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Classification and Detection of Brain Tumor Using Machine Learning

***Mr.M.Rajakumar* [a], *Mr.M.Manaskumaryogi* [b], *Ms.K.Srisatyasaitulasi* [a], *Ms.K.Shivaharika* [b], *Mr.S.Sudheer babu* [c], *Mr.R.Bheema raju* [d]**

a Asst.Prof.,CSE Dept,Pragati Engineering College(A),Suurampalem,A.P,India
b Asst.Prof.,CSE Dept,Pragati Engineering College(A),Suurampalem,A.P,India
a,b,c,d B.Tech. III Year Student,CSE Dept,Pragati Engineering College(A),Surampalem,A.P,India

A B S T R A C T

A tumor is a mass of tissue formed by the accumulation of abnormal cells that continue to grow. The brain is the most important organ in the human body, responsible for controlling and regulating all critical life functions for the body, and a tumor is a mass of tissue formed by the accumulation of abnormal cells that continue to grow. A brain tumor is a tumor that has grown in the brain or has spread across the brain. To yet, no one reason has been found for the development of brain tumors. Though brain tumors are uncommon (approximately 1.8 percent of all recorded cancers in the world), the death rate of malignant brain tumors is quite high due to the tumor's location in the body's most vital organ. As a result, it is critical to accurately detect brain tumors at an early stage in order to reduce mortality. As a result, we've presented a computer-assisted radiology system that will assess brain cancers from MRI scans for brain tumor diagnosis treatment. In this paper, we developed a model that accurately segments images using the Watershed and PSO algorithms, extracts features using the DWT and PCA procedures, and then classifies tumors using the CNN and SVM algorithms.

Keywords: Tumor,DWT,PCA,malignant,CNN,SVM,PSO

1. Introduction

The human body is made up of a large number of cells. The additional mass of cells turns into a tumor when cell proliferation becomes unchecked. CT and MRI scans are utilized to determine the tumor's location. The purpose of our research is to accurately detect and classify brain malignancies using a combination of approaches including medical image processing, pattern analysis, and computer vision for brain diagnosis enhancement, segmentation, and classification. Neurosurgeons, radiologists, and other healthcare professionals can use this technology. Using the industry standard simulation software tool, MATLAB, the system is projected to improve the sensitivity, specificity, and diagnostic efficiency of brain tumor screening. These methods entail pre-processing MRI scans gathered from numerous pathology labs as well as scans obtained from internet cancer imaging archives. After resizing the images, the proposed segmentation and classification methods are applied. The method is projected to improve the present brain tumor screening procedure and, by reducing the need for follow-up treatments, potentially lower health-care expenses. For accurate characterization and analysis of biomedical imaging data, several processing steps are required. Our research focuses on the automated detection and categorization of brain tumors. MRI or CT scans are commonly used to examine the anatomy of the brain. Our approach is designed to determine whether an MRI image contains a tumor and, if so, to classify the tumor as malignant or benign

2.Pre – Processing and Enhancement

To increase the detection of the suspicious zone from a Magnetic Resonance Image, preprocessing and enhancement techniques are applied (MRI). The gradient-based image enhancement method for brain MR images is presented in this part, which is based on the first derivative and local statistics. The preparation and enhancement procedure is divided into two steps: first, using a tracking algorithm, film artifacts such as labels and X-ray marks are eliminated from the MRI. Second, using the weighted median filtering technique [12], high frequency components are removed. In comparison to the median filter, adaptive filter, and spatial filter, it provides high resolution MRI. The suggested method's performance is also assessed using peak single-to-noise ratio (PSNR) and average signal-to-noise ratio (ASNR) (ASNR).

2.2 Segmentation

Picture segmentation is the first and most important stage in image analysis. Its goal is to extract information from an image via image segmentation. The mechanization of medical picture segmentation has found widespread use in domains as diverse as patient verdicts, treatment management planning, and computer-assisted surgery. The segmentation algorithms that have been implemented are as follows:

2.2.1 Particle Swarm Optimization:

The method based on swarm intelligence was created by modifying the collective behavior that has been demonstrated for finding food sources [6]. Each solution in the PSO method is a "particle," which is a bird in the search space. Every particle has a fitness value that is determined by a fitness function, as well as velocity data that guides their battles. The particles in the issue space move by following the most favorable solutions that already exist. The PSO Department of Computer Engineering Page 5 of 89 technique begins with a set of randomly generated solutions (particles) and iteratively investigates the best answer [7]. All particles are updated according to two best values in each iteration. The first of these best values is a particle named "pbest" that has been discovered thus far. The other is the best value that any particle in the population has found thus far. This value is referred to as the "gbest" value because it is the best value for the entire population

2.2 Watershed:

Watershed segmentation is a technique that uses gradients to segment data. It treats the image's gradient map as a relief map [9]. As a dam, it divides the image. Catchment basins are the divided regions. Watershed segmentation is a technique that can be used to handle a range of image segmentation issues. It is appropriate for photographs with a higher intensity value. Marker controlled watershed segmentation is used to maintain control over segmentation. The Sobel operator can be used to detect edges [10]. The Sobel operator is used to distinguish the object's edge in marker controlled watershed segmentation [11].

2.3 Feature Extraction

The process of obtaining quantitative information from an image, such as color properties, texture, shape, and contrast, is known as feature extraction. The discrete wavelet transform (DWT) was used to extract wavelet coefficients, and the gray-level co-occurrence matrix (GLCM) was utilized to extract statistical features.

2.3.1 Discrete Wavelet Transform:

Using multiple scales, the wavelet was utilized to evaluate distinct frequencies of an image. We're utilizing the discrete wavelet transform (DWT), which is a useful technique for extracting features. It was used to derive wavelet coefficients from MR pictures of the brain. The wavelet localizes signal function frequency information, which is crucial for categorization. The images were decomposed into spatial frequency components using the 2D discrete wavelet transform, which were extracted from LL (low–low) sub-bands. However, because HL (high–low) sub-bands have better performance than LL (low–low), we have used both LL (low–low) and HL (high–low) for better analysis that describes image text features [21].

2.3.2 Principal Component Analysis:

The Principal Component Analysis (PCA) is one of the most successful picture recognition and compression techniques, and it is used to minimize the data's huge dimensionality. The main idea is to compute the Eigen vectors of the original data's covariance matrix and then approximate it with a linear combination of the leading eigenvectors. The test picture can be identified using the PCA approach by first projecting the image onto the Eigen space to acquire the matching set of weights, and then comparing those weights to the weights of the faces in the training set [21].

2.4 Classification

Several candidate feature extraction approaches are frequently accessible in classification challenges. By training neural networks to execute the needed classification task using various input features, the most appropriate method can be selected (derived using different methods). The inaccuracy in the neural network response to test samples indicates whether the appropriate input features (and consequently the method used to obtain them) are suitable for the classification task under consideration. The classification methods that have been implemented are as follows

2.4.1 Support Vector Machine:

SVM is a classification approach used in a variety of domains, including face recognition, text categorization, cancer diagnosis, glaucoma diagnosis, and analysis of microarray gene expression data [15]. SVM classifies brain MR images as normal or tumor-affected using binary classification. SVM separates the input data into two groups using a decision surface (also known as a hyperplane). The primary goal of SVM is to maximize the margins between two hyperplane classes [16]. During the training and testing phases, dimensionality reduction and a precise feature set were given as input to the SVM. SVM is a binary classifier that uses supervised learning to improve its performance.

2.4.2 Convolutional Neural Networks:

Convolutional Neural Networks (CNNs) have proven to be extremely effective image recognition frameworks. In the last few years, CNN models have improved their object categorization performance significantly [1].

3.Materials and Methodology:

3.1 Data Collection and Dataset Preparation:

Images can be found on the Internet by searching for plant and disease names in the search box. As a result, all of the photos can be divided into several groups.

3.2 Training

The deep convolutional neural network will be trained in this step to create an image categorization model. To serve our many categories, the Caffe Net architecture will be employed and tweaked (classes). After that, saturating non linearities will be replaced with Rectified Linear Units (ReLU). This adaptive activation function will learn the parameters of rectifiers and increase accuracy at a low computing cost. Graph 3.2.1

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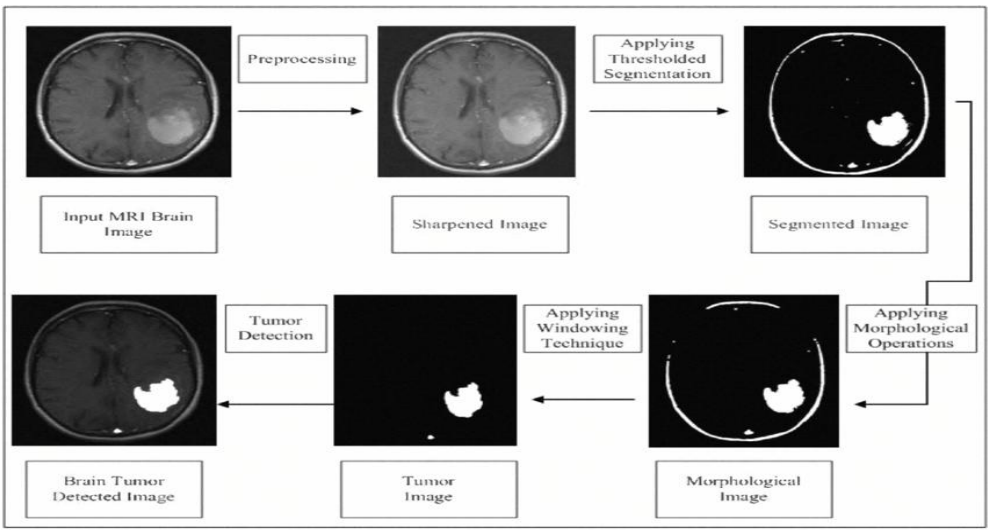

Fig 3.2.1

3.3 RESULT

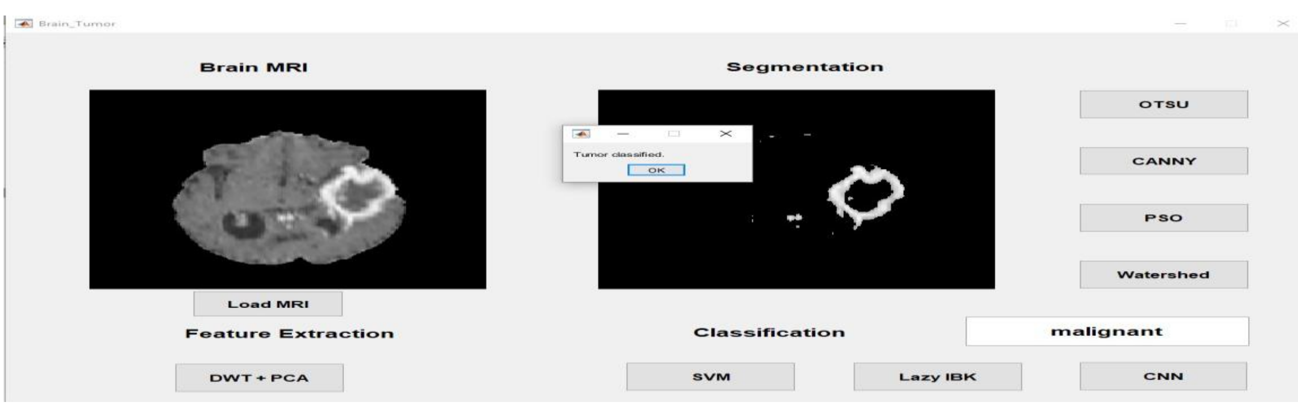

Figure 3.3: Classified Output (Malignant)

4. CONCLUSION & FUTURE SCOPE:

As technology advances, automated monitoring and management solutions are becoming more popular. In the medical field, yield loss is primarily caused by disease transmission. When the condition has progressed to a severe degree, the detection and identification of the disease is usually noted. As a result, there is a loss in terms of yield, time, and money. The proposed technology can detect the disease at an early stage, as soon as it appears in the brain. As a result, it is possible to save money and reduce reliance on experts to some extent. It may be of assistance to someone who is unfamiliar with the disease. We must extract the disease-related characteristics based on these objectives. There are numerous benefits to automating the process of detecting a brain tumor using photographs. When compared to the current scenario (i.e., manually identifying the disease at a later stage where we may not have the opportunity to take any precautions), we can use the technique described here, which has the capability of identifying the disease at an earlier stage where we can take at least some precautions to save our crop before it escapes our control. It also helps a farmer's economic growth because it is dependent on the quality of the things they create, which is dependent on the plant's growth and production. The need for continuous monitoring of the field with a naked eye by a person with superior knowledge of the plants and their corresponding diseases is eliminated by implementing this technique, which saves the farmer a lot of time and money because appointing such a person (with superior knowledge) could be costly.

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