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An Efficient Classification of Flower Images using Deep Learning Neural Networks

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ABSTRACT

This paper is focused on classifying the five (5) different types of flower images using various Deep Learning methods like Convolution Neural Network (CNN) and Deep Belief Networks (DBF). Python is used as a programming language which comes with the Tensor Flow framework. An Imagenet database is used wherein 3670 different types of flower images were extracted and used for the purpose of research. The input data mainly focuses on 5 different types of flowers namely Rose, Daisy, Dandelion, Sunflower and Tulip. On the application of Deep Learning Network's (DNN) through training and testing the flower images a very high percentage of accuracy was observed as 99.626% in case of Daisy flower.

Keyword:- Machine Learning ,Python, Numpy, CNN, BDF, Tensor Flow.

INTRODUCTION

Recently, image classification is growing and becoming a trend technology among developers especially with the growth of data in different parts of industry such as e-commerce, automotive, healthcare, and gaming. The most obvious example of this technology is applied to Facebook. Facebook now can detect up to 98% accuracy in order to identify your face with only a few tagged images and classify it into your Facebook's album. The technology itself almost beats the ability of humans in image classification or recognition (What is the Working of Image Recognition and How it is Used, 2017).

One of the dominant approaches for this technology is deep learning. Deep learning falls under the category of Artificial Intelligence where it can act or think like a human. Normally, the system itself will be set with hundreds or maybe thousands of input data in order to make the 'training' session to be more efficient and fast. It starts by giving some sort of 'training' with all the input data (Faux & Luthon, 2012).

Machine learning is also a frequent system that has been applied towards image classification. However, there are still parts that can be improved within machine learning. Therefore, image classification is going to be merged with deep learning systems. Machine Vision has its own context when it comes with Image Classification. The ability of this technology is to recognize people, objects, places, action and writing in images. The combination of artificial intelligence software and machine vision technologies can achieve the outstanding result of image classification (Haughn M, 2017).

The fundamental task of image classification is to make sure all the images are categorized according to its specific sectors or groups (Xie, Hong, Zhang, & Tian, 2015). Classification is easy for humans but it has proved to be a major problem for machines. It consists of unidentified patterns compared to detecting an object as it should be classified to the proper categories. The various applications such as vehicle navigation, robot navigation and remote sensing by using image classification technology. It is still undergoing challenging work and limited resources are needed to improve it (Xie et al., 2015).

Image classification has become a major challenge in machine vision and has a long history with it. The challenge includes a broad intra-class range of images caused by color, size, environmental conditions and shape. It requires big data of labelled training images and to prepare this big data, it consumes a lot of time and cost as for the training purpose only (X. Li & Guo, 2013).

In this paper, deep neural networks, based on Tensor Flow, are used with Python as the programming language for image classification. Thousands of images are used as the input data in this project. The accuracy of each percentage of 'train' sessions will be studied and compared.

RELATED WORK

In [1], studied Neural Network Architecture (NNA) as a method for the image classification. The framework consists of a combination between mimics of two pairs of human eye and variation sequence auto-encoding. It involved many complex images but in the process of this study, the system slowly improved the MNIST models. The MNIST is the open source database to be used as the training set. It also tests with Street View House Numbers dataset where the result was improved because even the human eyes cannot distinguish it.

According to [2], the journal discussed an image classification system based on the structure of a Convolutional Neural Network (CNN). The training was performed such that a balanced number of face images and non-face images were used for training by deriving additional face images from the face images data. The image classification system employs the bi-scale CNN with 120 trained data and the auto-stage training achieves 81.6% detection rate with only six false positives on Face Detection Data Set and Benchmark (FDDB), where the current state of the art achieves about 80% detection rate with 50 false positives

From [3] the research used Decision Tree (DT) as the techniques in image classification. The DT has multiple datasets that are located under each of Hierarchical classifiers. It must be done in order to calculate membership for each of the classes. The classifier allowed some rejection of the class on the intermediary stages. This method also requires three (3) parts, the first one is to find terminal nodes and second is the placement of class within it. The third one is partitioning of the nodes. This method is considered very simple and has a high rate of efficiency.

In the journal [4], this paper discusses Support Vector Machine (SVM) active learning that was very actively growing interests during that time. It also proposed some new ideas by combining spatial information from a sequential process in the trial process with spectral. It requires three strategies where the first one is Euclidean distance. It calculated some of the training samples from the main part of spatial. The second strategy is based on the Parzen window technique and finally, it includes spatial entropy. The result showed that two of the images have high resolution in terms of effectiveness.

Based on the journal [5], it proposed fast image classification by boosting the Fuzzy Classifiers. It was a simple way to differentiate between known and unknown categories. This method is simply boosting Meta knowledge where local characteristics can be mostly found. It was tested with some big data of images and compared with the bag-of-features image model. The result gave much better classification accuracy as it was a testing process that gave a short period of time where it produced 30% shorter compared to the previous one.

METHOD

There are four (4) phases throughout this process and each of the phases will be discussed. Each of the phases are included on TensorFlow as the open source software and Python as its programming language. Then, the process is continued to collect some of the images (inputs), by applying DNN and lastly all images will be classified into their groups.

Training Images

Input data for this paper mainly uses thousands of images. All These images are taken from ImageNet. ImageNet also was known as Large Scale Visual Recognition Challenge where it is a competition about detecting and classified thousands of objects into its categories. This is an annual competition until today. This is a benchmarking or starting of revolution on ‘big data’. In this paper, thousands of images of flowers were obtained through this ImageNet website as shown in Figure 1 and it is free. It is meant to be used by researchers or engineers. This research paper solely focuses on classifying flowers into each of its categories. There are thousands of flower images and there are five types of flowers here. Each type of flower contains hundreds of images with different sides and also colors. The total number for all of this flower is 3670 images as shown in Table 1.

Table 1. Number of images according to the type of flowers

No.	Type of Flowers	No of Images
1.	Daisy	633
2.	Dandelion	898
3.	Roses	641
4.	Sunflower	699
5.	Tulips	799
Total of flower images		3670

Figure 1. The block diagram of Image Classification

Implementation Deep Neural Network (DNN)

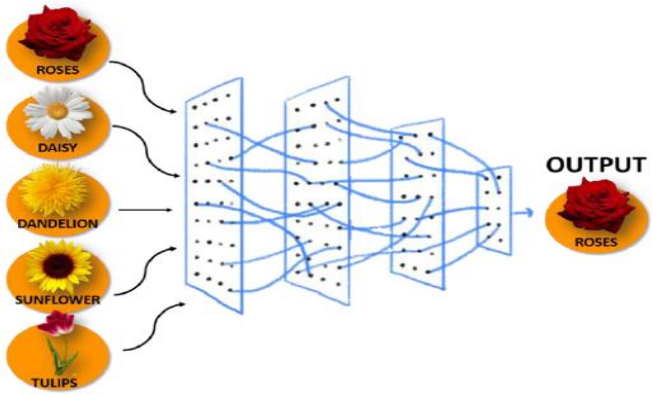

Figure 2. DNN process towards flower images

As shown in Figure 2, it consists of five (5) data inputs (five types of different flowers) and undergoes training with multiple hidden layers. The inputs are also set with fixed-size of the 224x224 RGB image. The convolution process is configured with MobileNet as it produces an efficient CNN (Convolution Neural Network) . DBF (Deep Belief Network) is a Series of constrained Boltzmann machines connected in a specific order make a Deep Belief Network. A Restricted Boltzmann Machine (RBM) is a type of generative stochastic artificial neural network that can learn a probability distribution from its inputs.

MobileNet Performance

In this paper, MobileNet is used as the 'trainer' as it consists of small efficient deep neural networks (DNN). It has two (2) ways to configure this MobileNet which is the first one is input image resolution and the size of the model within MobileNet. As for this research, it was set as shown in Figure 4 where Input Image Resolution is set as 224 and Size of the model is set as 0.50.

Flowchart

The classification systems Based on Figure 3, the flowchart of image classification that will be implemented using TensorFlow. The programming language that will be used in the software in Python. The flowchart shows that the systems will be started by collecting images of the flowers. After that, DNN is applied to train the model. Running for validation or testing and if it is not the image of a particular flower that supposedly acts as output then it needs to start over again from DNN.

The process ends after the output is classified into the right type of flowers. The flowchart starts with inserting sets of flower images as an input in this research. It has five (5) types of the flower which is Roses, Daisy, Dandelion, Sunflowers, and Tulips. After that, all of these input images undergo 'training' with the deep neural network (DNN). The deep neural network (DNN) had to train all of these sets of data until the systems recognized each of these 3670 images. Then, each of the classifications occurred when one of the images being tested whether it belongs to any of these five (5) type of flowers.

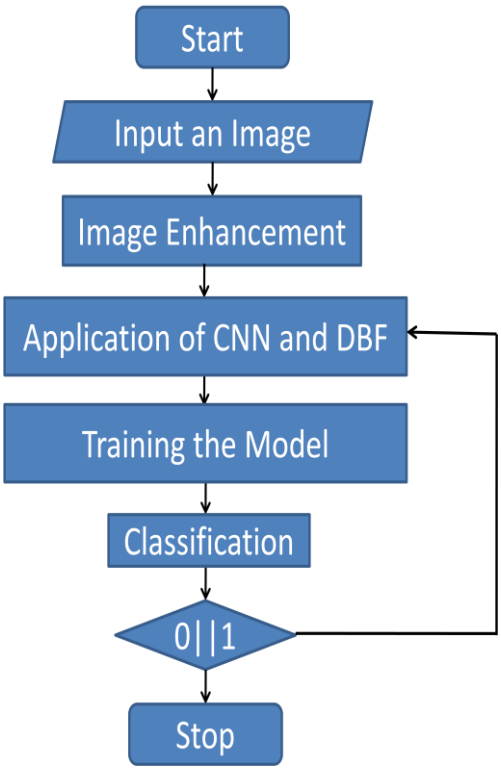

Figure 3. The flowchart of image classification system

RESULT

The Accuracy of the flowers

Table 2. Different types of flowers and their respective accuracies

Sl. No.	Flower	Flower Name	Accuracy
1		Rose	90.525%
2		Daisy	99.626%
3		Dandelion	99.823%
4		Sun Flower	99.982%
5		Tulip	100%

Comparison of two Different Size Model MobileNet and DBN

This shows the graph of MobileNet with two different size models. The size model was one of the parameters that can be adjusted or changed. From Figure 11, it can be seen that the training session of MobileNet 0.50 was much faster as it only required 51 seconds while MobileNet 1.00 took more time with 6 minutes 44 seconds to complete the training session. However, MobileNet 1.00 had a higher rate of accuracy compared to MobileNet 0.50. It can be concluded that as the size of the model is bigger it is going to take more time to finish the training session but despite that, it produces higher accuracy compared to the smaller model of MobileNet.

Figure 4. Graph of 0.50 vs 1.00 MobileNet

CONCLUSION

In conclusion, this research is about image classification by using deep learning via the framework TensorFlow. It has three (3) objectives that have been achieved throughout this research. The objectives are linked directly with conclusions because it can determine whether all objectives are successfully achieved or not. It can be concluded that all results that have been obtained, showed quite impressive outcomes. The deep neural network (DNN) becomes the main agenda for this research, especially in image classification technology. DNN technique was studied in more details starting from assembling, training models and to classify images into categories. The roles of epochs in DNN were able to control accuracy and also prevent any problems such as over fitting. Implementation of deep learning by using framework TensorFlow also gave good results as it is able to simulate, train and classify with up to 97.989% percent of accuracy towards five (5) different types of flowers that have become a trained model. Lastly, Python has been used as the programming language throughout this research since it comes together with framework TensorFlow which leads to designing of the system involving Python from start until ends.

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