistics are then analyzed to measure the effectiveness of transfer learning in this context.

Keywords: Retinal Blood Vessel Segmentation (RBVS), Fundus Images (FI), U-Net Model, Transfer Learning (TL), Diabetic Retinopathy (DR), Deep Learning (DL) in Medical Imaging

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