BRAIN TUMOR SEGMENTATION USING CONVOLUTIONAL NEURAL NETWORKS IN MRI IMAGES

Submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering

By

DEVADHARSHINI. G (391030108)
RUTH BALAJI (39130382)
R. SAKTHI AISHWARYA (39130389)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC I 12B Status by UGC I Approved by AICTE JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119.

MARCH - 2023

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE
www.sathyabama.ac.in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Devadarshini. G (39130108), Ruth Balaji (39130382), R. Sakthi Aishwarya (39130389) who carried out the PBLA project entitled "Brain Tumor Segmentation using Convolution Neural Networks in MRI Images".

Internal Guide

Dr. EMALDA ROSLIN

Head of the Department

Dr. T. RAVI M.E., Ph.D.,

Submitted for Viva voce held on: ______________________________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We, Devadharshini (39130108), Ruth Balaji (39130382), R.Sakthi Aishwarya (39130389) hereby declare that the Project Report entitled **“Brain Tumour Segmentation using Convolutional Neural Networks in MRI images**” done by us under the guidance of **“Dr. EMALDA ROSLIN ”** is submitted in partial fulfilment of the requirements for the award of Project Based Learning Assessment on “**Medical Instrumentation and Imaging Techniques**”.

DATE: 25.03.2023

PLACE: Chennai

1.

2. R.Sakthi Aishwarya

3.

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGMENT

We are pleased to acknowledge our sincere thanks to the **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. N. M. NANDHITHA, M.E., Ph.D.** Dean, School of Electrical and Electronics Engineering and **Dr. T . RAVI, M.E., Ph.D.** Head of the Department, Department of Electronics and Communication Engineering for providing us with necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to our faculty in charge**, Dr. EMALDA ROSLIN,** for her valuable guidance, suggestions and constant encouragement that paved the way for our project's successful completion work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Electronics and Communication Engineering who were helpful in many ways for the completion of the project.

CONTENTS

LIST OF FIGURES

ABSTRACT

A tumor is a swelling or abnormal growth resulting from the division of cells in an uncontrolled and disorderly manner. Brain tumors are an exceptionally threatening kind of tumor. There exist several types of brain tumors which are classified into four grades. The process for the medical treatment of brain tumors depends on the type, the grade as well as the location of the tumor. If not detected at the early stages, brain tumors can turn out to be fatal. Magnetic Resonance Imaging (MRI) is a widely used imaging technique to assess these tumors, but the large amount of data produced by MRI prevents manual segmentation in a reasonable time, limiting the use of precise quantitative measurements in the clinical practice. We propose an automatic segmentation method based on Convolutional Neural Networks (CNN), exploring small 3×3 kernels. The use of small kernels allows designing a deeper architecture, besides having a positive effect against overfitting, given the fewer number of weights in the network. Data augmentation to be very effective for brain tumor segmentation in MRI images.

CHAPTER 1

INTRODUCTION

INTRODUCTION ON IMAGE PROCESSING

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

INTRODUCTION ON MRI

Magnetic Resonance Imaging (MRI) is a non-invasive imaging technology that produces three dimensional detailed anatomical images. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissues.

INTRODUCTION ON BRAIN TUMOR

A brain tumor is a growth of cells in the brain or near it. Brain tumors can happen in the brain tissue. Brain tumors also can happen near the brain tissue. Nearby locations include nerves, the pituitary gland, the pineal gland, and the membranes that cover the surface of the brain. Brain tumors can begin in the brain. These are called primary brain tumors. Sometimes, cancer spreads to the brain from other parts of the body. These tumors are secondary brain tumors, also called metastatic brain tumors. Many different types of primary brain tumors exist. Some brain tumors aren't cancerous. These are called noncancerous brain tumors or benign brain tumors. Noncancerous brain tumors may grow over time and press on the brain tissue. Other brain tumors are brain cancers, also called malignant brain tumors. Brain cancers may grow quickly. The cancer cells can invade and destroy the brain tissue.

OBJECTIVE

The main objective of the project is to propose an automatic segmentation method based on Convolutional Neural Networks (CNN), exploring the 3 × 3 kernels. By using small kernels we design a deeper architecture, besides having a positive effect against overfitting, given the fewer number of weight in the network. Data augmentation to be very effective for braintumor segmentation in MRI Images.

PROBLEM STATEMENT

A brain tumor is a growth of cells in the brain or near it. Brain tumors can happen in the brain tissue. Brain tumors also can happen near the brain tissue. Nearby locations include nerves, the pituitary gland, the pineal gland, and the membranes that cover the surface of the brain. So in order, Magnetic Resonance Imaging (MRI) is a widely used imaging technique to assess these tumors, but the large amount of data produced by MRI prevents manual segmentation in a reasonable time, limiting the use of precise quantitative measurements in the clinical practice. We propose an automatic segmentation method based on Convolutional Neural Networks (CNN), exploring small 3×3 kernels. The use of small kernels allows designing a deeper architecture, besides having a positive effect against overfitting, given the fewer number of weights in the network. Data augmentation to be very effective for brain tumor segmentation in MRI images**.**

CHAPTER 2

LITERATURE SURVEY

Nitu Kumari(2018) et al. Brain tumor segmentation is important task in medical image processing. Manual segmentation of brain tumor for cancer diagnosis, from large amount of MR images generated in clinical routine, is a difficult and time consuming task. There is a need for automatic brain tumor image segmentation. This paper does the review of different literatures of brain tumor segmentation. For segmentation, mostly used clustering algorithm like fuzzy c-means, k-means some researchers used convolution neural network approach, Particle Swarm Optimization (PSO). The purpose of every segmentation algorithm is to achieve accurate and efficient system developed, so that to find tumor in minimum ti me with maximum accuracy. Mostly support vector machine (SVM) classification technique is used for finding the accuracy of the developed system some different technique like K-NN, NSC, SRC and k-means are also used and different researchers compared these techniques for better accuracy. Keywords— Brain Tumor; Segmentation; MRI; Medical image processing,FLAIR I.A Brain tumor is a collection of abnormal cells in the brain. Brain tumors can destroy brain cells, increase inflammation in the brain. Tumors are mainly of two types: Malignant or cancerous tumors- Further can be divided into:- (a) Primary tumor that starts within the brain. (b) Secondary tumor also called brain metastasis tumor, spreading from other part of body. Benign tumor - Mass of cells/tissues, lacking the ability to spread. Medical imaging plays necessary part in diagnosis and prognosis of brain tumors, which in turn help to manage the disease [1]. Magnetic Resonance Imaging (MRI) is nowadays one of the most used medical imaging techniques for brain tumors as it is non-invasive (using no ionizing radiation) [1]. Different MRI modalities are produced by altering excitation times during image acquisition [5]. These different MRI sequences generate different types of tissue contrast images, providing very important structural information and capable to diagnosis and segmentation of tumors along with their sub regions [5]. Fig.1 depicts the three standard MR images sequences for brain tumor diagnosis which are T1-weighted MRI (T1), T2-weighted MRI (T2), and Fluid Attenuated Inversion Recovery (FLAIR). TABLE I shows the comparison of T1 vs. T2 vs. FLAIR (Brain). Generally T1- and T2-weighted images are easily differentiated by CSF Comparison which is dark for T1-weighted and bright for T2-weighted.

FLAIR sequence is same as T2-weighted except that TE and TR times are longer [16]. By doing so, abnormalities remain bright but normal CSF fluid is attenuated and made dark. These sequences easily differentiate between CSF and an abnormality. In MR Images, it is sometimes difficult to differentiate between specific tissues and cells from the rest of the image [1]. Hence, Image Segmentation is used - manually or automatically partitioning the image into a set of relatively homogeneous regions with similar properties [1]. The process of image segmentation, help radiologists in finding tumors more accurately. Hence, it is increasingly becoming an important step in medical image processing. Manual process of image segmentation, is time consuming and quite difficult for large amount of MR images [2]. Therefore, automatic process of segmentation of MR images is required for above mentioned reasons. From among the several researches which have been done on brain tumor segmentation by using various techniques.

Alvin Matthew (2020) et al. Computer Vision has played a crucial role in multiple fields of work including in medical applications. Some of these applications can be found in brain tumor detection. Early detection of brain tumors is highly important in terms of improving the patient's chance of survival. Magnetic Resonance Image (MRI) has been the go-to solution in terms of detecting brain tumors. Even so, the methods used are still vastly reliant on multiple manual procedures which creates a potential human error. This is due to the high variety of human tissue that could look closely similar to some of the brain tumors. With the growth of computer vision, image segmentation has shown to be reliable and can aid medical experts in detecting brain tumors using the MRI image provided. In this paper, we will explore how image segmentation can be applied in brain tumor detection and how beneficial it can be in the medical field with the help of the Mathematical Morphological Reconstruction (MMR) algorithm. Keywords—Image Segmentation, Computer Vision, Brain Tumor Detection, Mathematical Morphological Reconstruction, Magnetic Resonance Image I. INTRODUCTION Cancer is known as the uncontrolled and unnatural growth of cells in the body. Cancer is also a dangerous thing that can cause abnormalities inside our body, especially when it happens to grow inside our brain. These cancer cells affect the brain tissue and are known as the most lethal cancers [1]. Up until today, there has never been a cure for cancer that is 100 percent effective. However, there are things we can do to speed up the detection and treatment of this cancer, specifically in this case is a brain tumor. One of the leading reasons for increased mortality among children and adults is brain tumors. Depending on the tumor's origin, development pattern, and malignancy, complicated brain tumors can be divided into two types. The first tumor type is tumors that grow from the brain cells themself, whereas the second type is tumors that spread from cancer cells of another body part [2]. Computer vision has brought us the ability to be able to increase the accuracy and efficiency of brain tumor detection [3]. Magnetic Resonance Imaging (MRI) is the tool to obtain brain images. Unlike PET scans that use x-rays and radiations, MRI produces a cross-sectional image with unprecedented tissue contrast using radio waves and magnetic fields similar to nuclear magnetic resonance [4]–[6]. Most current diagnosis technique involves human experience and judgment towards the results given by the MRI scans. The involvement of human interaction results in excessive and tedious human labor. In addition to that, analyzing the data without automated segmentation would decrease the reliability of the detection [7], [8]. These techniques have a high possibility of falsepositive detections due to the human elements of the technique [5]. The image resulted by an MRI scan is often prone to artifacts and noise that could cause disturbance and misdetection of Brain Tumor [9]. With the help of image processing, we can deeply recognize these unclear images for easier visualization [10].

Mahesh Swami (2020) et al. Cancer as a disease has taken the form of an epidemic for human beings. This work processes radiograph CT and MRI images to perform detection of brain tumour using a hybrid algorithm based on image processing and segmentation. The database taken is from Google open source brain scans and the system has been developed on MATLAB v2019 for Windows. Section I reviews image processing for medical imaging and Section II reviews associated state-of-art literature. Section III details the proposed system. An engineering analysis is detailed in Section IV; a sensitivity of 100%, similarity of 89.66% and accuracy of 87.50% is achieved for the algorithm. This work proposes to develop a cost-effective system accessible to medical practitioners on everyday computers. Smart systems of today employ an approach towards data processing and output acquisition where computer vision forms an integral part. Applications in the field of medical imaging are gaining popularity owing to growing population and the magnitude of lifestyle diseases like cancer [1]. Another word for “neoplasm”, a tumour is an abnormal benign or malignant new growth of tissue that possesses no physiological function and arises from uncontrolled usually rapid cellular proliferation. Growing environmental pollution and lifestyle diseases are the generally attributed causes. Brain tumours can be categorised on the basis of their origin, growth pattern and malignancy. A primary brain tumour arises from brain cells or from the meninges while a secondary or metastatic brain tumour is one that starts multiplying in another part of the body and spreads to the brain. According to the National Brain Tumour Foundation (NBTF) of United States (2012), each year more than 6,88,000 people in the U.S. are diagnosed with primary brain tumours [2]. The incidence of central nervous system (CNS) tumours in India ranges from 5 to 10 per 100,000 population with an increasing trend and accounts for approximately 2% of malignancies [3]. Different sizes and forms of the lesions make it cumbersome to find accurate dimensions. Moreover, tumours may grow abruptly affecting neighbouring tissues; which results in a dynamic problem and an incorrect diagnosis of healthy tissues as well. Figure 1: Brain tumour facts in the USA (source - braintumor.org) Medical field imaging such as in MRI and CT scan mainly depend on computer technology to create or display P images of the internal organs which helps the medical practitioner to visualize inner organs in better way, and also allow them to visualize body multi-dimensionally [4]. In health sectors, brain tumour measurements are obtained mainly by radiologists, who measure the tumour manually through widely available imaging software on MRI/CT scans. The approach has been followed since the development of medical imaging. This work proposes to develop a cost-effective method to segment tumours from open source brain scans on Google on MATLAB v2019 for Windows 10.

S.U.ASWATHY (2014) et al. Brain tumor detection and segmentation is one of the most challenging and time consuming task in medical image processing. MRI (Magnetic Resonance Imaging) is a medical technique, mainly used by the radiologist for visualization of internal structure of the human body without any surgery. MRI provides plentiful information about the human soft tissue, which helps in the diagnosis of brain tumour. Accurate segmentation of MRI image is important for the diagnosis of brain tumor by computer aided clinical tool. After appropriate segmentation of brain MR images, tumor is classified to malignant and benign, which is a difficult task due to complexity and variation in tumor tissue characteristics like its shape ,size ,gray level intensities and location. Taking in to account the aforesaid challenges, this research is focussed towards highlighting the strength and limitations of earlier proposed classification techniques discussed in the contemporary literature. Besides summarizing the literature, the paper also provides a critical evaluation of the surveyed literature which reveals new facets of research. Cancer in a body occurs when the cell in the body grows and divides in an uncontrollable manner. If this happens in brain then it is called as brain tumor. A brain tumor is a mass of unnecessary and abnormal cell growing in the brain or it can be defined as an intracranial lesion which occupies space within the skull and tends to cause a rise in intracranial pressure. Brain tumors are mainly classified in to two ie Benign and Malignant. Benign tumors are noncancerous and they seldom grows back where as malignant tumors are cancerous and they rapidly grows and invade to the surrounding healthy brain tissue. The location of tumor in brain helps the individual to determine how the brain tumor effects an individual normal functioning. Brain tumor can be diagnosed by taking personal and family medical history and also by physical examination, brain CT/MRI scan, brain angiogram, spinal tap biopsy etc. diagnosis of brain tumor can be delayed because its symptom is similar to symptom of other condition. There are several image processing technique such as histogram equalisation, image segmentation, image enhancement, morphological operation, feature selection and extraction and classification.

Aditya Miglani (2021) et al. A tumor is a swelling or abnormal growth resulting from the division of cells in an uncontrolled and disorderly manner. Brain tumors are an exceptionally threatening kind of tumor. There exist several types of brain tumors which are classified into four grades. The process for the medical treatment of brain tumors depends on the type, the grade as well as the location of the tumor. If not detected at the early stages, brain tumors can turn out to be fatal. Magnetic Resonance Imaging (MRI) images are used by specialists and neurosurgeons for the diagnosis of brain tumors. The accuracy depends on the experience and domain knowledge of these experts, and is also a time consuming and expensive process. To overcome these restrictions, several deep learning algorithms have been proposed for the detection of presence of brain tumors. In this review paper, an extensive and exhaustive guide to the sub-field of Brain Tumor Detection, focusing primarily on its segmentation and classification, has been presented by comparing and summarizing the latest research work done in this domain. This research work has made a comparison between 28 research papers and highlighted the different state-of-the-art approaches. With a lot of ongoing research work in this area, this paper would assist all future researchers. The brain is one of the most vital and sensitive organs of the body and is the centre of all nervous activity. Issues pertaining to the brain are widely considered the most difficult to operate on. There are roughly 350,000 new brain tumor cases across the world each year and the 5-year survival rate for people diagnosed with a brain tumor is only 36% [11]. Brain tumors can be classified as benign (non-cancerous tumors) or malignant (cancerous tumors) [18]. The World Health Organisation (WHO) has classified brain tumors into four grades from Grade I to Grade IV depending on the severity of the case. Neurosurgeons often recommend surgery for the treatment of brain tumors. However, for the latest stages of the tumors, alternative approaches using radiation and chemotherapy are often suggested, since the only possible diagnosis is to try to kill or slow down the growth of the cancerous cells [15]. Since the fatality rate of people diagnosed with brain tumors is very high, the detection of brain tumors at the early stages is extremely important for correct treatment. For diagnostic purposes, images can be gathered from several medical imaging techniques. Some of the medical imaging techniques are PET(Positron Emission Tomography), MRI(Magnetic Resonance Imaging), CT(Computed Tomography) [13]. Among these, MRI is considered to be the most effective medical imaging technique, especially for taking a look at soft tissues and the nervous system. MRI makes use of a powerful magnet and radio waves to produce images of body structures by causing them to emit faint signals. Unlike CT scans, MRI does not use radiation of X-rays which can be damaging. MRI images have high resolution and are quite detailed, due to which they can even detect tiny things [6, 17]. The tumor may show up as a white area, or bright white-coloured pattern. However, there are other parts of the brain which have a similar behaviour as these cells and can lead to a wrong diagnosis. With tens of thousands of patients suffering from brain tumors each year, the use of deep learning techniques for the purpose of automatic detection and classification of brain tumors has become an area of interest. These techniques have also been employed for the segmentation of brain tumors, and this area is getting widespread attention from the medical community [16]. The aim of segmentation is to change the representations of the different areas of an image, making areas of the image having different characteristics easier to interpret. By dividing the image of the brain into these different and unique areas, each area becomes spatially contiguous [1, 2]. Some of the common problems in manual detection of the brain tumors are the significant time requirements and the possibilities of misclassifications due to the complexity of the problem. Therefore, the automatic segmentation of MRI images of brain tumors can significantly improve the diagnosis and methods of treatment, especially in cases where access to trained experts and radiologists is difficult [3]. This paper will discuss about the latest research work done in this domain.

Sakshi Ahuja et al.,[1] used transfer learning and superpixel technique for detection of brain tumor and brain segmentation respectively. The dataset used was from BRATS 2019 brain tumor segmentation challenge and this model was trained on the VGG 19 transfer learning model. Using the superpixel technique the tumor was divided between LGG and HGG images. This resulted in an average of dice index of 0.934 in opposition to ground truth data.

Hajar Cherguif et al.,[2] used U-Net for the semantic segmentation of medical images. To develop a good convoluted 2D segmentation network, U-Net architecture was used. BRATS 2017 dataset was used for testing and evaluating the model proposed. The U-Net architecture proposed had 27 convolutional layers, 4 deconvolutional layers, Dice coef of 0.81.

Chirodip Lodh Choudhury et al.,[3] made the use of deep learning techniques involving deep neural networks and also incorporated it with a Convolutional Neural Network model to get the accurate results of MRI scans. A 3-layer CNN architecture was proposed which was further connected to a fully Connected Neural Network. F-score equal to 97.33 and an accuracy equal to 96.05% was achieved.

Ahmad Habbie et al.,[4] MRI T1 weighted images were taken and using semi automatic segmentation analyzed the possibility of a brain tumour using an active contour model. The performance of morphological active contour without edge, snake active contour and morphological geodesic active contour was analyzed. MGAC performed the best among all three as suggested by the data.

Neelum et al.,[5] used a concatenation approach for the deep learning model in this paper and the possibility of having a brain tumor was analyzed. Pre trained deep learning models which are Inception - v3 and DenseNet201 were used to detect and classify brain tumors. Inception - v3 model was pre trained to extract the features and these features were concatenated for tumor classification. Then, the classification part was done by a softmax classifier.

Ms. Swati Jayade et al.,[6] used Hybrid Classifiers. The classification of tumors was done into types, malignant and benign. Feature dataset here was prepared by Gray level Cooccurrence Matrix (GLCM) feature extraction method. A hybrid method of classifiers involving KNN and SVM classifiers was proposed to increase efficiency.

Zheshu Jia et al.,[7] the author made a fully automatic heterogeneous segmentation in which SVM (Support Vector Machine) was used. For training and checking the accuracy of tumor detection in MRI images, a classification known as probabilistic neural network classification sytem had been used. Multi spectral brain dataset is used and this model focused on the automated segmentation of meningioma.

DR. Akey Sungheetha, DR. Rajesh Sharma R.[8] used Gabor transform along with the soft and hard clustering for detecting the edges in the CT and MRI images. A total of 4500 and 3000 instances of MRI images and CT were used respectively. K-means clustering was used for the separation of similar features into sub-groups To represent the images in the form of histogram properties, the author used Fuzzy c means.

Parnian Afshar et al.,[9] used a bayesian approach for the classification of brain tumor using capsule networks. To improve the results of tumor detection, capsule network instead of CNN was used as CNN can loose the important spatial information. The team proposed BayesCap framework. To test the proposed model they used a benchmark brain tumor dataset.

Suraj S. Gawande (2017) et al. A literature overview is described on cerebrum (brain) tumor diagnosis. The aim of this survey is to provide an outline for those who are new to the field of image processing, and also to provide a reference for those searching for literature in this applications. Tumor is because of an abnormal development of cells (tissues) inside the brain. Magnetic Resonance Imaging (MRI), Computer Tomography (CT) imaging techniques are used for early detection of abnormal changes in tumor tissues or cells. Its correct detetcion and identification at an early stage is the only way to get cure. Brain tumor tissues may become malignant (cancerous) if not diagnosed at right time. A recent couple of years various image processing algorithms have been proposed for correct and efficient computer aided diagnosis of cerebrum tumors. An algorithm effectively work on CT, MRI images. It is been observed that an automatic segmentation method using Convolutional Neural Network (CNN) with 3*3 kernels provide deeper architecture and positive results against overfitting. Watershed segmentation algorithm removes the salt & pepper noise without disturbing edges. It is very easy for automatic and accurate calculation of tumor area. Sobel edge detection based improved edge detection algorithm provide superior performance over conventional segmentation algorithm. The Otsu segmentation method for brain tumor makes the diagnosis and treatment planning more easy and accurate. Morphological operators can be used in the detection of tissues in the scan image of tumor. The use of PCA in optimizing the features obtained from segmented region can give the very good results as compared to other methods. The intensity based and wavelet based features are very useful for classification of benign and malignant tumors. Artificial Neural Network (ANNs), Support Vector Machine (SVM) based decision support system are reviewed. A tumor is an abnormal development of brain tissues. Tumor can be dangerous (Malignant) or non-carcinogenic (Benign). A cerebrum tumor happens when anomalous cells frames inside the cerebrum i.e. Brain [2]. Primary malignant brain tumor are tumors that begins in the brain. They are actually quite rare. Cerebrum metastases, usually called as “brain mets", are much more normal. Thesis propose cerebrum metastases happen in 10%-30% of patients with malignancy i.e. cancer; an estimated 150,000 to 200,000 cases for every year in the United States. Brain tumor is one of the leading causes of death in the world [1]. Medical anatomical imaging, for example, x- rays beams and later followed by Computer Tomography (CT) and Magnetic Resonance Imaging (MRI), each one of these have been Extensively utilized by the scientist in the medical image processing. Extraction of useful organic information from xray brain image is not very effective due to their limitation of poor image quality and not stronger interaction with the light element. CT imaging is very especially useful for viewing changes in bony structure i.e. hard tissues. Brain tumor contains soft tissues therefore soft tissues are not very cleared in CT scan image of brain tumor. MRI is said to be most sensitive, powerful, successful and broadly used technique [1]. In brain tumor diagnostic study, MRI assumes an extremely viable part keeping in mind the end goal is to separate delicate and hard tissues doubtlessly i.e. clearly. Radiologist strongly recommend MRI image of cerebrum tumor for diagnosis. In MRI image analysis of brain, describe a very large set of data. MRI data tracks the size of brain tumor and respond to treatment accordingly [16]. The feature extraction is information lessening process i.e. data reduction process. The feature extraction process results in a much smaller and richer set of valid data. Feature extraction reduces over fitting problem. Gray-level-co-occurrence matrix (GLCM) is the quantifiable procedure for breaking down the surfaces that consider the spatial relationship of the pixels this forms the extraction of statistical measures from this matrix [3]. Discrete Wavelet Transform (DWT) performs multi-resolution of images that is simultaneous representation of image on different resolution levels [2]. Classification of tumor is to make a decision on what kind of tumor is. The ordinary techniques, utilized for classification are Biopsy, Human examination, Expert assessment and so forth [2]. The biopsy methods is time consuming, it takes around 10-15 days of duration to take decision about type of tumor. The human decision is not always accurate and correct. The human may wrong but computer cannot. The expert cannot take decision by himself on tumor type. He need to discuss with other expert for his opinion, this is again a time consuming process. Now a days there is a quick development in Artificial Intelligence (AI) in bio-medical field. Further sections cover the survey of different image processing algorithms for the tumor diagnosis i.e detection, feature extraction & classification.

CHAPTER 3

INVESTIGATION

3.1. EXISTING SYSTEM

Support Vector Machines and Random Forests (RF) were successfully used in brain tumor segmentation. The RF became very used due to its natural capability in handling multi-class problems and large feature vectors.

3.2. PROPOSED SYSTEM

We propose a novel CNN-based method for the segmentation of brain tumors in MRI images.

Use a binary CNN to identify the complete tumor. Then cellular automata smooth the segmentation.

The activation function LReLU was more important than ReLU in effectively training our CNN.

3.3. FLOW DIAGRAM DESCRIPTION

- First the image selected for the processes listed below.
- The selected image may have some noise so the image is filtered using a median filter.
- Then the shape of the brain will be segmented using Otsu's thresholding method.
- Features of the selected image will be extracted using haar wavelet transform (HWT) and histogram of oriented gradients (HOG).
- The extracted features will be classified with the training dataset using CNN.
- Finally the result will be displayed .

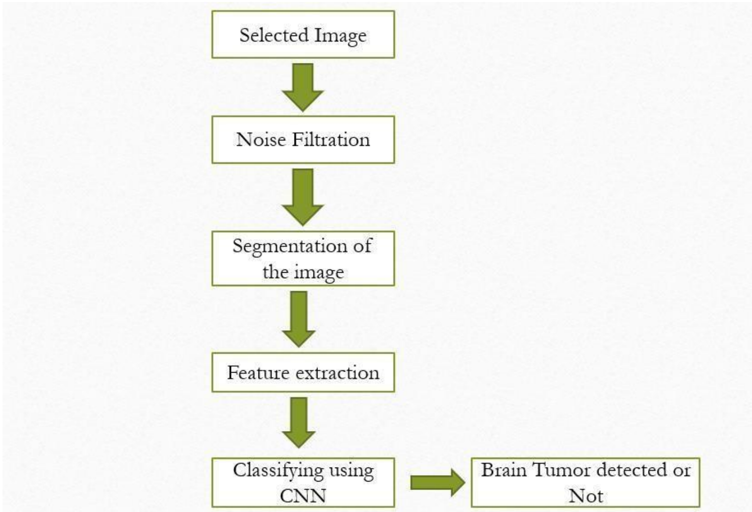


Figure 1. Block Diagram

3.4. WORKING

In this project, MRI Images are used to detect whether the patient has Brain Tumor or not. We use D- planning technique, which uses three processes, they are preprocessing, segmentation, and classification. Classification is a backhand process, that is we train a database using a CRM. Preprocessing enhances the images, by increasing brightness, and contrast, and if there is any noise it removes it. Segmentation is of three types Kmean, ACM, and Watershed. Kmean shows images in black and white, ACM shows the region which is affected and Watershed the images in a blur. Using the mat lab we first run the code, then we need to select the MRI Image that needs to be identified. After this, the selected image may have some noise so the image is filtered using a median filter. Then the shape of the brain will be segmented using Otsu's thresholding method. Features of the selected image will be extracted using haar wavelet transform (HWT) and histogram of oriented gradients (HOG). The extracted features will be classified with the training dataset using CNN. Finally, the result will be displayed whether the brain is affected or not.

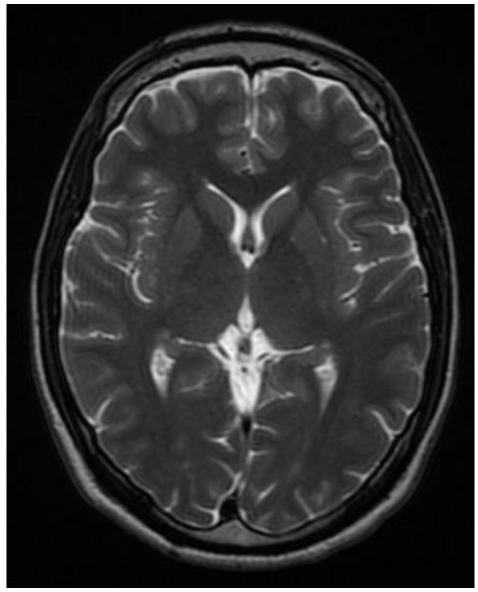


Figure 2. MRI image of the Brain

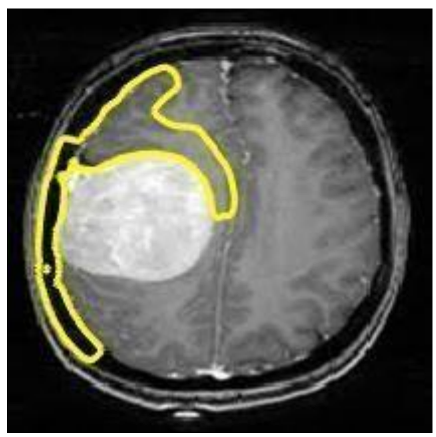


Figure 3. Region being affected

Figure 4. Contrast stretched image

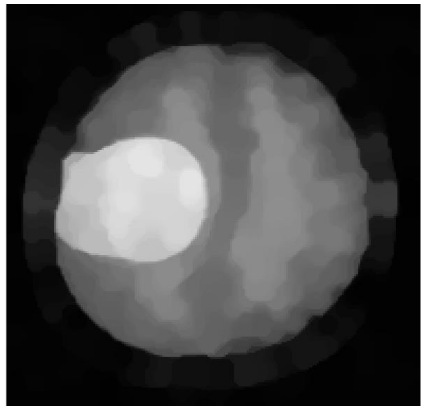


Figure 5. Blur image of the brain

OUTPUT

The MRI images are analyzed and the outputs are displayed.

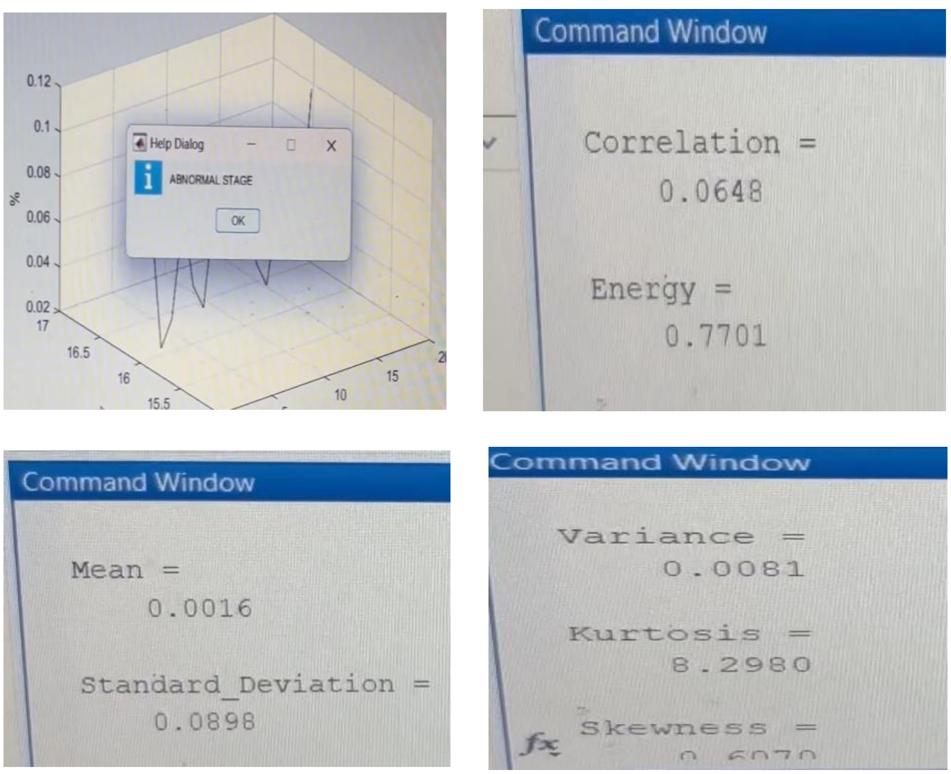


Figure 6. Outputs

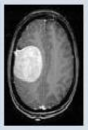
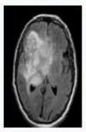
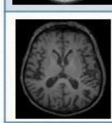
IMAGE	STAGE	CORRELATION	ENERGY	MEAN	STANDARD DEVIATION	RMS	KURTOSIS	ACCURACY
	ABNORMAL STAGE	0.1990	0.7621	0.0031	0.0898	0.0898	7.3282	99.2%
	ABNORMAL STAGE	0.1502	0.7693	0.0031	0.0898	0.0898	7.3726	99.2%
	ABNORMAL STAGE	0.0648	0.7701	0.0016	0.0898	0.0898	8.2980	99.2%
	ABNORMAL STAGE	0.1247	0.7488	0.0042	0.0897	0.0898	7.7305	99.2%
	ABNORMAL STAGE	0.1142	0.7554	0.0047	0.0897	0.0898	9.3640	99.2%
	NORMAL STAGE	0.1318	0.7746	0.0044	0.0897	0.0898	8.2850	99.2%
	NORMAL STAGE	0.0664	0.7493	0.0036	0.0897	0.0898	7.1184	99.2%
	NORMAL STAGE	0.0576	0.8254	0.0023	0.0898	0.0898	21.4385	99.2%
	NORMAL STAGE	0.1345	0.7803	0.0045	0.0898	0.0898	9.7959	99.2%
	NORMAL STAGE	0.0531	0.8757	0.0053	0.0897	0.0898	34.0145	99.2%

Figure 7. Output table

3.5. SYSTEM REQUIREMENTS

- Windows 7 (or) higher
- 64-bit operating system
- Disk Space
- 2 GB for MATLAB only,
- 4–8 GB for a typical installation.
- Minimum 2GB RAM needed
- No specific graphic cards required.

3.6. SOFTWARE REQUIREMENTS

Mat lab 2016(A)

MATLAB is a scientific programming language and provides strong mathematical and numerical support for the implementation of advanced algorithms. It is for this reason that MATLAB is widely used by the image processing and computer vision community. New algorithms are very likely to be implemented first in MATLAB, indeed they may only be available in MATLAB.

3.7. Advantages and Disadvantages

ADVANTAGES

- CNN easier to train
- Less prone to overfitting

DISADVANTAGES

- Time-consuming.
- Inter- and intra-rater errors are difficult to characterize

CHAPTER 4

CONCLUSION

Therefore, this project is very much helpful for doctors to identify if a patient has Brain Tumoror not and if yes which region of the brain is being affected. It also gives the accuracy of theMRI Image if the person has Brain Tumor. It makes the work of the doctor simpler and easier by giving all the details from the MRI image.

REFERENCES

1. D. Kwon et al., “Combining generative models for multifocal glioma segmentation and registration,” in Medical Image Computing and Computer-Assisted Intervention–MICCAI 2014. Springer, 2014, pp. 763–770.
2. Pinto et al., “Brain tumor segmentation based on the extremely randomized forest with high-level features,” in Engineering in Medicine and Biology Society (EMBC), 2015 37th Annual International Conference of the IEEE. IEEE, 2015, pp. 3037–3040.
3. K. Simonyan and A. Zisserman, “Very deep convolutional networks for large-scale image recognition,” arXiv preprint arXiv:1409.1556v6.
4. S. G, Ranjith Balakrishnan, “Brain Tumor Diagnosis from MRI feature Analysis – A Comparative Study”, IEEE-2nd International Conference on Innovation in Information Embedded and Communication Systems ICIIECS’15, 2015.
5. P. Sangeetha, “Brain Tumor Classification Using PNN and Clustering”, International Journal of Innovative Research in Science, Engineering and Technology, 2014. Pp. 796-803.
6. D. M. Joshi, Dr.N. K. Rana, V. M. Misra,”Classification of Brain Cancer Using Artificial Neural Network“, IEEE-2nd International Conference on Electronic Computer Technology (ICECT), 2010, pp. 1-5
7. S. R. Telrandhe, Amit Pimpalkar, Ankita Kendhe, “Detection of Brain Tumor from MRI images by using Segmentation &SVM”, IEEEWorld Conference on Futuristic Trends in Research and Innovation for Social Welfare (WCFTR’16) , 2016, pp. 1-6.
8. S. B. Gaikwad and M. S. Joshi, “Brain Tumour Classification Using Principle Component Analysis and Probabilistic Neural Network”, International Journal of Computer Application, International Journal of Computer Applications (0975-8887), 2015, pp. 5-9.
9. M. Razaei, Haojin Yang and Christoph Meinel, “Brain Abnormality Detection by Deep Convolutional Neural Network”, unpublished. [unblished]
10. Pham N. H. Tra, Nguyen T. Hai, Tran T Mai, “Image Segmentation for Detetcion of Benign and Malignant Tumors”, IEEE, 2016, pp. 51- 54.
11. R. K, Joshila Grace L. K., “Brain Tumor Detection Based on Watershed Transformation”,

IEEE-International Conference on Communication and Signal Processing, pp. 0049-0054, 2016.

12. C. Arizmendi, Alfredo Vellido, Enrique Romero, “Binary Classification of Brain Tumors Using a Discrete Wavelet Transform and Energy Criteria”, IEEE 2011, 2011, pp. 1-4.
13. S. Pereira, Adriano Pinto, Victor Alves, and Carlos A. Silva, “Brain Tumor Segmentation Using Convolutional Neural Networks in MRI Images”, IEEE TRANSACTION ON MEDICAL IMAGING, VOL 35, MAY 2016.
14. P. Dhage, M. Phegade, S. K. Shah, “Watershed Segmentation Brain Tumor Detection”, IEEE International Conference on Pervasive Computing (ICPC), 2015
15. Asra Aslam, Ekram Khan, M.M. Sufyan Beg, “Improved Edge Detection Algorithm for Brain Tumor Segmentation”, Elsevier, ScienceDirect, Procedia Computer science , pp. 430-437., 2015.
16. R. Shelkar, M. N. Thakare, “Brain Tumor Detetcion and Segmentation by using Thresholding and Watershed Algorithm”, IJACT, Volume 1, Issue 3, July 2014
17. K. Sharma, Akwinder Kaur and Shruti Gujral, “A review on various brain tumor detection techniques in brain MRI images”, IOSR Journal of Engineering (IOSRJEN), Vol. o4, Issue 05, May-2014
18. D., Akansha Singh, “Review on Brain Tumor Detection from MRI images”, Computing for Sustainable Global Development (INDIACom), 2016 3rd International Conference on IEEE, 2016
19. S. Amin Banday, Ajaz Hussain Mir, “Statistical Textural Feature and Deformable Model Based MR Brain Tumor Segmentation”, IEEEConference on Advaces in computing, communications and informatics (ICACCI) 2016,PP.1-7