Report

Title

Image processing with convolutional neural networks -a review

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Abstract

We review several paper of image processing with convolution neural network and demonstrate the processing step of image in CNN. The report is considering two categories. The one category we try to overview the image processing step, comparative analysis,comparametric equation of image processing. In second category we overview about some popular libraries in deep learning and a vast explanation of deep dreaming algorithm using PyTorch.

Keywords: Convolution Neural networks; Image processing; Comparametric equation, PyTorch, Deep dreaming.

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1. Introduction

Image processing is the process of extracting valuable features from an image for analysis. This processing refers to the application of transformation and recovery techniques to enhance the image quality. The analysis entails extracting characteristics and features from the photos in order to categorize, locate, or find patterns. Complex algorithms could not be executed on a home computer 25 years ago. These facts give us the opportunity to use those sophisticated algorithms on our personal computers [1]. Right now, CNN is one of the best algorithms for automatically processing photos. These algorithms are widely used by businesses to do tasks like object identification in images.

1.1 Objectives

There are two groupings of goals for this report. We try to find out in this report:

- How neural networks handling image processing techniques?
- comparametric equation of image processing [2]
- Implement Deep Dreaming Network [1]

2. Processing of image

The five distinct activities in the image processing pipeline of neural network is given in Figure 1

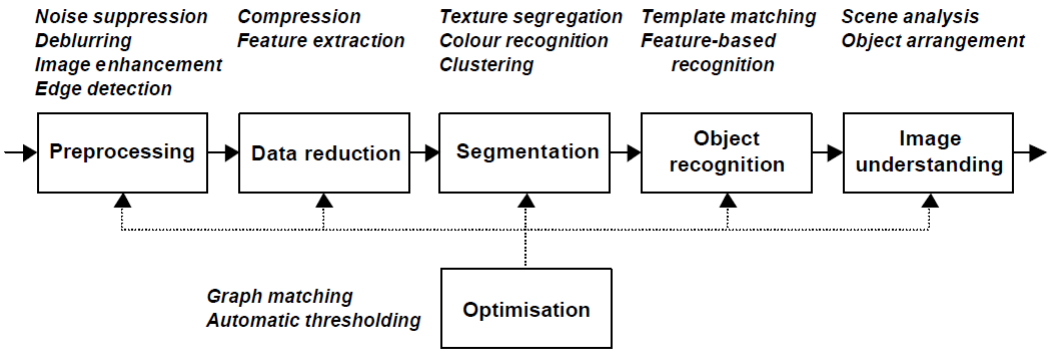

Figure 1: image processing chain in neural network
[3]

2.1 Comparative analysis of CNN

Now we can see how effective CNN for analysis and spread day by day from Table 1

Ref	Year	Technique Used	Results
[4]	2018	CNN	Results on several datasets demonstrated that the deep learning-based model performed better than competing methods.
	2018	R-CNN	The suggested R-CNN-based model could process 155 pixels per second of images.
	2016	Convolution Neural Network models for medical image	85% accuracy rate was obtained using medical imaging cases.
	2003	Face recognition	The findings revealed that male individuals may be simpler to identify than female individuals.

Table 1: Comparative Analysis

2.2 Comparametric equation of image processing

The idea of quantigraphic images of the same subject matter that were taken at various exposures in order to create a composite image with a broad dynamic range [2]. Wyckoff set functions [2]

$$f_i(x) = f(k_i q(x)) \tag{1}$$

k=scalar constant
f(x)=set of image
q=quantity of light
Now the equation of lightmeter

$$q(x,y) = \int_0^\infty q_{ss}(x,y,\lambda)s(\lambda)d\lambda \tag{2}$$

q_{ss}=spectral distribution of image
$q(x,y)$=a vector quantity
λ=continuous spectral information
So the equation will be computed

$$\widehat{q}_{ss}(x,y,\lambda) = \int\int B(x-u,y-v)q_{ss}(u,v,\lambda)dudv \tag{3}$$

Now from equation (2) and equation (3) we formulate

$$\begin{aligned} q(x,y) &= \int_0^\infty \widetilde{q_{ss}}(x,y,\lambda)s(\lambda)d\lambda \\ &= \int_0^\infty \int_0^\infty \int_0^\infty B(x-u,y-v)q_{ss}(u,v,\lambda)s(\lambda)dudvd\lambda \\ &= \int_0^\infty \int_0^\infty B(x-u,y-v)(\int_0^\infty q_{ss(}u,v,\lambda)s(\lambda))dudv \\ &= \int_0^\infty \int_0^\infty B(x-u,y-v)q(u,v)dudv \end{aligned} \tag{4}$$

Now, We considering several tools and platforms that facilitate the creation of deep learning:

2.3 TensorFlow

TensorFlow is a well known libraries for higher level computations. Despite being one of the newest frameworks, Google Brain team support has helped it gain a strong reputation. Its advantages include having a sizable and dynamic population, both down and upper level network training apis, quicker models construction, and smoother multi-GPU functionality. The disadvantege is the slower learning rate [1].

2.4 Kers

The most advanced and user-friendly library is Keras. It gives developers the option of using TensorFlow. The TensorFlow group has declared plans to integrate Keras like a subset of the TensorFlow project in the near future. The ecosystem of Keras is huge and engaging [1].

2.5 PyTorch

Torch, a Lua library, has been ported to Python as Pytorch. With its built-in Deep Neural Networks and powerful GPU acceleration, Pytorch offers tensor computation. The Facebook Artificial Intelligence Research Team supports it [1].

3. Algorithm

Convolution is a type of mathematical operation that is carried out between matrices that each represent an image and a kernel in image processing. Each component of the image is added to its nearby neighbors after being weighted by the kernel for this convolution procedure [5]. We see the mathematical equation from equation (4). The algorithm pseudo code:

Algorithm 1: CNN for image recognition

```
[5] Input: x,y,z,u,v,h,i,j
Result: result
for each image row in input: do
    for each pixel in row do
        set accumulator to 0
    end
    for kernel row in kernel: do
        for element in kernel: do
            if elementposition == pixelposition then
                result = (elementvalue * pixelvalue) + accumulators
            end
        end
    end
end
```

3.1 Deep dreaming algorithm explanation

An algorithm called Deep Dream can produce visuals with hallucinogenic overtones. Additionally, it demonstrates the properties that specific CNN layers have learned [6]. Information in the layers generally reacts to [1]:

Initial layers	Middle layers	Deep layers
Conscious of fundamental features like borders or orientations	Capable of understanding common components and shapes, such as leaves or doors	These are responsive to extremely complex groups, like trees

Table 2: Deep dreaming layer information

Figure 2: Deep dream output by Google
[1]

The technique is carried out in a recurring rescaling approach employing octaves and octaves factors in order to enhance the outcomes and provide a more pleasing resultant image. Every octave is a depth level that has been scaled down to a scale factor, which when combined with the previous image creates a hallucinogenic fractal effect [1].

3.2 Model

The GoogLe Net model for deep dreaming in the original study was developed using the ImageNet dataset. Utilizing PyTorch Model Zoo's training dataset, this technique will be carried out on a VGG 19. This model can successfully recognize patterns and objects thanks to training for picture classification. This layer is sufficiently deep to allow for broad feature recognitions, which are crucial for producing effective high-level patterns in the original image [1].

4. Results

Three random photos were chosen and put through the network to analyze the outcomes [1].

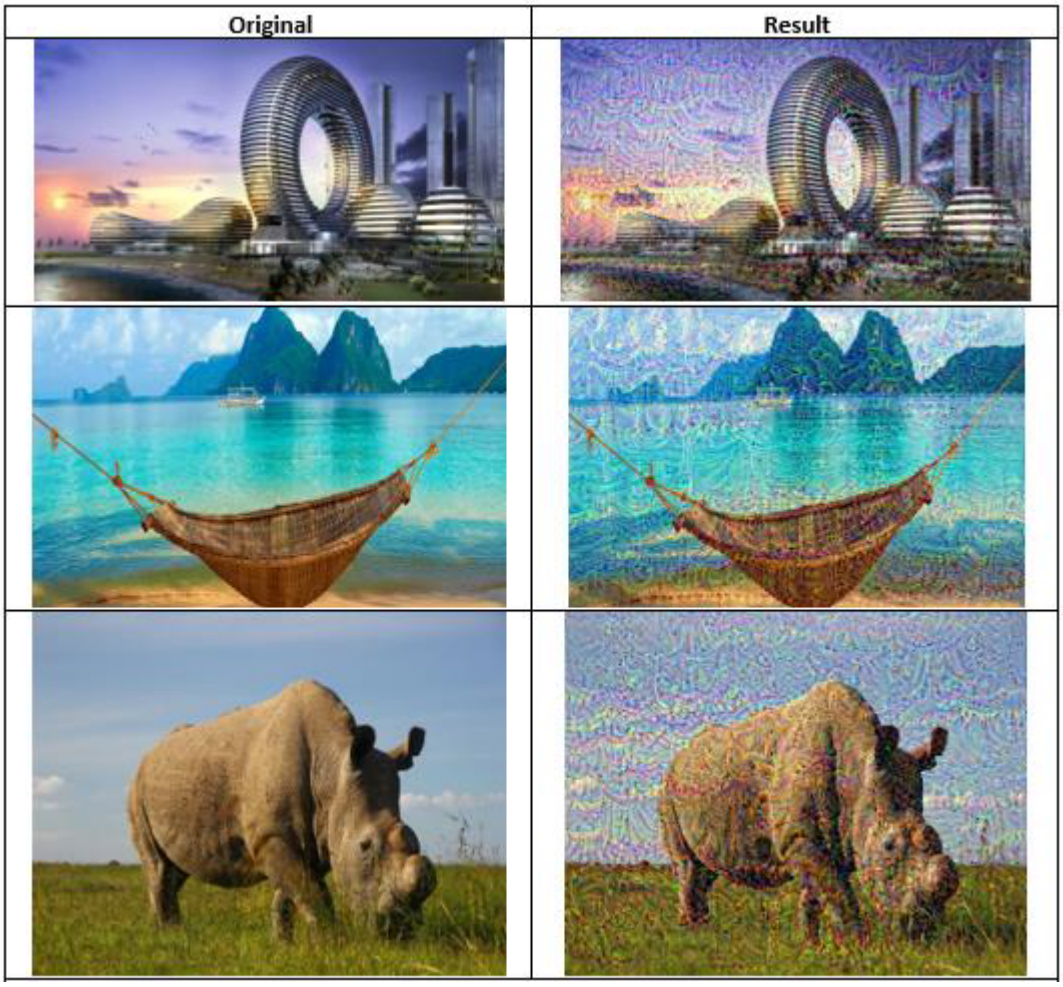

Figure 3: Deep dream output for three images
[1]

Every layer of a neural network interprets the input in a different manner. So, the initial and final layer scenario given below:

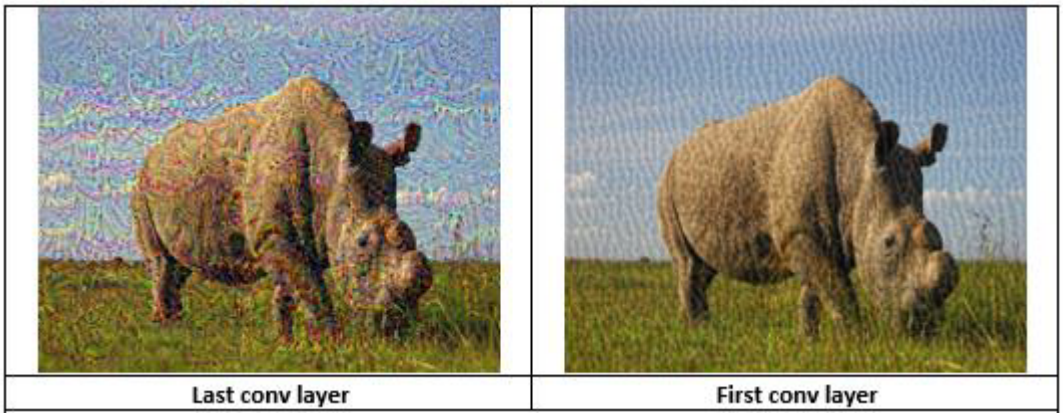

Figure 4: Initial and final layer
[1]

Every layer's ability to recognize information depends on the depth of that layer. The final convolutional layer may recognize complicated objects on its picture, whereas the first convolutional layer appears to be sensitive to edge detection.

5. Conclusion

The fundamental deep learning knowledge set has been a problem for the project. Get familiar with the PyTorch framework. This problem has gradually been resolved. In terms of utilizing PyTorch and comprehending the articles, it has been simpler to obtain pertinent material [1].

6. References

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