International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 5 Issue 1, January - 2021, Pages: 51-56

Deep Learning for Classifying Types of Onion using Google Colab

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Abstract : *Classification is generally considered is one of the most popular topics in remote sensing , is considered to be the classification of images at a large size is labor-intensive and time-consuming task if performed manually. A large number of methods have been proposed to deal with the problem of data classification for large size. In this paper we present the classification of three colors (types) of onions using the environment of Google Colaboratory which dependent for accelerating deep learning for computer vision and other GPU-centric applications .Using a public dataset of 1333 images of onions, we trained a deep convolutional neural network to identify three types (White, Red Peeled, and Red) Onion. The trained model achieved an accuracy of 99.99% of test set, demonstrating the feasibility of this approach.*

Keywords: Deep Learning, Classification, Google Colaboratory, Onions.

1. Introduction:

"Onions" are excellent sources of vitamin C, sulphuric compounds, flavonoids and phytochemicals" [4]. Phytochemicals, or phytonutrients, are naturally occurring compounds in fruits and vegetables that are able to react with the human body to trigger healthy reactions. Flavonoids are responsible for pigments in many fruits and vegetables. Studies have shown that they may help reduce the risk of Parkinson's disease, cardiovascular disease and stroke[5][6].

A particularly valuable flavonoid in onions is quercetin, which acts as an antioxidant that may be linked to preventing cancer. "It also might have heart health benefits, though more studies need to be done.
Quercetin has a host of other benefits, as well, according to the University of Maryland Medical Center, reducing the symptoms of bladder infections, promoting prostate health and lowering blood pressure [5].

Other important phytochemicals in onions are disulfides, trisulfides, cepaene and vinyldithiins. They all are helpful in maintaining good health and have anticancer and antimicrobial properties, according to the National Onion Association [5].

Partly because of their use in cooking around the world, onions are among the most significant sources of antioxidants in the human diet, according to a 2002 report in the journal Phytotherapy Research. Their high levels of antioxidants give onions their distinctive sweetness and aroma [6].

"Foods that are high in antioxidants and amino acids allow your body to function optimally. Antioxidants help prevent damage, and cancer. Amino acids are the basic building block for protein, and protein is used in virtually every vital function in the body."

It should be noted here that the onion color varies, including red and white, and there are other types other than that. The difference in onion color indicates a change in its benefits and harms and may change the method of cooking, as red onions help in fighting germs and infections, and the oils in it work to reduce the severity of coughing and healing From the common cold.
This type of onion relieves allergy that affects the body, because it contains a substance that helps inhibit the action of allergy-stimulating hormones that are accompanied by itching and runny nose. It also maintains the health of the heart, vessels and arteries[7].
And red onions reduce the amount of cholesterol in the blood, and prevent blood clotting and arteriosclerosis, and contribute to preventing the formation of cancer cells, and supports the immune system[5][8].

As for white onions, it is considered an important antiseptic for the mouth from bacteria and germs, and it also treats respiratory problems, such as infections of the lungs, nose and throat, as well as the trachea.

And white onions relieve the severity of asthma symptoms, treat colds, and help cure coughs and get rid of the phlegm associated with it.

White onions play a role in male fertility, by stimulating blood circulation, as well as helping to protect body cells from damage[5].

Onions, regardless of their color, contain several minerals and various vitamins important to the human body, and they are considered a low-calorie vegetable.

Through the aforementioned benefits of either red onions or white onions, it is difficult to abandon either of them, because they contain large nutrients, although they differed slightly from one to the other[9].

From here it is worth noting the importance of classifying data such as images, so we explain in this work how to use Google Colaboratory (a.k.a. Colab), a cloud service for disseminating machine learning education and research. The runtime provided by this cloud service is fully configured with the leading artificial intelligence (AI) libraries and also offers a robust GPU. This Google service is linked to a Google Drive account, and it is free-of-charge[10].

A convolutional neural network (CNN) is a type of artificial neural network used in image recognition and processing that is specifically designed to process pixel data. A CNN uses a system much like a multilayer perceptron that has been designed for reduced processing requirements[11].

Convolutional Neural Networks (CNNs) have proven very effective in image classification and show promise future good on classification.
They are also known to perform predictions relatively faster than other algorithms while maintaining competitive performance at the same time [12].

2. Deep Learning:

Deep learning is a class of machine learning algorithms that use multiple layers to extract gradually higher level features from primary input. For example, in image processing, the lower layers may define edges, while the upper layers may define human-related concepts such as numbers, letters, or faces[13][14].

Deep learning applications are used in industries from robotic driving to medical devices. Automated driving: Car researchers use deep learning to automatically detect things like stop signs and traffic lights. Additionally, deep learning is used to detect pedestrians, which helps reduce accidents[15].

Nowadays, digital image processing is used in a variety of applications, whether to divide an object into images, extract image information or even classify patterns . Many applications of computer vision aim to use the operational power of deep learning methods, such as Convolutional Neural Networks (CNN)[16][18].

In deep learning, a convolutional neural network (CNN) is a class of deep neural networks, and it is most commonly used in analyzing visual images. convolutional networks were inspired by biological processes in that the pattern of communication between neurons is similar to the organization of an animal's visual cortex[18].

Finally, CNNs are primarily used to solve difficult image-driven pattern recognition tasks and with their precise yet simple architecture as we will also use it to classify the types of onions in this paper [17].

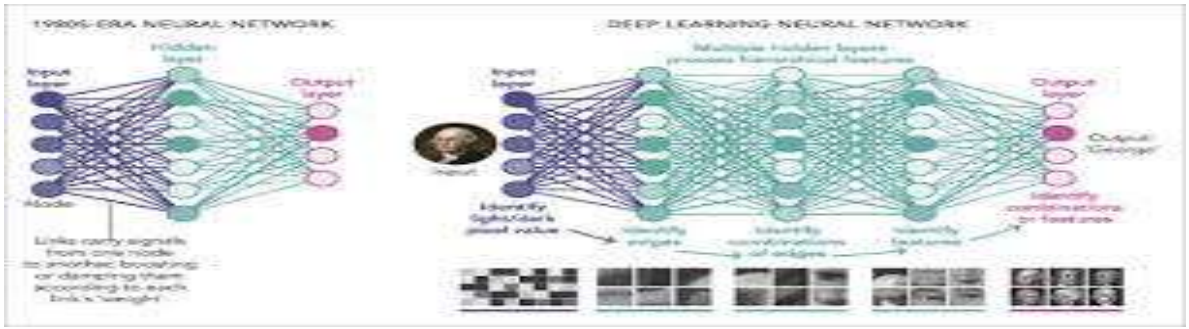

Figure 1: CNN Architecture

Highlights

•A convolutional neural network is trained to classify Types of onion.
•Transfer learning with fine-tuning is applied to a pre-trained neural network.
•Neural networks are trained, validated and tested using freely available images.
•A true positive rate of 99% is achieved.

3. Research Objective:

1- Demonstration of the feasibility of using deep convolutional neural networks to classify onion species.
2- Developing a model that the developer can use to create a smart phone application or web application to detect plant diseases.

The dataset contains approximately 133 onion images
The types used are three types of onions
Categories in total are as follows:
Class (A): Onion white.
Class (B): Onion Red Peeled.
Class (C): Onion Red.

This Describe Dataset from Colab:

Type 1 : total Onion White: 438	Train 70%: 307 Validation 30%: 131
Type 2 : total Onion Red Peeled: 445	Train 70%: 312 Validation 30%: 133
Type 3 : total Onion Red: 450	Train 70%: 315 Validation 30%: 135

Figure 2: Onion types

4. Related Work :

- Deep learning for the classification of human sperm[19].
- Potato Classification Using Deep Learning[20].
- Grapefruit Classification Using Deep Learning[21].
- Classification and quantification of cracks in concrete structures using deep learning image-based techniques[22] .
- Plant Seedlings Classification Using Deep Learning[23].
- Comparison of Deep Learning and Traditional Machine Learning Techniques for Classification of Pap Smear Images[24].

5. Basic Convolutional Neural Network Architecture :

CNN architecture is inspired by the organization and functionality of the visual cortex and designed to mimic the connectivity pattern of neurons within the human brain[25].

The neurons within a CNN are split into a three-dimensional structure, with each set of neurons analyzing a small region or feature of the image. In other words, each group of neurons specializes in identifying one part of the image. CNNs use the predictions from the layers to produce a final output that presents a vector of probability scores to represent the likelihood that a specific feature belongs to a certain class[25].
Layers : Convolutional Layer, Activation Function, Pooling Layer, and Fully-connected Layer.

- In the convolution layer, a filter is applied (also known as a kernel) that determines the presence of certain features or patterns in the original image (input), and then it is possible to use several filters in order to extract different features[26].

- The purpose of the aggregation layer is to reduce the size of the activation maps (we said maps for the possibility of using more than one filter). Not only does this reduce the amount of calculations necessary, it also prevents you from falling into an overfitting situation.

- Activation Function : for example RELU , ElU , MAXOUT etc.
- This is the last layer in a multi-layer perceptron in the convolutional network, in which neurons are fully connected to all the nodes of the previous layer. The reason it exists at the end is because the final classification process takes place in it [27].

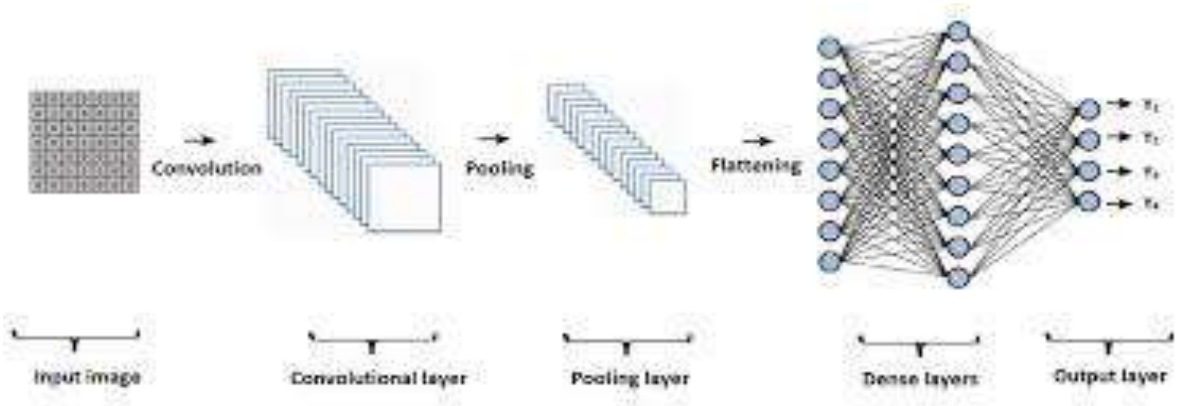

Figure 3: Proposed model architecture

How it works
Our model takes raw images as an input, so we used Convolutional Neural Networks (CNNs) to extract features, in result the model would consist from (features extraction), which was the same for full-color approach and gray-scale approach, it consist of 4 Convolutional layers with Relu activation function, each followed by Max Pooling layer[28].

Network model design

1. Insert an image into a convolutional layer.
2. Apply the activation function to the output of the convolutional layer.
3. Send the function output to another convolutional layer, and repeat the process several times,
4. Send the output to an aggregation layer.
5. Repeat steps (1-4) multiple times and produce trainable classifiers.
6. Send the output matrix to a fully bound layer, which in turn rejects the weights beam; It has the probability of every classification we want to train the network on.

6. Methodology

We demonstrate a deep learning method to classify type of onion into one of several types from onion by using a deep convolutional neural network (CNN) initially trained on Images group, which we retrain for types onion classification, and monitor the result .

Model

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 126, 126, 32)	896

max_pooling2d (MaxPooling2D)	(None, 63, 63, 32)	0
conv2d_1 (Conv2D)	(None, 61, 61, 64)	18496
max_pooling2d_1 (MaxPooling2	(None, 30, 30, 64)	0
conv2d_2 (Conv2D)	(None, 28, 28, 128)	73856
max_pooling2d_2 (MaxPooling2	(None, 14, 14, 128)	0
conv2d_3 (Conv2D)	(None, 12, 12, 128)	147584
max_pooling2d_3 (MaxPooling2	(None, 6, 6, 128)	0
flatten (Flatten)	(None, 4608)	0
dropout (Dropout)	(None, 4608)	0
dense (Dense)	(None, 256)	1179904
dense_1 (Dense)	(None, 3)	771

Total params: 1,421,507
Trainable params: 1,421,507

7. Experiments And Discussions

In order to evaluate our own model of designing onion varieties, we had to divide the available data set into training and validation groups. So we ran an experiment. So we used the onion dataset that consists of 1333 images. We divided the data into training (70%), validation (30%). The training accuracy was 99.99% and the validation accuracy was 99.99%. After training the model we tested it with un-seen data set (testing data set) and the accuracy was 99.99%.

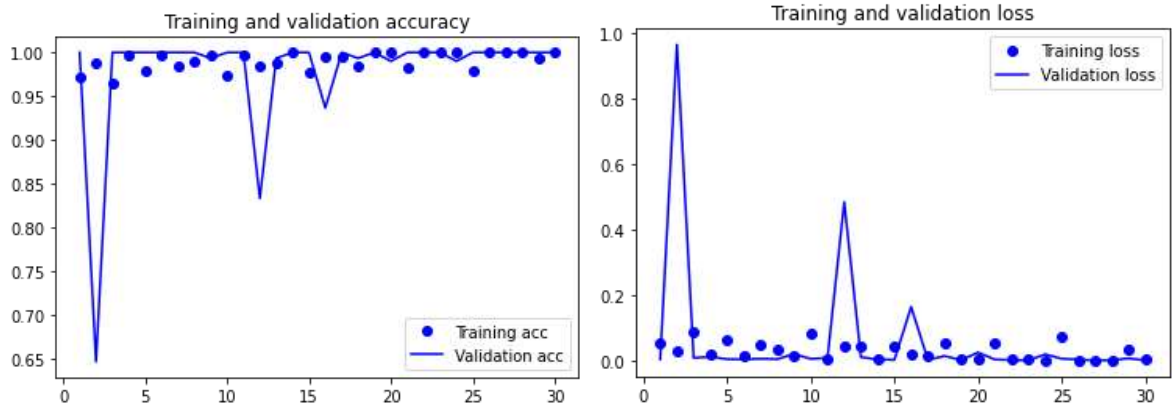

Figure 4: training and validation accuracy and loess

8. Conclusion

We proposed a solution to help people determine the type of onion more accurately, 99.99% accurately for your best model, builds a model using deep learning convolutional neural networks and uses this model to predict the type of (previously unseen) images of onion with a network from 4 layers and a dropout of 0.5, that takes onion images with 3 different species an input.

We show that our deep learning approach to onion classification represents a viable method to automate, standardize, and accelerate onion types. Our approach highlights the potential of artificial intelligence technologies to eventually exceed human experts in terms of accuracy, reliability, and throughput.

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