Vegetables and Fruit Classification using Deep Convolutional Neural Network

BACKGROUND

Smart Fridge still cannot be called a Smart Fridge yet. Previously, Smart Fridge can only work with the help of the user, by giving a tag, or barcode, or just by showing the inside of the fridge. But, if Smart Fridge and Image Classification can be combined, it will be a Smart Fridge with automated identification system which also can be applied to the inventory system. Currently, Deep Convolutional Neural Network (DCNN) is one of the most used Artificial Neural Network for Image Classification and Image Recognition. But, DCNN itself is heavy and slow, and a new DCNN architecture with a high accuracy and fast prediction time will be researched.

OBJECTIVE AND SIGNIFICANCE

By completing this research, it will produce:

1. DCNN model and architecture with fast prediction time and high accuracy,
2. An application to test the model.

And this research is hoped to help in some sections, including:

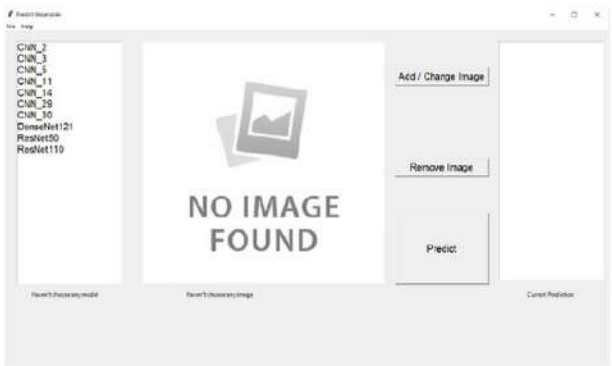
1. Helping the future research to have an architecture with fast prediction time and high accuracy which also possible to be implemented in real-time,
2. Helping the implementation of online inventory system which automatically scan the receipt and check what goes into the smart fridge and what is not.

METHODOLOGY

To produce an accurate and fast DCNN, the steps taken are:

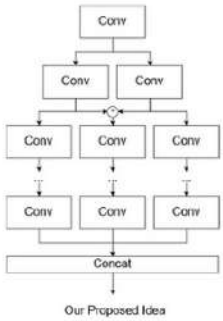
1. Make a dataset containing images of Vegetables and Fruits that consisted of apples, avocados, bananas, carrots, garlic, grapes, kiwis, mangos, oranges, pineapples, and tomatoes,
2. Make a model and analyze the result using the built dataset,
3. Compare it with DenseNet121, ResNet50 and ResNet110,
4. Convert into TFLite and apply in the application.

The application that will be used to test the time and accuracy is our model tester with model picker and image loader as below:



RESULT

Based on the methodology, we have found the best architecture which consisted from 1 input and divided into 2 branch, and made into 3 individual branch. Each branch will be called **strand**, and for each strand it will be considered as an individual Convolutional Neural Network (CNN) or DCNN, which may consist of multiple CNN Block or Convolutional Blocks.



Our Proposed Idea

After comparing with the state-of-the-arts, the result is as follows:

MODEL	AVERAGE TIME	ACCURACY
DCNN (CNN_30)	**38 ms**	**90,34%**
DenseNet121	45 ms	89,77%
ResNet50	74 ms	90,34%
ResNet110	150 ms	90,34%

And to test further the DCNN model, it will tested again using 2 base image and 8 filtered images.


Banana (1).jpg Banana (2).jpg Banana (3).jpg Banana (4).jpg Banana (5).jpg


Carrot (1).jpg Carrot (2).jpg Carrot (3).jpg Carrot (4).jpg Carrot (5).jpg

With the result as follows:

Filename	CNN_30	T	DenseNet121	T	ResNet50	T	ResNet110	T
Banana (1).jpg	Banana	33	Avocado	39	Banana	69	Banana	132
Banana (2).jpg	Banana	33	Avocado	39	Kiwi	67	Banana	132
Banana (3).jpg	Garlic	33	Garlic	39	Garlic	68	Garlic	131
Banana (4).jpg	Pineapple	33	Garlic	39	Garlic	69	Garlic	129
Banana (5).jpg	Garlic	33	Garlic	42	Garlic	67	Garlic	128
Carrot (1).jpg	Carrot	32	Avocado	38	Tomato	66	Carrot	129
Carrot (2).jpg	Carrot	34	Garlic	39	Tomato	67	Carrot	131
Carrot (3).jpg	Carrot	33	Banana	38	Tomato	66	Carrot	127
Carrot (4).jpg	Garlic	33	Avocado	39	Garlic	65	Garlic	127
Carrot (5).jpg	Carrot	33	Banana	38	Tomato	68	Carrot	127
	60%	**33**		**0%**	**39**	**10%**	**67**	**60%**	**129**

CONCLUSION

Based on the result, the DCNN model created is as good as ResNet110, where on the first testing it got 90,43% accuracy and on the filtered image it also can work quite accurately with 60% accuracy. It is also use lesser time which almost quarter of the time used by ResNet110.

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