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DIABETIC RETINOPATHY DETECTION SYSTEM

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Abstract: Among grownup people Diabetic retinopathy (DR) is the primary cause of vision loss. Having diabetes for a prolonged period leads to DR in every four out of five cases. If this is detected early, more than 90 percent of the new DR cases can be prevented from turning into blindness through proper treatment. Even though we have multiple treatment procedures that are capable to deal with DR, the negligence and failure of early detection of the DR results in patients to lose their precious eyesight. The recent developments in the field Machine Learning (ML) have shown a way in this regard. The condition of a person eyes is automatically detected by using these technologies based on their retinal images.

Keywords: Diabetic retinopathy, Resnet, Deep Learning, Machine Learning, Fundus.

I. INTRODUCTION

Human eye is the light-sensitive organ that enables us to see the environment. It can be compared to a camera. The way the image forms on the retina of the eye in the same way in a camera the image is formed on film. The cornea and the crystalline lens of the human eye are similar to the lens of a camera and the iris works like the diaphragm of a camera, which controls the amount of light that is reaching the retina by adjusting the size of pupil. Number of diseases affect the retina of the eye. Complications of such diseases are diabetic retinopathy from diabetes, hypertensive retinopathy from cardiovascular disease, and multiple sclerosis. On the other hand, the retina is vulnerable to organ-specific and systemic diseases. Imaging the retina allows to check diseases of the eye properly, as well as complications of diabetes, hypertension and other cardiovascular diseases are detected, diagnosed and managed.

II. LITERATURE SURVEY

Ling Dai, A deep learning system for detecting diabetic retinopathy across the disease spectrum" , 2021 It shows the development and validation of a deep learning-based DR screening system called Deep DR (Deep-learning Diabetic Retinopathy), which was a transfer learning assisted multi-task network to evaluate retinal image quality, retinal lesions, and DR grades.This system was developed using a real-world Diabetic retinopathy screening dataset consisting of approximately 666 fundus images from 173 thousand patients.In addition, we annotated retinal lesions, including microaneurysms, cotton-wool spots (CWS),hard exudates, and hemorrhages on 14,901 images, and used transfer learning to enhance the lesion-aware DR grading performance. This system has high sensitivity and accuracy in-the whole-process detection of Diabetic retinopathy from an early stage to severe stages.

Veena Mayya, Sowmya Kamath "Automated microaneurysms detection for early diagnosis of diabetic retinopathy" 2021 Ophthalmologists are trained to identify DR, predicated on examining specific minute changes in the eye- micro-aneurysms, retinal haemorrhage,macular-edema and changes in the retinal bloodvessels. Segmentation of microaneurysms(Mama) is a critical demand for the early opinion of DR and has been the primary focus of the disquisition community over the formerly numerous times. In this work, a regular review of being literature is carried out to examine the individual use of automated Mama discovery and segmentation for early DR opinion. We mainly concentrate on being early DR opinion ways to understand their strengths and sins. The early DR opinion methodologies reviewed in this composition can be vastly classified into classical image processing, conventional machine knowledge(ML), and deep knowledge(DL) predicated ways.

N Satyanarayana murthy "An effective technique for diabetic retinopathy using hybrid machine learning technique" jan 2021 The recognition of the BV for DR by developing an automatic approach is a major end of our exploration study. In the proposed system, there are two major way one is segmentation and the alternate bone is bracket of affected retinal BV. The proposed system uses the Kinetic Gas Molecule Optimization grounded on centroid initialization used for the Fuzzy C- means Clustering. In the bracket step, those segmented images are given as input to cold-blooded ways similar as a complication neural network with bidirectional-long short- term memory(CNN with Bi-LSTM). The literacy degree ofBi-LSTM is revised by using the tone- attention medium for enriching the bracket delicacy. The trial consequences bared that the admixture algorithm achieved advanced delicacy, particularity, and perceptivity than being ways.

Xi Yau ,Yingrui Yang "Distribution of diabetic retinopathy in diabetes mellitus patients and its association rules with other eye diseases" 20 august 2021 Data were attained from 1284 DM cases at Henan Provincial People's Hospital. Association rules were employed to calculate the probability of the common circumstance of eye- related conditions in DM cases. A web visualization network illustration was used to display the association rules of the eye-related conditions in DM cases. The number of strong rules in cases ' ≥ 60 times old was further than those in people under 60 in age, and those in pastoral areas had more strong rules than those in communal areas. DM cases with one or farther eye conditions are at advanced risks of other eye conditions than general DM cases. These association rules are affected by factors analogous as age, region, complaint duration, and DR strictness. Multiple correspondence analysis and association rules were used to anatomize the distribution characteristics of DR and determine its association rules with other eye conditions in DM cases. These data handed a frame of reference for developing applicable measures for better netting, opinion, and prevention of DR.

Sylvie feldman-billard "Eye disorders other than diabetic retinopathy in patients with diabetes" November 2021 While diabetic retinopathy is the most specific complication of habitual hyperglycaemia, multitudinous other optical conditions also can involve the eyes of people with diabetes. Cataract, glaucoma, age- related macular degeneration, retinal vascular occlusion, and acute ischaemic optical neuropathy combine to vitiate vision in people with diabetes, especially when they're old. Cases with diabetes have a high- to-moderate increased threat for utmost of the usual optical diseases we reviewed with the exception of age- related macular degeneration. Exposure to habitual hyperglycaemia promotes the development of numerous eye diseases while acute glucose changes are involved in refractive diseases, diabetic papillopathy and acutecataract.Diabetes, beyond diabetic retinopathy, increases the threat of multitudinous eye diseases leading to low vision with counteraccusations for diurnal diabetes operation. Indeed in the absence of easily demonstrated benefit from glucose control in all eye conditions, achieving good glycaemic control and adherence to diabetes treatment will probably help avoid an fresh threat of visual impairment in people with diabetes.

III. PROPOSED METHODOLOGY

A. EXISTING SYSTEM

The identification of EXs in retinal images is reliable on the system. Morphological operators and adaptive thresh holding method are utilized in the computation of noise map distribution. The existing method is used for accurate segmentation of Exs. K-means clustering method is applied for the diagnosis of bright lesions. Disadvantages of the existing system are Both scientific and nonscientific issues arise, when we are trying to translate the automated DR detection, these scientific issues can be studied and measured, political and ethical issues also need to be addressed, but these are difficult to measure, it is very important to understand the benefits and limitations of automated detection.

B. MOTIVATION AND PROBLEM STATEMENT

Diabetic Retinopathy is a disease which is increasing and the main cause of blindness among working-age population. By timely diagnosis and treatment, the risk of severe vision loss can be significantly reduced. Systematic screening of DR has been identified as a cost-effective way. Automatic retinal image analysis is introduced as an important screening tool for early DR detection, which can reduce the workload that is associated with manual grading as well as save diagnosis cost and time. Many efforts in the last years have been dedicated to develop automated tools to help in the detection and evaluation of DR lesions. Main aim is to automate this prediction using machine learning and deep learning models.

C. PROPOSED SYSTEM

CNN pre-trained model resnet152 of deep learning classification technique is used to classify the various severity levels of DR ranging from 0 (NO DR) to 4 (Proliferative DR). This approach consists of developing, training and testing various CNN models. we can rely on DL pre-trained models which looks promising because different types of image classification tasks have been performed by various CNN's. A GUI based system has been made using Tkinter and MySQL to maintain and store a list of predictions with their patient id and name. Twilio API has been used to Make SMS connectivity to patients possible in case they are not contactable or accessible (in that case we can also use mail). Advantages of proposed system are More accurate results, highly scalable, long-range detection, User friendly, highly reliable and robust.

D. MODULES

UI MODULE/LOGINPAGE MODULE

A GUI based system has been made using Tkinter which has a signup page and login page and uses MySQL to maintain and store a list of predictions with their patient id and name. We first signup into the system and then login using our credentials and then upload the image of our retina ,then the system predicts the severity of the diabetic retinopathy using the classifier module and this information will be directly stored into the database. Twilio API have been used to make SMS connectivity to patients possible in case they are not contactable or accessible.

UPLOAD IMAGE MODULE

The user can only upload the image, if he/she has logged into the system. If not, a pop up will show on the screen saying that the user must login in first into the system, to upload an image. After logging into the system, the user will be able to upload any retinal image, one at a time, from their device to detect the level of damage or in which stage the condition of their retina is in. Result will be immediately displayed on the screen and the user can further reach out to any medical professional after considering the detected stage of the retinal damage.

CLASSIFIER MODULE

Module uses a file classifier.pt which contains pre-trained parameters (weights and biases) learnt using transfer learning using resnet152 in Pytorch. This file helps in classifying the images using this predefined parameter and let us know the severity level. One can download it from the Aptos blindness detection site in kaggle.

TWILIO API/MESSAGE MODULE

Twilio Application programming interface, in short also termed as API is used as a platform for communications. It allows the user to call and message anyone globally. The organization using the software will have to register in the Twilio service and use the generated token in order to send and receive the reports. After the user gets the detected condition or stage of his/her diabetic retinopathy, the image will be displayed on the screen and a SMS will be sent to the patient, containing details of their report immediately.

E. IMPLEMENTATION PROCESS

The aptos2019-blindness-detection dataset is filtered and cleaned in the jupyter notebook using python libraries such as pytorch.If graphics card is available on the users laptop/PC, then project can be implemented using cuda. In case, if it is not available it can be implemented using "CPU" versions of the various open-source platforms.

Graphical User Interfaces (GUI) of the project is created using tkinter, this is included in all python distributions. It shows a rectangular box to enter username and password if the account of the user already exists on the system, the user can log into the system. It fits a new user, the user has to create an account first, by clicking on sign up button and then user can login to the system using created credentials.

The user can upload an image, only after logging into the system. The user can choose the retinal images and upload them to the system. The system then detects the severity of the diabetic retinopathy and displays the level of severity on the screen. Along with it, a report will be generated which showcases the selected retinal image by the user and class of the image.

In the backend, MySQL works as a database here; it stores the information of patient id, patient name and the detected severity. Then we use Twilio API, to make SMS connectivity to patients directly about their report in case they are not contactable or accessible. The report contains the severity level and its class.

F. PROPOSED ARCHITECTURE

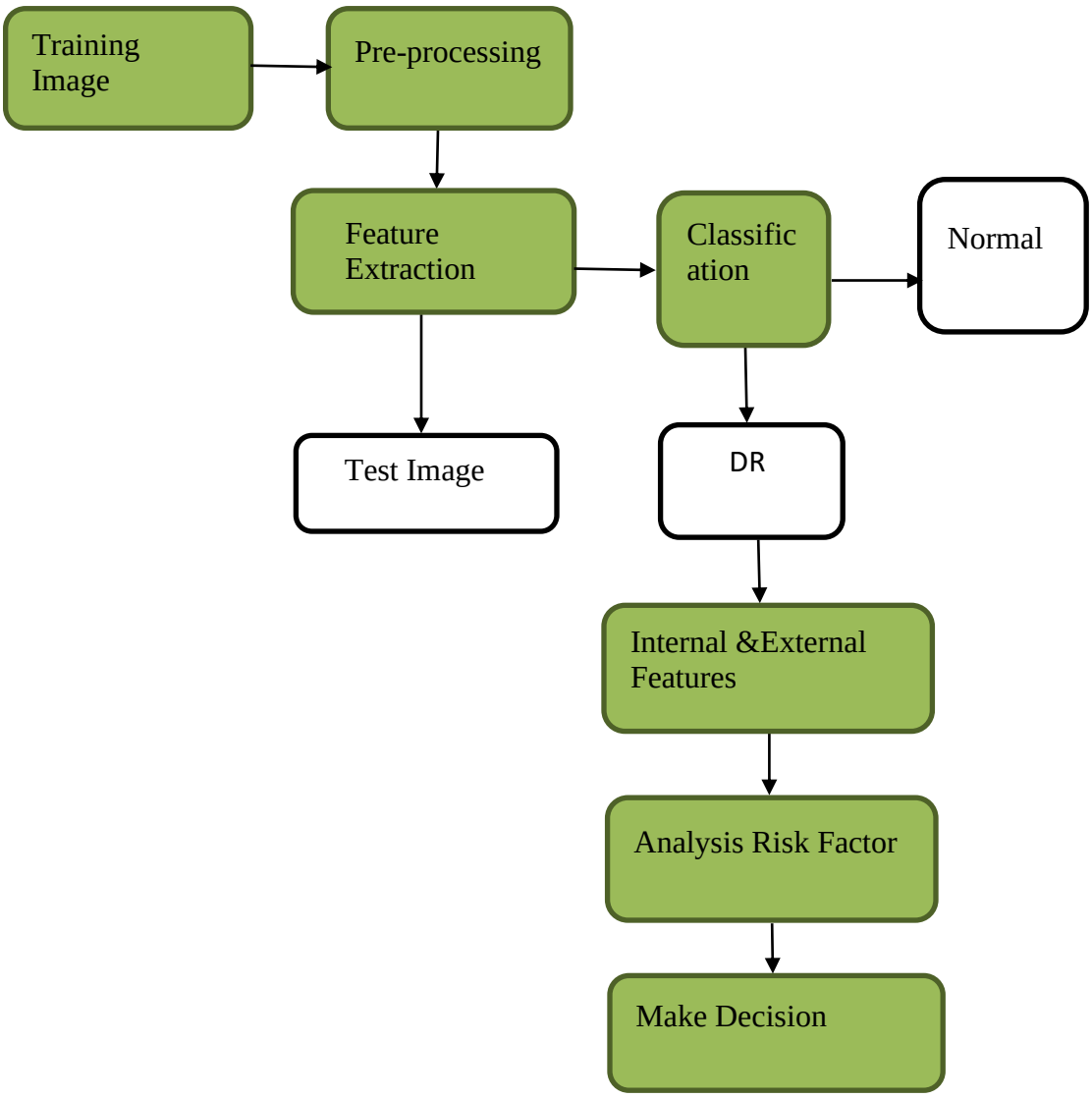

Figure 1: Proposed Architecture

G. ALGORITHMS USED

CONVOLUTIONAL NEURAL NETWORK

In neural networks, Convolutional Neural Network is used to do image classification and image recognition. Convolution neural networks are widely used in Scene labeling, objects detections, and face recognition, etc. CNN takes image as an input, which is classified and processed under a certain category. The computer depends on the resolution of the image and sees an image as an array of pixels. It consists of a set of learnable filters.There are four types of convolutional layers: Input Layer, Convolution Layer, Activation Function Layer, and Pool Layer.You can extract valuable features from an already trained CNN ,by feeding your data on each level and tuning the CNN for a specific purpose.

IV. EXPERIMENTAL ANALYSIS

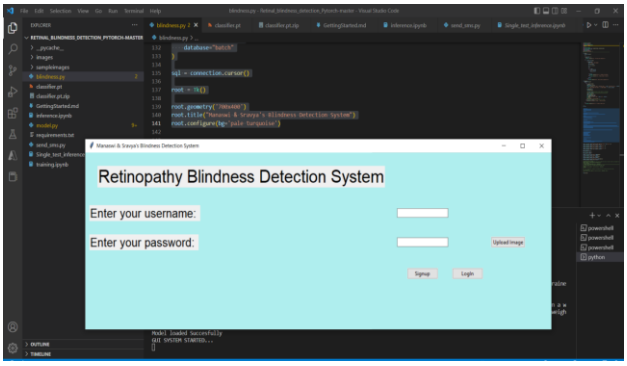

Figure 2: Graphical user interface of DR

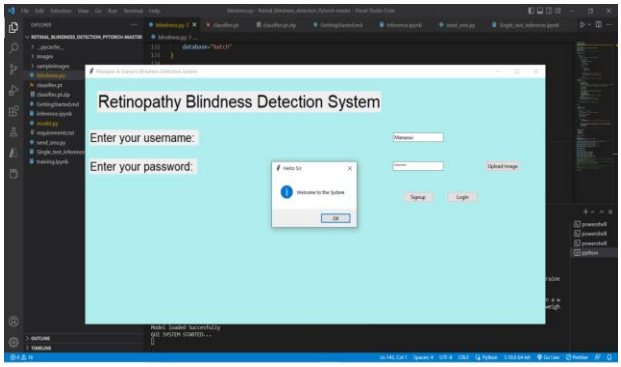

Figure 3: Login page

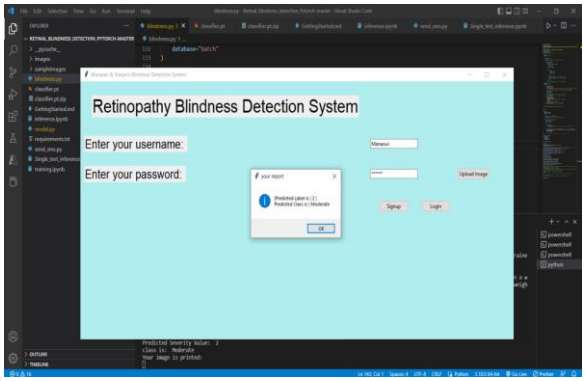

Figure 4: Report of the severity of DR

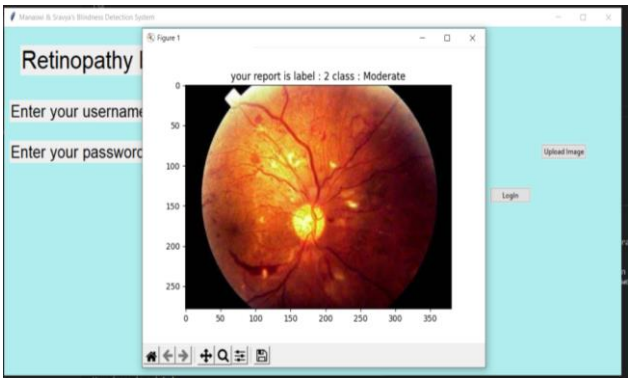

Figure 5: Class label with retinal image

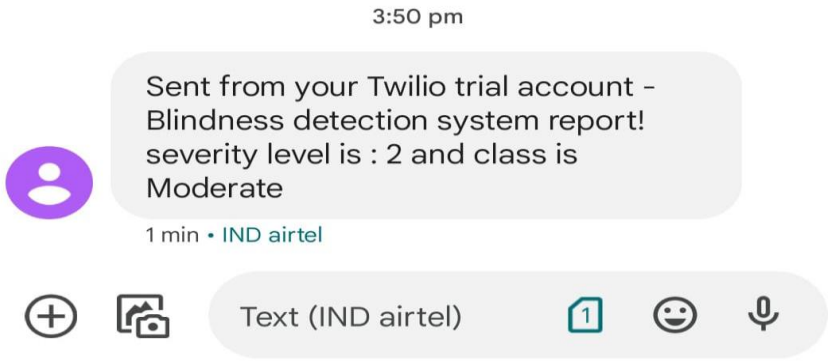

Figure 6: Report will be sent to the user, in the form of SMS.

V. CONCLUSION

For identifying the different stages of diabetic retinopathy most of the other existing supervising algorithms require more pre-processing or post-processing stages. Manual feature extraction stages require other algorithms stages to classify the fundus images. In our proposed system, Deep convolutional Neural Network (DCNN) is used to all levels of diabetic retinopathy stages. In this system, no manual feature extraction stages are needed. Our network architecture yields significant classification accuracy and True positive rate or recall is also improved.

There is a significant scope for future enhancement of our project. Using encryption techniques to achieve not only high accuracy but also high level of privacy in terms of differentially private basis and use techniques such as Federated learning. Achieving a level of privacy is also very important task in medical datasets so that there can be factor of trust established between different stakeholders using the system. It can be developed into WebApp, so that multiple users can use the system at the same time when deployed on web. This feature completes the project.

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