Study on Glaucoma Detection Using CNN

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Abstract - *Glaucoma is a persistent and incurable eye condition that makes eyesight and life quality to deteriorate. We present a deep learning (DL) architecture using a convolutional neural network for automated glaucoma detection in this study. Deep learning systems, like as CNN models, can infer a hierarchical representation of pictures in order to distinguish between glaucoma and non-glaucoma patterns for diagnostic purposes. Six learned layers are included in the proposed DL architecture: four convolutional layers and two fully-connected layers. In this paper, we suggest a CNN method to glaucoma diagnosis. We create a network using Convolutional Neural Network (CNN) architecture and data augmentation to recognize the subtle elements involved in the classification job, such as microaneurysms, exudate, and haemorrhages on the retina.*

Key Words: **Convolutional Neural Network, Deep Learning.**

1. INTRODUCTION

Glaucoma is a disorder that damages the optic nerve in your eye and worsens over time. It is frequently linked to greater in eye pressure. Glaucoma is usually hereditary and may not manifest it until later in life. The increased pressure, known as optic nerve, which sends images to the brain, can be damaged by intraocular pressure. Glaucoma can cause irreversible vision loss if the damage also isn't treated. Glaucoma, if left untreated, can result in complete and irreversible blindness within several years.

1.1 Existing System

Glaucoma is frequently detected too late because it is generally asymptomatic for years: half of all cases have mitigate to progressive disease first shows itself, it is in the worse eye, even in countries with high standards, massively increasing the disease's human and economic burden on individuals and society. Measurements of intraocular pressure (IOP) are used during regular eye exams, but they cannot distinguish between healthy and glaucomatous eyes up to half of glaucoma patients may not have an elevated IOP upon examination, and many ocular hypertensive patients do not require treatment and will never develop glaucoma. By several observational studies (Rotterdam Eye Study, Blue Mountains Eye Study, Visual Impairment Project, Proyecto VER, and Latino Eye Study), glaucoma is untreated in 50 percent of cases in the Western part of the world, with greater rates in specific ethnic groups, and up to 90 percent in developing countries. On the other side, glaucoma is frequently over treated: many patients are treated even when they have no illness. This strongly advocates for a global increase in illness detection precision.

1.2 Proposed System

Glaucoma is an eye disorder that leads to lifelong blindness. Glaucoma is a chronic condition that can only be prevented if it is recognised properly at an early stage. The proposed method creates an automated glaucoma detection computer-aided system that allows ophthalmologists to accurately diagnose glaucoma patients early. The method uses a pre-processed fundus picture and extracts the optic cup and optic disc before calculating the Cup to disc ratio. To train and evaluate the classifier, intensity and textural information are taken from the picture. The outcomes of disease diagnosis using CDR are combined with characteristics to identify the picture as glaucoma or non-glaucoma suspect.

2. DESIGN AND DEVELOPMENT

2.1 Objectives

- To develop an efficient Pre-processing /Data Augmentation technique.
- To develop a Novel algorithm to extract features using CNN.
- To develop high computational classifier to detect the Glaucomatous images

2.2 Tools and Technologies

- Pycharm IDE development of code.
- Python version 3.7 for implementation of algorithms.
- Convolutional neural network for Glaucoma Detection.
- TensorFlow- TensorFlow is a complete open source machine learning framework.
- FrontEnd: HTML5, CSS3, JavaScript.

2.3 Methodology

By processing features extraction and classification simultaneously inside the same network of neurons, we construct an algorithm using CNN architecture that avoids the standard hand-crafted features extraction stage and, as a result, automatically and without user input provides a diagnosis. One of the most sophisticated picture categorization models available today is the Convolutional Neural Network. They are divided into two parts. An image in the form of a pixel matrix is provided as input. It is a gray scale image with two dimensions. To represent the fundamental colors, a third dimension, depth 3, is used (RGB). The first section of a CNN is the traditional component. It works as an image characteristic extractor. Convolution maps are created by passing a picture through a sequence of filters, or convoluted nuclei. Some intermediate filters use a local maximum operation to lower image resolution. Eventually, the convolution maps are flattened and concatenated to generate a CNN code, which is a feature vector. CNN obtains this code from the evasive party, which is then linked in the entrance of a second component, which is made up of totally connected layers (multilayer perceptron). The purpose of this section is to combine the CNN code's features in order to categorize the image. As a result, the final layer has one neuron of each type. Pre-processing is used in the input layer to shrink photos with random pixels to 224 × 224 x 3. The picture pixels 224 x 224 x 3 are then convolved using the weights and bias terms in the convolutional layer. The activation function (Rectified linear) is used to convert all negative values produced after convolution to 0 while maintaining positive values unchanged. This activation function determines to choose whether or not trigger a neuron. The data are then passed to the max-pooling layer, which decreases the image dimensionality and boosting computing performance. Again, this pooled image is provided for batch normalization, which rationalizes the image in each channel within 0 and 1. (RGB). And this procedure is repeated three times with the layer network in the important difference, the dropout periodically dropping certain units in our model to reduce model complexity and optimize performance speed. We also use a regularizes that averages all the squares weighting factors in the weight matrices to generate the gradient descent, which updates the weights to reduce model loss. Following all of these steps, the picture pixel values are sent to the flattening layer, which aids in the transformation of 2D data to ID for input to the fully - connected network for classification.

A data-flow diagram (DFD), like the one in Figure 1, demonstrates how data flows through with a process or system. The DFD also give more knowledge about each entity's inputs and outputs as well as the process itself.

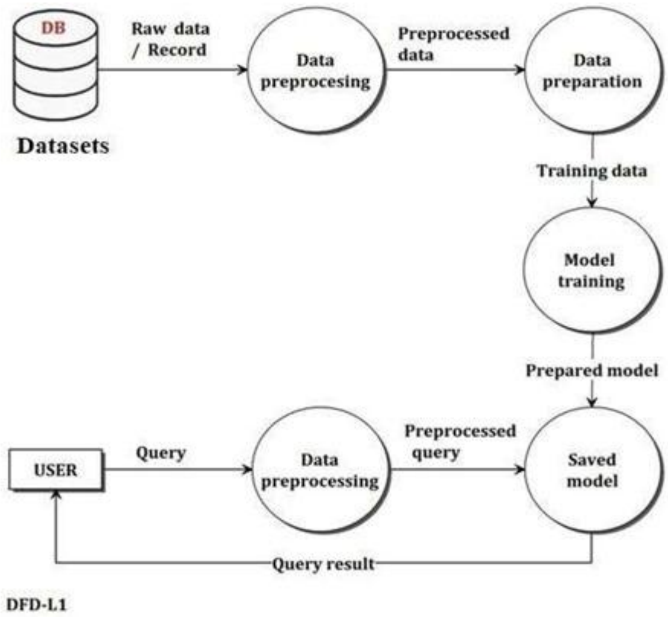

Fig-1: Data Flow Diagram of the system.

3. RESULTS AND DISCUSSIONS

Most current supervisory algorithms allow for additional pre- or post-processing stages in order to differentiate between the various stages of glaucoma. Further algorithms that demand human feature extraction stages are required to specify the fundus images. Convolutional Neural Networks (CNN) provide a comprehensive solution to all stages of glaucoma in our suggested solution. There is no need for manual feature extraction procedures. With dropout techniques, our network architecture produced a significant improvement in classification accuracy. Our network architecture is complex and computationally demanding, requiring the need for a graphics processing unit to process fundus images as the number of layers is increased. By increasing the number of photos in each class and the number of convolutional layers, it is possible to improve the testing accuracy for Glaucoma.

A thorough explanation of the Convolutional Neural Network (CNN) was provided in this project. It was explained how different layers, including convolution, polling, Rectified Linear Unit (ReLu), and fully connected layers, function. We are known that the pooling layer reduces dimensionality, the ReLU layer tends to increase non-linear properties, and the fully connected layer is the result of the previous layer. The convolution layer is used to extract features from the input image. To put it another way, the fully connected layer takes neurons from the previous layer and connects them to every single neuron it has to form a neural network, which will then be gathered for further classification.

Input:

Image of human eye is put into the glaucoma detector system as shown in figure 2 to check if it is healthy or not.

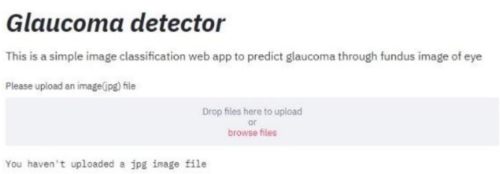

Fig2:Browsing human eye Images

Output:

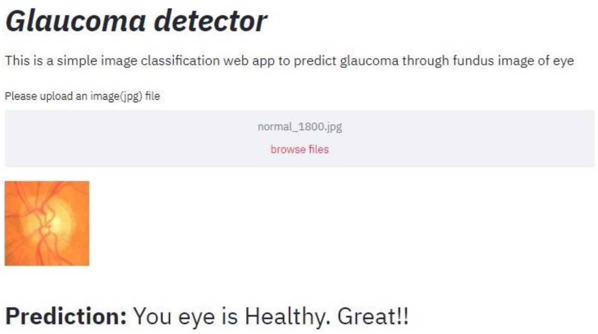

Fig-3: Healthy Eye

If it is healthy as shown in figure 3

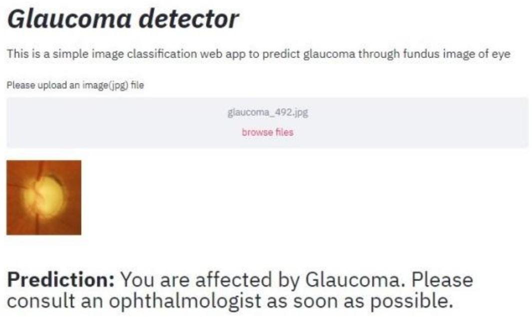

Fig-4:Glaucoma affected Eye

If it is affected by glaucoma as shown in figure 4

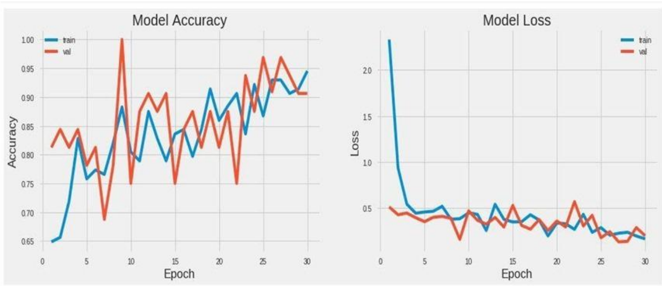

Fig 5: Model Accuracy and Model loss

The graph as shown in figure 5 describe the model accuracy and model loss in which we compare the validated data with trained data and the accuracy.

4. CONCLUSIONS

Convolutional Neural Network (CNN) is a systematic approach to all levels of Glaucoma in our proposed solution. There are no manual feature extraction processes required. The classification performance of our network design using dropout methods was substantial. Our system architecture is complicated and computationally costly, necessitating the use of a graphics processing unit to interpret fundus pictures as the number of layers piled increases. The accuracy of glaucoma testing can be improved by increasing the number of images in each class and the number of fully connected layers.

ACKNOWLEDGEMENT

We have been given the privilege of thanking everyone who assisted us in the completion of the paper. We'd want to offer our heartfelt appreciation to Dr. Pushpalatha S. Nikkam and Dr. Jagadeesh Pujari of the Department of Information Science and Engineering at SDMCET Dharwad, our project guide and Head of the Department for assisting and guiding us throughout the process of polishing the work responsible for producing this paper. Finally, we owe a great deal to our parents for their unwavering support and assistance.

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