

Bell pepper Classification using Deep Learning

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Abstract: Bell pepper is an important food crop, Bell pepper has a uniform shape with size and color. With a shiny appearance and green color in a pre-maturing stage but can turn red, golden, purple, orange or brown upon ripening, the flavor can be sweet, mild, or very tart. Several recent studies have shown many health benefits of Bell pepper. It is an excellent source of dietary fiber, and vitamin C which is necessary for growth and repair of body tissue, as well as for the formation of collagen, a protein used for skin regeneration and the creation of blood vessels. Vitamin C is also needed for cartilage, bones, and teeth. In this paper, machine learning based approach is presented for identifying type of Bell pepper with a dataset that contains 2368 images. We used 1243 images for training 533 images for validation and 592 images for testing.

Our trained model achieved an accuracy of 100% on a held-out test set, demonstrating the feasibility of this approach

Keywords: Type of Bell pepper, Deep Learning, Classification, Detection.

INTRODUCTION

Bell peppers come in green, yellow, red and orange varieties, Bell peppers are loaded with various vitamins and minerals, all of which give it special properties and benefits, which include [1]:

- Eye Health: Bell peppers contain over 30 different types of carotenoids that they help heal eyes and ward off eye disease because they absorb damaging blue light as it enters the eye.
- Prevent Cancer: Carotenoids also have powerful antioxidant effects that can prevent certain types of cancers, they also have sulfur which helps prevent cancer.
- Boosts Immunity: bell peppers are full of vitamin C.
- Balances Mood: B6 helps your brain produce serotonin and norepinephrine, two chemicals that affect your mood.
- Natural Sleep Aid: The vitamin B6 found in bell peppers also aids in melatonin production, which your body needs to regulate its internal clock.
- Weight Loss: Bell peppers are very low in fat and calories.
- Beautiful Skin: Bell peppers helps keep skin looking fresh and young, and hair strong and vibrant.
- Lowers Cholesterol: capsaicin is a nutrient that lowers the levels of bad cholesterol in your system.
- Helps with Pain: The bell pepper relieves chronic pain in a couple ways. Vitamin C and vitamin K, both found in bell peppers, have anti-inflammatory properties, which reduces swelling and protects against osteoporosis. Capsaicin also relieves chronic pain.
- Heart Healthy: The anti-inflammatory properties in bell pepper also lowers inflammation in arteries. That means that bell peppers help prevent heart disease and diabetes.



Figure 1: Show some types of Bell pepper

Bell pepper Types

There are more kinds of Bell pepper than just different colors of bell peppers. Figure 2 show different types of Bell pepper. [2]



Figure 2: show different types of Bell pepper.[2]

DEEP LEARNING

Deep learning or deep neural network also known as deep neural learning is an artificial intelligence (AI) function that imitates the workings of the human brain in processing data and creating patterns for use in decision making. [3]

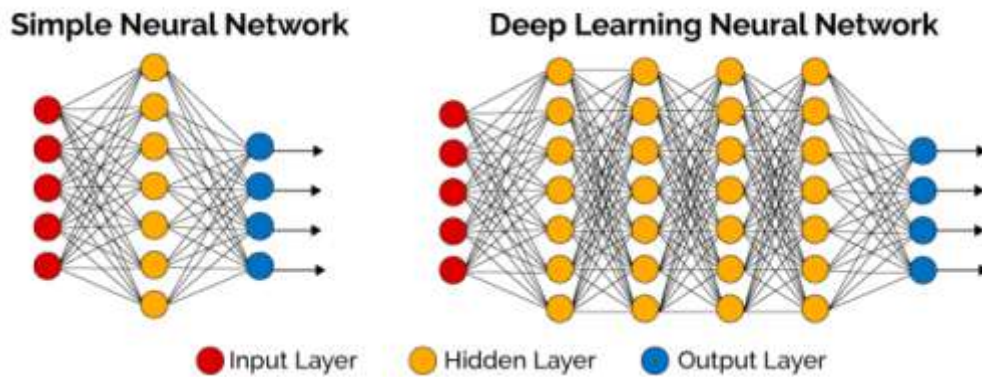


Figure 3 show simple neural network and DLN network

Deep learning approach using convolutional neural network (CNN) is an excellent method for image recognition and is one of the neural network techniques that deals with computer vision in artificial intelligence.

Three types of main layers are there in a CNN: (a) Convolution layer, (b) Pooling layer, and (c) Output layer. Feed-forward structure is used to arrange these layers in the network.

Each convolution layer is followed by a pooling layer, whereas last convolution layer is followed by output layer. Convolution and pooling layers are 2-D layers

In this work, we introduce that a deep convolutional neural network (CNN) does well in classifying Bell pepper. CNN is a class of deep neural network (DNN) which is widely used for computer vision. During the training process the network's building blocks

are repeatedly altered in order for the network to reach optimal performance and to classify images and objects as accurately as possible.

STUDY OBJECTIVES

- Demonstrating the feasibility of using deep convolutional neural networks to classify Types of Bell pepper.
- Crating a model that can be used by developer to design and develop smartphones application or web site to detect the thing we need to classify.

DATASET

The dataset contains a set of 2368 images use 1243 images for training, 533 images for validation and 592 images for testing belonging to 3 species from Bell pepper.

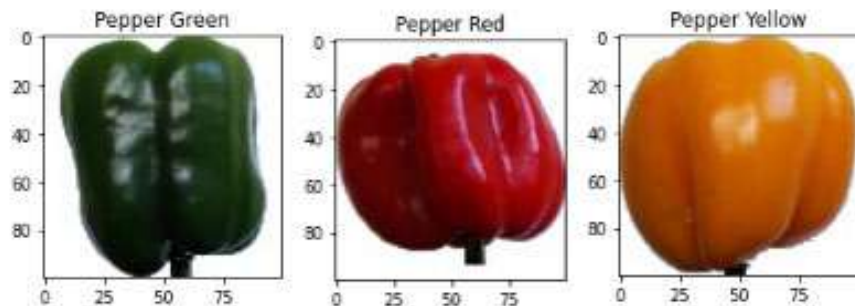


Figure 4: show different types of Bell Pepper

The output 3 classes as follow:

- class (0): Pepper Green.
- class (1): Pepper Red.
- class (2): Pepper Yellow.

METHODOLOGY

In this section we describe the proposed solution as selected convolutional network (ConvNet) architecture and discuss associated design choices and implementation aspects.

MODEL

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, the architecture of our model shown in the table 1.

Layer (type)	Output Shape	Param #
input_1 (Input Layer)	(None, 256, 256, 3)	0
block1_conv1 (Conv2D)	(None, 256, 256, 64)	1792
block1_conv2 (Conv2D)	(None, 256, 256, 64)	36928
block1_pool (MaxPooling2D)	(None, 128, 128, 64)	0
block2_conv1 (Conv2D)	(None, 128, 128, 128)	73856
block2_conv2 (Conv2D)	(None, 128, 128, 128)	147584
block2_pool (MaxPooling2D)	(None, 64, 64, 128)	0
block3_conv1 (Conv2D)	(None, 64, 64, 256)	295168
block3_conv2 (Conv2D)	(None, 64, 64, 256)	590080
block3_conv3 (Conv2D)	(None, 64, 64, 256)	590080
block3_pool (MaxPooling2D)	(None, 32, 32, 256)	0
block4_conv1 (Conv2D)	(None, 32, 32, 512)	1180160
block4_conv2 (Conv2D)	(None, 32, 32, 512)	2359808
block4_conv3 (Conv2D)	(None, 32, 32, 512)	2359808
block4_pool (MaxPooling2D)	(None, 16, 16, 512)	0
block5_conv1 (Conv2D)	(None, 16, 16, 512)	2359808
block5_conv2 (Conv2D)	(None, 16, 16, 512)	2359808
block5_conv3 (Conv2D)	(None, 16, 16, 512)	2359808
block5_pool (MaxPooling2D)	(None, 8, 8, 512)	0
dense_1 (Dense)	(None, 3)	1539

Table 1: Architecture of our model

SYSTEM EVALUATION

We used the original Bell pepper dataset that consists of 2368 images, we divided the data into training (70%), validation (30%). The training accuracy was 100% and the validation accuracy was 100%.

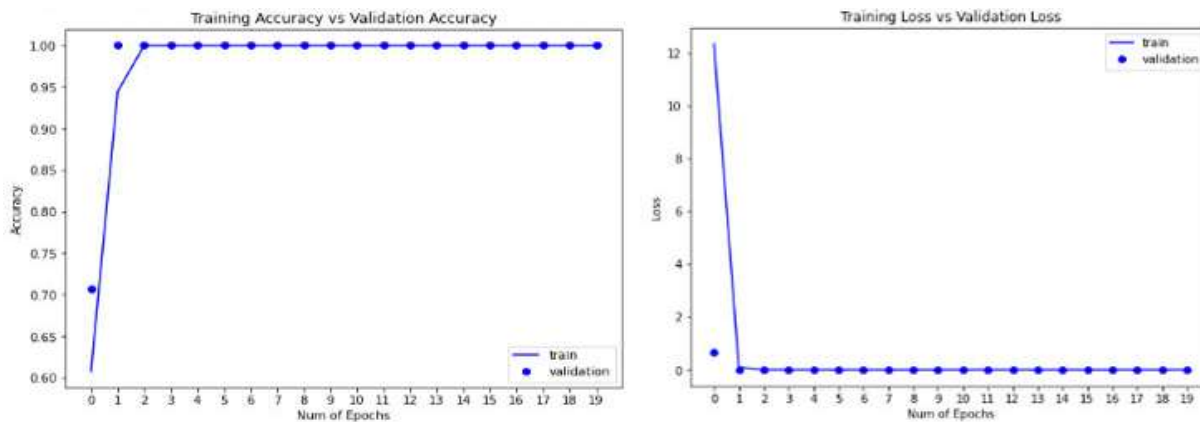


Figure 4: Training and validation accuracy and loss

CONCLUSION

We proposed a solution to help people determine the type of Bell pepper. More accurately. We got 100% accuracy for our best model. We built a model using deep learning convolutional neural networks and uses this model to predict the type of (previously unseen) images of Bell pepper.

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