Image-Based Pineapple Type Detection Using Deep Learning

Hamdan N. al Buhaisi

Department Information Technology, Faculty of
Engineering and Information Technology,
Al-Azhar University, Gaza, Palestine

Abstract: A pineapple (Ananas comosus)[1] is a tropical plant with eatable leafy foods most monetarily critical plant in the family Bromeliaceous. The pineapple is native to South America, where it has been developed for a long time. The acquaintance of the pineapple with Europe in the seventeenth century made it a critical social symbol of extravagance. Since the 1820s, pineapple has been industrially filled in nurseries and numerous tropical manors. Further, it is the third most significant tropical natural product in world creation. In the twentieth century, Hawaii was a prevailing maker of pineapples, particularly for the US; be that as it may, by 2016, Costa Rica, Brazil, and the Philippines represented almost 33% of the world's creation of pineapples. In this paper, machine learning based approach is presented for identifying type pineapple with a dataset that contains 1,312 images use 688 images for training, 295 images for validation and 329 images for testing. A deep learning technique that extensively applied to image recognition was used. use 70% from image for training and 30% from image for validation. Our trained model achieved an accuracy of 100% on a held-out test set.

Keywords: Pineapple, Deep Learning, Classification, Detection.

INTRODUCTION:

Raw pineapple pulp is 86% water, 13% carbohydrates, 0.5% protein, and contains negligible fat (table). In a 100-gram reference amount, raw pineapple supplies 50 calories, and is a rich source of manganese (44% Daily Value, DV) and vitamin C (58% DV), but otherwise contains no micronutrients in significant amounts.[2]

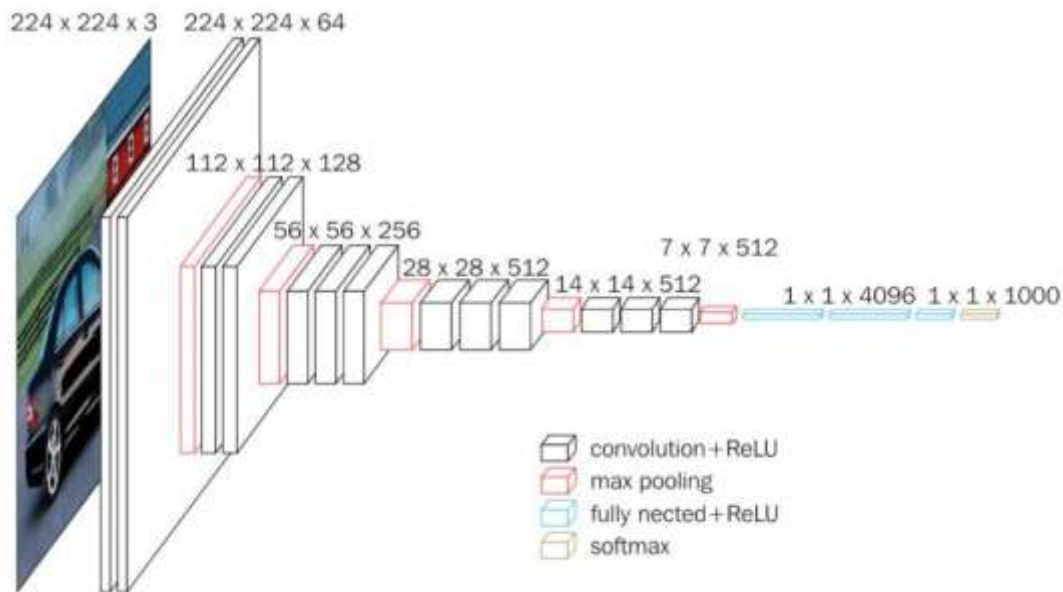Pineapple is providing human by many health benefits, below 8 Health benefits of Pineapples:

1. Loaded with Nutrients: Pineapples are packed with a variety of vitamins and minerals. They are especially rich in vitamin C and manganese.
2. Contains Disease-Fighting Antioxidants: Pineapples are a good source of antioxidants, which may reduce the risk of chronic diseases such as heart disease, diabetes, and certain cancers. Many of the antioxidants in pineapple are bound, so they may have longer lasting effects.
3. Its Enzymes Can Ease Digestion: Pineapples contain bromelain, a group of digestive enzymes that breaks down proteins. This may aid digestion, especially in those with pancreatic insufficiency.
4. May Help Reduce the Risk of Cancer: Pineapple contains compounds that reduce oxidative stress and inflammation, both of which are linked to cancer. One of these compounds is the enzyme bromelain, which may stimulate cell death in certain cancer cells and aid white blood cell function.
5. May Boost Immunity and Suppress Inflammation: Pineapples have anti-inflammatory properties that may boost the immune system.
6. May Ease Symptoms of Arthritis: The anti-inflammatory properties of pineapple may provide short-term symptom relief for people with common types of arthritis.
7. May Speed Recovery After Surgery or Strenuous Exercise: The bromelain in pineapples may reduce the inflammation, swelling, bruising and pain that occurs after surgery. Bromelain's anti-inflammatory properties may also aid recovery after strenuous exercise by reducing tissue inflammation.
8. Delicious and Easy to Add to the Diet: Pineapples are delicious, accessible, and easy to add to the diet.

DEEP LEARNING

Deep learning is a branch of machine learning which is completely based on artificial neural networks, as neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain. In deep learning, we don't need to explicitly program everything. The concept of deep learning is not new. It has been around for a couple of years now. It's on hype nowadays because earlier we did not have that much processing power and a lot of data. As in the last 20 years, the processing power increases exponentially, deep learning and machine learning came in the picture. A formal definition of deep learning is- neurons

VGG16 – Convolutional Network for Classification and Detection
The architecture depicted below is VGG16.

VGG16 is a convolutional neural network model proposed by K. Simonyan and A. Zisserman from the University of Oxford in the paper "Very Deep Convolutional Networks for Large-Scale Image Recognition". The model achieves 92.7% top-5 test accuracy in ImageNet, which is a dataset of over 14 million images belonging to 1000 classes. It was one of the famous model submitted to ILSVRC-2014. It makes the improvement over AlexNet by replacing large kernel-sized filters (11 and 5 in the first and second convolutional layer, respectively) with multiple 3×3 kernel-sized filters one after another. VGG16 was trained for weeks and was using NVIDIA Titan Black GPU's.

Study Objective

Demonstrating the feasibility of using deep convolutional neural networks to classify Type Pineapple.

Dataset:

The dataset used, contains a set of 1,312 images use 688 images for training, 295 images for validation and 329 images for testing belonging to 2 species from pineapple.
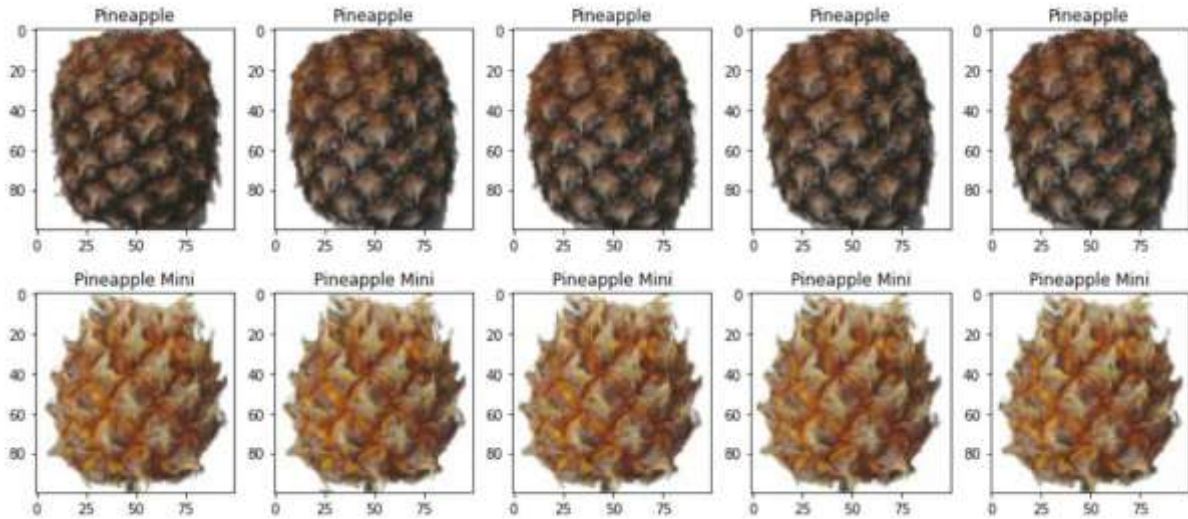
There are 2 classes as follow:
- Pineapple   Class 0
- Pineapple Mini   class 1

We resize the images into 256×256

```
Pineapple
Pineapple Mini
Training data shape:  (983, 256, 256, 3)
Training labels shape:  (983, 2)
```

Model:

We used Convolutional Neural Networks - VGG16 application, and for optimizers: Adam and activation: softmax. As following:

Layer (type)	Output Shape	Param #
input_2 (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
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
global_max_pooling2d_2 (Glob		(None, 512)	0
dense_2 (Dense)		(None, 2)	1026

===
Total params: 14,715,714
Trainable params: 14,715,714
Non-trainable params: 0

Also, we used the augmentation to prevent overfitting. **System**

Evaluation
We used the original Pineapple dataset that consists of 1,312 images after resizing the images to 256x256 pixels.

We divided the data into training (70%), validation (30%). The results comes as following:

Training Accuracy vs Validation Accuracy

Training Loss vs Validation Loss
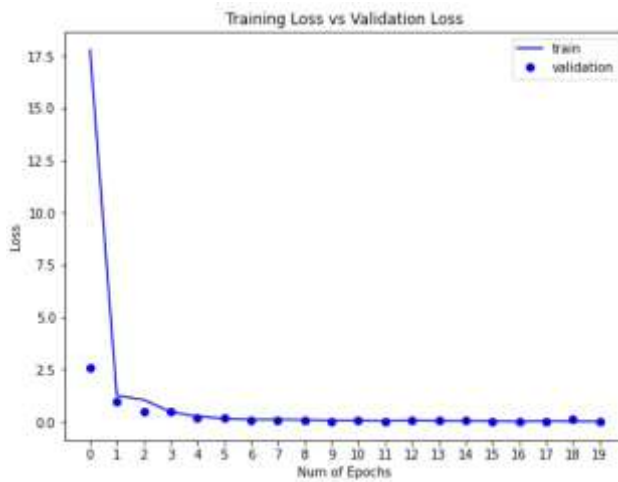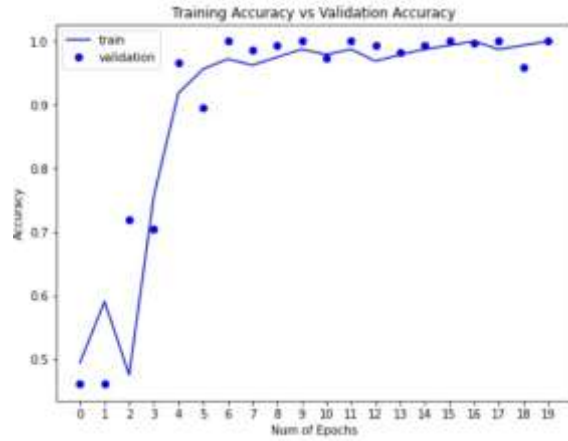
Also for *testing*, we used the original Pineapple dataset that consists of 329 images The testing accuracy was 100%

```
count total :  Pineapple 166 166
count total :  Pineapple Mini 163 163
acc= :  329 329 100.0 %
```

Conclusion

We proposed a solution to help people determine the type of Pineapple, 100% accurately for your best model , builds a model using deep learning (VGG16) and uses this model to predict the type of Pineapple.

References:
1. Morton, Julia F (1987). "Pineapple, Ananas comosus". Retrieved 22 April 2011.
2. "Nutrient data for pineapple, raw, all varieties, per 100 g serving". Nutritiondata.com, USDA SR-21.
3. Abu Nada, A. M., et al. (2020). "Age and Gender Prediction and Validation Through Single User Images Using CNN." International Journal of Academic Engineering Research (IJAER) 4(8): 21-24.
4. Abu Nada, A. M., et al. (2020). "Arabic Text Summarization Using AraBERT Model Using Extractive Text Summarization Approach." International Journal of Academic Information Systems Research (IJAISR) 4(8): 6-9.
5. Abu-Saqer, M. M., et al. (2020). "Type of Grapefruit Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 4(1): 1-5.
6. Afana, M., et al. (2018). "Artificial Neural Network for Forecasting Car Mileage per Gallon in the City." International Journal of Advanced Science and Technology 124: 51-59.
7. Al Barsh, Y. I., et al. (2020). "MPG Prediction Using Artificial Neural Network." International Journal of Academic Information Systems Research (IJAISR) 4(11): 7-16.
8. Alajrami, E., et al. (2019). "Blood Donation Prediction using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(10): 1-7.
9. Alajrami, E., et al. (2020). "Handwritten Signature Verification using Deep Learning." International Journal of Academic Multidisciplinary Research (IJAMR) 3(12): 39-44.
10. Al-Araj, R. S. A., et al. (2020). "Classification of Animal Species Using Neural Network." International Journal of Academic Engineering Research (IJAER) 4(10): 23-31.
11. Al-Atrash, Y. E., et al. (2020). "Modeling Cognitive Development of the Balance Scale Task Using ANN." International Journal of Academic Information Systems Research (IJAISR) 4(9): 74-81.
12. Alghoul, A., et al. (2018). "Email Classification Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 2(11): 8-14.
13. Al-Kahlout, M. M., et al. (2020). "Neural Network Approach to Predict Forest Fires using Meteorological Data." International Journal of Academic Engineering Research (IJAER) 4(9): 68-72.
14. Alkronz, E. S., et al. (2019). "Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network." International Journal of Academic and Applied Research (IJAAR) 3(2): 1-8.
15. Al-Madhoun, O. S. E.-D., et al. (2020). "Low Birth Weight Prediction Using JNN." International Journal of Academic Health and Medical Research (IJAHMR) 4(11): 8-14.
16. Al-Massri, R., et al. (2018). "Classification Prediction of SBRCTs Cancers Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 2(11): 1-7.
17. Al-Mobayed, A. A., et al. (2020). "Artificial Neural Network for Predicting Car Performance Using JNN." International Journal of Engineering and Information Systems (IJEAIS) 4(9): 139-145.
18. Al-Mubayyed, O. M., et al. (2019). "Predicting Overall Car Performance Using Artificial Neural Network." International Journal of Academic and Applied Research (IJAAR) 3(1): 1-5.
19. Alshawwa, I. A., et al. (2020). "Analyzing Types of Cherry Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 4(1): 1-5.
20. Al-Shawwa, M., et al. (2018). "Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(9): 1-6.
21. Ashqar, B. A., et al. (2019). "Plant Seedlings Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 3(1): 7-14.
22. Bakr, M. A. H. A., et al. (2020). "Breast Cancer Prediction using JNN." International Journal of Academic Information Systems Research (IJAISR) 4(10): 1-8.
23. Barhoom, A. M., et al. (2019). "Predicting Titanic Survivors using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(9): 8-12.
24. Belbeisi, H. Z., et al. (2020). "Effect of Oxygen Consumption of Thylakoid Membranes (Chloroplasts) From Spinach after Inhibition Using JNN." International Journal of Academic Health and Medical Research (IJAHMR) 4(11): 1-7.
25. Dalffa, M. A., et al. (2019). "Tic-Tac-Toe Learning Using Artificial Neural Networks." International Journal of Engineering and Information Systems (IJEAIS) 3(2): 9-19.
26. Dawood, K. J., et al. (2020). "Artificial Neural Network for Mushroom Prediction." International Journal of Academic Information Systems Research (IJAISR) 4(10): 9-17.
27. Dheir, I. M., et al. (2020). "Classifying Nuts Types Using Convolutional Neural Network." International Journal of Academic Information Systems Research (IJAISR) 3(12): 12-18.
28. El-Khatib, M. J., et al. (2019). "Glass Classification Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 3(2): 25-31.
29. El-Mahelawi, J. K., et al. (2020). "Tumor Classification Using Artificial Neural Networks." International Journal of Academic Engineering Research (IJAER) 4(11): 8-15.
30. El-Mashharawi, H. Q., et al. (2020). "Grape Type Classification Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 3(12): 41-45.
31. Elzamly, A., et al. (2015). "Classification of Software Risks with Discriminant Analysis Techniques in Software planning Development Process." International Journal of Advanced Science and Technology 81: 35-48.
32. Elzamly, A., et al. (2015). "Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis: Statistical Methods." Int. J. Adv. Inf. Sci. Technol 38(38): 108-115.
33. Elzamly, A., et al. (2017). "Predicting Critical Cloud Computing Security Issues using Artificial Neural Network (ANNs) Algorithms in Banking Organizations." International Journal of Information Technology and Electrical Engineering 6(2): 40-45.
34. Habib, N. S., et al. (2020). "Presence of Amphibian Species Prediction Using Features Obtained from GIS and Satellite Images." International Journal of Academic and Applied Research (IJAAR) 4(11): 13-22.
35. Harz, H. H., et al. (2020). "Artificial Neural Network for Predicting Diabetes Using JNN." International Journal of Academic Engineering Research (IJAER) 4(10): 14-22.
36. Hassanein, R. A. A., et al. (2020). "Artificial Neural Network for Predicting Workplace Absenteeism." International Journal of Academic Engineering Research (IJAER) 4(9): 62-67.
37. Heriz, H. H., et al. (2018). "English Alphabet Prediction Using Artificial Neural Networks." International Journal of Academic Pedagogical Research (IJAPR) 2(11): 8-14.
38. Jaber, A. S., et al. (2020). "Evolving Efficient Classification Patterns in Lymphography Using EasyNN." International Journal of Academic Information Systems Research (IJAISR) 4(9): 66-73.
39. Kashf, D. W. A., et al. (2018). "Predicting DNA Lung Cancer using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(10): 6-13.
40. Khalil, A. J., et al. (2019). "Energy Efficiency Predicting using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 3(9): 1-8.
41. Kweik, O. M. A., et al. (2020). "Artificial Neural Network for Lung Cancer Detection." International Journal of Academic Engineering Research (IJAER) 4(11): 1-7.
42. Maghari, A. M., et al. (2020). "Books' Rating Prediction Using Just Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 4(10): 17-22.
43. Mettleq, A. S. A., et al. (2020). "Mango Classification Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 3(12): 22-29.
44. Metwally, N. F., et al. (2018). "Diagnosis of Hepatitis Virus Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(11): 1-7.
45. Mohammed, G. R., et al. (2020). "Predicting the Age of Abalone from Physical Measurements Using Artificial Neural Network." International Journal of Academic and Applied Research (IJAAR) 4(11): 7-12.
46. Musleh, M. M., et al. (2019). "Predicting Liver Patients using Artificial Neural Network." International Journal of Academic Information Systems Research (IJAISR) 3(10): 1-11.
47. Oriban, A. J. A., et al. (2020). "Antibiotic Susceptibility Prediction Using JNN." International Journal of Academic Information Systems Research (IJAISR) 4(11): 1-6.
48. Qwaider, S. R., et al. (2020). "Artificial Neural Network Prediction of the Academic Warning of Students in the Faculty of Engineering and Information Technology in Al-Azhar University-Gaza." International Journal of Academic Information Systems Research (IJAISR) 4(8): 16-22.
49. Sadek, R. M., et al. (2019). "Parkinson's Disease Prediction Using Artificial Neural Network." International Journal of Academic Health and Medical Research (IJAHMR) 3(1): 1-8.
50. Salah, M., et al. (2018). "Predicting Medical Expenses Using Artificial Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 2(20): 11-17.
51. Salman, F. M., et al. (2020). "COVID-19 Detection using Artificial Intelligence." International Journal of Academic Engineering Research (IJAER) 4(3): 18-25.
52. Samra, M. N. A., et al. (2020). "ANN Model for Predicting Protein Localization Sites in Cells." International Journal of Academic and Applied Research (IJAAR) 4(9): 43-50.
53. Shawarib, M. Z. A., et al. (2020). "Breast Cancer Diagnosis and Survival Prediction Using JNN." International Journal of Engineering and Information Systems (IJEAIS) 4(10): 23-30.
54. Zaqout, I., et al. (2015). "Predicting Student Performance Using Artificial Neural Network: in the Faculty of Engineering and Information Technology." International Journal of Hybrid Information Technology 8(2): 221-228.