[Team 17] ProjF Proposal: Eye Cataract Glucoma Retina-Disease (ECGR) Classifier

Pramodini Karwande
M.S. in Electrical Engineering
North Carolina State University
Durham, North Carolina
pkarwan@ncsu.edu

Md Farhamdur Reza
PhD in Electrical Engineering
North Carolina State University
Raleigh, North Carolina
mreza2@ncsu.edu

Rageeni Sah
M.S. in Electrical Engineering
North Carolina State University
Raleigh, North Carolina
rsah@ncsu.edu

I. Motivation

Eye diseases like cataract, glaucoma, and retina diseases are prevalent in the present world and causing more of blindness among people [1]. It is required to have a highly trained eye specialist to detect the eye diseases, and for a layperson, it sometimes becomes difficult to carry the expense. However, the capability of trained machine learning algorithms can help doctors to classify eye problems easily without having huge experience.

In this work, we will build a model that will classify whether a person's eye is normal or not. The classifier will also classify, if the person's eye is not normal, the type of problem in the eye. Cataract dataset [2] from Kaggle will be used to train our model. To propose a model, deep neural network model will be used and evaluate the performance using the given dataset.

The main technical difficulty that may be faced is due to the number of available samples of the Cataract dataset. Moreover, the dataset is an imbalance in terms of the number of normal images and the number of images for each type of eye problem.

II. Dataset Description

As it is mentioned, we are going to use the Cataract dataset available in Kaggle. The cataract dataset consists of 601 retina images, and are classified into four categories: normal, cataract, glaucoma, and retina disease. In the datasets, the number of normal retina images is 300, and the number of images with cataract, glaucoma and retina diseases are 100, 101 and 100 respectively. Furthermore, it is found that the dimension of the given dataset varies from around 1848×1728 to 2592×1728 pixels. The baseline models are four classical models. Each of the models are trained on all classes to classify the category (multi-monial classifier).

Logistic Regression, Random Forest Classifier, Gradient Boosting Algorithm, Support Vector Machine are used classical models [3]. The training and test sets accuracy are as given in Table 1.

III. Methodology

The goal of our work is to build a multi-class supervised model using neural network architecture that can help to classify an eye retina into either of the classes: normal, glaucoma, cataract or diseased retina with higher precision. In the first phase, we aim to replicate baseline model accuracy using NN and in later phases, the focus will be to enhance model performance through feature engineering and hyper parameter tunning. The baseline models are designed using sklearn framework, but our working framework will be Pytorch.

The Cataract dataset will be used to train different neural networks (difference in terms of hyper-parameters) and the performance amongst models will be compared for the given dataset. The model available in Kaggle will be considered as a baseline model. By comparing the performance of the trained NN model with the baseline model, a neural network model will be proposed for the Cataract dataset.

IV. Evaluation

To evaluate the performance, F1 score will be our primary metric for the validation set data. Moreover, the other metrices that can also be used are Accuracy, ROC and confusion matrix. Accuracy is as performance evaluation metric for the baseline models which are as given in Table 1.

Table 1: Baseline metrics

Classica Model	Training Accuracy	Validation Accuracy
Logistic Regression	0.616	0.618
Random Forest	0.604	0.607
Gradient Boosting	0.690	0.646
Support Vector Machine	0.531	0.569

References

[1]. World Health Organization. Global initiative for the elimination of avoidable blindness. WHO/PBL/97.61 Rev 2.2006. Available from : http://www.who.int/blindness/Vision2020_report.pdf

[2]. Jr2ngb. (2019, August) Cataract Dataset, Version 2. Retrieved Sep 25, 2021, from https://www.kaggle.com/jr2ngb/cataractdataset

[3]. John Doel. (2019 October). Cataract Data Exploration with ML models, Version 1. Retrieved Sep 25, 2021, https://www.kaggle.com/tsantra/cataract-data-exploration-with-ml-models