Diabetes detection using ML

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Objectives

Detection of retinal damage due to diabetes using OpenCV and Tensorflow.

- Data preprocessing which includes cropping of the image to remove unnecessary background, scale all the images to same dimension.
- Increasing the brightness of the image with the help of alpha beta correction.
- Plot heat maps, histograms of different levels to understand the underlying pattern.
- Select hyperparametres for neural network model.

Introduction

Diabetic Retinopathy (DR), also known as diabetic eye disease, is a medical condition in which damage occurs to the retina due to diabetes mellitus. It is a leading cause of blindness.

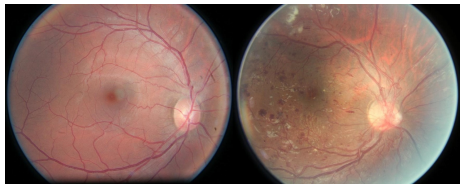

Figure 1:Left side of figure shows a healthy eye while right side shows a eye with severe DR

- Currently, detecting DR is a time-consuming and manual process.
- This requires a trained clinician to examine and evaluate digital colour fundus photographs of the retina.
- By the time human readers submit their reviews, often a day or two later, the delayed results lead to lost follow up, miscommunication, and delayed treatment.

The Approach

The dataset consists of retinal images of both left and right eyes. Data augmentation was performed which included applying horizontal and vertical flips and assigning a random hue to the image for adjusting contrast. Each image then had 4 copies to ensure:

- Data set is independent of the eye colour and the type of eye whether right or left as we are only interested in detecting white patches on the retina.
- After preprocessing of data, model was applied i.e CNN(Convolutional Neural Network) was applied with varied layer structure to match our goal.

MODEL

- Developed a Machine Learning model that (a) can predict the severity of diabetes on a scale of 0-4 based on the image of eyes. (b) can replace the age old clinical process of detection.
- Model uses CNN with layers - Input, Dropout, Convolution 2-D, Max-Pooling, Fully connected layer(Dense).
- Convolutional layer- to detect the patterns of white spots in image, Dropout- to reduce the dimensionality of our image and Max-Pooling- to select pixels with highest effect on the outcome.
- Hue was assigned to the image as a preprocessing step with a value that kept the total brightness in range from m−1.2∗s to m+1.2∗s where m is mean and s is standard deviation.

Workflow

Figure 2:This image acts as a noise because the retinal arterioles are not clearly distinguished.

Inference

- The model was able to detect results with an accuracy of nearly 80%.
- Through hue assignment and flipping the images, the model was introduced to different images which made it independent of the type of eye.
- The dataset was large so we abstracted out the type of eye and the brightness and colour of the eye.

Experiments and analysis

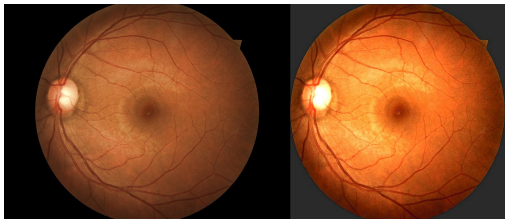

Figure 3:This figure represents the change in image after applying data pre-processing.

Results after CNN

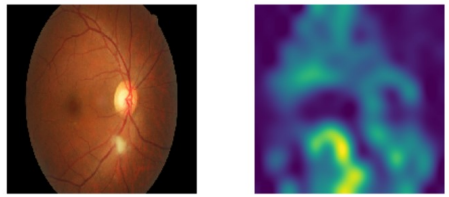

Figure 4.This heat map represents the effect of each pixel on the outcome, lighter pixels have more weightage.

References

- https://www.kaggle.com/tanlikesmath/diabetic-retinopathy-resized
- https://www.mayoclinic.org/diseases-conditions/diabetic-retinopathy/symptoms-causes/syc-20371611
- https://medium.com/@RaghavPrabhu/understanding-of-convolutional-neural-network-cnn-deep-learning-99760835f148

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