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Cataract Fundus Image Classification using Convolutional Neural Network

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ABSTRACT: There are various kinds of eye disease are there, among them cataract is one of the major problematic disease. Primary stage concern and the diagnosis of eye cataract can reduce the rate of infected worldwide. In our proposed system l CNN model has been used to train and test the data. The proposed model does not need expensive equipment based on a image. In the training CNN algorithm and other algorithm is used and check the accuracy of both. The CNN gives the best accuracy. The main aim of the model is to achieve accuracy of the algorithm and predict the model using CNN model but also to solve problems in the existing method of diagnosis and treatment of the disease.

KEYWORDS: Cataract, CNN (Convolutional Neural Network), Classification, Prediction

I. INTRODUCTION

One of the major problems in the globe is vision impairment. Cataract is one of the major leading problem and causing blindness. The current system needs a lot of resource to detect and treat cataract. In the existing method we use acuity test, slit-lamp and retinal exam. In visual acuity test, where a chart is placed with symbols and places at a distance of 6meters or 20 feet. The chart consists of symbols of different shapes and sizes. This text finding is very helpful in knowing the extent or onset of cataracts. In the existing approach it is difficult to diagnose cataracts at very early stage when person has no symptom of cataract affected.

Usually human beings are familiarized as a witness of the happenings within and around incidence with the help of eyes. New technologies are improvising the current technology with most improved version of treatment, measuring and curing. AI is playing the vital role in this field and solving the problem. One among such issue is cataract. Cataract will develop slowly and affect one or the other of the eye. The symptoms of this are like pale colors, visual disorder light – weight with bright lights and it is not bother seeing in the dark. This will lead to improper vision while driving recognizing of the person and reading. Cascades square on occasion measure because of developing in any case may also occur considering radiation transparency, or injury, or are moreover favoring from birth, or happen following eye an operation for different issues.

Machine Learning has a branch which is called as deep learning it is a virtual representation and works similar to the human brain it mimic the human activity. Deep learning has created the results in such a way that it gives better result than human experts. CNN is the one of the deep learning technique which has been used in various field of image processing. Deep learning model mostly depend on CNN .Tensor flow and keras are most common likely methods / libraries used in this. In order to build tensor flow model, keras will be used. Performance is the important measure in machine learning. Tensor flow will give good performance. This can be used for classification, prediction, understanding, creation and discovery.

II. RELATED WORK

Some of the existing system which has been used to implement in detecting the cataract were studied. Many of the method are successful in detecting the cataract, but when we give large scale of input the requirement is not meet the expectation.

In the paper [2] object detection algorithm has been used to detect and classify the images. It has good accuracy and low false negative for the images. But it requires the images with higher accuracy, for normal images the algorithm will not work properly.

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In paper [3] feature extraction has been done for 2000 normal eye images using RNN model to find the cataract. This has been reached accuracy of 92% and lower error rate. This model has not been set on diverse dataset, so when we apply same with diverse dataset the result may vary.

The model has applied another philosophy in distinguishing proof and classification [5]. It's anything but a common eye picture and individual information to study and consider various factors related with cascade. The model has a more than exactness speed of 75% and this is generally an after effect of the use of a more unassuming neural association.

The paper makes reference to an investigation system using simply common medium objective eye images [7]. It's anything but a high accuracy of 98%. Nevertheless, this precision might be a direct result of the over fitting of the dataset. The model necessities to over fit the planning dataset. The genuine execution may yield a lower exactness rate.

All things considered, the current structures had issues with either the model, dataset, or their frailty to be used on a public scale. The proposed system hopes to determine these issues and would have the alternative to be used for an immense degree premise.

III. IMPLEMENTATION

A. Pre-processing:

The implementation starts from collection of the data(a proper data) for both normal and cataract eye dataset. 1st step is pre-processing of the images here mainly resizing and cropping of the image will be done. This has to be done to avoid fluctuation in the size of the images. This is one of the important step. This will clear the irregularities which might create problem with the model. Here images are cropped and resized to the predefined image size given in the program. This enhance the decision making while classification so that dataset can be easily detected and used by the model.

B. Training:

The eye image dataset has been taken as an input and which is further processed by subsequent layers of convolution neural network. Normalization technique is used to train the model and standardize the input images to a layer based on the batch wise with stabilize the learning process. By doing normalization number of epochs will get decreased. Conv2D layer is the one which gives the conv kernel with the layer input and gives tensor of outputs. Pooling layer will down sample the image and reduce its dimensions. It will allow making assumptions in the sub-regions. The feature map obtained from the pooling layer is fed to the flatten layer. Then from array is processed to the fully connected layer for the classification.

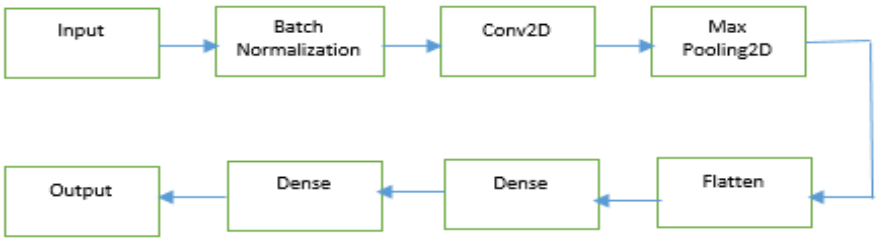

Figure 1: CNN Model

The model has been created at the training part where in the training data, features of the dataset will be extracted and model will be created.

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The CNN algorithm is mainly divided into 3 main layers: input layer, hidden layer, fully connected layer.

Again hidden layer has 3 sub layers: convolution 2D layer, Relu Layer, pooling Layer and fully connected layer

In convolution model there are 4 filters i.e..,

1. Convolution 8- 4×4 filters.

2. Convolution 16- 4×4 filters.

3. Convolution 32- 4×4 filters.

4. Convolution 64- 4×4 filters.

Pooling layer: Next to convolution layer we have pooling layer, this again consists of 4 layer. Each has pool size of 2x2

Dropout Layer: Dropout are noticeable close by specific layers in the arrange or can be utilized in input layer. There utilized two dropout layer, initial one-layer rate is 0.25 and second one is 0.5.

Flatten Layer: It will converts the output of pooled feature map into single linear vector and send data to the fully connected layer , it means the result from pool layer is converted into single continuous vector.

Dense Layer: Order is the last layer of CNN. It's called thick layer which is an ANN classifier. In the model here two thick layer that is one is 512 units and last one has 5 units. That likewise called yield layer.

After training our model on the training dataset, we observed the accuracy improved by increasing the epochs. But too many epochs created the problem of over fitting where the accuracy of the classification of new eye images tends to be poor. We found the optimal epoch value to be 20, where our testing and training losses were the lowest and hence model predictions were the most accurate.

After dataset has been trained, we observe the accuracy improved by increasing the number of epochs. But increasing in too many epochs leads to problem because of over fitting of the data. As per the experiment we had found maximum epoch of 20 will be suitable. For this testing and training loss will be lowest and predictions was most accurate.

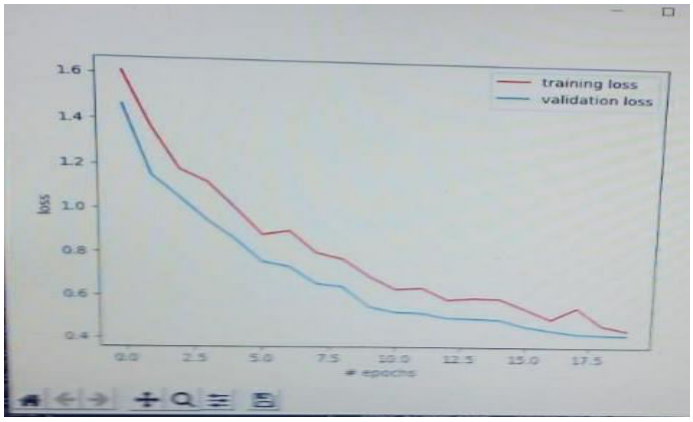

Figure 2: Model Loss with epochs

C. Testing:

In the test part used to test the data. Then comes validation/testing phase, in this phase model which has been created in the training phase will be fed and test data will be given as an input, the features of the test data will compared with the model generated and gives the prediction. Testing and validation will be done using Convolution neural network .in validation is accurate the output. Compare Convolution neural network and other algorithm we check which gives better accuracy.

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D. Prediction:

In the prediction part used to predict the data. Convolution neural network is used predict the data and check whether the model is cataract or non-cataract.

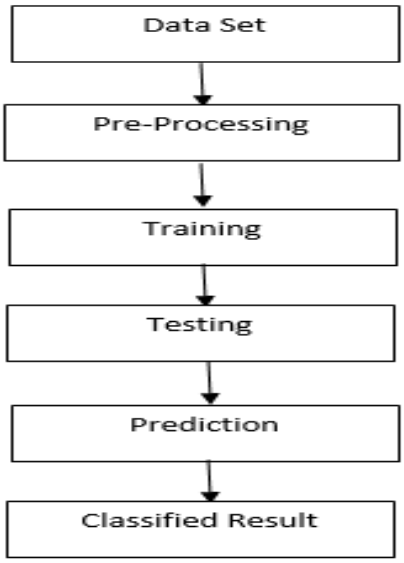

Fig 3: Implementation Methodology

IV. RESULTAND ANALYSIS

In this paper, we collected local dataset of cataract fundus image. The dataset was spilt into train and test Convolution Neural Network model is used training and test the data. In the experiment part we choose Convolution neural network and binary classification. The algorithm like random forest, svm_rbf, svm_linear, k-nearest neighbor, lostic regression. And compare both the algorithm Convolution neural network is more suitable for cataract fundus images classification. Table 1 shows the accuracy of Convolution neural network and other algorithm. Convolution neural network accuracy is good and perform very good classification. In the figure 4 and figure 5 using Convolution neural network and to implement flask server is used to predict the model.

Algorithm	Accuracy
CNN	99%
Random Forest	50%
SVM_RBF	50%
SVM_Linear	57%
K Nearest Neighbor	71%
Logistic Regression	57%

Table 1: Accuracy Result

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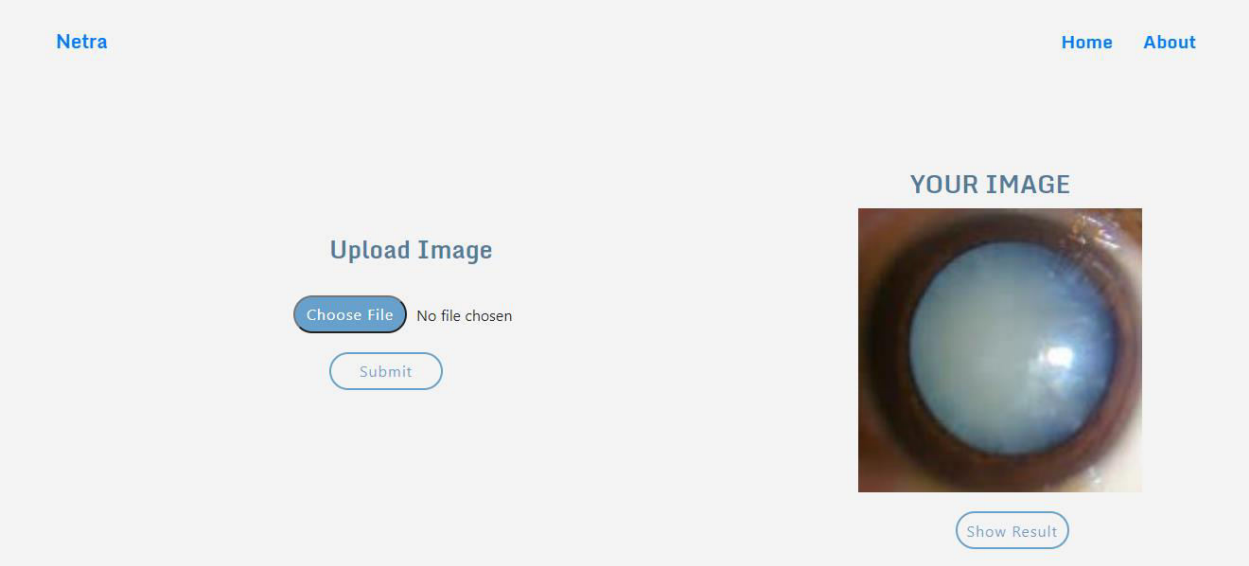

Figure 4: Uploading the image

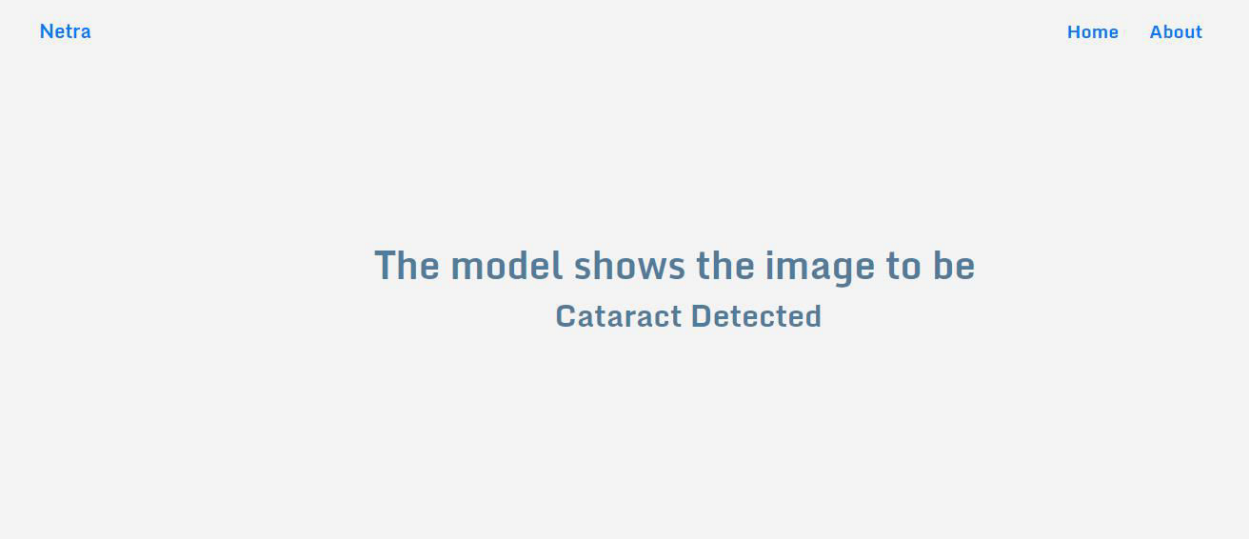

Figure 5: Classified result

V. CONCLUSION

A convolutional neural network model is in this manner created utilizing loads got via preparing the model on an enormous dataset of cataract and non-cataract eye pictures. We proposed Convolutional neural network technique to group pictures into two classes to be specific cataract and non-cataract. The dataset has been gathered and named cataract and non-cataract eye. Out of the relative multitude of pictures, some are saved for preparing and some for testing. The model is prepared with the preparation dataset and tried with the testing dataset to distinguish and group the cataract in the new information picture effectively. The dataset is collected and pre-process. Then dataset is saved. CNN and other algorithm is used for predicting the accuracy. When accuracy compared between CNN and other algorithm, CNN gives best accuracy.

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