Chapter 14
SCRNN:
A Deep Model for Colorectal Cancer Classification From Histological Images – Implementation Using TensorFlow

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ABSTRACT

Colorectal cancer holds a prominent place on the global health landscape. Its early detection is crucial for successful patient outcomes. Histological analysis of tissue samples plays an indispensable role in diagnosing and classifying colorectal cancer. Accurate classification is paramount, as it influences the choice of treatment and patient prognosis. This chapter investigates the statistics surrounding colorectal cancer, its vital role in the healthcare sector, and the transformative potential of artificial intelligence in automating its diagnosis. This chapter proposes a ShuffleNetV2-CRNN (SCRNN), a novel deep learning architecture designed for colorectal cancer classification from histological images. SCRNN combines the efficiency of ShuffleNetV2 for feature extraction with the context-awareness of a convolutional-recurrent neural network for precise classification. SCRNN is evaluated against chosen deep models – Simple CNN, vGG16, ResNet-18, and MobileNet. Experimental results demonstrate appreciable performance of SCRNN across a diverse range of tissue types.

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INTRODUCTION

Colorectal cancer is a significant global health concern, characterized by the uncontrolled growth of abnormal cells in the colon or rectum (Mármol et al. 2017). This chapter probes into the statistics surrounding colorectal cancer, its vital role in the healthcare sector. Also, the transformative potential of artificial intelligence in automating its diagnosis is highlighted.

Colorectal cancer ranks as the most common forms of cancer worldwide, and its impact on healthcare cannot be overstated (Patil et al. 2017). It accounts for a substantial portion of global cancer cases (Raj et al. 2023). According to statistics, it is the third most common cancer in the world, with over 1.9 million diagnosed cases and nearly 1 million deaths in 2020 (Siegel et al. 2020). In 2023, it is estimated that there will be 153,020 cases in USA and approximately 35% death cases will be there (Siegel et al. 2023). This high incidence places colorectal cancer at the forefront of healthcare concerns, emphasizing the need for effective diagnosis and treatment strategies.

Early detection of colorectal cancer is critical for successful treatment. Timely diagnosis increases the chances of survival and reduces the burden on healthcare systems (Castelo et al. 2022). Furthermore, colorectal cancer profoundly impacts the lifestyle and quality of life of patients (Bouter et al. 2022). Also, their families get affected as well. This underscores the importance of accurate and efficient diagnostic tools.

Covid-19 pandemic significantly disrupted healthcare services worldwide. Elective surgeries and diagnostic procedures, including cancer screenings and treatments, were either canceled or postponed. This contributed to the adverse effects of the covid-19 pandemic on potential cancer care. The global healthcare system has to continue to be flexible and responsive as people struggle with the pandemic's aftereffects (Kajiwara Saito et al. 2022). To ensure that cancer patients receive the care they need. Understanding these dynamics is vital to develop strategies that minimize the impact of future healthcare disruptions.

The emergence of artificial intelligence has opened new avenues for improving colorectal cancer diagnosis (Yu et al. 2022). These technologies enable the development of automated systems. Such systems can analyze histological images with precision, speed, and consistency, thereby enhancing the diagnostic process .

Colorectal cancer detection and classification represent a pivotal application of machine learning and deep learning for healthcare (Waljee et al. 2022). These techniques provide the means to extract intricate patterns and features from histological images. Thus, allowing for accurate differentiation between healthy and cancerous tissues. The context and significance lie in the potential to reduce human error, improve diagnostic accuracy, and expedite the decision-making process in clinical settings.

The proposed ShuffleNetV2-CRNN (SCRNN) model represents a novel approach to the classification of colorectal cancer from histological images. Its core strength lies in its efficient feature extraction capabilities, enabled by ShuffleNetV2 (Ma et al. 2018). Also, by its ability to analyze and interpret these features using the Convolutional-Recurrent Neural Network (CRNN) (Shi et al. 2016). By implementing SCRNN with TensorFlow, it leverages a versatile and robust deep learning framework, ensuring scalability and practicality in real-world healthcare applications. The experimental results showcase SCRNN's ability to accurately classify colorectal tissue types.

This chapter aligns with the book's theme by showcasing the practical application of deep learning within the healthcare domain. The proposed SCRNN architecture represents a novel approach that illustrates how deep learning techniques can be harnessed to address challenges in medical field.