Machine Learning Approach for Brain Tumor Detection

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Abstract

The main organ in human nervous system is human brain which is located in human head and covered by skull. The function of the human brain is to control overall parts of the human body. It is a kind of appendage which can co-ordinate other organs and can assign the duties for them.Figure 1.1 shows the general parts of the human brain, Whereas the major parts occupies the human brain are the brain stem and the cerebrum. The cerebrum was the largest part of the brain. The cerebrum can responsible for the emotions. There are two halves in a cerebrum that controls the contrary side of the body. Each of the halves comprising the four lobes. Cerebellum occupies the major part next to the cerebellum. In recent years, brain tumor detection and segmentation has created an interest on research areas. The process of identifying and segmenting brain tumor is a very tedious and time consuming task, since human physique has anatomical structure naturally. The main objective of this project work is to detect the brain tumor, this work proposed a computerized method for the segmentation and identification of a brain tumor using the Convolution Neural Network. The input MR images are read from the local device using the file path and converted into grayscale images. These images are pre-processed using an adaptive bilateral filtering technique for the elimination of noises that are present inside the original image. The binary thresholding is applied to the denoised image, and Convolution Neural Network segmentation is applied, which helps in figuring out the tumor region in the MR images. The proposed model had obtained an accuracy of 84% and yields promising results without any errors and much less computational time.

1. INTRODUCTION

Image processing is an attractive technique for advancement of human perception. Interest in image processing methods stems from two principal application areas: improvement of pictorial information for human interpretation and processing of image data for storage, transmission, and representation for autonomous machine. It can be applied to analyzed images in a large number of domains. The influence and impact of digital images on modern society are tremendous, and image processing is now a critical component in science and technology. The fastest method in the segmentation process was depends upon the computerized methods which is progressive in the field of scientific imaging.

Medical image processing has experienced dramatic expansion, and has been an interdisciplinary research field attracting expertise from applied mathematics, computer sciences, engineering, statistics, physics, biology and medicine. Computer-aided diagnostic processing has already become an important part of clinical routine. Accompanied by a rush of new development of high technology and use of various imaging modalities, more challenges arise. For instance, how the process and analyze of a significant volume of images, so that high quality information can be produced for disease diagnosis and treatment.

It is a very broad field and covers medical signal gathering, image forming, picture processing, and image display to medical diagnosis based on features extracted from images. There are many areas in medical image processing, of which some emphasize general applicable theory while some focus on specific applications. The objective is to provide a computational output as a second opinion in order to assist physicians in the disease diagnosis and also for the early medication. The imaging technique was mainly used to diagnose the diseases. The are several other medical imaging techniques are there which includes magnetic resonance imaging, computer tomography, spectrophotography, ultrasound scanning, positron emission tomography, X- rays etc. Among all of them MRI can gave better results when compared to the other techniques. Generally it will having the strong magnetic fields which can strongly monitor the electric pulses generated due to the abnormality structure. For getting a quality image for detection of the brain tumor MRI imaging was preferred.

The human brain is one of the most important parts of human body, but sometimes unwanted growth of brain cells causes massive damage to the brain. Brain is a multipart organ which is composed or else connection of neurons that can form a huge network. Cancer is an uncontrolled growth of tissue in any part of the body which is of different types having different characteristics and different treatments. Nowadays, the number of brain tumor patients is increasing considerably. Brain tumors affect the humans badly because of the abnormal growth of cells within the brain. It can disrupt proper brain function and tumors are life threatening.

Two types of brain tumors have been identified namely, benign tumors and malignant tumors. Benign tumors are less harmful than malignant tumors, as malignant are faster than benign tumors in growth. Brain tumor develops because of unusual cell

growth within the brain. A primary brain tumor originates in the brain. In the secondary type of brain tumor, the tumor expansion in the brain results from other parts of the body. Imaging tumors with more accuracy plays pivotal role in the diagnosis of tumors. A benign brain tumor grows step by step, has specific boundaries, and at times spreads. In spite of the fact that its cells are not malignant, this tumor made out of benign cells and situated in indispensable ranges can be considered life debilitating. A malignant brain tumor develops rapidly, has unpredictable boundaries, and spreads to adjacent brain zones. Despite the fact that they are now and again called brain cancer, malignant brain tumors don't fit the meaning of cancer since they don't spread to organs outside the brain and spinal string. Metastatic (optional) brain tumors start as cancer elsewhere in the body and spread to the brain. They shape when cancer cells are passed on into the circulatory framework to the brain. The most generally perceived cancers that spread to the brain are lung cancer and breast cancer. Ametastatic brain tumor is a cancer that spreads from elsewhere in the body to the brain. MRI is widely used because it gives better quality images of the brain and cancerous tissues, compared with other medical imaging techniques such as X-Ray or Computed Tomography (CT). As being a non-invasive technique, MRI is majorly used. The basic principle behind MRI is to generate images from MRI scan using strong magnetic field and radio waves of the body, which helps in investigating the anatomy of the body. The brain images are obtained using Magnetic Resonance Imaging (MRI), which are prone to noise and artifacts such as labels and intensity variations during acquisition. In addition, there are many structures in the brain image such as cerebrospinal fluid, grey matter, and white matter and skull tissues apart from the tumor.

All types of brain tumors may produce symptoms that vary depending on the part of the brain involved. These symptoms may include headaches, seizures, problem with vision, vomiting, and mental changes. Headache is classically worse in the morning and goes away with vomiting. More specific problems may include difficulty in walking, speaking, and with sensation. As the disease progresses, unconsciousness may occur

2. LITERATUREREVIEW

Adesina (2010) Each MRI image was extracted to prepare training data, which was introduced to neural network as input and target vectors. Brain Cancer Detection and Classification System uses computer based procedures to detect tumor blocks or lesions, and classify the type of tumor using Artificial Neural Network in MRI images of different patients with Astrocytoma type of brain tumors. The image processing techniques, such as histogram equalization, image segmentation, image enhancement, morphological operations and feature extraction have been developed for detection of brain tumor in MRI images of the cancer affected patients.

Aslam et al. (2015) had suggested an advanced edge detection algorithm called Sobel edge detection for tumor segmentation. Their proposed approach comprises sobel edge operator information with image dependent threshold method in several regions by using closed contour algorithm. The

affected tissues (tumors) are extracted based on image intensity level within the closed contours. The approach employed a Computer aided system method which follows Multi thresholding dependent K-Means algorithm, to detect area and shape of the tumor.

Lakra et al. (2015) revealed a comparative analysis of familiar segmentation technique from MRI images. For these images, they used Genetic algorithm with improved KSW entropy evaluation technique to attain a low error value. The Entropy value is selected by deriving a threshold and KMW Entropy value is modified upto two times to collect the maximum information. In addition, they used Fuzzy C and K-means Algorithm for analyzing clustering of MRI data to segment many abnormal tissues automatically and simultaneously. The segmentation process is done based on threshold level and maximum value of threshold level depends on the amount of information collected from the object and image background.

Chadded (2015) proposed a novel method for automatic feature extraction in tumor MRI images, which uses Gaussian mixture model (GMM) especially for Glioblastoma. The proposed model (GMM) has certain special features and contains features of principle component analysis and wavelet features. Further, they added a new task to recognize the Glioblasma by T1, T2 weighted MRI images. Through the simulation applied in the proposed study, the obtained performance level was 92.73 % and 97.05 % respect to T1 and T2 images. While most of the proposed methods follow after segmentation, the tested images undergo image classification of normal or abnormal. But, Devkota et al. (2017) introduced a revised and innovative method, on computer aided detection approach, by using Mathematical morphological method, to recognize abnormal tissue which causes tumor in its prior stage. Further, the elimination of noise and other unwanted artifacts are done in image preprocessing. After that, image segmentation process was executed through region of interest, and statistical image features are extracted.

Olenska et al. (2018) have determined the most commonly diagnosed neoplasms in the MRI scanned patient population and indicate correlations based on the descriptive variables. The scanned MRI patient's information details are correlated with descriptive variables to determine the incidence of neoplasm's in specified brain region. Their proposed study demonstrated the number of people affected by neoplasm's indicating gradual increase percentages.

Praveen et al. (2015) had prescribed a hybrid based approach in classifying the brain tumor from MRI images. Raj et al. (2009) had introduced a system that categorizes status of brain tumor in multiple stages. In the first stage, the whole brain region is segmented from the human skull part while in other region input image is still present. Then, as a usual process like pre-processing, feature extraction and classification were performed. Their proposed segmentation process involved different algorithms such as Otsu's method, K-Means clustering and Watershed segmentation, texture filter and few other segmentation approaches.

Sudharani et al. (2015) revealed Morphological based automatic brain tumor detection and also separation of non-enhancing tumors from the healthy tumors in brain that can be done by performing

localization process. This localization process easily predicts the position of affected tumor and provides full references for statistical analysis. In addition, a new mechanism was introduced to measure the area of affected tumor region. In morphological processing, a filter is used to remove low frequency component from the input MRI images. Traditionally, single scale framework network is followed to detect and segment the abnormal tissues from the brain.

Zhao et al. (2016) proposed an automatic brain tumor segmentation system which is based on the Convolutional neural network (CNN) that considers both local features, input image and global region features. This system has three peculiar frameworks called Multi-scale CNN, and high level three scale of image information are taken, and both are tested and trained. Moreover, pixel classification was done by estimating integrated information collecting from the proposed network.

Bahadure et al. (2017) implied a method in order to improve accuracy and decrease complexity during the medical image segmentation. To implement this, they proposed a Berkeley wavelet transform for tumor segmentation. After that, SVM classifier was used to classify a segmented image while relevant features of corresponding images were extracted in each segmented tissue. Through simulation, the proposed system has obtained a capacity of 94.2% of specificity, 97.72% of sensitivity and average of 0.82 % dice similarity index coefficients value.

Varuna Shree et al. (2018) concentrated on noise eliminating technique by which crucial image features can be extracted by using gray-level co-occurrence matrix (GLCM) features. Discrete Wavelet Transform (DWT) based brain tumor segmentation was applied to decrease complexity which improved the performance. The proposed system follows the morphological filtering which can remove the unwanted noise precisely after segmentation. Finally, classifier was designed based on probabilistic neural network which is used to train and test MRI images accurately.

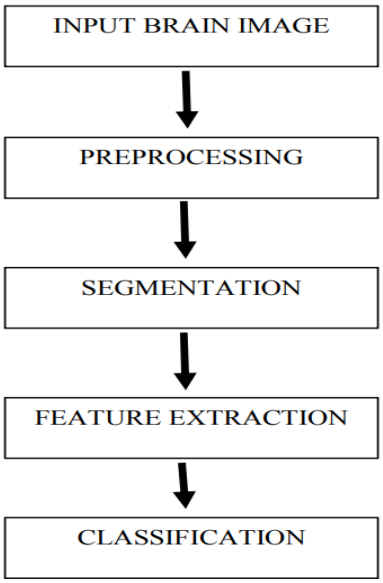
Dhage et al. (2015) had suggested a watershed management based segmentation to differentiate the abnormal issue from healthy one from brain. They also suggested that watershed management effectiveness is really helpful to know about exact location of tumor. The issue is segmented after detection. The connected component labeling algorithm will further improve the segmentation results in terms of tumor area, eccentricity, perimeter, entropy and other crucial values.

3. PROPOSED SYSTEM

Python is a popular programming language, which is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Python is dynamically typed and garbage collected. It supports multiple programming paradigms, including structured, object-oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library.

Python is a general-purpose more interactive, interpreted, high-level, and object-oriented programming language. It was

discovered by Guido van Rossum during the year 1985- 1990. Like Perl, this Python source code available under the GNU- General Public License (GPL), this gives proper understanding on language the Python programming. Python provides following libraries for image processing. The CNN method is proposed to solve the problem of data complexity of this project work used. CNN is able to extract features without removing the spatial information from the input data. CNN is a machine learning method to process two-dimensional data.



Steps in the detection of the brain tumo

Fig 2: Image Pre-processing

The Brain MRI image dataset has been downloaded from the Kaggle. The MRI dataset consists of around 1900 MRI images, including normal, benign, and malignant. These MRI images are taken as input to the primary step. The pre-processing is an essential and initial step in improving the quality of the brain MRI Image. The critical steps in pre-processing are the reduction of impulsive noises and image resizing. In the initial phase, we convert the brain MRI image into its corresponding gray-scale image. The removal of unwanted noise is done using the adaptive bilateral filtering technique to remove the distorted noises that are present in the brain picture. These improves the diagnosis and also increase the classification accuracy rate. Image enhancement is a technique used to improve the image quality and perceptibility by using computer-aided software. This technique includes both objective and subjective enhancements. This technique includes points and local operations. The local operations depend on the district input pixel values. Image enhancement has two types: spatial and transform domain techniques. The spatial techniques work directly on the pixel level, while the transform technique works on Fourier and later on the spatial technique

Image segmentation is a technique of segregating the image into many parts. The basic aim of this segregation is to make the images easy to analyze and interpret with preserving the quality. This technique is also used to trace the objects' borders within the images. This technique labels the pixels according to their intensity and characteristics. Those parts represent the entire original image and acquire its characteristics such as intensity and similarity. The image segmentation technique is used to create contours of the body for clinical purposes. Segmentation is used in machine perception, malignant disease analysis, tissue volumes, anatomical and functional analyses, virtual reality visualization, and anomaly analysis, and object definition and detection.

Segmentation methods has ability to detect or identify the abnormal portion from the image which is useful for analyzing the size, volume, location, texture and shape of the extracted image. MR image segmentation with the aid of preserving the threshold information, which is convenient to identify the broken regions extra precisely. It was a trendy surmise that the objects that are placed in close propinquity might be sharing similar houses and characteristics

Different set of Images	True Positive (%)	True Negative (%)	False Positive (%)	False Negative (%)
128 * 128 Images	83.7	84.5	16.3	15.5
256 * 256 Images	82.4	84.1	17.6	15.9
512 * 512 Images	82.1	83.7	17.9	16.3

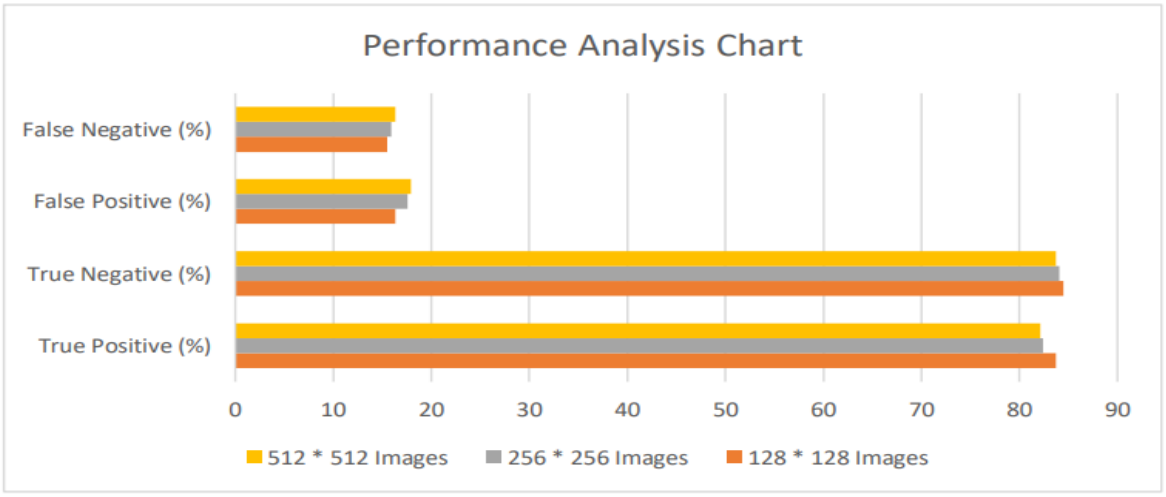


Fig 2: Represents the performance analysis of CNN

Analysis based on economic is the most frequently used technique for evaluating performance and effectiveness of the proposed model. More commonly known as cost benefit analysis. This procedure determines the benefits and saving that are expected from the system of the proposed system. The hardware section in department of system if sufficient for development of system model

This study center around the system's department hardware, software and to what extend it can support the proposed system department is having the required hardware and software there is no question of increasing the cost of implementing the proposed system. The criteria, the proposed system is technically feasible, and the proposed system can be developed with the existing facility

Different set of Images	Accuracy (%)	Sensitivity (%)	Specificity (%)
128 * 128 Images	84.1	84.4	83.8
256 * 256 Images	83.3	83.4	82.7
512 * 512 Images	82.9	83.3	82.4

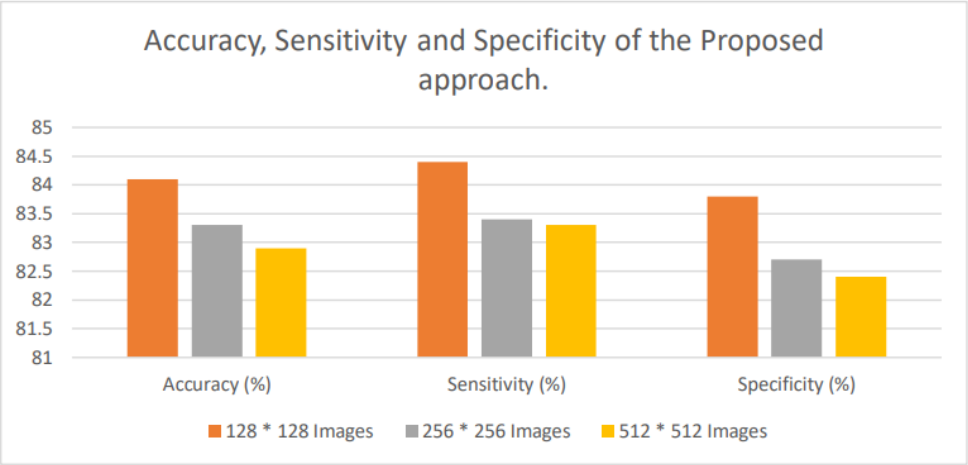


Fig 2: Represents the performance analysis of proposed CNN

Software testing is a critical element of software quality assurance that represents the ultimate review of specifications, design and coding. The user tests the developed system and changes are made according to their needs. The changes are made according to their needs. The testing phase involves the testing of the developed system using various kinds of data. While testing, errors are noted and corrections are made system testing is the stage of implementation, which is aimed at ensuring that the system works accurately and efficiently before live operation commences. The candidate system is subject to a variety of test: stress recovery, and security and usability tests.

4.CONCLUSION

We proposed a computerized method for the segmentation and identification of a brain tumor using the Convolution Neural Network. The input MR images are read from the local device using the file path and converted into grayscale images. These images are pre-processed using an adaptive bilateral filtering technique for the elimination of noises that are present inside the original image. The binary thresholding is applied to the denoised image, and Convolution Neural Network segmentation is applied, which helps in figuring out the tumor region in the MR images. The proposed model had obtained an accuracy of 84% and yields promising results without any errors and much less computational time. It is observed on extermination that the

proposed approach needs a vast training set for better accurate results; in the field of medical image processing, the gathering of medical data is a tedious job, and, in few cases, the datasets might not be available. In all such cases, the proposed algorithm must be robust enough for accurate recognition of tumor regions from MR Images. The proposed approach can be further improvised through in cooperating weakly trained algorithms that can identify the abnormalities with a minimum training data and also self-learning algorithms would aid in enhancing the accuracy of the algorithm and reduce the computational time.

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