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DIABETIC RETINOPATHY DETECTION SYSTEM USING MACHINE LEARNING

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Abstract: Diabetes is a diseases that affect the body's ability to produce or use insulin, a hormone that regulates blood sugar or glucose levels.Diabetic Retinopathy (DR) is an eye disease in humans with diabetes which may harm the retina of the eye and may cause total visual impairment. Therefore it is critical to detect diabetic retinopathy in the early phase to avoid blindness in humans. Our aim is to detect the presence of diabetic retinopathy by applying Machine learning algorithms. Hence we try and summarize the various models and techniques used along with methodologies used by them and analyze the accuracies and results. It will give us exactness of which algorithm will be appropriate and more accurate for prediction. Machine learning consists of a number of stages to detect retinopathy in the images that includes converting image to suitable input format, various preprocessing techniques. It also includes training a model with a training set and validating with a different testing set. Method proposed in this project is Resnet 152.Berfore applying alorithum retinal images must be Preprocessing, and Feature Extraction. First, the images are preprocessed. They are converted. Proper resizing of image is also done. As the images are heterogeneous they compressed into a suitable size and format. Data set used for this project is taken from Kaggle. The main objective of this work is to build a stable and noise compatible system for detection of diabetic retinopathy.

Keywords: Machine learning, Diabetic Retinopathy, Resnet-152

I. INTRODUCTION

This project presented the development of an automated system for diabetic retinopathy detection in color retina images, through the implementation of Deep learning techniques Diabetic retinopathy is indeed one of the most common and serious complications of diabetes. It results from damage to the blood vessels in the retina due to prolonged high blood sugar levels. Traditionally, detecting DR is a time-consuming and manual process, which requires an ophthalmologist or trained clinician to examine and evaluate digital color photographs of the retina, to identify the presence of vascular abnormalities caused by the DR. There are different stages of DR no DR, mild DR, moderate DR, severe DR and proliferative DR. People with DR whose eye sight is at risk can be treated with laser, to prevent visual blindness. But currently there is no treatment that can restore the vision that has already been lost therefore early detection of DR is important to stop further damage of eye and to save patient life.

The proposed methodology is use of Deep learning technique to detect diabetic disease using Retinal images of an eye and to introduce the effect of as a diagnosis imaging modal which are helpful for ophthalmologists to do the clinical diagnosis. In the proposed Project work to design and implement a system that can be provide eye diabetic disease detection using Retinal image, the system carried out various features extraction using image segmentation and use CNN Deep learning classification algorithm to detect the stage of DR. The Interface will be in the form of application software where user can insert retina image and then it will be pre-processed and feature extracted and then these will compare with training dataset and then analysed the actual result.

The largest publicly available dataset of retina images Kaggle dataset (APTOS) is used to train and evaluate our model and then image processing is performed and Gaussian filter is applied to convolve with the image. It helps in smoothening the image to reduce the effects of obvious noise on the edge detector. In this project we used CNN Deep learning classification algorithm to detect the the stage of DR. Resnet 152 Convolution Neural Network (CNN) architecture used for feature extraction and prediction of the class of DR. It has the ability to train to understand the complexity of the image more efficiently. The main objective of this work is to build a stable and noise and high accuracy, compatible system for detection of diabetic retinopathy.

II. LITERATURE SURVEY

Abràmoff et al. [1], considered two fundus images from each eye which was analyzed by a retinal expert. Author applied

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two algorithms separately on the dataset. The result of applying the Eye Check algorithm gave an AUC of 0.839 and applying the Challenge 2009 algorithm gave an AUC of 0.821. Gargey et al. [2], developed a device for automatic discovery of Diabetic Retinopathy and classified the images into healthy or having DR. Author tested model using the public MESSIDOR 2 and E-Ophtha databases for external evaluation and resulted 0.94 and 0.95 AUC values. Wilfred Franklin and Edward Rajan [3] proposed automated tool with high accuracy of the detection of blood vessels. Author worked on automatic segmentation algorithm on images of the DRIVE database and noticed 95.03% accuracy.

Antal and Hajdu et al. [4], used image level, lesion-specific and anatomical compo- nents. Author worked on classifiers and tested on the publicly available dataset Messidor, where resultant AUC is observed 0.989. Liskowski et al. [5], used super- vised approach along with deep neural networks on image datasets also proposed a supervised method which makes use of deep neural networks on raw images data. But they can work more efficiently on preprocessed images. Author performs struc- tured prediction with classification and produced result with AUC greater than 0.99, accuracy greater than 0.97. Results also derived sensitivity greater than 0.87 in fine vessels. Revathy et al. [6], used an SVM-based training approach to data and classified them into three classes as mild, moderate non-proliferative Diabetic Retinopathy and proliferative Diabetic Retinopathy. Approach used various classification algorithms and noted good accuracy with 82%.

III. METHODOLOGY

3.1 Dataset:

The Asia Pacific Tele-Ophthalmology Society 2019 Blindness Detection (APTOS 2019 BD) dataset contains 3662 retinal Image samples collected from many participants of rural India. The, Aravind Eye Hospital, India, organized the dataset. The fundus photographs were collected in varying conditions and environments over a long period. Later, a group of Expert doctors reviewed and labeled the gathered retinal image samples following the principle of the International Clinical Diabetic Retinopathy Disease Severity Scale (ICDRSS). As per the scaling system, the APTOS 2019 Blindness Detection Dataset are divided into five Classes: no Diabetic Retinopathy (DR), mild DR, moderate DR, severe DR, and proliferative DR.

This dataset has 3662 images and consists of 1805 images diagnosed as non-diabetic (labeled as 0) retinopathy and 1857 images diagnosed as diabetic retinopathy, as shown in Figure 4.5shows the distribution of examples in the four classes using a severity range from 1 to 4 with the following interpretation: 1: Mild, 2: Moderate, 3: Severe, 4: Proliferative DR.

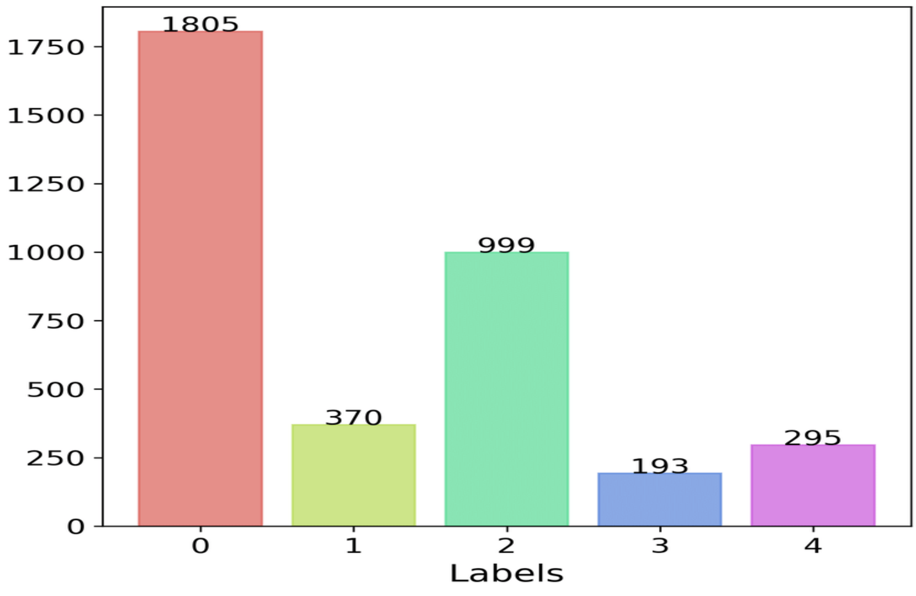

Fig 5.1 Distribution of APTOS Dataset

3.2 Architecture Used:

In this project Resnet 152 Pretrained Architecture is Used

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IV. FINDINGS AND TRENDS

Findings

1. Improved Diagnostic Accuracy:
The deep learning model (CNN) achieved high accuracy in classifying Diabetic Retinopathy stages, demonstrating strong potential for assisting ophthalmologists.

2. Effectiveness of Transfer Learning:
Using pre-trained models like EfficientNet and InceptionV3 significantly improved performance compared to training from scratch, especially with limited labeled medical data.

3. Importance of Image Quality:
Prediction accuracy was highly dependent on the clarity and resolution of retinal images — poor lighting, blur, or occlusions reduced model confidence.

4. Real-Time Prediction Capability:
Integration with Flask allowed for real-time prediction (within 2–3 seconds per image) without major performance loss, showing practical usability.

5. Robust Data Handling:
Secure user authentication and database storage enabled safe management of medical image data and prediction histories.

6. Model Generalization:
The model performed consistently across different data subsets, indicating good generalization ability when proper preprocessing and augmentation were applied.

7. User Engagement:
The simple, web-based interface encouraged non-technical users (e.g., healthcare workers) to easily upload and interpret results.

Trends

1. Increasing Role of AI in Healthcare:
There is a growing global trend toward integrating AI-based image analysis tools into clinical diagnosis, especially in ophthalmology.

2. Use of Cloud-Based Screening Tools:
Cloud and web-based systems like the Flask app enable remote diabetic eye screening, especially useful in rural or under-served regions.

3. Transfer Learning and Pretrained Models:
Transfer learning has become a key trend in medical imaging, allowing efficient training on smaller datasets.

4. Explainable AI (XAI):
Visualization tools like Grad-CAM are trending to make AI models more transparent and trustworthy for clinical use.

5. Integration of Patient Data Systems:
There's a trend toward connecting such AI diagnostic tools with Electronic Health Record (EHR) systems for centralized medical data management.

6. Focus on Ethical AI:
New research emphasizes data privacy, bias reduction, and fairness in medical AI applications.

7. Real-Time, User-Centric Systems:
The move from offline model testing to real-time, user-friendly web and mobile applications continues to shape the future of healthcare AI deployment

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V. CONCLUSION

Diabetes is a significant health concern globally. According to various surveys, a patient having diabetes has around 30% chances to get Diabetic Retinopathy (DR). Diabetic retinopathy has Five stages from mild to severe and then PDR (Proliferative Diabetic Retinopathy). In the last stages of the diseases, it leads to floaters, blurred vision and finally can lead to blindness if it is not detected in the early stages. Manual diagnosis of these images requires highly trained experts and is time-consuming and difficult. Computer vision-based techniques for automatic detection of DR and its different stages have been proposed in this Project. Our main aim to classify all the stages of DR,especially the early stages.We proposed a CNN ensemble-based Transfer learning model which is pretrained on millions of images.Resnet 152 is Pre-trained model used to detect and classify the DR's different stages in color fundus images. We used the largest publicly available dataset of Retinal images (APTOS dataset) to train and evaluate our model.In this project we get accuracy of 87% for APTOS dataset.

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