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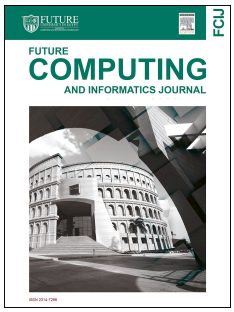


Classification using Deep Learning Neural Networks for Brain Tumors

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ACCEPTED MANUSCRIPT

# Classification using Deep Learning Neural Networks for Brain Tumors

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**Abstract**—Deep Learning is a new machine learning field that gained a lot of interest over the past few years. It was widely applied to several applications and proven to be a powerful machine learning tool for many of the complex problems. In this paper we used Deep Neural Network classifier which is one of the DL architectures for classifying a dataset of 66 brain MRIs into 4 classes e.g. normal, glioblastoma, sarcoma and metastatic bronchogenic carcinoma tumors. The classifier was combined with the discrete wavelet transform (DWT) the powerful feature extraction tool and principal components analysis (PCA) and the evaluation of the performance was quite good over all the performance measures.

**Keywords**— machine learning, deep learning, deep neural network, discrete wavelet transform, Principle component analysis, fuzzy c-means, magnetic resonance images

## 1. Introduction

Brain is one of the most complex organs in the human body that works with billions of cells. A brain tumor raise when there is uncontrolled division of cells forming an abnormal group of cells around or inside the brain. That group of cells can affect the normal functionality of the brain activity and destroy the healthy cells [1, 2]. Brain tumors classified to benign or low-grade (grade I and II) and malignant tumors or high-grade (grade III and IV). Benign tumors are non-progressive (non-cancerous) so considered to be less aggressive, they originated in the brain and grows slowly; also it cannot spread to anywhere else in the body. However, malignant tumors are cancerous and grow rapidly with undefined boundaries. They can be originated in the brain itself which called primary malignant tumor or to be originated elsewhere in the body and spread to the brain which called secondary malignant tumor [3, 4, 5].

Brain magnetic resonance imaging (MRI) is one of the best imaging techniques that researchers relied on for detecting the brain tumors and modeling of the tumor progression in both the detection and the treatment phases. MRI images have a big impact in the automatic medical image analysis field for its ability to provide a lot of information about the brain structure and abnormalities within the brain tissues due to the high resolution of the images [3, 6, 7, 8]. In fact, Researchers presented different automated approaches for brain tumors detection and type classification using brain MRI images since it became possible to scan and load medical images to the computer. However, Support Vector Machine (SVM) and Neural Networks (NN) are the widely used approaches for their good performance over the last few decades [9]. But recently, deep learning (DL) models set an exciting trend in machine learning as the deep architecture can efficiently represent complex relationships without requiring a huge number of nodes like in the shallow architectures e.g. SVM and K-nearest neighbor (KNN). For that reason, they grew rapidly to become the state of the art in different health informatics areas such as bioinformatics, medical informatics and medical image analysis [7, 9, 10].

The contribution of this paper is applying the deep learning concept to perform an automated brain tumors classification using brain MRI images and measure its performance. The proposed

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