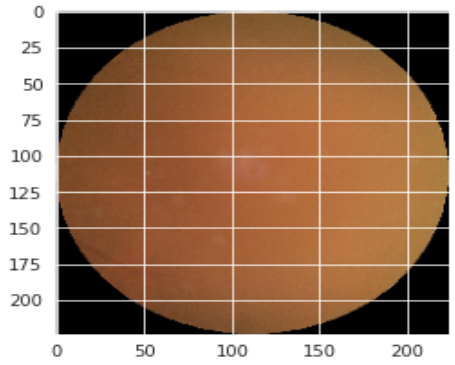
Insight: Cross-platform application to predict occular diseases

MALLEK Ghassen, HBAIEB Rami, KLAI Ghassen, MBARKI Iheb, ZiITOUN Yassine, KARRAY Gargouri

{ mallek.ghassen, rami.hbaieb, ghassen.klai, iheb.mbarki, yassine.zitoun, karray.gargouri }@esprit.tn

Abstract

This article reviews a Cross-platform application for predicting more than ocular disease by uploading an external eye picture or medical picture as OCT or retina, allowed to quickly find the nearest ophthalmologist to you and make an appointment online, also it helps them to save patients' medical follow up.



Keywords: MEAN technology, Django, Tensor-flow, Deep-learning, PyTorch, Kaggle, Collab, Anaconda

I. Introduction

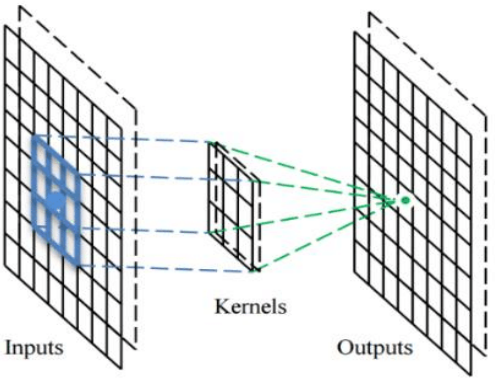
According to the World Health Organization, the number of people with ocular problems has reached 2.2 billion.
Ocular diseases affect the patient's eye health and vision. With Insight, we help the ophthalmologists to diagnose a wide range of common eyes diseases. Eye disease is a very blanket term that refers to the group of diseases that impact the function of the eye. Early detection is an absolute key in here, so the best way to treat these common conditions is to visit your eye doctor on an annual basis.
The diseases that Insight can predict are:

- **Cataract: Eye disease that typically affects older adults. Cataracts occur when there is a clouding or opacity of the natural internal lens of the eye. In some cases, this opacity is a small spot, whereas in others it will cover the entire lens. When this occurs, the light that enters the eye becomes scattered, causing images to appear blurred and hazy.**
- **Glaucoma: Eye disease characterized by an increase in the intraocular pressure in the eyes, which results in damage to the optic nerve. In most cases, there are no signs or early symptoms of the disease, which is why it is often referred to as "the silent thief of sight". Unfortunately, there is no cure for glaucoma, but there are medications and surgical options that can stop further vision loss from setting in.**
- **Macular Degeneration: Eye disease that can blur your central vision. It happens when aging causes damage to the macula (part of the retina) — the part of the eye that controls sharp, straight-ahead vision.**
- **Diabetic : Diabetic eye disease is a group of eye problems that can affect people with diabetes. These conditions include diabetic retinopathy, diabetic macular edema, cataracts, and glaucoma. Over time, diabetes can cause damage to your eyes that can lead to poor vision or even blindness.**
- **Hypertension: Ocular hypertension occurs when the pressure in your eyes is above the range considered normal, with no detectable changes in vision or damage to the structure of your eyes. The term is used to distinguish people with elevated pressure from those with glaucoma**

II. Our approach

2.1 Model overview

A Convolutional neural network[1] (CNN) is a neural network that has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other auto correlated data.
A convolution is essentially sliding a filter over the input. One helpful way to think about convolutions is this quote from Dr Prasad Samarakoon: "A convolution can be thought as "looking at a function's surroundings to make better/accurate predictions of its outcome."
Rather than looking at an entire image at once to find certain features, it can be more effective to look at smaller portions of the image.



2.2 Preprocessing

We use a dataset from kaggle "ocular-disease-recognition-odir5k" starting with cleaning it from Removing the noisy Data then Encapsulating diseases in dictionaries by Finding each disease separately and Finding those who has only one disease (to make differentiation betweeen diseases in visualization mor easier)

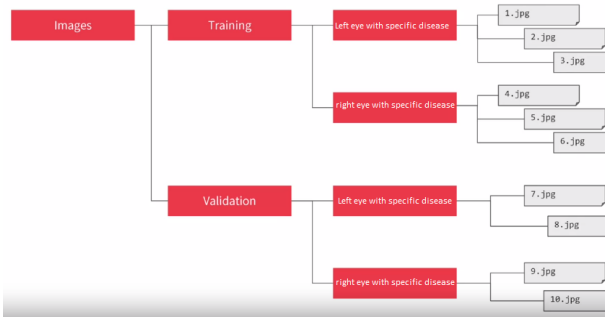
Then all diagnostic keywords were got for each disease and generating new label columns for each side.

2.3 Architecture VGG16

VGG16[2] is a convolution neural net (CNN) architecture which was used to win ILSVR(Imagenet) competition in 2014. It is considered to be one of the excellent vision model architecture till date.

First importing all the libraries which I will need to implement VGG16.

Creating and object of ImageDataGenerator for both training and testing data and passing the folder which has train data to the object trdata and similarly passing the folder which has test data to the object tsdata.



The ImageDataGenerator will automatically label all the data inside cat folder as cat and vis-à-vis for dog folder. In this way, data is easily ready to be passed to the neural network.

Here, I have started with initializing the model by specifying that the model is a sequential model. After initializing the model, I add

→ 2 x convolution layer of 64 channels of 3x3 kernal and same padding
→ 1 x maxpool layer of 2x2 pool size and stride 2x2
→ 2 x convolution layer of 128 channels of 3x3 kernal and same padding
→ 1 x maxpool layer of 2x2 pool size and stride 2x2
→ 3 x convolution layer of 256 channels of 3x3 kernal and same padding
→ 1 x maxpool layer of 2x2 pool size and stride 2x2
→ 3 x convolution layer of 512 channels of 3x3 kernal and same padding
→ 1 x maxpool layer of 2x2 pool size and stride 2x2
→ 3 x convolution layer of 512 channels of 3x3 kernal and same padding
→ 1 x maxpool layer of 2x2 pool size and stride 2x2

I also add relu (Rectified Linear Unit) activation to each layers so that all the negative values are not passed to the next layer.

After creating all the convolution I pass the data to the dense layer so for that I flatten the vector which comes out of the convolutions and add

→ 1 x Dense layer of 4096 units
→ 1 x Dense layer of 4096 units
→ 1 x Dense Softmax layer of 2 units

I will use RELU activation for both the dense layer of 4096 units so that I stop forwarding negative values through the network. I use a 2 unit dense layer in the end with softmax activation as I have 2 classes to predict from in the end which are dog and cat. The softmax layer will output the value between 0 and 1 based on the confidence of the model that which class the images belongs to.

After the creation of softmax layer, the model is finally prepared. Now I need to compile the model.

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 224, 224, 64)	1792
conv2d_2 (Conv2D)	(None, 224, 224, 64)	36928
max_pooling2d_1 (MaxPooling2	(None, 112, 112, 64)	0
conv2d_3 (Conv2D)	(None, 112, 112, 128)	73856
conv2d_4 (Conv2D)	(None, 112, 112, 128)	147584
max_pooling2d_2 (MaxPooling2	(None, 56, 56, 128)	0
conv2d_5 (Conv2D)	(None, 56, 56, 256)	295168
conv2d_6 (Conv2D)	(None, 56, 56, 256)	590080
conv2d_7 (Conv2D)	(None, 56, 56, 256)	590080
max_pooling2d_3 (MaxPooling2	(None, 28, 28, 256)	0
conv2d_8 (Conv2D)	(None, 28, 28, 512)	1180160
conv2d_9 (Conv2D)	(None, 28, 28, 512)	2359808
conv2d_10 (Conv2D)	(None, 28, 28, 512)	2359808
max_pooling2d_4 (MaxPooling2	(None, 14, 14, 512)	0
conv2d_11 (Conv2D)	(None, 14, 14, 512)	2359808
conv2d_12 (Conv2D)	(None, 14, 14, 512)	2359808
conv2d_13 (Conv2D)	(None, 14, 14, 512)	2359808
max_pooling2d_5 (MaxPooling2	(None, 7, 7, 512)	0
flatten_1 (Flatten)	(None, 25088)	0
dense_1 (Dense)	(None, 4096)	102764544
dropout_1 (Dropout)	(None, 4096)	0
dense_2 (Dense)	(None, 4096)	16781312
dropout_2 (Dropout)	(None, 4096)	0
dense_3 (Dense)	(None, 2)	8194

Total params: 134,268,738
Trainable params: 134,268,738

2.4 Deployment

After testing the model and get results, and we integrated in our application Insight.

Conclusion:

Recently, deep learning has been widely applied in many fields and research areas such as healthcare, sentiment analysis, natural language processing, visual recognition and many more …

This paper reviews the predicting of more than ocular disease by uploading an external eye picture or medical pictures as OCT or retina.

References:

[1] Saad Albawi, Tareq Abed Mohammed, Saad Al-Zawi "Understanding of a convolutional neural network" added to IEEE Xplore march 8, 2018.

[2] Rohit Thakur, "Step by step VGG16 implementation in Keras for beginners" Published in Towards Data Science, Aug 6, 2019.