International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-6, March 2020

Tensorflow Based Image Classification using Advanced Convolutional Neural Network

Pradumn Kumar, Upasana Dugal

Abstract*: In this Research study image identifications will be done by the help of Advanced CNN (Convolutional Neural Networks with Tensorflow Framework. Here we use Python as a main programming language because Tensorflow is a python library. In this study input data mainly focuses on Plants categories by the help of leaves for identifications. Selecting CNN is the best approach for the training and testing data because it produces promising and continuously improving results on automated plant identifications. Here results are divided in terms of accuracy and time. Using advanced CNN results are above 95% while on others accuracy is below 90% and taking much time than this.

Keywords: Tensorflow, CNN, Image Identification.

I. INTRODUCTION

Currently image identification is fastest developing technology for developers in the form of data. Let us take an example to better understand that what image identification is. Today Google uses image captcha for validation of users. Now a days in social media in which there are multiple images of users in the form tagged images or untagged images. So in social media this technology plays an vital role to identify users by their facts with 95% and above accuracy [1].

Now a days technology is beating human's ability for image identifications. Here machine learning having power and influence over other approach. Machine learning is a part of Artificial Intelligence which can perform activities without human intervention.

The term biodiversity is very remarkable for obvious features of organic things. In spite of the different categories of organisms can be grouped into the taxonomy. In biological terms taxonomy consists with the classes by their names and its behavior and properties, so here one question arises why we are using the term identification. The identification shows the assignment of unknown organic things [14].

In this study we focus on plants identification, it is the process of assigning a particular plant to taxonomy according to their characteristics. These characteristics will be identified by the help of Quantitative and Qualitative features.

Manuscript received on February 10, 2020.
Revised Manuscript received on February 20, 2020.
Manuscript published on March 30, 2020.
* Correspondence Author
Pradumn Kumar, Department of Computer Science & Engineering,Babu Banarasi Das University, Lucknow, India. Email: Pradumnyadav18@gmail.com
Upasana Dugal, Department of Computer Science & Engineering, Babu Banarasi Das University, Lucknow, India. Email: upasana_gupta31@bbdu.ac.in.

Quantitative features provide counted or measured data while Qualitative features gives in terms of their properties like shape, colour, texture etc. All these things require classification because more than one plant look exactly same to each other [11].

Taxonomists want more efficient methods to fulfill the requirements for identification [9] because the image identification is biggest challenge in Machine visions. So in this paper Tensorflow based CNN is used for identification, here thousands of images should be use in the form of datasets.

II. RELATED WORK

This study proposed a new algorithm for plant identification using fractal dimensions [2]. Here 3- stages of fractal requirement had performed of leaves. In these stages Contour Nervure and Nervure fractal dimensions are used. Here the accuracy rate is 84% but have drawbacks. It is fully dependent on clarity of images.

In studied about deep learning as a method for image classification with hand crafted feature approach. In both approach only valid bias introduced. In this picture of speciman is not training it wins realistic to assume. Due to unavailability plant image dataset the accuracy is low and time consuming [3].

According to research paper Neural Network Architecture as a method for image classification. In Neural Network Architecture framework, the combination between mimics of two pairs of human eye and variations sequence auto encoding. In this complex images improve the MNIST models. MNIST datasets also used for fashions, automobiles and so many other image identification.

This study is about image classification by using deep learning via framework tensorflow. This classification is performed on 5- different types of flowers with an accuracy of up to 90% but in this there is drawback that if the size of smaller then accuracy was slightly low as compared to bigger.

This research paper introduced plant leaf species identification using Curvelet transform with Support Vector Machine. In this digital image of leaves divided into 25 sub images and the SVM is used for classification. On comparing with other method, it was good relatively slow and less efficient [4].

In this study Multilevel Deep learning architecture is used for classification of land cover and crop types using remote sensing data. Here optical image classification is done by the unsupervised learning and to restore the missing data and supervised entities. As a results 2-D CNNs depicts highest accuracy for certain supervised data. The target accuracy was 85% but in actual results it was 94.6%. In this study if the object is small in size then image misclassifies [5] [12].

III. CHALLENGES IN IMAGE-BASED TAXONOMY IDENTIFICATION

A. Huge Number of taxonomy to be Biased

In this world there are large number of species available like plants, animals, insects and so many others. It is very difficult to prejudice them into taxonomical form. In any event, while confining the concentration to the verdure of an region, thousands of flora and fauna categories should be upheld. Let us take an example of German's Flora exhibits thousands of flowering species and in each single genus there will be many other species.

B. Variations on Huge Intraspecific

Some species plants have some different horticulture characteristics like location, moisture, nutrition, life cycle and climatic conditions etc. These changes in horticulture characteristics can occur on their measuring units , flowers, fruits, leaves and sometimes even whole plants. For example Knautia arvensis commonly known species of knautia genus. This ranges from huge whole or dentate lanceolate ground leafs over profoundly lobed and practically pinnate stem leafs to little and again lanceolate and whole upper stem leafs

C. Accession process for variation

Plants leaves are in 3-d images in reality but when we capture then it becomes in 2-d so sine of the features change like appearance. By this large differences create between original images and captured images like shape and appearance. External conditions of image capturing also limited like zoom, focus, sensor, and resolutions etc.

D. Variation on small intraspecific

In the species look similar to each other but there is challenging task to distinguish them. These variations are invisible characteristics so in these situation horticulture characteristics are very crucial to prejudice. Even sometimes experts are challenged to distinguish the species in safely manners by almost invisible characteristics. For example, accurate distinguishing between species required visible characteristics like flower or fruits but all these are seasonable things. So out of season its very difficult to distinguish

IV. METHODOLOGY

Specially using CNN is a very trending procedure for Deep learning in computer point of view. ImageNet have produced a lot of expectation by giving exciting results [9]. Here CNN takes the most challenging task for identification of plants by using their complete picture or any parts of that plants while others tackles one by one process like firstly they take any specific organisms (flowers, leaves and bark etc.) then whole picture of organisms. In CNN there are some limitations like it is not better with very large sets of images or lack of explanatory power.

So Advanced CNN will replace CNN because in Advanced CNN is small in size as compare to CNN for recognizing images. Here large models can be easily scale up and these models are small enough to train fast, by this we will get out new ideas and have a good chance for experiment on other methods also.

The architecture of Advanced CNN is multi-layer consisting of alternate use of Convolution layers and nonlinearities. All these layers are followed by fully connected layers leading into a softmax classifier. This model gives a good accuracy results with in few time when we run on a GPU.

There are approximately between 750 – 780 operations with different modules independently in whole training graph. There are generally three steps in training graphs:-

Model Inputs: Read operations and preprocess CIFAR images operations will be added for evaluation and training respectively.

Model Prediction:- On supplied images classifications should be done by adding operations that perform inferences.

Model Training:- Add operations that compute the loss, gradients, variable updates and visualization summaries.

A. Training a Model Using Multiple GPU Cards

In scientific operations of computer multiple GPUs are used for modern workstations. Tensorflow can influence this surroundings to run the training operation simultaneously across multiple GPUs cards. A proper training processes are required to run a training model in a parallel or distributed manner.

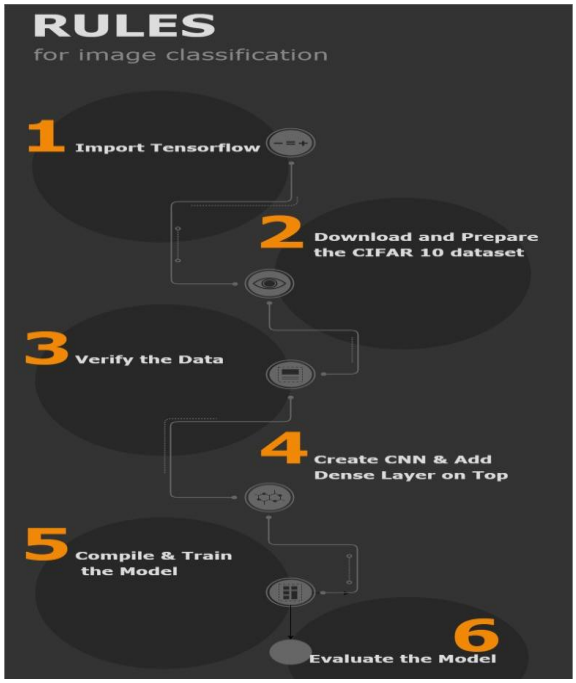
Here we entitled model replication to be one replica of a model training on a subset of data. Naively the usage of Asynchronous updates of model parameters results in sub-greatest training overall performance due to the fact an individual model replication is probably be trained on musty replica of the model parameters. Conversely using completely synchronous updates might be as gradual because the slowest version replica.

Using multiple GPUs in modern workstation, each GPU contains same processing speed and enough memory to run CIFAR models. Therefore we will design our training model as follows:-

- Import an individual model replication on every GPU.
- Updating should be done in synchronously manner which means wait for all GPUs to finish their batch data.

B. Proposed Method

According to this architecture image classification will be done by CNN. In this whole framework there are 7 stages and each stages has their own discussion. All these stages depend on Tensor flow function which is an open source software and all the Tensorflow libraries are on python programming language and on importing Tensorflow each stage process will be done as per design [6] [7][15].



1. *Download and Prepare CIFAR-10 Dataset :-*

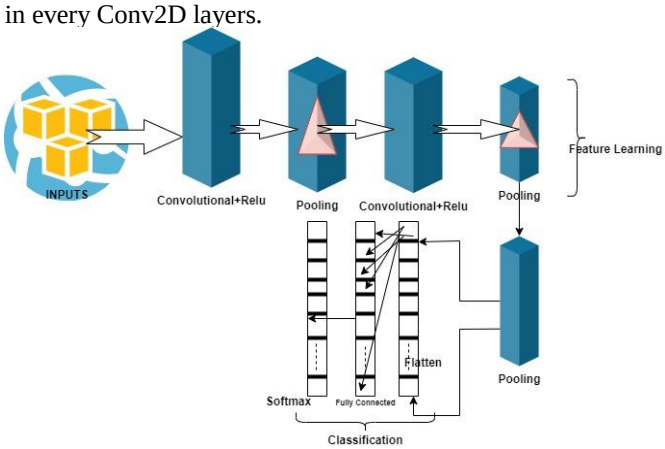
In CIFAR-10 dataset there are 60000 images which are in 10 classes and in each class there will be 6000 images. Here the dataset will be divided into two phase first is training and second is testing phase.In training phase there are 50000 images while in testing phase there are 10000 images. Here all the classes are mutually exclusive and no overlapping between them.

2. *Verification of Data :-*

Verification of dataset plays a vital role here. This verification will be done to check whether the given dataset is correct or not. For verification few images will used for plotting and these images are from training phase and each image will be shown by their specific class name.

3. *Create the Convolutional Base :-*

Here Convolutional Base follows common pattern in form if Con2D and maxPooling2D layers in a stack. In this CNN takes input in the form of tensor shape (RGB) which means (image_height, image_width, colour_channels) [8].
As per above the output of Conv2D and maxPooling2D layers are in 3-D tensor shape. If you go deeper in the Network the height and width will be shrinked. The output of each Conv2D controlled by the arguments, if height and width is shrinked then we have to add more output channels in every Conv2D layers.



4. *Adding Dense Layer on Top :-*

To perform classification we will use one or more dense layer on the output tensor of the convolutional base. The output will be in 3-D form and dense layers will take into vector form i.e. 1-D. so firstly we have to unroll or flatten 3-D output into 1-D then addition of one or more dense layer on the tip. As we know CIFAR has 10 output classes so we use final dense layer which 10 outputs and a SoftMax activation layer [13].

5. *Compile and Train the Model:-*

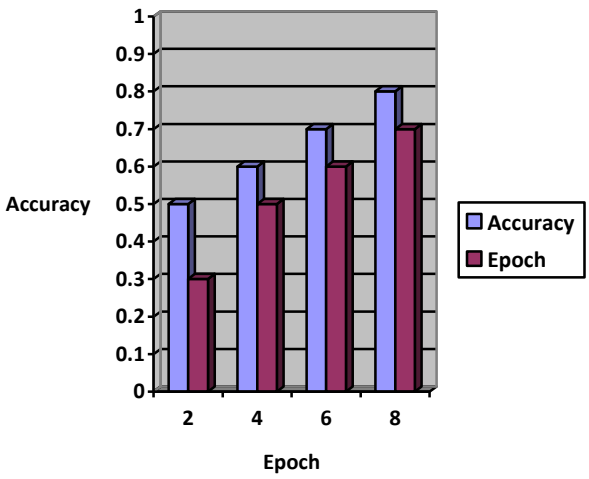
Feeding the trained data to the mode which means two arrays will be create train images and train labels. Association of images and labels into the model. Predictions will be performed about a testsets.

To start training an epoch in Machine learning is the complete processing via the studying set of rules of the complete train-set. In epoch these is one training iterations and one iteration will iterate all the sample once after calling tensorflow.

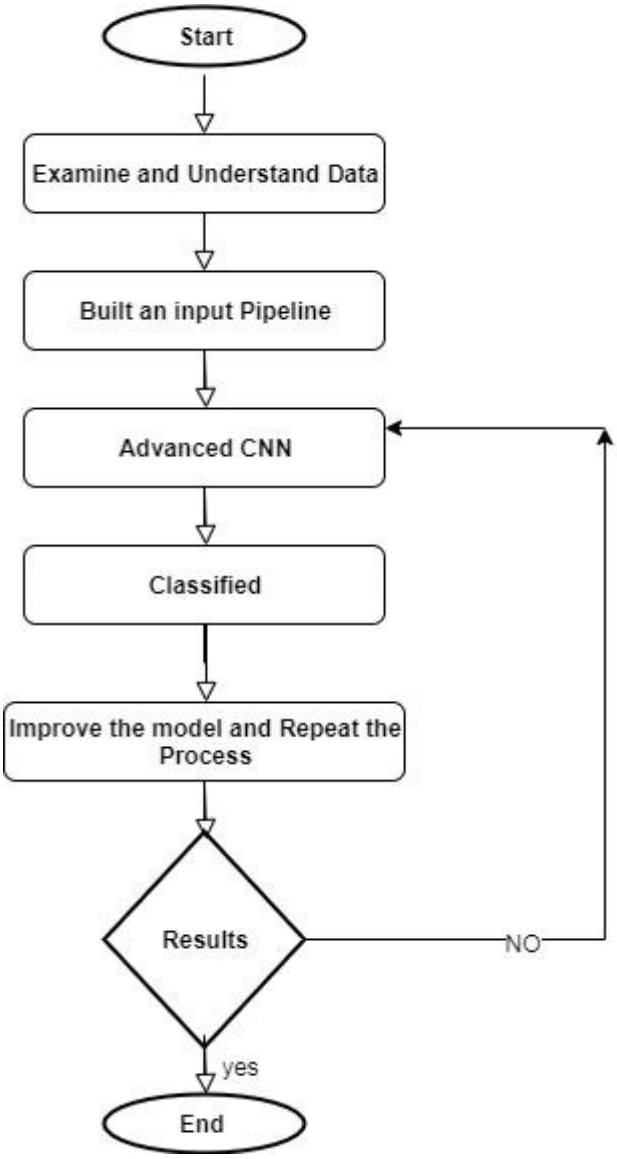
Train function and outline the value for the parameter epochs, you determine how generally model need to be trained on sample data(commonly at least some hundred instances).

6. *Evaluation of Model:-*

Here Image classifier will train towards better accuracy with less time.



C. Image Classification Flowchart:-



The implementation of image classification flowchart will be done using Tensorflow. Here flowchart depicts that the classification will start from examining and understand the data. After that input pipeline will be built then CNN is applied to train the model. In CNN testing depends on the images of leaves and if the output is not according to your expected results then it needs to restart the CNN to get accurate results. This process will end when output is classified into their specified category.

V. COMPARISON OF IMAGE CLASSIFICATION MODELS & RESULTS

In Deep learning models there are various image classifications models which are used in practical applications. Many methodologies have been created and even still popping up. So here we will introduce some basics of other models in comparison with our Advanced CNN.

1. Deep Neural Networks(DNN) is used to train a neural networks for regression and classification. The performance of DNN is not well with the images because the accuracy is bad.

2. Convolutional Neural networks (CNN) represented to be very successful in image classification, object identification, recognition etc. Here results are very optimized as compare to DNN. But in CNN validation loss is high which causes over-fitting.
3. Transfer Learning is another approach which are used for reusing the acquired knowledge. It means already trained model are used on large dataset to get well results on related works. But here accuracy is good and less time comparison to others.

But further we can improve our accuracy and time management by adding more data augmentation, more epochs and most importantly adding layers. So Advanced CNN is complete replacement of all these.

TABLE I. RESULTS FOR IMAGE CLASSIFICATION MODELS

	Accuracy rate	Time Consume	Error rate	Validation loss
DNN	70-80%	6.4Hrs	Very high	7.8
CNN	90%	5.4Hrs	High	3.3
Transfer Learning	92%	12mins	Low	0.64
Advanced CNN	More than 95%	8mins	Very low	0.3

VI. CONCLUSION AND FUTURE DIRECTION

In conclusion, this research study we have discussed about image identification or classification by using Advanced CNN via Tensorflow Framework. In this study we have performed classifications on leaves of plants by using CIFAR 10 dataset. As results we check the comparison between multiple models with specified dataset. All the results are achieved as per objectives by the Advanced CNN with accuracy of more than 95% while others are not capable to give results as per objective. Advanced CNN is our main agenda for image classification because in this adding dense layers and increasing epochs gives desired results in better way. Epochs are used to control the over fitting problems. Advanced CNN are very faster in comparison to other, it take very less time for classification. Because Advanced CNN works on GPUs and will also work their own TPUs. TPU is even more faster than the GPU. So by this we will get better results than others. We will further improve our Advanced CNN for classification for large number of images and even we can modify our model. Tensorflow framework is wide technology to create data models so research will continues on this by providing large number of images of species.

REFERENCES

1. Mohd Azlan Abu1, Nurul Hazirah Indra1, Abdul Halim Abd Rahman1, Nor Amalia Sapiee1 and Izanoordina Ahmad1, "A study on Image Classification based on Deep Learning and Tensorflow". International Journal of Engineering Research and Technology. ISSN 0974-3154, Volume 12, Number 4 (2019), pp. 563-569
2. Antony Jobina,*, Madhu S. Nairb, Rao Tatavarti, Plant Identification Based on Fractal Refinement Technique(FRT). 2nd International Conference on Communication, Computing & Security [ICCCS-2012]
3. Trishen Munisami, Mahess Ramsurn, "Plant leaf recognition using shape features and colour histogram with k-nearest neighbor classifiers". Second International Symposium on Computer vision and the Internet(VisionNet"15).
4. Shitala Prasad, Piyush Kumar, R. C. Tripathi, "PlantLeaf Species Identification using Curvelet Transform". International Conference on Computer & Communication Technology (ICCCT)-2011.
5. Nataliia Kussul, Mykola Lavreniuk, Sergii Skakun, and Andrii Shelestov, "Deep Learning Classification of Land Cover and Crop Types Using Remote Sensing Data" IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 14, NO. 5, MAY 2017.
6. Heba F. Eid1,∗ and Aboul Ella Hassanien2,3,∗ and Tai-Hoon Kim4, "Leaf plant identification system based on hidden naive bays classifier" 2015 4th International Conference on Advanced Information Technology and Sensor Application.
7. Kody G. Dangtongdee,Dr. Franz Kurfess, "Plant Identifica-tionUsing Tensorflow". Plant Phenomics Volume 2019, Article ID 9237136, 14 pages https://doi.org/10.34133/2019/9237136CPE 462, Winter 2018
8. Marco Seeland1* , Michael Rzanny2, David Boho1, Jana Wäldchen2 and Patrick Mäder1,"Image-based classification of plant genus and family for trained and untrained plant species". Institute for Computer and Systems Engineering, Technische University Ilmenau, Helmholtzplatz 5, 98693 Ilmenau, Germany. 2Max-Planck-Institute for Biogeochemistry, Department Biogeochemical Integration, Hans-Knöll-Str. 10, 07745 Jena, Germany.
9. Jana Wäldchen , Michael Rzanny, Marco Seeland, "Automated plant species identification—Trends and future directions". PLoS Comput Biol 14(4): e1005993. journal.pcbi.1005993 & April 2018.
10. Faith Ertam, Galip Aydin,"Data classification with deep learning using Tensorflow". 2nd International Conference On computer Science and Engineering.ISSN 978-1-5386-0930-9/17.
11. Jonathan Y.Clark, David P.A. Corney and H.LIlian Tang,"Automated Plant Identification Using Artificial Neural Networks".presented at CIBCB2012 @IEEE12.
12. Atharva Sharma a,*, Xiuwen Liu a, Xiaojun Yang b, Di Shi c, "A patch-based convolutional neural network for remote sensing image classification" Neural Networks 95 (2017) 19–28.
13. Kanit Wongsuphasawat en al, "Visualizing Dataflow Graphs of Deep Learning Models in TensorFlow" IEEE Transactions On Visualization And Computer Graphics, Vol. 24, No. 1, January 2018
14. Xiaoling Xia, Cui Xu, Bing Nan," Inception-v3 for Flower Classification" 2017 2nd International Conference on Image, Vision and Computing, 978-1-5090-6238-6/17
15. Zixian Zeng1 ,Qingge Gong2 ,Jun Zhang1," CNN Model Design of Gesture Recognition Based on Tensorflow Framework"2019 IEEE 3rd information Technology,Networking,Electronic and Automation Control Conference (ITNEC 2019).

AUTHORS PROFILE

Pradumn kumar holds a B.Tech in Computer Science & Engineering from Greater Noida, India. He is currently pursuing M.Tech in Software Engineering at Babu Banarasi Das University of Lucknow in India. His research interests include machine learning with Tensorflow framework for image classifications. He has knowledge of various programming skills which requires for his area of interests. He is a member of Institution of Engineers (India).

Upasana Dugal received Master's degree from Karnataka, India. Currently she serves as Associate Professor at the Department of Computer Science at Babu Banarasi Das University of Lucknow, India. She has 14 years' experience of teaching. Her area of interest in research includes Machine Learning, Natural Processing language, Design and Analysis of Algorithms, Theory of Automata and Formal Languages and Computer Graphics. She has participated in many research projects for multiple journals and she holds Various certifications from IBM and Indian Institute of Technology(IITs).