Automatic Classification of Diabetic Retinopathy Stages

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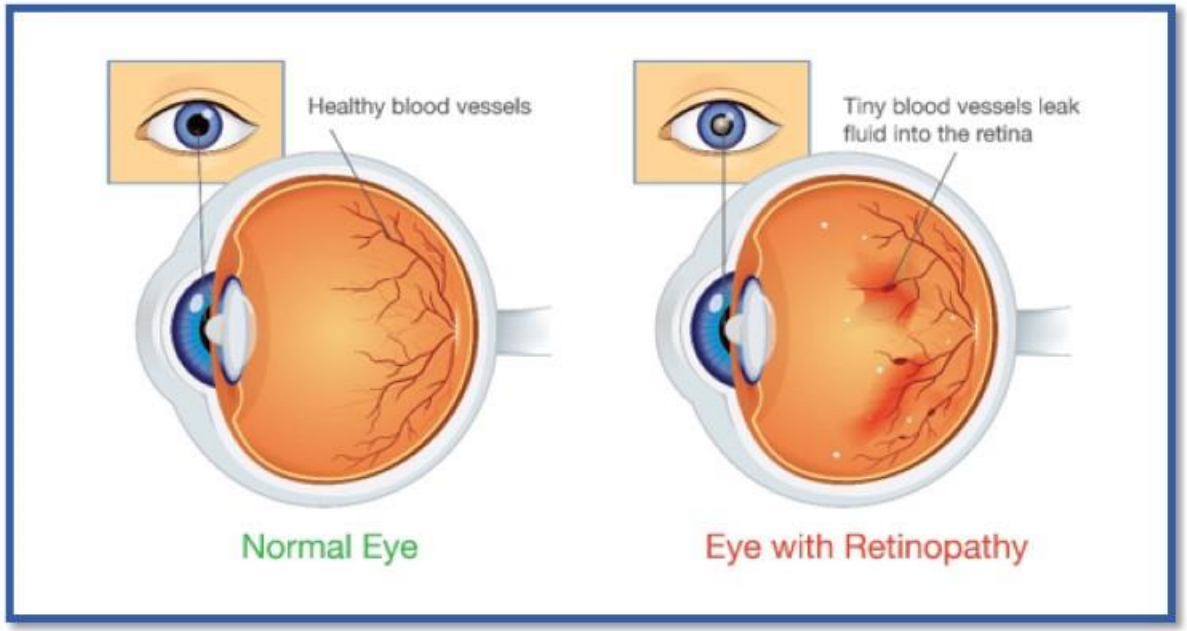
Introduction 1/3

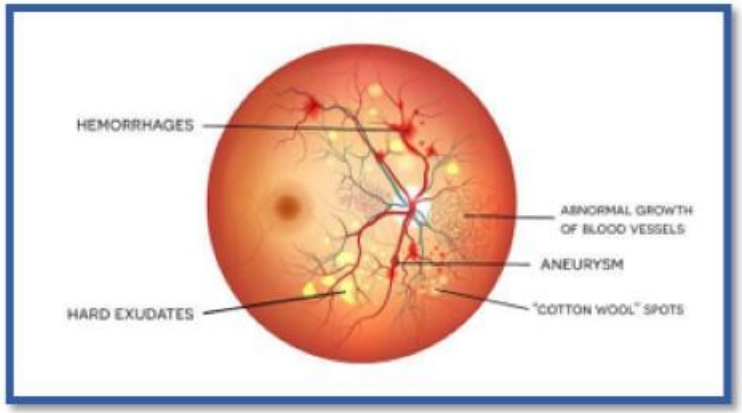
- Too much sugar in the blood, can cause damage throughout the body, including the eyes [1].
- The walls of the blood vessels in the retina weaken.
- Leaking fluid and blood into the retina.
- Diabetic Retinopathy is a disease that causes retina abnormality and can lead to total blindness.

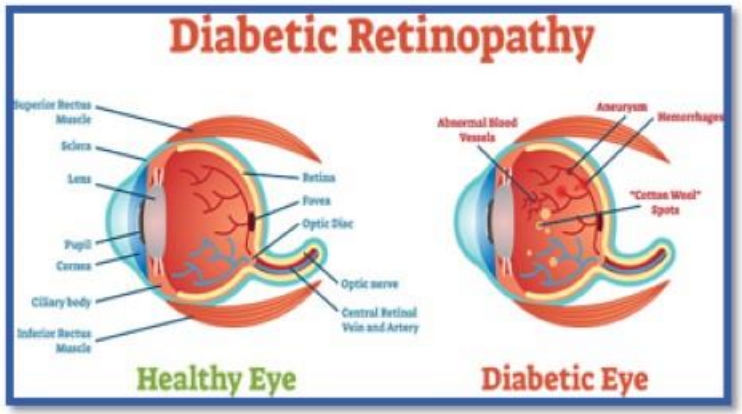


[1] "Diabetic Retinopathy." Mayo Clinic, Mayo Foundation for Medical Education and Research, 30 May 2018, https://www.mayoclinic.org/diseases-conditions/diabetic-retinopathy/symptoms-causes/syc-20371611. Accessed 8 Oct. 2019.

Introduction 2/3

- According to the (WHO) around 422 million people worldwide have been diagnosed with Diabetes Mellitus [2].
- One third of people suffering from Diabetes Mellitus are expected to also be diagnosed with Diabetic Retinopathy [3].



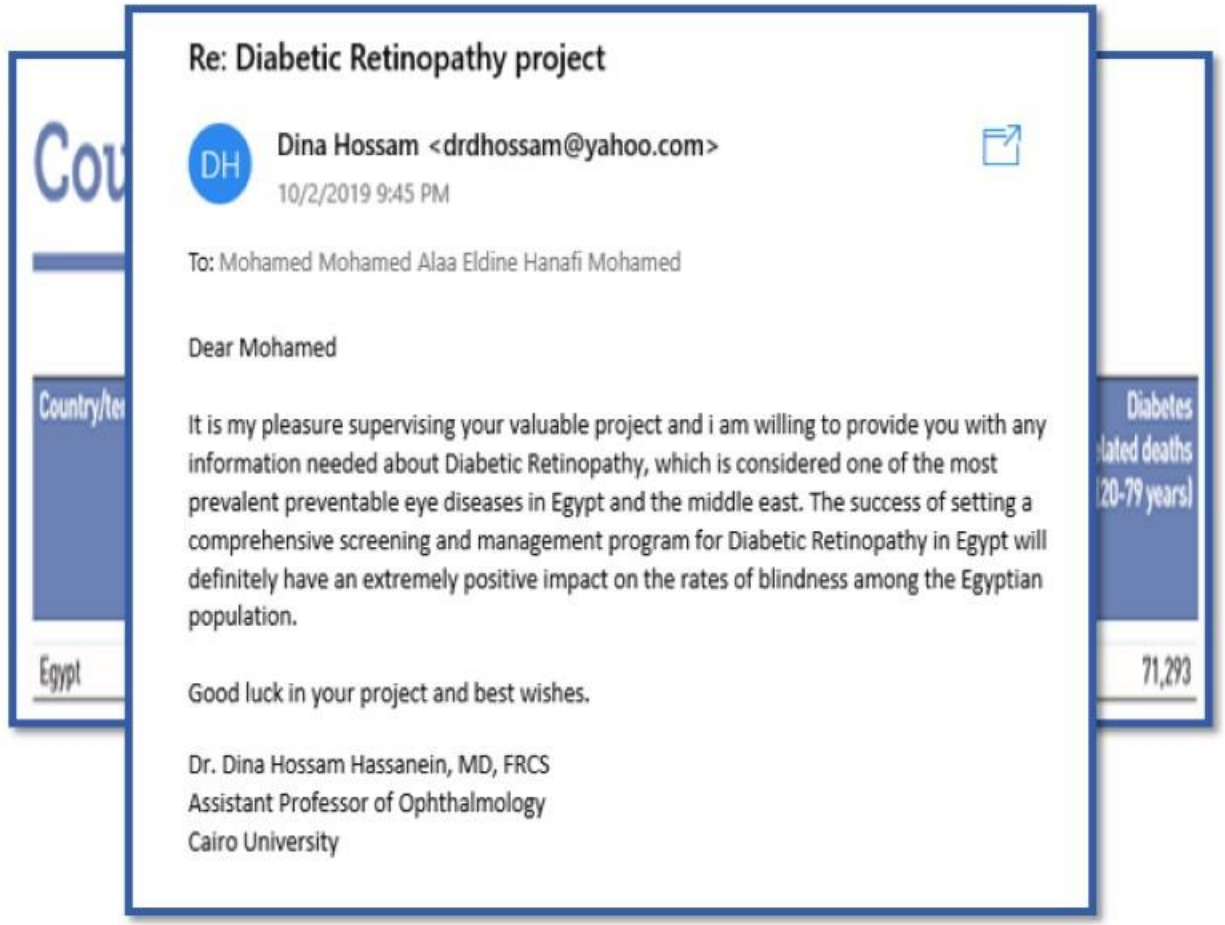


[2]- "Diabetes." World Health Organization, World Health Organization (WHO), https://www.who.int/health-topics/diabetes.

[3]- Lee, Ryan, Tien Y. Wong, and Charumathi Sabanayagam. "Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss." Eye and vision 2.1 (2015): 17.

Introduction 3/3

- More than 39 million people in the MENA region (Middle East and North Africa) suffer from Diabetes Mellitus.
- 8.2 million cases were in Egypt in 2017; around 2.73 million Diabetic Retinopathy (DR) patients [4].



[4] International Diabetes Federation. "IDF Diabetes Atlas 8th Edition (2017)." (2017).

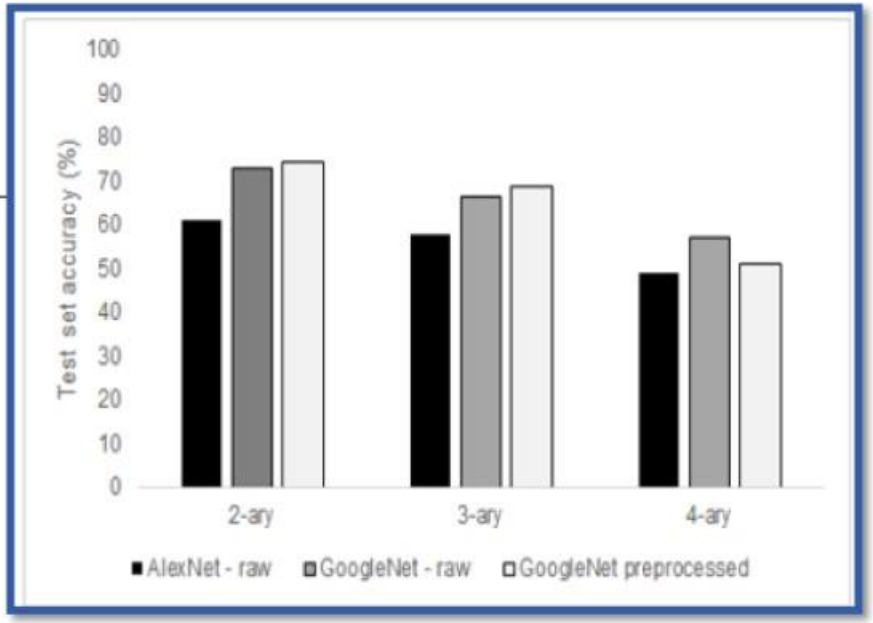
Related Work 1

- Overview - They implemented an automatic DR grading system capable of classifying retinal fundus images, they used pre-trained CNN models i.e. AlexNet and Inception (GoogleNet) [5].
- Staging & Classification - 4 stages - No DR, Mild, Moderate, Severe.
- Dataset Size – They used two image datasets :

1- Kaggle dataset – **35,000** colored fundus images with 5- class labels .

2- MESSIDOR dataset – **1200** colored fundus images with 4-class labels

- Overall Recognition Accuracy - Between **57.2** % and **74.5** % .



Grade	Description	Nb Images
R0	$(N_{MA} = 0)$ AND $(N_{HE} = 0)$	546
R1	$(0 < N_{MA} \leq 5)$ AND $(N_{HE} = 0)$	153
R2	$(5 < N_{MA} < 15)$ AND $(0 < N_{HE} < 5)$ AND $(N_{NV} = 0)$	247
R3	$(N_{MA} \geq 15)$ OR $(N_{HE} \geq 5)$ OR $(N_{NV} > 0)$	254

[5] D. Y. Carson Lam, M. Guo, and T. Lindsey, "Automated detection of diabetic retinopathy using deep learning," AMIA Summits on Translational Science Proceedings, vol. 2018, p. 147, 2018.

Related Work 2

- Overview – They Introduced a mobile application that is powered by a tensor-flow deep neural network (DCNN) , It is developed to perform DR screening in real time.
- Staging & Classification – No Staging [6].
- Dataset Size - **16,798** fundus images from Kaggle.
- Overall Recognition Accuracy - **73.3** %.

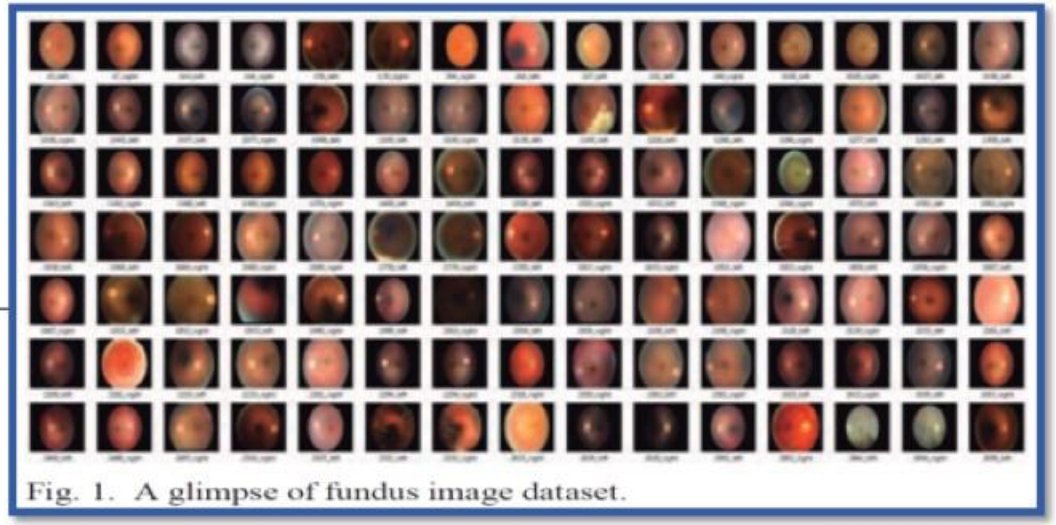


Fig. 1. A glimpse of fundus image dataset.

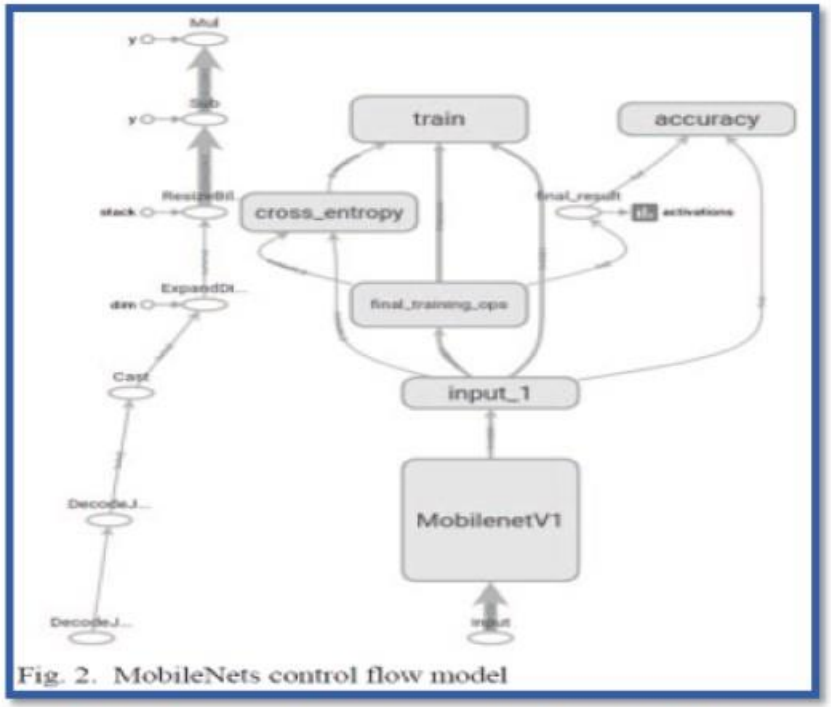


Fig. 2. MobileNets control flow model

[6] S. H. Khan, Z. Abbas, S. D. Rizvi et al., "ClassificS. Suriyal, C. Druzgalski, and K. Gautam, "Mobile assisted diabetic retinopathy detection using deep neural network," in 2018 Global Medical Engineering Physics Exchanges/Pan American Health Care Exchanges (GMEPE/PAHCE). IEEE, 2018, pp. 1–4. ation of diabetic retinopathy images based on customised cnn architecture," in 2019 Amity International Conference on Artificial Intelligence (AICAI). IEEE, 2019, pp. 244–248.

Related Work 3

- Overview – Features are extracted from the images using image preprocessing and furnished into "SVM".
- Staging & Classification – 4 Stages - Mild, Moderate non proliferative diabetic retinopathy (NPDR) and proliferative diabetic retinopathy (PDR) [7].
- Dataset Size – **150** images.
- Overall Recognition Accuracy - **92.6** %.

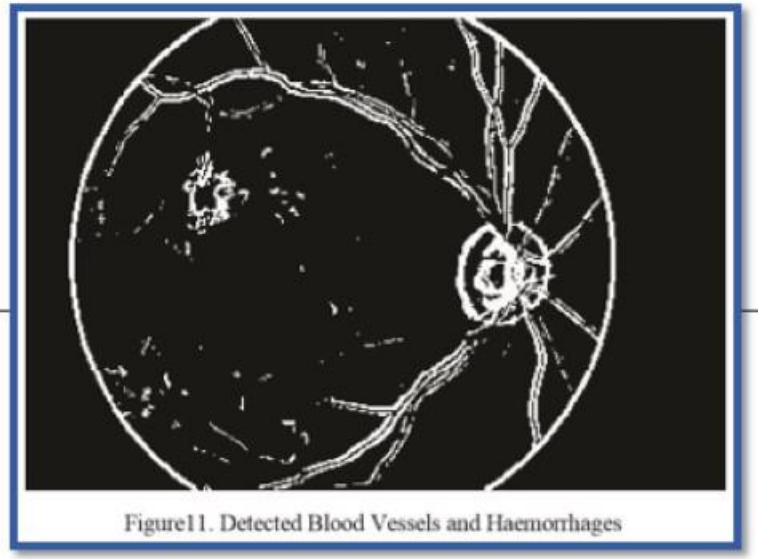
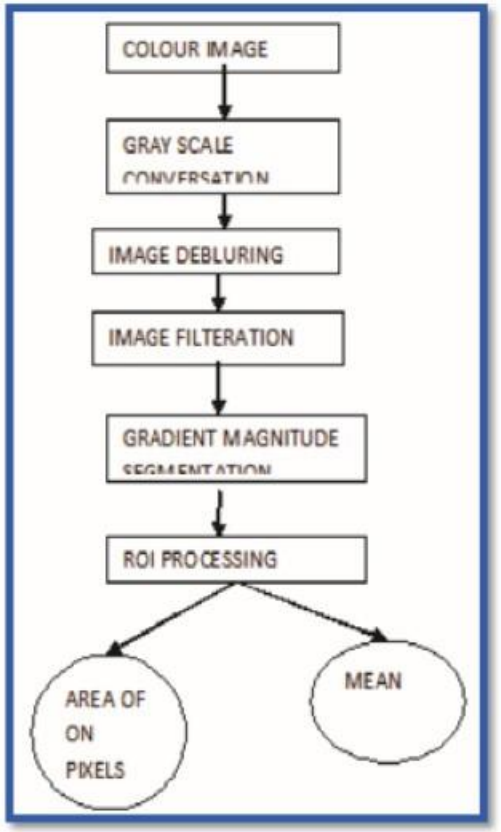


Figure11. Detected Blood Vessels and Haemorrhages

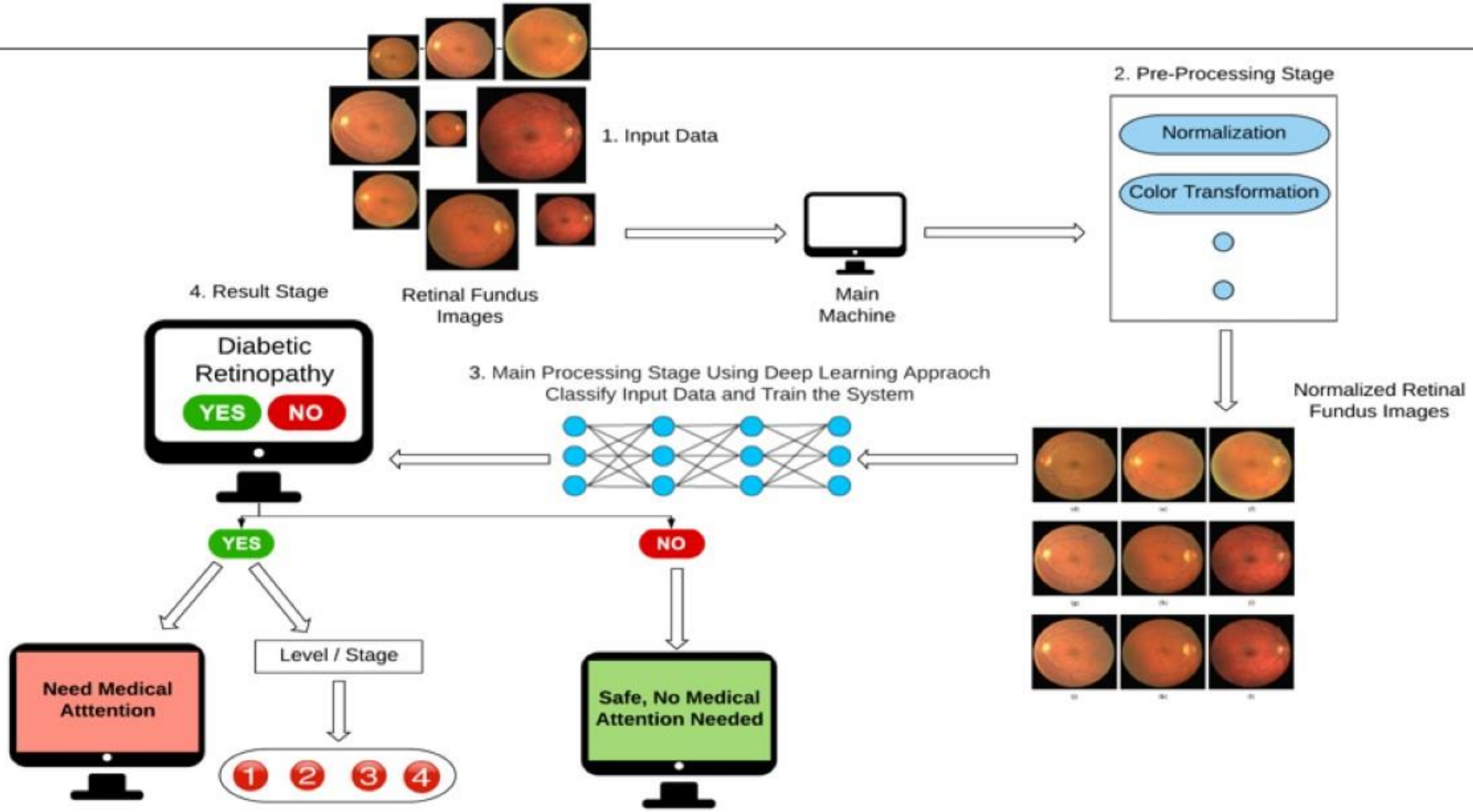


[7] S. Sangwan, V. Sharma, and M. Kakkar, "Identification of different stages of diabetic retinopathy," in 2015 International Conference on Computer and Computational Sciences (ICCCS). IEEE, 2015, pp. 232–237.

Problem Statement

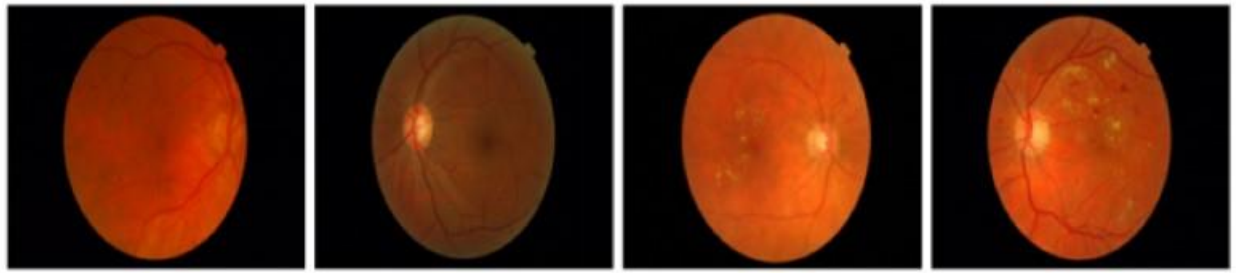
- Detecting and Classifying The Different Stages Of Diabetic Retinopathy and Developing our very own Architecture/Model and enhancing the overall System Accuracy.

System Overview



System Overview – Dataset 1

- The Dataset we will start with in our project is called MESSIDOR [8].
- In total, there are 1200 images, 800 images were acquired with pupil dilation and 400 without dilation.
- MESSIDOR is composed of 546 images from DR level 0 (normal), 153 images form DR level 1 (mild), 247 images from DR level 2 (moderate), 254 images from DR level 3 (severe).



(a) No DR (b) Mild NPR (c) Moderate NPR (d) Severe NPR

Fig. 4. Levels of diabetic retinopathy (DR) with increasing severity.

[8] G. PATRY, G. GAUTHIER, B. LAY, J. ROGER, D. ELIE, A. DONJON, and H. MAFFRE, "Messidor." [Online]. Available: http://www.adcis.net/en/third-party/messidor

System Overview – Dataset 2

- The Dataset we intend to use in our project is provided by a Kaggle competition [9].
- In total, there are 35,126 images of left and right eyes.
- The images are labeled in five stages: Normal (0), Mild (1), Moderate (2), Severe (3) and Proliferative DR (4).

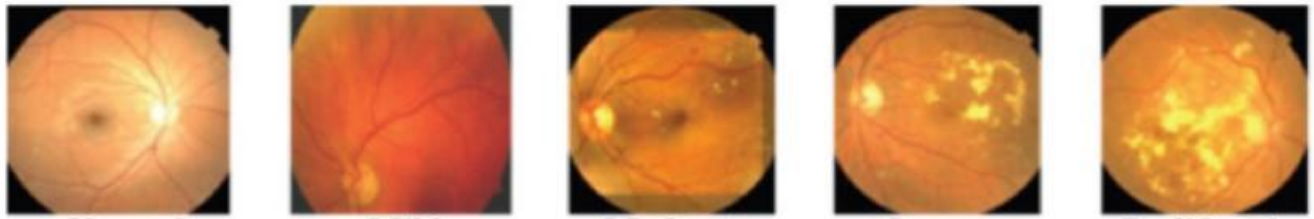
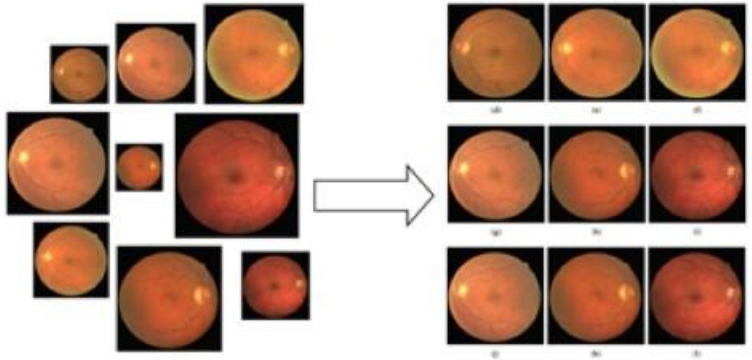


Figure 1. Some samples in the EyePACS dataset

[9] "Diabetic retinopathy (resized)," May 2019. [Online]. Available: https://www.kaggle.com/tanlikesmath/diabetic-retinopathy-resized.csv

System Overview – Pre-Processing

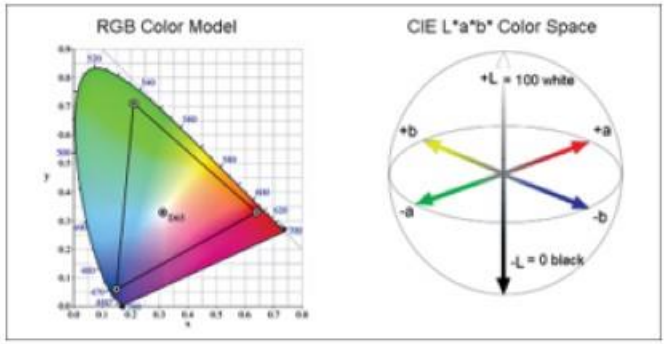
- Normalization: First we will normalize all the input images so they are all the same size, before the processing stage.



Retinal Fundus Images

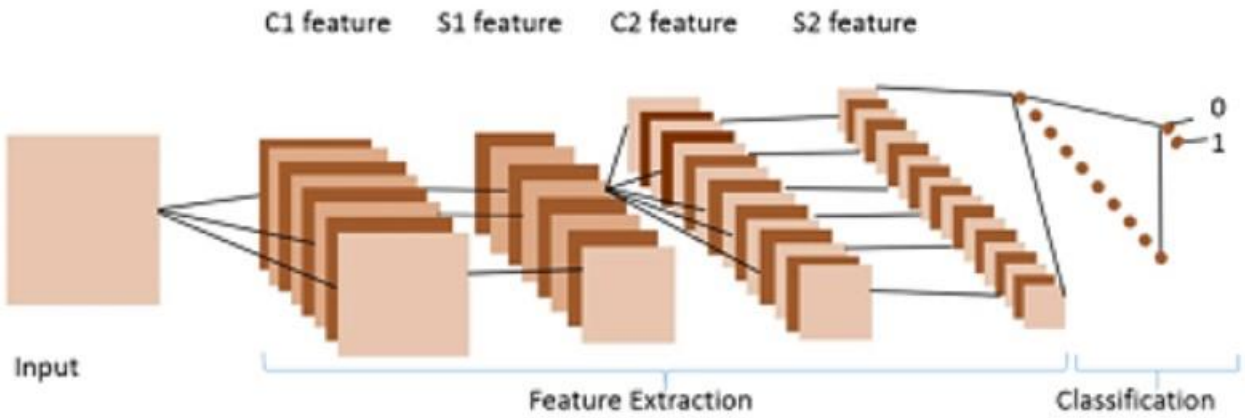
Normalized Retinal Fundus Images

- Color Transformation: We will then choose the most suitable color space for the images.



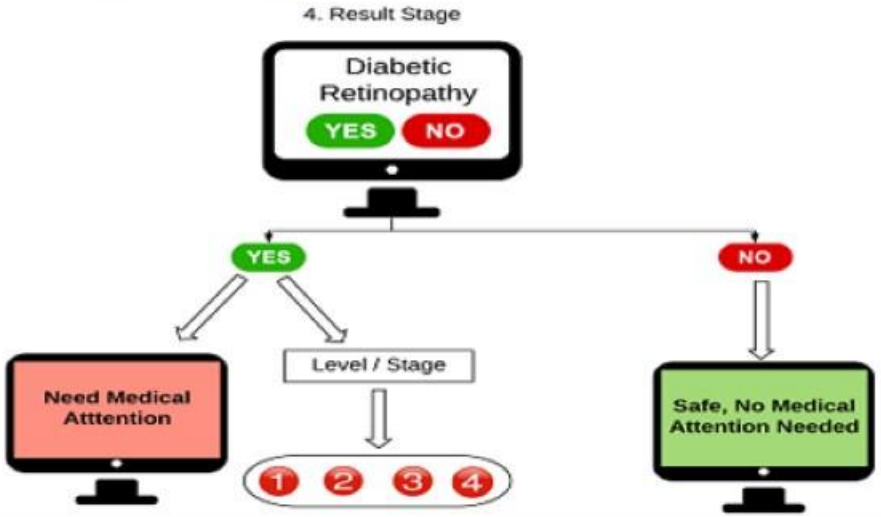
System Overview – Detection & Classification

- Using a Convolutional Neural Network (CNN) to train and test the system.
- Using the Tensor-flow library for feature extraction and classification into different levels and classes.



System Overview – Output

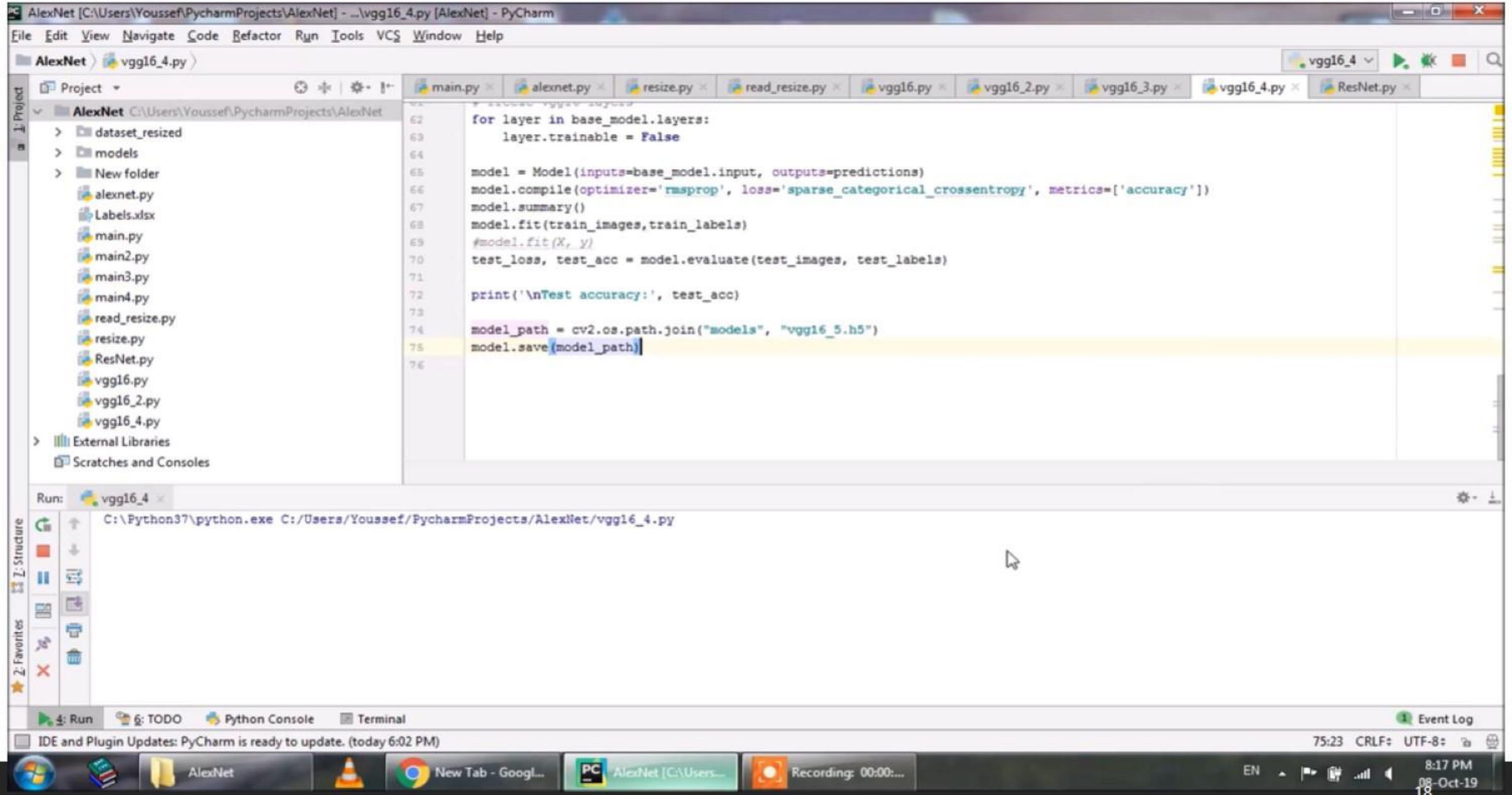
- Scenario A- There IS Diabetic Retinopathy (YES) - The System shows the level/stage of the disease on a scale of 4-stages, and signals the need for immediate medical attention.
- Scenario B- No Diabetic Retinopathy (NO) - The System signals that the case is safe, and doesn't need any medical attention.



Expected Results

- Detecting the presence of Diabetic Retinopathy and Classifying the Stage of the disease in the patient's body.
- Developing our very own Architecture / Model.
- High System Accuracy and Recognition Rate.

Demo


AlexNet [C:\Users\Youssef\PycharmProjects\AlexNet] - ...\vgg16_4.py [AlexNet] - PyCharm
File Edit View Navigate Code Refactor Run Tools VCS Window Help
AlexNet
vgg16_4.py
vgg16_4
Project
AlexNet C:\Users\Youssef\PycharmProjects\AlexNet
dataset_resized
models
New folder
alexnet.py
Labels.xlsx
main.py
main2.py
main3.py
main4.py
read_resize.py
resize.py
ResNet.py
vgg16.py
vgg16_2.py
vgg16_4.py
External Libraries
Scratches and Consoles
main.py
alexnet.py
resize.py
read_resize.py
vgg16.py
vgg16_2.py
vgg16_3.py
vgg16_4.py
ResNet.py
for layer in base_model.layers:
layer.trainable = False
model = Model(inputs=base_model.input, outputs=predictions)
model.compile(optimizer='rmsprop', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
model.summary()
model.fit(train_images,train_labels)
#model.fit(X, y)
test_loss, test_acc = model.evaluate(test_images, test_labels)
print('\nTest accuracy:', test_acc)
model_path = cv2.os.path.join("models", "vgg16_5.h5")
model.save(model_path)
Run: vgg16_4
C:\Python37\python.exe C:/Users/Youssef/PycharmProjects/AlexNet/vgg16_4.py
4: Run
6: TODO
Python Console
Terminal
Event Log
IDE and Plugin Updates: PyCharm is ready to update. (today 6:02 PM)
75:23 CRLF: UTF-8:
AlexNet
New Tab - Googl...
AlexNet [C:\Users...
Recording: 00:00:...
EN
8:17 PM
08-Oct-19

Thank You