

Classification of Pears Using Deep Learning

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Abstract: Pears are fruits produced and consumed around the world, growing on a tree and harvested in late summer into October. The pear is native to coastal and mildly temperate regions of the Old World, from Western Europe and North Africa east across Asia. It is a medium-sized tree, reaching 10–17 m (33–56 ft) tall, often with a tall, narrow crown. Convolutional Neural Network (CNN) algorithms, a deep learning technique extensively applied to image recognition was used, for this task. The results found that CNN-driven pear classification applications when used in classification automation it enables people to know the type of pear properly. The trained model achieved an accuracy of 100% on test set, demonstrating the feasibility of this approach

Keywords: pear, Classification, Deep Learning

INTRODUCTION:

Pears most are deciduous, but one or two species in Southeast Asia are evergreen. Most are cold-hardy, withstanding temperatures as low as -25 to -40 °C (-13 to -40 °F) in winter, except for the evergreen species, which only tolerate temperatures down to about -15 °C (5 °F). Pear cultivation has a history of more than 3000 years in China, and it is planting in a large area covering 80% of area in the world. Pear diseases and their contagiousness can significantly affect the normal growth of pear trees. As a result, scientific diagnosis measures are of crucial important to avoid misuse of prescriptions, excessive application of pesticides, pesticide residues, can cause significant reduction of yield of pear etc. Also, it can increase the cost of disease prevention and control and reduction of economic benefits together with the enthusiasm of farmers. Even worse, it can cause food safety problems

HOW MANY VARIETIES OF PEARS ARE THERE?

There are over 3000 known varieties of pears around the world. However, in North America, there is a more limited selection in most grocery stores.

The nice aspect of pears is that there are varieties for every taste. Some are juicy, some are tart. Some are firm while others are softer. Whether you want a tasty snack to sink your teeth into or want to create an elaborate dessert, there is a variety of pear that will meet your criteria.

Pears do have a typical shape, that is rounded on the top with a larger roundness at the bottom. However, some pears will have longer necks while other pears appear more like a round apple than anything else.

THE COMMON TYPES OF PEARS

1. Green and Red Anjou



Figure 1: Green and Red Anjou

Anjou pears are some of the most common varieties of pear, and for good reason. They are very juicy but also have a firm texture so they can be used in a lot of recipes. While you can expect a juicy texture from Anjou pears, their taste is not overly sweet. Instead, expect a hint of lemon when you bite into them. Green and Red Anjou pears are different colours but their tastes are virtually the same. You can use either type when cooking. Anjou pears are available from October to May.

2. Bartlet



Figure2: Bartlet

Bartlett pears, also known as Williams pears, are very juicy and great for eating raw. Unfortunately, their juiciness cooks down quickly, so they lose their shape in the process. If you want to show off a cooked pear's shape, then this isn't the best variety. However, Bartlett pears are great for sauces or butters. Bartlett pears are available from July to October.

3. Seckel



Figure3:Seckel

Seckel pears are the quintessential snacking pear. They are tiny and you can devour them in just one or two bites. Despite their size, these pears are very versatile. They can be eaten raw, cooked in many dishes, and even canned. Although they are often snacked on, be wary of their sometimes-bitter taste, which sometimes takes a while to get used to. Seckel pears are available from September to December

4.Bosc:



Figure4:Bosc

Bosc pears are the perfect, crisp treat. They can be eaten raw, they are often used in cooking because they hold their shape so well around heat. On the outside, expect Bosc pears to be a russet brown in color. They will be fairly firm, even when ripe, giving just a little when squeezed gently. You can use Bosc pears in just about any dishes, including the famous pear tarte. Bosc pears are available from September through the winter, and some are even available in March and April.

5. French Butter Pears:



Figure5:French Butter Pears

French Butter pears need a bit more knowledge when selecting them as they can be quite sour and tough when raw. However, once they are ripe, they are juicy and soft and perfect for eating raw.

These pears will start off green and turn a golden color as they ripen. They have a slight lemon flavor to them. French Butter pears are available from September to December.

6. Concorde:



Figure6: Concorde

Concorde pears have a traditional pear shape, although their necks are considerably longer than other varieties. Their taste is quite juicy. These pears are great for both eating raw and cooking. Their flesh retains its color and doesn't brown very much when cut. Furthermore, you can cook Concorde pears and they will retain their shape, thanks to their dense mass. Concorde pears are available September to February.

7. Forelle:



Figure7: Forelle

Forelle pears are small and oval in shape, making them quite distinguishable. They have a smooth skin which is freckled with yellow and green specks.

As the skin ripens, the paler skin will actually turn a deep red, which is a nice indicator of when it is ready to be eaten.

Forelle pears are quite sweet. They are a great choice for children because they are small and sweet, and make for a tasty snack.

8. Asian:



Figure8: Asian

Asian pears share a lot of similarities with apples. Not only are they rounder in shape, but they are very crunchy. Within the category of Asian pears are many varieties. Common in North America are Asian pears that have a tan color and a bit of roughness to their skin. Asian pears are available from August to February.

9. Starkrimson:



Figure9: Starkrimson

Starkrimson pears are incredibly beautiful. They have a very deep red color to them, although inside you can expect a mild flavor. They are sweet and a bit floral, and of average size. Expect the red skin to deepen in color as the pear ripens. Starkrimson pears are available from August to December.

10. Comice:



Figure10: Comice

Comice pears are the perfect lunch snack. They are delicious when eaten raw thanks to their fruity flavor. While some pears tend to have a grainy texture, Comice pears don't, which is why it is so nice to eat them raw.

These pears have a yellow-green skin color although there is often a red marking on one side. This red comes from when the sun hits that particular spot. Comice pears are usually available from September to February.

Deep Learning is an Artificial Intelligence (AI) subfield that imitates the works of a human brain in processing data and producing patterns for use in decision-making. Deep learning is a subset of machine learning in artificial intelligence that has networks the skills of learning from data that is unlabeled or unstructured. Deep learning is a class of machine learning algorithms that uses multiple layers to progressively extract higher-level features from the raw input

Deep learning and machine learning methods mainly have reported being essential for achieving higher accuracy, robustness, efficiency, computation cost, and overall model performance. This paper presents the state of the art of machine learning and deep learning methods and applications in this realm and the current state, and future trends are discussed. The survey of the advances in machine learning and deep learning are presented through a novel classification of methods. The paper concludes that deep learning is still in the first stages of development, and the research is still progressing. On the other hand, machine-learning methods are already established in the fields, and novel methods with higher performance are emerging through ensemble techniques and hybridization.

CNN is a deep neural network originally designed for image analysis. Recently, it was discovered that the CNN also has an excellent capacity in sequent data analysis such as natural language processing (Zhang, 2015). CNN always contains two basic operations, namely convolution and pooling. The convolution operation using multiple filters is able to extract features (feature map) from the data set, through which their corresponding spatial information can be preserved. The pooling operation, also called

subsampling, is used to reduce the dimensionality of feature maps from the convolution operation. Max pooling and average pooling are the most common pooling operations used in the CNN. Due to the complicity of CNN, relu is the common choice for the activation function to transfer gradient in training by back propagation.

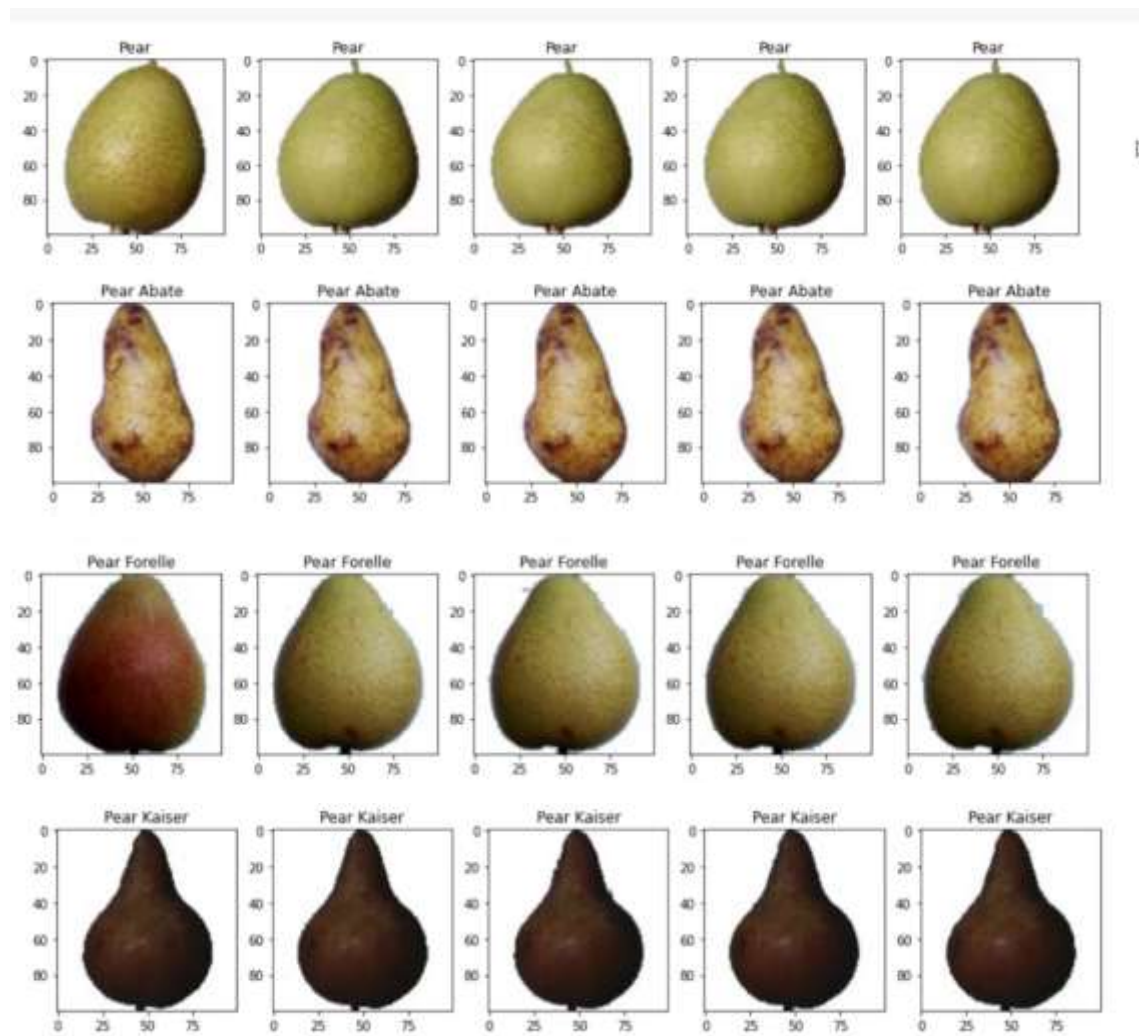
CNNs are regularized versions of multilayer perceptrons. Multilayer perceptrons usually mean fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer. The "fully-connectedness" of these networks makes them prone to over fitting data

METHODOLOGY

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

Dataset :

Pear all classes of the pears were grouped into one category, Validation and training datasets have proportion 25 % and 75 %. The dataset has 120 classes of fruits and provides 3 640 images of pears , which are obtained photographing fruits, vertically and horizontally turning them at 360 degrees. The validation dataset contains 20 622 images



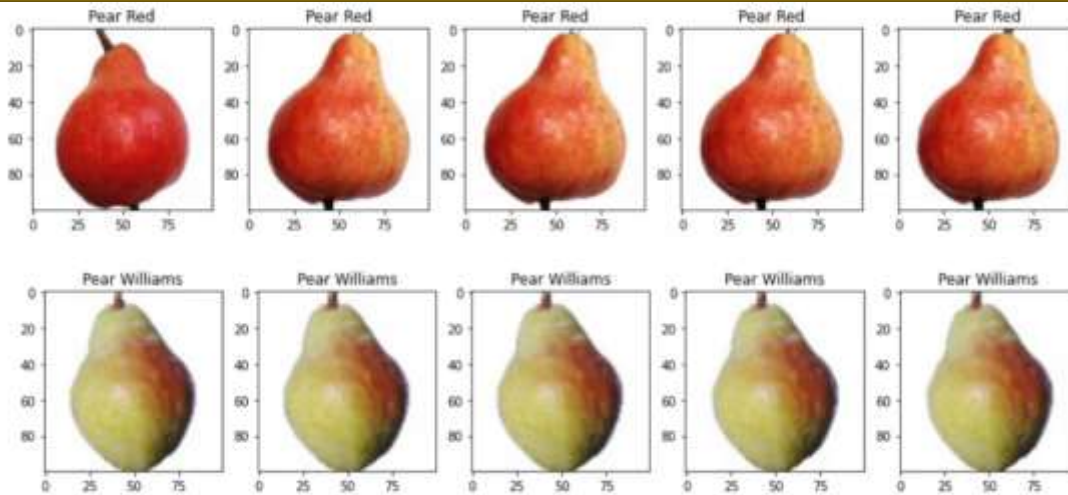


Figure 11: Images of the segmented pear

Convolutional layer:

Convolutional layers in a convolutional neural network systematically apply learned filters to input images in order to create feature maps that summarize the presence of those features in the input. Convolutional layers prove very effective, and stacking convolutional layers in deep models allows layers close to the input to learn low-level features and layers deeper in the model to learn high-order or more abstract features, like shapes or specific objects. A limitation of the feature map output of convolutional layers is that they record the precise position of features in the input. This means that small movements in the position of the feature in the input image will result in a different feature map. This can happen with re-cropping, rotation, shifting, and other minor changes to the input image.

Pooling layers:

They provide an approach to down sampling feature maps by summarizing the presence of features in patches of the feature map. Two common pooling methods are average pooling and max pooling that summarize the average presence of a feature and the most activated presence of a feature respectively.

The pooling layer operates upon each feature map separately to create a new set of the same number of pooled feature maps. Pooling involves selecting a pooling operation, much like a filter to be applied to feature maps. The size of the pooling operation or filter is smaller than the size of the feature map specifically, it is almost always 2×2 pixels applied with a stride of 2 pixels. The result of using a pooling layer and creating down sampled or pooled feature maps is a summarized version of the features detected in the input. They are useful as small changes in the location of the feature in the input detected by the convolutional layer will result in a pooled feature map with the feature in the same location. This capability added by pooling is called the model's invariance to local translation.

Fully connected layers:

Fully connected layers are layers from a regular neural network. Each neuron from a fully connected layer is linked to each output of the previous layer. The operations behind a convolutional layer are the same as in a fully connected layer. Thus, it is possible to convert between the two.

Recurrent neural network:

The paper proposes an improvement to the popular convolutional network in the form of a recurrent convolutional network. In this kind of architecture the same set of weights is recursively applied over some data. Traditionally, recurrent networks have been used to process sequential data, handwriting or speech recognition being the most known examples. By using recurrent

convolutional layers with some max pool layers in between them and a final global max pool layer at the end several advantages are obtained. Firstly, within a layer, every unit takes into account the state of units in an increasingly larger area around it. Secondly, by having recurrent layers, the depth of the network is increased without adding more parameters. Recurrent networks have shown good results in natural language processing

Table 1: Full-Color Model Summary.

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(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
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
global_max_pooling2d_1 (Glob	(None, 512)	0
dense_1 (Dense)	(None, 7)	3591

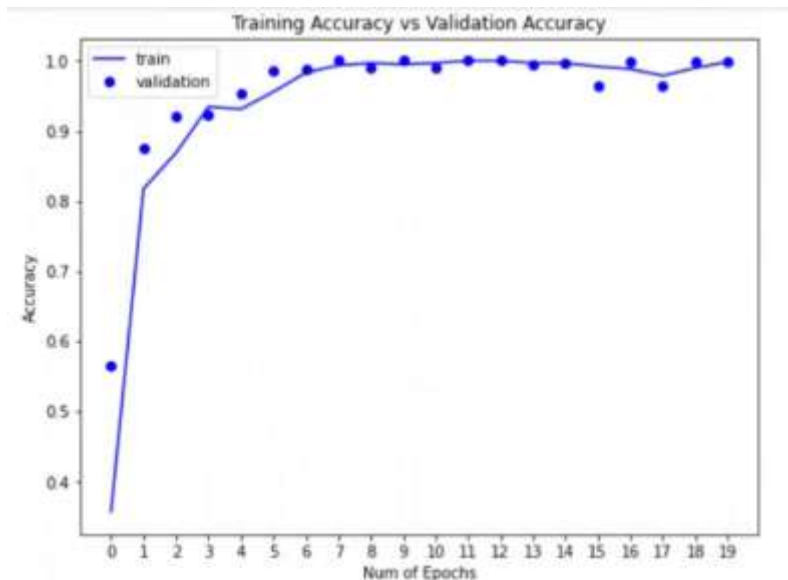


Figure 12: Training accuracy vs validation accuracy

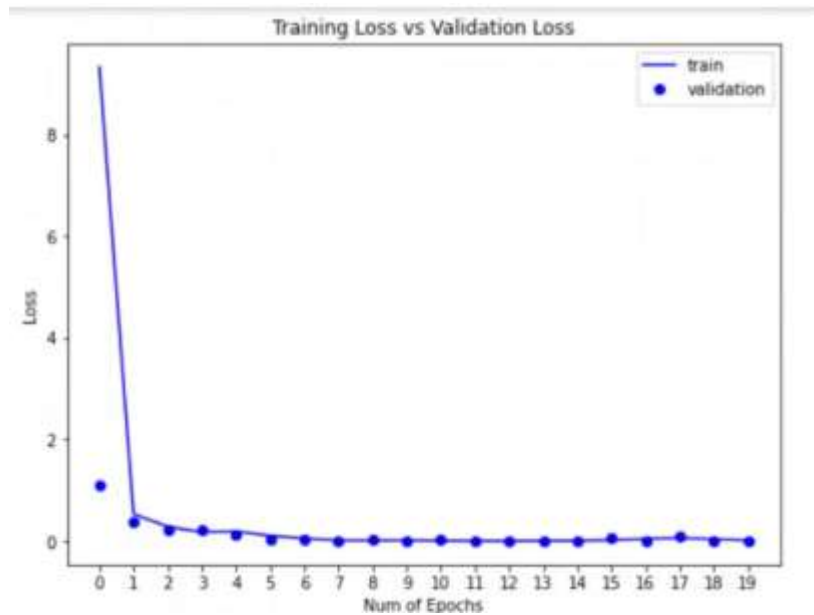


Figure 13: Training loss vs validation loss

CONCLUSION:

This paper provides basic analysis of effects the choice of the classification loss function has on deep neural networks training as well as their final characteristics, This model provides the ability to distinguish types of pear faster and more accurate than the traditional classification. And the result of the training accuracy was 100% and the validation accuracy was 100%. It does not require extensive training to use. It was developed using Convolutional Neural Network (CNN).

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