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# Enhanced MR Image Classification Using Hybrid Statistical and Wavelets Features

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**ABSTRACT** Classification of brain tumor is one of the most vital tasks within medical image processing. Classification of images greatly depends on the features extracted from the image, and thus, feature extraction plays a great role in the correct classification of images. In this paper, an enhanced method is presented for glioma MR images classification using hybrid statistical and wavelet features. In the proposed method, 52 features are extracted using the first-order and second-order statistical features (based on the four MRI modalities: Flair, T1, T1c, and T2) in addition to the discrete wavelet transform producing a total of 152 features. The extracted features are applied to the multilayer perceptron (MLP) classifier. The results using the MLP were compared with various known classifiers. The method was tested on the dataset MICCAI BraTS 2015 which is a standard dataset used for research purposes. The proposed hybrid statistical and wavelet features produced 96.72% accuracy for high-grade glioma and 96.04% accuracy for low-grade glioma, which are relatively better compared to the existing studies.

**INDEX TERMS** MRI classification, glioma tumor, hybrid statistical features, multilayer perceptron.

## I. INTRODUCTION

The human brain contains billions of neurons for information processing and body organ operations making it an extremely complex part of the human body. The brain is composed of three part namely; the cerebellum, the brainstem and finally the cerebrum. Surrounded a protective shield known as the skull that is able to protect the brain from injuries and direct damage. The skull cannot, however, protect the brain from internal neurological affects. These affects can cause the most common problem known as tumors. Tumors damage the brain at the cellular level, and thus causing death in most cases. Early detection of tumors and correct diagnosis can assist in early intervention and lifesaving medications and procedures [1].

The Brain MRI uses radio waves, magnetic field and other computing devices to produce images of the brain tissues. Based on magnetic field strength and signal frequency, the Brain MRI can produce four different types of images. The types are; longitudinal relation time (T1) weighted, T1-contrasted, transverse relaxation time (T2) weighted, and fluid-attenuated inversion recovery (Flair) [2]. The different types can be easily identified as tissues in T1 type are dark, tissues in T2 type are bright, and tissues in Flair type clearly shows water and macromolecules. Since MRI depends on the use of magnetic field, it can be used to detect tissue inflammation, bleeding, swelling and tumors.

The early diagnosis and correct classification of brain tumors is extremely important in deciding the type of treatment the patient must undergo. Numerous recent research studies have developed on the design of Convolutional Neural Networks (CNNs) to assist in the process of correct classification of brain tumors based on MR Images. Classifying tumors by physicians is an extremely slow process and is prone to errors. This is one of the main reasons that there has been an increased interest in developing automated highly accurate image processing systems for tumor classification in general, and brain tumor classification in particular [3].

Once a brain abnormality or tumor is detected, it needs to be segmented. However, this is a complex task because MR images are low contrast and highly correlated. This complexity is increased due to the inconsistency of the brain anatomy. Yet correct segmentation is crucial in the proper diagnosis and analysis of the various types of brain tumors.