Chapter 1
Deep Learning in Retinal Diseases Diagnosis: A Review

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ABSTRACT

Retinal diseases are among the leading causes of blindness and severe vision loss at the global level. Early diagnosis of retinal disease is of great importance in order to prevent irreversible damage to the eye. In recent years, deep learning methods have been widely used to diagnose retinal diseases. These models are developed for diagnosing a particular retinal disease. Most of these models detect and analyze disease features from the retinal image. Thanks to systems that can predict the detection of retinal diseases with high accuracy, it has allowed ophthalmologists to reduce their workload and reach more patients. This extensive literature review presents a comparative study of deep learning methods used to detect retinal diseases. For this purpose, the studies conducted on the subject between the years 2015-2022 will be examined. The related studies will be analyzed according to (1) rates of studies according to publishing years, (2) the data sets used, (3) the deep learning methods used, and (4) diagnosed retinal diseases.

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INTRODUCTION

The eyes are one of the five sense organs that are very important in human life. The eye is an organ that allows us to see by distinguishing between dark and light (Juniati & Suwanda, 2022). Retina, iris, cornea, sclera, choroid, optics nerve, optics disc, anterior and posterior chambers, lens, vitreous chamber, fovea, pupil, macula, ciliary body, and aqueous humor are the various segments of a human eye (Sharmila & Shanthi, 2021). The retina is the most sensitive to light and the most complex part of the eye (Juniati & Suwanda, 2022). The retina detects light and images and sends impulses to the brain associated vith the visual data (Shekar et al., 2021). Damages or diseases of the retina are among the main causes of blindness and severe vision loss. It is of great importance to diagnose disease early to prevent this irreversible damage to the eye (Pennington & DeAngelis, 2016).

The most common retinal diseases are diabetic retinopathy (DR), diabetic macular edema (DME), and age-related macular degeneration (AMD). Among these diseases, DR is considered an epidemic. There are approximately 285 million people with diabetes worldwide, and a third of these patients have DR symptoms. One third of these patients with DR symptoms are at risk of losing their sight (Lee et al., 2015). According to today's data, there are 170 million people affected by AMD disease worldwide and it is predicted that there will be 288 million by 2040. On the other hand, the number of DR patients is estimated to triple by 2050 (Schmidt-Erfurth et al., 2018). DME currently affects approximately 26.7 million people worldwide, which is expected to increase to about 50 million by 2025 (Zhang et al., 2014; Sivaprasad & Oyetunde, 2016).

Analyzing medical images by deep learning methods has gained significant importance in the literature (Lin et al., 2018). With the introduction of the Convolutional Neural Networks (CNN) deep learning model into the literature, significant advances have been made in image classification and object detection (Krizhevsky et al., 2017). This model creates an abstract representation of the images in each layer by systematically combining multiple filters throughout the image and presenting it as input to the next layer. In this method, pixel images are taken as input and desired classes are obtained as output (Kermany et al., 2018).

Deep learning approach has been widely used in to diagnose retinal diseases in recent years. Deep learning models are generated to detect and analyze disease features from the retinal image. Systems that can predict retinal diseases with high accuracy have allowed ophthalmologists to reduce their workload and reach more patients.

This chapter conducts an extensive literature review about the deep learning algorithms used to detect retinal diseases. For this purpose, studies on the subject in recent years have been examined. The related studies were analyzed according to (i)

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