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Brain Tumour Detection Using CNN

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***Abstract*—** In the early days, people were not aware of the brain tumour and they thought it was not curing a disease. Major control over the humanoid system is provided by the human brain. A brain tumour develops when brain cells grow and divide abnormally, and brain cancer develops when brain tumours continue to grow. Computer vision is important in the field of human health because it eliminates the need for human judgement to produce correct findings. The most dependable and secure imaging techniques for magnetic resonance imaging (MRI) are CT scans, X- rays, and MRI scans. MRI can identify minute items. Our paper wants to concentrate on the application of several methods for the identification of brain cancer using brain MRI. The bilateral filter (BF) was used in this study's pre-processing to get rid of any noise that was present . Imaging is the method and procedure used to provide visual depictions of a body's interior for use in clinical analysis and medical intervention, as well as to show how certain organs or tissues work. Medical imaging aims to identify and cure diseases as well as disclose internal structures that are covered by the skin and bones. In order to detect anomalies, medical imaging also creates a database of typical anatomy and physiology.

Keywords— Brain tumor, Magnetic resonance imaging, Adaptive Bilateral Filter, Convolution Neural Network.

1. Introduction

The handling of pictures on a computer is referred to as medical imaging processing. This processing entails a wide range of methods and actions, including picture acquisition, archiving, display, and communication. This procedure aims to manage and identify disorders. Through this approach, a database of the typical organ anatomy and function is created, making it simple to spot irregularities. This procedure uses sonography, magnetic scopes, thermal and isotope imaging, as well as radio-logical and organic imaging using electromagnetic energy (X-rays and gamma rays). The location and operation of the body are recorded using a variety of various technologies. Those methods are far more constrained than the techniques that result in pictures. A method of processing images involves using a computer to change the digital image. Using a computer to a

lter a digital image is known as an image processing technique. This method offers a lot of advantages, including flexibility, adaptability, data storage, and communication. The development of several picture scaling algorithms has made it possible to maintain photos effectively. This method requires numerous sets of criteria to be applied simultaneously in the pictures. Multiple dimensions can be handled for both 2D and 3D pictures. In this study, two distinct approaches are suggested for separating a tumour from an MRI picture and identifying the type of tumour. One segmentation approach and one clustering technique have both been used for this. Each MRI picture goes through an imaging chain where it is first cleaned up to reduce noise and then enhanced to increase contrast. In order to extract the tumour from the picture, two distinct strategies are proposed in this work. SVM Classification and SOM Clustering are two of these segmentation methods. By utilising each segmentation methodology, we are able to choose the best way to separate the tumour from each picture. Using the ginput() command, the tumour area represents the pixel values for the foreground points derived from a texture image. The range filt() technique is used to create the texture image. To make the texture better
The texture picture is given a smoothing filter to enhance its qualities. The principal obstacle encountered in this endeavour was was to identify the correct tumour location in the photograph, and then extract it. Because of a number of illumination difficulties, excessive white

There were elements in the picture that may have been mistakenly segmented as tumours. Additionally, the undesired noise and Contrast shows a number of areas from the picture that are incorrectly identified as tumours. Another difficulty was reduced MRI picture quality as a result of many issues that might have arisen during the acquisition phase.

2. Brain Anatomy:

One of the most prevalent and deadly brain disorders that has impacted and destroyed many lives throughout the world is the brain tumour. Cancer is a condition when cancer cells grow in the tissues of the brain. According to a recent cancer research,

more than 1 lakh people worldwide

receive a diagnosis of a brain tumour each year. Despite consistent attempts to deal with brain tumour consequences, statistics indicate unfavourable outcomes for tumour patients. To counter this, researchers are focusing on computer vision to better comprehend cancers in their early stages and how to treat them with cutting-edge therapies. The two most common procedures to determine the presence of a tumour and pinpoint its location for further treatment choices are magnetic resonance imaging (MR imaging) and computed tomography (CT) scans of the brain. Due to its portability and greater capacity to provide high-definition pictures of diseased tissues, these two scans are still employed often. There are currently a number of other treatments available for tumours, including chemotherapy, radiation therapy, and surgery.

The choice of treatment depends on a number of variables, including the tumor's size, kind, and grade as seen in the MR imaging. It is also accountable for determining whether cancer has spread to other bodily parts.

2.1 Motivation For Work

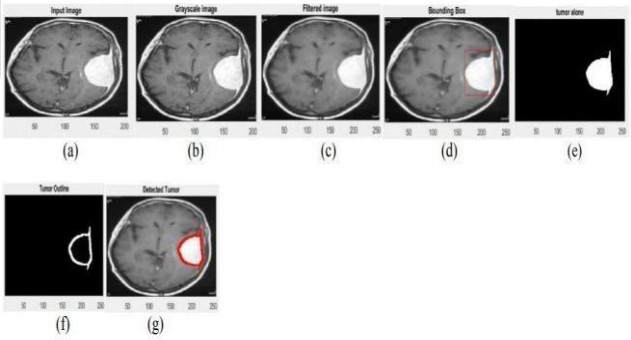
An abnormal development of cells in the brain or central spinal canal is referred to as a brain tumour. Some tumours may be malignant, therefore it's important to find them early and treat them. People may have brain tumours without being aware of the danger since the precise origin and specific set of symptoms are not known. Benign (do not include cancer cells) or malignant primary brain tumours are also possible (do not contain cancer cells).

When cells are dividing and developing in an improper way, brain tumours result. When it is identified by diagnostic medical imaging methods, it seems to be a solid mass. Primary brain tumours and metastatic brain tumours are the two different forms of brain tumours. A primary brain tumour is one that develops in the brain and is more likely to remain there than a metastatic brain tumour, which forms elsewhere in the body and spreads to the brain.

The location, size, and kind of the tumour all affect the symptoms of a brain tumour. It happens when the tumour exerts pressure on the cells in its vicinity. Additionally, it happens when the tumour obstructs the movement of fluid throughout the brain. Headache, nausea, and vomiting, as well as balance and walking issues, are typical complaints. The diagnostic imaging modalities like CT scans and MRI can find brain tumours. Depending on the site type and inspection goal, both modalities offer benefits in terms of detection. Since MRI scans are simple to analyse and provide precise information on where calcification and foreign masses are located, we chose to utilise them in our research.

2.2 Proposed Method

In this project, we have divided our goal into two parts; the first part deals with finding a brain tumour by looking for it in the MRI that has been supplied. The categorization of the tumour is found in the second component, which is the other part. Here, we will evaluate the MRI scans to determine if the tumour is benign or malignant based on its stage. The process flow diagram in general. The steps that the input photographs will go through may be summed up as follows:



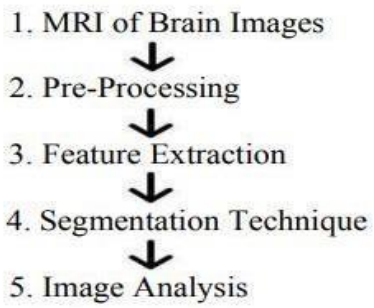


Figure 1: Brain tumor detection steps

2.2.1 MRI of Brain images

This is the first step of our proposed project .In this, the data is provided is the magnetic resonance images(MRI) that have been collected in their original format that (.img , .dcm). Mostly the mri images are of .dcm (DICOM[13]) Digital imaging and communications in medicine. We have used file operations file open(), file close() available in Matlab to read MRI images. Here the gray scale MRI images are been provided as input to the system.

2.2.2 Pre-Processing

The pre-processing phase of our project mainly involves those operations that are ordinarily essential before the goal analysis and extraction of the required data and ordinarily geometric corrections of the initial image. These enhancements embrace correcting the information for irregularities and unwanted region noise, removal of non-brain element images and converting the data so that they are correctly reflected in the original image. The first step of preprocessing is the conversion of the given input MRI image into a suitable form on which further work can be performed.

This conversion of DICOM image to .jpeg is done by using function dicom2image()[7]. Major issues related to the preprocessing stage are as follows:-

a. Noise,
b. Blur Low Contrast,
c. The bias,
d. The partial-volume effect.

This pre-processing stage is used for reducing image noise, highlighting important portions, or displaying obvious portions of digital images.

2.2.3 Feature Extraction

In this phase, the features of the given input image is are extracted . These features include smoothness, entropy, variance, kutosis, skewness, idm, correlation, homogeneity, mean and standard deviation . And on the basis of these features, the image is analysed and the detection of the tumor region is done. Below in figure 2 there are output results of an MRI image up till the feature extraction phase of the project.

In this project, segmentation means a method of dividing an image into many segments, but most of the difficulty in segmentation is related to the degree of the image, and the images are also individually housed, like X-ray film or MRI. . In a 2D image, each activity arrangement is called an element, and in a 3D image it is called a voxel. For simplicity, we usually use the term "pixels" to denote both the 2D and 3D cases.

When the constraint of having to combine regions is removed, the set is called a pixel classification, and the set itself is called a class. Pixel classification, rather than conventional segmentation, is usually an interesting goal in medical images, especially when distinct regions with similar tissue categories are known.

There are many types of phase action potentials for tumor segmentation from brain MRI. This split has some advantages and disadvantages. These strengths and weaknesses are explained meticulously in the first quadrangle described here. No algorithm is consistently good for all types of brain MRI images. Optimal selection of functional, tissue, brain, and non-brain elements is believed to be the main difficulty in brain image segmentation. Accurate segmentation across the field of view is therefore another very big problem. To solve this problem, we use the most reliable method of segmentation , a support vector machine and a self-organizing map, to determine whether a tumor is present in an input MRI image and, if present, classify its type as benign or malignant tumor. The support vector machine (SVM) approach is considered a good candidate due to its good generalization performance especially when the feature space has very high dimensionality. SVM uses the following concept: maps the input vector x to the high-dimensional feature house Z by an a prior chosen nonlinear mapping. The SVM accepts the use of images as input and provides similar accuracy to a neural network with hand-designed options on extraordinary handwriting recognition tasks.

The training point whose separation plane eventually equals the training point lying in one of the hyperplanes (H1, H2) and whose removal changes the found solution is called the support vector (SV). SVM classification Victimization T1-weighted and T1-weighted images that classify the brain into categories of neoplasm and nontumor. Here in our project, some of the functions used to implement svm are fitsvm()[7], crossval()[7], kfoldloss()[7]. The SVM methodology has the advantage of generalization and handling of high-dimensional feature domains. It assumes that knowledge is independent and identically distributed.

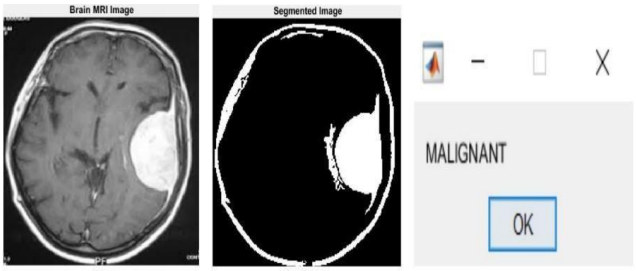
Though another strategy for thinking about data abstraction and exploiting the advantages of such classifiers is that they

are freed from the spatiality of the function house and the results obtained are quadratically correct , the training time is very long. Additionally, patient-specific learning and retention issues must be sacrificed for SVM-based strategies. It can also be seen that the SVM does not consider negative information that the feedback cannot learn well. Self- Organizing Maps (SOM) [10]. This is another classification technique used in this project. It consists of two layers of pieces, The first is an input layer, The number of neurons in this layer corresponds to the input dimension, The second is a competitive layer of pieces, Each neuron in this layer corresponds to a category or pattern. The number of neurons in this layer depends on the number of clusters and is organized in a regular geometric mesh structure.

Each association from an input layer to a neuron in a competing layer is labeled with a weight vector. SOM works in two steps , first finding the winning neuron. H. Geometric distance, the most similar neuron input by a similarity problem such as and the next winning neuron load and changes that input supported by neighboring pixels. As an unsupervised learning technique, the SOM algorithm relies heavily on training data representation and connection weight initialization. Secondly, they are terribly computationally costly, since because the dimensions of the information is increasing, dimension reduction visual image techniques become additional vital, Sadly, the time to calculating them conjointly increases. Self-organizing maps(SOM) is associate degree agglomeration network that maps inputs which may be higher dimensional to two- dimensional distinct lattice of neuron cell units

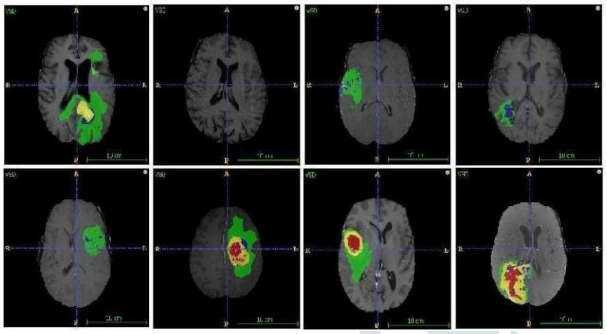
2.2.4 Image Analysis

After the type of tumor is been identified the image analysis is done to determine the accuracy of the result. Here in this project four types of accuracy are been shown. that are Rbf accuracy, Linear accuracy, Polygonal accuracy and Quadratic accuracy. These accuracies help in analysis of the image result.



3. Challenges In Tumor Classification

Tumor identification is an extremely difficult process. Segmentation is an extremely difficult process since the tumor's location, shape, and structure differ greatly from patient to patient. The photos of the same brain slice taken from many patients are displayed in the figure below, which amply demonstrates how the tumour might vary from patient to patient. In each of the eight images/patients shown, the position of the tumour is distinct as can be easily seen. Even worse, each of the eight patients and photos has a different intra-tumoral anatomy and form. In reality, as seen in the photos below, a tumour may exist in more than one place. This does definitely illustrate how intricate automated segmentation is.



4. Module Division

This offers the system's design as it would be created by human hands. It entails six steps: obtaining an input picture from the data collection, image pre-processing, image enhancement, binary thresholding image segmentation, and classification of brain tumours using Convolutional neural networks.

Following the completion of all the a fore mentioned procedures, the product is then scrutinised. Every module is distinctive in some manner. Every action has a purpose. A testing and training data set is also included in this design. Nearly 400 photos make up the data set, which was downloaded from Kaggle and is used to train and test the system. The noise filter like Median is used to pre-process the input picture.

Software Requirement

Python: The design philosophy of Python, an interpreted, high-level, general-purpose programming language developed by Guido Van Rossum, stresses With its noticeable usage of considerable Whitespace, the code is readable. Its language elements and object-oriented methodology are designed to aid programmers in creating clean, comprehensible code for both small and big projects. Python has garbage collection and dynamic typing.

Programming paradigms including procedural, object-oriented, and functional programming are all supported.

Pip: It is used to install packages and manage software written in python.

NumPy:

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays. It is the fundamental package for scientific computing with Python. It contains various features, including these important ones:

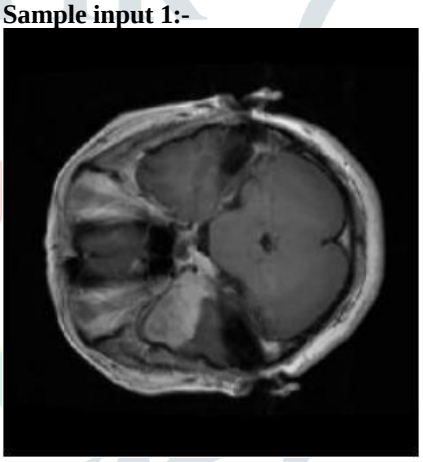
- A powerful N-dimensional array object
- Sophisticated (broadcasting) functions
- Tools for integrating C/C++ and Fortran code
- Useful linear algebra, Fourier transform, and random number capabilities

Kaggle: Data scientists and machine learning experts may connect online at Kaggle, a division of Google LLC. Users may discover and share data sets on Kaggle, study and develop models in a web-based data science environment, collaborate with other data scientists and machine learning experts, and participate in contests to address data science issues.

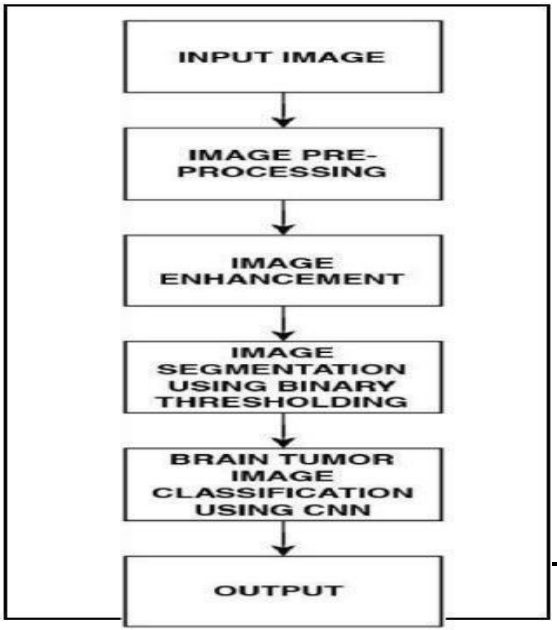
In addition to a public data platform, a cloud-based workbench for data science, and artificial intelligence courses, Kaggle now provides machine learning tournaments, which is how it was initially introduced in 2010.

5. Experimental Result:

Sample input 1:-

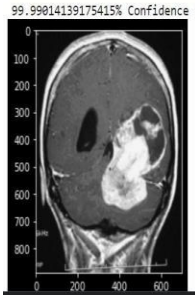


Predicted output:- Yes this is tumour

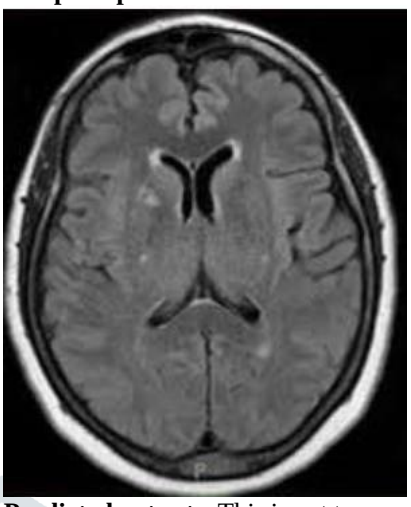


```
from matplotlib.pyplot import imshow
img = Image.open("/kaggle/input/brain-mri-images-for-brain-tumor-detection/yes/Y104.j
x = np.array(img.resize((128,128)))
x = x.reshape(1,128,128,3)
res = model.predict_on_batch(x)
classification = np.where(res == np.amax(res))[1][0]
imshow(img)
print(str(res[0][classification]*100) + '% Confidence This Is A ' + names(classificat
```

```
99.99014139175415% Confidence This Is A Its a Tumor
```



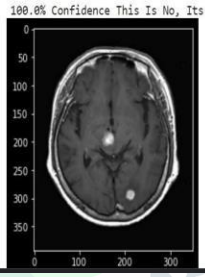
Sample input 2:-



Predicted output:- This is not tumour

```
from matplotlib.pyplot import imshow
img = Image.open(r"../input/brain-mri-images-for-brain-tumor-detection/no/N17.jpg")
x = np.array(img.resize((128,128)))
x = x.reshape(1,128,128,3)
res = model.predict_on_batch(x)
classification = np.where(res == np.amax(res))[1][0]
imshow(img)
print(str(res[0][classification]*100) + '% Confidence This Is ' + names(classificatio
```

```
100.0% Confidence This Is No, Its not a tumor
```



Conclusion

In this project we have automated the diagnosis procedure for the brain tumor detection by the use of image processing. Apart from several existing brain tumor segmentation and detection methodology are present for MRI of brain images, our project has proved to provide an all accuracy of up to 97%. All the steps for detecting brain tumors that have been discussed, starting from MRI image acquisition ,pre-processing steps to successfully classification of the tumor using the two segmentation techniques have been done. Pre-processing involves operations like wavelet based methods has been discussed. Quality enhancement and filtering are important because edge sharpening, enhancement, noise removal and undesirable background removal improve the image quality as well as the detection procedure. Among the different filtering techniques, Gaussian filter suppresses the noise without blurring the edges and it is better outlier without reducing the sharpness of the images. It reduces noise; enhances the image quality and is computationally more efficient than other filtering methodology. After the image quality improvement and noise reduction discussed here, segmentation methodology for a brain tumor from MRI brain images has been used. Classification based segmentation segments tumors accurately and produces sensible results for a big information set, , However, undesirable behaviours can occur in cases wherever a

category is unrepresented in training data. Clustered based segmentation is straight forward, quick and produces sensible results for non-noise images except for noise pictures, it leads to serious inaccuracy within the segmentation . In Neural network based segmentation performs better on the noise field and there is no need for assumption of any fundamental data allocation, but the learning process is one of the great disadvantages of it. In spite of several dealing of problems, an automization of brain tumor segmentation using combination of threshold based and classification with SVM and SOM overcame the problems and gives effective and accurate results for brain tumor detection. These classification methods are able to first detect whether there is a tumor or not, and, if it is there, then they are able to determine whether the tumor is benign or malignant type.

Using the Convolution Neural Network, we suggested a computational technique for the segmentation and detection of a brain tumour. Using the file location, the input MR pictures are read from the local device and transformed into grayscale images. To remove noises that were present in the original photos, these images are pre-processed using an adaptive bilateral filtering algorithm. Convolution Neural Network segmentation and binary thresholding are performed to the denoised picture to identify the tumour location in the MR images. The suggested model yields encouraging results without any errors and takes a great deal less computational time, with an accuracy of 95%.

Future scope

Experimentation shows that the suggested method requires a large training set for more accurate results; in the field of medical image processing, collecting medical data is a laborious task, and in certain rare instances, the datasets could not be accessible. In each of these scenarios, the suggested method must be trustworthy enough to reliably identify tumour locations from MR images. The suggested method can be further improved by working with weakly trained algorithms that can detect irregularities with little or no training data. Self-learning algorithms would also help to improve algorithm accuracy and speed up processing.

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