COMP9517 Group Project

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*Abstract——Examination of the retina and its associated parts, such as optic-nerve, cup, vessel, disc are widely preferred in Ophthalmology to identify the retinal abnormalities and to plan/implement appropriate treatment procedure to cure the disease. Retinal ... segmentation is a key step towards the accurate visualization, diagnosis, early treatment and surgery planning of ocular diseases. Recently, deep learning based retinal vessel segmentation methods have reached the state of the art performance. Due to the extreme variations in the morphology of the vessels against the noisy background, these methods still have issues of dealing with small thin vessels, low discriminative ability at the optic disk area, etc. In this paper, we proposed a U-Net-like model with the weighted attention mechanism and the skip connection scheme for addressing these issues.*

Keywords—Retinal image, Segmentation, Deep learning, (key words)

# Introduction (*Heading 1*)

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# Literature Survey

## Group 1: U-net

I analyzed the essay IDRiD Diabetic Retinopathy Segmentation and Grading Challenge [1] which is a comprehensive report of the Retinopathy Segmentation challenge. The manners of segmentation in this essay is mainly based on deep learning. We compared different neural network structures. Most of the structures used U-net and ensembled other structure. The team VRT in the challenge used original U-net structure and averagely got the best performance. Also, according to their essay[2], after reducing image resolution by about 6 times, compared to original resolution, U-net achieved less false positive and better sensitivity with lower resolution input. Using lower resolution image also alleviates computation pressure. Therefore, we referred their U-net structure which is elaborated in their essay.

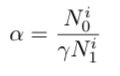
# Method

## Group 1: U-net

#### Image Preprocessing: Firstly, we cropped original image from 4288 x 2848 to 3500 x 2848 by reducing its width. Secondly, we padding the image to 3500 x 3500 and followed by resizing it to 640 x 640 through bicubic interpolation to protect image details. Thirdly, to do normalization, each image is divided by 255 as the network input. Also, we did augmentation such as flipping, scaling, rotating and adding Gaussian noise.

#### Network Model: We used U-net structure which is modified by team VRT [3]. The input fundus image size is 640 x 640 x 3, the detail of convolutional blocks are shown as Table 1. After 4 times max-pooling, the image size is down to 40 x 40, and then the image is up-sampled to the original size with one channel. In the process of up-sampling, we concatenate the up-sampling layers with corresponding initial layers because the features are important in both initial layers and up-sampling layers for segmentation.

#### Loss Function: Because of the last layer of the model is sigmoid, the output of the image is in the range of [0, 1]. We used weighted binary cross entropy as loss function. In the function, k is the batch size. α is the weight which is calculated by N0 and N1. N0 is the number of background and N1 is the number of foreground. γ is the hyperparameter that we need to choose. The reason why we use the weight in the binary cross entropy is because the background area is significantly large in the image. We need to use the weight to reduce the false negative to reduce the loss. We use Adam optimizer as optimization and set learning rate as 1e-4.



(2)

# Experimental Setup

## Group 1: U-net

In this method, we use deep learning method to achieve the Retinopathy Segmentation. The neural network we use is U-net structure.

#### Image Preprocessing: The preprocessing is based on the method illustrated in Section III(A). On the original image which has size of 4288 x 2848, we crop and pad it to 3500 x 3500. Then we use bicubic interpolation to resize it to 640 x 640.

### Segmentation result: We used formula and byper parameters in the Section III(A). Here we show some of the result of our output.

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1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
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7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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