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EYE DISEASE IDENTIFICATION USING DEEP LEARNING

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Abstract - *There are around 15 million blind people in India, and the unfortunate fact is that 75% of these cases were curable at certain point of time. In India, there are 10,000 patients for every doctor. Numerous eye conditions, including trachoma, corneal ulcers, and cataracts, among others, can impair vision. According to studies, early-stage disorders that go untreated are the main causes of blindness in India. The advancement of these eye diseases can only be stopped if they are appropriately diagnosed at an early stage. These eye diseases have a wide range of visually discernible symptoms. To accurately diagnose eye diseases, it is required to analyze a wide range of symptoms. Utilizing digital image processing methods like segmentation and morphology as well as deep learning methods like convolution neural network, we propose a unique method to give an automated eye disease identification model using visually observable symptoms. Four eye diseases, namely crossed eyes, bulging eyes, cataracts, uveitis and conjunctivitis are analyzed and categorized using the proposed method. The suggested deep neural network model aids in the early detection of the existence of eye disorders. If required, the model prompts patients to seek out an ophthalmologist for screening purposes.*

Key Words: **Deep Learning, Convolutional Neural Network, Deep Neural Network, Cataracts, Bulged eyes, Crossed eyes, Uveitis and Conjunctivitis.**

1. INTRODUCTION

Eyes are essential part of human life, each and every person rely on the eyes to see and sense the world around them. One of the most vital senses is sight because it accounts for 80% of all information, we take in. By taking proper care of eyes, we will lower the risk of becoming blind and losing vision, while also keeping an eye out for any developing eye-conditions like glaucoma and cataracts. Most people experience eye issues at some point of time. Some of the eye issues are minor and simple to cure at home which will go away on their own, other major eye issues need assistance from the expert doctors. When these eye diseases are accurately diagnosed at an early stage, only then the progression of these eye diseases can be stopped. These eye diseases have a wide range of visually discernible symptoms. To accurately diagnose eye illnesses, it is required to analyse a wide range of symptoms. In this paper, our proposed model analyses and classifies eye diseases namely cataracts, crossed eyes, bulging eyes, uveitis and conjunctivitis.

2. LITERATURE SURVEY

Many eye conditions, including trachoma, cataracts, and corneal ulcers, can impair vision. Only when these eye illnesses are effectively diagnosed at an early stage can progression be stopped. These eye illnesses have a wide range of visually discernible symptoms. To accurately diagnose eye illnesses, it is required to analyze a wide range of symptoms. Therefore, utilizing machine learning techniques like deep convolution neural network (DCNN) and support vector machine, paper [1] suggested a novel strategy in to create an automated eye illness recognition system using visually observable symptoms, from experimental findings it is observed that the DCNN model performs better than SVM models. In paper [2] the author have used a deep neural network model to discriminate between different diseases like diabetic retinopathy, which aids in the early detection of glaucoma and diabetic retinopathy, and high-resolution retina images taken under a variety of imaging settings. In terms of screening Eye Disease Identification using Deep Learning, it may prompt patients to contact an ophthalmologist. The created model has a lower level of complexity and achieved an accuracy of 80%. The author of the paper [3] developed a method for automatically classifying any retinal fundus image as healthy or sick using a deep learning model. They created a system named LCD Net using CNN that was able to do the binary classification.

Two sources of retinal fundus pictures were used to construct a total of eight testing datasets. Using existing datasets, image preprocessing methods, deep learning models, and performance evaluation criteria, the author of the paper [4] developed a model for the automated identification of diabetic eye illness. It includes works that used TL, built DL network architecture, and used a combined DL and ML approach in terms of classification algorithms. From medical photos, we may deduce that CNN is now the most popular deep neural network, especially for the identification of diabetic eye illness and the diagnosis of other pathological indications. The effectiveness of different current models, including neural networks and deep learning algorithms, in detecting eye disease has been examined in the research work [5]. The process of identifying eye diseases using retinal images is broken down into several smaller processes, including feature extraction, classification, and picture pre-processing. This study provides an overview of deep learning, its algorithms, the operation of convolution neural networks, and its applications to image processing, machine learning, and deep learning techniques that are utilized for retinal image-based eye disease identification.

For quick diagnosis, medical health systems have been focusing on artificial intelligence solutions. To make machine learning more accurate and dependable by taking into account different features, health data must still be recorded in a consistent format. In order to make it easier for machine learning algorithms to anticipate the diagnosis of diseases based on symptoms, a generic framework for recording diagnostic data in an international standard format must be developed. [6] The author has developed a workable solution for this and taken attempts to assure error-free data entering by creating a user-friendly interface. In addition, a variety of machine learning techniques, such as Decision Tree, Random Forest, Naive Bayes, and Neural Network algorithms, were used to analyze patient data based on a variety of variables, such as age, medical history, and clinical observations. When compared to more sophisticated techniques like neural networks and the naive Bayes algorithm, the random forest and decision tree algorithms' prediction rate is more than 90% because of a structured data arrangement. Intelligent machine learning techniques are employed in the proposed study [7] to categorize the various types of eye diseases using ophthalmology data gathered from patients of the Mecca hospital in Sudan. The severity of the eye that occurred during the research is predicted using three machine-learning techniques: Nave Bayesian, SVM, and J48 decision tree. J48 decision tree model outperforms Naive Bayesian and SVM in classifying new eye disease patients with an accuracy of 98.75 percent. The application of various image processing (Image Acquisition, Image Segmentation, Image Normalization, Feature Extraction and Matching) and machine learning (NB, KNN, SVM, DCT, HMM, AUC and PCA approaches) techniques for the detection of eye diseases is described in the author's review [8] on Image Processing and Machine Learning Techniques for Eye Disease Detection and Classification using a system. With the use of image processing and data mining techniques, the suggested system can detect and recognize eye diseases. The authors of the report have focused their research on applying AI to screen for diabetic eye disease. They have provided an overview of the development and progress of using AI and DL technology for diabetic eye disease screening, as well as the difficulties currently facing DL implementation in screening programmes and the conversion of DL research into practical clinical screening applications in a community setting. They have come to the conclusion that using AI and DL technology, human intelligence can be supplemented to enhance decision-making and operational procedures. Nearly the perfect task for AI in healthcare is screening for DR. With the hope of increasing the effectiveness and accessibility of screening programmes and so preventing sight loss and blindness from this deadly disease, AI will inevitably become pervasive and vital for screening in the future.

3. PROBLEM DEFINITION

Data shows that, since the current century people around the world have a higher likelihood of having diabetes as they age, which ultimately plays a bigger role in causing eye issues and diseases.

In the present scenario, any type of irritations in any part of the body can be described to get instant details regarding it from google (basically for non- medical purposes) but, when it comes to the human eye unless there is a vision problem, people tend to neglect other irritation or changes in the eye until it becomes an emergency. Probable reason for this is mainly due to the non-availability of a particular application made solely to detect the early stages of eye diseases and warn the user with the complete details regarding the same. Our model resolves this issue by guiding the end user to test his own eye to get the details of the eye disease and the present condition of his eye.

4. OBJECTIVES

- To build a deep learning model which classifies between normal eye and a diseased eye.
- To inform the user about eye-related problems and disorders via a simple interface.
- The proposed model would be able to guide the users to know their eye condition (for specified eye diseases namely crossed eye, bulged eye, cataracts, uveitis and conjunctivitis)
- The model shares the details of the nearby eye doctors to the use to get their eye check-up.

5. DESIGN AND IMPLEMENTATION

Image processing can be divided into several classes, including "image compression," "image upgrade," and "reclamation and measurement extraction." It helps to reduce the amount of memory needed to store a sophisticated image. The image can be stolen. The photographs may be discarded due to issues with the digitizing process and other factors. Image enhancement techniques can be used to fix a neglected image. After testing and approving the information, we next utilized this model's preparation method after doing an informational collection assortment, information resizing, information planning, and information expansion. In this study, we combined our own designed CNN architecture with the image processing capability.

Background of CNN:

Convolutional networks are a type of sophisticated neural network. It was calculated using deep learning. The way this computation is done is that the model can initially take an input image and then assign significance to various arguments or points of view in that image so that the machine can choose to divide one class from the other. Prepossessing is this model's main requirement. CNN's layout includes network representations of neurons found in the human brain. Additionally, 2D structures of information pictures have specific desirable positions. Here, slope-based augmentation is used. There are several layers in this model, including convolutional and subsampling layers.

Dataset Collection:

In this paper, we will discuss 5 different eye conditions: conjunctivitis, cataract, uveitis, bulging eyes, and crossed eyes. The Kaggle website and a small portion of the internet were used to gather the data set for the disorder's cataract, bulging, and crossed eyes. Datasets for uveitis and conjunctivitis have also been gathered online, albeit with a local optometrist's assistance.

Data Augmentation:

To avoid overfitting, we expanded our informational collection. In order to expand our significant dataset and motivate us to group our model, we added to our real informational collection using five methods. 1. Make a 90-degree turn 2. Make a 90-degree turn Shading 3. 4. A salt-and-pepper grind 5. Horizontal Flip.

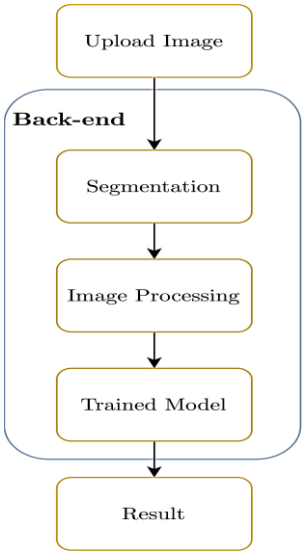

Fig -1: Proposed Model

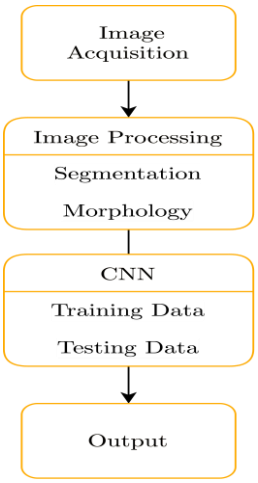

Fig -2: Training Process

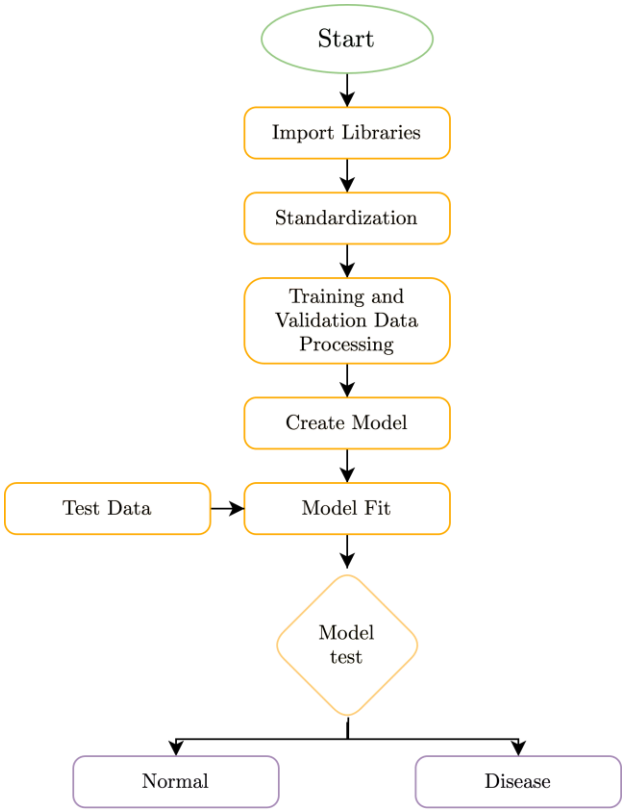

Fig -3: Software Flow Diagram

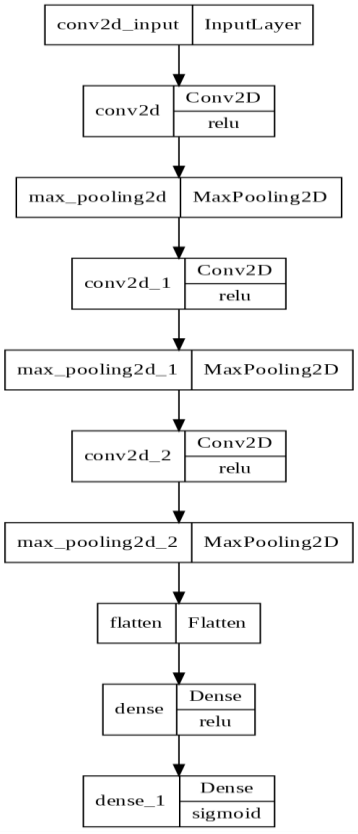

Fig -4: Model Architecture

Data Preparation:

All of the photos were in a different measurement when we first started collecting them. For their height, width, and size, our informational index is varied. In any event, for creating and testing the informational index, our profound neural classifier requires a corresponding informational index. The pixels were therefore set to 200 X 200.

Our model has nine layers as shown in fig.4. Three convolutional layers are also present:

- The first layer has an activation function of "linear" and 16-3 3 filters.
- The second layer has 32-3 3 filters, and the activation function is "linear".
- The third layer has 64-3 3 filters, and the activation function is "linear".

Training the Model:

Our model is put together using the Adam optimizer. Eighty percent of our training dataset is used for training, while the remaining twenty percent is used for validation. Our training dataset has 1200 photos in it. We may therefore state that there are 960 photographs in the training sets and 240 images in the validation sets. We trained the model using 30 epochs, with a batch size of 50 for our classifier.

6. PERFORMANCE EVALUTATION

For this model we are comparing different classes of diseases like crossed eyes, bulging eyes, uveitis/conjunctivitis and cataract. The training is done for single-eye and two-eye images using two separate models. One model predicts diseases namely crossed eye and bulging eye using two-eye images as in fig-5 and fig-6. The other model predicts diseases like cataract and conjunctivitis/uveitis using single-eye images as in fig-7 and fig-8 .

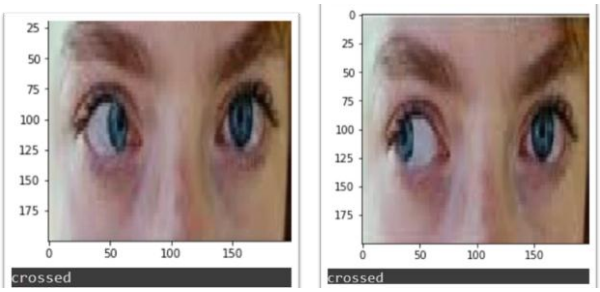

Fig -5: Model Prediction of Crossed eye

Table-1: Model Accuracy

Eye Configuration	Accuracy in %
Single Eye	96.00
Two Eyes	92.31

As mentioned in the Table-1, we have obtained an accuracy of 96% for the dataset of single- eye images and accuracy of 92.31% for the dataset of two-eye images.

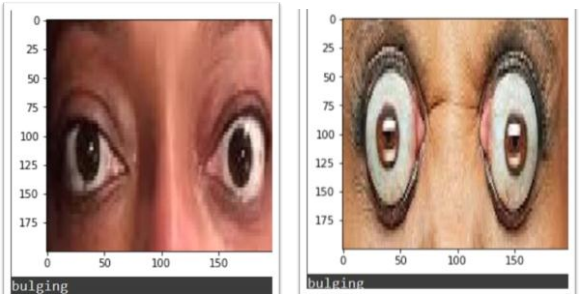

Fig -6: Model Prediction of Bulging eye

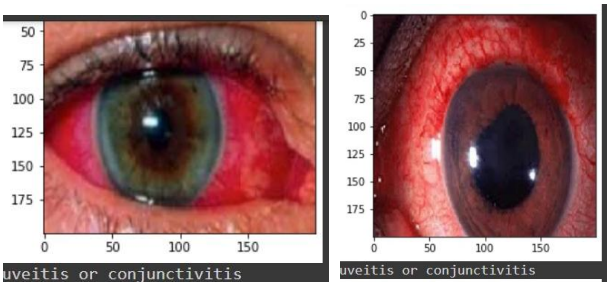

Fig -7: Model Prediction of Uveitis and Conjunctivitis

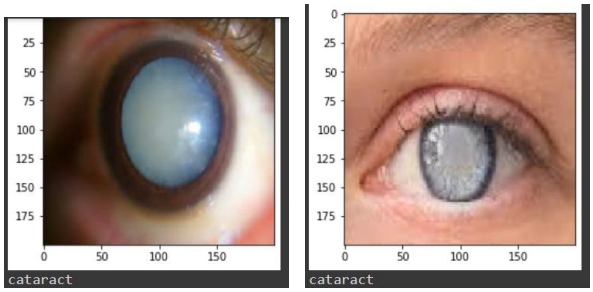

Fig -8: Model Prediction of Cataract

7. CONCLUSIONS

There are various models developed for eye disease detection in the recent years. In this paper, we have used the deep neural networks along with some core libraries like OpenCV, keras, TensorFlow, pandas, NumPy. We are successfully able to achieve all our objectives.

- Deep learning model which classifies between normal eye and a diseased eye has been successfully built.

- The model will be able to guide the users to know their eye condition (for specified eye diseases namely crossed eye, bulged eye, conjunctivitis and cataract).
- The model is cost effective and has simple interface.
- The model shares the details of the nearby eye doctors to the use to get their eye check-up.

8. FUTURE SCOPE

In future, we can create a App and web based application for a customized Deep Learning model that diagnoses externally observable eye issues/diseases from an uploaded eye picture.

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