TIMELY DETECTION OF DIABETIC EYE DISEASE(RETINOPATHY)

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***Abstract*—Diabetes is a condition in which a person is suffer from high level of glucose which potentially damage the retina ,cause a permanent damage of eye and vision loss. This condition in medical called diabatic retinopathy , which is a common problem among old age people. The fundus oculi is an evolved technology used to observed the eyeball and check ,diagnose and gives a pathology evolution. In this work, we used deep convolution network or Resnet18 to process the fundus oculi image to determine the eye ball and presence of diabetic retinopathy and segregate in into 5 different categories of pre detection. The model optimized the parameter by mapping it to corresponding label. The dataset used contain pathology severity scale situated in eyeball and training and testing of model is happened on same dataset. The scale basically separate image into 5 classes from healthy to proliferative. The benefits of model is predetermine of diabetics which prevent complete and permanent blindness.**

Keywords—DiabeticDetection,CNN,Resnet-18,machiene learning.

I.INTRODUCTION

Diabetes Mellitusis a A public health issue perturbing 463 million people worldwide and projected to affect 700 million by 2045. At least one-third of diabetics also suffer from diabetes-related eye disease, the most usual of which is diabetic retinopathy (DR). In 2020, Diabetic retinopathy will strike 33% of adults with diabetes, and one in three will have visual impairment. It is Anticipated that the total number of individuals diagnosed with DR may triple by 2050, so early exposure of diabetic retinopathy is important to eliminate the perilous of vision loss due to misdetection. Diagnosing DR requires advanced expertise and we can detect it using deep CNN deep learning techniques using res-net to classify DR into sub-categories for its early detection.

The Future aim of the project is to Find diabetic retinopathy and use Deep CNN with Res-Net Layer to prevent blindness before it's too late. We can do this by classifying the Retina-Bilder of a patient into 5 categories. Labels which is Prolific, Normal, Mild, Moderate, and Berat Deep Learning illustrates the intricacies of deep learning.

II.LITERALURE SURVEY

A. *Introduction*

Diabetic retinopathy (DR) is a medical phenomena caused by multiple changes into set of some metabolic disorders which affect the retina vasculature.The generation of blood vessels give damage to capillaries which is called pericyte depletion.which is a contractile cell that make a blanket around capillary enthothelial cell in venules.Tfhe increase amount of glucose molecule affect the blood and make a lump together in blood vessels and decrease the blood flow lead to situation called ischemia.These blood vessels deterioration gives birth to microaneurysms which cause enlargement of vessels and affect the blood flow.These random increase in size of vessels cause lose of properties end up to sudden opening such as haemorrhages or lipid sweating.

B. Survey Key Points

- They first discuss the prevalence and cause of diabetic retinopathy, which leads to blindness in working-age adults. They then highlight the importance of early detection and treatment to prevent vision loss. However, manual screening of retinal images is time-consuming and subject to human error. Hence, they propose an mechanize system that can rightly detect exudates, a common symptom of diabetic retinopathy. The literature survey conducted by the authors covers previous work on machine retinal image analysis, with a point on exudate detection. [1].

- the criticality of early detection, and the shortcomings of manual screening, necessitating automated CAD systems for improved accuracy and efficiency. Various approaches, encompassing traditional image processing, machine learning, and hybrid methods, are discussed, comparing their performance metrics. The role of feature extraction, incorporating color, texture, and morphological features, is emphasized, along with the significance of image segmentation. [2].
- They commence by addressing the prevalence and impact of pulmonary diseases, underscoring the significance of early detection and treatment using medical imaging modalities 19 like computed tomography (CT) and X-ray. The survey covers diverse approaches, encompassing established expert learning , depth learning, and transfer learning, with a comparative analysis of their pros and cons in terms of accuracy, sensitivity, and specificity. [3].
- They initiate with an overview of DR, emphasizing its prevalence and the urgent need for pre detection and treatment. The drawback of manual screening are highlighted, underscoring the possibilites of automated systems to enhance accuracy and efficiency. The survey covers various DR detection approaches, including traditional image technique , machine learning, and deep learning. The authors analyze the pros and cons of each approach, comparing 14 their performance metrics such as accuracy, sensitivity, and specificity. [4].
- They commence with an perspective of DR and its stages, underscoring the importance of Pre detection and treatment. The limitations of manual screening are highlighted, pointing to the potential of automated systems to enhance accuracy and efficiency. The survey encompasses various DR detection approaches, including traditional image technique , machine learning, and signal processing methods. The authors analyze the pros and cons of each approach, comparing their performance metrics like rightness, reactive, and specificity. [6].
- They compare various DR detection approaches, including traditional image technique, machine learning, and deep learning. The focus then shifts to SVMs, explaining their principles and advantages in handling high-dimensional data and nonlinear classification. The authors present SVM-based approaches, including twin SVMs designed for imbalanced datasets. Results show twin SVMs outperform existing methods in accuracy, sensitivity, and specificity. [7].
- They commence with an overview of SVMs, emphasizing their efficacy in handling high-dimensional data and nonlinear classification problems. Feature selection and weighting in SVM-based classification, along with the challenges of managing large-scale datasets, are discussed. The survey covers diverse approaches to enhance SVM-based classification performance, including kernel methods, ensemble methods, and feature weighting methods. [8].

C. Conclusion

The project, developed using Python and Streamlit library The user’s requirements and the evaluation of the current system guide the design, with an emphasis on adaptability for future improvements.. This web application was successfully take a group of eye jpeg and import into model to find the prediction weather person is suffering through diabetic or not . This process brings a new platform manager useful to post service and comments. The users can browse through all the available service and users easily which makes this platform user friendly. The project teaches us the essential skills like:

- Understanding the machine learning model handling and implementation .
- Implement, analyze and evaluate the project developed for an application.
- Demonstrate the working of different concepts of ML.

D. Future work and Enhancement

It is worth mentioning that this project is open for future enhancement. Additional features like a 11 display of all Use-Case can be implemented. More categories of different disease can be added to the service. Further enhancements can be made in the current website which is adding a good user interface make website more good and attractive . It is extracted that the website work good on given input and gives suitable result. The application is tested under many circumstances and work properly with suitable result. The website also work as a sharing of files and make the used of valuable resources.

III. PROPOSED MODEL

- Early detection is crucial to prevent vision loss. Here's an outlook for the detection of diabetic retinopathy:
- Image Acquisition: It acquire high-quality retinal images using fundus photography.
- Preprocessing: Perform image registration and cropping to focus on the relevant retinal area.
- Image Segmentation: Segmentation can be achieved using methods like thresholding, edge detection, or machine learning-based approaches.
- Lesion Detection: Identify and segment lesions associated with diabetic retinopathy, such as microaneurysms, hemorrhages, fluid leakage, and cotton wool spots. Expert learning algorithms, especially deep learning Framework like CNN, have shown effectiveness in lesion detection.

- Feature Extraction: Identify pertinent characteristics in segmented retinal structures and lesions. These features may include size, shape, texture, and intensity characteristics. Feature extraction is Integral for subsequent classification.
- Classification: Utilize machine learning paradigms for classification based on the draw out features. Train the model on a labelled dataset, using classes such as no retinopathy, mild, moderate, severe, and pro-liferative diabetic retinopathy.
- Deep Learning Models: Explore the use of deep learning models, exceptionally CNNs, for end-to-end learning from raw images to disease classification. Transfer learning with pre-trained models on huge datasets can be constructive when dealing with circumscribed labelled data for diabetic retinopathy.
- Validation and Testing: The dataset is split into three parts training, testing, validation to check the model's performance. Employ metrics such as sensitivity, specificity, and area under the receiver operating characteristic curve (AUC-ROC) for evaluation.
- Integration with Clinical Workflow: Integrate the developed model into the clinical workflow, ensuring that it can be used by healthcare professionals for real-time analysis and decision-making.
- Regular Updates and Improvement: Periodically update the model using new data to improve its accuracy and robustness. Stay informed about the latest research and advancements in diabetic retinopathy detection to incorporate new techniques.Mayer Multiple. These indicators provide valuable insights into market momentum, trend strength, and potential reversal points, which are essential for making informed trading decisions.

It's important to note that any implementation of a mechanism to determine the medical condition should be validated thoroughly and used in conjunction with the expertise of healthcare professionals. Regulatory compliance and ethical considerations are also critical aspects of deploying such systems in clinical settings

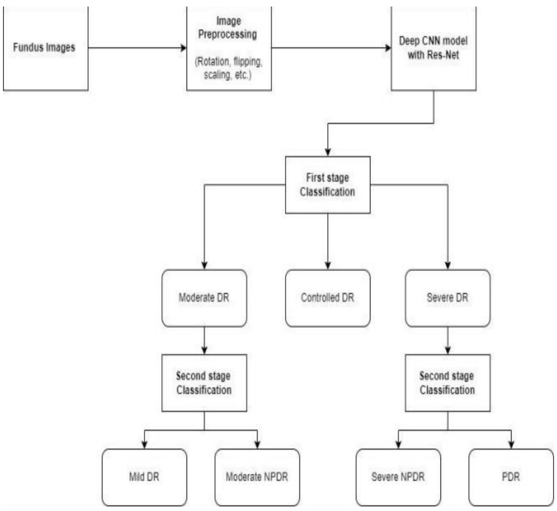

Figure 1: System Architecture

IV.IMPLEMENTATION

The code is a Python script designed to extract images from a PDF file, save them as individual image files, and display them with corresponding headings in a Jupyter Notebook environment. Initially, necessary libraries such as os, fitz, Image from PIL, and display, Markdown from IPython.display are imported. The file paths for the PDF file and the directory where the images will be saved are defined. Then, the script checks if the specified directory for saving images exists and creates it if it doesn't. It proceeds to open the PDF file and iterates through each page, extracting images and storing them in a list. If no images are found, it raises a ValueError. After extracting images, they are saved as individual files in the designated directory. Finally, the script displays the saved images along with corresponding Markdown headings indicating their sequence numbers. This code serves as a comprehensive solution for extracting and displaying images from a PDF file in a Jupyter Notebook, which make it good for users to analyze and worked with image data embedded within PDF documents

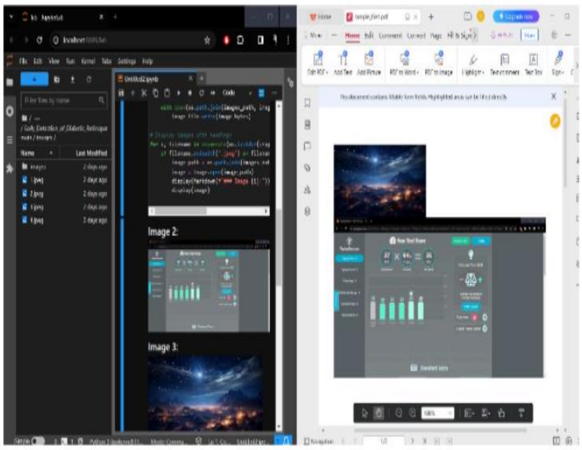

Figure 2: Pdf to jpeg Extraction

Firstly, we import all the important various libraries and modules commonly used in Automation and data analysis tasks. Eg: import tensorflow as tf: This gave TensorFlow, an open-source robotic and automated application module introduced by Google, and assigns it the alias tf. from tensorflow import keras: This imports the Keras API, which is collab into TensorFlow, for building and training neural networks. import matplotlib.pyplot as plt: This gave the Matplotlib library for creating visualizations in Python, and specifically imports the pyplot module and assigns it the alias plt.

```
import pandas as pd
import numpy as np
import os
import tensorflow as tf
from tensorflow import keras
import matplotlib.pyplot as plt
import PIL
from PIL import Image
import seaborn as sns
import plotly
import plotly.graph_objs as go
from sklearn.model_selection import train_test_split
from sklearn.utils import shuffle
from plotly.offline import iplot, init_notebook_mode
```

Figure 3: Importing necessary libraries

The model consists of multiple layers organized into sequential blocks. It starts with an input layer (input_1) expecting input images of size 256x256 with 3 channels (RGB). The first layer is a zero-padding layer (zero_padding2d) to adjust the input size. The subsequent layers include convolutional layers followed by batch normalization, activation functions, max pooling layers and residual connections with identity blocks. The final layers include average pooling (Averagea_Pooling), flattening (flatten), and a heavy layer (Dense_final) with 5 output neurons for classification. The model has overall 4,987,525 parameters (19.03 MB), out of which 4,967,685 (18.95 MB) are trainable parameters, and 19,840 (77.50 KB) are non-trainable parameters. This architecture closely follows the ResNet (Residual Network) design, which utilizes residual connections to deal with the fading gradient problem in deep neural networks, enabling training of very deep networks effectively.

```
def res_block(X, filter, stage):

  # Convolutional_block
  X_copy = X

  f1 , f2, f3 = filter

  # Main Path
  X = Conv2D(f1, (1,1),strides = (1,1), name ='res_'+str(stage)+'_conv_a'
  X = MaxPool2D((2,2))(X)
  X = BatchNormalization(axis =3, name = 'bn_'+str(stage)+'_conv_a')(X)
  X = Activation('relu')(X)

  X = Conv2D(f2, kernel_size = (3,3), strides =(1,1), padding = 'same', na
  X = BatchNormalization(axis =3, name = 'bn_'+str(stage)+'_conv_b')(X)
  X = Activation('relu')(X)

  X = Conv2D(f3, kernel_size = (1,1), strides =(1,1),name ='res_'+str(sta
  X = BatchNormalization(axis =3, name = 'bn_'+str(stage)+'_conv_c')(X)
```

Figure 3: Building the ResNet model

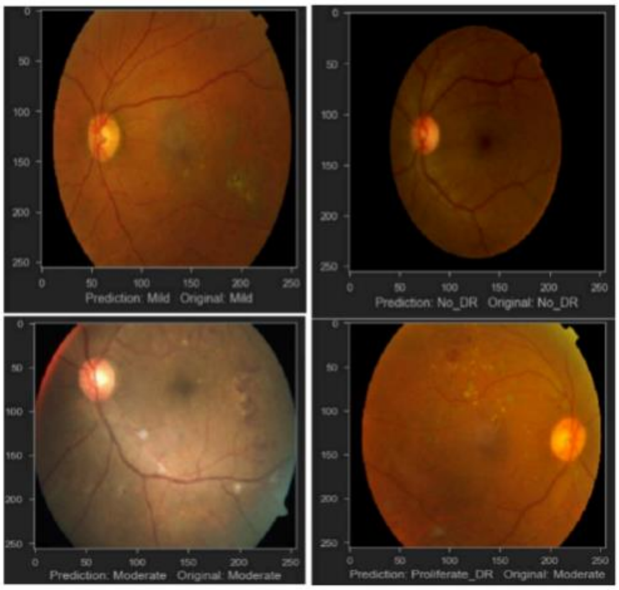

Figure 3: Comparative results predicted by the Deep CNN model

REFERENCES

[1] T. Walter, J.-C. Klein, P. Massin, and A. Erginay "A contribution of image processing to the diagnosis of diabetic retinopathy" IEEE Conference 2021.

[2] M. Mookiah, et al., "Computer-Aided Diagnosis of Diabetic Retinopathy: A Review, Computers in Biology and Medicine", vol. 43, no. 12, pp. 2136–2155, 2021.

[3] Wang, D. Chen, L. Hao, X. Liu, Y. Zeng, J. Chen, and G. Zhang, "Pulmonary image classification based on inception-v3 transfer learning model," IEEE Access, vol. 7, pp. 146 533–146 541, 2020.

[4] S. Masood, T. Luthra, H. Sundriyal, and M. Ahmed, "Identification of diabetic retinopathy in eye images using transfer learning," in 2020 International Conference on Computing, Communication and Automation (ICCCA), 2020

[5] U. Acharya et al., Application of Higher Order Spectra for the Identification of Diabetes Retinopathy Stages, Journal of Medical Systems, vol. 32, no. 6, 2018

[6] M. Singla, S. Soni, P. Saini, A. Chaudhary, and K. K.Shukla "Diabetic retinopathy detection using twinsupport vector machines", published in book "Advances in Bioinformatics, Multimedia, and Electronics Circuits and Signals",2020

[7] Cao, M. Wang, Y. Li, and Q. Zhang, " Improved support vector machine classification algorithm based on adaptive feature weight updating in the Hadoop cluster environment " published in PLoS ONE in 2019

[8]E. Decencière et al.," TeleOphta: Machine learning and image processing methods for teleophthalmology" published in IRBM in 2020

[9] Lam et al, " Retinal lesion detection with deep learning using image patches ", Investigative Ophthalmology & Visual Science in 2022

[10] K. S. Sreejini and V. K. Govindan. .," Retrieval of pathological retina images using bag of visual words and pLSA model" , published in Engineering Science and Technology, International Journal in 2019

[11] Charu Bhardwaj,Shruti Jain, Meenakshi Sood, .," Appraisal of Pre-processing Techniques for Automated Detection of Diabetic Retinopathy", IEEE International Conference on Parallel, Distributed and Grid Computing(PDGC-2018), Dec 2018

[13] Juan Wang, Yujing Bai, Bin Xia." Simultaneous Diagnosis of Severity and Features of Diabetic Retinopathy in Fundus Photography Using Deep Learning "., IEEE Journal of Biomedical and Health Informatics (Volume: 24, Issue: 12, December 2020)

[14] Ghulam Ali, Aqsa Dastgir, Muhammad Waseem Iqbal, Muhammad Anwar, Muhammad Faheem ." A Hybrid Convolutional Neural Network Model for Automatic Diabetic Retinopathy Classification From Fundus Images "., IEEE Journal of Translational Engineering in Health and Medicine (Volume: 11),2023