RetinalVasNet: Integrating DenseNet and UNet for the Retinal Microvasculature Segmentation using the Multi-Proportion Channel Data of the Fundus Images

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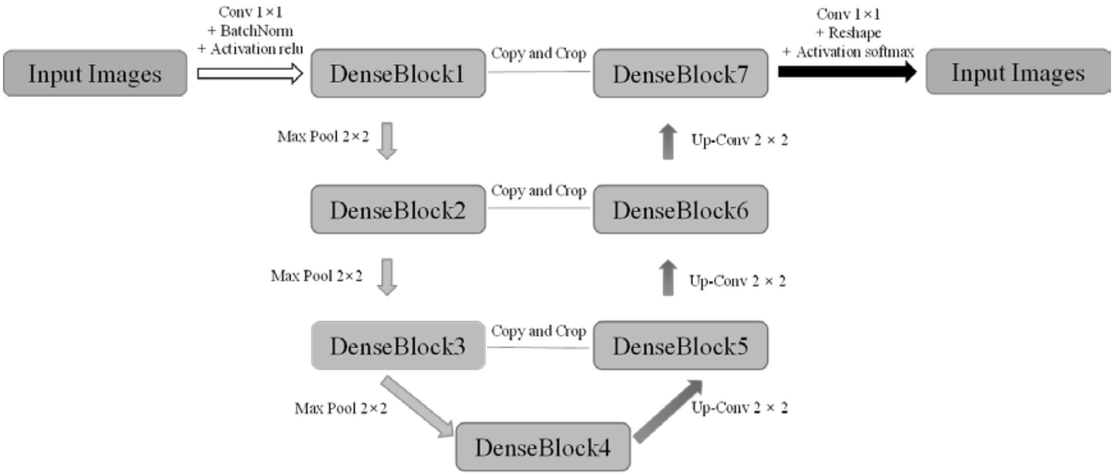
Framework of RetinalVasNet

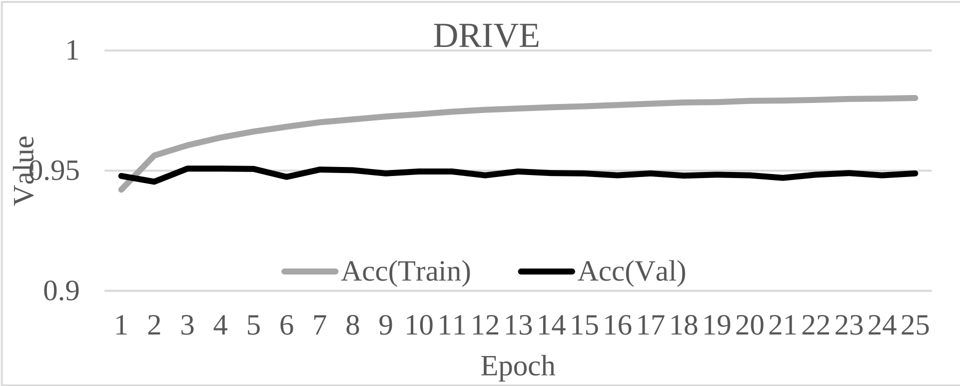


Supplementary Figure 1. Architecture of RetinalVasNet.

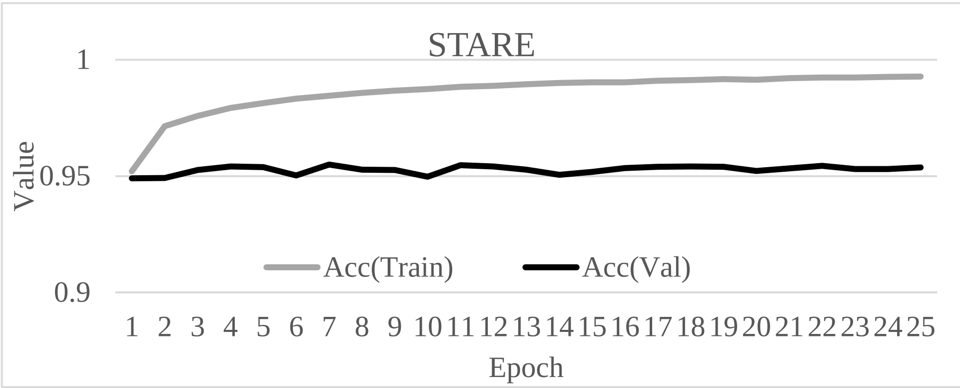
This study replaced the Conv2d layers of UNet [1] with the Conv2d layer DenseBlock of the DenseNet [2]. RetinalVasNet is symmetric in shape and has two paths of inter-layer connections, as shown in Supplementary Figure 1. The down-sampling path is designed to connect the layers DenseBlock1, DenseBlock2, DenseBlock3 and DenseBlock4, which may capture semantic and contextual information. The other up-sampling path is designed to remove spatial information, and connects the layers DenseBlock4, DenseBlock5, DenseBlock6 and DenseBlock7. The skip connections between layers DenseBlock1 and DenseBlock7, DenseBlock2 and DenseBlock6, and DenseBlock3 and DenseBlock5 were added to recover the image information lost in the pooling or down-sampling layers. The skip connections applied a concatenation operator, instead of the sum operator in UNet.

Tuning the parameter epoch

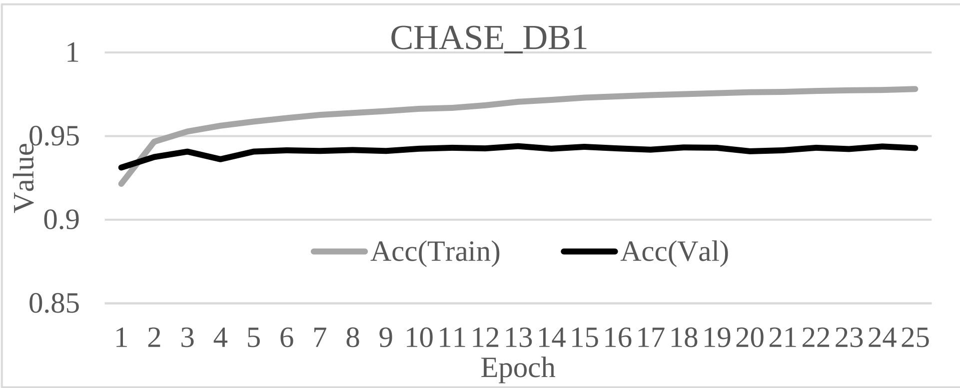
As shown in the Supplementary Figure 2, when the epoch is 20, the train accuracies of the three groups of data had been roughly stabilize. After 20 epochs, there are no significant change in their train accuracies (Acc(Train). Similar patterns were also observed for the validation dataset. So this study chosen 20 epochs for the proposed RetinalVasNet.



(a)



(b)



(c)

Supplementary Figure 2. Prediction accuracies of RetinalVasNet on the training and testing datasets. Acc(Train) and Acc(Val) are the prediction accuracies of the model on the training and validation datasets for the datasets (a) DRIVE, (b) STARE, and (c) CHASE_DB1.

References

1. U-net: Convolutional networks for biomedical image segmentation. International Conference on Medical image computing and computer-assisted intervention; 2015. Springer.
2. Densely connected convolutional networks. Proceedings of the IEEE conference on computer vision and pattern recognition; 2017.