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DETECTION OF EYE CONDITIONS USING DEEP LEARNING

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Abstract : Eye Disease is a frequent health issue that can cause partial or total visual loss. Early diagnosis is essential for eye disease to be effectively treated and managed .Deep learning has become a potent tool for the detection and diagnosis of numerous medical disorders, including eye diseases , in recent years. Convolutional Neural Network(CNN) is a deep learning technique that is often used for image analysis and pattern recognition. In this approach, we use a CNN based method for classifying various eye diseases. The suggested method extracts features from eye images and categorises them using CNN.A dataset of eye images was collected, including images of healthy eyes as well as diseased eyes which are Cataracts, Glaucoma, Bulging eyes, Uveitis, and Crossed Eyes. The dataset underwent preprocessing to normalise the images and get rid of any noise. The training and testing sets were then created from the preprocessed dataset. A CNN model is trained using the pre-processed pictures, and it is then tuned using fine-tuning methods. The proposed approach will achieve high accuracy in detecting eye conditions. The results indicate that this approach can be a valuable tool in the early detection and diagnosis of eye conditions, which can improve the outcomes of treatment and prevent vision loss.

Keywords - Convolutional neural networks , Cateract, Dataset , preprocessing.

1. INTRODUCTION

Our vision heavily relies on the health of our eyes. They act as a vital sensory organ, enabling us to detect light and hues, observe motion and shapes, and interpret our surroundings. Practicing proper eye care habits is essential to minimize the likelihood of vision-related ailments such as cataracts, glaucoma, crossed eyes, uveitis, and bulged eye. It's common to encounter eye-related complications at some stage in life. Though some minor conditions like eye irritation, redness, or itching can be addressed with at-home remedies or over-the-counter treatments, more severe eye issues necessitate professional medical intervention. To prevent or slow the progression of eye diseases, or preserve our vision, it's imperative to receive an early diagnosis and prompt treatment. Multitude of eye diseases exhibit diverse sets of symptoms, and a precise diagnosis demands a comprehensive assessment of these symptoms in combination with other diagnostic exams.

With the help of machine learning models to evaluate and categorize eye diseases holds tremendous potential in enhancing early detection efforts. Through analyzing the distinct features and symptoms of each disease, the model can formulate knowledgeable predictions and precisely categorize the disease. Here we present a deep learning model designed to detect and classify five common eye conditions.

2. NEED OF THE STUDY.

In the discipline of ophthalmology, a deep learning system for identifying eye diseases can be a useful tool. Artificial intelligence known as "deep learning" is capable of learning to spot patterns and features in vast data sets. An eye illness detection system may learn to recognise and categorise various eye disorders based on photographs of the eye by applying deep learning algorithms. Digital images of the eye would be analysed by the system to function. Convolutional neural networks (CNNs) are used in deep learning algorithms to find patterns and features linked to various eye illnesses.
The technology could be used to detect a variety of eye conditions, such as cataracts,uveitis, glaucoma,bulging eyes ,and crossed eyes. For these disorders to be effectively treated and to avoid irreversible vision loss, early detection is essential.

Overall,a deep learning-based system for diagnosing eye disorders has the potential to completely change the practise of ophthalmology by increasing the precision and speed of diagnosis and,eventually,enhancing the results for patients with eye diseases.

3. LITERATURE REVIEW

”Deep learning-based diabetic retinopathy assessment on embedded system.”Ardiyanto, Igi, Hanung Adi Nugroho, and Ratna Lestari Budiani Buana. [1] This paper suggests a technique for automatically classifying retinal pictures into various phases of diabetic retinopathy using a deep convolutional neural network. Deep learning's use to medical image analysis has drawn attention recently because of its potential to automate diagnosis and lighten the strain on medical specialists. The proposed approach is embedded system-optimized,which is a promising trait for contexts with limited resources. According to the scientists, the approach classified the various phases of diabetic retinopathy with great accuracy. The technique might be helpful in places like remote clinics or underdeveloped nations where access to specialised medical equipment might be constrained. Overall, this study's proposed method for detecting diabetic retinopathy on an embedded system shows promise, and more research might allow for its practical implementation.

Computer-based classification of eye diseases_x001D_ In Engineering in Medicine and Biology Society,”Acharya, U. R., Kannathal, N., Ng, E. Y. K., Min, L. C., & Suri, J. S. (2006, August), [2] In the study, an approach for classifying eye conditions based on digital fundus images is described. The suggested system classifies several eye conditions, such as diabetic retinopathy, glaucoma, and age-related macular degeneration, using a mix of wavelet-based feature extraction and neural network-based classification methods.The proposed system has a high accuracy rate according to the authors when it comes to categorising the various eye illnesses. In order to improve treatment outcomes and prevent vision loss, the study emphasises the potential of computer-based solutions to support medical practitioners in the early detection and diagnosis of eye illnesses.The modest amount of the dataset utilised for training and validation is one of the study's shortcomings. The system's performance was also not evaluated against other cutting-edge techniques for classifying eye diseases. To assess the system's performance in real-world scenarios and with bigger datasets, more investigation is required. Overall, the system that was suggested in this study has the potential to help medical practitioners classify eye illnesses using digital fundus photographs. The study emphasises the opportunity to enhance medical diagnosis and treatment by integrating image processing methods with machine learning algorithms.

‘‘Improved automated detection of diabetic retinopathy on a publicly available dataset through integration of deep learning,’’ M. D. Abràmoff, Y. Lou, A. Erginay, W. Clarida, R. Amelon, J. C. Folk, and M. Niemeijer [3] This study uses deep learning algorithms and a publically accessible dataset to propose an improved automated approach for the identification of diabetic retinopathy. In order to increase the detection precision of diabetic retinopathy, the authors combined deep learning algorithms with conventional machine learning techniques. They claim that their automated technologies for detecting diabetic retinopathy have greater rates of sensitivity and specificity. The study emphasises the potential of deep learning algorithms in enhancing the precision of medical image analysis systems and aiding medical specialists in the early detection and diagnosis of diabetic retinopathy. The use of a single dataset for training and validation is one of the study's shortcomings.

“Deep learning for medical image processing: overview, challenges and the future. In: Classifification in bioApps”,Razzak MI, Naz S, Zaib A[4] This The study gives a general overview of how deep learning techniques are used in medical image processing, along with an explanation of the difficulties that come with it and possible future developments in this area. The latest deep learning methods for analysing medical images are discussed, along with their advantages and disadvantages. They give a broad overview of the main issues facing the discipline,such as the requirement for extensive and varied datasets,the interpretability and explanability of deep learning models, and the moral and legal issues raised by the application of these models.The usage of generative models,transfer learning,and reinforcement learning are some of the potential future paths of deep learning in medical image processing that are covered by the authors. They draw attention to how these methods have the potential to boost the precision and effectiveness of medical image analysis as well as support doctors in making decisions about diagnoses and treatments. Overall,the study offers a thorough analysis of deep learning's uses in medical image processing, demonstrating both the advantages and drawbacks of this technology for the sector.

"Improved automatic localization of optic disc in Retinal Fundus using image enhancement techniques and SVM.” Farooq, U.; Sattar, N.Y. [5] In the paper, an enhanced method for automatically locating the optic disc in retinal fundus pictures is proposed. This method makes use of image enhancement techniques and an SVM classifier.In order to diagnose and treat a variety of retinal illnesses, the authors stress that precise localisation of the optic disc is essential. The suggested method begins by enhancing the contrast and removing noise from the retinal fundus pictures using image enhancement techniques like Contrast Limited Adaptive Histogram Equalisation (CLAHE) and morphological operations. The SVM classifier is then trained to recognise the optic disc using the characteristics that were retrieved from the improved pictures. According to the authors, the suggested technique had a success rate of 97.6% and surpassed other methods in terms of accuracy and computing efficiency.The research offers a promising method for automatically locating the optic disc in retinal fundus pictures,which may help with the detection and management of a variety of retinal illnesses.

"Development and validation of a deep learning system for diabetic retinopathy and related eye diseases using retinal images from multiethnic populations with diabetes” Ting DSW, Cheung CY, Lim G, et al [6] This study conducted by Ting et al. is a significant contribution to the field of diabetic retinopathy (DR) detection. The development of a deep learning system

for DR and other related eye diseases using retinal images from a multiethnic population with diabetes provides a reliable and accurate method for screening diabetic patients. The scientists trained their deep learning system on a sizable collection of retinal pictures, and it was then tested on a different dataset. The deep learning system's excellent sensitivity and specificity for DR and other associated eye problems show its promise as a screening tool for diabetic patients. This study's emphasis on a multiethnic community,which guarantees the deep learning system's applicability across different ethnicities, is one of its strong points. Furthermore, the authors' comparison of the effectiveness of their deep learning system with that of human graders sheds important light on the precision and dependability of the system. Overall, Ting et al.'s creation and validation of a deep learning system for diabetic retinopathy (DR) and associated eye illnesses opens up a potential new path for the early diagnosis and treatment of these problems in diabetic patients.

4. METHODOLOGY

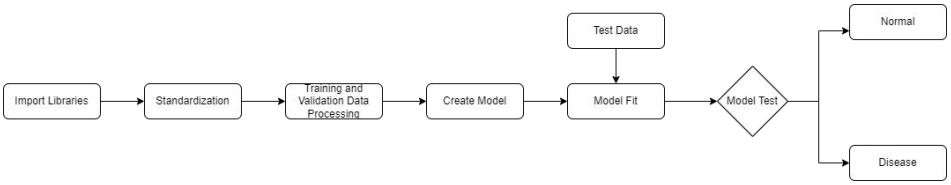

Fig1.Working of the Model

In this research, we combined image processing capabilities with our own CNN architecture. Image processing can also be divided into other categories such as "image compression", “image upscaling”,and “standardization”. After checking and accepting the data,we performed data classification before using the planning model.

4.1 Data Collection

We have collected the datasets of 5 eye conditions mentioned which are cataract, uveitis, glaucoma, bulging eyes, and crossed eyes. Kaggle website was used to collect the most of the datasets and some of the datasets were collected from internet. A local optometrist” assistance was there while collecting the datasets.

4.2 Data Preperation

When we started collecting the photos,they were different in sizes.Our measurement data includes height, width and dimension. All our photos need to be of the same size inorder train and test the CNN deep learning model.We have chosen 48 x 48 pixels as the resolution for this model.

The model has 3 convolutional layer with “linear” activation function and 1 fully connected layer. Each convolutional layer has different amount of filters:

- The first layer has .64-5 5 filters.
- The second layer has 64-3 3 filters.
- The third layer has 128-3 3 filters.

To build our model we have to make use any of the optimizer, here we have used the adam optimizer due its smaller leraning rate. The 20% of dataset is utilised for testing and the 80% of the dataset being used for training. Our dataset has 410 images with 328 images for training and 82 images for testing.we have used 65 batches for our classifier and for the training model we used 12 epochs .

After the training we have obtained an accuracy of 96.73.

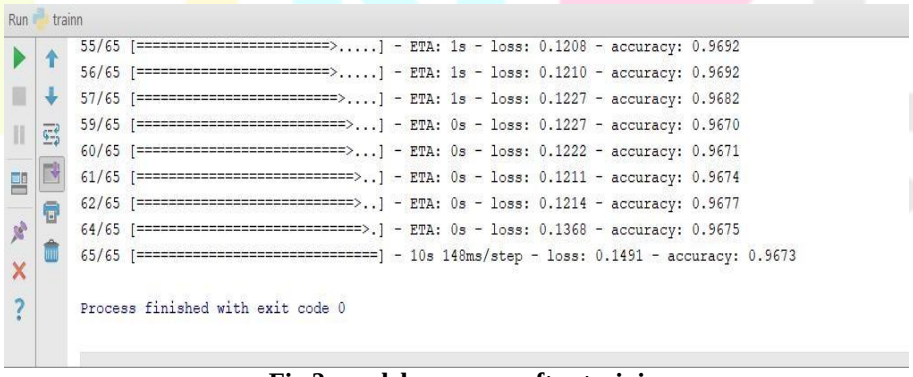

Fig 2. model accuracy after training

5. RESULTS AND DISCUSSION

We are comparing 5 different eye conditions for this model , uveitis,bulging eyes, glaucoma,cataract and crossed eyes. The training is done using one cnn model. In recent years, many models for detecting eye diseases have been developed.We have used deep learning model CNN and also made use of some of the libraries like numpy,keras ,and OpenCV. We are able to successfully accomplish all of our goals. We have also created web application as an interface for predicting the disease.

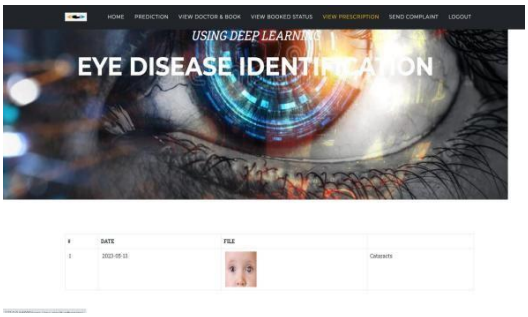

Fig 3. prediction of cateracts

Fig 4. prediction of Bulging Eyes

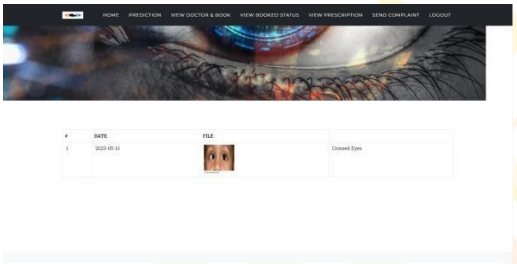

Fig 5. prediction of crossed eyes

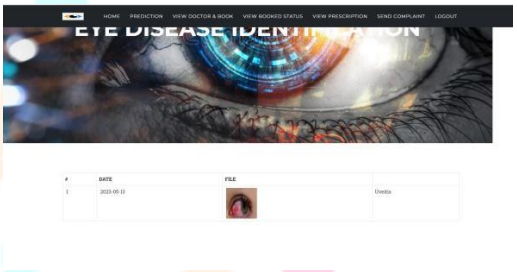

Fig 6. prediction of Uveitis

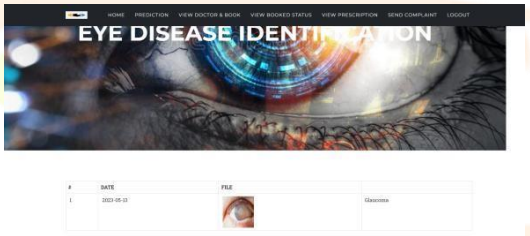

Fig 7. prediction of glaucoma

6. CONCLUSION

Deep Learning convolutional neural network (CNN) models for detection of eye conditions holds great promise. These models have demonstrated high accuracy and robustness in identifying the eye diseases like uveitis,glaucoma,bulging eyes,cateract and crossed eyes using eye images.

Current deep learning models could have certain drawbacks because to their dependence on a lot of labelled data, which can be time-consuming and expensive to collect. Future research might concentrate on creating more effective algorithms that can produce reliable findings with smaller datasets. In order to increase the precision and specificity of these models.Despite these challenges, the use of deep learning CNN models for detection of eyecondition has the potential to save a lot of people from going blind due to lack of early detection of certain eye dieaseses.

Further advancements in deep learning techniques, coupled with the availability of larger and more diverse datasets, are expected to continue improving the accuracy, robustness, and interpretability of deep learning CNN models for detection of eye condition using deeplearning.

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