Chapter 55
A Survey on Supervised Convolutional Neural Network and Its Major Applications

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ABSTRACT

With the advances in the computer science field, various new data science techniques have been emerged. Convolutional Neural Network (CNN) is one of the Deep Learning techniques which have captured lots of attention as far as real world applications are considered. It is nothing but the multilayer architecture with hidden computational power which detects features itself. It doesn't require any handcrafted features. The remarkable increase in the computational power of Convolutional Neural Network is due to the use of Graphics processor units, parallel computing, also the availability of large amount of data in various variety forms. This paper gives the broad view of various supervised Convolutional Neural Network applications with its salient features in the fields, mainly Computer vision for Pattern and Object Detection, Natural Language Processing, Speech Recognition, Medical image analysis.

1. INTRODUCTION

With the advent of deep learning, the world has proceeded into the new era of machine learning. With the main intention of getting closer to the original goal of machine learning, that is, Artificial Intelligence, deep learning has opened up new avenues to explore. Artificial Neural Networks (ANNs) are biologically motivated machine learning algorithms applied to solve problems, where conventional approach fails, such as computer vision. It takes in the input, let it be an image or an audio signal, extracts features which describe the input and generalizes these features so that the results obtained can be replicated for other examples of the input. This paper gives an overview of a particular type of ANN, known as supervised

Convolutional Neural Network (CNN) and gives information of its development and results in various fields. Initially, we see the history of CNN followed by its architecture and results of its applications. The references of the few used papers have been mentioned here.

2. HISTORY OF CNN

The idea of modeling brain networks has been a research question even before the advent of computers. In initial stages, neural networks were evaluated with propositional logic. Then with the discovery of concepts such as convolution and back propagation applied to neural networks, NN got better. Until the emergence of GPUs, the computers were not fast enough to implement multi-layer neural networks. So NN were not commercially viable. With the power of GPUs and more efficient algorithms, CNNs can be applied to real life applications (see Table 1).

3. OVERVIEW OF CNN

Convolutional Neural Network is a supervised machine learning algorithm where a group of neurons are responsible for recognizing a specific feature and classifying them into categories. These algorithms perform convolution on the input to reduce the size of the input features without adversely affecting the output. This feature could be an edge in an image, or speech subsample. Certain convolution kernels are used so as to highlight the essence of the input especially in case of images, where a lot of unnecessary pixels are present which do not represent any feature. CNN consists of multi-layered neurons, which extract more high level features with consecutive increase in layer. A typical CNN architecture is as shown in Figure 1 (LeCun, Kavukcuoglu, & Farabet, 2010).

Table 1. Time line chart of CNN

Period	Progress	Year	Activity
1940 - 1979	Emergence of NN	1943	McCulloch, Pitts compare neural activity with propositional logic.
		1949	Hebb proposes cell assembly theory.
		1962	Hubel and Wiesel model the visual system in Cat brain.
1980 - 1998	Concept of Convolution	1980	Fukushima proposed a self-learning NN which preserves the intrinsic geometric representation.
		1989	LeCun et al demonstrated the use of back propagated CNN for real life Application.
1999-2010	More Efficient CNN	1999	Poggio et al proposed max pooling.
		2006	Ranzato et al proposed max pooling for CNN.
2011-Present	GPGPU acceleration of CNN	2011	Ciresan et al put forth the concept of CNN on GPUs.
		2012	Hinton et al demonstrated Drop Out for CNN.
		2013	Lecun et al proposed Drop Connect for better CNN.
		2014	Min Lin et al designed Network in Network concept for CNN.
		2015	Google releases different open source libraries for CNN

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