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Blindness Avoid (Diabetic) Retinopathy Detection

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Abstract: It is better to cure any disease as early as possible before it's too late. if diabetic retinopathy is left untreated it can cause permanent blindness. Also, identification of the stage of DR is tricky and it requires a human expert of fundus images. So simplified thing of detection is easy and can help many people.it occurs mainly when diabetes is unmanageable. It classifies the fundus images based on their severity levels as No DR, Mild, Moderate, Severe, and Proliferative DR. The datasets Aptos 2019 Blindness Detection were both obtained from Kaggle. Our proposed model achieved 90% of accuracy. The Regression model was also employed, manifested up the accuracy of 78%.
Keywords: Deep learning, diabetic retinopathy, deep convolution neural network, kaggle, APTOS 2019.

I. INTRODUCTION

Diabetes can be a widespread disease within the world, and up to 2014 around 422 million people worldwide have had this disease. Diabetic retinopathy (DR) may perhaps be a watch-fixed disease caused by long-standing diabetes. DR affects blood vessels within the light-sensitive tissue (i.e. retina). It becomes the leading reason behind vision impairment and blindness for working-age adults within the world today [8], and around half of Americans with diabetes have this disease to some extent. A widely-known challenge for DR is that it's no early be-careful call, even for diabetic macular edema. Thus, it's highly-desired that DR is detected in time. Unfortunately, in practice, this DR detection solution is fiddling infeasible to satisfy this requirement. Specifically, this solution requires a well-trained clinician to manually evaluate digital color fundus photographs of the retina, and DR is identified by locating the lesions related to vascular abnormalities thanks to diabetes. Though this current solution is effective, it's time-consuming and highly relies on the expertise of well-training practitioners. To unravel this issue, within the past few years considerable efforts are placed on developing an automatic solution for DR detection. The image of the Retina with Diabetic retinopathy is shown in figure I-1 [6].

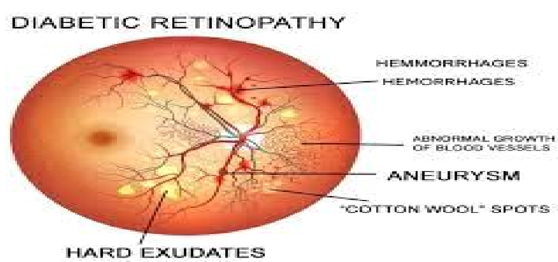

Figure I-1: Diabetic Retinopathy

However, Deep Learning has gained popularity in recent years in various fields like sentiment analysis, handwritten recognition, exchange prediction, medical image analysis, etc. CNN in deep learning tends to supply constructive results when it involves the work of image classification.

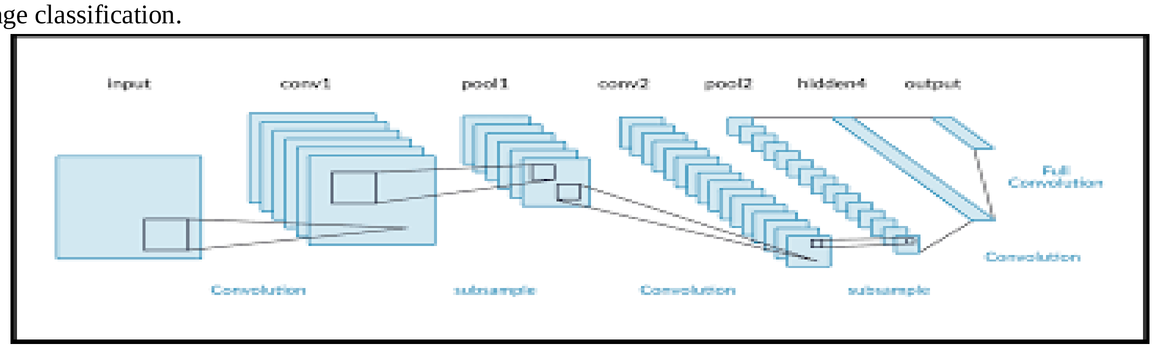

Figure I-2: CNN Architecture

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Such a ramification of processing units can yield an efficient nonlinear representation of the local salience of the signals. Then, the deep architecture allows multiple layers of those processing units to be stacked, so this deep learning model can characterize the salience of signals on numerous scales. Also, in CNN, feature extraction and prediction algorithm are unified joimodelsodel. Thus, the extracted features own more discriminative power, since the complete CNN model is trained under the supervision of output labels.

II. RELATED WORK

The two-step (i.e., feature extraction and prediction) automated DR detection approaches dominated the sphere of DR detection for several years. Given color fundus photography, this sort of approach often extracted visual features from the photographs on the parts of blood vessels, fovea, and point.

Diabetic Retinopathy is one of the grave concerns that engrossed the complete world. Receiving the eye from various researchers so on find the optimal solutions for the first detection of this disease, consequently resulting in the prevention of premature fluctuations in vision. Many studies are conducted and continue during this field to ease the lives of both doctors additionally as patients. However, the dataset employed during this study was quite small with 71 images. It's useful to notice that Asiri et al. reviewed an infinite amount of methods and datasets available, highlighting their pros and cons (Asiri et al., 2018). Besides, they discerned the challenges to be addressed in designing and learning about efficient and robust deep learning algorithms for various problems in DR diagnosis and drew attention to directions for future research.

III. PROBLEM STATEMENT

The main objective of this work is to build a stable and noise-compatible system for the detection of diabetic retinopathy. This work employs the deep learning methodology for detecting diabetic retinopathy based on severity level (No DR, Mild, Moderate, Severe, and Proliferative DR). Many processes were carried out before feeding the images to the network.

A. Data Source

Data used for this study has been taken from Diabetic Retinopathy Detection 2015[4] and APTOS 2019 blindness detection [1] from Kaggle. Both the datasets contain thousands of retinal images under different conditions. For each subject, two images of both the eyes are given as left and right. Because the images come from different sources like different cameras, different models, etc, it’s an abundance of noise related to it, which has to be removed, thus, requiring a variety of preprocessing steps. The diabetic retinopathy associated with each image has been rated on the scale of 0-4 as:

1) 0 - No DR
2) 1 - Mild
3) 2 – Moderate
4) 3 - Severe
5) 4 - Proliferative DR

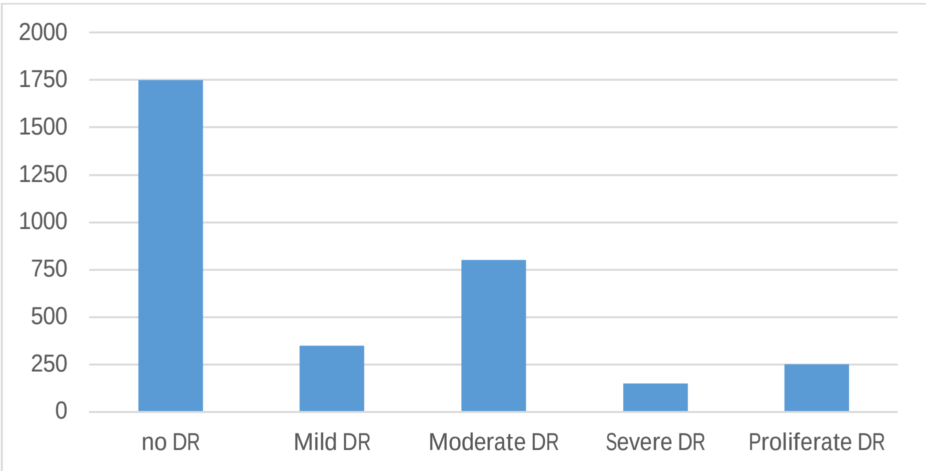

Figure III-1: Classes distribution in APTOS 2019 Dataset

B. Preprocessing

As the images within the dataset contain lots of noise like some images could also be out of focus, some may have lots of exposure, some may have extra lighting, presence of the black background, etc. so we'd like to try to preprocess to induce them within the standard format. Following things are administrated in preprocessing steps:

1) Cutting the black border
2) Remove the black corner
3) Resizing image
4) Applying the Gaussian Blur

C. Data Augmentation

We used online augmentations, at least one augmentation was applied to the training image before inputting it to the CNN. After analyzing the data, we notice that the data is highly unbalanced among the diabetic retinopathy severity image classes, which gave rise to the propensity of data augmentation.

Data augmentation is framed by aligning one class to the class with most samples, to balance the data among the diabetic retinopathy severity classes. Images were mirrored and rotated to augment the dataset, 7000 images were obtained in each class after augmentation.

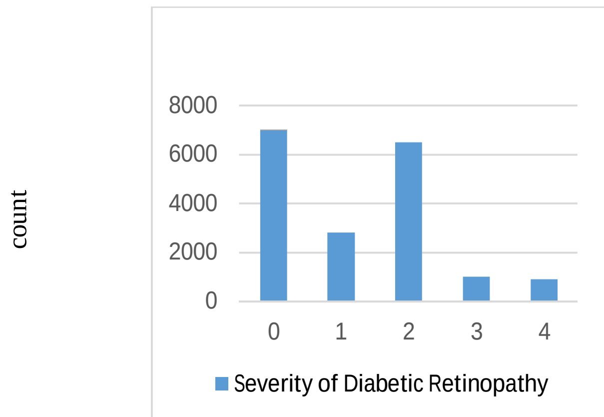

Figure III-2: Highly unbalanced data before data augmentation

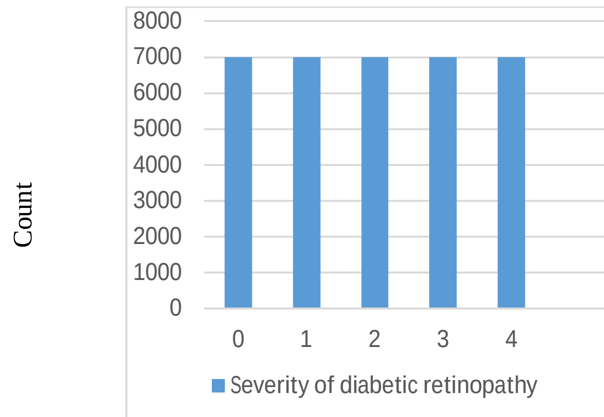

Figure III-3: balanced data after data augmentation

D. Modeling

We used a DenseNet-169 (Densely connected convolutional neural network) and a Regression model for training purposes. In DenseNet-169 weights are loaded into the network without the top or last layer.

IV. RESULTS

We trained our proposed model using DenseNet-169 on a combination of the dataset from Diabetic Retinopathy Detection 2015[4] and APTOS 2019 blindness detection[1] from Kaggle.

There was plenty of noise related to the photographs provided by the dataset therefore, preprocessing was needed. For preprocessing, we first removed the black border of the photographs to focus more on the fundus image only, black corners of images were also removed, then the photographs were resized to a typical format of 256*256 of width and height. Finally, a Gaussian blur was applied to the pictures to get rid of the Gaussian noise.

After preprocessing we analyze that the information is extremely unbalanced among the severity classes, the majority of information belonged to the category ‘0’i.e. No DR. to deal with this issue, we used data augmentation, which supplies us 7000 images from each severity class and made the info balanced. After preprocessing and augmentation of images, data was finally fed to the DenseNet-16for training the model.

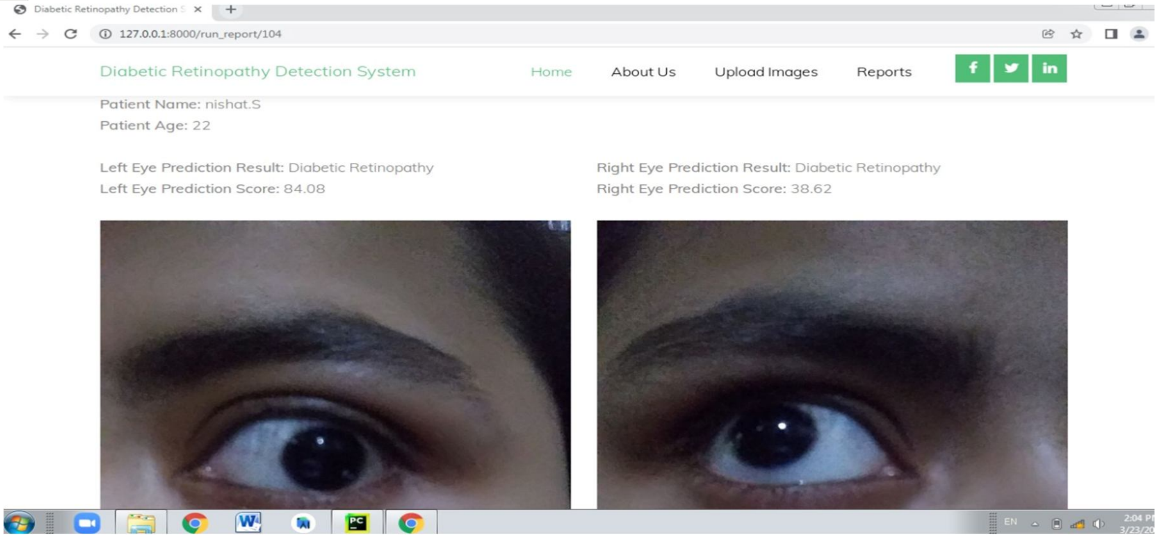

Figure IV-1: Output detection of Diabetic retinopathy

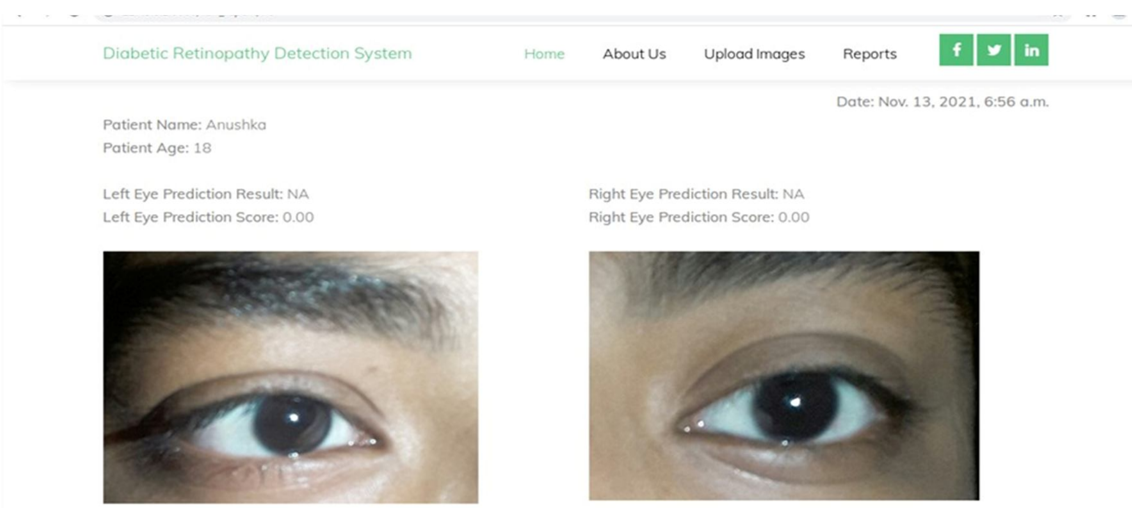

Figure IV-2: Output detection of No diabetic retinopathy

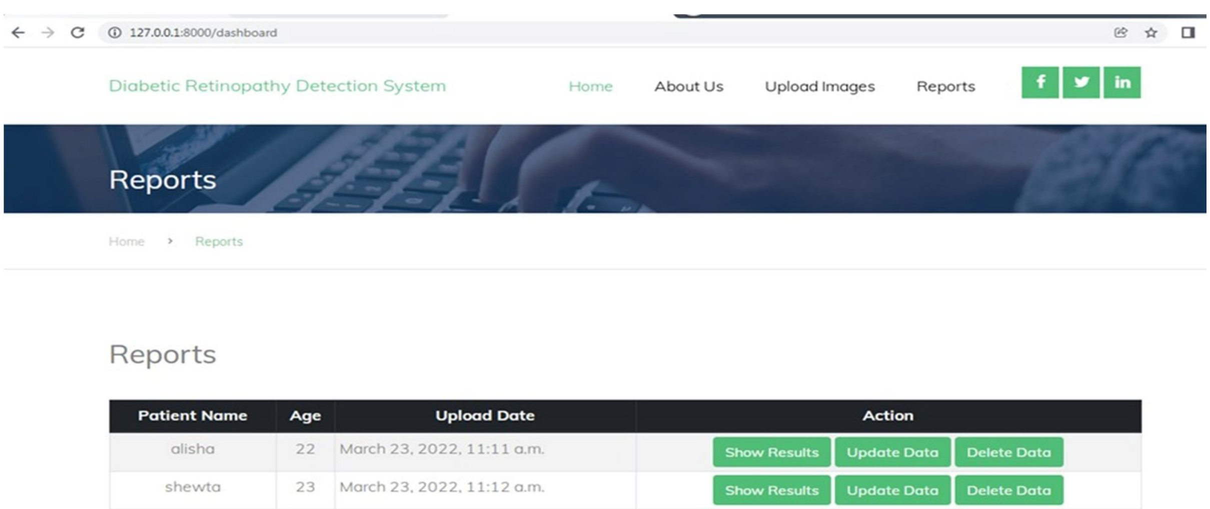

Figure IV-3: Reports of patients

V. CONCLUSION

Thus we've got developed sort of a web app Imagine having the ability to detect blindness before it happened. We will be achieving this by building a Convolutional neural network model that may automatically examine a patient's eye image and estimate the severity(severity scale which is one among [0,1,2,3,4].) of blindness within the patient.

The traditional method for detection of DR is prolonged, challenging, and dear, thus many types of research were remarked to automate the detection process by using machine learning and deep learning approaches. During this work, we presented a comprehensive study of assorted methodologies for detecting diabetic retinopathy automatically and attempted to propose our deep learning approach for the first diagnosis of retinopathy by employing a DenseNet169(which could be a new CNN architecture, having many deep layers). Two datasets: 'Diabetic Retinopathy Detection 2015'and 'APTOS 2019 blindness detection' from Kaggle were used together for this study. Plenty of preprocessing and augmentation was done to standardize the information in an exceedingly desired format and to get rid of the unwanted noise.

VI. LIMITATIONS AND FUTURE SCOPE

As there are a variety of images taken under different conditions, has to undergo plenty of preprocessing and augmentation, some features of the image could be passed over, so such techniques should be used that not only preserve all the small important features but at an identical time is in a position to try to a successful pre-processing. Moreover, multiple images should be provided for each patient which might successively increase the chance of classifying the pictures correctly as more information is gathered instead of only two images per person. The likelihood of tweaking hyperparameters is consistently growing with the emergence of recent neural networks through better pooling methods. Such methods are often considered for future work to uncover the chances of accelerating performance during this area. Furthermore, using different networks for training the model by the method of ensemble may also lead to higher results. As different models have their advantages in terms of performance, if tied together, can help in improving the overall productivity of a system instead of a personal model. We've used two datasets in our study, using more no of datasets or a mix of assorted datasets may improve the generalizability. The deployment of such systems will be done by using the Mobile Net, which could be a convolutional neural network for developing mobile applications. The net applications will be developed which will work for Windows, Linux, and Android operating systems as a diabetic retinopathy diagnostic tool.

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Lastly, we would like to thank our college Principal Dr. Pramod R Rodge for providing lab facilities and permitting us to go on with our project. We would also like to thank our colleagues who helped us directly or indirectly during our project.

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