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Eye Cataract Detection using VGG-19

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***Abstract*—According to a report of the World Health Organization, one of the main causes of blindness would be due to cataracts. Although cataracts mainly affect the elderly population, now they can also be seen in juveniles. Among the different types, there is evidence that three types of cataracts affect the mass which are nucleus, cortex, and retro capsular cataracts. Common methods of diagnosing cataracts include slit lamps. Doctors' imaging tests are not effective in early classification of cataracts stage and may also be inaccurate in determining the correct type of cataract. Our current job is to automate the workflow on binary detection-only or considered a single type of cataract among those mentioned to continue to enlarge the system. In addition, little research has been done in the area of cataract classification types. Our system works with the aim of reducing errors during manual detection of early cataracts. Our proposed system successfully classifies the images as cataracts affected or as a normal eye using VGG-19.**

***Keywords*—Python, Tensorflow, Deep learning, Eye cataract detection.**

I. INTRODUCTION

On the normally transparent lens of the eye, a cataract is a white cloud that gradually hardens and develops into a yellow plate. A healthy eye with this disorder loses vision because light cannot reach the retina because the lens is obscured by a hard, white fog.

In a survey done by the World Health Organisation on World Sight Day 2019, 217 million individuals were found to have a moderate or severe visual impairment (MSVI), and 36 million were found to be pedigree. Of these, 65 million people have cataracts, making them susceptible to MSVI and blindness. Thus, 48% of cases of blindness are caused by cataracts.

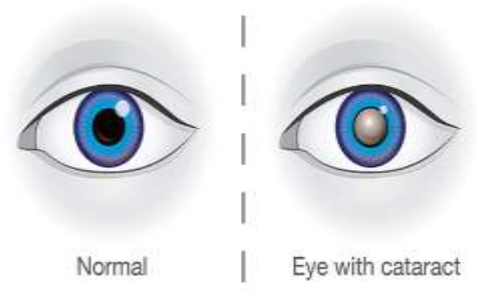

Fig. 1. Difference between normal and cataract eye

Although cataracts develop very gradually, it can cause problems as it moves out of the coating. A very small part spreads over the lens leading to loss

II. LITERATURE SURVEY

As we have studied the existing work done on this subject, an image-based system processed and developed on the MATLAB platform for accuracy of about 90% or more suggests using SVM to improve accuracy [2]. Another project using retinal fundus images, RGB image is first converted to green channel and image processing is applied technique, contrast is enhanced and noise is suppressed. Binary SVM is implemented for classification fundus image with MDA algorithm. Classification is done for two classes, i.e. no cataracts and cataracts. The grading section consists of three grades: light, medium and heavy Cataract. The dataset used consists of 261 images [3].

A system is developed using the following approaches 1. Computer vision approach to mining features and their use to develop machine learning models (b) automatically generate features and classified by a convolutional neural network. A set of six hundred labeled retinal images was used to train the models [4]. A project has proposed a method of detecting cataracts with a smartphone such as Android, iOS. The camera detects the eyes, cuts the required eye area. When cropping students, they are stored in an array. They are analyzed with the Android Native Development Kit Communication. The two main average or average intensity characteristics of images and histograms are used to determine the presence of cataracts in patients [5] .

Fundus image analysis has been the subject of extensive research. He uses four essential components to categorize cataracts: preprocessing, feature extraction, feature selection, and classifiers. While creating and transferring images, noise can be consistently introduced. [6].Therefore, preprocessing methods also have few approaches needed to improve image conditions, such as image enhancement and denoising. Numerous studies have been conducted on the segmentation and localization of retinal structures such as lesions, vessels, optic nerves, and aneurysms. To prevent issues from dimensional errors, feature extraction and selection are crucial. Different characteristics were extracted from retinal fundus images. B. Acoustic and spectral parameters, sketches, wavelets, colours, etc. As a functional representation, the three central components are gathered together. The main computational and testing work of the system is done in this section, and a solid functional representation plays a crucial role in the accuracy of the final algorithm. Cataract identification and grading have been adapted using classifiers based on different algorithms.

Automatic cataract grading techniques now in use [5] frequently deliver inaccurate, redundant, or noisy representations. utilizes a set of predefined image features. Furthermore, every one of the predefined features is artificially extracted. This is a very time-consuming heuristic strategy that requires a high level of knowledge,

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a lot of trial and error, and fine tuning. The author of [7] suggested a system that learns features automatically. Vector regression is used to ascertain the cataract grade using these features. achieving an accuracy of cataract categorization with an exact integral agreement of 70.7%. However, feature extraction and classifier remained independent.

Understanding the representations learnt by DCNNs, noticing the invariance of learned features at various layers, and the high activation of the final fully connected layer in the image served as the inspiration for our study. permits you to track to a location. These methods shed light on the elements that influence categorization performance the most. For dominating qualities and semantic concepts, Zeiler et al. [8] demonstrated that feature maps succeeding further convolutional layers store both geographical and semantic information.

The interpretation of representations obtained from DCNNs is the main topic of this white paper. The Pool5 layer of the CNN architecture's feature maps are used in the proposed technique. It has been demonstrated to understand semantics and maintain coarse geographical information [9]. We investigate the impact of the G-filter and the database's scalability on the DCNN classification accuracy in this research and show that our method performs better on the cataract identification and grading task.

III. Proposed System

Deep learning-based approaches can learn the critical features and then incorporate the feature learning processes into the model building process in order to reduce the incompleteness of the manual design features and apply them in various medical imaging. Local filters are created by clustering the picture patches supplied into a convolutional neural network (CNN). Khan et al. employed the VGG-19 model with a transfer learning approach to achieve roughly the same accuracy for fundus images using a recently made available dataset in KAGGLE. A further recent work by Pratap and Kokil investigated cataract detection in noisy settings. A pre-trained CNN was created for feature extraction by combining a number of independently trained, locally and globally trained support vector networks.

A. CNN

With tens or even hundreds of layers, a convolutional neural network can learn to recognise various image features. Each training image is subjected to various filtering at various resolutions, and the result of each convolved image is utilized as the input to the following layer. Beginning with very basic features like brightness and borders, the filters can advance to features that specifically identify the object.

Because neutral networks extract the aforementioned features, they require more training data. CNN's performance is heavily reliant on the data fed into the neural network. When there is less data, however, the common data collection technique Boost is used, in which each sample in the data set is changed in response to some category and a new image is created. In a single batch, these new images can be fed into the neural network. Variations to the image include flip, scale, prop, translate, zoom, Gaussian noise, and so on. We used a horizontal flip and a zoom factor of 0.2 in the implementation. Transfer learning is used in the multiclass classification process, and the following pre-trained models were used to perform multi-class classification on pre-processed images.

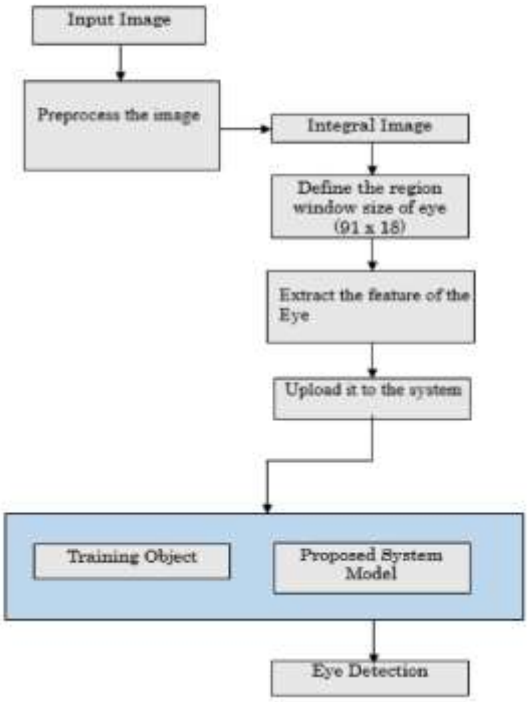

Fig. 2. Architecture Diagram

B. Preprocessing

Image preprocessing is the process of converting the image to require our needs and to add to the model efficiently. This includes resizing, orienting, and color corrections, among other features. Additionally, image preprocessing can speed up model inference and cut down on model training time. If the input images are especially huge, shrinking them will greatly reduce the amount of time needed to train the model without affecting model performance.

C. VGG-19

A 19-layer convolutional neural network is called the VGG-19. A trained version of the network can be loaded from the ImageNet database. Images can be categorised into tens of thousands of different item categories using the pretrained network. The network has therefore acquired in-depth feature representations for a range of images. The network's picture input has a resolution of 224 by 224.

D. Tensorflow

Machine learning platform TensorFlow is totally open source. Researchers may readily push the limits of machine learning, and developers can quickly create and

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deploy ML-powered applications because of its extensive, adaptable ecosystem of tools, libraries, and community resources.

The Google Brain team, which is composed of researchers and engineers, developed TensorFlow to undertake machine learning and deep neural network research. The technique is versatile enough to work in many different additional fields. While backward compatibility with other languages is not guaranteed, TensorFlow provides stable Python and C++ APIs.

IV.RESULT

A structured ophthalmic database of 5,000 patients containing age, color fundus images of the left and right eyes, and doctors' diagnostic keywords from doctors called Ocular Disease Intelligent Recognition (ODIR) has been effectively applied to our suggested approach.

The confusion matrix of the system is shown below:

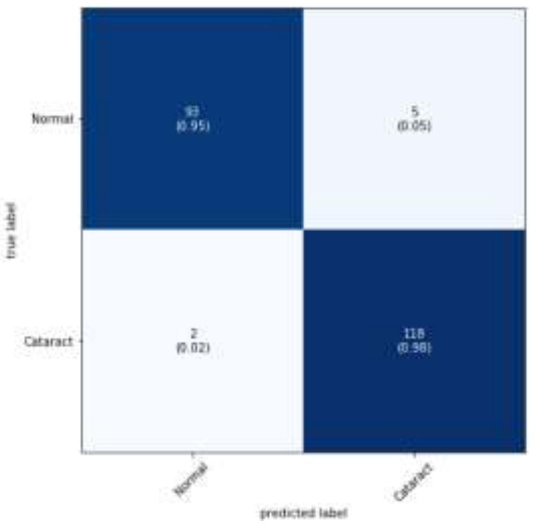

Fig. 3. Confusion matrix

The other models accuracy are shown below compared to our proposed model

TABLE 1: COMPARISON OF OTHER MODELS

Sr.No	Model	Validation Accuracy
1	VGG 16	96.88
2	MobileNet	90.62
3	SqueezeNet	97.66

The above table shows the accuracy obtained by applying different deep learning models namely VGG16, Mobile Net and Squeeze Net. The highest accuracy achieved was 97.66% by Squeeze Net. And our proposed model using VGG has an accuracy of 98.62%.

The Accuracy and loss graphs of the proposed system is shown below:

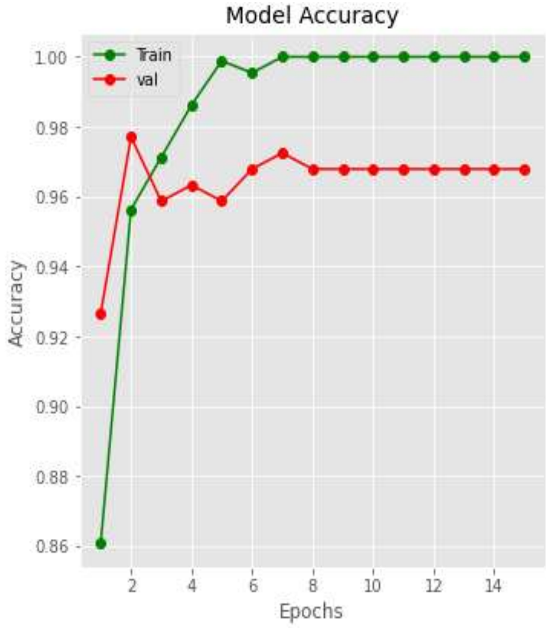

Fig. 4. Model accuracy

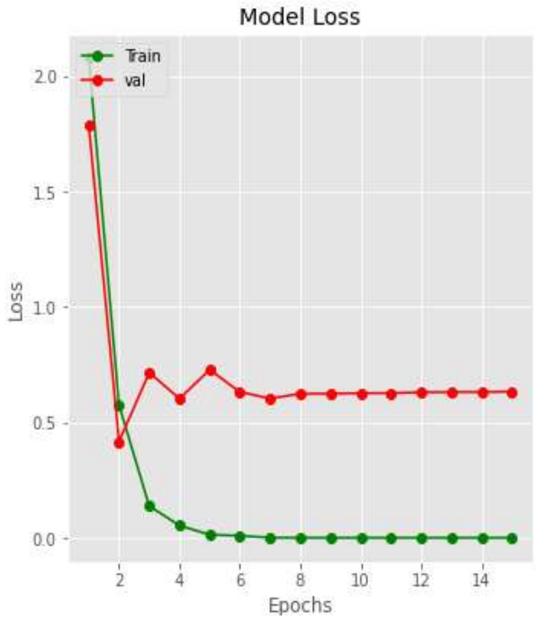

Fig. 5. Model loss

V.CONCLUSION

The main challenge was managing this large dataset. Therefore, we divided the dataset into smaller pieces to enable the proposed system. Deep learning techniques for cataract detection have been proposed in this effort. We identified and extracted certain ocular features for cataract identification using texture features.

To identify cataracts, we extracted the region of interest, i.e. pupil, and formed deep learning models to classify eye images into cataracts, normal eye image. The Deep Learning model used is VGG-19. We also evaluated the accuracy of various machine learning algorithms such as SVM-linear, Random Forest and Adaboost Classifier

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on texture features obtained from SIFT and GLCM algorithms. However, the accuracies obtained are less than deep learning models VGG-19. `

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