Chapter 8
Future Directions and Innovations in AI and Imaging

Induni Nayodhara Weerarathna
https://orcid.org/0009-0007-6996-8270
Datta Meghe Institute of Higher Education and Research, India

Matteo Hirushan Jayakody Arachchige
University of Birmingham, UK

Austin Jojo Jallah
https://orcid.org/0009-0004-0941-0281
Datta Meghe Institute of Higher Education and Research, India

Mohammad Affan Kareem
https://orcid.org/0009-0008-0303-8262
Datta Meghe Institute of Higher Education and Research, India

Kidus Manaye Mulugeta
https://orcid.org/0009-0006-4872-0076
Datta Meghe Institute of Higher Education and Research, India

ABSTRACT

Radiology has been significantly impacted by artificial intelligence (AI), which has increased imaging capabilities, workflow efficiency, and diagnostic accuracy. With an emphasis on technologies like explainable AI, generative adversarial networks, and deep learning, this book chapter examines developments in AI applications in Imaging. These tools have changed medical Imaging by making automatic segmentation, picture reconstruction, and multimodal data integration possible. AI has also

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improved theranostic techniques, predictive analytics, and point-of-care diagnostics. Even though these developments mark a new age in radiography, issues including data privacy, moral dilemmas, and integration barriers still exist. This chapter highlights the revolutionary potential of AI-powered Imaging in both clinical and non-clinical applications while speculating about its future paths.

1. INTRODUCTION

Contextually, the continuous evolution of artificial intelligence methods to enhance and extend imaging technology is key to this field, explicitly employing AI-powered technologies to automate or improve medical imaging processes and developing more sophisticated computer vision models to analyze and interpret image and video data correctly. Since rule-based expert systems were developed in the 1980s to mimic human diagnostic reasoning, artificial intelligence has advanced dramatically in Medical Imaging. The advent of machine learning methods, particularly supervised learning, in the early 2000s made it possible to extract features from radiography data automatically. Convolutional neural networks (CNNs) have been used in radiology to diagnose breast cancer from mammograms and classify chest X-rays using ImageNet-trained models, marking a significant advancement in the field. The first autonomous AI system utilized for clinical diagnostics was IDx-DR, which was approved by the Food and Drug Administration (FDA) in 2018 (Hosny et al., 2018a).

Neural networks have long been studied for their ability to classify and interpret medical imaging data. Early systems in the 1990s used backpropagation algorithms for tumor classification. The availability of large annotated datasets, such as ImageNet, NIH ChestX-ray14, and MIMIC-CXR, catalyzed the development of more robust AI models. Landmark studies have shown that AI systems can match or even outperform radiologists in specific diagnostic tasks, increasing interest in clinical adoption (*Segmentation and Classification on Chest Radiography: A Systematic Survey | The Visual Computer*, n.d.).Through intelligent image processing, emerging breakthroughs may use deep learning, generative adversarial networks, and other AI techniques to create synthetic medical pictures, enhance image quality and resolution, and provide more precise illness identification and diagnosis (Khalifa & Albadawy, 2024a). Medical technology advancement has enhanced disease diagnosis, prevention, monitoring, treatment, and care. Imaging technologies such as computer tomography (CT), medical imaging resonance (MRI), ultrasonography (USG), positron emission tomography (PET), and others, along with digital pathology, make it easy for medical practitioners to assess and treat any disorder (Akhter et al., 2023).

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