BRAIN TUMOR DETECTION USING MACHINE LEARNING

 Pankaj Kunekar1 Tanmay Khiratkar2

 pankaj.kunekar@vit.edu tanmay.khiratkar20@vit.edu

1,2Department of Multi-disciplinary Engineering

Vishwakarma Institute of Technology,

Pune 411037, Maharashtra, India

***Abstract: -*** **A brain tumour is a disease caused due to the uncontrolled growth of abnormal cells in the brain. Survival rate of a tumour prone patient is difficult to predict because brain tumour is uncommon and are different types. As per the cancer research by United Kingdom, around 15 out of every 100 people with brain cancer will be able to survive for ten or more years after being diagnosed. Treatment for brain tumour depends on various factors like: the type of tumor, how abnormal the cells are and where it is in the brain etc. With the growth of Artificial Intelligence, Deep learning models are used to diagnose the brain tumor by taking the images of magnetic resonance imaging. Magnetic Resonances Imaging (MRI) is a type of scanning method that uses strong magnetic fields and radio waves to produce detailed images of the inner body. The research work carried out uses Deep learning models to detect the tumor region in the scanned brain images. We have considered Brain MRI images of 1222 patients, out of which 827 MRI images are tumorous and 395 of them are non-tumorous. This project aims to offer a fast and convenient solution for healthcare workers to help them identify cancereous tumor. This project helps in moving towards digital future where machine learning will be used in healthcare sector .**

**Keywords: CNN, VGG-16, Tumour cells, Data pre-processing, Convolution.**

1. **INTRODUCTION**

A brain tumor is a disease caused due to the abnormal growth of mass in the brain. Normally in our body, new cells are produced which replace the old and damaged cells in a controlled manner. But in case of brain tumor, tumor cells go on multiplying uncontrollably. As per the National Brain Tumor Society nearly 70,000 people in United States are suffering from primary brain tumor. Brain tumor is ranked as 10th most common tumor in India. The presence of tumor is noticed by the Magnetic Resonance Imaging [MRI] scanning. The MRI scanning should be diagnosed by the physician and later based on the results; the treatments shall be started. This procedure can be a little time consuming. Hence to overcome this, the proposed work presents an automated system that will classify if the subjected patient is suffering from brain tumor. This system can assist the physician to make early decisions so that the treatments are carried out at an earlier stage.

The proposed approach uses CNN and VGG-16 architecture and weights to train the model for this binary problem. Accuracy is used as the metric for evaluation. In the presented approach, we have augmented the dataset (MRI images of brain), performed certain data pre-processing steps to convert the raw data, further investigated two deep learning models namely CNN and VGG-16 and have presented the comparative analysis in the results section. Depending upon the algorithm complexity, computation time and other results one can choose any of the abovementioned algorithm in their work. This automatic detection system can assist the physician to make early decisions and hence start the treatments at an early stage.

1. **OBJECTIVE**
* To detect presence of tumor from image of MRI scans from patients.
* This project aims to offer a fast and convenient solution for healthcare workers to help them identify cancereous tumor. This project helps in moving towards digital future where machine learning will be used in healthcare sector .
1. **LITERATURE SURVEY**

1. Komal Sharma1 , Akwinder Kaur2 , Shruti Gujral3[ 1] proposed brain tumor detection method for MRI brain images. The proposed work is divided into three parts: preprocessing steps are applied on brain MRI images, texture features are extracted using Gray Level Co-occurrence Matrix (GLCM) and then classification is done using machine learning algorithm.

2. M. Havaei, et al, Brain tumor segmentation with deep neural networks, Medical image analysis, 35, 18-31, 2017. a completely automated brain tumor classification method is proposed based on DNN. The proposed networks have been designed to be used in low-grade and high glioblastoma disease images. In this paper, a new architecture of CNN is presented. The proposed a cascading architecture is proposed in which the output of a core CNN is used as an additional source of information for the next CNN.

3. Y. Xu, et al, Deep convolutional activation features for large scale brain tumor histopathology image classification and segmentation, In 2015 IEEE international conference on acoustics, speech and signal processing (ICASSP), efficient and effective method which uses CNNs used for classification and segmentation. The proposed method, used Image-Net for extract features. The results obtained 97.5% accuracy for classification and 84% accuracy for segmentation.

4. In Y. Pan, et al, Brain tumor grading based on neural networks and convolutional neural networks, In 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, multiphase MRI images in tumor grading have been studied and a comparison has been made between the results of deep learning structures and base neural networks. The results show that the network performance based on the sensitivity and specificity of CNN improved by 18% compared to the neural networks.

5. Lefkovits, L., Lefkovits, S., Vaida, M. F., Emerich, S., & Măluțan, R. (2017), there are many challenges in the medical image processing with segmentation due to different location shape and other characteristics of the cells. The MRI images are analysed by pre-processing, extraction, and classification and post-processing. In segmentation the classifier algorithms like SVM, AdaBoost and Random Forest (RF) are used. In this paper these three classifiers are compared for their segmentation of brain tumor. These help to use the classifiers based on the accurate segmentation on particular set of data. The future developing classifiers should make segmentation on any level of data sets.

6. Abdulraqeb, A. R., Al-Haidri, W. A., Sushkova, L. T., Abounassif, M. M., Parameaswari, P. J., & Muteb, M. A. (2017). image processing is for creating the picture view of the different anatomy structure of human body. MRI images are the view of abnormal human brain to identify the tumor cells. These also help to identify the internal structure of human brain and scan them for perfect clarification of cells. The proposed work consists of GLCM feature extraction and wavelet based region segmentation. The morphological filtering method is used for noise removing.

7. Meiyan Huang et.al presents using the LIPC (local independent projection-based classification) method for classifying the voxel of the brain. Also using this method, Path feature is extracted. Explicit regularization need not be performed in LIPC. Low accuracy is achieved [6]. Bjoern H. Menze et.al, presents new brain tumor segmentation also referred to as multimodal brain tumor segmentation scheme. Various segmentation algorithm are being combined to gain better performance in contrast to the existing method. Though, still it depicts high complexity.

8. Baljinder Singh et.al, has initially presented, the process of pre-processing wherein there is noise elimination from the images by employing fuzzy filter and a new mean shift based fuzzy c-means algorithm which requires low computing time span and offers better segmentation output in contrast to traditional techniques. The above segmentation techniques has a mean field phrase in the traditional fuzzy c-means objective function. Since it’s possible for the mean shift to locate cluster centers quiet easily and promptly, all the techniques can carry out effective diagnosis of the image area.

1. **METHODOLOGY**

As per literature survey, it was found that automated brain tumor detection is very necessary as high accuracy is needed when human life is involved. Automated detection of tumor in MR images involves feature extraction and classification using machine learning algorithm. In this paper, a system to automatically detect tumor in MR images is proposed.

The dataset considered consists of MRI scanned images of 1222 patients out of which 827 of them are tumorous and 395 of them are non-tumorous. The presented work aims to develop a detection model that detects the tumour in the MRI scanned image of a patient. The detection model in general can be given as: 

Fig 1. Flowchart of General Brain tumour detection model

The Stages involved are:

1. Input: It is assumed that the patient is all fit and capable to undergo an MRI scan as per the doctor’s assistance. The present work considers the Brain MRI images of a patient as the input.
2. Data pre-processing: Data pre-processing is a method in which the raw data is converted to a useful data by applying some pre-processing techniques. The pre-processing techniques we have used are:

Step1: Importing libraries The libraries such as TensorFlow, NumPy, pandas, matplotlib, os and scikit-learn etc are imported.

Step 2: Data augmentation The images in the dataset are increased by creating modified versions of the image using techniques like rotation etc, this process is known as Image data-augmentation. Image Data Generator class is used to generate the images.

Step 3: Import the augmented data .

Step 4: Convert the images to grayscale

Step 5: Removal of noise and Smoothening the image

For the removal of noise Gaussian Blurring is done. Now, four points of the paper to be processed is determined through canny edge detection and perspective transformation is applied. There are possibilities of the image getting skewed with either left or right orientation. So, canny edge detection checks for an angle of orientation and applies perspective transformation till the lines match with the true horizontal axis, which produces a skew corrected image.

Step 6. Grab the largest contour.

Step 7. Find the extreme points of the contoured image

Step 8. Resize the image

Step 9. Crop the images using the extreme points

Step 10. Splitting of dataset.

# C. Algorithms used: The algorithms used in the proposed work are: sklearn ,Support Vector Machine in Python

.

D. Output

The system is trained to detect the tumour in the MRI of the patient and thus predict whether the patient is suffering from tumour or no

V. RESULT AND DISCUSSIONS:

The model was successful in classifying

whether the people are having tumor or not with the help of the machine learning algorithm. The input parameters are taken from the user and

based on it, the result is displayed. The

data which is present in the dataset is

standardized, and then the accuracy of

training and testing data was found out,

which was 78.6% and 77.3% respectively.

The accuracy of the training data was 78%

for logistic regression. However, the

testing set results were not very

satisfactory, 75%. Hence predictive model

was built on the support vector machine.

VI. LIMITATIONS

The model is not 100% accurate. This

means that the prediction may not always

be correct.

VI. FUTURE SCOPE

1.The accuracy of the model can be

increased up to 95% to get the exact

accurate results.

2.More accurate optimizers can be used for

increased accuracy.

VII. ACKNOWLEDGEMENT

I would like to express my sincere gratitude to

my project guide Prof. Pankaj Kunekar who

guided me throughout the project. I would also

like to thank all the authors of the reference

research papers because of whom I was able to

expand my knowledge which was required for

this project.

IX. REFERENCES

1. Shamsul Huda et al, “A Hybrid Feature Selection with Ensemble Classification for Imbalanced Healthcare Data: A Case Study for Brain Tumor Diagnosis”, IEEE Access, 4: (2017).
2. Yuehao Pan, Weimin Huang et.al “Brain Tumor Grading based on Neural networks and Convolutional Neural Networks”,IEEE.
3. Darko Zikic, Yani Ioannou et.al “Segmentation of Brain tumor tisssues with convolutional neural networks”, MiCCAI,2014,Brats challenge.
4. C.Hemasundara Rao, Dr. P.V. Naganjaneyulu, Dr.K.Satya Prasad “Brain tumor detection and segmentation using conditional random field”, © IEEE 7th International Advance Computing Conference, 2017, p.p. 807-810.
5. Atiq Islam et al, “Multi-fractal Texture Estimation for Detection and Segmentation of Brain Tumors”, IEEE, (2013).
6. Meiyan Huang et al, “Brain Tumor Segmentation Based on Local Independent Projection based Classification”, IEEE Transactions on Biomedical Engineering, IEEE, (2013).
7. Bjoern H. Menze et al, “The Multimodal Brain Tumor Image Segmentation Benchmark (BRATS)”, IEEE Transactions on Medical Imaging, (2014).
8. Shamsul Huda et al, “A Hybrid Feature Selection with Ensemble Classification for Imbalanced Healthcare Data: A Case Study for Brain Tumor Diagnosis”, IEEE Access, 4: (2017).
9. Sergio Pereira et al, “Brain Tumor Segmentation using Convolutional Neural Networks in MRI Images”, IEEE Transactions on Medical Imaging, (2016).
10. J. Seetha and S. Selvakumar Raja “Brain Tumor Classification Using Convolutional Neural Networks”, Biomedical & Pharmacology Journal, 2018. Vol. 11(3), p. 1457-1461. Karen, Zisserman “Very deep convolutional networks for large scale image recognition”,ICLR.[Published in 2014].
11. Taranjit Kaur, Tapan Kuamar Gandhi, “Automated brain image classification based on VGG-16 and tranfer learning”,ICIT [Published in 2019]
12. 5.https://www.youtube.com/watch?v=5lgrlddp-98
13. Baljinder Singh, Pankaj Aggarwal “Detection of brain tumor using modified mean-shift based fuzzy c-mean segmentation from MRI Images”, © IEEE, 2017, p.p. 536-545.
14. N. Varuna Shree, T. N. R. Kumar “Identification and classification of brain tumor MRI images with feature extraction using DWT and probabilistic neural network”, © Springer, Brain Informatics, p.p. 23-30.
15. Zhenyu Tang, Ahmad Sahar, Yap Pew-Thian, Shen Dinggang “Multi-Atlas Segmentation of MR Tumor Brain Images Using Low-Rank Based Image Recovery”, © IEEE Trans Med Imaging, vol. 37(10), 2018, p.p. 2224–2235.