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Additive Noise Removal and Human-like Face Detection

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Abstract: ***Image noise is the random variation of brightness or color information in images. Noise is the result of errors in the image acquisition, transmission and processing. Noise corrupted image do not reflect the true intensities of the real scene. Noise maybe additive and can be removed by using a fuzzy based filter. Ultimate aim of image restoration is to improve an image to a pre-defined sense. Face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detectors perform well when an image is in a perfect condition and that without any random noise. The goal of this research is to find out the impact of providing more training data to a convolutional neural network (CNN) based face detector. The face detector is constructed by the deep learning framework Caffe, and the AlexNet is the model used. The performance gain is increased when more training data is presented.***

Keywords: Fuzzy based filter, Deep learning, Convolutional Neural Network, Gaussian membership function, bounding boxes

1. Introduction

Image noise is an undesirable by-product of image capture that adds spurious and extraneous information. Noise degrades the image quality and hence it is no longer the required image. Usually noise is described by its probabilistic characteristics. Gaussian noise is a very good approximation of noise. Noise may be additive, where noise 'v', and image signal 'g' are independent.

$$f(x,y)=v(x,y)+g(x,y)$$

where f(x,y) is the noisy image signal, g(x,y) is the original image signal and v(x,y) is the noise signal. The goal of restoration is to recover an image 'h' that resembles 'g' as closely as possible by reducing 'v'.

A two-step fuzzy based filter is employed for restoring the corrupted image. In the first step, the difference between the central pixel and its neighborhood in a selected window is computed. A fuzzy membership degree for each difference value is also computed using a Gaussian membership function. These values are used as weights for each pixel and then compute the weighted average which represents the modified value for the current central pixel. The second step is used as an augmented step to the first one and its goal is to improve the result obtained in the first step by reducing the noise in the color component differences without destroying the fine details of the image. In order to make it faster, each color component are treated independently and the filtering process is applied separately. This method gives better results compared to existing advanced filters for additive noise reduction.

Deep learning is a concept that is impacting our daily lives more often. Google search algorithm is an example of deep learning. Google finds patterns in data that are acquired and try to come up with relevant search results. The learning algorithms that are used in deep learning are based on how a human learns things. Here we use deep learning algorithm for face detection. Face detection is used in convenient HMI applications as well as surveillance software. The surveillance software scans the image and tracks through facial recognition software to recognize a face. Face detection is a challenge when it is affected of noise, and when the image is not focused properly. Hence demand for a good face detector is high. Here, we remove the noise in the input image and then face detection is performed with a convolutional neural network (CNN).

2. Two Step Fuzzy Based Filter

In the case of images corrupted with additive noise, noise is spread over all the pixel values in the window. So we cannot eliminate any pixel values during the restoration process. We consider each pixel value, which may give its own contribution during the restoration process. Each pixel value in the window will be assigned a non-zero weight, which can be eventually be used to compute the weighted average. These non-zero weights are assigned based on the non-zero fuzzy membership value computed for each difference value in the window. Forcomputing the membership values, fuzzy membership function known as Gaussian membership function is used. Computed fuzzy membership values are used as weights for each pixel and then computes the weighted average representing the modified value for the current central pixel. The second step is used as an augmented step to the first one and it improve the result obtained in the first step.

Figure 1: Image of photographer corrupted with additive noise and output at each step of image restoration.

3. Convolutional Neural Network

A convolutional neural network is a deep learning algorithm used for object recognition. The concept of CNN is to train the network as human learn things. A CNN is trained by a huge dataset. Each layer of the CNN have specific algorithm for extracting features from the image. All the layers are connected to each other and hence all the features extracted can be combined at the end. Also the CNN will be trained with non-human faces in order to differentiate with the human face. CNN performs calculations in iterations to calculate the features.

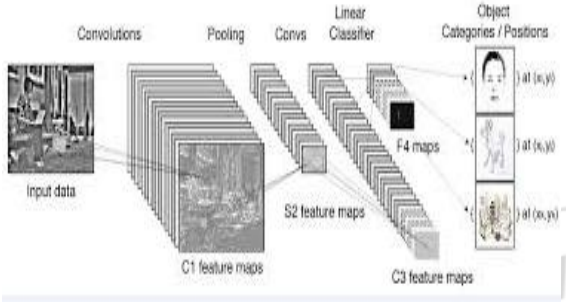

Figure 2: Example of a CNN

4. Face Detection

There are a number of face detection algorithms which can be mainly classified in to three categories.

a) Cascade- Based
The fundamental element of this type of face detectors are haar-features that define how pixels are aligned. An array of haar-features gives an idea of how a feature looks like in an image.

b) DPM-based
DPM stands for deformable parts model. This model is based on parts that construct a face based on their geometric position relative to each other.

c) Neural Network-based
These face detectors works based on self-learned features. So, a neural network-based face detector can learn new patterns and is more reliable in difficult conditions.

5. Research Method

A two-step fuzzy based filter is used to remove additive noise from the input images. Face detection algorithm is performed on noise free images. The CNN model used for face detection is AlexNet. The main reason for selecting AlexNet is that it is a proven method on face detection. The framework used to implement AlexNet is Caffee. The LFW provides the positive examples while ImageNet provides the negative examples for the model.

6. Detector

In order to detect faces in images, bounding boxes are created. The algorithm for creating bounding boxes is selective search. Irrespective of the image size, this algorithm produces 2000 boxes for the image. The boxes vary in size and position in the image and hence even small faces can be detected.

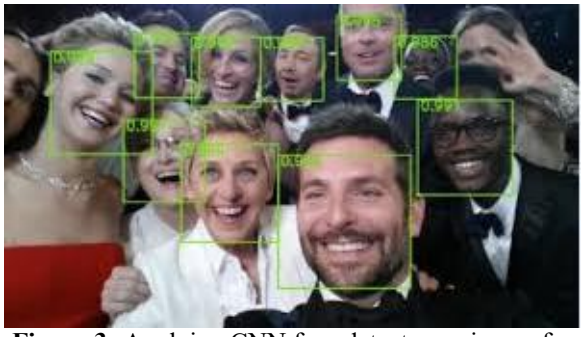

Figure 3: Applying CNN face detector on image for multiple face detection

7. Conclusion

In this paper noise corrupted image is taken and using a two-step fuzzy based filter additive noise is removed. Noise free image is then taken for face detection. The CNN based face detector is used to check whether its performance improves with a large set of training data or not. A clear performance gain can observed. However, it does not outperform the human eye.

References

[1] Additive Noise Removal Using Novel Fuzzy Based Filter, Madhu S Nair, G Raju, IEEE 2011.
[2] ImageNet: A large-scale hierarchical image database, Jia Deng, R. Socher, L.-J.Ki, and L. Fei-Fei, IEEE 2009.
[3] Deep Networks for Early Stage Skin Disease and Skin Cancer Classification, A. Esteva, B. Kuprel, and S. Thrun, 2015.
[4] Neocognitron: A Self-organizing Neural Network Model for a Mechanism of Pattern Recognition Unaffected by Shift in Position, K. Fukushima, Biological Cybernetics, 1980.
[5] Multi-view Face Detection Using Deep Convolutional Neural Networks, S.S. Farfade, M. Saberian, Li-Jia Li, 2015