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BRAIN TUMOR DETECTION FROM MRI IMAGES USING CNN

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ABSTRACT: Brain tumor is the main threat among the people. But currently, it become more advancedbecause of the many Machine Learning techniques. Magnetic Resonance Imaging is the greatesttechnique among all the image processing techniques which scans the human body and gives aclear resolution of the tumors in an improved quality image. The fundamentals of MRI are todevelop images based on magnetic field and radio waves of the anatomy of the body. The majorarea of segmentation of images is medical image processing. Better results are provided by MRIimages than CT scan, Xrays etc. Nowadays the automatic tumor detection in large spatial andstructural variability. Recently Convolutional Neural Network plays an important role in medicalfield and computer vision. One of its application is the identification of brain tumor. Here, thepre-processingtechniqueisusedtoconvertnormalimagestograyscal evaluesbecauseitcontains equal intensity butin MRI, RGB contentis included. Then filtering is used to remove the unwanted noises using median and high pass filter for better quality of images. The deeper architecture design in CNN is performed using small kernels. Finally, the effect of using this network for segmentation of tumor from MRI images is evaluated with better results.

1. INTRODUCTION

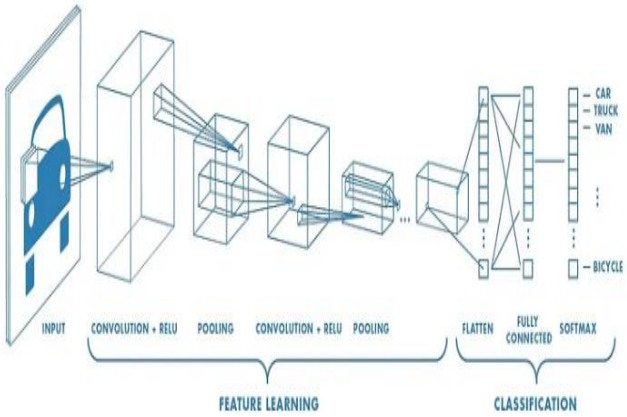
Magnetic resonance Imaging (MRI) provides brief information about brain tumor anatomy,cellular structure and vascular supply, making it a vital tool for the effective diagnosis, treatmentand monitoring of the disease. Magnetic resonance imaging (MRI) is a non-invasive medical testthat helps physicians diagnose and treat medical conditions. MRI uses a powerful magnetic field,radio frequency pulses and a computer to produce detailed pictures of organs, soft tissues, boneand virtually all other internal body structures. The images can then be inspected on a computermonitor,transmittedelectronically,printedorcopiedtoaCD.MRI doesnotuseionizingradiation (x-rays). Detailed MRI images allow physicians to figure out various parts of the bodyandresolvethepresenceofcertaindiseases.Automatedbraintumordetection from MRI images is one of the most demanding tasks in today's modern medical imaging research. Automaticdetection requires brain image segmentation, which is the process of separating the image intodistinct regions, is one of the mostvital and demanding aspect of computer aided clinicaldiagnostic tools. Noises present in the Brain MRI images are multiplicative noises and reductions of the senoisesarecomplextask. Thesemakesaccurate`segmentationofbrainimagesachallenge. However, accurate segmentation of the MRI images is very vital and crucial for theexact diagnosis by computer aided clinical tools. A large variety of algorithms for segmentationof MRI images had been developed. Surgical planning, post-surgical assessment, abnormalitydetection, and many other medical applications require medical image segmentation. In spite ofwide number of automatic and semi-automatic image segmentation techniques, they fail in mostcaseslargelybecauseofunknown and irregularnoise, inhomogeneity,poorcontrast.

2. LITERATURE SURVEY

In the paper of R. B. Dubey, he removed noises from the input ofMRI image by using the Gaussian filter. Weierstrass Transform is almost similar to the Gaussianfilter, which involves convolving using a GaussianFunction. The purpose of using Gaussianfilter is to convert the image as a smooth image. The outlook of the image is similar to viewthrough a translucent screen. Gaussian filter is a type of low pass filter, so by passing the filter inthe high frequency regions of an image remove the noises. But it takes more time to complete theprocess and also more details will not be given. Bahadure et al. proposed SVM and BWTtechniquesimageanalysisforMRI-basedbraintumordetectionandclassification.95%ofaccuracy is achieved by using this method, using skull stripping which eliminated all nonbraintissues for the detection purpose. Joseph et al. suggested the K-means clustering algorithm forsegmentation of MRI brain images along with morphological filtering for the detection of tumorimages. Support Vector Machine for automated brain tumor classification of MRI images wasproposed by Alfonse and Salem. The author Sachdeva et al. used an Artificial Neural Net- work(ANN) and PCA–ANN for the multiclass brain tumor MRI images classification, segmentationwithdataset of 428MRIimagesand an accuracyof75– 90% wasachieved.

3. CONVOLUTIONALNEURALNETWORK

A. INTRODUCTIONTOCNN:



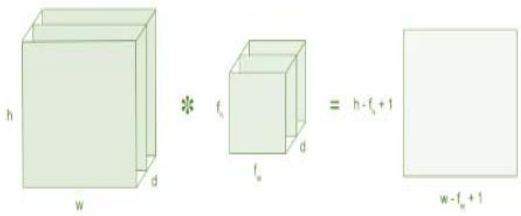
Convolutional Neural Network (CNN) are a biologically-inspired variation of the multilayerperceptron's (MLPs). In CNN, neurons contribute weights but in MLPs every neuron has aseparateweightvector. Applying the weight ssharingmethod, neuronsareabletoachieveconvolutions on the input of the data with the help of convolution filter being composed by theweights. This process is then succeeded by a pooling action which is a form of non-linear down-sampling, which decreases the spatialsize of the image which decreases the volume of
parameters and computation in the net. Activation function is in between the convolution and pooling layer. The important function is Re Lu layer which is a non-saturating activation functionis correlated element-wise, i.e., f (x) = max (0, x) thresholding at zero. After by using theselayers,the size of the image isdecreased andfurthercomplexfeaturesare obtained.

B. LAYERS OF CNN 1. Convolutional layer 2. ReLu layer 3. Pooling layer 4. Fully connectedlayer

C. CONVOLUTIONALLAYER:

Inneuralnetworks, the inputis in theformofvector,whereas in CNN the input is a multi-channeled image i.e. three channels. In CNN, the inputimage is convolved with the kernel matrix (dot product operation) or filter and the result will bescalar. The filter is moved along the input image to achieve repeated convolution thus it gives anoutputmatrix termedasfeaturemap

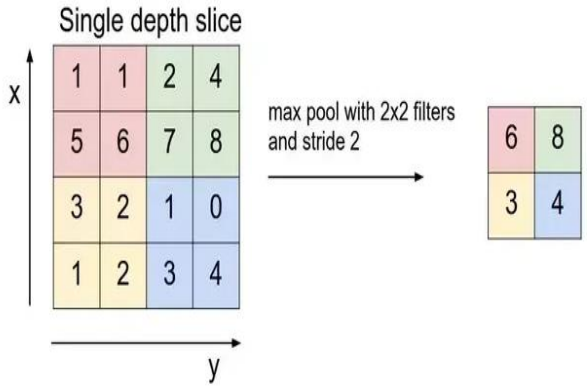
- An image matrix (volume) of dimension **(h x w x d)**
- A filter **(f_h x f_w x d)**
- Outputs a volume dimension **(h - f_h + 1) x (w - f_w + 1) x 1**



D. ReLu Layer The simplest non-linearity is achieved by the pursuing a linear filter by a non-linear gating function, related identically to every component (point-wise) of a feature map. Thisk ind of function is termedas Rectified Linear Unit (Re Lulayer).Yijk=max{0,Xijk}

E. POOLINGLAYER:

Later the convolutionlayer, poolingisachievedtodecrease the dimensionality. This permittodecrease thenumberofparameters,whichboth reduces thecombats overfitting and training time.These layers ensample every feature map separately whichdecreasesthewidthand height whereasthedepth ismaintained perfect.

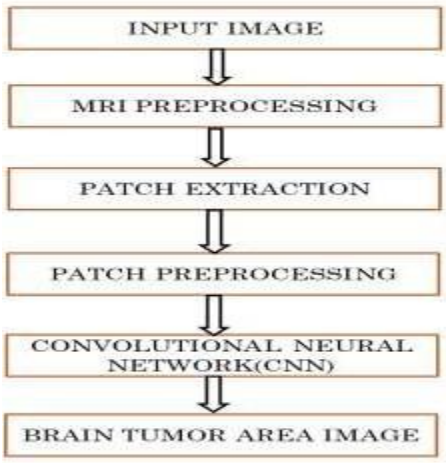


The dimensional of the pooling layer of an input image is 32x32x10. The result of this poolinglayerwillbein16x16x10featuremap.Intheoutputthewidthandheightofthefeaturemapare
split into two whereas there is no change in depth because pooling layer functions separately onthe depth oftheinput image.

F. FULLY CONNECTED LAYER: The Fully Connected layer is a traditional Multi-LayerPerceptron that uses an activation function called SoftMax in the output layer (SVM classifierscanalsobeused).Theterm"FullyConnected"signifiesthateachneuroninthepreceding layeris connected to each neuron on the adjacent layer. The high-level feature of the input image isobtained from the output of the convolution and pooling layers. The aim of using theFullyConnected layer is to use these features for segmenting the image into several classes based onthe training dataset. The output of the fully connected layer is 1D vector of numbers whereas theoutputfrombothconvolutionaland
poolinglayersare3Dvolumes.

4. RESULTSANDDISCUSSION

A. BLOCK DIAGRAM EXPLANATION The main theme of the project is to extract thetumor part in the brain image. This can be achieved by using preprocessing, CNN and post-processing. The feature map is obtained by using kernels. And the back-proportion algorithm isused to enhance the characteristics the input image. Here, the feature map helps to reduce overfitting.Thedetaileddescription of the processisexplainedbelow:



B. INPUT IMAGE The main aim of this project is to find the brain tumor part in the brainimage.ThisProcessisdonebyusingpre-processing,classificationviaCNNandpost-processing. The main aim of this project is to find the brain tumor part in the brain image. ThisProcessisdonebyusingpre-processing, classification via CNNand post-processing.

C. PRE-PROCESSING These pre-processing techniques consist of filtering, image detection,and image enhancement mentioned in figure. To enhance and smooth the image while processingthe Convolutional neural networkpreprocessingisused.

D. PATCH EXTRACTION Brain image is patched pixel by pixel and to find the brain tumorpart in the image. There are basically two types of patch-based image models-descriptive andgenerative. Descriptive models focus on the extraction of the distinctive features from the givenimagesothattheycanfacilitatethetaskofclassifyingtheimageintooneofseveralclasses.So,
we can say that they are suitable for the task of classification and recognition. Generative modelspreservetheinformationinanimagethatiswhy they aremoredesirableforthetaskofcompressionand restoration.

E. PATCH PRE-PROCESSING The ultimate goal of the pre-processing is to develop the dataof an image which overcomes the undesired distortions or raise some relevant features of animageforfurtherprocessing andanalysing thetask.Repetitioninimagesisdoneby pre-processing. The brightness value is similar to the neighbouring pixels which is identical to onereal object. The distorted pixel in an image can be replaced by average value of neighbouringpixels.

F. MEDIAN FILTER To retain the vital image details like edges, removal of noise, medianfilter has been widely used in image processing. The reason back its comprehensive usage is thatit preserves the edges of the image. As the name indicates, in this every entry is replaced with themedian of its adjacent entries. Salt and pepper noise and poisson's noise is removed by this filter.This filter works by moving the whole signal in a pattern. The intensity of the median of thepixels in the pattern becomes the output intensity. The median is calculated by sorting the pixelvaluesintotheascendingorderandreplacethepixelvaluewiththecalculatedmiddlepixelvalue.

G. SEGMENTATION

Theprocessofsegmentationisdividinganimageintopartswithidenticalpropertiessuchaslevel,grey,colour,brightness,contrast and texture theroleofsegmentation isto divide theregionsin an image. The aimofsegmentationis toextracttheregion of local tumor in the case of medical image segmentation. It is a difficult task because themedical images are complex and hardly have any linear feature. Several researchers have donethe segmentation techniques in different ways at present from the medical image segmentationpoint of view. Here, the segmentation technique is achieved on the basis of grey level usingconvolutionalneural network.

CONCLUSION

The main theme of this project is to study the automatic brain tumor analysiswith high accuracy, performance and low complexity. Fuzzy C Means (FCM) logic is performedby conventional brain tumor based on its segmentation, shape and texture of feature extraction,Support Vector Machines (SVMs) and Deep Neural Network (DNN) based division are carriedout. There is low complexity. The time required for computation is high and there will be lowaccuracy. To avoid the low accuracy and high computation time, the Convolutional NeuralNetwork (CNN) is established in the scheme. The result will be classified as tumor and normalimages of brain. CNN comes under the technique of deep learning, which consists of chain feedforward layers. Python language can also used for working. Database based on image net is usedfor classification. Pre trained models are performed so that the training is executed only for finallayer. In CNN, the results are obtained in 3D volume i.e. raw pixel value with depth, width andheight.Highaccuracy isobtainedby usingGradientdecentbasedlossfunction.Herethecalculation is obtained by training accuracy, validation accuracy and validation loss. Here, thevalidation loss is very low whereas the validation accuracy is high. The training accuracy will be97.5%.

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