BRAIN TUMOR CLASSIFICATION USING CNN OF BRAIN MRI IMAGES

[1]P.Rajeshwari ,[2]Boosa Gowtham Goud,[3]Julakanti Sri Tejaswini,[4]Beerelly Dheeraj Mahanidhi

[1]Assistant professor, Department of Computer Science and Engineering
Anurag Group of Institutions, Hyderabad, Telangana, India

[2,3,4]Department of Computer Science and Engineering
Anurag Group of Institutions, Hyderabad, Telangana, India

ABSTRACT

Brain tumor is a severe cancer disease caused by uncontrollable and abnormal partitioning ofcells and it requires early and accurate detection methods. The brain tumors, are the mostcommon and aggressive disease, leading to a very short life expectancy in their highest grade.Thus,treatmentplanningisakeystagetoimprovethequalityoflifeofpatients.MRIimagesareused to diagnose tumor in the brain. However, the huge amount of data generated by MRI scanthwartsmanualclassificationoftumorvsnon-tumorinaparticulartime.Recentstudyinthefieldof deep learning has helped the health industry in Medical Imaging for Medical Diagnostic ofmany diseases. For Visual learning and Image Recognition tasks CNN is the most prevalent andcommonly used machine learning algorithm. Similarly, we introduce the convolutional neuralnetwork(CNN)approachalongwithDataAugmentationandImageProcessingtocategorizebrain MRIscanimagesintocancerousandnon-cancerous,thatispresenceoftumorornot.CNNisthemost effective model in classifying images. Here the model is trained to specifically identify tinyaberrationsfromMRIimagesand predicttheimagesintocancerousandnon-cancerous.

Keywords: Braintumor,MRI,DeepLearning,DataAugmentation,ImageProcessingand CNN.

Introduction

Braintumorisoneofthemostrigorousdiseasesinthemedicalscience.Aneffectiveandefficientanalysis is always a key concern for the radiologist in the premature phase of tumor growth.Histologicalgrading,basedonastereotacticbiopsytest,isthegoldstandardandtheconventionfo rdetectingthegradeofabraintumor.Thebiopsyprocedurerequirestheneurosurgeontodrillasmallholei ntotheskullfromwhichthetissueiscollected.Therearemanyriskfactorsinvolvingthe biopsy test, including bleeding from the tumor and brain causing infection, seizures, severemigraine,stroke,comaandevendeath.Butthemainconcernwiththestereotacticbiopsyisthatitisn ot100%accuratewhichmayresultinaseriousdiagnosticerrorfollowedbyawrongclinicalmanagement ofthedisease.

Tumorbiopsybeingchallengingforbraintumorpatients,non-invasiveimagingtechniqueslikeMagneticResonanceImaging(MRI)havebeenextensivelyemployedindiagnosingbraintumors.Therefore,developmentofsystemsforthedetectionandpredictionofthe grade of tumors based on MRI data has become necessary. But at first sight of the imagingmodality like in Magnetic Resonance Imaging (MRI), the proper visualization of the tumor cellsanditsdifferentiationwithitsnearbysofttissuesissomewhatdifficulttaskwhichmaybeduetothe presence of low illumination in imaging modalities or its large presence of data or severalcomplexityandvarianceoftumors-likeunstructuredshape,viablesize,andunpredictablelocationsofthetumor.

RelatedWorks

In, the Fuzzy C-Means (FCM) segmentation is applied to separate the tumor and non-tumorregionofbrain.AlsowaveletfeatureareextractedbyusingmultilevelDiscreteWaveletTransform (DWT).Finally,DeepNeuralNetwork(DNN)isincorporatedforbraintumorclassification with high accuracy. This technique is compared with KNN, Linear DiscriminantAnalysis (LDA) and Sequential Minimal Optimization (SMO) classification methods. An accuracyrateof96.97%intheanalysisofDNNbasedbraintumorclassification,Butthecomplexityisveryhigh and performance is very poor. In, a novel bio-physiomechanical tumor growth modeling ispresented to analyze the step by steps tumor growth of patients. It will be applied for gliomasandsolidtumorwithindividualmarginstoseizurethesignificanttumormasseffect.Thediscrete andcontinuousmethodsarecombinedtomakeatumorgrowthmodeling.Theproposedschemeprovides the likelihood to tacitly segment tumor-bearing brain images based on atlas-basedregistration. This technique is mainly used for brain tissue segmentation. But the computationtimeishigh.In,newmulti-fractal(MultiFD)featureextractionandimprovedAdaBoostclassification schemes are used to detect and segment the brain tumor. The texture of braintumor tissue is extracted by using MultiFD feature extraction scheme. The improved AdaBoostclassificationmethodsareusedtofindthegivenbraintissueistumorornon-tumortissue.

Complexity is high. In, 4 local independent projection based classification (LIPC) method is usedtoclassifythevoxelofthebrain.Alsopathfeatureisextractedinthismethod.Hencenoneedtoperformexplicitregularizationin LIPC.Theaccuracyislow.In,thesurveyofbraintumorsegmentation is presented. Discuss about Various segmentation methods such as Region basedsegmentation,thresholdbasedsegmentation,fuzzyCMeanssegmentation,Atlasbasedsegmentation,MargoRandomField(MRF)segmentation,deformablemodel,geometricdeformable model, The accuracy, robustness, validity are analyzed for all the methods. In,8hybridfeatureselectionwithensembleclassificationisappliedforbraintumordiagnosisprocess.The GANNIGMAC, decision Tree, Bagging C based wrapper approach is used to obtain thedecision rules. Also simplify the decision rules by using hybrid feature selection, which containsthe combination of (GANNIGMAC + MRMR C+ Bagging C + Decision Tree). In, the fuzzy basedcontroltheory isusedforbraintumorsegmentationandclassificationmethod.

TheFuzzyInterferenceSystem(FIS)isaonespecial4technique,whichismainlyusedforbrainsegmentation.Supervisedclassificationisusedtocreateamembershipfunctionoffuzzycontroller.Theperformanceishighandaccuracyislow.In,10theadaptivehistogramequalization is used to improve the contrast of the image. Then Fuzzy CMeans (FCM) basedsegmentation is performed to separate the tumor from the whole brain image. After that Gaborfeature are extracted to filter the abnormal cells of brain. Finally, the fuzzy with K NearestNeighbor(KNN)classificationisappliedtofindtheabnormalityofbrainMRIimage.Thecomplexityishigh.Buttheaccuracyislow.Inthiswork,anovelautomaticbraintumorclassificationisperformed by convolutions neuralnetwork.

Artificialintelligenceanddeeplearningareprimarilyusedinimageprocessingtechniquesto segment, identify, and classify MRI Images and are also used to classify and detect braintumors. So many works have already been done on the classification and segmentation of brainMRI images. Some of the international journals we reviewed on the detection and classificationof brain tumor using deep learning are Sheikh Basheera et al., [4] proposed a method forclassifyingbraintumorswherethetumorisinitiallysegmentedfromanMRIimageandsegmented portion is then extracted through a pretrained convolutional neural network usingstochastic gradient descent. Muhammad Sajjad et al. [5] suggested classification of multi-gradetumors by applying data augmentation technique to Mri images and then tuning it using a pre-trainedVGG-19CNNModel.

ProposedSystem

Theproposedsystemfocusesonhowtoidentifythepersononimagewithorwithouttumorwiththehelp ofdeep learningalgorithmbyusingtheCNN,OpenCV,Tensorflow,Kera'slibrary.

Inthenormalneuralnetwork,imagecannotscalable.Butinconvolutionneuralnetwork,image can scalable. it will take 3D input volume to 3D output volume (length, width, height).TheConvolutionNeuralNetwork(CNN)consistsofinputlayer,convolutionlayer,RectifiedLinearUnit(Relu) layer, pooling layer and fully connected layer. In the convolution layer, the given inputimage is separated into various small regions. Element wise activation function is carried out inRelulayer.Poolinglayerisoptional.Wecanuseorskip.Howeverthepoolinglayerismainlyusedfor down sampling. In the final layer, fully connected layer is used to generate the class score orlabel scorevaluebasedontheprobability inbetween0to 1

The block diagram of brain tumor classification based on convolution neural network isshown in fig.1. The CNN based brain tumor classification is divided into two phases such astraining and testing phases. The number of images is divided into different category by usinglabelsnamesuchastumorandnon-tumorbrainimage…etc.Inthetrainingphase,preprocessing,feature exaction and classification with Loss function is performed to make a prediction model.Initially,labelthetrainingimageset.Inthepreprocessingimageresizingisappliedtochangesizeoftheimage.Finally,theconvolutionneuralnetworkisusedforautomaticbraintumorclassification.

AlgorithmforCNNbasedClassification

1. Applyconvolutionfilterinfirstlayer
2. Thesensitivityoffilterisreducedbysmoothingtheconvolutionfilter,subsampling
3. Thesignaltransfersfromonelayertoanotherlayer iscontrolledbyactivationlayer
4. Fastenthetrainingperiodbyusingrectifiedlinearunit(RELU)
5. Theneuronsinproceedinglayer isconnectedtoeveryneuroninsubsequentlayer
6. DuringtrainingLosslayerisaddedat theendtogiveafeedbacktoneuralnetwork

Advantages

● ACNNusesconvolutionkernelstoconvolvewiththeoriginalimagesorfeaturemapstoextracthigher-levelfeatures, thusresultinginaverypowerfultoolfor ComputerVisiontasks.

● Savestimeandeffort.

● Givesmoreaccuracy

ResultsandDiscussions

We experimented on brain tumor MRI Images dataset by Navoneelchakrabrothy. The dataset ispublicly available, consists of 253 real brain images developed by radiologists using data fromreal affected patients. Its available on Kaggle, a shared data platform used for machine learningcompetitions. Our data set consists of 155 tumor images and 98 no tumor images. Since thedataset size is less which may lead to under fitting issue which directly effects our modelaccuracy. So to overcome this is problem we have applied a data augmentation to increase thesize of the dataset. It is a process to increase the amount of data by adding slightly modifiedcopies of already existing data. Hence, data augmentation is done to enhance our dataset bydoingminorchangesinourMRIimagesandextracttheseaugmentedimagesfromourproposedCNN model. After data augmentation the size of the dataset is 2064 images, 1084 tumor imagesand 980 non tumor images. We trained the models for 15 epochs with a batch size of 32. Theexperiment is done using TensorFlow and Keras libraries in python on a CPU having a 2.3 GHzcore i5processorwith8Gb ofram. Ourproposedmodelshowed96%.

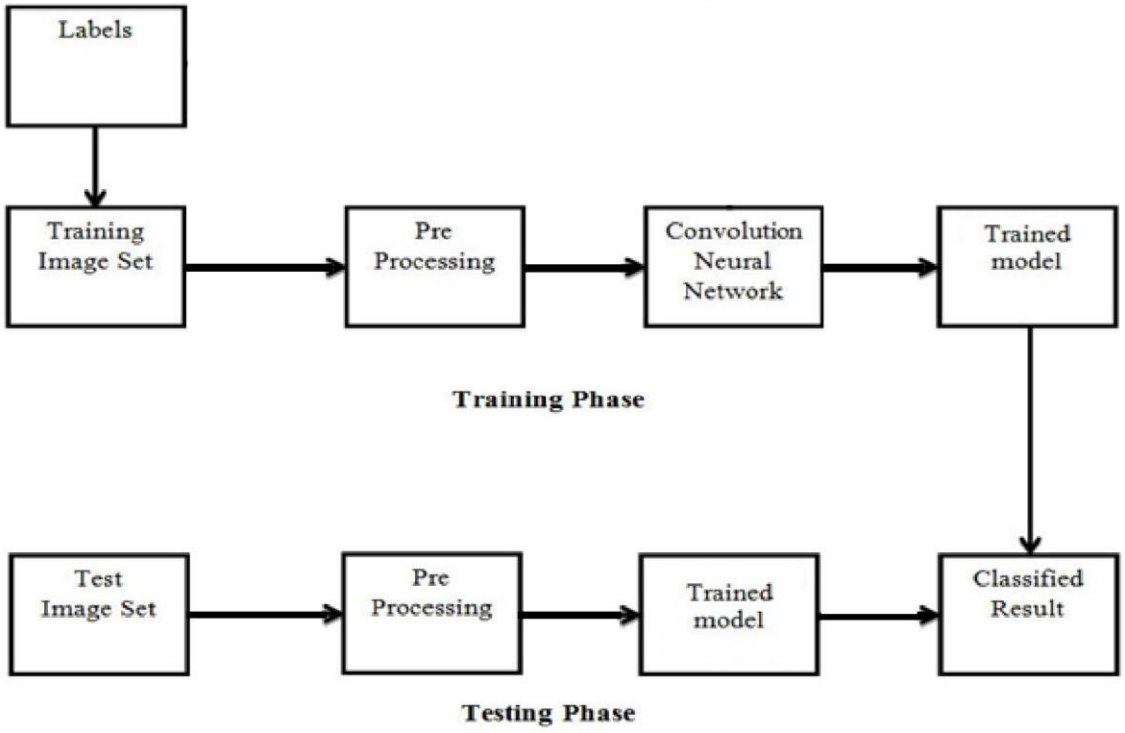

Fig.1. Blockdiagramofproposedbraintumorclassificationusing CNN

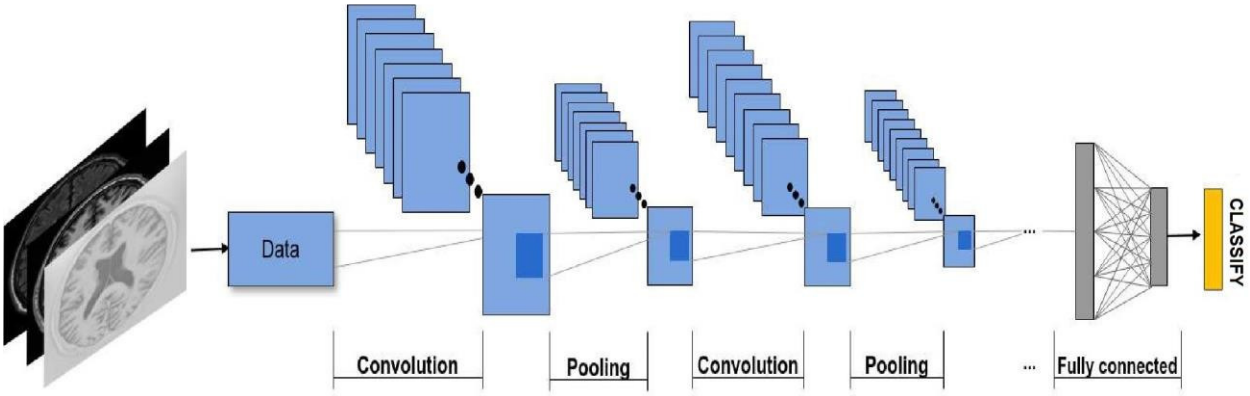

Fig.2.CNNArchitecture

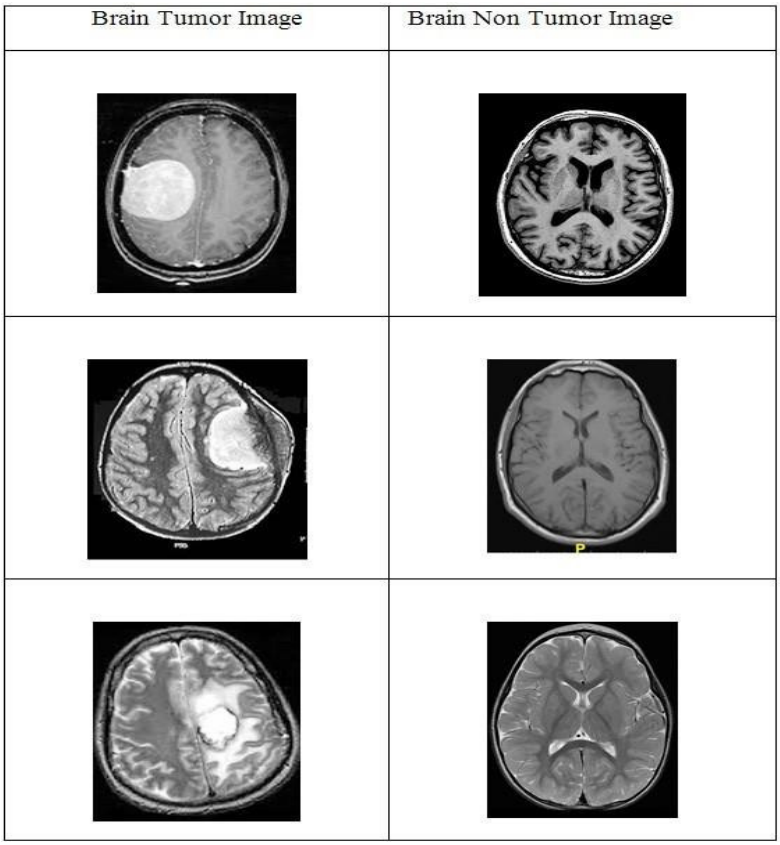

Fig.3. Dataset Images

CONCLUSION

We are able to create and train a model which give good results and accuracy in classifying thepresence of tumor. Our system can play an effective role in the early diagnosis of dangerousdisease in other clinical domains related to medical imaging. using the image edge detectiontechnique, we find the region of interest in MRI images and cropped them then, we used thedataaugmentationtechniqueforincreasingthesizeofourtrainingdata.Weprovideanefficientmethodologyfor braintumorclassification byproposingasimple CNNnetwork.

FUTUREENHANCEMENT

Build an app-based user interface in hospitals which allows doctors to easily determine theimpact of tumor and suggest treatment accordingly Since performance and complexity of ConvNets depend on the input data representation we can try to predict the location as well as stageof the tumor from Volume based 3D images. By creating three dimensional (3D) anatomicalmodels from individual patients, training, planning and computer guidance during surgery isimproved. Ultimately, we would like to use very large and deep convolutional nets on videosequences where the temporal structure provides very helpful information that is missing or farlessobviousinstaticimages.Unsupervisedtransferlearningmayattractmoreandmoreattentioninthe future.

REFERENCES

1. Kasban, Hany& El-bendary, Mohsen &Salama, Dina. (2015). "A Comparative Study ofMedicalImagingTechniques".InternationalJournalofInformationScienceandIntelligentSy stem. 4. 37-58.J. ClerkMaxwell,ATreatise onElectricityandMagnetism,3rded.,vol.
2. Oxford:Clarendon,1892,pp.68–73.[2].D.SuryaPrabhaandJ.SatheeshKumar,"Performance Evaluation of Image Segmentation using Objective Methods", Indian Journal ofScience andTechnology,Vol9(8),February 2016.
3. BrainTumor:Statistics,Cancer.NetEditorialBoard,11/2017(Accessedon17thJanuary2019)
4. KavithaAngamuthuRajasekaran and ChellamuthuChinnaGounder, Advanced Brain TumorSegmentationfromMRIImages, 2018.
5. A.M. Reddy, V. V. Krishna, L. Sumalatha and S. K. Niranjan, "Facial recognition based on straight angle fuzzy texture unit matrix," 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC), Chirala, 2017, pp. 366-372, doi: 10.1109/ICBDACI.2017.8070865. (
6. A.M. Reddy, K. SubbaReddy and V. V. Krishna, "Classification of child and adulthood using GLCM based on diagonal LBP," 2015 International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT), Davangere, 2015, pp. 857-861, doi: 10.1109/ICATCCT.2015.7457003.
7. Swarajya Lakshmi V Papineni, SnigdhaYarlagadda, HaritaAkkineni, A. Mallikarjuna Reddy. Big Data Analytics Applying the Fusion Approach of Multicriteria Decision Making with Deep Learning Algorithms *International Journal of Engineering Trends and Technology*, 69(1), 24-28, doi: 10.14445/22315381/IJETT-V69I1P204.
8. Srinivasa Reddy, K., Suneela, B., Inthiyaz, S.,Kumar, G.N.S., Mallikarjuna Reddy, A." Texture filtration module under stabilization via random forest optimization methodology "International Journal of Advanced Trends in Computer Science and Engineering, Volume 8, No.3, May - June 2019
9. General Information About Adult Brain Tumors". NCI. 14 April 2014. Archived from theoriginalon5 July 2014. Retrieved8June2014. (Accessedon11thJanuary2019)
10. M.Young,TheTechnicalWriter'sHandbook.MillValley,CA:UniversityScience,1989.
11. B. Devkota, AbeerAlsadoon, P.W.C. Prasad, A. K. Singh, A. Elchouemi, "Image Segmentationfor Early Stage Brain Tumor Detection using Mathematical Morphological Reconstruction," 6thInternational Conference on Smart Computing and Communications, ICSCC 2017, 7-8 December2017,Kurukshetra,India.
12. Song, Yantao&Ji, Zexuan& Sun, Quansen&Yuhui, Zheng. (2016). "A Novel Brain TumorSegmentationfromMulti-ModalityMRIviaALevel-Set-BasedModel".JournalofSignalProcessingSystems. 87.10.1007/s11265-016-1188-4.

13. Mallikarjuna Reddy, V. Venkata Krishna, L. Sumalatha," Face Recognition based on Cross Diagonal Complete Motif Matrix", International Journal of Image, Graphics and Signal Processing(IJIGSP), Vol.10, No.3, pp. 59-66, 2018.DOI: 10.5815/ijigsp.2018.03.07.
14. Ayaluri MR, K. SR, Konda SR, Chidirala SR. 2021. Efficient steganalysis using convolutional auto encoder network to ensure original image quality. PeerJ Computer Science 7:e356 https://doi.org/10.7717/peerj-cs.356
15. Ehab F. Badran, EsraaGalal Mahmoud, NadderHamdy, "An Algorithm for Detecting BrainTumors in MRI Images", 7th International Conference on Cloud Computing, Data Science &Engineering-Confluence, 2017.
16. PeiL,RezaSMS,LiW,DavatzikosC,IftekharuddinKM."Improvedbraintumorsegmentationbyutilizingtumorgrowth model inlongitudinalbrainMRI".ProcSPIEIntSocOptEng.2017