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BRAIN TUMOR DETECTION

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Abstract – *The growth of abnormal cells in our brain is called tumor. Our skull, which encloses our brain, is very rigid. Any increase inside this type of constrained space can purpose issues. According to study and research, if the tumor is detected in early stage then the patient can be cured by appropriate treatment. So, it is very critical to hit upon and treat the mind tumor in early stage. We present a model that helps in detecting and classifying the brain tumor using Watershed algorithm for image segmentation and Deep learning algorithm such as Convolution Neural Network which is used to classify the tumorous cells using the datasets.*

***Key Words*: Watershed, CNN, Accuracy, Tumor**

1.INTRODUCTION

An Intracranial Neoplasm or brain tumor is a mass that is formed inside the brain by the tissues surrounding the brain or the skull and directly affects human life. Tumor is classified into two types based totally on the vicinity of foundation and how cancerous they're. The noncancerous form of the tumor is called Benign. These are without problems distinguishable and have a sluggish growth price. Cancerous tumors are called Malignant. These are very aggressive and can be life-threatening as they are hard to detect. These tumors grow unevenly in the brain and apply pressure around them. The effect of pressure causes various disorders in the brain that affect the body and symptoms of such diseases in humans; dizziness, headache, fainting attacks, paralysis, etc. Unlike benign tumors, malignant tumors grow erratically, damaging the encircling tissues. For detecting tumor doctors opt for X-ray, CT scan or an MRI. MRI's are appropriate and provide sufficient information. An MRI experiment uses the homes of magnetism and radio waves to supply correct pictures. Neurosurgeons most commonly prescribe MRI's as it provides them with sufficient information to detect even the smallest abnormalities. Now after scanning the image, it is important to accurately detect the tumor, its size, and its location. All these records is essential for the Neurosurgeon to complete his diagnosis. This is wherein Computerized Image Processing involves assist. With the use of different segmentation techniques and feature extraction methods, we can accurately detect and classify the tumor with no human intervention.

Below shown are some of the images of tumorous cells and non-tumorous cells along with the cancerous and non-cancerous cells.

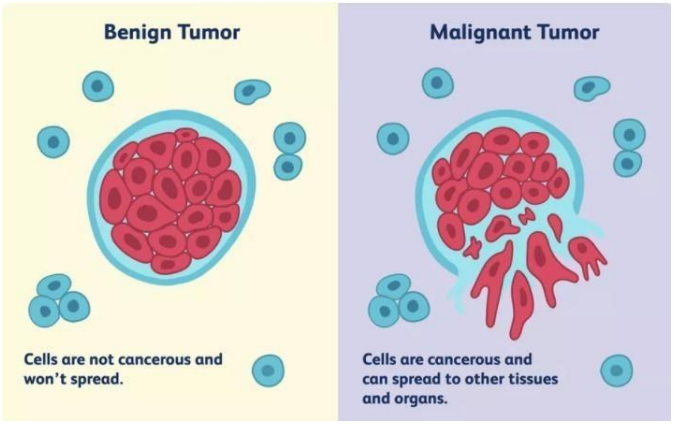

Fig 1.1: Cancerous and non-cancerous cells

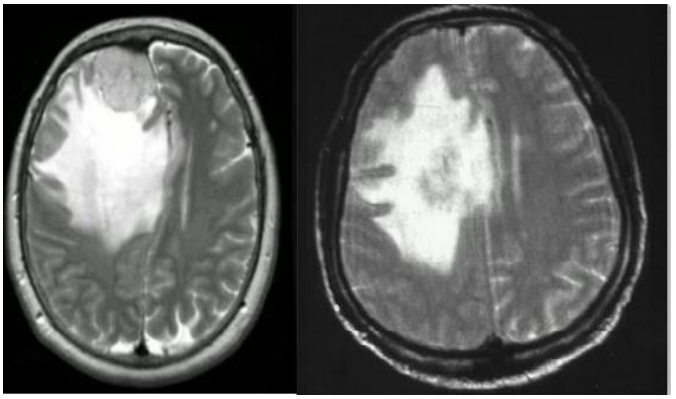

Fig 1.2: Tumorous cells

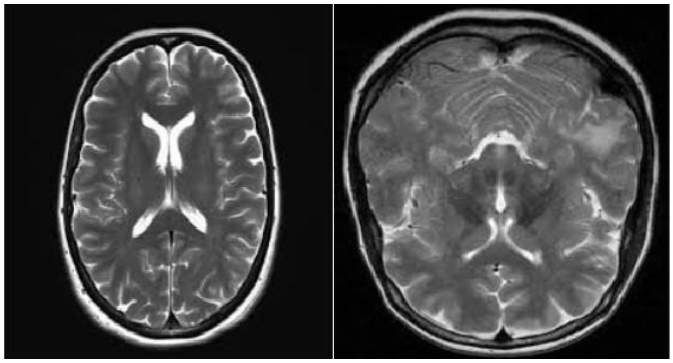

Fig 1.3: Non-tumorous cells

2. RELATED WORKS

In [1], Milica M. Badza et al., Here a CNN structure is used for the classification of brain tumor on 3 tumor types. Technological improvements and machine studying can resource radiologists in tumor prognosis without the use of invasive methods. An algorithm for machine learning that the CNN has achieved significant success in picture segmentation and classification.

In [2], Imran Ashraf et al., In this paper they explained about how the classification of brain tumor is done by doing the following steps, the proposed approach includes five middle steps. In step one, the linear comparison stretching is hired using region-primarily based histogram equalization and Discrete Cosine Transform (DCT). In the second one step, deep learning function extraction is achieved. By making use of switch mastering, two pre-skilled Convolutional Neural Network (CNN) fashions have been used for feature extraction.

In [3], Dr. R. C. Suganthe et al., They explained about detail about image classification algorithm helps in detecting the tumor at early stage with high accuracy brain tumor and types and how dangerous it is, and for detection and classification they proposed a deep learning method CNN and RNN for accuracy between them they proved RNN have 90% accuracy.

In [4], Rupal R Agravat et al., The main focus of this paper is to segment tumor from BRATS 2018 benchmark dataset and use age, shape and volumetric features to predict overall survival of patients and also, they tackled a problem of classifying the Brain tumor type and overall survival prediction they used several methods and they found the accuracy for each method so that they can adapt that method. The proposed technique makes use of fewer features however achieves better accuracy than nation-off-the-artwork strategies. In this they will divide the survival prediction into 3 parts based on factors like age and type of tumor as short mid, long survivors.

In [5], Axel Davy et al., In this paper they proposed a deep neural community based on convolutional neural networks and residual community for photo information. So, the CNN exploits both close by capabilities similarly to extra worldwide contextual features concurrently. Also, exclusive from maximum conventional makes use of CNNs, this community makes use of a final layer that may be a convolutional implementation of a totally related layer which allows a forty-fold accelerate. This also describe a 2-section schooling manner that lets in us to address difficulties associated with the imbalance of tumor labels. Finally, we discover a cascade structure wherein the output of a number one CNN is treated as a similarly supply of records for a subsequent CNN.

In [6], Lina Chato et al., Proposed paper automatically predict the survival rate of patients with a Glioma brain tumor by classifying the patient's MRI image using machine learning (ML) methods.in this the classes of survivors are divided as short-term, mid-term, and long-term. To improve the prediction results. For these Features like volumetric, statistical and intensity texture, histograms and deep features are taken. And used CNN for best accuracy prediction.

In [7], G. Hemanth et al., Proposes an automatic segmentation technique that relies upon CNN (Convolution Neural Networks), figuring out small 3 x three kernels. By incorporating this single method, segmentation and classification is carried out. CNN (a ML technique) from NN (Neural Networks) where it has layer based for results classification and steps involved to achieve this method with highest accuracy is also explained.

In [8], A. Martin et al., Proposed a new variational model for feature detection in images and its application to brain tumor segmentation. They explained about how Deep Learning framework for used for available knowledge from a specific application to optimize the parameters of the energy functional. They used only glio-blastoma patients database for detection hence its common type of brain tumor.

In [9], Muhammad Waqas Nadeem et al., This study is a assessment that summarizes a massive number of clinical contributions to the subject (i.e., Deep learning in thoughts tumor analysis), by using way of mapping a coherent taxonomy of research landscape from the literature), by mapping a coherent taxonomy of research landscape from the literature. The predominant characteristics of this new field had been examined and analyzed.

In [10], Li Sun et al., Using multimodal MRI scans, they demonstrated a deep learning-based system for brain tumor segmentation and survival prediction in glioma. Then, to find the most effective features, decision trees and cross validation are utilized. Finally, to predict patient overall survival, a random forest model is trained.

3. PROPOSED SYSTEM

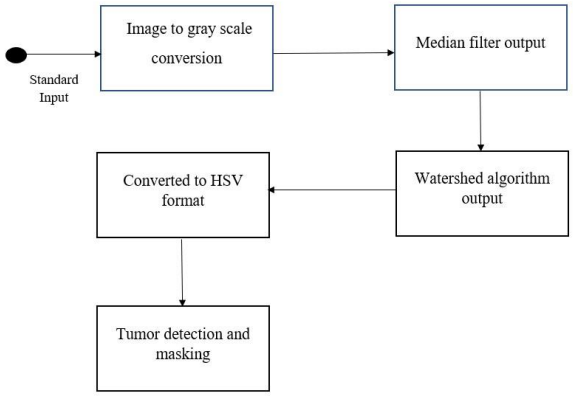

Fig 3.1: Methodology

Step 1: Input MRI image

- Input the data set from Kaggle website and it consists of 153 tumorous images and 94 non-tumorous images. Augmentation to the data set is done which means increasing the data set to make the training effective. Some of the augmentation techniques we followed are rotation, translation etc.
- The training data are split into validation and train data set by using Keras Image data generator.
- Obtain 1444 training image with 310 validation image and around 310 test images to evaluate our trained models on

Step 2: Data Pre-processing

- It is essential thing for the high-quality results. The fundamental part of pre-processing of picture information consists of removal of undesirable statistics and picture ought to be in proper format for processing so that effects are correct.

- Pre-processing involves processes like conversion to gray scale, noise reduction and noise removal, image reconstruction, Photo enhancement and regarding clinical pics may additionally contain steps like skull removal from an MRI image.

- One of the most common pre-processing practices is the conversion of the RGB image to a gray scale image. A gray scale picture includes sunglasses of gray without a obvious colour. This way that every pixel represents the intensity fee at that pixel without showing any colour. Also, not like a black and white picture, a gray scale picture has many splendid solar shades with white being the lightest coloration and black being the darkest. Also, in a gray scale image the intensity values at a pixel are not absolute and can be in fractions.
- Gray scaling is important as it provides a more accurate colour information which aids during segmentation. This is the number one step taken by means of all the researchers. Once the photograph is converted to a gray scale photograph, it's miles then filtered to get rid of extra noise.
- Filters are of two types, one that allows the low-end frequencies to pass or filters that allow the high-end frequencies to pass. A filter can either flatten the image or sharpen the image. When a filter is used to flatten the image, the noise is blurred leaving behind a smooth image however the finer details of the image are lost. If the photograph is to be sharpened than the filter out enhances the finer information, however this results in an multiplied quantity of noise within the photo. This noise have to be clipped before in addition processing as it is able to intervene with the accuracy of the detection program.

Step 3: Segmentation

- Image segmentation is a part of digital image processing and computer vision, segmentation is the process of dividing a digital image into a number of segments.
- The important intention of the segmentation is to change the illustration of an image into something that is extra significant and less complicated so this is less complicated to analyse.
- Perform the segmentation technique to segment out the tumor using Watershed algorithm which uses Morphological opening and Dilation techniques to detect the boundaries in the image.
- The input image for the segmentation algorithm is the image which is free from noises. We perform median filter for noise removal. Morphological watersheds provide a complementary approach to the segmentation of objects of an image so it is especially useful for segmentation of objects that are touching each other.
- In watershed method we view a gray scale picture as a topological surface, where the values of f(x, y) corresponds to heights. This algorithm also finds catchment basins and ridge lines.to get proper segmentation of image post processing of image is to be done, so the output image is converted to HSV format to mask out the tumor part in the image.

Step 4: Training Parameters

- The training was using Keras library of tensor flow. We used Adam optimizer for training with a learning rate of 1e-4. Learning rate plateau was applied to reduce the learning rate according to val loss improvement.
- We used binary cross entropy as our loss function and soft max layer was used to limit the probability between 0 and 1 in last layer of the neural network. The activation function used is ReLu which is the most commonly used function.

Step 5: Classification

- The Models that gives state of art results have a huge number of parameters. For a model to train properly number of samples required in the data set should be comparable to the number of parameters in the model. However, in medical domain getting so many data points is near to impossible hence, to handle this issue we use pretrained models.
- In this we load the weights for a training in which the model is trained on a very large data set, so while training on small number of medical data, we don't have to start from the scratch. The basic features like edge, corners are already covered in the pre-trained weights, hence training on the other image is simple.
- Classification is done using CNN algorithm: The Convolutional Neural Network (CNN) is a deep neural structure used to decode visual symbols. The most common uses are in recommender systems, image and video recognition, and clinical image examination. CNN is a multilayer perceptron version used in natural language processing, image classification, brain-computer interfaces, and monetary time series.

Step 6: Identification

- In this step the MR images categorized into two classes as normal and tumor. The accuracy is obtained by CNN. As the user inputs the image of the MRI image, the output will be displayed to the user along with its stage of the tumor description.

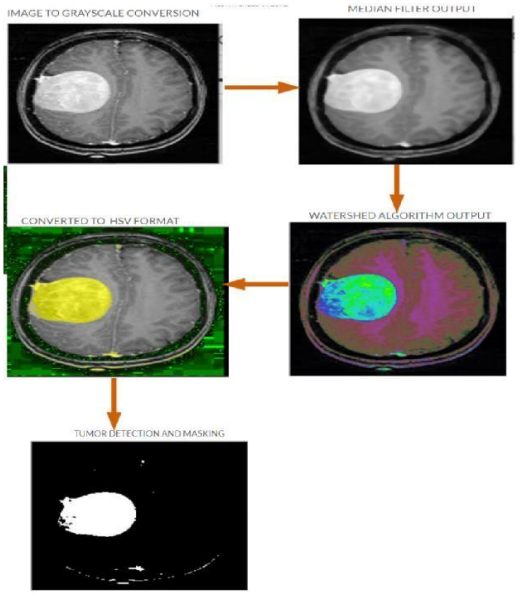

Fig 3.2: Flow of image through different processes

4. CONCLUSIONS

- The proposed model detects the tumor at early stage using the deep learning techniques such as convolution neural networks and watershed algorithms.
- In future studies, we hope to propose a model that will make it possible to use it on different medical images and in different fields.

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