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BRAIN MRI SEGMENTATION MODELLING USING DEEP LEARNING

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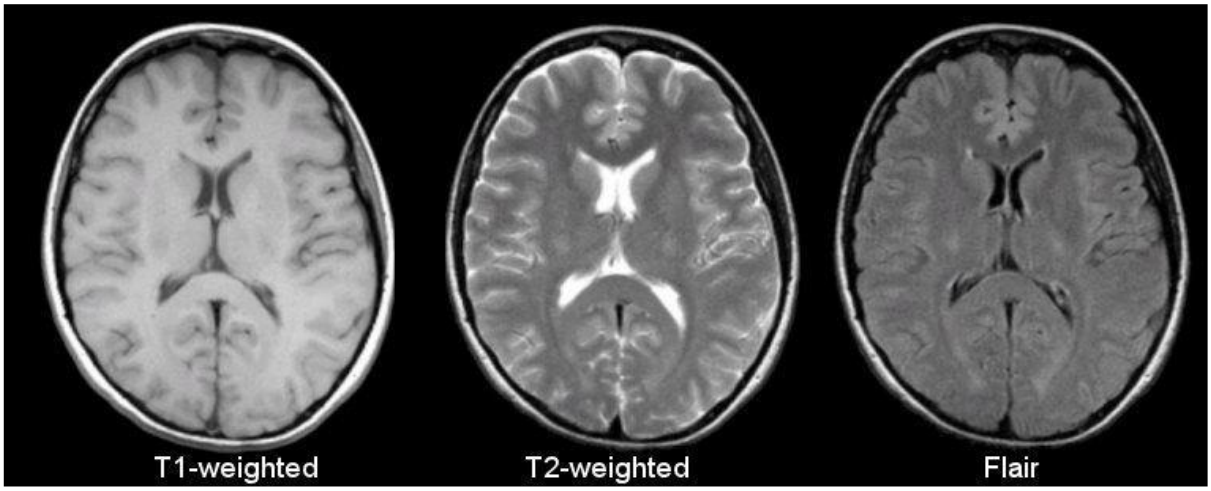
1. Introduction

The human body is made up of many organs and brain is the most critical and vital organ of them all. One of the common reasons for dysfunction of brain is brain tumor. A tumor is nothing but excess cells growing in an uncontrolled manner

Currently, doctors locate the position and the area of brain tumor by looking at the MR Images of the brain of the patient manually. This results in inaccurate detection of the tumor and is considered very time consuming.

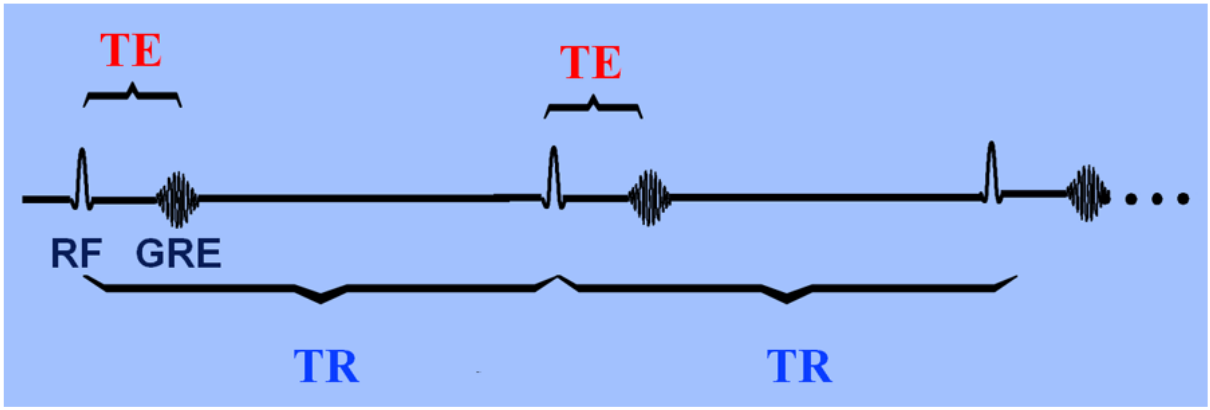
The brain tumor detection and classification system is available so that it can be diagnosed at early stages. Cancer classification is the most challenging tasks in clinical diagnosis.

This project deals with such a system, which uses computer, based procedures to detect tumor blocks and classify the type of tumor using Convolution Neural Network Algorithm for MRI images of different patients. Different types of image processing techniques like image segmentation, image enhancement and feature extraction are used for the brain tumor detection in the MRI images of the cancer-affected patients. Detecting Brain tumor using Image Processing techniques its involves the four stages is Image Pre-Processing, Image segmentation, Feature Extraction, and Classification. Image processing and neural network techniques are used for improve the performance of detecting and classifying brain tumor in MRI images.



MAGNETIC RESONANCE IMAGING (MRI)

There are different images of MRI for mapping tumor induced Change including T1 weighted, T2 weighted and FLAIR (Fluid attenuated inversion recovery) weighted shown in figure.



The most common MRI sequence is T1 weighted and T2 weighted. In T1 weighted only one tissue type is bright FAT and in T2 weighted two tissue types are Bright FAT and Water both. In T1 weighted the repetition time (TR) is short in T2 weighted the TE and TR is long. The TE an TR are the pulse sequence parameter and stand for repetition time and time to echo and it can be measured in millisecond(ms)[9]. The echo time represented time from the centre of the RF pulse to the centre of the echo and TR is the length of time between the TE repeating series of pulse and echo is shown in figure.

2. Literature survey

Name Of Topic : Classification of Brain Cancer using Artificial Neural Network
Ref No : DOI 10.1109/ICECTECH.2010.5479975
In this paper a Brain Cancer Detection and Classification System have been developed with the use of ANN. The image processing techniques such as histogram equalization, image segmentation, image enhancement, and feature extraction have been used. The proposed approach using ANN as a classifier for classification of brain images provides a good classification efficiency as compared to other classifiers. The sensitivity, specificity and accuracy is also improved. The proposed approach is computationally effective and yields good result.

Name Of Topic : A CNN based Approach for the Detection of Brain Tumor Using MRI Scans
Ref No : ResearchGate publication/336312306

In this research work , the Convolutional Neural Network (CNN) was implemented, which drives an overall accuracy of 91.3% and a recall of 88%, 81% and 99% in the detection of meningioma, glioma and pituitary tumor respectively. Deep learning architecture by leveraging 2D convolutional neural networks for the classification of the different types of brain tumor from MRI image slices. In this paper techniques like data acquisition, data preprocessing,
pre –model, model optimization and hyper parameter tuning are applied. Moreover the 10-fold cross validation was performed on the complete dataset to check for the generalizability of the model.

Name Of Topic : Hough-CNN: Deep Learning for Segmentation of Deep Brain Regions in MRI and Ultrasound
Ref No : June 2020Test Engineering and Management 83:16580 – 16586
The method applied in this paper is based on Hough voting, a strategy that allows for fully automatic localization and segmentation of the anatomies of interest. It also used learning techniques-based segmentation method which is robust, multi-region, flexible and can be easily adapted to different modalities. Different amount of training data and different data dimensionality (2D, 2.5D and 3D) are applied in predicting the final results.
Convolutional neural networks, Hough voting with CNN, Voxel-wise classification and Efficient patch-wise evaluation through CNN are used in analyzing the image.

Name Of Topic : Brain and Nervous System
Ref No : https://www.nemours.org/welcome.html?external_id=RE2350801010600
The brain is an essential organ in the human body which control and coordinates the tasks carried out by the other parts of the body. It is primarily the control center of the central nervous system and is responsible for performing the daily voluntary and involuntary activities in the human body. The tumor is a fibrous mesh of unwanted tissue growth inside our brain that proliferates in an unconstrained way. To prevent and to cure the tumor, magnetic resonance imaging (MRI) is widely used by radiologists to analyze stages of brain tumors. The result of
this analysis reveals the presence of the brain tumor.

3. Problem Definition

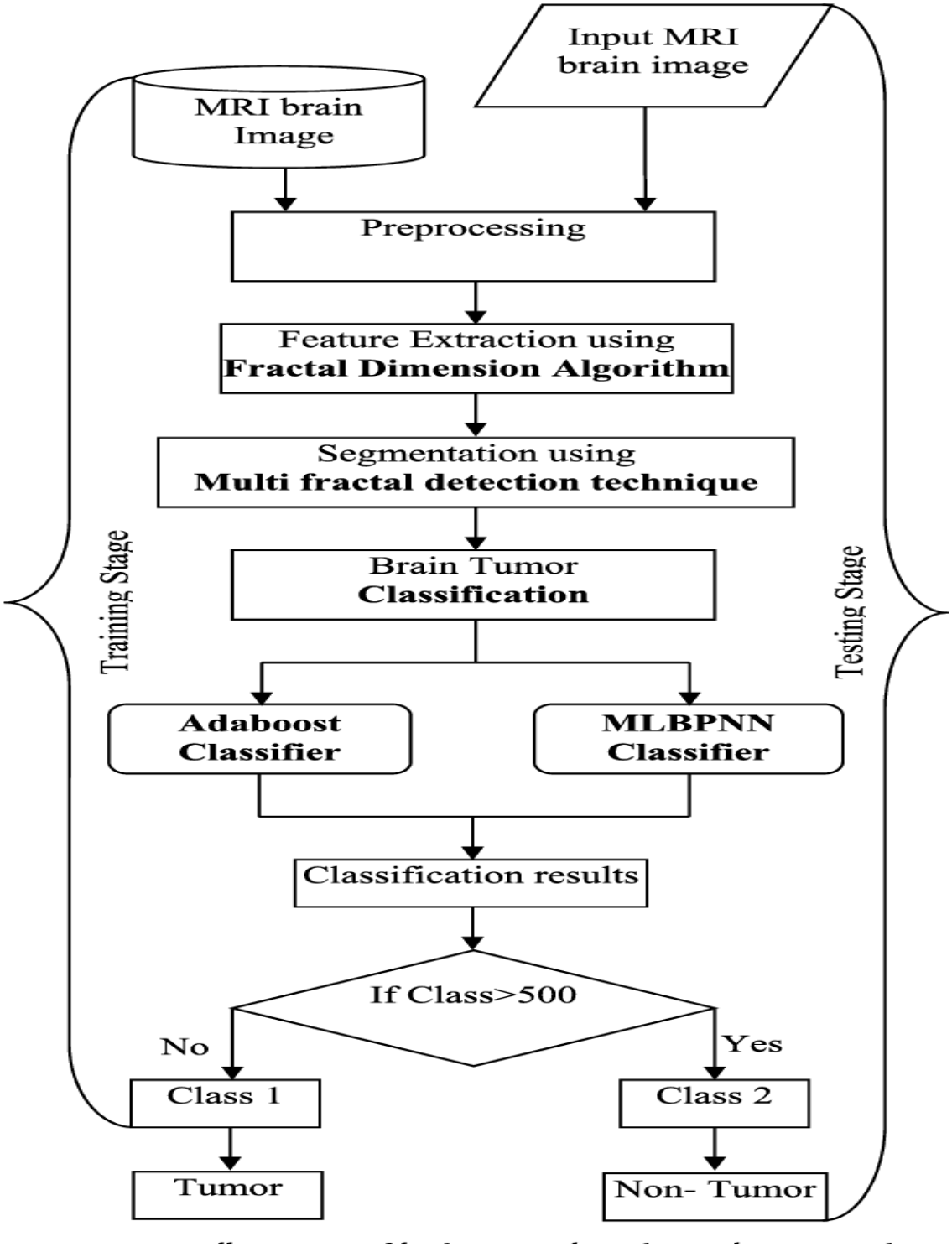
Brain tumor is the growth of abnormal cells in brain some of which may leads to cancer. The usual method to detect brain tumor is Magnetic Resonance Imaging (MRI) scans. From the MRI images information about the abnormal tissue growth in the brain is identified. In various research papers, the detection of brain tumor is done by applying Machine Learning and Deep Learning algorithms. When these algorithms are applied on the MRI images the prediction of brain tumor is done very fast and a higher accuracy helps in providing the treatment to the patients. This prediction also helps the radiologist in making quick decisions. In the proposed

work, a self-defined Artificial Neural Network (ANN) and Convolution Neural Network (CNN) is applied in detecting the presence of brain tumor and their performance is analyzed.

- To provide doctors good software to identify tumor and their causes.
- Save patient's time.
- Provide a solution appropriately at early stages.
- Get timely consultation.

The main motivation behind Brain tumor detection is to not only detect tumor but it can also classify types of tumor. So it can be useful in cases such as we have to sure the tumor is positive or negative, it can detect tumor from image and return the result tumor is positive or not. This project deals with such a system, which uses computer, based procedures to detect tumor blocks and classify the type of tumor using Convolution Neural Network Algorithm for MRI images of different patients.

4. Proposed System Block Diagram



Working of system

The two techniques ANN and CNN are applied on the brain tumor dataset and their performance on classifying the image is analyzed. Steps followed in applying ANN on the brain tumor dataset are

1. Import the needed packages
2. Import the data folder
3. Read the images, provide the labels for the image (Set Image having Brain Tumor as 1 and image not having brain tumor as 0) and store them in the Data Frame.
4. Change the size of images as 256x256 by reading the images one by one.
5. Normalize the image
6. Split the data set into train, validation and test sets
7. Create the model
8. Compile the model
9. Apply the model on the train set.
10. Evaluate the model by applying it on the test set.

The ANN model used here has seven layers. First layer is the flatten layer which converts the 256x256x3 images into single dimensional array. The next five layers are the dense layers having the activation function as relu and number of neurons in each layer are 128,256,512,256 and 128 respectively. These five layers act as the hidden layers and the last dense layer having the activation function is sigmoid is the output layer with 1 neuron representing the two classes.
The model is compiled with the adam optimization technique and binary cross entropy loss function. The model is generated and trained by providing the training images and the validation images. Once the model is trained, it is tested using the test image set. Next the same dataset is given to the CNN technique. Steps followed in applying CNN on the brain tumor dataset are

1. Import the needed packages
2. Import the data folder (Yes and No)
3. Set the class labels for images (1 for Brain Tumor and 0 for No Brain Tumor)
4. Convert the images into shape(256X256)
5. Normalize the Image
6. Split the images into the train, validation and test set images.
7. Create the sequential model.
8. Compile the model.
9. Apply it on the train dataset (use validation set to evaluate the training performance).
10. Evaluate the model using the test images.
11. Plot the graph comparing the training and validation accuracy.
12. Draw the confusion matrix for actual output against the predicted output.

The CNN sequential model is generated by implementing different layers. The input image is reshaped into256x256. The convolve layer is applied on the input image with the relu as activation function, padding as same which means the output images looks like the input image and the number of filters are 32,32,64,128,256

for different convolve layers. The max pooling applied with the 2x2 window size and dropout function is called with 20% of dropout. Flatten method is applied to convert the features into one dimensional array. The fully connected layer is done by calling the dense method with the number of units as 256 and relu as the activation function. The output layer has 1 unit to represent the two classes and the sigmoid as activation function. The model is applied for 200 epoches with the training and the validation dataset. The history of execution is stored and plotted to understand the models generated.

Method Of Application

1. Import the needed packages

2. Import the data folder(Yes and No)

3. Set the class labels for images(1 for Brain Tumor and 0 for No Brain Tumor)

4. Convert the images into shape(256X256)

5. Normalize the Image

6. Split the images into the train, validation and test set images.

7. Create the sequential model.

8. Compile the model.

9. Apply it on the train dataset(use validation set to evaluate the training performance).

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11. Plot the graph comparing the training and validation accuracy.

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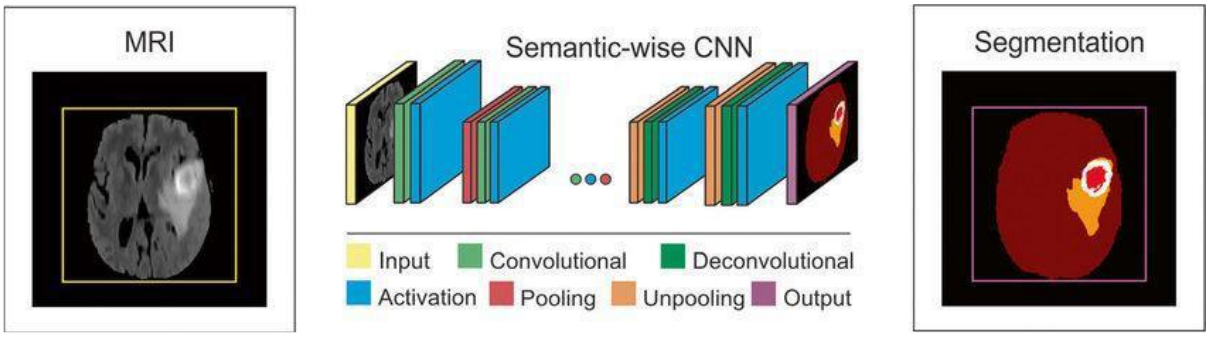

5. Applications

• The main aim of the applications is tumor identification.
• The main reason behind the development of this application is to provide proper treatment as soon as possible and protect the human life which is in danger.
• This application is helpful to doctors as well as patient.
• The manual identification is not so fast, more accurate and efficient for user. To overcome those problem this application is design.
• It is user friendly application.

6. Work Plan

Sr.No.	Nature of Work	No. of Months Required for completion
1	To study multiple research paper for research purpose	1
2	Language and algorithm selection	1.5
3	Building project flow with process diagram	1
4	Making of project's 30% work	0.75
5	Making of papers on proposed work	0.5
6	Completion phase of final project	2
7		

References

[1]. Raheleh Hashemzehi Seyyed Javad Seyyed Mahdavi Maryam Kheirabadi Seyed Reza Kamel 2020 **Detection of brain tumors from MRI images base on deep learning using hybrid model CNN** and NADE Elsevier B.V. on behalf of Nalecz Institute of Biocybernetics and Biomedical Engineering of the Polish Academy of Sciences Online Publication.

[2]. Javeria Amin Muhammad Sharif Mudassar Raza Mussarat Yasmin 2018 **Detection of Brain Tumor based on Features Fusion and Machine Learning** Journal of Ambient Intelligence and Humanized Computing Online Publication.

[3]. Rajeshwar Nalbalwar Umakant Majhi Raj Patil Prof.Sudhanshu Gonge 2014 **Detection of Brain Tumor by using ANN** International Journal of Research in Advent Technology 2.

[4]. International Journal of Research in Advent Technology, Vol.2, No.4, April 2014
E-ISSN: 2321-9637

[5]. Fausto Milletari Seyed-Ahmad Ahmadi Christine Kroll Annika Plate Verena Rozanski Juliana Maiostre Johannes Levin Olaf Dietrich Birgit Ertl-Wagner Kai Bötzel, Nassir Navab 2016 Hough-CNN: **Deep learning for segmentation of deep brain regions in MRI and ultrasound** Elsevier Inc 164 92-102.

[6]. Dena Nadir George Hashem B Jehlol Anwer Subhi Abdulhussein Oleiwi 2015 **Brain Tumor Detection Using Shape features and Machine Learning Algorithms** International Journal of Scientific & Engineering Research 6 12 454-459.

[7]. Biocybernetics and Biomedical Engineering Volume 40, Issue 3, July–September 2020, Pages 1225-1232

[8]. IOP Conference Series: Materials Science and Engineering, Volume 1055, International Virtual Conference on Robotics, Automation, Intelligent Systems and Energy (IVC RAISE 2020) 15th December 2020, Erode, India

Project Outcomes

1.Demonstrate a sound technical knowledge of their selected project topic.

2.Undertake problem identification, formulation and solution.

3.Be able to identify and summarize an appropriate list of literature review, analyze previous researchers' work and relate them to current project.

4.Communicate with engineers and the community at large in written an oral forms. (**Real life, Industry based project**)

5.Be able to compile, analyze and present the output of project in the form of report.