

A comparative analysis of multiple methodologies of brain tumor detection in machine learning techniques

Cite as: AIP Conference Proceedings 2519, 030064 (2022); <https://doi.org/10.1063/5.0109719>
Published Online: 03 October 2022

S. Kalaiselvi and G. Thailambal



View Online



Export Citation

ARTICLES YOU MAY BE INTERESTED IN

[A meta-analysis and roadmap of Alzheimer's diseases prediction by machine learning algorithms](#)

AIP Conference Proceedings 2519, 030062 (2022); <https://doi.org/10.1063/5.0109700>

[Understanding issues in cloud forensics](#)

AIP Conference Proceedings 2519, 030061 (2022); <https://doi.org/10.1063/5.0109835>

[Defending against advanced attack vectors on biometric and authentication systems](#)

AIP Conference Proceedings 2519, 030063 (2022); <https://doi.org/10.1063/5.0110607>

Trailblazers. New

Meet the Lock-in Amplifiers that measure microwaves.

Zurich Instruments [Find out more](#)

A Comparative Analysis of Multiple Methodologies of Brain Tumor Detection in Machine Learning Techniques

S Kalaiselvi^{a)}, and G Thailambal^{b)}

*Department of Computer Science, Vels Institute of Science, Technology & Advanced Studies,
Pallavaram, Chennai- 600 117, Tamil Nadu, India*

^{a)}harshinimk@gmail.com,
Corresponding author: ^{b)}thaila.research@gmail.com

Abstract. Detecting the brain tumor via Magnetic Resonance Image is difficult within the scientific imaging studies area. MRI is a scientific method, frequently utilized with the x-rays for visual images of the inside shape of the physical body with no surgical operation. The primary expectation of medical imaging is to split essential and precise statistics from these pics with the least blunder doable. Out of the more than a couple of forms of clinical imaging paperwork reachable to us, MRI is the most reliable and secure. It does no longer incorporate providing the body with any hurtful radiation. This MRI could then be capable of being handled, and the tumor can be portioned. Tumor Segmentation incorporates the utilization of particular diverse methods. The entire approach of distinguishing tumor from a Magnetic Resonance Image into three specific training: Pre-Processing, Segmentation, and Post Processing. Aside from summarizing the literature, this paper evaluate s multiple techniques utilized in the literature survey.

Keywords: Brain Tumor Detection, MRI, post-processing, Segmentation, pre-processing.

INTRODUCTION

Cancers were the most dangerous disease in an exceeding body. The region of the cell in the body can change and be divided in an intractable way. This region within the brainstem miles was a tumor. A tumor could be a group of unessential and irregular cells developing within the brain [1].

The brain had the trickiest section of our body. The signs and symptoms of a tumor may additionally be not unusual complications and migraines. Through the years, it might also even result in vision loss. The second era is approximately the origins and elements number one to this bizarre boom [2].

Tumors were categorized on two bases: whether or not they might be cancerous or not and their beginning area. The noncancerous shape of the cancer is called Benign. No troubles are distinguishable and feature a gradual increase fee. Cancerous tumors are known as Malignant. These are very aggressive and can be life-threatening as those is tough to hit upon [3].

Techniques like MRI or CT scan offer the entire shape of a brain tumor, as it is directed into the intracranial cavity producing a clear picture of cancer. MRI scans by using sturdy magnetic fields and excessive radio frequencies to provide particular facts of tender tissues. Computed Tomography scans (CT), scans via sending X-ray beams. Figure 1 shows the most common primary brain tumors [4].

As per the survey has finished the best possible demise charge in the world has the highest due to a brain tumor. Symptoms encompass changes in the hormones, blood clots, weakness, uncontrolled walking, disorganized speech, mood swings, loss of vision, etc. The tumor location defines its type, and its proper diagnosis can store the patient's lifestyle [5].

The identity and detection of infected tumor vicinity from mind MRI was an essential assignment. Clinical professionals look at medical photographs to perceive signs and symptoms and the tumor region. Because of the complex nature of MRI, the human eye cannot analyze the minute variations [6]. In latest years, the

computer-Aided diagnosis (CAD) systems added by using various authors to assist the radiologists for correct prognosis. Figure 1 shows the Types of a brain tumor.

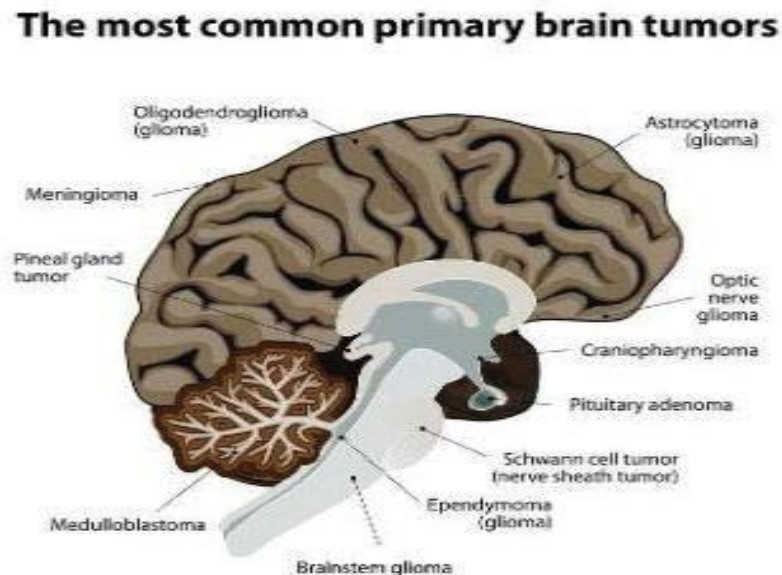


FIGURE 1.Types of a brain tumor [15]

BRAIN TUMOR DETECTION

The initial step is pre-processing the image. The next step is the segmentation of the brain tumor image. The final step is the structural activity and then find the position using the windowing method for post-processing [7]. Figure 2 represents the flow chart of the proposed methodology for brain tumor detection given below.

a. Pre-processing

Brain MR Image, an initial step was Pre-processing. The pre-processing method had reduced the unwanted noise and deepen the MRI of the brain. In the medical field, getting the precise images accurate was essential. The step has been considering a lot of unwanted and irrelevant parts were removed. The Pre-processing techniques were filtering, contrast enhancement, and skull stripping [8].

b. segmentation

The next step was segmentation, followed by an MRI of brain image were deepen. This process of splitting an image into multiple parts. The purpose of the segments was to separate the tumor region from MR Image [9].

c. Post Processing

After segmentation of the brain MRI, to visibly identify the position of the affected region within the brain, some post-processing operations were applied. The reasons for the operation are to display that only the region of the MRI, which had the brain, was the region of the image having more strength and additional areas. Post-processing methods where operations are included morphological processes and windowing technique. [10]. Figure 2 shows the Flow Chart of the proposed methodology for brain tumor detection.

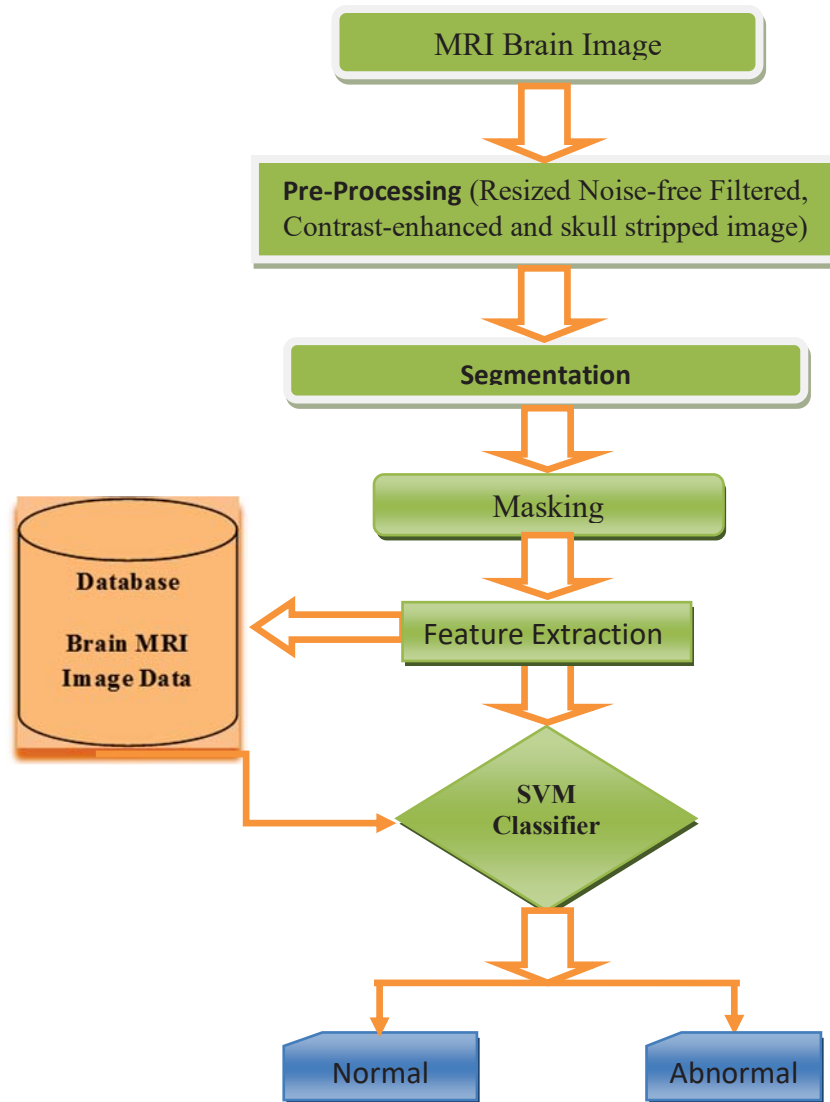


FIGURE 2. Flow Chart of the proposed methodology for brain tumor detection

LITERATURE SURVEY

Amruta Hubli et al. have created a proposed method to differentiate between benign and malignant cells in brain MRIs. This method has analyzed the segmentation, brain tumors precisely as well as categorized as benign and malignant. The authors were used the three-database methodology had been analyzed. The scientific database was once identified from the Gokul Scan center, Mumbai. [11]

The non-clinical database used to be taken from the internet site complete brain cells and Google data set. The evaluation was executed two databases and a mixture of this additionally to be analyzed. The data set could be carried out using the classification algorithm to aid in using three unique methods. This methodology was demonstrating the result of accuracy level of education and trying to get all combined databases. The accuracy level might be 100% used above the methodology. [12]

Nilesh Bhaskarrao Bahadure et al. paper enhances the general overall analysis and restriction the quality entails within a scientific image segmentation process. Right here, research of the SVM classifier absolutely, appropriate points were briefly mentioned explained from each segmentation cell. This proposed method was evaluated and demonstrated for actual performance and extra assessment of magnetic resonance intelligence photos, based on research to identify accuracy and sensitivity. This MRI scan images segmented

skills tissues into normal tissues inclusive of white relies, gray relies on, cerebrospinal fluid heritage, and tumor-inflamed tissues. [13]

K. Machhale et al. proposed a hybrid distribution framework to look at the standard and irregular MRI brain images. Magnetic resonance imaging was the best fundamental controlled device for the grossest of tumor cells of the brain. In the current position, distinct techniques had been used for the characterization of talent tissues. Most cancers were efficaciously performed under image pre-processing, picture function, extraction, and subsequent classification of intelligence. The combined algorithm of SVM and K Nearest Algorithm were utilized to order 50 pictures, it was viewed from the effects that the combined algorithm exhibited the most increased association precision charge of 98% amongst others. [14]

Mahboob Alam et al., the proposed methodology had MRI Images of tumor cells and taken from the Google image data set, and the scan was performed. After that, an SVM approach brain cells, which in flip offers a greater environment-friendly end outcome with excessive accuracy level for brain MRI scan cells. [15]

Professor Hind Rustum Mohammed et al. analyzed the easiest algorithm to identify the array and the shape of the tumor in concept MRI images. The combined rules in pre-processing phase wiener filter out when you consider that the motive to reduce the amount of noise and so forth within the photograph, as in the evaluation of the estimate of an image bearing error and the second level (feature extraction) has three steps: The first step was curved allow transform into scrimp for the precise image. This reason was able to furnish sparse expression for every element part and smooth elements of the photo concurrently then comply with another step was Fuzzy C-means Clustering algorithm on the correct image [16]. The statistics aspects can be assigned to every cluster middle because these cells that might be over belong to more cluster cells. Opposite of the k-means algorithm, an information component needs to belongs only to the cluster middle. Right here, one was assigned to the club facts element for every cluster center. The data aspect is suite d to the extra than a cluster middle. The method follows confronted wavelet for two output photographs of the fuzzy C-suggest Cluster and Curve allow remodel. Finally, fused through the manner of the inverse wavelet for merging two strategies for detection the tumor within the brain [17].

Beno M. Marsaline, et. al., the proposed method, an intelligence tumor analysis gadget, comprises this approach was implemented for segmentation of MRI affected image data sets. A mix of the ABC with the GA was used to analyze to employ and identify threshold values.

Anaraki et al. the proposed methodology was primarily combined with Convolutional Neural Networks with Genetic Algorithm to classify several Glioma pix the usage of MRI scan image. It received 90.9% correctness of the images to predict for Glioma images used three categories.

G Rajesh Chandra et al this paper has analyzed image segmentation methods to become aware of intelligence cells. The cells classification and segmentation from brain computed radiology image facts were vital. However, time-eating research was carried out with the aid of scientific experts.

Nikhita Biradar et al proposed a novel cell detection system in MRI images that applied the k-means method, which built in the FCM with clustering algorithm and Artificial Neural Network. ANN was used the MRI classified images into two categories. The proposed methodology device was taken of gain of each built-in algorithm in minimal computation time and accuracy. It precisely extracts the tumor location and calculates the tumor area. The accuracy was calculated by way of evaluating outcomes with the floor fact of the processed image.

COMPARISON OF MULTIPLE METHODOLOGIES IN LITERATURE SURVEY

Out of the several techniques are studied, Lamia Sallemi et al. proposes the quickest one, as it can technique an image in 0.5 seconds. As a result, it has a brilliant prospect for real-time applications. While the quality approach based on accuracy is proposed by way of Guoqing Wu et al., having 98.5% accuracy. Table 1 shows the Comparison table of methodologies.

TABLE 1.Comparison table of methodologies

Journal Name	Title of Paper	Authors	Year	Method	Advantages	Accuracy (%)
IEEE Access	Deep Learning Model Based on Concatenation Approach for the Diagnosis of Brain Tumor[14]	Neelum Noreen , et.al	2020	Two Pre-trained deep learning models (DensNet201, Inception v3) are concatenated.	Pre-trained models are excellent performance	99.51%
IEEE Access (ICCCS 2020)	Programmed Multi-Classification of Brain Tumor Images Using Deep Neural Network[18]	P.Nagara jet al[18]	2020	Convolution Neural Network	What kind of tumor and which kind of present in the brain	90%
IEEE (CASERT 2019)	Brain Tumor Detection Using Convolutional Neural Network[19]	Tonmoy Hossain, et.al	2019	Detect brain tumor for 2D Magnetic Resonance intelligence Images (MRI) by Fuzzy C-Means clustering algorithm and convolutional neural network.	Can predict tumor cells accurately.	97.87%
IJEAT	A BrainNet Classification Technique Based on Deep Convolutional Neural Network for Detection of Brain Tumor in FLAIR MRI Images[12]	T.H. Manoj, et.al	2019	BrainNet algorithm combines that Fuzzy C Means and Morphological operators and CNN to discover image areas that are suspicious	Increase the accuracy level	100%
IEEE (JSRCSEIT)	Brain Tumour Detection Using Deep Learning Techniques[13]	Dr. P. Tamije Selvy,et. al	2019	Probabilistic Neural Network (PNN) classifier method using performance accuracy in the understanding of tumor area in brain MRI images.	The developed model helps in the detection of brain tumor routinely and it is carried out the usage of image processing and synthetic neural network. The most fundamental phase of image processing is the evaluation and manipulation of a digitized image, in particular in order to enhance its quality.	90.96%
Journal of Computational Science (2018)	Multi-Grade Brain Tumor Classification using Deep CNN with Extensive Data Augmentation[24]	Muham mad Sajjad, et.al[24]	2019	A convolutional neural network (CNN) and deep learning methods using brain tumor classification system	Extensive statistics augmentation for heading off lack of information hassle for multi-grade tumor classification	94.58%
International Journal of Applied Engineering Research	Hybrid Method for Detection of Brain Tumor Using Fuzzy C-Mean Clustering and Discrete Curve let Transform[6]	Professor. Hind Rustum Mohamed et.al	2018	To filtering a unique image using Curve let Transform and segmentation for Fuzzy C-Mean Cluster on authentic image	The research technique gives a more specific end result	Curlevelt -0.705882 Fuzzymean-0.882353 Fuzzy logic- 0.941176
IEEE	Segm entation and Classification of Brain MR Images Using Big Data Analytics[5]	Mahboob Alam et.al	2018	Classification for Support vector machine (SVM), segmentation used for fuzzy c-means (FCM) and discrete wavelet transform (DWT).	Predict with more accuracy.	The accuracy of both the segmentation algorithms is compared.
Hindawi International Journal of Biomedical Imaging	Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM[3]	Nilesh Bhaskarrao et.al	2017	Berkeley wavelet seriously change (BWT) and support vector machine (SVM) classifier is in contrast with The ANFIS, Back Propagation, and [1]NN classifier on the Basis of overall performance measure such as sensitivity, specificity, And accuracy.	The a range of overall performance elements additionally point out that the proposed algorithm presents higher end result with the aid of improving Certain parameters such as mean, MSE, PSNR, accuracy, Sensitivity, specificity, and cube coefficient.	<u>Without feature Extraction</u> ANFIS 86.14 Back Propagation 80.29 SVM(proposed classifier) 90.54 [1]NN 84.55 <u>With feature Extraction</u> ANFIS 90.04 Back Propagation 85.57 SVM(proposed classifier) 96.51
IEEE	Machine Learning and Deep Learning Techniques to Predict Overall Survival of Brain Tumor Patients using MRI Images[17]	Lina Chato et.al	2017	Classifying the patient's MRI image the use of machine computer learning (ML) methods.	The special classification accuracy was once executed by using deep characteristic extraction based totally on pre-trained Alex Net and educated by means of Linear Discriminant.	The classification accuracy based totally on two training increased approximately to 69%, not exceed 46%

CONCLUSION

The brain tumor was a huge or abnormal development of cells of the brain. Cell detection, a very difficult task in the MR images, processes the Brain Tumor Detection that consists of three Sections: Preprocessing, Segmentation, and Post-processing. Table 1 has clearly shown the comparison of various techniques in brain cells. In this comparative analysis, more than 95% accuracy results gave the Integration of a combined algorithm (FCM+CNN) and Concatenation of Deep Learning Models and Brain Net Classification with Deep Learning CNN. The Feature Extraction in biologically SVM gave better results. In the future, a new algorithm will be extended to find the accuracy level increased for brain tumor affected cell detection than the existing methods. We have demonstrated with evidence that active contour algorithms, combined with localized outputs of deep learning architectures such as R-CNN, may improve segmentation accuracy and precision in MRI tumor segmentation applications in the research presented. As a result, we may infer that the current model can be utilized to assist brain tumor classification and segmentation in situations with limited human resources and knowledge.

REFERENCES

1. J. J. Heimans, *et al.*, “Paclitaxel (TAXOL®) concentrations in brain tumor tissue”, *Annals of Oncology*, vol. 5, no. 10, pp. 951-953, (1994).
2. Amruta Hebli and Dr. Sudha Gupta “Brain Tumor Prediction and Classification using support vector Machine”, 978-1-5386-3852-1/17/\$31.00 ©2017 IEEE
3. Nilesh Bhaskarrao Bahadur, 1 Arun Kumar Ray, one and Har Pal Thethi 2, “Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM”, *International Journal of Biomedical Imaging*, Article ID 9749108, p. 12, (2017).
<https://doi.org/10.1155/2017/9749108>
4. K. Machhale, H. B. Nandpuru, V. Kapur, and L. Kosta, “MRI brain cancer classification using the hybrid classifier (SVM-KNN)”, in *2015 International Conference on Industrial Instrumentation and Control (ICIC)*, Pune, pp. 60–65, (2015)
5. Mahboob Alam Mohd Amjad “Segmentation and Classification of Brain MR Images Using Big Data Analytics”, 978-1-5386-7167-2/18/\$31.00 ©2018 IEEE
6. Professor. Hind Rustum Mohammed & Lamia Fahim Katran, “Hybrid Method for Detection of Brain Tumor Using Fuzzy C-Mean Clustering and Discrete Curvelet Transform”, *International Journal of Applied Engineering Research*, ISSN 0973-4562, vol. 13, no. 3, pp. 1670-1674, (2018)
7. Beno, M. Marceline, *et al.*, “Threshold prediction for segmenting tumor from brain MRI scans”, *International Journal of Imaging Systems and Technology*, vol. 24, no. 2, pp. 129-137, (2014)
8. A. Kabir Anaraki, M. Ayati, and F. Kazemi, “Magnetic resonance imaging-based brain tumor grades classification and grading via convolutional neural networks and genetic algorithms,” *Biocybern. Biomed. Eng.*, vol. 39, no. 1, pp. 63-74, (2019). DOI: 10.1016/j.bbe.2018.10.004.
9. G Rajesh Chandra, Dr. Kolasani Ramchand H Rao, “Tumor Detection In Brain Using Genetic Algorithm”, *Procedia Computer Science*, vol. 79, pp. 449–457, (2016)
10. Nikhita Biradar and Prakash H. Unki, “Brain Tumor Detection Using Clustering Algorithms in MRI Images”, *International Research Journal of Engineering and Technology (IRJET)*, e-ISSN: 2395 -0056, vol. 04, issue 06, (2017). www.irjet.net p-ISSN: 2395-0072
11. S. U. Aswathy, Dr. G. Glan Deva Dhas and Dr. S. S. Kumar, “A Survey on Detection of Brain Tumor from MRI Brain Images”, *2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT)* 978-1-4799-4190-2/14/\$31.00 ©2014 IEEE
12. T. H. Manoj, M. Gunasekaran and W. Jaisingh “A Brain Net Classification Technique Based on Deep Convolutional Neural Network for Detection of Brain Tumor in FLAIR MRI Images”, *International Journal of Engineering and Advanced Technology (IJEAT)* ISSN: 2249 – 8958, vol. 9, issue 1, (2019)
13. Dr. P. Tamije Selvy, V. P. Dharani and A. Indhuja “Brain Tumour Detection Using Deep Learning Techniques”, *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, © 2019 IJSRCSEIT, vol. 5, issue 2, ISSN: 2456-3307 DOI :
<https://doi.org/10.32628/CSEIT195233>
14. Neelum Noreen 1, Sellappan Palaniappan1, Abdul Qayyum 2, Iftikhar Ahmad 3, Muhammad Imran 4,

- And Muhammad Shoaib 4, “A Deep Learning Model Based on Concatenation Approach for the Diagnosis of Brain Tumor”, *Digital Object Identifier*, 10.1109/ACCESS.2020.2978629
15. Damandeep Kaur and Surender Singh “Detection of Brain Tumor using Image Processing Techniques”, *International Journal of Engineering and Advanced Technology (IJEAT)*, ISSN: 2249-8958, vol. 8, issue 5S3, (2019)
 16. Nilesh Bhaskar Rao Bahadur,1 Arun Kumar Ray, one and Har Pal Thethi2, “Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM Hindawi”, *International Journal of Biomedical Imaging*, vol. 2017, Article ID 9749108, p. 12
<https://doi.org/10.1155/2017/9749108>
 17. Lina Chato Shahram Latifi “Machine Learning and Deep Learning Techniques to Predict Overall Survival of Brain Tumor Patients Using MRI Images”, *2017 IEEE 17th International Conference on Bioinformatics and Bioengineering*, 2471-7819/17/31.00 ©2017 IEEE DOI 10.1109/BIBE.2017.00009.