[Team 27] ProjF Proposal: Brain Tumor Detection using Convolutional Neural Networks

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I. Motivation

Brain tumor is one of the most hostile diseases affecting over 700,000 people within the United States alone. Once formed, it has the ability to infiltrate the remaining portions of the brain and spinal cord, resulting in death among adults and children. Caution and care is taken in the accuracy of the diagnosis, treatment, and planning to increase the life expectancy of that patient. Due to such caution being instrumental in the patient's life, radiologists and clinical experts are tasked with the tedious task of ensuring not only detecting the tumor but also segmentation. To reduce the introduction of human error when evaluating these MRI scans, Machine Learning (ML) can be implemented for automatic classification. We want to implement a model with the ability to detect and identify not only that there is a brain tumor present but also accurately identify the tumor position (segmentation).

II. Data Set Description

We have decided to use two different data sets that are publicly available.

The Brain Tumor Dataset, found on Kagle, consists of 3, 565 raw MRI images with brain tumors in varying locations of the brain [1]. The images are segmented into the tumor types : Glioma, Meningioma, and pituitary. This dataset is divided into training and testing sets.

The BRATS 2018 dataset consists of 285 3D brain tumor MRI scans with 4 different MRI modalities: T1, T1ce, T2, and Flair [3].

III. Methodology

The initiation for this problem is at the image segmentation stage where we have to identify from MRI images. We will be using a basic Convolutional Neural Network (CNN) as our baseline model and the proposed model will be a variant of this.

1. *Baseline:* A CNN is an algorithm that primarily rose to prominence because of its ability to take input images, assign weights and biases to different parts of the images and differentiate them from one another.

   The data is trained by iterating through the training dataset multiple times and weighing the outputs or applying a bias on the neurons based on how close the output is to the expected output.

2. *Proposed:* We plan to use variants of CNN called Fast R-CNN and Mask R-CNN. While a CNN is adequate to classify the images, to determine the location of an object, we need to use segmentation and for that we need Mask R-CNN. This Mask R-CNN is overlaid on a fast R-CNN which basically uses the feature maps we get from the images using normal CNN and then passes it through a Region Proposal Network (RPN) which creates boundaries and tries to determine if an object is there in those boundaries.

IV. Evaluation

To test these models, we will be comparing our model accuracy, recall and F1-Measure with the U-Net based Deep CNN model and mask - RCNN models. The correct classification of brain tumor into 4 different types of tumors is also an evaluation metric.

F1 score and accuracy greater than 90% for each tumor type will shows better performance in our model creation.

V. Reference

[1] S. Bhuvaji , A. Kadam, P. Bhumkar, and S. Dedge, "Brain tumor classification (mri)," Kaggle, 24-May-2020. [Online]. Available: https://www.kaggle.com/sartajbhuvaji/brain-tumor-classification-mri

[2] RADHAMADHAB DALAI, July 1, 2021, " Brain Tumor Dataset", IEEE Dataport, doi: https://dx.doi.org/10.21227/2qfw-bf10.

[3] S. Ankireddy, "Assistive diagnostic tool for brain tumor detection using computer vision," arXiv.org, 17-Nov-2020. [Online]. Available:https://arxiv.org/abs/2011.08185