***DIGITAL IMAGE PROCESSING PROJECT***

***TOPIC: BRAIN TUMOR DETECTION USING CONVOLUTION NEURAL NETWORK***

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**ABSTRACT:**

This project it is suggesting a brain tumor segmentation method using a Convolutional Neural Network (CNN). MRI images are preprocessed, and then the CNN with convolutional and pooling layers automatically extracts features to differentiate between normal and tumor tissue. Finally, the trained CNN segments unseen MRI scans by classifying each pixel based on learned features. This data-driven approach eliminates manual feature engineering and leverages the CNN's ability to capture spatial information for accurate tumor segmentation.

**INTRODUCTION:**

Early and accurately diagnosis of brain tumors it is crucial for effective treatment. Medical image processing, particularly utilizing Magnetic Resonance Imaging (MRI) scans, plays a vital role in this process. However, manual segmentation of brain tumors from MRI scans is time-consuming, prone to human error, and becomes increasingly challenging with large datasets.

This project is proposing a novel approach for brain tumor segmentation that addresses these limitations. It leverages the power of Convolutional Neural Networks (CNNs). CNNs are a type of deep learning architecture particularly adept at image analysis tasks. By training a CNN on a large collection of labeled MRI scans, the model can automatically learn to differentiate between healthy brain tissue and tumor regions. This eliminates the need for manual feature engineering, a complex and expertise-dependent step in traditional methods. The trained CNN it can then analyze unseen MRI scans, classifying each pixel and generating a segmentation map that accurately identifies the tumor location and extent. This data-driven approach it offers the potential for faster, more consistent, and potentially more accurate brain tumor segmentation compared to manual methods.

**PURPOSE:**

The purpose of this project is to develop an automated method for accurately detecting and outlining brain tumors in MRI scans using Convolutional Neural Networks (CNNs). By eliminating the need for manual segmentation, this approach aims to streamline the diagnosis process, reduce human error, and potentially improve the speed and accuracy of tumor detection. Ultimately, the goal is to facilitate early and precise identification of brain tumors, enabling healthcare professionals to initiate timely treatment and improve patient outcomes.

**LITERATURE REVIEW:**

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| **YEAR** | **TITLE** | **AUTHOR** | **DATASET LINK** | **METHODOLOGY** | **RESULT** | **CONCLUSION** |
| 2011 | Brain tumor detection using cnn | Sunil Kumar, Renu Dhir, Nisha | Dataset combination of Br35H 2020 and central research UK | CNN | Obtained a accuracy of up to 92% | his paper presents a novel brain tumor detection method utilizing preprocessing with median filtering and CNN-based segmentation, achieving 92% validation accuracy and enhancing segmentation and spatial localization. |
| 2019 | CNN for Brain Tumor detection | D.C Fedrianto, Soesanti, H.A Nugroho | Brain MRI images dataset obtained from kaggle | CNN | Obtained a prediction accuracy of up to 93% | In conclusion, this study demonstrates the effectiveness of Convolutional Neural Networks (CNNs) in classifying brain tumors from MRI images, achieving a prediction accuracy of up to 93%. |
| 2019 | Brain tumor detection using cnn | Tonmony Hossain, Fairuz Shadmani, Mohsena | BRATS dataset | CNN | Obtained a accuracy of up to 97.87% | method combines Fuzzy C-Means clustering with traditional classifiers and CNN for brain tumor segmentation from 2D MRI images, achieving 97.87% accuracy. We focus on distinguishing normal and abnormal pixels using texture-based and statistical-based features. |
| 2022 | MRI Based brain tumor image detection using CNN based deep learning | Arkapravo Chattopadhyay, Mausumi Maitra | BRATS dataset | CNN | Obtained a accuracy of up to 99.74% | After refining CNN parameters and adopting RMSProp optimizer, our model achieved 99.74% accuracy in segmenting and classifying tumors from MRI images, utilizing a 9-layer CNN model with 14 stages and mitigating overfitting through image deletion. |
| 2022 | brain tumor detection using deep convolutional neural network | [Md. Saikat Islam Khan](https://pubmed.ncbi.nlm.nih.gov/?term=Khan%20MS%5BAuthor%5D),[Anichur Rahman](https://pubmed.ncbi.nlm.nih.gov/?term=Rahman%20A%5BAuthor%5D), | BRATS  dataset | CNN, Transfer learning | Obtained a accuracy of up to 96.74% | MRI image processing with Support Vector Machine offers effective brain tumor detection, with potential for enhanced performance through method integration |

**DATASET DESCRIPTION:**

The provided dataset it consists of 4001 MRI scans for brain tumor segmentation. These are 2D T1-weighted contrast-enhanced images captured in axial, coronal, and sagittal views. The dataset it categorizes the brain tissue into four classes: Glioma, Meningioma, healthy tissue (No Tumor), and Pituitary tumors. It offers a balanced split with 2891 images for training and 410 for testing, allowing researchers to develop and evaluate machine learning models for accurate tumor segmentation.

**METHODOLOGIES:**

This project it tackles brain tumor segmentation using Convolutional Neural Network (CNN) architecture built with the Keras Sequential API. The CNN extracts relevant features directly from the MRI scans. The Sequential API it allows us to stack different layers sequentially, creating a linear pipeline. Here, the CNN will likely consist of convolutional layers for feature extraction, followed by pooling layers for dimensionality reduction. The extracted features are then fed into fully-connected layers for classification. This final layer classifies each pixel in the MRI scan, differentiating between healthy brain tissue, various tumor types (Glioma and Meningioma in this case), and Pituitary tumors. By training the CNN on the provided dataset, the model learns to identify these patterns and perform accurate segmentation on unseen MRI scans. This data-driven approach eliminates the need for manual feature engineering and leverages the CNN's ability to capture spatial information within the images, leading to potentially more robust brain tumor segmentation.

**RESULT:**

The code trained a CNN model to classify brain tumors within MRI pictures. Post training on labeling data, it predicted the tumor type for an innovative image.The code achieving an accuracy of about 90% (based on split validation data) amidst training and monitoring for overfitting utilizing validation accuracy. You could also evaluate the model's performance utilizing metrics similar to F1-score and explore methods such as data augmentation for conceivably better outcomes.

**CONCLUSION:**

This project introduced a new method for finding and outlining brain tumors in MRI scans using a type of advanced computer system called a Convolutional Neural Network (CNN). Manual methods of doing this can be slow and prone to mistakes, especially with a lot of data. The CNN learns from a large set of MRI scans to automatically recognize tumor areas without needing human intervention to pick out features. This means it could make the process faster and more reliable. Overall, using this technology could lead to quicker and more accurate detection of brain tumors, which is important for effective treatment.