OCULAR PROGNOSIS USING MACHINE LEARNING

H. RITHIKASRI [1], M. SHREEDHARSHINI [2], N. SUBASHINI [3], E. GOMA [4]

UG SCHOLARS [1][2][3], DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING,

PG SCHOLARS [4], DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING,

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR,

TAMIL NADU, INDIA

ABSTRACT

Diabetes mellitus,a chronic metabolic disorder,poses a significant global health challenge. Early detection and proactive management of diabetes can significantly mitigate its impact on individuals. This research introduces eye lens, a novel predictive model that leverages ocular features extracted from retinal images for early diabetic prediction. By employing advanced machine learning algorithms, eye lens aims to offer an accessible and non-invasive solution to identify individuals at risk of developing diabetes. Image processing algorithms extract informative features from retinal images, capturing subtle abnormalities associated with early stages of diabetes. This system explores the application of machine learning, specifically Convolutional Neural Network (CNN) and Residual Networks (ResNet), in predicting ocular prognosis.The accuracy came upto the range of 98%. This system delves into how CNN and ResNet models effectively recognize patterns and features within images, contributing to a more nuanced understanding of ocular health. Eye Lens offers a non-invasive and cost-effective screening method, potentially enhancing early diabetic prediction in resource-constrained settings. The results demonstrate the potential of Eye Lens as an effective and accessible tool for early diabetic prediction, offering a valuable contribution to the field of preventive healthcare.

Keywords: *Machine learning (ML), Convolutional neural network (CNN), residual network (ResNet).*

1.INTRODUCTION

Diabetic retinopathy is caused by high blood sugar due to diabetes. Over time, having too much sugar in your blood can damage your retina — the part of your eye that detects light and sends signals to your brain through a nerve in the back of your eye (optic nerve). Diabetes damages blood vessels all over the body. The damage to your eyes starts when sugar blocks the tiny blood vessels that go to your retina, causing them to leak fluid or bleed. To make up for these blocked blood vessels, your eyes then grow new blood vessels that don't work well. These new blood vessels can leak or bleed easily. Anyone with any kind of diabetes can get diabetic retinopathy including people with type 1, type 2, and gestational diabetes (a type of diabetes that can develop during pregnancy) [1]. Risk increases the longer you have diabetes. Over time, more than half of people with diabetes will develop diabetic retinopathy. The good news is that you can lower your risk of developing diabetic retinopathy by controlling your diabetes. Women with diabetes who become pregnant or women who develop gestational diabetes are at high risk for getting diabetic retinopathy [2]. If you have diabetes and are pregnant, have a comprehensive dilated eye exam as soon as possible. Ask your doctor if you'll need additional eye exams during your pregnancy.

- **Diabetic macular edema (DME):** Over time, about 1 in 15 people with diabetes will develop DME. DME happens when blood vessels in the retina leak fluid into the macula (a part of the retina needed for sharp, central vision). This causes blurry vision.
- **Neovascular glaucoma**: Diabetic retinopathy can cause abnormal blood vessels to grow out of the retina and block fluid from draining out of the eye. This causes a type of glaucoma (a group of eye diseases that can cause vision loss and blindness) [3].

The early stages of diabetic retinopathy usually don't have any symptoms. Some people notice changes in their vision, like trouble reading or seeing faraway objects. These changes may come and go. In later stages of the disease, blood vessels in the retina start to bleed into the vitreous (gel-like fluid that fills your eye) [4]. If this happens, you may see dark, floating

spots or streaks that look like cobwebs. Sometimes, the spots clear up to their own but it's important to get treatment right away. Without treatment, scars can form in the back of the eye. Blood vessels may also start to bleed again, or the bleeding may get worse.

1.1 OVERVIEW

Recently, deep learning algorithms have enabled computers to learn from large datasets in a way that exceeds human capabilities in many areas. Several deep learning algorithms with high specificity and sensitivity have been developed for the classification or detection of certain disease conditions based on medical images, including retinal images. Current deep learning systems for DR screening have been predominantly focused on the identification of patients with referable DR (moderate NPDR or worse) or vision-threatening DR, which means the patients should be referred to ophthalmologists for treatment or closer follow-up. However, the importance of identifying early-stage DR should not be neglected. Evidence suggests that proper intervention at an early stage to achieve optimal control of glucose, blood pressure, and lipid profiles could significantly delay the progression of DR and even reverse mild.

1.2 PURPOSE

The purpose of using machine learning for diabetic eye prediction is to improve early detection, prognosis, and management of diabetic retinopathy (DR) and other ocular complications associated with diabetes [5].
Early detection: diabetic retinopathy is a progressive condition that can lead to vision impairment or even blindness if left untreated. Machine learning algorithms can analyze various ocular imaging modalities, such as fundus photographs and optical coherence tomography (OCT) scans, to detect subtle changes indicative of diabetic eye disease at its earliest stages, allowing for timely intervention and treatment [6].
Diabetic retinopathy (DR): An eye disease triggered due to diabetes, which may lead to blindness. To prevent diabetic patients from becoming blind, early diagnosis and accurate detection of DR are vital. Deep learning models, such as convolutional neural networks (CNNs), are largely used in DR detection through the classification of blood vessel pixels from the remaining pixels. In this paper, an improved activation function was proposed for diagnosing DR from fundus images that automatically reduces loss and processing time [7].
Causes: Diabetic retinopathy is the one of the common cause of blindness of the eye depending on diabetics. Early Detection of diabetic retinopathy is very important. The computer-based process of identifying the boundaries of eye from surrounding tissue on images, which is called segmentation. In this project, a deep learning based approach is presented for early detection of diabetic retinopathy from retinal image [8].

2. LITERATURE SURVEY

2.1 ENHANCING OCULAR HEALTHCARE: DEEP LEARNING-BASED MULTI-CLASS DIABETIC EYE DISEASE SEGMENTATION AND CLASSIFICATION

AUTHOR: maneesha vadduri; p. Kuppusamy

Diabetic eye disease (DED) is a serious retinal illness that affects diabetics. The timely identification and precise categorization of multi-class DED within retinal fundus images play a pivotal role in mitigating the risk of vision loss. The development of an effective diagnostic model using retinal fundus images relies significantly on both the quality and quantity of the images. This study proposes a comprehensive approach to enhance and segment retinal fundus images, followed by multi-class classification employing pre-trained and customized deep convolutional neural network (DCNN) models. The raw retinal fundus dataset was subjected to experimentation using four pre-trained models: resnet50, vgg-16, exception, and efficientnetb7, and the optimal performing model efficientnetb7 was acquired. Then, image enhancement approaches including the green channel extraction, applying contrast-limited adaptive histogram equalization (CLAHE), and illumination correction, were employed on these raw images. Subsequently, image segmentation methods such as the tyler coye algorithm, OTSU thresholding, and circular Hough transform are employed to extract essential region of interest (ROIS) like optic nerve, blood vessels (BV), and the macular region from the raw ocular fundus images. After preprocessing, the model is trained using these images that outperformed the four pre-trained models and the proposed customized dcnn model. The proposed dcnn methodology holds promising results for the cataract (CA), diabetic retinopathy (DR), glaucoma (GL), and normal detection tasks, achieving accuracies. The experimental evaluations highlighted

the efficacy of the proposed approach in achieving accurate and reliable multi-class ded classification results, showcasing the promising potential for early diagnosis and personalized treatment. This contribution could lead to improved healthcare outcomes for diabetic patients [5].

2.2 SYSTEMATIC DEVELOPMENT OF AI-ENABLED DIAGNOSTIC SYSTEMS FOR GLAUCOMA AND DIABETIC RETINOPATHY

AUTHOR: Khursheed Aurangzeb; Rasha Sarhan Alharthi

With the rapid advancements in artificial intelligence, particularly in machine learning and Deep learning, automated disease diagnosis is becoming increasingly feasible. Generating larger databases is crucial for training and validating the performance of models for chronic diseases such as glaucoma and Diabetic retinopathy, which progress slowly and unnoticed. Automated procedures for retinal vessel segmentation and optic cup/disk localization are preferred for large-scale screening of the public, contributing To the early detection and treatment of eye diseases, preventing blindness, and improving public health. This paper focuses on the challenges involved in segmenting the retinal vessels from fundus images and Presents a modified colonsegnet model for retinal vessel segmentation that includes efficient methods for locating the true vessels and applies data augmentation to overcome the issue of fewer graded images. The paper uses the optimal values for the contrast enhancement of retinal fundus images using intelligent Evolution algorithms. The central vessel reflex, bifurcation, crossover, thin vessels, and lesion presence Are highlighted as significant challenges in retinal vessel segmentation. The proposed method achieves High sensitivity, specificity, and accuracy, segmenting retinal vessels on drive, chase_db, and stare. The work is crucial in developing automated systems for the early detection and treatment of eye diseases, thereby improving public health [4].

2.3 CLASSIFICATION OF EYE DISEASES IN FUNDUS IMAGES

AUTHOR: Omar Bernabé; Elena Acevedo

Eye diseases have been a severe problem worldwide, especially in developing countries where technology and finance are limited. Today, the problem is being resolved thanks to the task of classification that is part of pattern recognition. Its primary goal is to group standard features from any entity, object, phenomenon, or event belonging to the real or abstract world. Convolutional neural networks are a type of artificial neural network used in intelligent pattern classification, machine learning, and data mining. Also, medicine and ophthalmology used these algorithms for detecting diseases in the human body. This work presents a novel intelligent pattern classification algorithm based on a convolutional neural network, which is validated through the k-fold cross validation test. Two different groups of retinography images are given: glaucoma and diabetic retinopathy. The result of accuracy is high percentage. Numerical metrics: accuracy, recall, specificity precision, and f 1 score with values close to 1, and roc curves support the suitable performance of the proposed classifier. The contributions of this proposal were the improvement of the image by implementing a new channel for the RGB matrix, the classification of two diseases, and a high percentage of model accuracy. Also, the two most crucial eye diseases can be classified, while other papers only work with one condition. In this paper, healthy images were not analyzed because we considered it more important to distinguish between the two incident diseases [3].

2.4 DISEASE CLASSIFICATION BASED ON SYNTHESIS OF MULTIPLE LONG SHORT-TERM MEMORY CLASSIFIERS CORRESPONDING TO EYE MOVEMENT FEATURES

AUTHOR: Yuxing Mao; Yinghong He

Medical research confirms that eye movement abnormalities are related to a variety of psychological activities, mental disorders and physical diseases. However, as the specific manifestations of various diseases in terms of eye movement disorders remain unclear, the accurate diagnosis of diseases according to eye movement is difficult. In this paper, a deep neural network (DNN) method is employed to establish a disease discrimination model according to eye movement. First, multiple eye-tracking experiments are designed to obtain eye images. Second, pupil characteristics, including position and size, are extracted, and the feature vectors of eye movement are obtained from the normalized pupil information. Based on a long short-term memory (LSTM) network, a classifier that corresponds to each feature, which is referred to as a weak classifier, is built. The experimental samples are pre-classified, and the classification ability of each weak classifier for different diseases is also calculated. Last, a strong classifier is achieved for disease discrimination by synthesizing all the weak classifiers and their classification abilities. By classification testing for three categories of healthy controls, brain injury patients and vertigo patients, the experimental results demonstrated the efficiency of this method. With the deep

learning method, more medical information can be excavated from eye movement to improve the values in disease diagnosis [2].

2.5 EYE FATIGUE ASSESSMENT USING UNOBTRUSIVE EYE TRACKER

The movement of human eye is controlled by the ocular muscle, which is further controlled by the brain through a motor nerve, eye behavior may provide insight into human behavior corresponding to cognitive workload. In this paper, we propose to find a simple method to assess eye fatigue using an eye tracker rather than expensive medical devices. Eye tracker has been used to detect human fatigue in previous studies. One of the popular applications is driver fatigue detection. Human eyes suffer no injury from this kind of fatigue since they are relaxed when viewing distance. The eye fatigue investigated in this paper is caused by viewing vicinity, from which human eyes may suffer injury. Most of the eye trackers used for drivers are obtrusive devices. Drivers may be distracted by the eye tracker, which is contrary to its motivation of making drivers drive safer. Proposed a model using natural-viewing eye tracker. His model can only judge whether the participant is fatigued or not. Our model provides a real-time eye fatigue level for participants. Blinking is one of the visual behaviors that can be easily observed when participants experience fatigue. Several studies have observed increased fatigue results in longer and more frequent blinking. Several studies have investigated the validity and sensitivity of saccadic metrics, including saccade velocity, duration, and amplitude, as indexes of an individual's fatigue. In our assessment model, blink and saccadic metrics are selected. We provide an integrated and accurate eye fatigue assessment [5].

3.SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In the Existing system, it only predicts an eye-based diseases. The Accuracy of the system is low because of using LSTM algorithms. Using Long Short-Term Memory (LSTM) networks for eye disease prediction involves leveraging the capabilities of recurrent neural networks (RNNs) with specialized memory cells to capture temporal dependencies and patterns in sequential data. Design the LSTM network architecture, including the number of LSTM layers, hidden units, dropout regularization, and other hyper parameters [9]. Additionally, incorporate additional layers such as convolutional layers for processing imaging data if applicable. By utilizing LSTM networks for eye disease prediction, healthcare providers can benefit from improved accuracy in early detection, prognosis, and management of ocular conditions, leading to better patient outcomes and reduced healthcare costs. However, it's essential to interpret the model's predictions within the context of clinical expertise and consider potential limitations, such as data quality issues and the need for validation in diverse patient populations [10].

DISADVANTAGES

TRAINING TIME: Training LSTM Models Can Be Computationally Expensive and Time-Consuming, Especially When Dealing with Large Datasets or Complex Architectures.

OVERFITTING: LSTMS Are Prone to Over fitting, Especially When Trained on Small Datasets or When the Model Architecture Is Too Complex.

3.2 PROPOSED SYSTEM

Diabetic retinopathy (DR) is a common complication of diabetes associated with retinal vascular damage caused by long standing diabetes. likewise, the opinion of DR substantially depends on the observation and evaluation to fundus photos of which Procedure can be time- consuming indeed for educated experts. Thus, computer backed automated opinion approaches have great eventuality in clinical to directly descry DR in A short time which can further help to ameliorate the webbing rate of DR and reduce the Blindness. For a deep literacy model, the most important corridor that should be concentrated on Are data set, network armature and training system. Before being used to train our Model, fundus images data set attained from public coffers is preprocessed and stoked. The model accepts two fundus images corresponding to the left eye and right Eye as inputs and also transmits them into the Siamese like blocks. The information from two eyes is gathered into the completely connected subcaste and eventually the model will affair the opinion result of each eye independently.

ADVANTAGES

- Time saving and efficient, it is operated online.
- This system has database which helps in retrieving images.

- It provides authentication and it is user friendly.

3.3 SYSTEM ARCHITECTURE

A system architecture or systems architecture is the conceptual model that defines the structure, Behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. The Behavior) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture; collectively these are called architecture description languages (ADLS).

Various organizations define systems architecture in different ways, including:

- An allocated arrangement of physical elements which provides the design solution for a consumer product or life-cycle process intended to satisfy the requirements of the functional architecture and the requirements baseline.
- Architecture comprises the most important, pervasive, top-level, strategic inventions, decisions, and their associated rationales about the overall structure (i.e., essential elements and their relationships) and associated characteristics and behavior.
- If documented, it may include information such as a detailed inventory of current hardware, software and networking capabilities; a description of long-range plans and priorities for future purchases, and a plan for upgrading and/or replacing dated equipment and software
- The composite of the design architectures for products and their life-cycle processes.

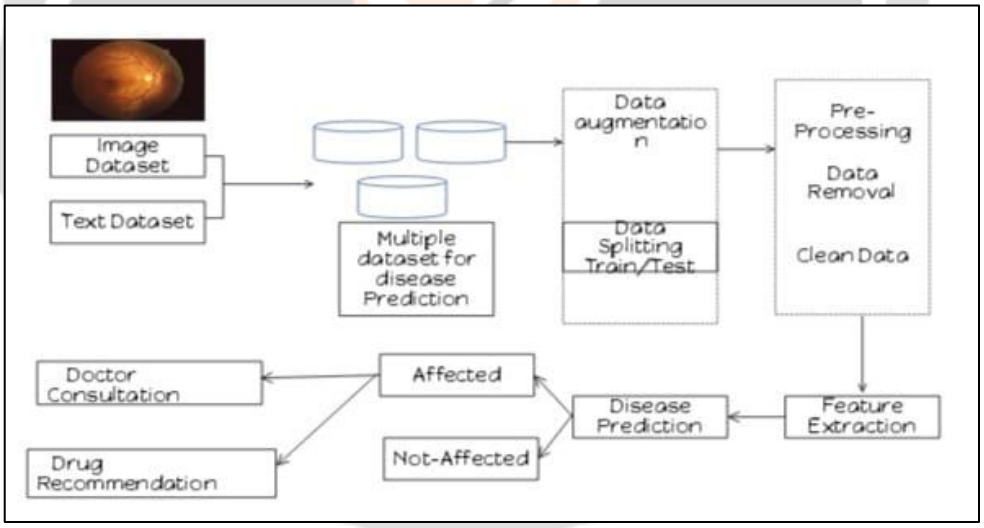

Fig - 3.1: Architecture Diagram

- INPUT IMAGE
- PRE-PROCESSING
- FEATURE EXTRACTION
- CLASSIFICATION
- DISEASE PREDICTION
- MEDICINE RECOMMENDATION

4.SYSTEM REQUIREMENT

4.1 HARDWARE REQUIREMENT

- Processor : Dual Core Processor 2.6.0 GHZ
- RAM : 8 GB
- Hard Disk : 160 GB
- Compact Disk : 650 Mb
- Keyboard : Standard Keyboard
- Monitor : 15 Inch Color Monitor

4.2 SOFTWARE REQUIREMENT

- Operating system: Windows 10
- Front End : PYTHON
- Back end : MySQL server
- Tool : Python 3.7
- IDE : PyCharm

5.SYSTEM IMPLEMENTATION

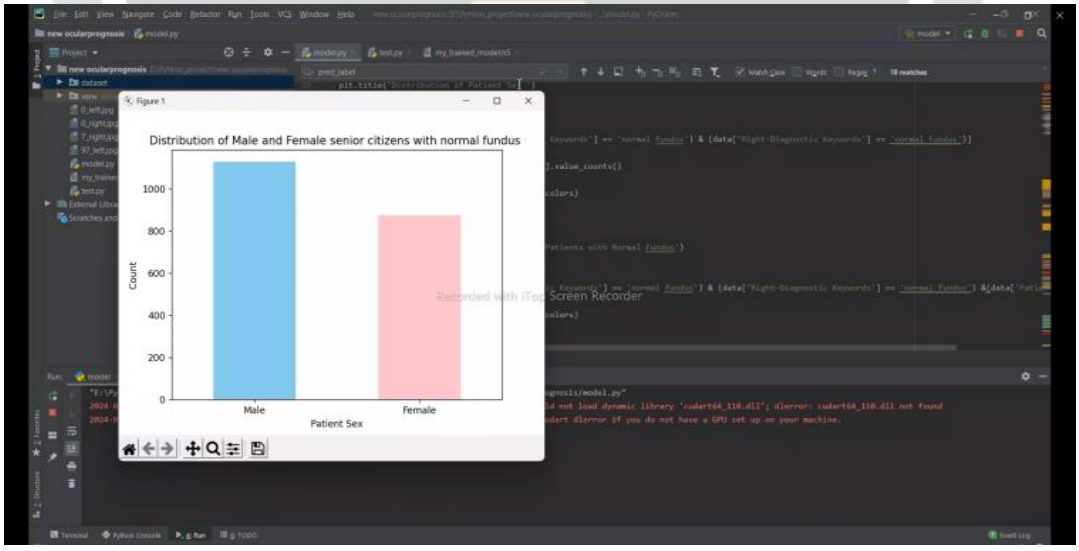

Fig – 5.1: Trained Dataset

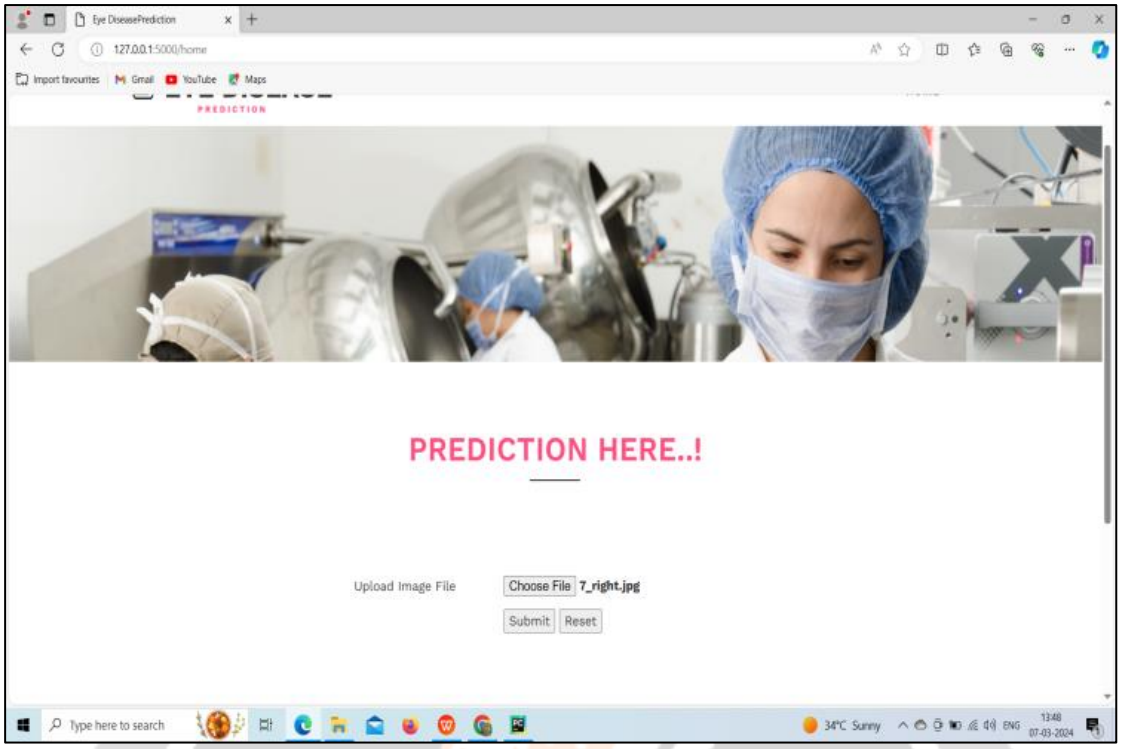

Fig – 5.2: Home Page

5.1 ALGORITHM IMPLEMENTATION:

5.2 EXPRIMENTAL RESULT AND ANALYSIS

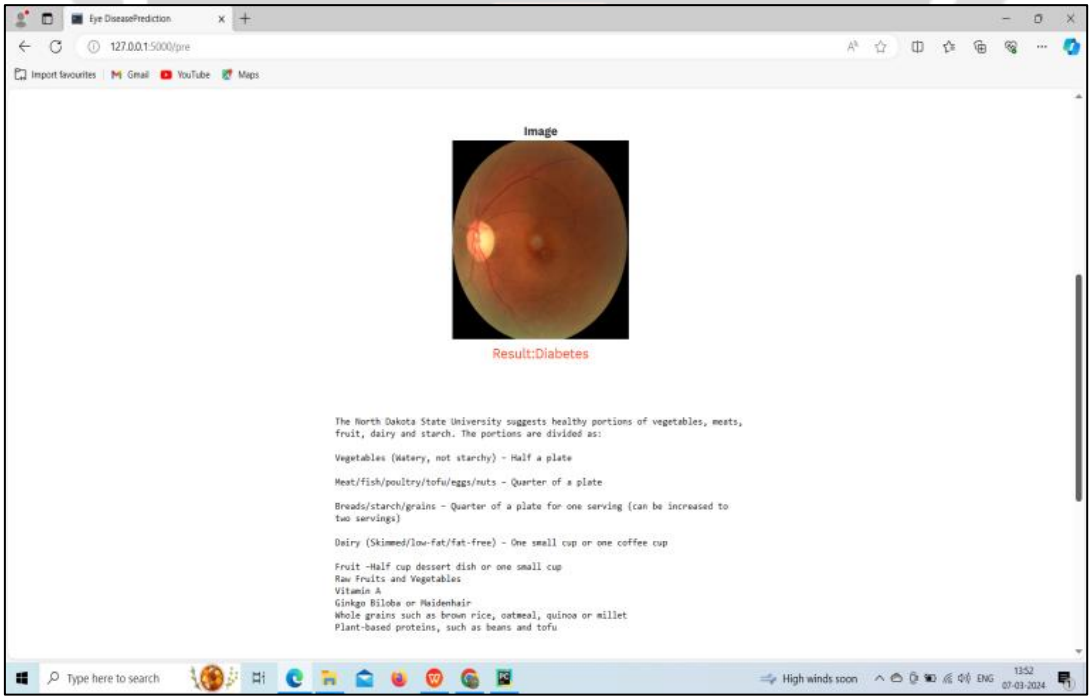

Fig – 5.3: PREDICTED RESULT

6.SYSTEM TESTING

TESTING APPROCHES

After a system has been verified, it needs to be thoroughly tested to ensure that every component of the system is performing in accordance with the specific requirements and that it is operating as it should including when the wrong functions are requested or the wrong data is introduced. Testing measures consist of developing a set of test criteria either for the entire system or for specific hardware, software and communications components. For an important and sensitive system such as an electronic voting system, a structured system testing program may be established to ensure that all aspects of the system are thoroughly tested.

Testing measures that could be followed include:

• Applying functional tests to determine whether the test criteria have been met

• Applying qualitative assessments to determine whether the test criteria have been met.

• Conducting tests in "laboratory" conditions and conducting tests in a variety of "real life" conditions. Conducting tests over an extended period of time to ensure systems can perform consistently.

• Conducting "load tests", simulating as close as possible likely conditions while using or exceeding the amounts of data that can be expected to be handled in an actual situation.

Unit Testing

The first test in the development process is the unit test. The source code is normally divided into modules, which in turn are divided into smaller units called units. These units have specific behavior. The test done on these units of code is called unit test. Unit test depends upon the language on which the project is developed. Unit tests ensure that each unique path of the project performs accurately to the documented specifications and contains clearly defined inputs and expected results. Functional and reliability testing in an Engineering environment. Producing tests for the behaviour of components (nodes and vertices) of a product to ensure their correct behaviour prior to system integration.

Integration Testing

Testing in which modules are combined and tested as a group. Modules are typically code modules, individual applications, source and destination applications on a network, etc. Integration Testing follows unit testing and precedes system testing. Testing after the product is code complete. Betas are often widely distributed or even distributed to the public at large in hopes that they will buy the final product when it is release.

Acceptance Testing

This testing is done to verify the readiness of the system for the implementation. Acceptance testing begins when the system is complete. Its purpose is to provide the end user with the confidence that the system is ready for use. It involves planning and execution of functional tests, performance tests and stress tests in order to demonstrate that the implemented system satisfies its requirements.

Validation Testing

Valid and invalid data should be created and the program should be made to process this data to catch errors. When the user of each module wants to enter into the page by the login page using the use rid and password. If the user gives the wrong password or use rid then the information is provided to the user like "you must enter user id and password". Here the inputs given by the user are validated. That is password validation, format of date are correct, textbox validation. Changes that need to be done after result of this testing.

7.CONCLUSION & FUTURE ENHANCEMENT

7.1 CONCLUSION

In conclusion, the operation of machine literacy ways in optical prognostic demonstrates significant pledge and eventuality for revolutionizing clinical practice in ophthalmology. Through the analysis of vast datasets comprising patient demographics, medical histories, imaging results, and treatment issues, machine literacy

algorithms can effectively identify patterns, prognosticate complaint progression, and optimize treatment strategies. Therefore, from our being system, we can be suitable to exclude numerous complications faced by conventional discovery systems. This system heavily impacts and conceivably reduces the possibility of lags and any more inefficiency that was. Automated webbing systems significantly reduce the time needed to determine judgements, saving trouble and costs for ophthalmologists and affect in the timely treatment of cases. Automated systems for DR discovery play an important part in detecting DR at an early stage. The DR stages are grounded on the type of lesions that appear on the retina. This composition has reviewed the most recent automated systems of diabetic retinopathy discovery and bracket that used deep literacy ways. The common fundus DR datasets that are intimately available have been described, and deep - literacy ways have been compactly explained. utmost experimenters have used for the bracket and the discovery of the DR images due to its effectiveness. This review has also bandied the useful ways that can be employed to descry and to classify DR using DL.

7.2 FUTURE ENHANCEMENT

By addressing these research priorities and advancing innovation in prevention, diagnosis, and treatment, the future of diabetic eye disease management holds the promise of improved patient outcomes, reduced healthcare burden, and enhanced quality of life for individuals living with diabetes.

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