

Chapter 7

Deep Learning Applications in Medical Imaging: Introduction to Deep Learning– Based Intelligent Systems for Medical Applications

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ABSTRACT

Deep learning (DL) and artificial intelligence (AI) are emerging tools in the healthcare sector for medical diagnostics. This chapter elaborates on general reasons for the popularity of computational techniques such as deep learning and machine learning (ML) applications in the medical image processing domain. The initial part of this chapter focuses on reviewing the fundamental concepts of DL algorithms, competence with machine learning, need in healthcare, applications, and challenges in medical image processing. Doing so allows understanding the reasons for the construction of all of them and offers a different view on various domains in the medical sector. The tools and technology required for DL, selection, implementation, optimization, and testing are discussed with respect to an application of cancer detection. Thus, this chapter gives an overall vision of deep learning concepts related to biomedical research.

DOI: 10.4018/978-1-7998-5071-7.ch007

INTRODUCTION

Deep learning (DL) and artificial intelligence (AI) is becoming an emerging tool in the healthcare sector for medical diagnostics. This chapter elaborates on general reasons for the popularity of computational techniques such as deep learning, Machine learning (ML) applications in the medical image processing domain. The emergence of exploratory and confirmatory DL based decision making is the need for the most developed and developing countries. This fertile field of research is now the area of interest for multidisciplinary people such as computer science, biomedical, biochemistry, bioinformatics etc... However, the practical applications of DL in clinical diagnosis techniques are relatively small, with many challenges added to it. The initial part of this chapter focuses on reviewing the fundamental concepts of the neural network's algorithms. The ML versus DL algorithm is elaborated in brief. The major players in healthcare industries with AI support are also been discussed. The performance and assessment of different architectures for deep neural networks are discussed using the open-source software. Doing so allows us to understand the reasons for the construction of intelligent architectures like multilayer, feedforward, recurrent algorithms. All of them serve a different purpose and offer a different view on various domains in the medical sector. The tools and technology required for DL, selection, Implementation, optimization, testing are discussed with respect to an application of cancer detection. Thus this chapter gives overall vision of deep learning concepts related to biomedical research.

In today's vision, observably medical image processing is one of the thirteenth areas which have been largely intervening domain progressing back again with DL. The impact of the DL algorithms and models in healthcare domain has narrowed down its way for data mining, analysis and has also attracted attention in the area of medical image analysis. At present, DL is been employed to involve the classification problems in medical image segmentation, recognition, and brain function studies. The images mainly include ultrasound, X-rays, computed tomography (CT), nuclear magnetic resonance (MRI), digital blood vessel silhouette (DSA), and positron emission tomography (PET). In the field of medical image analysis, the main research directions are image segmentation, image registration, and information fusion, time-series image analysis, and content-based image retrieval. Hence, it is important to select methods of significance and describe them in high detail which is served in this chapter.

Added on, how to effectively perform medical image analysis is a major problem in the field of disease diagnosis, and further diagnostic methods in pieces of literature are also discussed in this chapter. At this stage, DL could be viewed as a black box requiring knowledge of its internal workings, and hence presents some crucial technical challenges that need further methodological development

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