

A Project Report

On

BRAIN TUMOR IDENTIFICATION

USING NEURAL NET AND SVM

Submitted in partial fulfilment of

the requirement for the award of

the degree of

**Bachelor of Technology in Computer Science and
Engineering**



(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Under The Supervision of

Mr. Tarun Kumar

Assistant Professor

Department of Computer Science and Engineering

Submitted By

19SCSE1010712 – SHISHIR SHEKHAR SINGH

19SCSE1010697 – RAHIL RATAN KUMAR

**SCHOOL OF COMPUTING SCIENCE AND ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
GALGOTIAS UNIVERSITY, GREATER NOIDA, INDIA**

DECEMBER - 2021



**SCHOOL OF COMPUTING SCIENCE AND
ENGINEERING
GALGOTIAS UNIVERSITY, GREATER NOIDA**

CANDIDATE'S DECLARATION

We hereby certify that the work which is being presented in the project, entitled "Brain tumor identification using neural net and svm" in partial fulfilment of the Bachelors in technology in computer science and engineering requirements for the award of the submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of JULY-2021 to DECEMBER-2021, under the supervision of Mr.Tarun Kumar, Assistant Professor, Department of Computer Science and Engineering of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the project has not been submitted by me/us for the award of any other degree of this or any other places.

19SCSE1010712 – SHISHIR SHEKHAR SINGH

19SCSE1010697 RAHIL RATAN KUMAR

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Supervisor

Mr Tarun Kumar

Assistant Professor

CERTIFICATE

The Project Report of 19SCSE1010712 – SHISHIR SHEKHAR SINGH
19SCSE1010697- RAHIL RATAN KUMAR has been held on
_____ and his/her work is recommended for the award of
BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND
ENGINEERING.

Signature of Examiner(s)

Signature of Supervisor(s)

Signature of Project Coordinator

Signature of Dean

Date:

Place:

Table of Contents

| Title | Page |
|--|------|
| Acknowledgement | |
| Abstract | |
| List of Table | |
| List of Figures | |
| Acronyms | |
| Chapter 1 Introduction | 1 |
| 1.1 Brain anatomy | 2 |
| 1.2 Motivation for the Work | 3 |
| 1.3 Problem Statement | 4 |
| 1.4 Scope | 5 |
| Chapter 2 Literature Survey/Project Design | 5 |
| Chapter 3 Experimental Analysis | 9 |
| Chapter 4 Results | 11 |
| Chapter 5 Conclusion | 41 |
| Reference | 43 |

List of Figures

| S.No. | Caption | Page No. |
|-------|--|----------|
| 1 | Location of tumors in eight different images | 8 |
| 2 | Module Division | 9 |
| 3 | Input Image | 11 |
| 4 | Gray-scale Image | 12 |

ABSTRACT:

The human brain is the major controller of the humanoid system. The abnormal growth and division of cells in the brain lead to a brain tumor, and the further growth of brain tumors leads to brain cancer. In the area of human health, Computer Vision plays a significant role, which reduces the human judgment that gives accurate results. CT scans, X-Ray, and MRI scans are the common imaging methods among magnetic resonance imaging (MRI) that are the most reliable and secure. MRI detects every minute objects. Our paper aims to focus on the use of different techniques for the discovery of brain cancer using brain MRI. In this study, we performed pre-processing using the bilateral filter (BF) for removal of the noises that are present in an MR image. This was followed by the binary thresholding and Convolution Neural Network (CNN) segmentation techniques for reliable detection of the tumor region. Training, testing, and validation datasets are used. Based on our machine, we will predict whether the subject has a brain tumor or not. The resultant outcomes will be examined through various performance examined metrics that include accuracy, sensitivity, and specificity. It is desired that the proposed work would exhibit a more exceptional performance over its counterparts.

1. INTRODUCTION

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues. Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities.

The medical imaging processing refers to handling images by using the computer. This processing includes many types of techniques and operations such as image gaining, storage, presentation, and communication. This process pursues the disorder identification and management. This process creates a data bank of the regular structure and function of the organs to make it easy to recognize the anomalies. This process includes both organic and radiological imaging which used electromagnetic energies (X-rays and gamma), sonography, magnetic, scopes, and thermal and isotope imaging. There are many other technologies used to record information about the location and function of the body. Those techniques have many limitations compared to those modulates which produce images.

An image processing technique is the usage of a computer to manipulate the digital image. This technique has many benefits such as elasticity, adaptability, data storing, and communication. With the growth of different image resizing techniques, the images can be kept efficiently. This technique has many sets of rules to perform in the images synchronously. The 2D and 3D images can be processed in multiple dimensions.

1.1 BRAIN ANATOMY:

The brain tumor is one all the foremost common and, therefore, the deadliest brain diseases that have affected and ruined several lives in the world. Cancer is a disease in the brain in which cancer cells ascends in brain tissues. Conferring to a new study on cancer, more than one lakh people are diagnosed with brain tumors every year around the globe. Regardless of stable efforts to overcome the complications of brain tumors, figures show unpleasing results for tumor patients. To contest this, scholars are working on computer vision for a better understanding of the early stages of tumors and how to overcome using advanced treatment options.

Magnetic resonance (MR) imaging and computed tomography (CT) scans of the brain are the two most general tests to check the existence of a tumor and recognize its position for progressive treatment decisions. These two scans are still used extensively for their handiness, and the capability to yield high-definition images of pathological tissues is more. At present, there are several other conducts offered for tumors, which include surgery, therapies such as radiation therapy, and chemotherapy. The decision for which treatment relies on the many factors such as size, kind, and grade of the tumor present in the MR image. It's conjointly chargeable for whether or not cancer has reached the other portions of the body.

Precise sighting of the kind of brain abnormality is enormously needed for treatment operations with a resolution to diminish diagnostic errors. The precision is often makeshift utilizing computer-aided diagnosis (CAD) systems. The essential plan of computer vision is to produce a reliable output, which is an associate estimation to assist medical doctors in image understanding and to lessen image reading time. These advancements increase the steadiness and correctness of medical diagnosis — however, segmenting an MR image of the tumor and its area itself a very problematic job. The occurrence of tumors in specific positions within the brain image without distinguishing picture intensities is an additional issue that makes a computerized detection of brain tumor and segmentation a problematic job.

1.2 MOTIVATION FOR THE WORK:

A brain tumor is defined as abnormal growth of cells within the brain or central spinal canal. Some tumors can be cancerous thus they need to be detected and cured in time. The exact cause of brain tumors is not clear and neither is exact set of symptoms defined, thus, people may be suffering from it without realizing the danger. Primary brain tumors can be either malignant (contain cancer cells) or benign (do not contain cancer cells).

Brain tumor occurred when the cells were dividing and growing abnormally. It is appearing to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain.

The symptom having of brain tumor depends on the location, size and type of the tumor. It occurs when the tumor compressing the surrounding cells and gives out pressure. Besides, it is also occurring when the tumor blocks the fluid that flows throughout the brain. The common symptoms are having headache, nausea and vomiting, and having problem in balancing and walking. Brain tumor can be detected by the diagnostic imaging modalities such as CT scan and MRI. Both of the modalities have advantages in detecting depending on the location type and the purpose of examination needed. In this paper, we prefer to use the MRI images because it is easy to examine and gives out accurate calcification and foreign mass location.

The MRI is the most regularly utilized strategy for imaging brain tumors and the identification of its vicinity. The conventional technique for CT and MR image classification and detection of tumor cells remains largely supported for the human reviewing apart from different other methods. MR images are mainly used because there are non-destructive and non-ionizing. MR imaging offers high-definition pictures that are extensively utilized in discovering brain tumors. MRI has diverse schemes such as flair, T1-weighted, T2-weighted images. There are many image processing techniques such as pre-processing, segmentation of images, image improvements, feature extraction, and classifiers.

1.3 PROBLEM STATEMENT:

Our study deals with automated brain tumor detection and classification. Normally the anatomy of the brain is analyzed by MRI scans or CT scans. The aim of the paper is tumor identification in brain MR images. The main reason for detection of brain tumors is to provide aid to clinical diagnosis. The aim is to provide an algorithm that guarantees the presence of a tumor by combining several procedures to provide a foolproof method of tumor detection in MR brain images. The methods utilized are filtering, erosion, dilation, threshold, and outlining of the tumor such as edge detection.

The focus of this project is MR brain images tumor extraction and its representation in simpler form such that it is understandable by everyone. The objective of this work is to bring some useful information in simpler form in front of the users, especially for the medical staff treating the patient. The aim of this work is to define an algorithm that will result in extracted image of the tumor from the MR brain image. The resultant image will be able to provide information like size, dimension and position of the tumor, and its boundary provides us with information related to the tumor that can prove useful for various cases, which will provide a better base for the staff to decide the curing procedure. Finally, we detect whether the given MR brain image has tumor or not using Convolution Neural Network.

1.4 SCOPE:

Our aim is to develop an automated system for enhancement, segmentation and classification of brain tumors. The system can be used by neurosurgeons and healthcare specialists. The system incorporates image processing, pattern analysis, and computer vision techniques and is expected to improve the sensitivity, specificity, and efficiency of brain tumor screening. The primary goal of medical imaging projects is to extract meaningful and accurate information from these images with the least error possible. The proper combination and parameterization of the phases enables the development of adjunct tools that can help on the early diagnosis or the monitoring of the tumor identification and locations.

1.5 ORGANIZATION OF REPORT:

In this report, chapter 2 consists about literature survey. The literature survey tells about the research done to work on the project. All the details about the papers, websites on which the research work is done in order to work on the project is provided in the literature survey. In chapter 4, we discuss about the various methodologies used in the project. In chapter 5, the details about experimental analysis is discussed. The experimental analysis includes sample code, result screenshots for a tested input image. In the next chapter we give the conclusion about the project and also provide information if the project can be implemented further or not. In the final chapter we provide all the references for this project.

2. LITERATURE SURVEY

In Medical diagnosis, robustness and accuracy of the prediction algorithms are very important, because the result is crucial for treatment of patients. There are many popular classification and clustering algorithms used for prediction. The goal of clustering a medical image is to simplify the representation of an image into a meaningful image and make it easier to analyze. Several Clustering and Classification algorithms are aimed at enhancing the prediction accuracy of diagnosis process in detecting abnormalities.

Shishir singh has presented a detection using enhanced edge technique for brain-tumor segmentation that mainly relied on Sobel feature detection. His presented work associates the binary thresholding operation with the Sobel approach and excavates diverse extents using a secure contour process. After the completion of that process, cancer cells are extracted from the obtained picture using intensity values. rovided a different clustering algorithm such as K-means, Improved K-means, C-means, and improvised C-means algorithms. Their paper presented an experimental analysis for massive datasets consisting of unique photographs. They analyzed the discovered consequences using numerous parametric tests.

Rahil Ratan has proposed that a computer-aided detection (CAD) approach is used to spot abnormal tissues via Morphological operations. Amongst all different segmentation approaches existing, the morphological opening and closing operations are preferred since it takes less processing time with the utmost efficiency in withdrawing tumor areas with the least faults. presented a K- nearest neighbor algorithm to the MR images to identify and confine the hysterically full-fledged part within the abnormal tissues. The proposed work is a sluggish methodology but produces exquisite effects. The accuracy relies upon the sample training phase defined a few clustering procedures for the segmentation process and executed an assessment on distinctive styles for those techniques. Kaur represented a scheme to measure selected clustering techniques based on their steadiness in exceptional tenders. They also defined the diverse performance metric tests, such as sensitivity, specificity, and accuracy

3. CHALLENGES IN TUMOR CLASSIFICATION

The identification of tumor is a very challenging task. The location, shape and the structure of tumor varies significantly from patient to patient which makes the segmentation a very challenging task. In the figure shown below, we have shown some images of the same brain slice from different patients, which clearly reflect the variation of the tumor. We can clearly see that the location of the tumor is different in all the 8 images/patients shown below. To make it worse, the shape and the intra-tumoral structure is also different for all the eight patients/images. In fact, there can be more than one region of the tumor as can be seen from the images below. This indeed reflects the complexity of automatic segmentation.

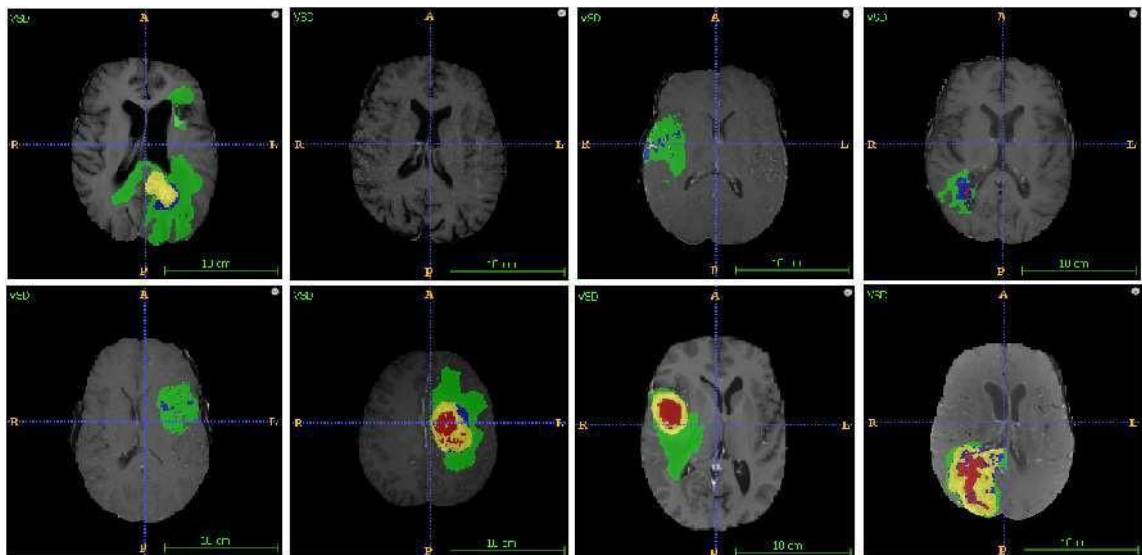


Fig.3.1 Location of tumors in eight different images.

4. MODULE DIVISION

This provides the architecture of the system that would be developed by our hands. It consists of six steps where the execution starts from taking an input image from the data set followed by the image pre-processing, image enhancement, Image segmentation using binary thresholding and the brain tumor classification using Convolutional Neural Network. Finally, the output is observed after all the above-mentioned steps are completed.

Each module is unique in its own way. Every step has its importance. This architecture also includes a testing and training data set. The data set used is has been downloaded from Kaggle which consists of nearly 2000 images that are used to test and train the system. The input image is pre-processed by using the noise filter like Median Filter and Bilateral Filter and the image is enhanced using the Sobel Filter. Then the obtained image using segmented using binary thresholding and morphological operations are performed on it. Finally, the image classification is done using Convolutional Neural Network to predict whether the tumor is present or not.

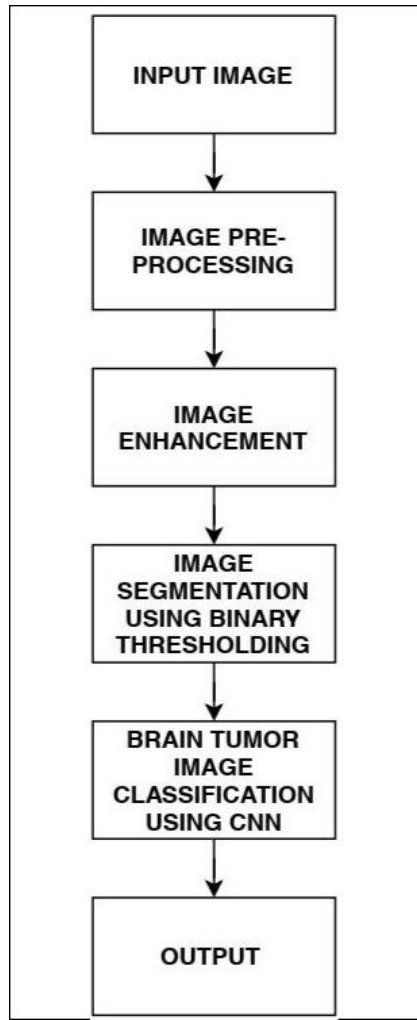


Fig 4.1 Module Division

MODULE 1: IMAGE PREPROCESSING AND IMAGE ENHANCEMENT

1. IMAGE PREPROCESSING:

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. This improves the diagnosis and also increase the classification accuracy rate.

2. IMAGE ACQUISITION FROM DATASET:

In image processing, image acquisition is done by retrieving an image from dataset for processing. It is the first step in the workflow sequence because, without an image no processing is possible. The image that is acquired is completely unprocessed. Here we process the image using the file path from the local device.

CONVERT THE IMAGE FROM ONE COLOR SPACE TO ANOTHER:

There are more than 150 color-space conversion methods available in OpenCV. For color conversion, we use the function `cv2.cvtColor(input_image, flag)` where flag determines the type of conversion. In our work, we convert the input image into the gray-scale image.

3.4 FILTERS:

In image processing, filters are mainly used to suppress the high frequencies in the image.

Median filter: It is a non-linear filtering technique used to remove noise from the images. It is performed by sorting all the pixel values from the window into numerical order and then replacing the pixel being considered with the median pixel value. This filter removes the speckle noise and salt and pepper noise through 'ON' and 'OFF' of pixels by white and dark spots.

Bilateral filter: It is also a non-linear, noise-reducing smoothing filter for images. It replaces the intensity of each pixel with a weighted average of intensity values from nearby pixels. This weight is based on the Gaussian distribution. Bilateral filtering smooth images while conserving edges utilizing a nonlinear grouping of neighbouring image pixels. This filtering technique is simple, local, and concise. It syndicates a grey level grounded on their likeness and the symmetrical nearness and chooses near vales to farther values in both range and domain.

3.5 IMAGE ENHANCEMENT:

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.

Edge detection is a segmentation technique that uses border recognition of strictly linked objects or regions. This technique identifies the discontinuity of the objects. This technique is used mainly in image study and to recognize the parts of the image where a huge variation in intensity arises.

3.6 SOBEL FILTER:

The Sobel filter is used for edge detection. It works by calculating the gradient of image intensity at each pixel within the image. It is widely used in image analysis to help locate edges in images. Sobel operator is used for segmentation purpose. This technique can be dependent on the central difference which tends toward the central pixels on average. This technique can be expressed as 3×3 matrix to the first derivative of the Gaussian kernel. It combines smoothing and differentiation. For Sobel edge detection the gradient of the image is calculated for each pixel position in the image.

1. We calculate two derivatives:
 - a. **Horizontal changes:** This is computed by convolving I with a kernel G_x with odd size. For example, for a kernel size of 3, G_x would be computed as:

$$G_x = \begin{bmatrix} -1 & 0 & +1 \end{bmatrix}$$

$$\begin{bmatrix} -2 & 0 & +2 \end{bmatrix}$$

$$\begin{bmatrix} -1 & 0 & +1 \end{bmatrix}$$

- b. **Vertical changes:** This is computed by convolving I with a kernel G_y with odd size. For example, for a kernel size of 3, G_y would be computed as:

$$\mathbf{G}_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ +1 & +2 & +1 \end{bmatrix}$$

2. At each point of the image we calculate an approximation of the *gradient* in that point by combining both results above:

$$G = (G_x^2 + G_y^2)^{1/2}$$

3. Although sometimes the following simpler equation is

$$\text{used: } G = |G_x| + |G_y|$$

After the completion of the pre-processing, the image will be free from the noises, but we still need to enhance the image since the obtained image is smoothed, edges may not be preserved, and the image will be dull. To overcome all these, we used edge detection called Sobel filtering technique. The whole thing is done by calculating the gradient of image intensities at each pixel within the image. It is widely used in image analysis to help locate edges in images. It will also enhance the darker areas of the image, slightly increase contrast and as sharp as possible.

3.7 IMAGE SEGMENTATION USING BINARY THRESHOLD

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.

3.8 THRESHOLDING:

Thresholding is the simplest method of image segmentation. It is a non-linear operation that converts a grey-scale image into a binary image where the two levels are assigned to pixels that are below or above the specified threshold value. In Open CV, we use `cv2.threshold()` function:

```
cv2.threshold(src, thresh, maxval, type[dst])
```

This function applies fixed-level thresholding to a single-channel array. The function is typically used to get a bi-level (binary) image out of a grayscale image for removing a noise, that is, filtering out pixels with too small or too large values. "maxval" is the set threshold value which compares with input values, when the input is greater than the set threshold value it gives output is set maxval value and it is shown with white color in gray images. when the input pixel intensity values are less than the set threshold, its output is black color. There are several types of thresholding supported by the function.

The function returns the computed threshold value and thresholder image.

1. **src** - input array (single-channel, 8-bit or 32-bit floating point). This is the source image, which should be a grayscale image.

2. **maxval** - maximum value to use with the THRESH_BINARY and THRESH_BINARY_INV thresholding types. It represents the value to be given if pixel value is more than (sometimes less than) the threshold value.

3. **type** - thresholding type

- cv2.THRESH_BINARY
- cv2.THRESH_BINARY_INV

3.9 MORPHOLOGICAL OPERATIONS:

Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors.

The Morphological techniques are also used with segmentation techniques. The morphological action is normally performed on binary images. It processes the operations based on shape and it has a wide set of the image processing operation. Erosion and Dilation are two methods of morphological operations which used in this proposed work. We perform both Erosion and dilation operations used together.

Two main steps of the erosion and dilation morphological operation are opening and closing. The first step is the opening of the MRI binary image. The main work of opening operation is open up a gap which is present in between object and connect that to a small collection of pixels. After setting of the bridge, the erosion again restored with their actual size using dilation. If the binary image has been opened then the subsequent opened same structured elements have not affected on that image. After completing the opening operations next step is the closing operation. Based on the closing operation while keeping the original region sizes, the erosion and dilation can handle different hole in the image region. Dilation and Erosion are the basic morphological operations. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries.

Watershed Method: considers the gradient magnitude of an image as a topographic surface where high gradient denotes peaks, while low gradient denotes valleys. Start by filling every isolated valley with different coloured water. As the water rises, water from different valleys will start to merge. To avoid that, barriers are built in the locations where water merges. Continue the work of filling water and building barriers until all the peaks are under water. Then the created barriers give the segmentation result.

4. BRAIN TUMOR IMAGE CLASSIFICATION USING CONVOLUTIONAL NEURAL NETWORK

Classification is the best approaches for identification of images like any kind of medical imaging. All classification algorithms are based on the prediction of image, where one or more features and that each of these features belongs to one of several classes.

An automatic and reliable classification method Convolutional Neural Network (CNN) will be used since it is robust in structure which helps in identifying every minute details. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNet have the ability to learn these filters/characteristics.

A ConvNet is able to successfully capture the spatial and temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better. The role of the ConvNet is to reduce the images into a form which is easier to process, without losing features which are critical for getting a good prediction.

For this step we need to import Keras and other packages that we're going to use in building the CNN. Import the following packages:

- *Sequential* is used to initialize the neural network.
- *Convolution2D* is used to make the convolutional network that deals with the images.
- *MaxPooling2D* layer is used to add the pooling layers.
- *Flatten* is the function that converts the pooled feature map to a single column that is passed to the fully connected layer.
- *Dense* adds the fully connected layer to the neural network.

4.1 SEQUENTIAL:

- To initialize the neural network, we create an object of the *Sequential* class.
- *classifier = Sequential ()*

4.2 CONVOLUTION:

- To add the convolution layer, we call the *add* function with the classifier object and pass in *Convolution2D* with parameters. The first argument *feature_detectors* which is the number of feature detectors that we want to create. The second and third parameters are dimensions of the feature detector matrix.
- We used 256 feature detectors for CNNs. The next parameter is *input_shape* which is the shape of the input image. The images will be converted into this shape during pre-processing. If the image is black and white it will be converted into a 2D array and if the image is coloured it will be converted into a 3D array.
- In this case, we'll assume that we are working with coloured images. *Input_shape* is passed in a tuple with the number of channels, which is 3 for a coloured image, and the dimensions of the 2D array in each channel. If you are not using a GPU it's advisable to use lower dimensions to reduce the computation time. The final parameter is the activation function. Classifying images is a nonlinear problem. So, we use the rectifier function to ensure that we don't have negative pixel values during computation. That's how we achieve non-linearity.

- *classifier.add (Convolution2D (256, 3, 3, input_shape = (256, 256, 3), activation='relu'))*

4.3 POOLING:

- The Pooling layer is responsible for reducing the spatial size of the convolved feature. This is to decrease the computational power required to process the data through dimensionality reduction. Furthermore, it is useful for extracting dominant features which are rotational and positional invariant, thus maintaining the process of effectively training of the model.
- There are two types of Pooling: Max Pooling and Average Pooling.

Max Pooling returns the maximum value from the portion of the image covered by the Kernel. On the other hand, Average Pooling returns the average of all the values from the portion of the image covered by the Kernel. Generally, we use max pooling.

- In this step we reduce the size of the feature map. Generally, we create a pool size of 2x2 for max pooling. This enables us to reduce the size of the feature map while not losing important image information.
- *classifier.add (MaxPooling2D (pool_size= (2,2)))*

4.4 FLATTENING:

- In this step, all the pooled feature maps are taken and put into a single vector for inputting it to the next layer.
- The *Flatten* function flattens all the feature maps into a single long column.
- *classifier.add (Flatten ())*

4.5 FULLY CONNECTION:

- The next step is to use the vector we obtained above as the input for the neural network by using the *Dense* function in Keras. The first parameter is *output* which is the number of nodes in the hidden layer. You can determine the most appropriate number through experimentation. The higher the number of dimensions the more computing resources you will need to fit the model. A common practice is to pick the number of nodes in powers of two.
- *classifier.add (Dense (output = 64))*

- The next layer we have to add is the output layer. In this case, we'll use the *sigmoid* activation function since we expect a binary outcome. If we expected more than two outcomes, we would use the *SoftMax* function.
- The *output* here is 1 since we just expect the predicted probabilities of the classes.
- *classifier.add(Dense (output=1, activation='sigmoid'))*

5. EXPERIMENTAL ANALYSIS

5.1 SOFTWARE REQUIREMENTS

- Windows
- Python 3.6.2 or above
- PIP
- NumPy 1.13.1

Python:

Python is an interpreted, high-level, general purpose programming language created by Guido Van Rossum and first released in 1991, Python's design philosophy emphasizes code Readability with its notable use of significant Whitespace. Its language constructs and 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 procedural, object-oriented, and functional programming.

PIP:

It is the package management system used to install and manage software packages written in Python.

NumPy:

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays. It is the fundamental package for scientific computing with Python. It contains various features including these important ones:

- A powerful N-dimensional array object
- Sophisticated (broadcasting) functions
- Tools for integrating C/C++ and Fortran code
- Useful linear algebra, Fourier transform, and random number capabilities

Pandas:

Pandas is the most popular python library that is used for data analysis. It provides highly optimized performance with back-end source code is purely written in *C* or *Python*. We can analyze data in pandas with

1. Series
2. Data frames

Anaconda:

Anaconda is a free and open-source distribution of the Python and R programming languages for scientific computing that aims to simplify package management and deployment. Package versions are managed by the package management system conda. The Anaconda distribution includes data-science packages suitable for Windows, Linux, and macOS. Anaconda distribution comes with 1,500 packages selected from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command-line interface (CLI).

Jupyter Notebook:

Anaconda distribution comes with 1,500 packages selected from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI). A Jupyter Notebook document is a JSON document, following a versioned schema, and containing an ordered list of input/output cells which can contain code, text mathematics, plots and rich media, usually ending with the “. ipynb” extension.

Tensor Flow:

Tensor flow is a free and open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It is used for both research and production at Google.

Keras:

Keras is an open-source neural-network library written in Python. It is capable of running on top of TensorFlow, Microsoft Cognitive Toolkit, R, Theano, or Plaid ML. Designed to enable fast experimentation with deep neural networks, it focuses on being user-friendly, modular, and extensible. Keras contains numerous implementations of commonly used neural-network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make working with image and text data easier to simplify the coding necessary for writing deep neural network code.

OpenCV:

OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by willow garage then Itseez (which was later acquired by Intel). The library is cross platform and free for use under the open source BSD license. OpenCV supports some models from deep learning frameworks like TensorFlow, Torch, PyTorch (after converting to an ONNX model) and Caffe according to a defined list of supported layers. It promotes Open Vision Capsules. which is a portable format, compatible with all other formats.

5.1.2 HARDWARE CONFIGURATION

- Processor: Intel core i5 or above.
- 64-bit, quad-core, 2.5 GHz minimum per core
- Ram: 4 GB or more
- Hard disk: 10 GB of available space or more.
- Display: Dual XGA (1024 x 768) or higher resolution monitors
- Operating system: Windows

6. CONCLUSION AND FUTURE SCOPE

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.

REFERENCES

- [1] A. Sivaramakrishnan And Dr.M.Karnan “A Novel Based Approach For Extraction Of Brain Tumor In MRI Images Using Soft Computing Techniques,” International Journal Of Advanced Research In Computer And Communication Engineering, Vol. 2, Issue 4, April 2013.
- [2] Asra Aslam, Ekram Khan, M.M. Sufyan Beg, Improved Edge Detection Algorithm for Brain Tumor Segmentation, Procedia Computer Science, Volume 58,2015, Pp 430-437, ISSN 1877-0509.
- [3] B.Sathya and R.Manavalan, Image Segmentation by Clustering Methods: Performance Analysis, International Journal of Computer Applications (0975 – 8887) Volume 29– No.11, September 2011.
- [4] Devkota, B. & Alsadoon, Abeer & Prasad, P.W.C. & Singh, A.K. & Elchouemi, A.. (2018). Image Segmentation for Early Stage Brain Tumor Detection using Mathematical Morphological Reconstruction. Procedia Computer Science. 125. 115-123. 10.1016/j.procs.2017.12.017.
- [5] K. Sudharani, T. C. Sarma and K. Satya Rasad, "Intelligent Brain Tumor lesion classification and identification from MRI images using k-NN technique," 2015 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), Kumaracoil, 2015, pp. 777-780. DOI: 10.1109/ICCICCT.2015.7475384
- [6] Kaur, Jaskirat & Agrawal, Sunil & Renu, Vig. (2012). A Comparative Analysis of Thresholding and Edge Detection Segmentation Techniques. International Journal of Computer Applications.vol. 39.pp. 29-34. 10.5120/4898-7432.
- [7] Li, Shutao, JT-Y. Kwok, IW-H. Tsang and Yaonan Wang. "Fusing images with different focuses using support vector machines." IEEE Transactions on neural networks 15, no. 6 (2004): 1555-1561.
- [8] M. Kumar and K. K. Mehta, "A Texture based Tumor detection and automatic Segmentation using Seeded Region Growing Method," International Journal of

