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REVIEW ARTICLE

A Review on Machine Learning and Deep Learning Based Systems for the Diagnosis of Brain Cancer

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Abstract
Brain cancer is a disease of the brain caused by a brain tumor. A brain tumor is the development of cells in the brain that grow in an unregulated and unnatural manner. Patients may suffer irreversible brain damage or even death if these tumors are not detected and treated properly. As with all types of treatment, Positional information and tumor size are critical for conventional systems. Thus, establishing a meticulous and automated approach to providing information to medical practitioners is required. With machine learning, deep learning, and several imaging modalities, physicians may now more reliably detect tumor types in a shorter period. The paper aims to provide an overview of newly developed systems that use machine learning and deep learning approaches to analyze various medical imaging modalities in the case of diagnosing brain tumors. Datasets used by the authors, dataset partitioning strategies, and different performance evaluation matrices are also described in this paper. To better understand the policy of categorization, we propose a taxonomy here where we have categorized deep learning and machine learning based systems with respect to single classifier, multiple classifiers, single dataset and multiple dataset. Finally, we focus on the challenges of deep learning algorithms for brain tumor classification and possible future trends in this field.

Keywords Brain cancer · Machine learning · Deep learning · Convolutional neural network

Introduction

In the human body, the brain functions as one of the most vital organs, assisting with decision making and controlling all actions. It works as the managing center of the nervous system. It should be protected from any kind of illness. The number of people affected by brain cancer worldwide is increasing day by day [1]. There are approximately 25,050 adults diagnosed with primary malignant brain tumors in the United States this year (14,170 men and 10,880 women) [1]. The American Cancer Society forecasts that in 2022, there will be more than 18,280 deaths from brain and spinal cord tumors in the U.S. [2]. This includes both children and adults. The identification of the tumor types plays a vital role in the case of the treatment of brain cancer. Medical imaging and computer-aided diagnosis (CAD) are currently benefiting from the developments in the field of deep learning and machine learning technologies [3, 4]. These technologies have made it easy for neuro-ecologists to detect and classify tumor types effectively and accurately within a very short time [5, 6].

In a clinical setting, medical imaging modalities help in the diagnosis of the patient as well as the application of treatment [7]. With the advancement of technology in medical sciences, imaging techniques are being used increasingly in medical radiation [8]. MRIs are non-invasive imaging technologies that produce detailed three-dimensional anatomical images that are often used for disease detection, diagnosis, and treatment monitoring [9]. The idea behind MRI is to detect changes in the direction of rotation of protons that make up the water that makes up living tissues through sophisticated technology [10]. In particular, MRI scanners are particularly effective at imaging soft tissue and non-bony parts of the body. MRI uses no

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