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BRAIN TUMOUR DETECTION USING CONVOLUTIONAL NEURAL NETWORKS

Mohammad Tahseen Raza*1

*1Department Of Computer Science And Engineering SRM Institute Of Science And Technology Chengalpattu, India.

ABSTRACT

As the tumour grows, it exerts pressure on adjacent brain tissue and alters its function, resulting in indications and symptoms such as headaches, nausea, and balance issues. Early detection of a brain tumour provides the possibility for effective medical therapy. When compared to computed tomography pictures, magnetic resonance imaging (MRI) images have been found to be more detailed and consistent. There are several methods for detecting brain tumours or neoplasms. After reviewing various relevant research publications, this paper discusses the most competent and effective algorithms. Brain image preprocessing, segmentation, feature extraction, grouping, and detection of the tumour are the methodologies in most research.

I. INTRODUCTION

A brain tumour is an abnormal cell growth or mass in the brain. There are many different types of brain tumours, such as medulloblastoma, chondrosarcoma, and chordoma. Some brain tumours are benign (noncancerous), while others are cancerous (malignant). Brain cancers can start in the brain (primary brain tumours) The rate at which a brain tumour grows varies substantially. The rate of growth of a brain tumour, as well as its location, define how it will influence the function of your neurological system. The type of brain tumour you have, as well as its size and location, influence your treatment options. Exposure to substantial levels of radiation from X-rays or previous cancer treatment is the only known environmental cause of brain tumours.

A brain tumour starts in the brain cells and spread to the rest of the body (as depicted). As the tumour grows, it exerts pressure on adjacent brain tissue and alters its function, resulting in indications and symptoms such as headaches, nausea, and balance issues.

MRI with tumor is difficult to segment due to a combination of the following factors:

1. The tumour mass effect causes non-tumor structures to distort.

2. Edema and tumour infiltration of brain tissue (swelling). Edema appears primarily in white matter regions around the tumour.

3. The change from tumour to edema is slow, and the line between the two forms is sometimes difficult to distinguish.

4. T1w with contrast enhancement (usually using gadolinium) is the conventional MRI modality for detecting tumours, although it isn't always the best option. Blood arteries and cortical cerebrospinal fluid are often highlighted alongside tumours, but necrotic tissue sections of the tumour are not increased at all. By merely thresholding the contrast enhanced t1w image, it is nearly hard to segregate tumours.

NOVELTY OF THE PROJECT

The first portion of this research is concerned with the detection of a brain tumour, which is defined as the existence of the tumour in the given MRI. The classification of the tumour is found in the other component, which is the second part. Here, we'll examine the MRI scans to determine whether the tumour is benign or malignant. The schematic represents our method in general. The input photos will go through several steps, which can be summarized as follows.

II. EXPERIMENTAL METHODOLOGY

MODULE 1: - Image Acquisition

The MRI pictures are first captured, and then these images are fed into the pre-processing stage. Collecting MRI pictures is the basic mechanism by which the process begins.

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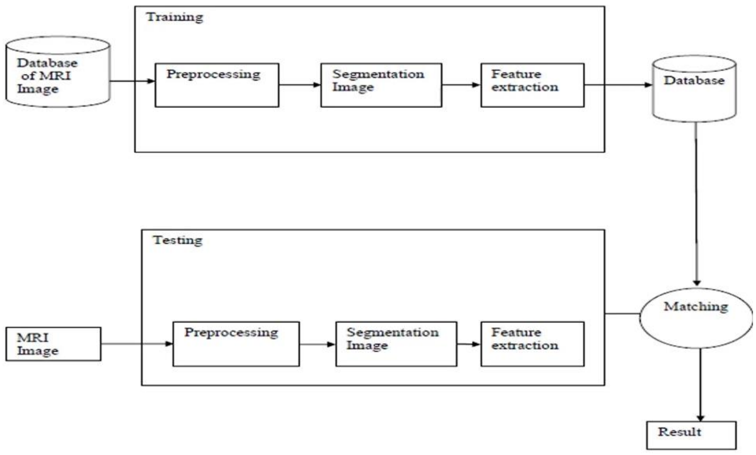
System Architecture:



MODULE 2: - Preprocessing

1.) Preprocessing is necessary because it improves the image data and improves some of the image attributes that are relevant for subsequent processing.

2.) The RGB MRI picture is transformed to grayscale, and the median filter is used to remove noise from brain MR images. Because great accuracy is required, the noise must be eliminated before further processing.

3.) Canny edge detection is used to detect edges in a filtered image. For image segmentation, the detected image of the edges is necessary.

4.) Watershed segmentation is used to pinpoint the tumor's position in the brain picture.

MODULE 3: - Segmentation

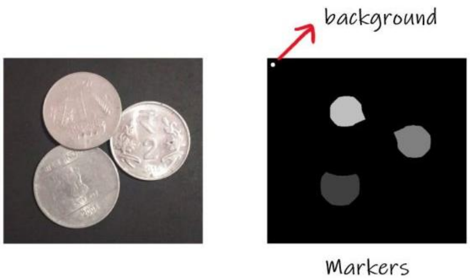
1) Segmentation is the process of dividing an image into multiple segments.

2) The goal of segmentation is to transform an image's representation into something that is easier to examine.

3) The process of separating the tumour from normal brain tissues is known as segmentation.

4) The watershed segmentation technique is used to locate the tumour in MRI images.

5) The label picture is the outcome of watershed segmentation. The different things that are identified in the label image will have distinct pixel values.



MODULE 4: - Feature Extraction

1) When an algorithm's input is too vast and redundant to process, it's turned into a smaller set of features called a feature vector. Feature extraction is the process of transforming this input data into a set of features. The main features necessary for picture categorization are extracted in this step.

2) A segmented brain MRI picture is employed, and texture features from the segmented image are retrieved, revealing the image's texture property.

3) Conv2d is used to extract these characteristics since it is a reliable and high-performing approach.

4) Conv2d layers are commonly employed in image recognition jobs to achieve high accuracy. They do, however, necessitate a lot of calculations and use a lot of RAMS. The complexity of the convolution procedure is reduced by using dilated or aurous convolutions.

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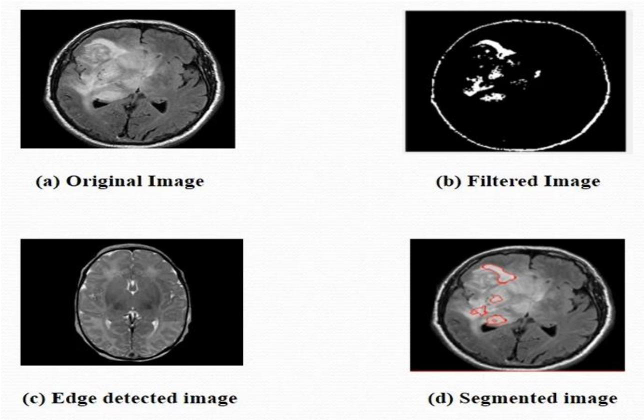


MODULE 5: - Classification

1) MRI brain picture classification into normal or pathological.
2) Each node in a multilayer perceptron is a neuron that has a nonlinear activation function.
3) We can determine whether a tumour is present or not using the above components.
4) This procedure aids in determining the tumor's size, shape, and location.

TECHNICAL SPECIFICATIONS

CV2: unofficial pre-built CPU-only OpenCV packages for python" is the module import name for OpenCV-python. Traditional OpenCV contains a lot of difficult procedures that need you to develop the module from the ground up, which is unnecessary. I'd suggest sticking with the OpenCV-python library.

Python imaging library pillow (PIL): The Python Imaging Library (abbreviated as PIL) (now known as pillow in latest versions) is a free and open-source extension library for the Python programming language that adds support for accessing, processing, and storing a wide range of image file types. It works on Windows, Mac OS X, and Linux. Pillow has a number of standard images altering methods.

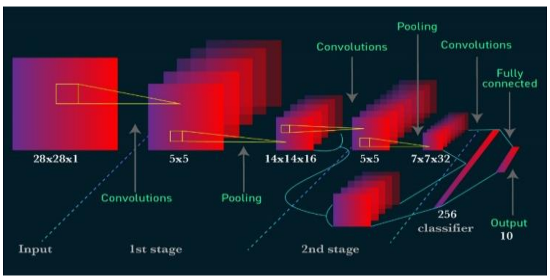
NumPy: Python's numerical programming language is known as NumPy. It is an open-source project that you are free to use. NumPy is a Python module that allows you to interact with arrays. It also provides functions for working with matrices, Fourier transforms, and linear algebra. We have lists in Python that act as arrays, however they are slow to process. NumPy intends to deliver a 50-fold quicker array object than ordinary Python lists.

Tensor Flow: Is now an open-source machine learning platform based on start to finish. It has a large, flexible ecosystem of tools, libraries, and community resources that allow scholars to push the limits of ml and developers to quickly construct and deploy ml-powered applications.

Keras: Is an open-source software library for artificial neural networks that provides a python interface. keras is a library for tensor flow that functions as an interface. Keras supported several backends until version 2.3, including tensor flow, Microsoft cognitive toolkit.

Convolutional neural networks

Image classification is extracting features from an image in order to identify patterns in a dataset. A convolutional neural network (CNN) is a form of artificial neural network that is specifically intended to process pixel input and is used in image recognition and processing.CNN is a feed-forward artificial system whose connectivity structure is inspired by the arrangement of the visual cortex of animals. A limited group of cells in the visual cortex are sensitive to certain areas of the visual field.



Different steps used in CNN

Step-1: Select a dataset.

Choose a dataset that interests you or design your own image dataset to solve your own image classification problem. For the MRI pictures, we will be using the Kaggle data set.

Step 2: Prepare a training dataset

Assigning pathways and defining categories (labels), as well as resizing our images, will be part of the preparation our dataset for training.

Step 3: Gather data for training

The picture pixel values and the index of the image in the categories list will be placed in the training array.

Step 4: Labels and features are assigned

Both l shapes will be used in neural network categorization .

Step 5: Normalizing x and converting labels to categorical data

Step 6: Split the x and y coordinates for use in CNN

STEP-7 CNN Model Architecture

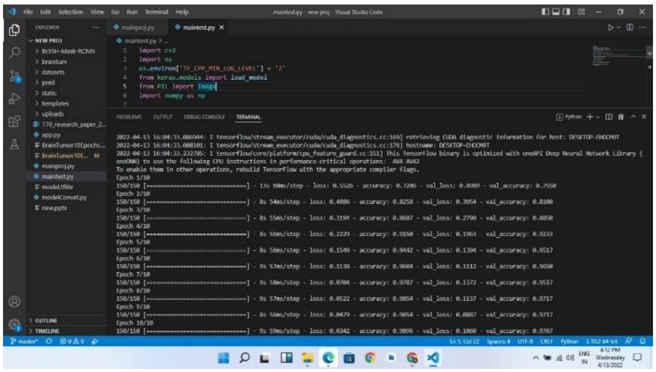
Accuracy Score : 0.9767

In these 7 simple steps, you would be ready to train your own convolutional neural networks.

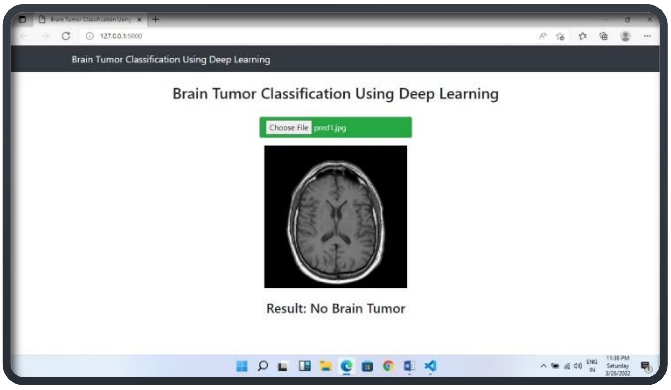
Result

CNN Model Architecture

Accuracy Score: 0.9767



Website



MOBILE APP

Advantages

User friendly interface:

• This software has capabilities that can be utilized for a variety of purposes. Other applications may take more computer memory; however, this application can bring photos from the server and free up computer memory.

• This is accessible in all the formats (website, Android app).

• Many other applications may have a difficult interface, but this application offers a graphical user-friendly interface that can save the operator and new users time while learning how to use this software.

Accuracy:

• As the base of this program is a machine learning, many data is collected from various hospitals or the CT scan of brain.

• A huge library is generated over servers, and it's regularly updated. This can guarantee accurate data reading and perfect representation of the sports or the whites which are reflected on the images to the image, which is been uploaded by a user, thus giving an accurate result.

Time consumption:

• The software's main goal was to shorten the amount of time it took to detect a tumour using a CT scan. By utilizing machine learning technology, the software substantially decreases the user's and doctors' time.

III. APPLICATIONS

• The application's main goal is to identify tumours and treat them.

• The primary goal for the development of this application is to deliver appropriate treatment as quickly as possible and to protect human life in danger.

• This software is used in the development and production of pharmaceuticals.

• Both doctors and patients will benefit from this application.

• This app is used to keep a record of smart health records.

• Manual identification is slow, inaccurate, and inefficient; consequently, this application was created to address these issues.

• The purpose of this application is to improve radiotherapy.

• It's an easy-to-use programmed.

CUI Manual diagnosis of tumours by clinicians referring MRI scans is a time-consuming task in the medical sector, and it might be ineffective for big amounts of data. Image processing and machine learning techniques can be utilized to identify the tumour from the images instead of manual identification. As a result, this model aids in the development of a system that will do image processing and identify the Brain Tumor using a machine learning approach. Also, in the highlighted area of the image, show the position of the tumour.

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IV. CONCLUSION

• In hospitals, provide an app-based user interface that allows clinicians to quickly assess the impact of a tumour and make treatment recommendations. even though the lopo test scheme is computationally expensive, it allows us to collect more training data, which is necessary for convnet training.

• Use classifier boosting approaches to improve testing accuracy and computation time, such as employing more number images with more data augmentation, fine-tuning hyper parameters, and training for a longer duration. using more epochs, adding more layers that are acceptable.

• Building a model from the training data, then developing a second model that seeks to fix the flaws from the first model for faster prognosis, is how classifier boosting works. such strategies can be utilised to improve the accuracy even more, allowing this technology to be a valuable addition to any medical facility that deals with tumours.

• We can use u-net architecture instead of CNN for more complex datasets, where the max pooling layers are simply replaced by up sampling ones. we eventually want to employ very big and deep convolutional nets on surveillance videos where the temporal structure provides very helpful info that is missing or less visible in static images.

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