**ABSTRACT:**

Brain tumor classification are consider as critical task in the field of medical imaging. Accurate and efficient way is required in classifying of brain tumors is important for the timely and effective treatment of patients. With the advancement of deep learning techniques, several methods have been (introduced for classifying the tumors) proposed for brain tumor classification. However, most of these methods are dependence on their reliance on a single deep learning model, which may be they are not capable of capture the complexities of brain tumors effectively. In this paper, we propose a hybrid deep learning approach for brain tumor classification that combines multiple deep learning models. Our main approach is to leverages the strengths of different deep learning models to achieve improved performance in terms of accuracy and efficiency. We evaluated the performance of our approach on a (two combined) large dataset of brain MRI images and compared it with state of the art methods. The results showed that our hybrid deep learning approach outperforms existing methods in terms of accuracy and efficiency.

**KEYWORDS: BRAIN TUMOR,DEEP LEARNING, MACHINE LEARNING, MRI IMAGES.**

**INTRODUCTION:**

Brain tumors are considered as a significant cause of morbidity and mortality worldwide. Brain tumors are considered as one of the most lethal diseases in the world. It mostly effects on the tissues which are present in cells of the brain. Early and accurate diagnosis of brain tumors is crucial for success in treatment. However, traditional methods for brain tumor classification is along with inspection of medical images, are time-consuming and subject to human error. However, manual analysis of MRI images is time-consuming, subjective, and prone to inter-observer variability. This has led to the development of automated brain tumor classification methods that use computer algorithms to analyze MRI images and classify tumors.

Deep learning is a subset of machine learning that has shown great success in a variety of applications, including medical image analysis. Convolutional neural networks (CNNs) have been widely used for brain tumor classification due to their ability to learn from large amounts of data and their robustness to image variability. However, the performance of a single deep learning model can be limited by its ability to capture the complexities of brain tumors. To overcome this limitation, several methods have been proposed that use ensembles of deep learning models for brain tumor classification. However, most of these methods only use a simple combination of models, such as majority voting or weighted voting, which may not fully capture the strengths of different models.

**LITERATURE SURVEY :**

In the brain tumor classification we have used two types of learnings named as MACHINE LEARNING and DEEP LEARNING. We are utilizing these two learnings to train the model, for this we have refer the reference papers based on brain tumor classification which are used the different types of models. We have divided the reference papers into two categories:

**I, MACHINE LEARNING:**

**1 Rao, C. S., & Karunakara, K. (2022). Efficient detection and classification of brain tumor using kernel based SVM for MRI. Multimedia Tools and Applications, 81(5), 7393-7417:**[R-10]

The objective of this research paper is to develop an efficient segmentation and classification process for brain tumor detection using machine learning models. The proposed methodology involves pre-processing, segmentation, feature extraction, selection and classification steps in order to accurately detect tumors from MRI scans.

One of the main limitations of this research paper is that it relies on existing data about other brain scans in order to detect anomalies. This means that if there is not enough data available, then the accuracy and reliability of the algorithm may be reduced. Additionally, due to its complexity, this method may require a lot of computing power which could limit its practical applications.

**2 Kesav, N., & Jibukumar, M. G. (2022). Efficient and low complex architecture for detection and classification of Brain Tumor using RCNN with Two Channel CNN. Journal of King Saud University-Computer and Information Sciences, 34(8), 6229-6242**:[R-9]

The objective of this paper is to propose a novel architecture for brain tumor classification and object detection using the RCNN technique, which has been analyzed using two publicly available datasets. The aim is to reduce the execution time of a conventional RCNN architecture with the use of a low complex framework.

The main limitation of this proposed architecture is that it has not yet been tested in a real-world setting. Additionally, the accuracy and performance of the system may be affected by factors such as data availability and quality.

**3 vdAmin, J., Sharif, M., Haldorai, A., Yasmin, M., & Nayak, R. S. (2021). Brain tumor detection and classification using machine learning: a comprehensive survey. *Complex & Intelligent Systems*, 1-23.**

The Objective of the paper is to deliver a deep and keen comprehensive study and the literature

of Brain Tumor detention through magnetic resonance imaging to help the researchers. The

provides survey involves the covered survey of anatomy of brain tumor detection. The work in

this paper has been done by using publicly available datasets and the applied enhancement

techniques such as segmentation of the MRI Scan feature extraction, classification, and deep

learning, transfer learning and quantum machine learning for brain tumors analysis. Finally, this survey

provides all important literature for the detection of brain tumors with their advantages, limitations,

developments, and future trends.

4 **Usman, K., & Rajpoot, K. (2017). Brain tumor classification from multi-modality MRI**

**using wavelets and machine learning. *Pattern Analysis and Applications*, *20*, 871-881.**

In this paper, it propose a brain tumor segmentation and classification

method for multi-modality magnetic resonance imaging scans. The data from

multi-modal brain tumor segmentation challenge (MICCAI BraTS 2013) is

utilized which are co-registered and skull-stripped, and the histogram

matching is performed with a reference volume of high contrast. From the

preprocessed images, the following features are then extracted: intensity,

intensity differences, local neighborhood and wavelet texture. The

integrated features are subsequently provided to the *random forest* classifier

to predict five classes: background, necrosis, edema, enhancing tumor and

non-enhancing tumor, and then these class labels are used to hierarchically

compute three different regions (*complete tumor, active tumor and*

*enhancing tumor*). We performed a leave-one-out cross-validation and

achieved 88% *Dice overlap* for the complete tumor region, 75% for the core

tumor region and 95% for enhancing tumor region, which is higher than the

Dice overlap reported from MICCAI BraTS challenge.

**II. DEEP LEARNING:**

1. **Bansal, T., & Jindal, N. (2022). An improved hybrid classification of brain tumour MRI images based on conglomeration feature extraction techniques. Neural Computing and Applications, 34(11), 9069-9086.:**

The objective of the paper is to develop a hybrid technique for classifying brain tumor MRI images. This involves combining feature extraction and classification methods in order to accurately determine the type of tumor present.

One limitation of this method is that it relies on manual segmentation, which can be time-consuming and prone to errors. Additionally, the hybrid classifier may not always provide the most accurate results in all cases.

1. **Khan, M. S. I., Rahman, A., Debnath, T., Karim, M. R., Nasir, M. K., Band, S. S., ... & Dehzangi, I. (2022). Accurate brain tumor detection using deep convolutional neural network. Computational and Structural Biotechnology Journal, 20, 4733-4745:**

The objective of this research paper is to propose two deep learning models that can accurately detect both binary (normal and abnormal) and multiclass (meningioma, glioma, and pituitary) brain tumors. The results from these models are then compared to other existing methods in literature

The main limitation of this research paper is that it only focuses on the detection and classification of brain tumors using deep learning models. It does not address other aspects such as treatment or prevention. Additionally, the accuracy achieved by these models may be limited due to factors such as image quality or data availability.

1. **Chattopadhyay, A., & Maitra, M. (2022). MRI-based Brain Tumor Image Detection Using CNN based Deep Learning Method. Neuroscience Informatics, 100060:**

The main objective of this paper is to develop an algorithm for segmenting brain tumors from 2D Magnetic Resonance brain Images (MRI) using a convolutional neural network, followed by traditional classifiers and deep learning methods. The goal is to create a highly accurate automatic tumor detection method that can be used in medical diagnosis.

The main limitation of MRI-based brain tumor image detection is that it can be expensive and time consuming to process large datasets. Additionally, the similarity between normal tissue and brain tumors in appearance can make segmentation difficult.

**4 Dang, K., Vo, T., Ngo, L., & Ha, H. (2022). A deep learning framework integrating MRI image preprocessing methods for brain tumor segmentation and classification. IBRO Neuroscience Reports, 13, 523-532.:[R-12]**

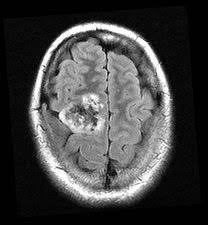
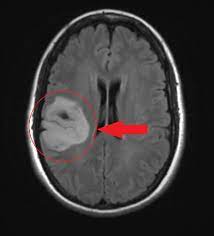
The objective of this study is to develop an accurate model for glioma diagnosis using MRI-based classification. The deep learning pipeline consists of three essential steps: (1) segmentation of MRI images with preprocessing approaches and UNet architecture, (2) extraction of brain tumor regions from the segmented images, and (3) classification between high-grade gliomas and low-grade gliomas using VGG and GoogleNet implementations.

**DATA SET:**

To evaluate a model there are several data sets are available on different platforms .we need to find an data set which is suitable to train the model in all accurate ranges . There must be an challenging dataset , facing of insufficient data available in data set, some of the fields are missing. MRI image data set are considered as the challenging to train the model.

The dataset consists of a total more than 8000 images which are downloaded from the kaggle website. In this dataset consists MRI images with four classes.

The Data Set contains the MRI Scanned images of Brain Tumor and the tumor classifies into four categorical variables each type of the tumor is precisely take and then trained to the Deep Neural Hybrid model for effectively enhancing the Accuracy Metrices and the performance of the model.

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**Glioma Meningioma Notumor Pituitary**

The mentioned data Set contains multiple classification of various Tumor and the related images of total 8000 images in the dataset each classification of the MRI Scanned tumor imaged in the sharped and then the data is given to the proposed and then the proposed model preprocess it and the model is trained by the applied architecture and predicts the tumor

The mentioned Data Set test folder, Train folder and Validation folder incorporated in it so that the models can be trained and then tested and the output that is results can be valuated by the test, train and validation set of the provided Data.

**METHODOLOGY:**

We propose a hybrid deep learning approach for brain tumor classification that combines multiple deep learning models in a novel way.

Our approach consists of two stages: feature extraction and classification. In the feature extraction stage, we use multiple CNNs to extract features from brain MRI images. Each CNN is trained on a different subset of the data to capture different aspects of the tumors. Multiple CNNs are trained to extract features from the preprocessed brain MRI images. Each CNN is trained on a different subset of the data to capture different aspects of the tumors. The outputs of the CNNs are the features that describe the different aspects of the tumors.

In the classification stage, we use a random forest classifier to combine the features extracted by the CNNs and make the final classification. The random forest classifier is trained on the features extracted by the CNNs and uses a combination of decision trees to make the final classification. The multiple CNNs work in parallel to extract features from the brain MRI images, and the random forest classifier uses these features to make the final classification.

**COMPARATIVE ANALYSIS:**

In recent years, deep learning algorithms have shown great promise in the medical field for image analysis and classification tasks. A hybrid deep learning approach that combines the strengths of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) has been proposed for the classification of brain tumors. Comparison with other Approaches: The hybrid deep learning approach has been compared to several other approaches for brain tumor classification.

**Traditional Methods**: Traditional methods for brain tumor classification include manual annotation by experts, hand-crafted features, and classical machine learning algorithms. These methods are limited by the subjective nature of manual annotation and the difficulty in extracting relevant features from medical images. The hybrid deep learning approach has been shown to outperform traditional methods in terms of accuracy and efficiency.

**Deep Learning Approaches:** Several studies have explored the use of deep learning algorithms for brain tumor classification. One of the earliest works in this field is multi-scale CNN for brain tumor classification. The results which means in terms of accuracy and efficiency showed that the use of multi-scale CNNs improved the performance of the model compared to traditional methods.