CNN based Image Identification with Python

MoturiYamini Lakshmi[1], Murikipudi SwethaSupriya[2], Jonnala Nandini[3], Dr.M.S.S.Sai[4]

B.Tech Student, Department of CSE, KKR & KSR Institute of Technology and Sciences, Guntur, AP, India[1,2,3]

Professor, Department of CSE, KKR & KSR Institute of Technology and Sciences, Guntur, AP, India[4]

Abstract: In computer vision problems, identifying an image is one thorny task. This image recognition and feature extraction can be done by using the programming language python and few other machine learning algorithms and python libraries, which are discussed in this paper. This paper also consists of a case study related to bird species identification.

Keywords: Image processing, sub-sampling, pooling layer, convolutional layer, Decision tree, opencv, scikit learn.

INTRODUCTION

Image identification and detection is the elementary trouble in computer vision. The concept of CNN (Convolutional neural networks) solved the trouble in image identification and detection. This technique gave an outstanding attainment to solve the computer vision problem. The CNN is brought up by the visional system of natural creatures.Nowadays Convolutional neural networks were effectively applied in the fields of face identification [4], pedestrian identification [5] and object identification [6]. Mainly, Image identification involves various factors, which include: (a) Effective training implementation on modern powerful GPUs [7]. (b) Easy access to an abundance of data for training larger models.

I. LAYERS IN CNN ALGORITHM

Convolutional neural network consists of either single or multiple blocks of convolutional and sub sampling layers, which also includes fully connected layers and finally an output block.
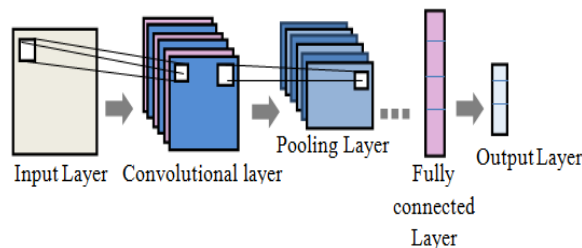

Fig.1 Block illustration of CNN

(a)   Convolutional Layer:
The convolution layer is the most important layer in CNN, as this layer convolves with the input and passes the result to the next layer. This is alike to the human vision identification. This layer only connects to specific (smaller) neurons in the upcoming layer. As a computer identifies an image using pixels, each pixel is given with a value. This layer has 3 mandatory attributes, say as; convolutional kernels, number of input channels and the depth of the filter.
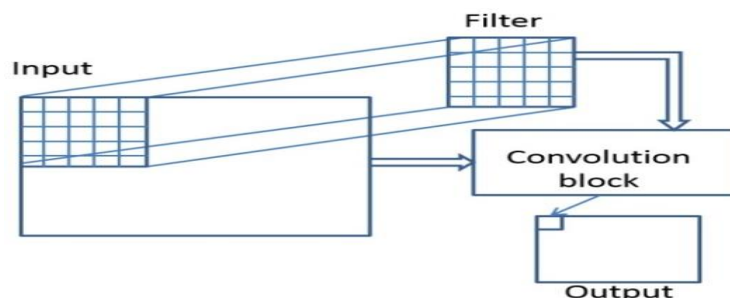

Fig.2 Convolutional Layer

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A smaller image is considered and the pattern is compared with all the pixels in the given input (Large image). Every single pixel is filtered by following certain steps: (i) Firstly, the filters are applied to each and every pixel of the images. (ii) each pixel is multiplied with the corresponding image (iii) all the pixels values have to be added. (iv) the value has to be divided by the feature pixel size. Hence, this layer outputs the lesser number of free parameters, allowing the network to be deeper with the free parameters.
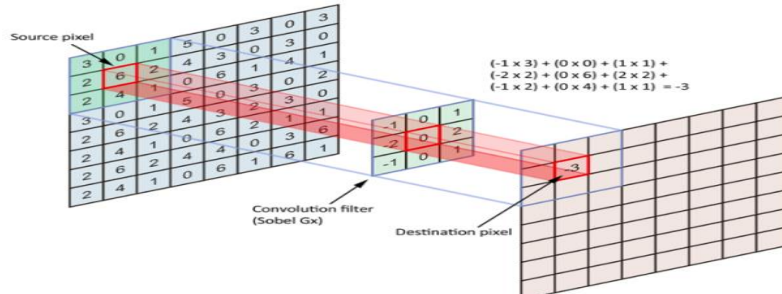

Fig.3 Mapping of CNN pixel value (central element of the convolutional layer is placed in the source pixel, the source pixel is then replaced with the weighted sum of itself and near pixels)

(b)   Pooling layer:

The input for this layer is taking from a small portion of the previous layer. The input is sampled into smaller proportions and produces a single output. Though there exist several non-linear functions such as max-pooling, mean pooling and average pooling for sub sampling, max pooling is widely used technique. This technique considers the maximum value of the pixel in the considerable window. This states the importance of ideal recognition of the related pattern, rather than the exact match. It continues pooling minimizes the spatial size representation and amount of computation in the memory.
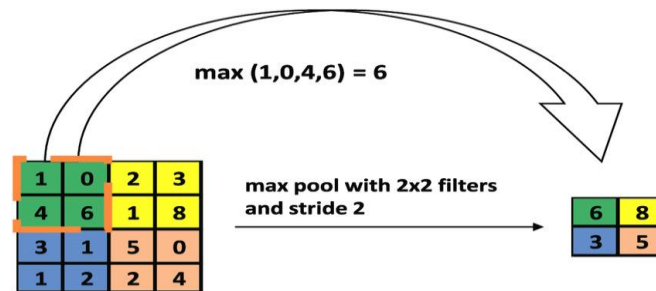

Fig.4 Max pooling process.

(c)   Fully connected layer:

Final part of the CNN is fully connected layer; this layer comes into existence after several layers of convolutional and pooling layers. The high-level reasoning is performed in this layer. As like in Artificial neural networks, neurons in this layer fully connected with the previous layers.
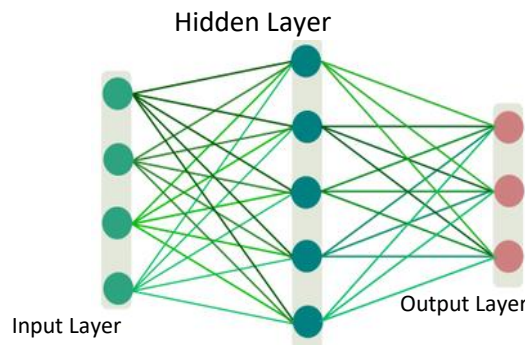

Fig. 5 Fully connected layer.

II. PYTHON LIBRARIES

Most important libraries used in the image processing are Opencv, scikit learn
(a)   Opencv
(b)   Scikit Learn

Opencv:

In programming language open cv is a library, it is useful to solve the major computer vision problems. This open cv contains greater than 2000 optimized algorithms, which perform face detection, pattern matching algorithms and image filtering. The image filtering can be either linear or nonlinear. The combination of input pixel and its nearest neighbours gives an value output pixel, which is said as an linear image filtering. If the value output is not from the linear combination then that is said as a nonlinear image filtering.

Feature detection:
Lines, edges, figures, shapes and angles in an image will be identified by the image detection process. Hence this feature extraction determines further decisions about the contents in the image. For feature detection, various specific modules are used from opencv:

IMGPROC: Image processing.It is a method to perform specific operations on an image. It gives the pixel value at the point of an image, the pixel value describes the brightness and color of the image.
HighGUI: High-level Graphical User Interface. It provides a pair of functions to load and save images. It allows multi-platform windows.
Shape: The shapes library contains different characteristics of the pos and shape attributes of the object. We can assign a path from the paths library to shape. It analyze the shape of image then perform shape detection operation.
Gapi: Graph API, It contains optimizing and porting image processing algorithms.
ML: It contains a set of training samples, Each training sample is a vector of values. All the vectors have the same number of features, Each feature can be ordered or categorised.
Core: It contains basic data structures, including the multi-dimensional array Mat and basic functions used by all other modules.

Scikit learn:
This library is released under "Modified BSD", and provides a well structured API for Python programing.In the current world, image analysis plays an important role to evaluate the generated data. For such accurate analysis software tools are required, where Scikit-Image is one of the python libraries that contains popular image processing algorithms.
This supports a standard NumPy and Matplotlib libraries for exploring each and every pixel data and maps it into an array and plotting of the arrays[9]. This package can be installed in various operating systems languages such as BSD, Linux, os x, Windows.To install the packages in python we use:
Pip installSKlearn
Pip installscikit-image

This sklearn package in python supports Logistic regression and KDTree algorithms, where these algorithms are used to predict the image match and classify the image. Various modules present in sklearn are as follows:
linear model module: implements generalized linear models.
Tree module: Includes decision tree modules for classification and regression of decision trees.
Feature extraction module: deals with the feature extraction of raw data.
To import the algorithms in python programing language we code as:

fromsklearn.linear_model import LogisticRegression
fromsklearn.neighbours import KDTree

III. SUPPORTIVE ALGORITHMS

To identify an image, we use different kinds of machine learning algorithms. We can use the algorithms such as support vector machines (SVM), Decision tree (KDTree algorithm)[11], Logistic regression.To identify an image, the fallowing steps has to be fallowed:
1.   An input image has to be uploaded.
2.   The uploaded image is separated into parts and analysed using the CV2 algorithms.
3.   Features are extracted from each individual part from the image.

4.   The data is analysed and multi classification is done using the KDTree algorithm.
5.   Based on the results obtained the similar matches are predicted using the logistic regression and the results are shown.

IV. CASE STUDY

Bird species identification is really an important task as many birds help to maintain the balanced ecosystem. To perform the classification related to bird species, consider the dataset Caltech-USD Birds 200[13], which contains 200 categories of birds with approximately 11800 images of birds. An unsupervised algorithm is used to develop this system as the input of the image is unknown and not labelled. To analyse the input image the CNN algorithm is used, where the channels considered in this project are Colour of the bird, size f the beak, shape of the beak, length of the tails, length of legs, wings, etc. Using python programming packages, the user interactions that are necessary are as follows:

1)   Uploading a bird image.
2)   Run CNN algorithm
3)   View Score graph

CNN algorithm couples with the trained data set along with feature extraction of the input image. CNN Based bird species identification project flow system is as follows:

▪   An input image of a bird has to be uploaded.
▪   The uploaded image is separated into parts and analysed using the CV2 algorithms, considering the features of bird such as beak, tail, legs, wings and colour.
▪   Features are extracted from each individual part from the image and stored.
▪   The data is analysed and multi classification is done using the KDTree algorithm.
▪   Based on the results obtained the similar matches are predicted using the logistic regression and the results are shown when clicked on view score button.
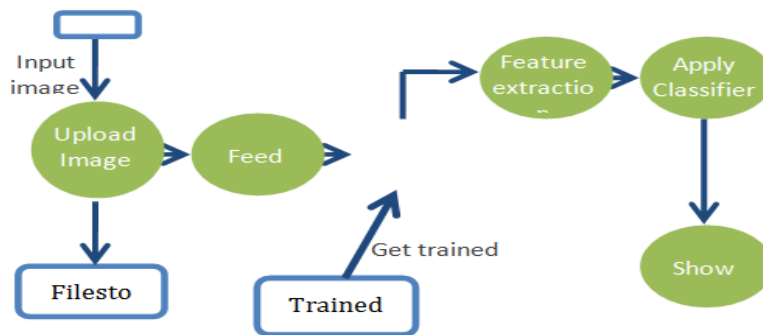

Fig6.Flow system of CNN based Bird Specie identification [12].

V. CONCLUSION

An image can be identified using Deep Learning techniques such as Convolutional neural networks and Unsupervised algorithms which include logistic regression and k-Decision Tree. This study also presents the classification of bird Spice using the dataset "Caltech-UCSD Birds 200", which contains 200 categories of bird species. The Feature extraction of the input bird image is done using   convolutional layers.

VI. FUTURE ENHANCEMENT

By using Cloud computing techniques and neural networks, the classification of images can be done with more ease, as the amount of storage of data reduces[12]. Using the latest technologies images of dogs and cats can also be identified. Android App can be created for the identification of the images of bird species.

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