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Deep Learning Approach for Brain Tumor Classification

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Abstract: ***Tumors are complex. There are a lot of variations in sizes and location of tumor. This makes it really hard for complete understanding of tumor. Brain tumour is the abnormal growth of cells inside the brain cranium which limits the functioning of brain. Now a days, medical images processing is a most challenging and developing field. Automated detection of tumor in MRI is extremely crucial because it provides information about abnormal tissues which is important for planning treatment. The conventional method for defect detection in resonance brain images is time consuming. So, automated tumor detection methods are developed because it would save radiologist time and acquire a tested accuracy. The MRI brain tumor detection is complicated task due to complexity and variance of tumors.There are many previously implemented approaches on detecting these kinds of brain tumors. In this paper, we used and implement Convolutional Neural Network (CNN) which is one among the foremost widely used deep learning architectures for classifying a brain tumor into four types. i.e Glioma , Meningioma, Pituitary and No tumour. CNN may be used to effectively locate most cancers cells in brain via MRI. classification.***

Keywords: Convolutional Neural Networks (CNN), Magnetic Resonance Imaging (MRI), Brain Tumor, K-means Clustering, Gray-level Co-occurrence Matrix(GLCM).

I. INTRODUCTION

Brain tumor is one of the most complex diseases in the medical science. Brain Tumour is unwanted growth of cells in brain in unconditional fashion. Medical Imaging technology plays important role in daily medical diagnosis and medical research. Therefore, research on medical diagnostic image data is very important. Brain tumour has become key research topic in the medical field.The diagnosis of brain tumour images is usually based on imaging data analysis of brain tumour images. The exact cause of brain tumour is not clear thus, people may suffering from it without realizing the danger. Primary brain tumour can be either malignant (contain cancer cells) or benign (do not contain cancer cells) and the types of brain tumours that generally occur based on the affected area are Meningioma, Glioma and Pituitary. Each type of these tumours has a certain level of malignancy. Gliomia is a type of brain tumour that grows on the area of the glia tissues and spinal cord, Meningioma is a type of tumour that grows on the area of the membrane, while the pituitary tumour grows on the pituitary gland area. Accurate analysis of brain tumour images is a key role in determining patient's condition. Therefore detection of brain tumour is very important. Magnetic Resonance Imaging (MRI) provide information on shape, size and position of human tissues and organ without high ionizing radiation. The system is used for detecting the brain tumour using the MRI Images of brain from normal person and the person who had a brain tumour. System will give correct output to the user. Brain MRI image is mainly used to detect the tumor and tumor progress modeling process. This information is especially used for tumor detection and treatment processes. MRI image gives more information about given medical image than the CT or ultrasound image. MRI image provides detailed information about brain structure and anomaly detection in brain tissue.The aim of this research is firstly to examine the classification of three tumor types from an imbalanced database with a CNN .In this paper, we present a new CNN architecture for brain tumor classification of four tumor types: Meningioma, Glioma, Pituitary tumor and No tumour.

II. LITERATURE REVIEW

Conventional brain tumor classification is performed by using Fuzzy C means(FCM) based segment, texture and shape feature extraction , SVM and DNN based classification are carried out. Classification results are as tumor or normal brain images. Image net database is used for classification, CNN is pre-trained model ,so the training is performed only on final layer .Row pixel values with width, depth and height feature value are extracted from CNN, then Gradient decent based loss function method is applied to achieve high accuracy[1].

Deep learning model based on a convolutional neural networks is proposed to classified brain tumor from MRI images. Network is constructed from 16 layers starting from the input layer which holds the preprocessed images processing through the convolution layers and their activation functions.Two dropdown layers are used to prevent overfitting followed by a fully connected layer and softmax layers to predict the output and finally a classification layers produces the predicted class[2].

Different features are extracted using grey level co-occurance matrix algorithm. GLCM extract texture based feature which works on the phenomena of the co-occurrence of neighbouring grey level. Features like correlation, constrast, dissimilarity, homogenity, energy, etc are being extracted .This features are further used for MRI image abnormality detection and classification. Texture features increases the performance of classifier[3].

Preprocessing is used to perform the filtering of noisy in the images. K-means clustering is use to segment MRI images .It gives the accurate result for tumor segmentation and detection. It's good result is helpful in feature extraction which is being extracted by using grey level co-occurance matrix[4].

A brain tumor detection and classification using convolutional neural network and grey level co-occurance matrix based features. GLCM extract the different texture features like constrast, dissimilarity, correlation ,etc. from different four angles for each and every image. These extracted features are fed into CNN to classify different types of tumors like Glioma, Meninglioma, Pitutary and No tumour[5].

III. SYSTEM ARCHITECTURE

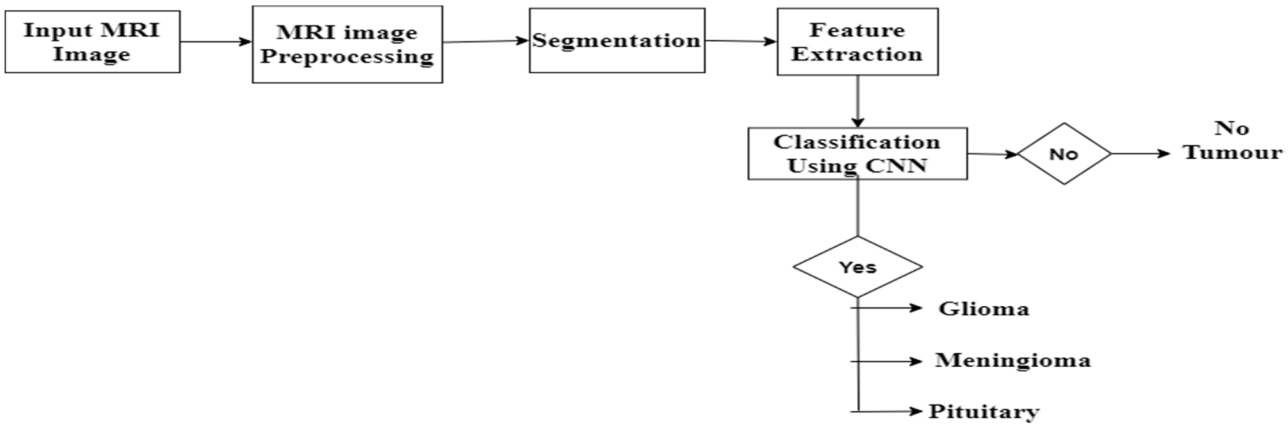

Figure 1: System Architecture

Figure 1 depict system architecture of this system. The main stages involved in this system are Image Aquisition, Pre-processing, Segmentation, Feature extraction and Classification via concolutional neural network.

A. Image Acquisition(MRI)

The first stage i.e. image acquisition starts with taking images from dataset. As this system is mainly focusing on detection of brain tumor, we gathered our data as MRI images. The dataset is collected from kaggle. It consisted of total 3264 images.926 images in which Glioma tumour is present, 937 images in which Meningioma is present, 901 images in which Pituitary tumour is present and 500 images in which tumor was not present.

B. Image Pre-processing

Image Pre-processing is carried out to improve the quality of the image and remove the unwanted noise in image followed by cropping of the image. Image cropping is carried out to re-move unwanted background from MRI image for that Image thresholding is used. Image enhancement method is carried out for increasing the contrast.

1) *Image Cropping:* The MRI's contain a black background around the central image of the brain. This black background provides no useful information about the tumor and would be waste if fed to neural networks. Hence cropping the images around the main contour would be useful. Here,first biggest contour is selected and marked. Next, then find the extreme points of the contour and crop the image on those end points. Thus removed most of the unwanted background and some noise present in the original image.

C. Segmentation

Image segmentation is a partitioning of image into multiple segments.Image segmentation is used to locate objects and boundaries in an image. Here we have implemented k-means Clustering method for image segmentation.

1) *K-means Clustering:* The k-means clustering is a pixel based method.It is one among the foremost simple technique as it's complexity is comparatively less than other methods.K-means clustering is suitable for biomedical image segmentation because the number of clusters is typically known for images of particular regions of the human anatomy.we are used and implement k-means clustering to segment the brain tumour.
2) *Steps for K-means*

a) Choose the number of cluster.
b) Select at random K points,the centroids.
c) Assign each data point to the closest centroid that forms K-clusters.
d) Compute and place the new centroid of each cluster.
e) Reassign each data point to the new closest centroid.If any reassignment took place,go to place 4,othervise the model is ready.

D. Feature Extraction

In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant then the input data will be transformed into a reduced representation set of features (features vector). Feature Extraction is helpful in identifying brain tumour where is exactly located and helps in predicting next stage. Transforming the input data into the set of features is called feature extraction. In this paper following features are extracted by using Grey -level Co-occurence matrix(GLCM).

1) Contrast
2) Correlation
3) Dissimilarity

E. Classification

MRI brain images have been used for detection of tumours using a deep learning method, namely Convolutional Neural Network(CNN). A model has been trained using 2452 images containing four types of classes of tumour. A CNN model consists of two parts: feature extraction and classification. CNN architecture consists five main layers: input layer, convolution layer, pooling layer, fully connected layer and classification layer. CNN performs feature extraction and classification through sequentially trainable layers placed one after the other. Feature extraction part of the CNN includes the convolutional and pooling layers, whereas the classification part includes the fully connected and classification layers. Although CNNs focus on image classification and accept images as input data.CNN takes MRI image as a input image and classify the tumour into four classes i.e. Glioma, Meningioma, Pituitary and No tumour.

IV. EXPERIMENTAL RESULT

Our aim is to classify MRI images into four classes. Data for system is in .jpg image format, collected from Kaggle. (https://www.kaggle.com/brain-tumor-classification-mri) .

Dataset consists of total 3264 images.It consist of four folders.Glioma, Meningioma, Pituitary and No tumour. 926 images in which Glioma tumour is present, 937 images in which Meningioma is present, 901 images in which Pituitary tumour is present and 500 images in which tumor was not present. We split dataset into training and testing. There are 2870 images for training and 394 for testing to evaluate model accuracy.

In pre-processing, we performed image cropping on MRI image. In this process following 4 steps are performed shown in Figure 2.

1) Take input image.
2) Find the biggest contour.
3) Find the extrme points..
4) Crop the image.

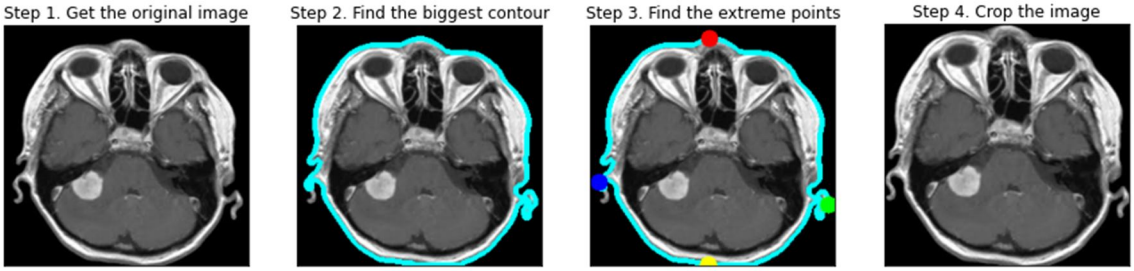

Figure 2: Image Cropping

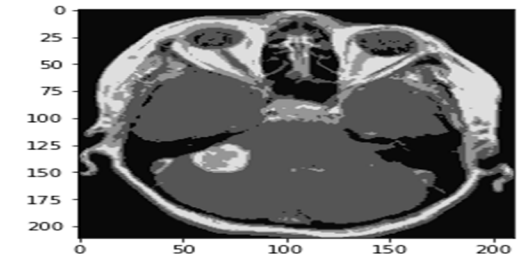

Figure 3: Segmentation by using K-means Clustering Algorithm

Figure 3 depict segmentation by using K-means clustering. After performing pre-processing on MRI image that image is given as input to segmentation module. Int this module MRI image is segment into different parts to segment brain tumour.

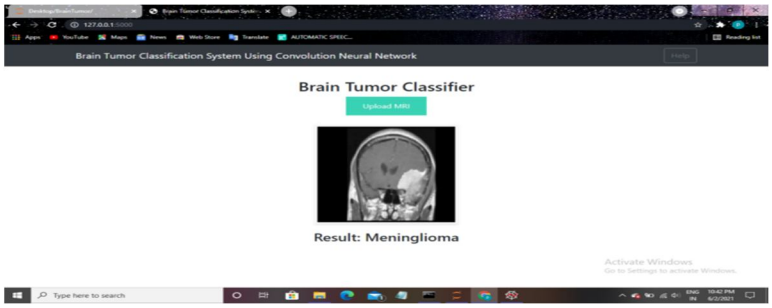

Figure 4: Classification using CNN.

Figure 4 shows classification using CNN.A CNN model consists of two parts: feature extraction and classification. Training images are loaded for perform classification.CNN classifier train on training dataset.Train classifier are used to predict tumour name for given testing images.

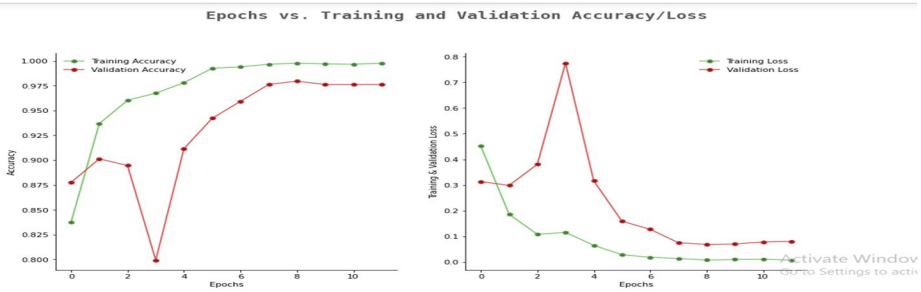

Figure 5: Epochs vs. Training and Validation Accuracy/Loss

Figure 5 shows the training-validation accuracy and training-validation loss of CNN model.The time of computation and complexity is low, and an accuracy is high.

V. CONCLUSION

In this paper, we presented idea of detecting brain tumour using Convolutional Neural Network (CNN).This system can significantly classify brain tumour into three types Meningioma, Glioma and Pituitary.The CNN has been used to detect a tumour through brain Magnetic Resonance Imaging(MRI) images.Our main intuition behind implementing this system is to help patients as well as doctors to detect presence of tumour in MRI images.

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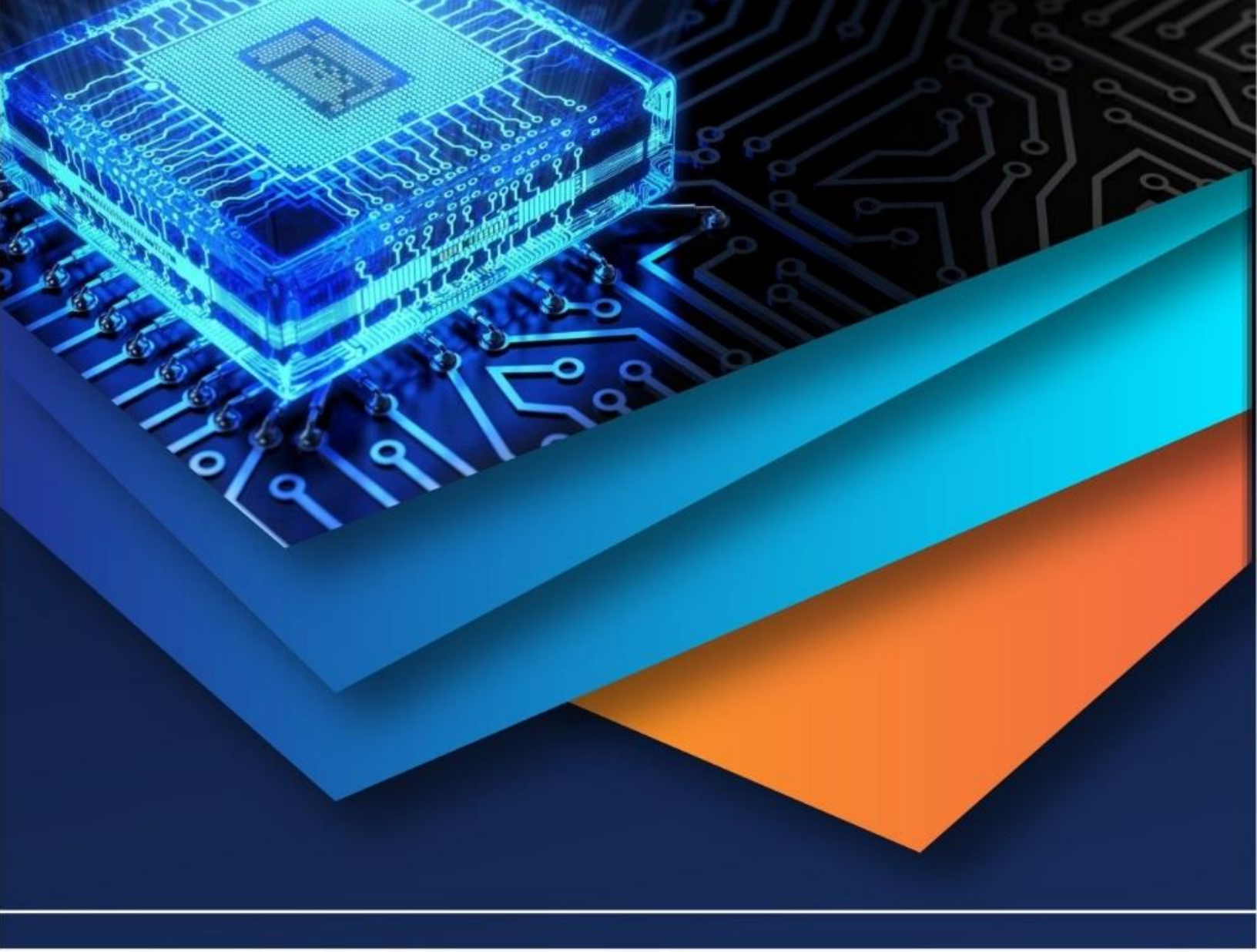

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