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Segmentation Of the Transverse section of the Carotid Artery using U-Net

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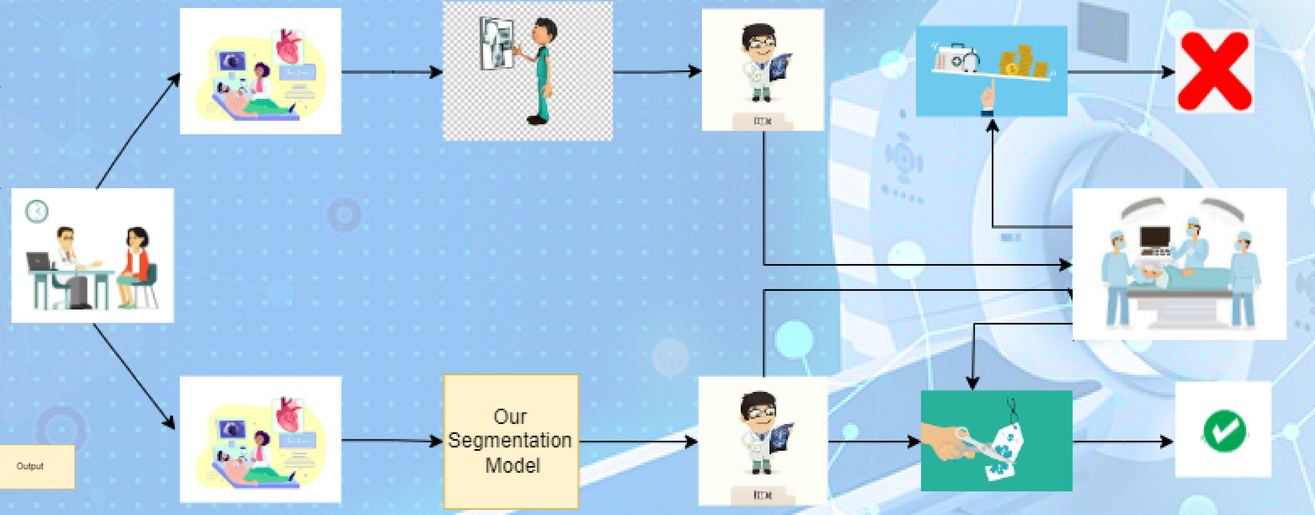
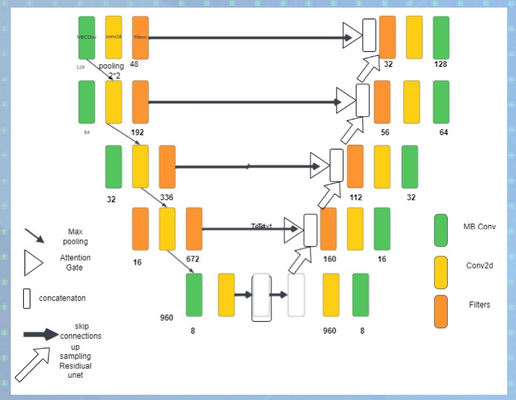
Abstract

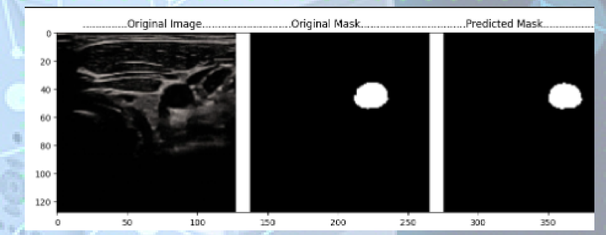
Accurate segmentation of the common carotid artery (CCA) is a challenging task in medical imaging analysis due to the complexity and variability of the CCA structure. In this paper, we propose a novel approach for CCA segmentation using an EfficientNetB4 Attention-Residual U-Net (EAR U-Net) model, which incorporates an attention mechanism and a Residual block to improve segmentation accuracy. We evaluate the performance of the EAR U-Net using the Common Carotid Artery Ultrasound Images dataset and compare its results with those of traditional U-Net and attention U-Net model.





The proposed solution in this project combines various techniques, particularly the EAR-UNET technique, to achieve improved image segmentation. The encoder-decoder framework involves using EfficientNetB4 as the first layer, which balances the model's width, depth, and resolution. The building block of EfficientNet, the MBConv block, performs essential operations such as expansion, depthwise convolution, and squeeze-and-excitation. The decoder part consists of residual blocks with skip connections to preserve spatial information. Skip connections, also known as residual connections, address the vanishing gradient problem and can be enhanced with attention mechanisms to selectively emphasize relevant features. The attention-based gating mechanism allows for improved performance by focusing on important features while suppressing irrelevant ones. The exact implementation may vary based on the specific network architecture and requirements.

Results



The EAR U-Net achieved a Dice coefficient of 0.9531, recall of 0.9441, and precision of 0.9663

Conclusion

we proposed a new architecture called EAR UNet for the segmentation of the common carotid artery (CCA) in ultrasound images. The proposed EAR U-Net incorporates an attention gate and residual blocks to improve the segmentation accuracy of the CCA. We compared the performance of EAR U-Net with a normal U-Net and a UNet with attention gates. The experimental results showed that EAR U-Net outperformed the other two models in terms of dice coefficient, recall, and precision.