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A Review On Brain Tumor Detection Methods And Technologies

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Abstract: Brain tumor detection is essential for early diagnosis and successful treatment, which significantly increases the chances of recovery and survival. Timely detection allows for appropriate and more effective treatment to begin, as delayed diagnosis can substantially increase mortality rates, especially with fast-growing malignant tumors. Artificial intelligence (AI) and machine learning (ML) are crucial tools that assist in early detection by automating the process of analyzing medical images. CAD systems, often powered by AI techniques, help physicians identify and classify tumors more accurately and efficiently than manual methods alone. Algorithms can extract intricate patterns from images that may be missed during manual review, leading to more accurate diagnoses.

***Index Terms* - :** brain tumor; MRI; deep learning; artificial intelligence; medical images; convolution neural networks (CNN); transfer learning.

I. INTRODUCTION

Early detection of brain tumor directly correlates with improved survival rates and life expectancy through timely and appropriate treatment. Detecting a tumor early allows for better characterization of its type and location, leading to more effective treatment plans. It helps to address the health problems caused by the tumor pressing on healthy brain tissue. The risk of mortality increases with each passing week of delay in diagnosis, particularly for aggressive tumors. Manually diagnosing brain tumors from medical images like MRI scans is time-consuming and complex for radiologists due to the heterogeneous and varied nature of tumor cells. The increasing prevalence of brain tumors worldwide underscores the urgent need for early and precise diagnostic methods. Algorithms can extract intricate patterns from images that may be missed during manual review, leading to more accurate diagnoses.

II. LITERATURE REVIEW

The paper "Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM"[1]. published by Nilesh Bhaskarrao Bahadure, Arun Kumar Ray. In this paper they use MR images of the brain, segmented brain tissues into normal tissues such as white matter, gray matter, cerebrospinal fluid (background), and tumor-infected tissues. The pre-processing done to improve the signal-to-noise ratio and to eliminate the effect of unwanted noise. The skull stripping algorithm its based on threshold technique for improve the skull stripping performance. "A Survey on Brain Tumor Detection Using Image Processing Techniques"[2] in this paper surveys the various techniques that are part of Medical Image Processing and are prominently used in discovering brain tumors from MRI Images. Based on that research this Paper was written listing the various techniques in use. A brief description of each technique is also provided. Also of All the various steps involved in the process of detecting Tumors, Segmentation is the most significant. "Identification of Brain Tumor using Image Processing Techniques"[3]. : This paper survey of Identifying brain tumors through MRI images can be categorized into

four different sections; pre-processing, image segmentation, Feature extraction and image classification [3]. Review of Brain Tumor Detection from MRI Images[4]. In this paper, some of the recent research work done on the Brain tumor detection and segmentation is reviewed. Different Techniques used by various researchers to detect the brain Tumor from the MRI images are described. By this review we found that automation of brain tumor detection and Segmentation from the MRI images is one of the most active Research areas[4]. "An efficient Brain Tumor Detection from MRI Images using Entropy Measures"[5]. In this paper, we have investigated the different Entropy functions for tumor segmentation and its detection from various MRI images. The different threshold values are obtained depend on the particular definition of the entropy. The threshold values are dependent on the different entropy function which in turn affects the segmented results.

Brain Tumor Detection from MRI Images Using MATLAB Code[6]. In this implementation pre-processed images are used for post processing operation like threshold and then features are extracted using GLCM and classification is done by Artificial Neural Network where authors have obtained 76.5% of accuracy when run on a dataset of 300 images in classifying tumor and non tumor images. Brain Tumor Detection Based on Deep Learning Approaches and Magnetic Resonance Imaging[8].This study introduced an enhanced YOLOv7 model for accurately detecting multiclass brain tumors, specifically meningioma, glioma, and pituitary tumors, as visually depicted in Figures 1 and 11. Our proposed model was carefully optimized, incorporating the CBAM attention mechanism and the SPPF+ and BiFPN components. The model was trained by employing MRI images acquired through T1-weighted contrast-enhanced sequences, harnessing the enhanced anatomical insights facilitated by contrast agents. Analysis of MRI Data for Brain Tumor Detection using MATLAB[11]. To achieve the expected result is used to this technique such as brain tumor detection through software-based estimation of the image of improvement image features, enhancement, sharpness, filtering is known well brain tumor and brain diseases. The MATLAB coding achieving to grey levels-based visualization in the MR Image de-creasing and increasing grey levels to sharpness and brightness in the images shows the tumor ages growth inside the brain anatomical structure MR images. Best performance and accuracy according to a dataset of the images.

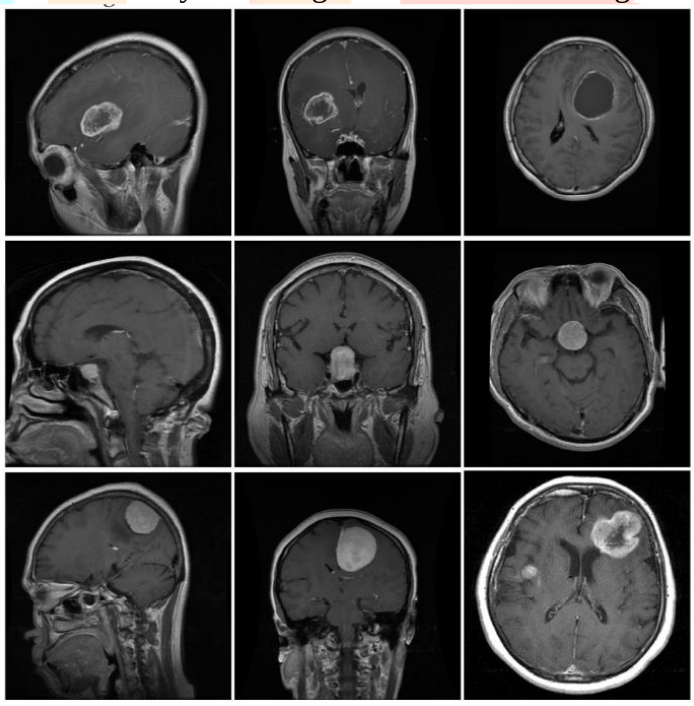

Figure 1.1 A sample of MRI images from the brain tumor dataset

III. DISCUSSION

The advancement in image processing methods in recent year confirmed the proper and fast detection of tumor. As discus in literature review section matab was used initially for tumor detection. The algorithm used for detection is Watershed Segmentation for detection.

CNN-based transfer learning

In transfer learning architectures, all parameters and layers outside the model are the same, but after the last 3 layers of transfer learning models are removed, layers unique to the dataset are added instead: the GlobalAveragePooling2D layer contains fewer parameters than the Flatten layer, which reduces the risk of

over fitting and helps build a more efficient model. Also, while the Flatten layer is used to organize the data, the Global Average Pooling 2D layer is used for feature extraction, making the network learning process more efficient.

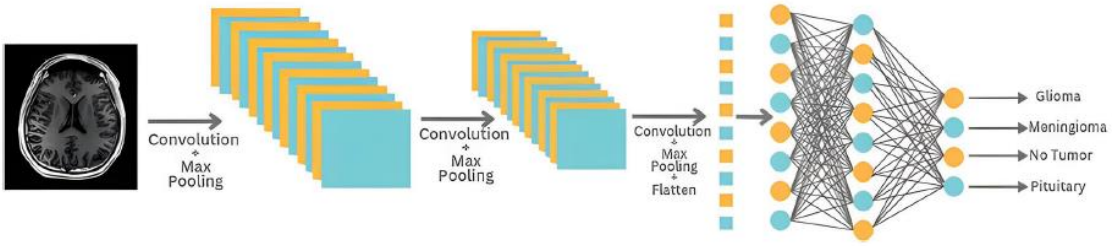

Figure 1.2 Multi-layer CNN model arthitecture

Table 1 Performances (%) of the models created in the study

Models	Accuracy	F-score	Recall	Precision	AUC
VGG19	96	96	96	96	99
EfficientNETB4	97	96	97	97	99
InceptionV3	96	96	96	96	99
3 CNN Model	91	90	91	91	98
VGG16	98	97	98	98	99

IV. CONCLUSION

MATLAB-based brain tumor detection mainly relies on traditional image processing techniques such as thresholding, segmentation, and manual feature extraction. It requires user-defined parameters and works well with small datasets. Algorithms like Convolutional Neural Networks (CNNs) are being used to automatically analyze medical images (especially MRIs) with high accuracy for faster and more consistent detection and classification. In contrast, CNN-based brain tumor detection uses deep learning to automatically learn image features, offering higher accuracy and automation. It performs better with large datasets and provides reliable classification results with minimal human intervention. CNN automatically learns and extracts features from data. Quantum Computing: Emerging research is exploring the use of quantum neural networks (QCNNs) for brain tumor detection, which could offer new levels of processing power. Quantum Computing: Emerging research is exploring the use of quantum neural networks (QCNNs) for brain tumor detection, which could offer new levels of processing power. Quantum Computing: Emerging research is exploring the use of quantum neural networks (QCNNs) for brain tumor detection, which could offer new levels of processing power. The integration of machine learning techniques, particularly deep learning methods like CNNs, with medical imaging modalities like MRI and CT has greatly advanced the field of medical image analysis. These techniques enable the automatic detection and classification of abnormalities like brain tumors, offering great potential for improving diagnosis and treatment planning. However, challenges remain, particularly in segmentation, handling noisy or low quality images, and managing the high computational demands of 3D medical imaging. Ongoing research is focused on improving these models, reducing computational complexity, and increasing accuracy in medical image classification tasks

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