Predicting the Presence and Severity of Diabetic Retinopathy Using Classifiers, Resnet50, and Generative Approaches

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Predicting

Diabetic retinopathy (DR) eye disease is the leading cause of blindness in the developing world and is notoriously difficult to diagnose. Current detection methods are time-consuming and require several days to yield a diagnosis, leading to lost follow up, miscommunication, and delayed treatment. We aimed to diagnose the presence and severity of DR given retina images by utilizing the following techniques: classifiers (linear and deep CNN), Resnet50 (frozen and finetuned, with and without classification layers) and generative approaches (basic and BigGans), as shown in Figure 1. We found that ____(results)_____________.

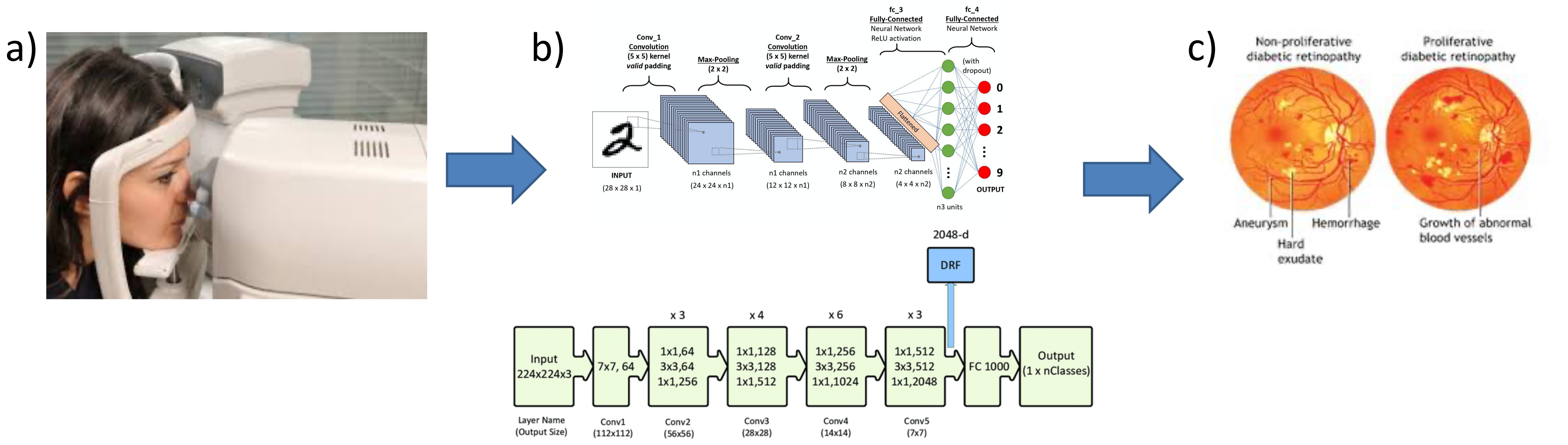

Figure 1: Schematic of the proposed approach to detect DR. a) An example of a fundus examination, which provides pictures of the retina, b) The proposed ML mechanisms: Deep CNN classifier (top) Resnet50 (bottom), c) Healthy and DR-diagnosed retina

Data

Our dataset contains high-resolution retina images taken using fundus photography. For each patient, photos of both the left and right eyes are included. The images in this dataset come from a wide variety of clinics over an extended period of time, and therefore were taken using different types of cameras, greatly influencing the visual appearance of the photos. While some photos display the eye as one may see it anatomically, others are inverted due to the use of a microscope condensing lens. Within the labeled data, a clinician has already rated the presence and severity of diabetic retinopathy (Figure 2). There also exists a large amount of unlabeled data that we used in our generative approaches.

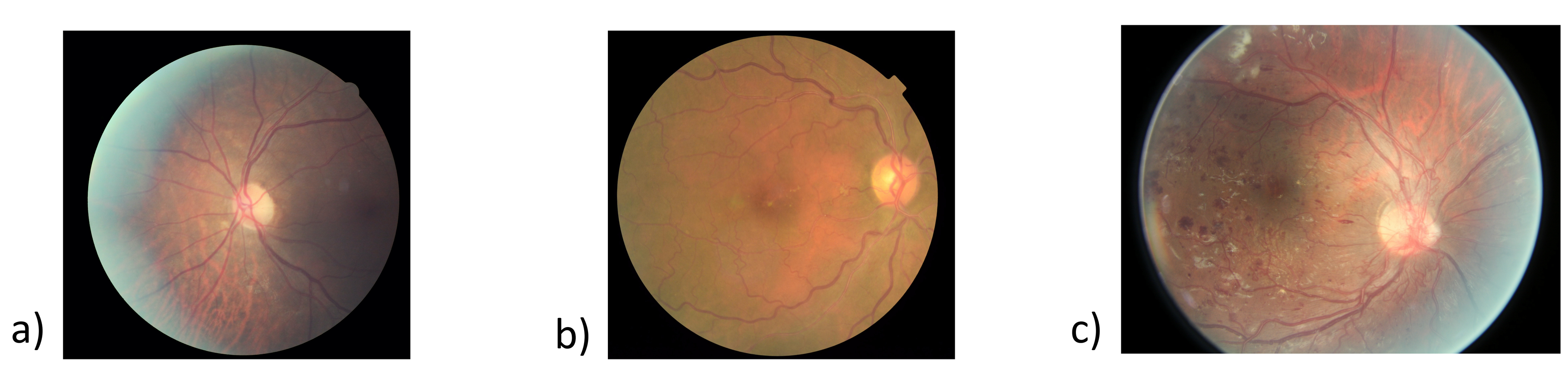

Figure 2: Examples of retina images from the dataset. a) Healthy left eye with no DR, b) Right eye with moderate DR, c) Left eye with proliferative DR, picture did not include top and bottom of retina

Features

We only utilized three features that all came from the raw input. These features were image, content, and level. None of our models required any other handcrafted features

Models

We first used a linear classifier, with the flattened image as the input, and a deep CNN classifier, using 6 layers of 2D convolutional neural network and ReLU activation to transform our image input. Our next model used the Resnet50 architecture, after which we both froze and finetuned the layers along with a classification layer, and also used two linear layers with frozen Resnet50. Our last set of models centered on a generative approach that created fake images (Figure 3). We evaluated a basic generator with a basic discriminator, as well as a BigGans generator with a Resnet50 discriminator.

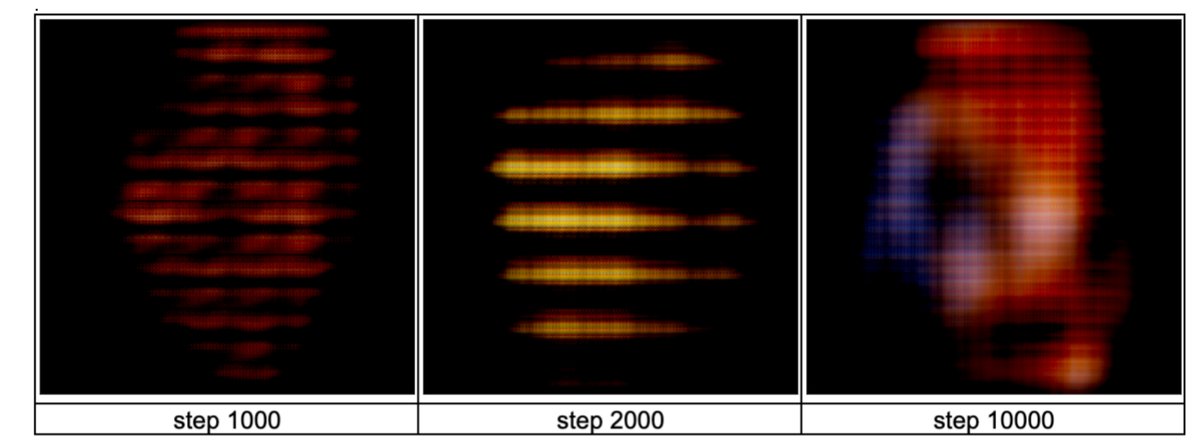

Figure 3: Sample of fake images from the generator at various steps

Results

Model	Train Accuracy	Test Accuracy
Linear Classifier	0.581	0.5761
Deep CNN classifier	0.7396	0.7292
Resnet50	0.7339	0.7288
Frozen Resnet50 + Classification layer	0.5897	0.5653
Finetuned Resnet50 + Classification layer	0.7358	0.73
Frozen Resnet + Deep Classifier	0.5699	0.5307
Basic Generator + Basic Discriminator	-	0.7331
BigGans Generator + Resnet50 Discriminator	-	0.7782

Discussion

Future

References

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