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Application of Deep Learning in Medical Science: Identification of Diabetic Retinopathy using Classification algorithms.

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Abstract *– The widespread use of Machine Learning in various fields such as Data Analysis in market, Recommendation systems for customer management, and Medical Science. Identification of diseases using an automated trained model is both fast and has high availability. Diabetic Retinopathy is a disorder found in diabetic patients, it has four stages, this paper will focus on the classification of the stages using a classification algorithm to differentiate the levels of severity in the Scanned inner eye structure images. Classification methods provide a distinction among the stages of the DR. The accuracy of classification thus depends on the diversity of the dataset used to train the model.*

Key Terms: Classification, Inception, Deep Learning, Image Processing, Transformation.

I. INTRODUCTION

Diabetic retinopathy is developed as a complication in the eye of diabetic patients and as the name suggests, it directly affects the retina of the eye, this is mainly caused by the damage to the blood vessels of the light-sensitive tissues. There are various stages of diabetic retinopathy, with varying severities. The severity factor is determined by the amount of damaged blood vessels in the retina. The different stages of severity in diabetic retinopathy patients can vary from being: Non-existent, Mild, Moderate, Severe, Proliferative. Machine learning uses label variables to classify the data given as the input. We have to design an approach where the output or target variable are exclusively obtained as the result for both training and testing data. The finished model should hence, be able to provide us with the result in the format of a string or a integer which depicts the severity class in diabetic retinopathy for the input image provided.

II. PRE-PROCESSING OF DATA

Data pre-processing is an important step in any machine-learning based model, the dataset available from various sources are not entirely accurate, they might have some errors which might lead to deviation in accuracy of training which in-turn affects the result accuracy thus giving incorrect results. There are different types of discrepancies that can occur in a dataset, in case of numerical or string datasets there may be missing row values, unsupported or invalid entries, many outliers, values too high or too low compared to the other values and more. Since here, image dataset is being used, the discrepancies in the dataset found are slightly different compared to “values” dataset, the possible discrepancies that can be found are: Images can be distorted, the resolution of images might not be clear enough, the type of images and orientation of the images can also result to inefficiency.

Image Pre-processing methods

There are various techniques used for image pre-processing which help in filtering the dataset for

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accurate training and predications. Some of the effective methods are: Image transformations, Image augmentation, and Gray-scaling of images. Let us first look at the dataset used and then analyse about the pre-processing method to be applied for the images.

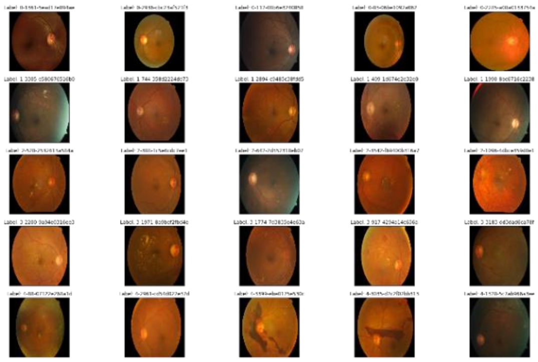

Fig 2.1: Sample dataset images used.

It can be seen from the sample dataset image shown (Fig 2.1), we can roughly identify the blood vessels and the amount of damage, these vessels can barely be seen through naked eye, to identify and distinguish the blood vessels from the other parts of the image we need to establish a contrast between the vessels and other image components. To do this, we can either use a pre-defined Gray-scaling method or apply appropriate pixel modification techniques and define the RGB values pre-set or manually.

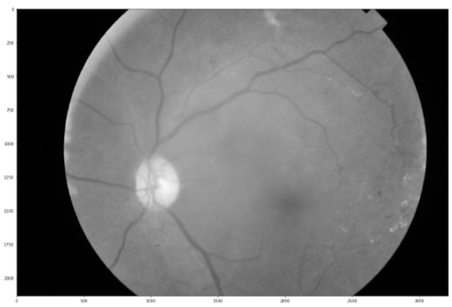

Fig 2.2: Gray-scaled image

The figure shown above (Fig 2.2) depicts the Gray-scale processed image of the original image, we can now see that the distinction between the blood vessels and the Aqueous humour can be seen clearly. Gray-scaling converts any coloured image into a scale range of black to white contrasts depending on the RGB original value. After analysing the Gray-scaled images, the distinguishing of the vessels is visible clearly, but the main objective is to identify the amount of damage in the blood vessels, which, as we can see from the image, cannot be distinguished easily. Hence, we need to find an alternative pre-processing technique which gives us clear distinction of the damages in the blood vessels.

Custom Pixel Brightness Transformation

Pixel Brightness Transformations (PBT) technique is used when we wish to alter the contrast and the brightness of the image, this allows for a better way to distinguish the blood vessels and the damage that has occurred can also be seen clearly by defining a certain level of increase in brightness and the pixel strength. After applying the pixel brightness transformations, we can further enhance the image smoothness by applying image smoothing techniques, one of the effective and efficient smoothing technique is applying a Gaussian Blur to the transformed image.

The smoothness of images additionally enhances the accuracy of the model, use of Gaussian Blur to outline the important parts of the image and blurring out the remaining parts also enhances the training time and the performance metric of the model in terms of fast computation and detection.

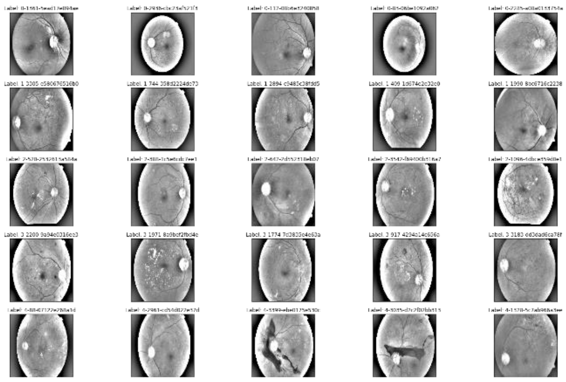

Fig 2.3: Sample images after Gray-scaling, Pixel transformations and applying Gaussian Blur

In the enhanced dataset sample figure shown (Fig 2.3), the borders can clearly be seen and distinguished, with the magnitude of damage to the blood vessels of the retina clearly visible.

Alternatively, there are pre-defined approaches which specify the RGB values of the severity of the damage with the magnitude, so, in the case that if one wants to retain the colour properties of the images instead of using Gray images, this approach can be implemented, it has a slightly significant enhancement on the performance and accuracy of the model.

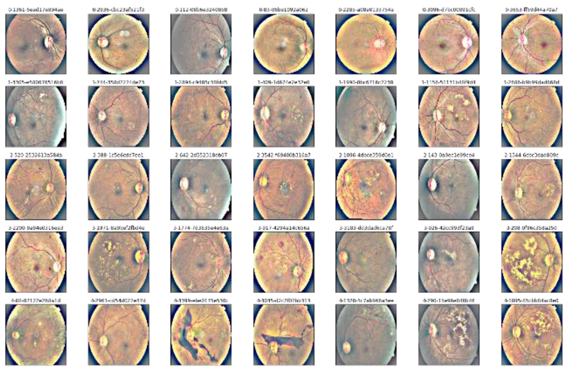

Fig 2.4: Applying PBT and Gaussian Blur without Gray-scaling the image set.

The Fig 2.4 shown depicts the coloured approach of Pixel transformation and applying Gaussian Blur to give similar result as the previous method used. We can also infer from the Fig 2.4 that the borders and the contrast among the different parts of the image are similar to the ones that are obtained from the gray-scaling procedure. The only complexity in the coloured approach is the pixel coding and transformation should be done manually as there are very less pre-defined or pre-set values for such methods. After the values are set, the images are now similar to the actual images which are used to identify such complications in the eye.

III. DESIGN APPROACH FOR THE CLASSIFICATION MODEL

The classification problem can be solved/implemented using various algorithms that are available from different sources. Some of the libraries which contain various algorithms for different models are: Scikit learn, TensorFlow (by Google), OpenCV (for computer vision). Additional libraries which help in data manipulation and easy data handling are also used such as: NumPy, Pandas which have various functionalities to handle and convert CSV based data into array format. Visualization libraries such as matplotlib, seaborn which plot and give us a statistical and graphical measures of the data being used before actually training the model. Visualization of data is an important step which gives us a basic outline about the dataset being used.

After a detailed analysis, it was found that the algorithm best suited for image classification is **Inception Base v3** algorithm. This is a cumulative algorithm which combines effective convolutions, max-pooling with fully connected layers on each neural network to fully train the model with increased accuracy. The stages are the target variables which determine the severity of the retinopathy. In this particular model the following conventions were found to be suitable: None – 0, Mild – 1, Moderate – 2, Severe – 3, Proliferative – 4. This convention is followed for both the train set and the test set.

IV. RESULTS AND CONCLUSION

The accuracy obtained by the model is nearly around 58% which is comparatively efficient for an image classifier. The accuracy even with the use of Inception v3 algorithm because of the lack of diversity in the dataset. The analysis obtained after the visualization depicted that the number of Non-existent (0), Mild (1) and Moderate (2) target variables were in higher numbers compared to the severe and proliferate images. This causes an imbalance in the weights for the neural network thus affecting the accuracy of the model

V. REFERENCES

[1]. A. P. Bhatkar and G. U. Kharat, "Detection of Diabetic Retinopathy in Retinal Images Using MLP Classifier," 2015 IEEE International Symposium on Nanoelectronics and Information Systems, 2015, pp. 331-335, doi: 10.1109/iNIS.2015.30.

[2]. X. Zeng, H. Chen, Y. Luo and W. Ye, "Automated Diabetic Retinopathy Detection Based on Binocular Siamese-Like Convolutional Neural Network," in IEEE Access, vol. 7, pp. 30744-30753, 2019, doi: 10.1109/ACCESS.2019.2903171.

[3]. S. Mishra, S. Hanchate and Z. Saquib, "Diabetic Retinopathy Detection using Deep Learning," 2020 International Conference on Smart Technologies in Computing, Electrical and Electronics (ICSTCEE), 2020, pp. 515-520, doi: 10.1109/ICSTCEE49637.2020.9277506.

[4]. K. K. Palavalasa and B. Sambaturu, "Automatic Diabetic Retinopathy Detection Using Digital Image Processing," 2018 International Conference (ICCSP), 2018, pp. 0072-0076, doi: 10.1109/ICCSP.2018.8524234.

[5]. D. K. Prasad, L. Vibha and K. R. Venugopal, "Early detection of diabetic retinopathy from digital retinal fundus images," 2015 IEEE Advances in Intelligent Computational Systems, 2015, pp. 240-245, doi: 10.1109/ RAICS.2015.7488421.

[6]. J. Yadav, M. Sharma and V. Saxena, "Diabetic retinopathy detection using feedforward neural network," 2017 Tenth International Conference on Contemporary Computing (IC3), 2017, pp. 1-3, doi: 10.1109/IC3.2017.8284350.

[7]. K. A. Anant, T. Ghorpade and V. Jethani, "Diabetic retinopathy detection through image mining for type 2 diabetes," 2017 International Conference on Computer Communication and Informatics (ICCCI), 2017, pp. 1-5, doi: 10.1109/ICCCI.2017.8117738.

[8]. Ö. Deperlioğlu and U. Köse, "Diagnogsis of Diabetic Retinopathy Using Image Processing and Convolutional Neural Network" 2018 Medical Technologies National Congress, 2018, pp. 1-4, doi: 10.1109/TIPTEKNO.2018.8596894.

[9]. A. Ahmad, A. B. Mansoor, R. Mumtaz, M. Khan and S. H. Mirza, "Image processing and classification in diabetic retinopathy: A review," 2014 5th European Workshop on Visual Information Processing (EUVIP), 2014, pp. 1-6, doi: 10.1109/EUVIP.2014.7018362.

[10]. S. D. Shirbahadurkar, V. M. Mane and D. V. Jadhav, "A modern screening approach for detection of diabetic retinopathy," 2017 2nd International Conference on Man and Machine Interfacing (MAMI), 2017, pp. 1-6, doi: 10.1109/MAMI.2017.8307893.