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Brain Tumor Detection Techniques : A Systematic Review

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Abstract: ***Brain tumor is a strange growth of brain cells inside the brain. Brain tumor detection and segmentation and is a standout amongst the most difficult and tedious assignment in medical image preparing. MRI (Magnetic Resonance Imaging) is a perception medical method, which gives abundant data about the human delicate tissue, which helps in the finding of brain tumor. The detection of brain tumor is complicated systems in medical field. The algorithm included steps for pre-processing, image segmentation, feature extraction and image classification. Different information mining algorithms like k-means, SVM, FCM, k-nearest neighbor, neural system utilized for this reason. In this survey paper, the audit of various brain tumor strategies utilizing the MR images with advantages and disadvantages are given. It likewise gives near investigation of all the assessed techniques.***

Keywords: Brain Tumor, Classification, DiseaseIdentification, Magnetic Resonance Imaging (MRI), Segmentation, Tumor Detection.

I. INTRODUCTION

In general, the tumor is characterized as tissue cluster shaped because of the collection of irregular cells in the body. Regularly, at a fitting time, the old cells are being supplanted by new ones. Because of the coming of a cancerous tumor(s), this cycle is disrupted. The tumor cells develop exponentially and don't die, not at all like healthy cells. Two sorts of brain tumors are a primary tumor and secondary or metastatic tumor [1]. Ordinarily, the primary brain tumor starts in the brain and tends to remain during its growth residency. While, the secondary brain tumor begins somewhere else as cancer in the body, later spreads to the brain region. Further, the primary brain tumor has two sub-division to be specific,

A. Benign tumor,
B. Malignant tumor.

Table 1 demonstrates the features of benign and malignant tumors incorporated. Figure 1 demonstrates the MRI brain images without and with tumors

Table 1. Features of Tumors

Benign Tumor	Malignant Tumor
Distinct borders	Invasive borders
Slow Growth	Rapid Growth
Rarely spreads	Often spreads
Less harm	Life- threatening

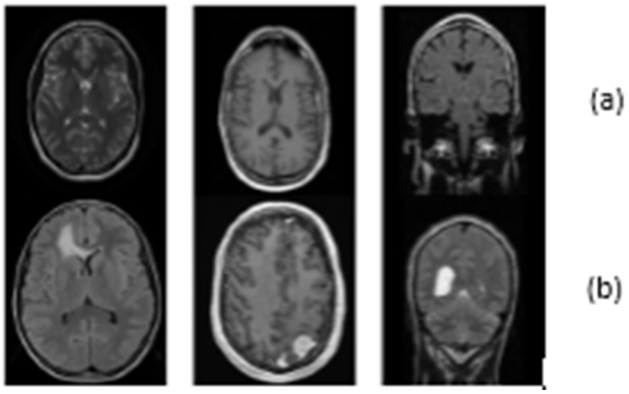

Fig.1. MRI brain images, (a)Typical MRI brain images, and (b) MRI brain images with tumor

"Glioma" is the small primary brain tumor, and its types incorporate; (1) Astrocytoma, (2) Brainstem Glioma, (3) Ependymoma, (4) Oligo Dendro Glioma, and (5) Optic nerve glioma. Some different kinds of a primary brain tumor incorporate (1) Primitive Neuroectodermal Tumor (PNET), (2) Pineal organ, (3) Pituitary tumor, (4) Craniopharyngioma, (5) Schwannoma, (6) Meningioma, and (7) Primary Central Nervous System lymphoma. A typical sort of Secondary brain tumor incorporated, (1) Lung cancer, (2) Colon cancer, (3) Breast cancer, (4) Melanoma, and (5) Kidney cancer. World Health Organization (WHO) has reviewed tumors into four kinds based on the accompanying criteria; (i) Growth rate, (ii) Similarities when contrasted with healthy cells, (iii) Uncontrolled growth, (iv) Blood supply, (v) Invasive potential and (vi) Tumor with dead cells in its middle locale. Table 2 demonstrates the notable features of four grades of tumors.

Table 2. Tumor Grades and its Salient Features

Grade I tumor	Grade II tumor	Grade III tumor	Grade IV tumor
Slow growth	Relatively slow growth	Active growth	Abnormal growth
Almost appears to be normal	Slightly seems to be abnormal	Appears to be abnormal	Seems to be very normal
Least preferred malignant	Possibly invade adjacent tissues	Penetrate to adjacent tissues	Maintains rapid growth
Less Harm	Possibilities of recurring as higher-grade tumors	Chances to recur as higher-grade tumor	Extremely harmful

For the most part, Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) techniques are utilized to dissect the tissues and also tumors show in the brain. Advanced image preparing procedures assume a fundamental part in the medical field to examine the medical reports. Further, Machine Learning Technology has effectively tackled various issues in the medical history. A portion of the procedures to identify and find the nearness of tumor in the MRI brain images are as per the following: (i) Edge-based detection technique, (ii) Shape-based detection strategy, (iii) Feature-based.

II. LITERATURE SURVEY

Parveenet al. [1], MRI is the most vital method, in detecting the brain tumor. In this paper data mining techniques are utilized for classification of MRI images. Another hybrid strategy in based on support vector machine (SVM) and fuzzy c-means for brain tumor classification is proposed. The purposed algorithm is a mix of Support vector machine (SVM) and fuzzy c-means, a hybrid method for expectation of brain tumor. In this algorithm, the image is upgraded utilizing improvement methods for example, differentiate change, and mid-run extend. Twofold thresholding and morphological tasks are utilized for skull stripping. Fuzzy c-means (FCM) clustering is utilized for the segmentation of the image to identify the suspicious area in brain MRI image. Gray level run length framework (GLRLM) is utilized for extraction of feature from the brain image, after which SVM method is connected to arrange the brain MRI images, which give precise and more successful outcome for classification of brain MRI images.

Astina Minzet al. [2], In medical diagnostic application, early deformity discovery is a crucial task as it gives basic understanding into analysis. Medical imaging system is currently developing field in engineering. Magnetic Resonance imaging (MRI) is one those dependable imaging strategies on which medical diagnostic depends on. Manual examination of those images is a repetitive activity as the measure of information and minute points of interest are difficult to perceive by the human. For this mechanizing, those strategies are exceptionally essential. In this paper, we are proposing a strategy which can be used to make tumor discovery simpler. The MRI manages the complicated issue of brain tumor recognition. Because of its multifaceted nature and getting better accuracy is a challenge. Utilizing Adaboost machine learning algorithm we can enhance over exactness issue. The proposed framework comprises of three parts, for example, Preprocessing, Feature extraction and Classification. Preprocessing has evacuated noise in the crude information, for highlight extraction we utilized GLCM (Gray Level Co-event Matrix) and for classification boosting strategy utilized (Adaboost).

Garima Singhet al. [3], Magnetic resonance imaging (MRI) is a strategy which is utilized for the assessment of the brain tumor in medical science. In this paper, a system to ponder and arrange the image de-noising channels, for example, Median channel, Adaptive channel, Averaging channel, Un-sharp covering channel and Gaussian channel is used to expel the added substance noises show in the MRI images i.e. Gaussian, Salt and pepper noise and spot noise. The de-noising execution of all the considered systems is analyzed utilizing PSNR and MSE. A clever thought is proposed for fruitful recognizable proof of the brain tumor utilizing standardized histogram and segmentation utilizing K-means clustering algorithm. Proficient classification of the MRIs is finished utilizing Naïve Bayes Classifier furthermore, Support Vector Machine (SVM) in order to give precise forecast and classification.

G Rajesh Chandraet al. [4], Detection of brain tumor is extremely regular casualty in current situation of health care society. Image segmentation is used to separate the irregular tumor partition in brain. Brain tumor is an irregular mass of tissue in which cells develop furthermore, duplicate wildly, obviously unregulated by instruments that control cells. A few procedures have been produced for discovery of tumor in brain. Our fundamental fixation is on the procedures which utilize image segmentation to identify brain tumor. Tumor classification and segmentation from brain figured tomography image information is a critical yet tedious assignment performed by medical specialists.

Mukambika P. S., et al. [5], Bio-medical image handling is the most testing and rising field in medical finding. Handling of MRI images is one of the troublesome parts of this field. The present work introduces the similar investigation of two methods utilized for tumor identification of MRI images. One depends on the Level set strategy that uses the non-parametric deformable models with dynamic shape to section the brain tumor from the MRI brain images. The other one is the K-means segmentation algorithm. After the segmentation basic leadership is performed in two phases: Highlight extraction utilizing Discrete Wavelet Transform and Dark Level Co-event Matrix, and classification utilizing the Support Vector Machine. It is observed that the results of segmentation accuracies from the proposed methods are comparatively high with the existing method.

K. Sudharani et al. [6], The Magnetic Resonance Imaging (MRI), and Figured Tomography (CT) gives checked images for Brain Tumor Detection. The development of abnormal cells in an uncontrolled way is tumor. The present paper proposed the c1assification and recognizable proof scores of brain tumor by utilizing a k-NN algorithm which depends on preparing of k. In this work, Manhattan metric has connected and ascertained the separation of the c1assifier. The algorithm has been executed utilizing the Lab View.

Ketan Machhaleet al. [7], This paper proposes a scholarly classification framework to perceive ordinary and strange MRI brain images. These days, choice and treatment of brain tumors depend on manifestations and radiological appearance. Magnetic resonance imaging (MRI) is a most vital controlled device for the anatomical judgment of tumors in brain. In the present examination, different strategies were utilized for the classification of brain cancer. Under these strategies, image preprocessing, image highlight extraction and resulting classification of brain cancer is effectively performed. At the point when different machine learning methods: Support Vector Machine (SVM), K-Nearest Neighbor (KNN) and Hybrid Classifier (SVM-KNN) is utilized to

order 50 images, it is seen from the outcomes that the Hybrid classifier SVM-KNN exhibited the most noteworthy classification exactness rate of 98% among others. The main objective of this paper is to give an excellent result of MRI brain cancer classification rate utilizing SVM-KNN.

Rasel Ahmmedet al. [8], Cell is the littlest unit of tissues, whose anomalous development causes tumor in Brain. Bolster Vector Machine (SVM) what's more, Artificial Neural Network (ANN) based tumor and its stages classification in brain MRI images is displayed in this examination work. This work is begun with the upgrade of the brain MRI images which are acquired from oncology division of College of Maryland Medical Center. The joining of Temper based K-means and adjusted Fuzzy C-means (TKFCM) clustering algorithm used to fragment the MRI images based on gray level intensity in small portion of brain images. The estimations of K in Temper based K-means algorithm more than the ordinary K-means once more, consequently refreshed participation of FCM annihilates the molding issue of detecting the tumor locale. At that point, from the divided images, the main request measurement and district property based features are extracted. The first kind of features is utilized to recognize and seclude tumor from typical brain MRI images with SVM. There is second kind which is utilized to arrange the tumors into favorable and four harmful stages tumor with ANNy is up to 97.37% with Bit Blunder Rate (BER) of 0.0294 which is superior to different strategies.

Zhe Xiaoet al. [9], Accurate tumor segmentation is a basic and pivotal advance for PC supported brain tumor analysis and surgical arranging. Subjective segmentations are broadly embraced in clinical conclusion and treating, yet they are neither exact nor solid. An automatically and target framework for brain tumor segmentation is firmly anticipated. Be that as it may, they are as yet confronting a few difficulties, for example, bring down segmentation precision, requesting from the earlier learning or requiring the human mediation. In this paper, a novel and new coarse-to-fine the strategy is proposed to portion the brain tumor. This various leveled system comprises of preprocessing, deep learning organize based classification and post-preparing. The preprocessing is utilized to remove image patches for every MR image and acquires the dim level groupings of image fixes as the contribution of the deep learning system. The deep learning organize based classification is executed by a stacked auto encoder system to remove the abnormal state unique element from the information and uses the extracted highlight to characterize image patches. After mapping the classification result to a double image, the post-handling is actualized by a morphological channel to get the last segmentation result. With a specific end goal to assess the proposed technique, the trial was connected to portion the brain tumor for the genuine patient dataset.

Mohammad Havaei et al. [10], In this paper, author exhibit a completely programmed brain tumor segmentation technique in view of Deep Neural Networks (DNNs). The proposed networks are custom-made to glioblastomas (both low and high review) imagined in MR images. By their exceptional nature, these tumors can show up anyplace in the brain and have any sort of shape, size, and difference. These reasons spur our investigation of a machine learning arrangement that endeavors an adaptable, high limit DNN while being to a great degree productive. Here, author give a depiction of various model decisions that creator have observed to be essential for acquiring aggressive execution. Author investigate specifically unique designs in view of Convolutional Neural Networks (CNN), i.e. DNNs particularly adjusted to image information.

TABLE I. Comparisons of various techniques and method used in present system

Author	Dataset Used	Method	Finding	Advantage	Disadvantage
Parveen et al. (2015)	120 MRI images	FCM Segmentation + SVM classification	In this proposed system brain MRI images proved to be a significant way to detect the brain tumor. The hybrid methodology of combining support vector machine and fuzzy-means clustering for classification gives accurate result for identifying the brain tumor.	It combines clustering and classification algorithm, Efficient method	Brain tumor type can't be classified Difficult to choose SVM kernel function
Astina Minz, et al.	50 MRI images	Adaboost & Neural Algorithms	In this paper, author is proposing a method which can be utilized to make tumor detection easier. The MRI deals with the	Minimize the error, Less time consuming	It can maximize the margin with respect to

(2017)			complicated problem of brain tumor detection. Due to its complexity and variance getting better accuracy is a challenge.		features that have already been selected.
Garima Singh, et al. (2016)	110 MRI images	K-Means Segmentation + SVM & Naïve Bayes classification	a methodology to study and classify the image de-noising filters such as Median filter, Adaptive filter, Averaging filter, Un-sharp masking filter and Gaussian filter is used to remove the additive noises present in the MRI images i.e. Gaussian, Salt & pepper noise and speckle noise.	Accurate results. Fast & efficient in term of computational time and cost	It doesn't work well with clusters (in the original input data) of different size and Different density
G Rajesh Chandra et al. (2016)	100 MRI images	DWT Filtering + Genetic Algorithm	In this paper we focused on the interest of soft thresholding DWT for enhancement and genetic algorithms for image segmentation. Author showed that this kind of approach can be applied either for grey-level magnetic resonance images.	Uses the ability of GA to solve optimization problems with large data set	Wavelettrans form required large storage and its computational cost is high
Mukambika P. S., et al. (2017)	41 MRI images	Level set method & k Means Segmentation + SVM classifier	Presents an effective method to segment and classify the MRI brain images as benign or malignant. It also presents a comparison study of two segmentation algorithms namely, Level set method and K-means algorithm.	Increased Accuracy and Robust modeling .	Potential of misidentification of what is supposed to be categorized .
K.Sudharani, (2015)	48 MRI images	K Nearest Neighbor	KNN algorithm is implemented on the brain tumor images to detect and localize the uncontrollably grown part in the brain tissues. KNN is a slow machine learning process but yields excellent results. the accuracy depends on how many samples undergone training.	Simple and flexible to implement, Handle multi class cases.	Large search problem to find nearest neighbor Storage of data
Ketan Machhale, (2015)	50 MRI images	VM & SVM KNN classification	This paper involves using SVM and SVM-KN to classify the input sample image into normal image or abnormal image. Experimental outcome show the effectiveness of the two models.	Handle multiclass cases Increased Accuracy.	When there is a change in dataset, fresh training dataset is required
Rasel Ahmmed, (2017)	39 MRI images	TKFCM Segmentation + SVM Classification + ANN classification	In this paper, the incorporated SVM and ANN based classification technique is proposed. The processed brain MRI images are firstly segmented using TKFCM algorithm. In which the k means and updated membership are different from conventional process.	Increased Accuracy Classify brain tumor with brain tumor affected stages.	Difficulty in selecting optimal features to distinguish different classes Time Consuming.
Zhe Xiao et al. [9]	10 different MRI images	Deep learning based algorithm	The proposed method has the ability to achieve higher classification accuracy and obtain a good matching rate between the segmentation result and the ground	The final performance shows that the proposed brain tumor segmentation method	Need to employ more features, such as texture features, as the input of the

			truth	is more accurate and efficient	deep network
Mohammad Havaei et al. [10]	MRI images	Deep convolution neural networks	Author presented an automatic brain tumor segmentation method based on deep convolution neural networks. Author considered different architectures and investigated their impact on the performance.	Architecture improves over the currently published state-of-the-art while being over 30 times faster.	More brain tumor MRI data is needed.

III. CONCLUSION

In this paper we have achieved a survey of different classification systems for MRI brain image and its advantage and disadvantage. A near report is made on different procedures. After assessment of surely understood procedure it is clearly demonstrated the different techniques which can identify the tumor proficiently and give exact outcome. In spite of the fact that a few algorithms creating exact and reasonable results, in the meantime they are having a few limitations like it isn't appropriate for large datasets and having longer calculation time. One of the foremost reasons may be the absence of standardized strategies. Computational time will additionally be considered to think about this method efficiently. As the analysis tumor is a sensitive and complicated task, exactness and dependability are constantly appointed much significance. For the future work we propose to introduce more exact, effective and also quicker technique for early detection and classification of brain tumors.

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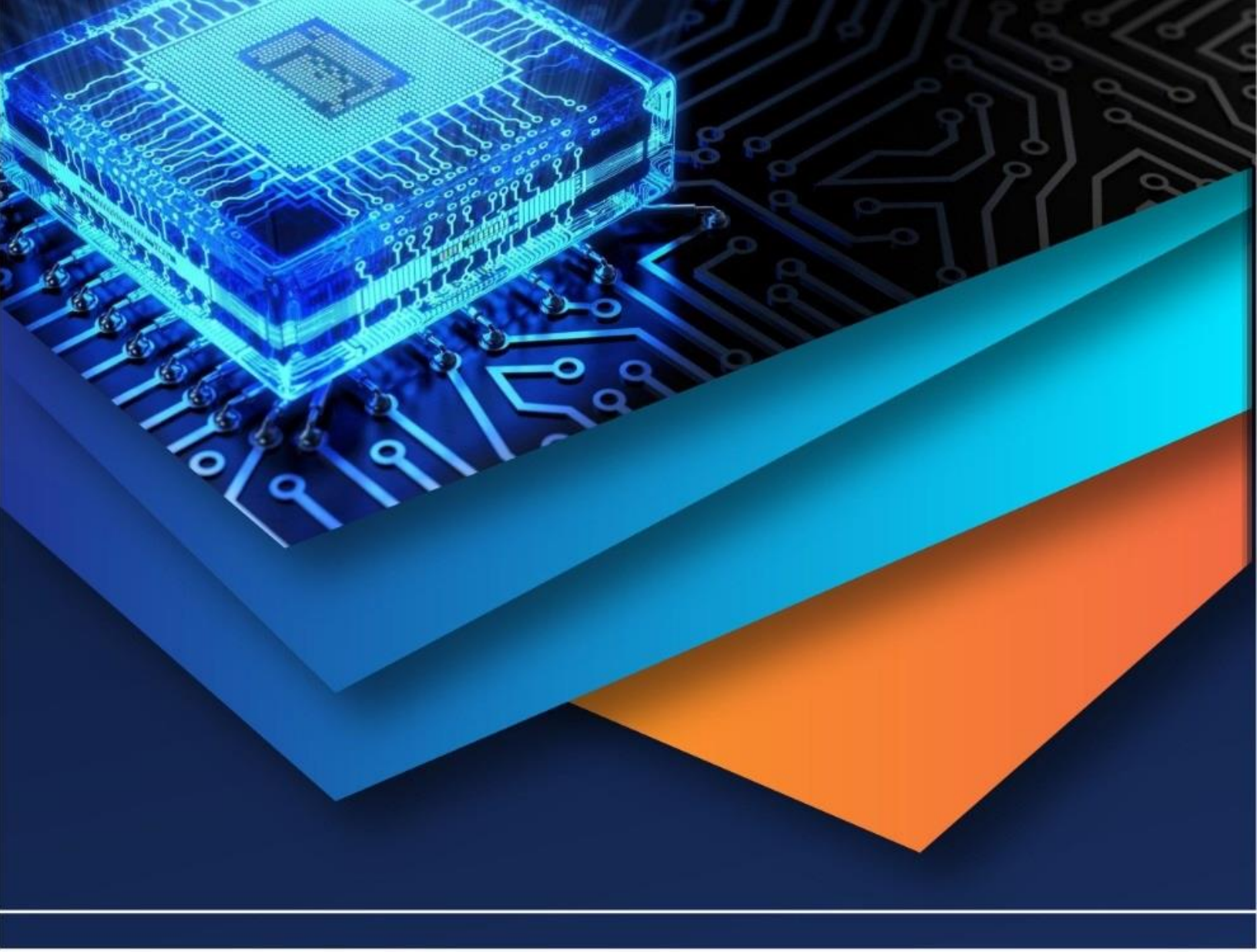

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