Retinal Vessel Segmentation(RVS)

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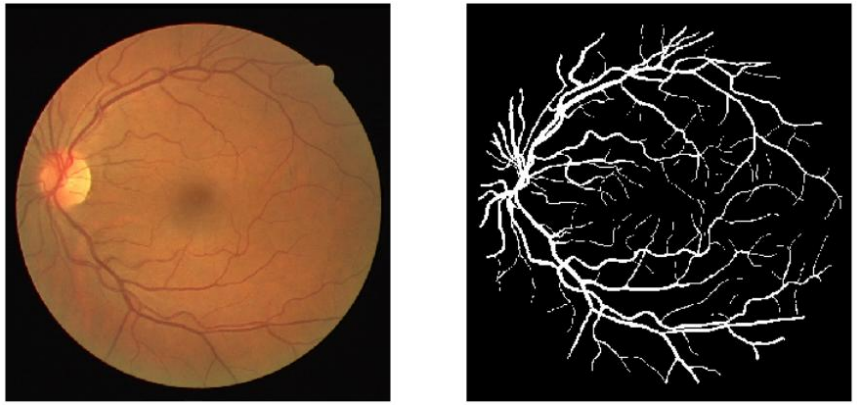
Contents

Background

- What is retinal vessel segmentation(RVS)?
  - retinal images[1]
    - a digital picture of the back of your eye.
    - it shows the retina, the optic disc, and blood vessels,which helps ophthalmologist find certain diseases
  - vessel segmentation
    - remove the background information and keep only the vascular information

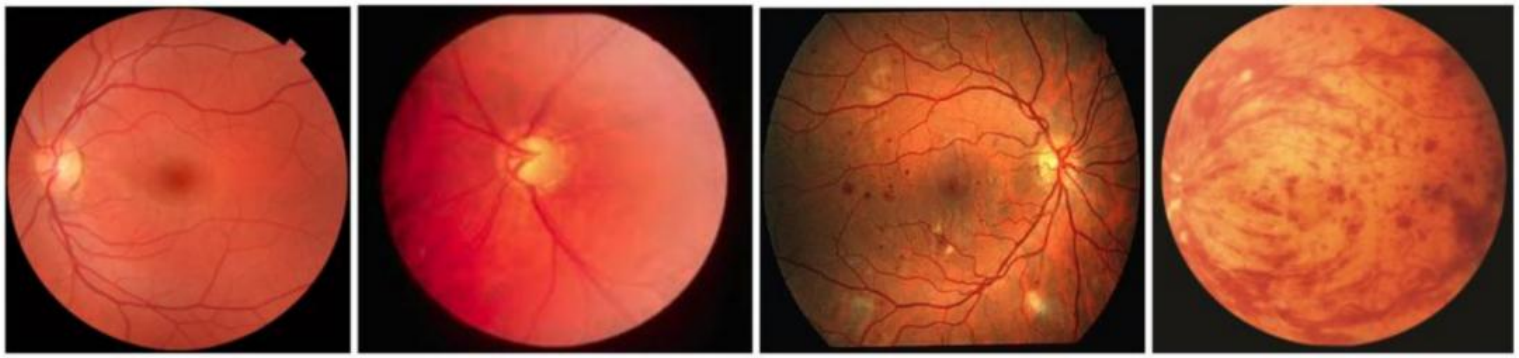


retinal image and manual annotation segmentation image[2]

[1] https://www.webmd.com/eye-health/what-is-retinal-imaging
[2] J. Staal, M. D. Abramoff, M. Niemeijer, M. A. Viergever and B. van Ginneken, "Ridge-based vessel segmentation in color images of the retina," in IEEE Transactions on Medical Imaging,

Background

- Why retinal vessel segmentation is important?
  - Analyzing the length, width, curvature, bifurcation pattern and other structural characteristics of blood vessels can obtain the pathological characteristics of many diseases[3][4]



Retina images under different conditions. (a) Healthy retina, (b) Glaucoma, (c) Diabetic Retinopathy, and (d) Retinal vein occlusion.

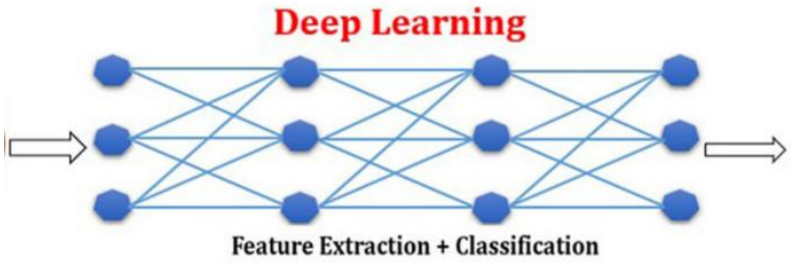
[3] WU H S, WANG W, ZHONG J F, et al. SCS-Net: a scale and context sensitive network for retinal vessel segmentation [J]. Medical Image Analysis, 2021, 70: 102025.
[4] WANG S J, YU L Q, LI K, et al. DoFE: domain- oriented feature embedding for generalizable fundus image segmentation on unseen datasets[J]. IEEE Transactions on Medical Imaging, 2020, 39(12): 4237-4248.,

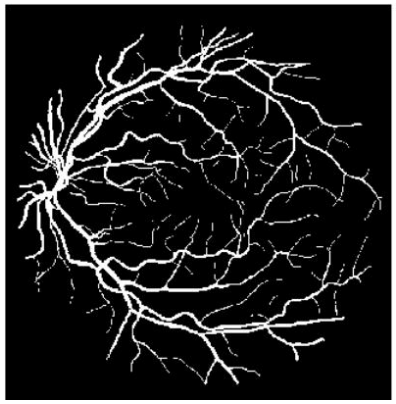
Contents

Goal statements

- Goal
  - generate the final retinal blood vessel segmentationimages
    - Input: retinal images
    - Output: corresponding vessel segmentation image

Input





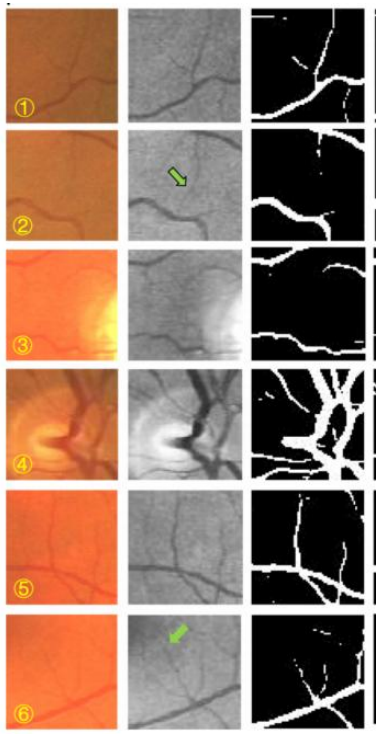
Output

Goal statements

Stretch Goals

- repair some breakpoints on blood vessel segmentation images

Examples of breakpoints on the segmentation images[5]



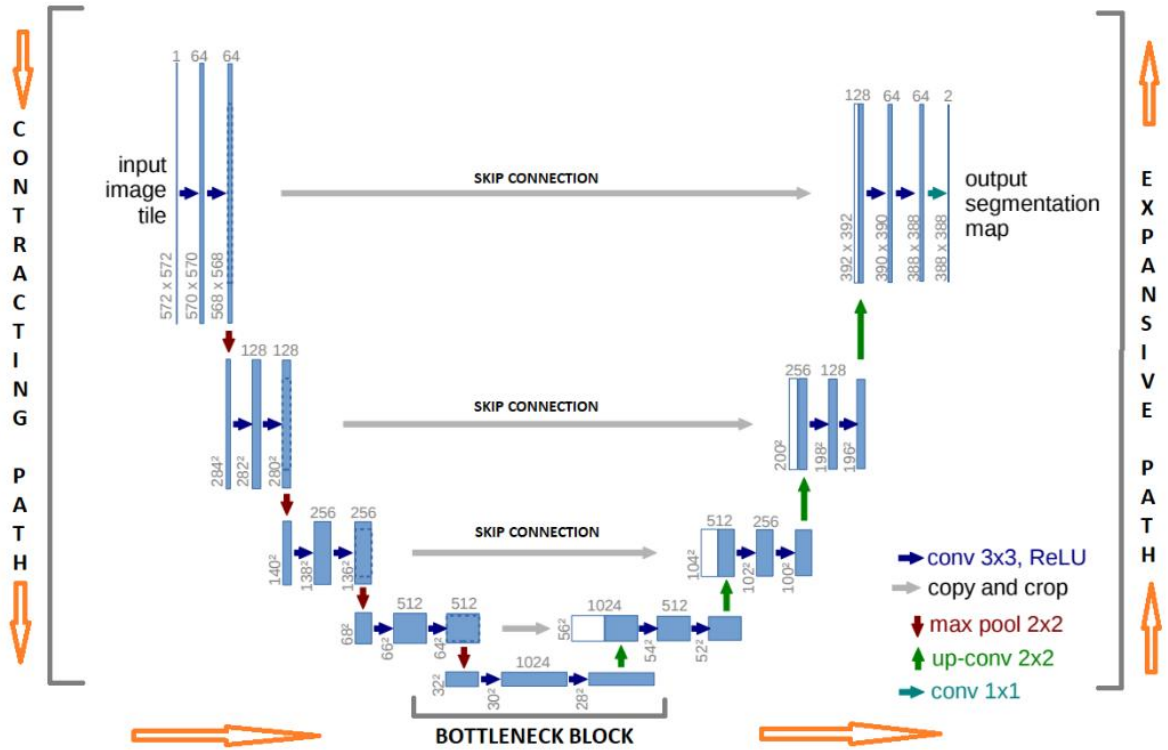
some patches on DRIVE dataset [5]

[5] Lian, Sheng, et al. "A global and local enhanced residual u-net for accurate retinal vessel segmentation." IEEE/ACM transactions on computational biology and bioinformatics 18.3 (2019): 852-862.

Contents

Model

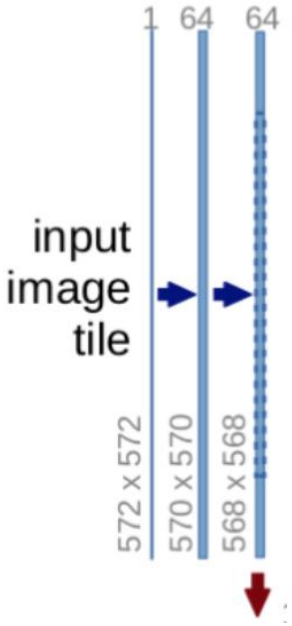
- U-Net[6]
  - The Contracting/Downsampling Path.
  - Bottleneck Block.
  - The Expansive/Upsampling Path.



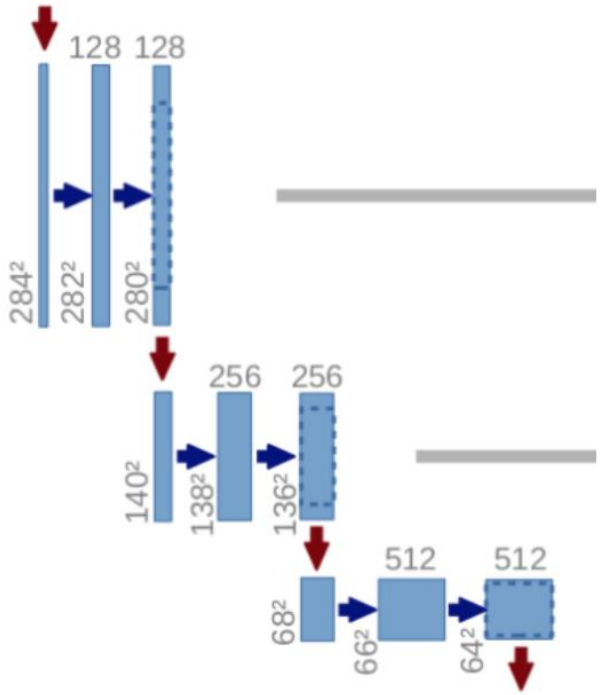
[6] Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation."

Model

- The Contracting/Downsampling Path.
  - It consists of two 3x3 unpadded convolutions each followed by a rectified linear unit (ReLU) and a 2x2 max pooling operation with stride 2 for downsampling. After each downsampling operation, the number of feature channels are doubled.



input block



contracting path

Model

Bottleneck Block

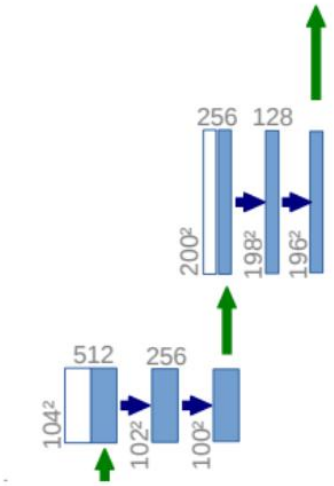
- The bottleneck block connects the contracting and the expansive paths. This block performs two unpadded convolutions each with 1024 filters and prepares for the expansive path.

bottleneck block

Model

Expansive Path

- Every step in the expansive path consists of an upsampling of the feature map followed by a 2x2 convolution (“up-convolution”) using transposed convolutions, a concatenation with the correspondingly feature map from the contracting path, and two 3x3 convolutions, each followed by a ReLU. Transposed convolution is an upsampling technique to expand the size of images.



Expansive Path

Model

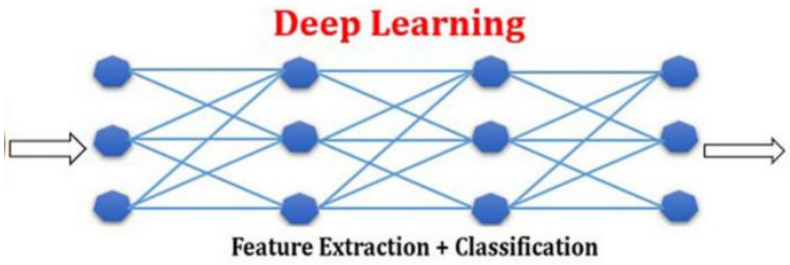
- Evaluation Criteria
  - Accuracy
    - a widely used evaluation metric for the task of binary segmentation
    - computes the percentage of correctly classified pixels in the whole image
    - $ACC = \frac{TP + TN}{TP + FN + TN + FP}$, where TP, TN, FP and FN represent the number of true positive, true negatives, false positives and false negatives, respectively.

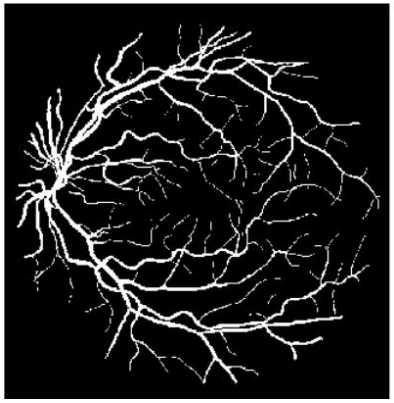
Contents

Conclusion

- Goal
  - Generate the final retinal blood vessel segmentation images
  - Stretch Goals: repair some breakpoints on blood vessel segmentation images

Input





Output

- Model
  - U-Net
  - Evaluation Criteria: accuracy

Questions?