Mini Project Report on

Brain Tumour Detection using Convolutional Neural Network

Submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by:

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CANDIDATE’S DECLARATION

I hereby certify that the work which is being presented in the project report entitled **“Brain Tumour Detection using Convolutional Neural Network”** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering of the Graphic Era (Deemed to be University), Dehradun shall be carried out by the under the mentorship of **Guru Prasad M S, Professor**, Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun.

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Chapter 1

Introduction

Brain tumours, also known as intracranial tumours can form at any age and are highly diverse in position and appearance along with being extremely debilitating. According to the International Association of Cancer Registries (IARC), more than 28,000 people are diagnosed with brain tumours every year just in India in which more than 24,000 people die. The detection of these tumours is a challenge faced by even the best doctors in the field of radiology, since a lot of times these tumours can materialise as normal tissue and can remain inconspicuous for a long period of time, enough to make them life-threatening for the patient. Moreover, the detection becomes more laborious once the quantity of data becomes substantial. The accurate identification of these tumours is very important and can be life-saving. Currently MRIs are used in manual-assisted detection of brain tumours. MRI (Magnetic Resonance Imaging) is used to generate 2-Dimensional images of these tumours which can be studied to identify and detect a tumour.

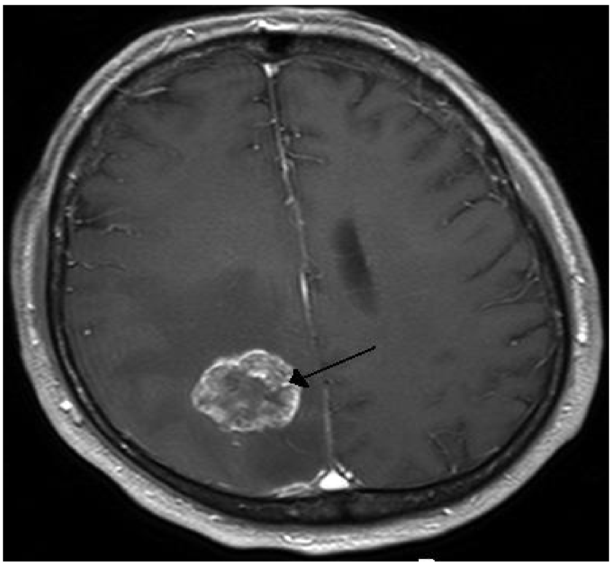

Fig 1.1: Showing a tumorous growth in the Brain

In this project we limit our discussion to one of the many solutions Machine Learning gives us to this grave problem i.e Convolutional Neural Networks. CNN is used to classify and detect objects in an image by using grid-like topology. It is also known as Convnet and is an important tool in image classification. There are various layers in a neural network, some of which are called hidden layers. These hidden layers extract image features by using different manipulations and calculations. Some examples of these hidden layers are pooling layer, ReLU layer etc.

A pre-made dataset containing MRI images of various patients was used as a feed, some of which had tumours and others didn't. High level APIs such as tensorflow and Keras were used to train the model and implement neural networks. It is important to note that Keras runs on top of tensorflow. Both these tools are used for image classification and tumour detection. For a smaller database like ours Keras is preferred much more over tensorflow which is more complex.

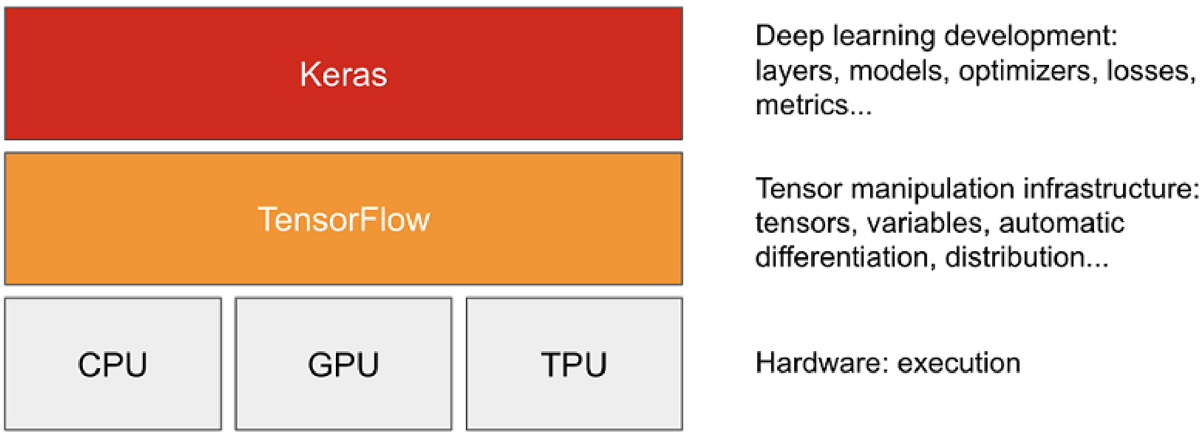

Fig 1.2: Shows the working of Keras and Tensorflow

The main idea behind using machine learning and CNN for solving this problem is to train a pre-existing model to predict the behaviour of a new problem. This type of prediction model is called Transfer Learning.

We have used accuracy as a metric to justify the model performance which can be defined as:

Accuracy = Number of correctly predicted images / Total number of tested images × 100%.

Chapter 2

Literature Survey

The Literature Survey for this project was done with primary focus on the different datasets and methodologies that can be used for brain tumour detection. The need for higher and more consistent accuracy was the main driving force behind using all these different techniques.
A detailed study was done to understand the implementation of these techniques and the future scope for research was also analysed.

[2022]: "Accurate brain tumour detection using deep convolutional neural network" [1]

Conclusions: The authors have used a finely tuned transfer model of VGG-16 and a 23-layered CNN model for the classification of normal and abnormal brain images. The project architecture begins with image extraction and feeding labels from the dataset. The extracted images then need to be preprocessed before splitting them into three sets namely training, validation, and test set. Several image pre-processing techniques were used before feeding the images to the classifiers. A comparative study of all the different methods used in the past was also done.

Classifier	Classification Type	Accuracy
CNN	Multi class	97
KNN	Binary Class	98.6
Deep Learning + Active Contouring	Multi class	92
Mask RCNN + ResNet-50	Multi class	95.9
SVM	Binary Class	98.0
SVM and KNN	Multi Class	91.2
VGG19	Multi Class	94.5
Fine-tuned VGG16	Binary Class	100

Fig 2.1: Figure showing the comparative accuracy using different classifiers

[2020]: “Convolutional Neural Network for Brain Tumour Detection”[3]

Conclusions: This is an open source, abstract paper that briefly talks about the two comparative methodologies that have been used to achieve an accuracy of 98%.

The authors use CNN and VGG-14 to carry out image segmentation and calculate results accordingly.

[2019]:”Brain Tumour Detection Using Convolutional Neural Network”[5]

Conclusions: Brain tumour segmentation is done using the six traditional classifiers namely , K-Nearest Neighbour (KNN), Multilayer Perceptron (MLP), Support Vector Machine (SVM), Logistic Regression, Naïve Bayes and Random Forest which was implemented in scikit-learn. Following this Keras and Tensorflow were used to build and CNN model.

[2018]: “Brain Tumour Classification Using Convolutional Neural Networks”[4]

Conclusions: The authors use Brain Tumour Image Segmentation Benchmark (BRATS) 2015 testing dataset. The pre-existing model of classification using Support Vector Machine (SVM) requires feature extraction output based on which the accuracy is calculated and output is generated, this results in high computation time and low accuracy. Hence, in this proposed model the feature value is taken from CNN itself, which increases the accuracy and also reduces the computation time.

Chapter 3

Methodology

Dataset:

The project uses a database available on Kaggle[2] provided by Navoneel Chakraborty. The dataset comprises around 260 images out of which 155 MRI images show tumorous growth whereas 105 images show an MRI scan with normal brain tissue.

Setting up the environment:

We import all the necessary libraries for our CNN model.

```
import numpy as np
from tqdm import tqdm
import cv2
import os
import shutil
import itertools
import imutils
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelBinarizer
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, confusion_matrix

import plotly.graph_objs as go
from plotly.offline import init_notebook_mode, iplot
from plotly import tools

from keras.preprocessing.image import ImageDataGenerator
from keras.applications.vgg16 import VGG16, preprocess_input
from keras import layers
from keras.models import Model, Sequential
from keras.optimizers import Adam, RMSprop
from keras.callbacks import EarlyStopping

init_notebook_mode(connected=True)
RANDOM_SEED = 123
```

Fig 3.1: Figure showing the setting up of our environment

Data Augmentation and Preprocessing:

To extrapolate the data, Image Augmentation was done on the dataset.

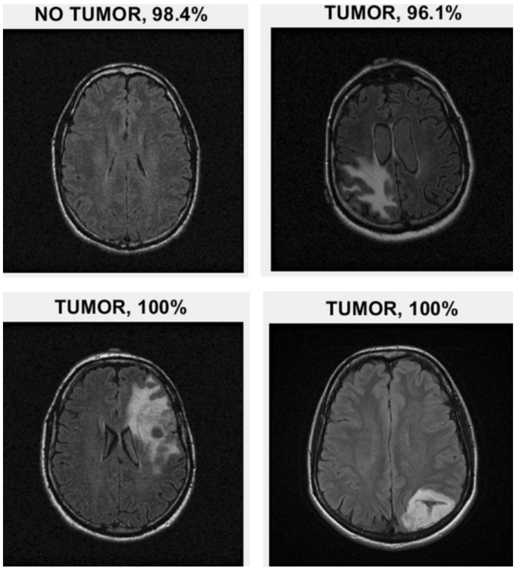

Fig 3.2: Shows some of the augmented images from the dataset

We have used “ImageDataGenerator” which is a tool provided by Keras to augment our data. It replaces the original batch, with a newly generated, randomly transformed batch of images. After this we loaded this newly augmented data into our python notebooks using the os module, we made three different directories namely img_dir, yes_dir, and no_dir containing all the images, the images with the tumour, and images without tumour respectively. Using Numpy we convert these images into arrays .After loading the images we perform some image contouring using reshape and resize.

```
def augment_data(file_dir, n_generated_samples, save_to_dir):
    data_gen = ImageDataGenerator(rotation_range=10,
                                  width_shift_range=0.1,
                                  height_shift_range=0.1,
                                  shear_range=0.1,
                                  brightness_range=(0.3, 1.0),
                                  horizontal_flip=True,
                                  vertical_flip=True,
                                  fill_mode='nearest'
                                 )

    for filename in listdir(file_dir):
        image = cv2.imread(file_dir + '/' + filename)
        # reshape the image
        image = image.reshape((1,)+image.shape)
        save_prefix = 'aug_' + filename[:-4]
        i=0
        for batch in data_gen.flow(x=image, batch_size=1, save_to_dir=save_to_di
r,save_prefix=save_prefix, save_format='jpg'):
                i += 1
                if i > n_generated_samples:
                    break
```

Then we append values into the array where

0: Images with no tumour

1: Images with tumour

Training and building our model for prediction:

For the scope of this project we have used a sequential model which is the easiest model you can build in Keras as it allows you to build layers one by one. There are three layers in our model consisting of 32, 64, and 54 nodes in each layer respectively.

```
model=Sequential([

                     #cnn
                    layers.Conv2D(32,(3,3),activation="relu",input_shape=(64,64,
3)),
                    layers.MaxPooling2D((2,2)),

                    layers.Conv2D(64,(3,3),activation="relu"),
                    layers.MaxPooling2D((2,2)),

                    layers.Conv2D(54,(3,3),activation="relu"),
                    layers.MaxPooling2D((2,2)),

                     #dense_layer
                     layers.Flatten(),
                     layers.Dense(64,activation="relu"),
                     layers.Dense(2,activation="softmax")


])

model.compile(
    optimizer="adam",
    loss="sparse_categorical_crossentropy",
    metrics=["accuracy"]
)
```

Fig 3.4: Figure showing Model building using Keras

Chapter 4

Result and Discussion

The outcomes of this project have provided valuable insight into the different techniques that can be used to implement image processing using Convolutional Neural Networks and various other classifiers. Along with this we also notice the use of techniques such as data augmentation, data padding, reshaping etc. Through the project we could achieve an accuracy of 89% in tumour prediction wherein our model was based on Sequential technique.Hence the results should be interpreted with caution due to the limitations of this project.

Chapter 5

Conclusion and Future Work

The proposed method of classification cannot achieve maximum accuracy and hence holds a lot of scope for improvement. Using our current model we can only achieve accuracy up-to 95% but recent research shows that using techniques such as "fine-tuned VGG-16", it is possible to achieve accuracy of even 100%. However, a more diverse dataset that caters to all possible types of tumours need to be evaluated and worked upon.

References

[1] Khan MSI, Rahman A, Debnath T, Karim MR, Nasir MK, Band SS, Mosavi A, Dehzangi I. "Accurate brain tumour detection using deep convolutional neural network." Comput Struct Biotechnol J. 2022 Aug 27;20:4733-4745. doi: 10.1016/j.csbj.2022.08.039. PMID: 36147663; PMCID: PMC9468505.

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