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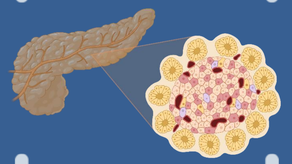

DIABETIC RETINOPATHY SEGMENTATION

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Abstract

The number of diabetes patients around the world is predicted to reach 700 million in 2045. Among this, 1 in 3 people will have Diabetic Retinopathy by 2040. Since Diabetic Retinopathy can lead to complications like loss of sight, its timely detection is highly preferable.

Currently, the doctor must physically analyze the fundus of the eye and grade it to find the progression of Diabetic Retinopathy. This is a tiresome and time-taking task. Hence, it is highly advantageous to have a smart method to automatically detect the presence of Diabetic Retinopathy. Retinal Blood Vessel segmentation plays a crucial role in developing such systems.

This study aims to explore a **Deep Learning** method that can be used to perform retinal blood vessel segmentation from fundus images.

Research Objective

Perform retinal blood vessel segmentation using arecentdeep-learning technique and test if it performs well on more than one dataset.

Introduction

Diabetic Retinopathy is a serious complication that can result from Diabetes. Currently, ophthalmologists must physically analyze the fundus of the eye to measure the seriousness of the condition. This procedure is time-consuming since the number of ophthalmologists present is too small compared to the number of people to be examined, which means a lot of patients are not receiving medical care at an early stage of their condition. Many deep learning techniques are being used for developing Computer-Aided Design systems for Diabetic Retinopathy detection. We used a deep learning method for segmenting the retinal vasculature from fundus images.

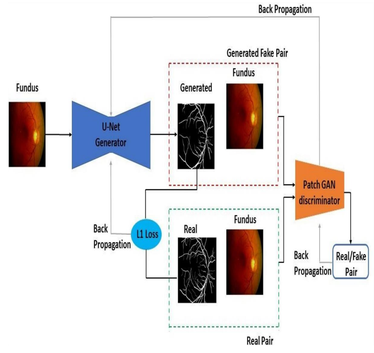

Figure 1. Proposed Method.

Results

Figure 2 illustrates the visual results that were obtained in this study.

Table 1 provides a comparison of this study with recent studies in terms of several metrics.

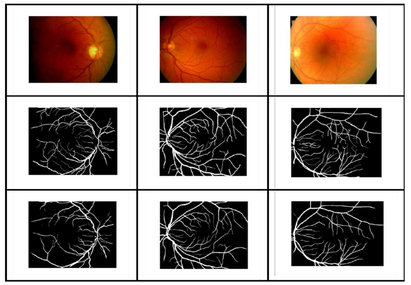

Figure 2. Retinal Blood Vessel Segmentation Results(First Row: Fundus Images, Second Row: Groundtruth, Last Row: Results).

Table 1. Comparison with previous methods.

Metric	Azzopardi's method [1]	Kar's method [2]	Prajna's method [3]	Proposed Pix2Pix GAN
Accuracy	0.94	0.963	0.925	**0.971**
Sensitivity	NA	0.718	0.566	**0.974**
Specificity	NA	**0.984**	0.961	0.969
Dice	NA	NA	0.649	**0.97**
Jaccard	NA	NA	0.48	**0.942**
Precision	NA	0.795	NA	**0.966**

Discussion

The Pix2Pix GAN model used in this study was found to yield good results for retinal blood vessel segmentation by obtaining high **accuracy, sensitivity, dice, Jaccard, and precision** values. The visual comparison between the obtained results and the ground truth also provides appealing results.

The experiment was repeated using another dataset to ensure that the model performs well on different datasets containing images collected under different settings. The results obtained were similar to those obtained in the initial experiment.

Conclusions

A comprehensive review of the existing literature in the field of Diabetic Retinopathy detection was conducted as part of this study.

The proposed Pix2Pix GAN model was able to perform retinal blood vessel segmentation with high accuracy, sensitivity, Dice, Jaccard, and precision.

In future work, we would like to work on detecting tiny blood vessels with higher accuracy. Another promising future direction of work will be to perform Diabetic Retinopathy lesion detection using Explainable Artificial Intelligence.

Sidra Medicine

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