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Brain Tumor Detection Using Skull-Stripping Algorithm

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ABSTRACT— *Brain Tumor is second leading cause of cancer. Due to cancer large no of patients are in danger. The medical field needs fast, automated, efficient and reliable technique to detect tumor like brain tumor. Detection plays very important role in treatment. If proper detection of tumor is possible then doctors keep a patient out of danger. Various image processing techniques are used in this application. Using this application doctors provide proper treatment and save a number of tumor patients. A tumor is nothing but excess cells growing in an uncontrolled manner. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cells and tissues, which results in brain failure. 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. A tumor is a mass of tissue it grows out of control. We can use a Deep Learning architectures CNN (Convolution Neural Network) generally known as NN (Neural Network) and VGG 16(visual geometry group) Transfer learning for detect the brain tumor. The performance of model is predict image tumor is present or not in image. If the tumor is present it return yes otherwise return no.*

Keywords—Convolution Neural Network,Deep Learning,Visual Geometry group,

1. BRAIN TUMOR DETECTION SYSTEM

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. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cells and tissues, which results in brain failure. 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.

A Brain Cancer is very critical disease which causes deaths of many individuals. 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.

2, OVERVIEW OF EXITING WORK

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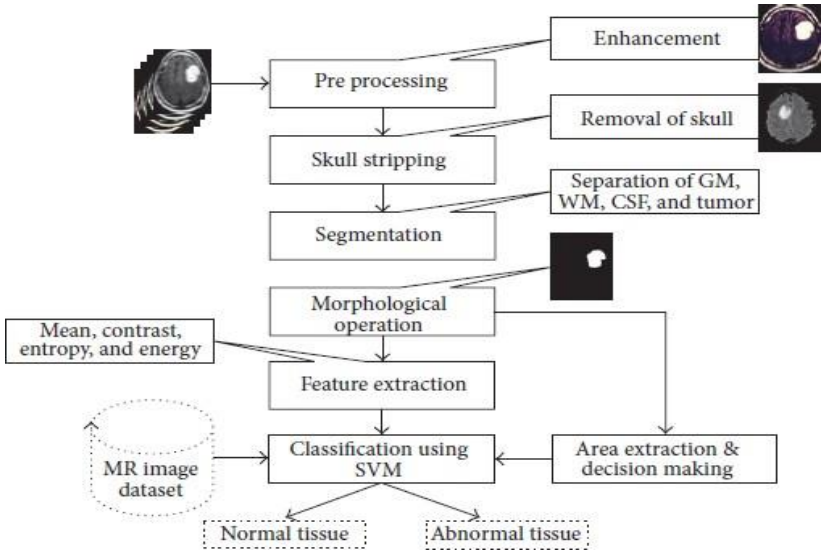


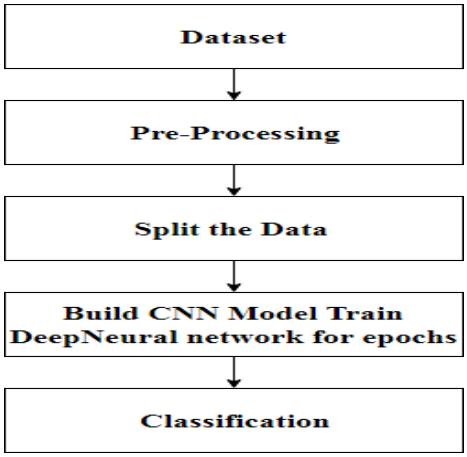
- In the first stage, there is a computer based procedures to detect tumor blocks and classify the type of tumor using Artificial Neural Network Algorithm for MRI images of different patients.
- The second stage involves the use of different image processing techniques such as histogram equalization, image segmentation, image enhancement, morphological operations and feature extraction are used for brain tumor detection in the MRI images for the cancer-affected patients.

- **Image Preprocessing:** As input for this system is MRI, scanned image and it contain noise. Therefore, our first aim is to remove noise from input image. As explained in system flow we are using high pass filter for noise removal and preprocessing.
- **Segmentation:** Region growing is the simple region-based image segmentation technique. It is also classified as a pixel based image segmentation technique since it is involve the selection of initial seed points.
- **Morphological operation:** The morphological operation is used for the extraction of boundary areas of the brain images. This operation is only rearranging the relative order of pixel value, not mathematical value, so it is suitable for only binary images. Dilation and

erosion is basic operation of morphology. Dilation is add pixels to the boundary region of the object, while erosion is remove the pixels from the boundary region of the objects.

- **Feature Extraction:** The feature extraction is used for edge detection of the images. It is the process of collecting higher level information of image such as shape, texture, color, and contrast.
- **Connected component labeling:** After recognizing connected components of an image, every set of connected pixels having same gray-level values are assigned the same unique region label.
- **Tumor Identification:** In this phase, we are having dataset previously collected brain MRIs from which we are extracting features. Knowledge base is created for comparison

2.1 PROPOSED WORKFLOW

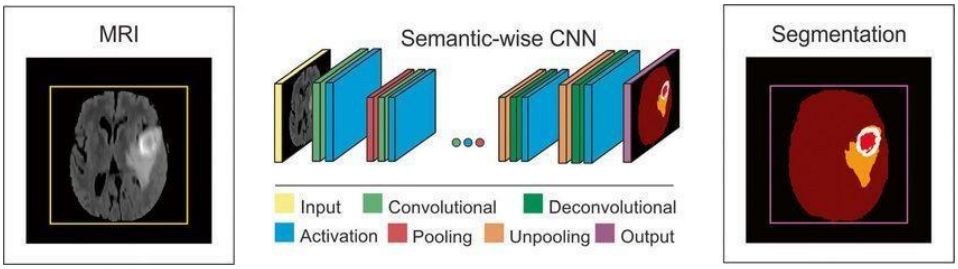


The proposed system has mainly five modules. Dataset, Pre-processing, Split the data, Build CNN model train Deep Neural network for epochs, and classification. In dataset we can take multiple MRI images and take one as input image. In pre-processing image to encoded the label and resize the image. In split the data we set the image as 80% Training Data and 20% Testing Data. Then build CNN model train deep neural network for epochs. Then classified the image as yes or no if tumor is positive then it returns yes and the tumor is negative the it returns no.

Different bio-medical image records are available for the study of brain tumour detection. Conventional methods are Computer Tomography CT and Magnetic Resonance Imaging MRI. Positron Emission Tomography, Cerebral , Lumbar Puncture, Molecular testing are also used for brain tumour detection. But these are expensive.MRI working with the principle that both the magnetic field and radio waves can create an image of the interior of the human body by detecting the water molecule present.

Portable and miniaturised MRI machines are developed now to avoid the complexity of conventional scanning methods. MRI has a better resolution and contains rich information. The MRI data set from the kaggle uploaded by Navoneel Chakrabarty has been used here.It contains 98 normal brain images and 155 abnormal images. In this data set, 'yes' means tumour images and 'no' means healthy images. The augmentation process is also applied here to increase the number of samples. Augmentation step

3, Working of CNN model



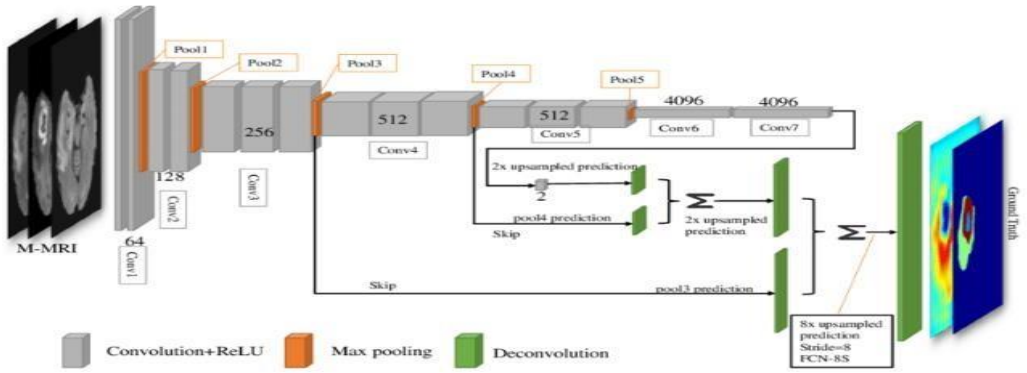
- **Convolution 2D:** In the Convolution 2D extract the featured from input image. It given the output in matrix form.
- **MAX Poolig2D:** In the MAX polling 2D it take the largest element from rectified feature map.
- **Dropout:** Dropout is randomly selected neurons are ignored during training.
- **Flatten:** Flatten feed output into fully connected layer. It gives data in list form.
- **Dense:** A Linear operation in which every input is connected to every output by weight. It followed by nonlinear activation function.
- **Activation:** It used Sigmoid function and predict the probability 0 and 1.
- In the compile model we used binary cross entropy because we have two layers 0 and
- We used Adam optimizer in compile model.

Adam:-Adaptive moment estimation. It used for non convex optimization problemlike straight forward to implement.

Working of VGG16 model

Transfer learning is a knowledge- sharing method that reduces the size of the training data, the time and the computational costs when building deep learning models. Transfer learning helps to transfer the learning of a pre-trained model to a new model. Transfer learning has been used in various applications, such as tumor classification, software defect prediction, activity recognition and sentiment classification. In this, the performance of the proposed Deep CNN model has been compared with popular transfer learning approach VGG16.

4. Working of VGG16 model for brain tumor detection



VGG16 is a convolutional neural network. The input of the 1 convolution layer is of fixed size 224 x 224 RGB image. The image is passed through a stack of convolutional layers, where the filters are used with a very small receptive field 3×3 (which is the smallest size to capture the notion of left/right, up/down, center). In the configurations, it is also utilizes 1×1convolution filters, and it can be seen as a linear transformation of the input channels. The convolution stride is fixed to 1 pixel, and the spatial padding of convolution. Input layer is the spatial resolution is preserved after convolution, i.e. the padding is 1-pixel for 3×3 convolution layers. Spatial pooling is carried out by five max-pooling layers, which follow the some convolution layers (not all the conv. layers are followed by max-pooling). Max-pooling is performed over 2×2 pixel window, with stride 2.

Three Fully-Connected (FC) layers are follow a stack of convolutional layers which has a different depth in different architectures and the first two have 4096 channels each, the third performs 1000-way ILSVRC classification and it contains 1000 channels one for each class. The final layer is the soft-max layer. The configuration of the fully connected layers is same in every network

All hidden layers are equipped with the rectification (ReLU) nonlinearity. It is also noted that none of the networks (except for one) contain Local Response Normalization (LRN), such normalization does not improve the performance on the ILSVRC dataset, but leads to increased memory consumption and computation time.

5. DATASET, IMPLEMENTATION AND RESULT

5.1 DATASET DETAIL

The dataset has 556 images with different types of tumor and also including images which has tissues of Fat or water.

1. DICOM Samples Image Sets, http://www.osirix-viewer.com/.[3]

2. "Brainweb:SimulatedBrainDatabase," http://brainweb.bic.mni.mcgill.ca/cgi/brainweb1.[4]

5.2 TOOLS & TECHNOLOGY USED

- **Python:** Python was the language of selection for this project. This was a straightforward call for many reasons.
    1. Python as a language has a vast community behind it. Any problems which may be faced is simply resolved with a visit to Stack Overflow. Python is among the foremost standard language on the positioning that makes it very likely there will be straight answer to any question
    2. Python has an abundance of powerful tools prepared for scientific computing Packages like NumPy, Pandas and SciPy area unit freely available and well documented. Packages like these will dramatically scale back, and change the code required to write a given program.This makes iteration fast.
    3. Python as a language is forgiving and permits for program that appear as if pseudo code. This can be helpful once pseudo code given in tutorial papers must be enforced and tested. Using python this step is sometimes fairly trivial. However, Python is not without its errors. The language is dynamically written and packages are area unit infamous for Duck writing. This may be frustrating once a package technique returns one thing that, for instance, looks like an array instead of being an actual array. Plus the actual fact that standard Python documentation does not clearly state the return type of a method, this can lead to a lot of trials .

- **Jupiter Notebook:** The Jupyter Notebook is an open-source web application that enables you to make and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modelling, data visualization, machine learning, and much more.
- **Noise Removal and Sharpening:** Unwanted data of element are remove using filter and image Can be sharpen and black and white gray scale image is used as a input.
- **Erosion and Dilation:** It is applied to binary image, but there are many versions so that can be work on grayscale images. The basic effect of the operator on a binary image is eroding away to the boundaries of regions for ground pixels.
- **Negation:** A negative is an image, usually it used on a strip or sheet of transparent plastic film, in negation the lightest areas of the photographed subject appear darkest and the darkest areas appear lightest.
- **Subtraction:** Image subtraction process is the digital numeric value of one pixel or whole image is subtracted from another image. The white part of tumor can be subtracted from another remaining part that is the black portion of the images.
- **Threshold:** Thresholding is a process of image segmentation. It converts the gray scale image into binary image.
- **Boundary Detection:** Total area or boundary can be form properly using boundary detection method. White part of tumor tissues can be highlighted and there proper boundary can be detected. It is useful method to calculate the size and shape occupy by tumor tissues.

6.Comparison table of CNN vs. VGG16

epochs	CNN	VGG 16
30	67.469877%	76.854917%
50	69.87952%	81.927711%
70	72.698794%	85.542166%

7, CONCULSION

In brain tumor detection we have studied about feature based existing work. In feature based we have study about image processing techniques likes image pre-processing, image segmentation, features extraction, classification. And also study about deep learning techniques CNN and VGG16.In this system we have detect the tumor is present or not if the tumour is present then model return's yes otherwise it return no. and we have compared CNN with the VGG 16 Model. The result of comparison VGG 16 is more accurate than CNN. However, not every task is said to be perfect in this development field even more improvement may be possible in this application. I have learned so many things and gained a lot of knowledge about development field

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