Modified U-Net for vessel centerline extraction and arteries veins classification

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Chapitre 1: Architecture details

1.1 Preprocessing

To achieve efficient extraction of the centerline of vessels and classify them as arteries or veins, preprocessing has been applied. The fundus images contain numerous intricate details, particularly due to the complex morphology of the eye. Additionally, the image contrast varies due to the curvature of the retina. To address these issues, the Contrast Limited Adaptive Histogram Equalization (CLAHE) technique was applied to the original images. However, it was observed that this process introduced some noise into the images. To mitigate the noise, a median filter was applied. Given the retina's high level of detail and to enhance training efficiency, the images were further cropped.

1.2 Training

After the preprocessing step, we obtained 14,400 cropped images. For training the architecture, we used 80% of these images, which amounts to 11520 images. A separate set consisting of 10% of the images, equivalent to 1440 images, was allocated for validation purposes. The remaining 10% (1440 images) were designated for testing the performance of the model.

The proposed architecture has been trained on the preprocessed images, with :

- ✓ Batch size : 16
- ✓ Learning rate : 10^-5
- ✓ Optimizer : Adam
- ✓ Loss function : categorical crossentropy

The modified U-Net architecture was trained for 150 epochs using 11520 cropped images. The validation process was performed on 1440 cropped images, and subsequently, the model was tested on an additional 1440 cropped images.

1.3 Evaluation

The model was evaluated using loss rate (fig 1), accuracy, recall, and precision metrics.

Accuracy measures the overall correctness of the model's predictions by calculating the ratio of correctly classified samples to the total number of samples evaluated.

Accuracy = (TP + TN) ÷ (TP + FP + FN +TN)

Recall, also known as sensitivity or true positive rate, measures the ability of the model to correctly identify positive samples. It is calculated as the ratio of true positives to the sum of true positives and false negatives.
Recall = (TP) ÷ (TP + FN)

Precision represents the model's ability to accurately identify positive samples among all samples predicted as positive. It is calculated as the ratio of true positives to the sum of true positives and false positives.
Precision = (TP) ÷ (TP + FN)

These metrics provide valuable insights into different aspects of the model's performance and can help assess its effectiveness in classifying arteries and veins accurately.

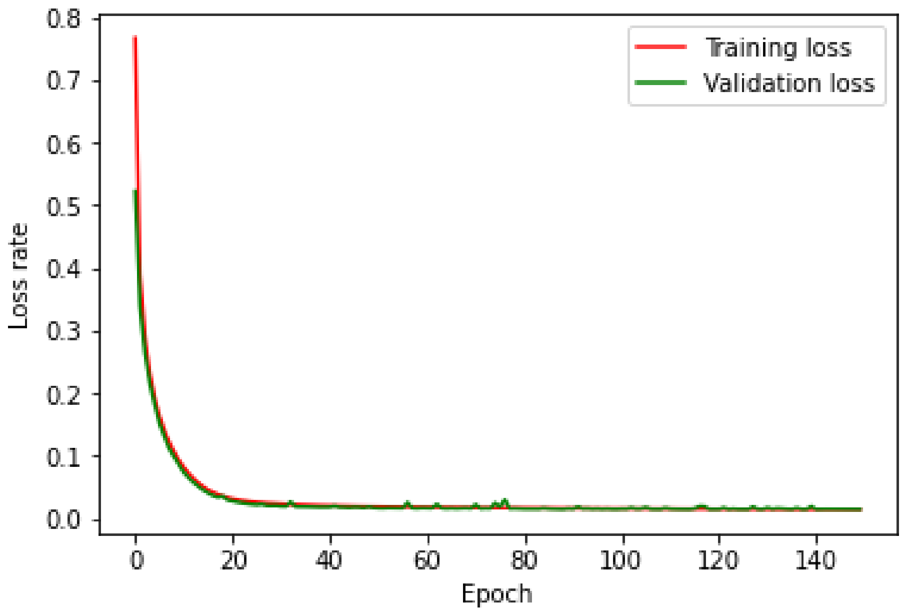

FIGURE 1. Loss rate curve