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A Review of Analysis of Various Brain Tumor Detection Technique

Hardeep Kaur[1], Karmjeet Singh[2]
[1]*M.tech Student,* [2]*Assistant Professor, ECE Department, BBSBEC Fatehgarh Sahib, India*

Abstract: ***Medical image processing or MIP has emerged possibly as the most efficient technology to monitor the people's state of health. The development of this technology has made the detection of the mass possible using image processing methods. The brain tumor detection have various phases which included pre-processing, feature extraction, segmentation and classification. The various feature extraction algorithms are used for the tumor detection which are textural and colour features. The various classification techniques which are classified into supervised and unsupervised learning are reviewed in terms of certain parameters***

Keywords: Brain Tumor, segmentation, feature extraction, classification

I. INTRODUCTION

The role of medical imaging technology has become quite significant in day-to-day diagnosis and research work concerning medical field due to the advancement of existing clinical guidelines. Subsequently, research on clinical diagnostic image data is vital. Detection of brain tumor has turned out to be a hot topic of research in the healthcare sector due to its frequent occurrence and intricacy. Brain is a complex organ of human body and consists of 50–100 billion neurons. The structure of brain is comprised of large number of cells with all cell shaving a particular function. The majority of cells generated in the body create fresh cells for proper functioning of the human body after division. The fresh cells replace the naturally growing, aged or damaged cells in the organ. At times, new cells are produced when the body no longer needs them. Furthermore, the old and defective cell don't expire in the way as they need to be. The body generates supplementary cells that create a lump of tissue termed as a tumor. A tumor created in the brain area distorts the sensitive body functions [1]. The treatment of brain tumor is extremely complex and life-threatening because of its location and proliferation capacity. Brain tumors are mainly classified into two types, i.e., benign and malignant. Benign tumors are non-cancerous tumors, while malignant ones comprise cancer cells.

Medical image processing or MIP has emerged possibly as the most efficient technology to monitor the people's state of health. The development of this technology has made the detection of the mass possible using image processing methods. Doctors can also use this technology to know the location of the tumor (i.e. within internal organs or not). Generally, the systems performing this process are known as CAD (Computer Aided Detection)frame works. The brain tumor detection mainly depends on the analysis of imaging data concerning brain tumor images. The information about the health status of patient highly depends on the accurate analysis of brain tumor images [2]. However, certain factors such as the personal medical expertise of doctors, difference in experience levels, and visual exhaustion may affect the accurate study of image outcomes. Therefore, it is extremely important to detect the brain tumor images accurately. MRI(Magnetic Resonance Imaging), without causing high ionizing radiation, is capable of providing info regarding different attributes (i.e., shape, size, and location) of human tissues. The obtained images are extremely clear and precise. MRI significantly enhances the diagnostic efficacy, prevents the process of thoracotomy orlaparotomy search, and guides the process of lesion localization and medical therapy in a better way. The MRI of Brain tumor makes use of 3D multi-band imaging technique, and chest X-ray scanning, etc. In contrast to two-dimensional images, 3D multiband MRI can be more helpful to the doctors in the accurate localization of the lesion region by providing the coordinate location of the lesion part [3]. Moreover, MRI imaging uses the unexploited development sequence, i.e., a multimodal MRI image to find various structures of the similar tissues. There are basically four stages involved in an image processing framework. These stages are Input Image, Pre-processing, Segmentation, Tumor region detection and dimensions calculations that further includes two tasks Feature Extraction and Classification. In MIP (Medical Image Processing), detection framework makes use of high-quality images. It is an important norm that impacts the percentage of success in direct manner. Therefore, the fundamental task of the pre-processing phase is to improve the quality of MRI images. One of the most commonly used methods for improving the quality of medical images is HE (Histogram Equalization). The two leading histogram-based methods normally adopted for strengthening the image are HE (Histogram Equalization) and dynamic set of image values (range). The histogram refers to a graphical illustration indicating the weight of the

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values of the image pixels. In simple terms, the histogram represents a graph that demonstrate the amount of colour values in the medical image. The image processing technique makes use of histograms to differentiate the images [4]. For instance, the image pixel values are gathered at a specific end is known as pixel distribution issue. The use of image-processing strategies (such as histogram equalization or histogram balancing) can provide a solution to this issue. The segmentation stage is concerned with partitioning a digital image into numerous segments. There is the need of decent segmentation to identify the brain abnormality and to obtain improved and easily understandable image. The use of Otsu's approach is quite common for automatically performing image thresholding based on clustering, or, converting a gray-level image into a binary image in image processing and artificial intelligence. The algorithm is based on the assumption that the image consists of two types of pixels, with a bimodal histogram, it then measures the best threshold that separates the two classes to minimize or uniform their mixed expansions, with the purpose to maximize their interclass variance [5].The process to gather the higher-level information regarding an image including shape, texture, colour and contrast is known as feature extraction. The texture analysis is an important parameter of human visual perception and ML (machine learning) system. The significant attributes are selected for enhancing the accuracy of diagnosis system in efficient manner. The GLCM is an image analysis application planned on the basis of texture attributes. This method has two phases to extract the attributes from the medical images. The initial stage includes the quantification of Grey Level Co-occurrence Matrix (GLCM). The next stage has the computation of texture attributes on the basis of GLCM. It is essential to extract the relevant attributes because of the intricate structure of diversified tissues such as WM, GM, and CSF in the brain magnetic Resonance (MR) images. The textural findings and analysis assists in enhancing the diagnosis, diverse phases of the tumour and therapy response assessment. The shape, size, location, and contrast of tumour tissue cells are varied due to which it becomes difficult to classify the brain tumours [6]. Various kinds of brain tumours are classified as gloom, meningioma and pituitary using DL (deep learning) methods. SVM (Support Vector Machine) algorithm is an effective technique whose generation is done from analytical learning. SVM is useful for alleviating the empirical classification error and increasing the geometric margin synchronously. This algorithm is utilized to classify the training data into two classes. The MRI brain tumour images having malign and benign tumour are comprised in training data. The data in training samples is arranged as vectors in which the number of rows in each vector represents diverse observations with regard to medical images and the set of attributes are denoted using the number of columns. The training samples help the classification algorithm in distinguishing the tumour as malign and benign. The detection of normal brain image is done. K-means clustering algorithm is an unsupervised algorithm implements to split the objects based on attributes into k groups [7]. This algorithm is very simple and emphasized on generating the close-fitting cluster and performing well for low dimensional data. The K-Means algorithm provides better performance in comparison with hierarchical clustering in case of massive number of variables. However, this algorithm is incapable of predicting the K-value and performing well with global cluster. Furthermore, this algorithm is not performed accurately due to different size and density. The NB (Naive Bayes) is non-complex Bayesian networks in which DAGs are comprised along with just single parent and multiple children with a powerful hypothesis that child nodes are independent in the context of their parent.

II. LITERATURE REVIEW

G.S. Gopika, et.al (2018) suggested a hybrid method in order to detect the brain tumors in MR (Magnetic Resonance) images with the help of gray scale and texture attributes [8]. Initially, anisotropic filter was utilized in filtering to eliminate the noise pixels from the image. The Grey-Level Co-occurrence Matrix (GLCM) was executed for extracting the attributes. Afterward, the PCA (Principal Component analysis) was applied with the purpose of mitigating the extracted features. Finally, the tumors were classified as cancerous or non-cancerous using the FSVM (Fuzzy Support Vector Machine). The outcomes depicted that the suggested technique generated the accuracy up to 95% and higher efficiency in contrast to existing techniques.

Md. Abu Bakr Siddique, et.al (2020) intended a DCNN (deep convolutional neural network) algorithm to diagnose the brain tumor from MR images [9]. A dataset, in which 253 brain MR images comprised out of which 155 images having tumors, had utilized for quantifying this algorithm. The accuracy for detecting the brain tumor was found 96%. The outcomes revealed that the intended algorithm provided the precision of 0.93, Sensitivity around 1.00 as compared to the traditional algorithms. In addition, the intended algorithm assisted the doctors in determining the brain tumor and accelerating the treatment process.

R. Meena Prakash, et.al (2019) projected an automated method on the basis of CNN (Convolutional Neural Network) to detect the tumor in brain images [10]. The ImageNet was applied for the pre-training of projected algorithm. The input images were trained using the pre-trained CNN algorithm. A dataset taken from Harvard medical school was implemented to test this algorithm. Three pre-trained models namely VGG16, ResNet and Inception were implemented to carry out the analysis. The projected algorithm had provided the accuracy around 100%. The projected algorithm was capable of enhancing the accuracy for classification.

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Md. Ahasan Kabir, et.al (2020) recommended a technique planned on the basis of SVM (support vector machine) and ANN (artificial neural network) for detecting the brain tumor [11]. Different phases were carried out in this technique in which image was enhanced; segmentation was done using SVM; attributes were extracted and classification was performed. The BRATS dataset was exploited to test the recommended algorithm so that its performance was evaluated. The outcomes of experiment represented that the accuracy of the recommended technique was calculated 97.7% which was found superior to traditional techniques.

Hein Tun Zaw, et.al (2019) introduced NB (Naïve Bayes) classifier in order to detect a tumor region in accurate manner [12]. This classifier emphasized on detecting the tumor region from various Magnetic Resonance imaging (MRI) images of brain and predicting the detected areas as cancerous or normal. The introduced approach was capable of detecting the tumor occurred in diverse regions of the brain such as middle region in comparison with other techniques. Fifty images were utilized for the testing of this approach. The outcomes validated that the DR (detection rate) on tumor images was obtained 81.25% and DR on non-tumor images was computed 100%.

A Jagan, et.al (2018) designed an integrated segmentation model in order to detect the brain tumor from three-dimensional MR images [13]. The EM (Expectation Maximization) and FCM (Fuzzy C Means) method were incorporated. The quality of brain Magnetic Resonance (MR) image was enhanced and the tumor was segmented and detected more efficiently using the designed approach. The brain Fluid-Attenuated Inversion Recovery MRI images and real brain dataset had employed to quantify the outcomes of designed approach. The designed approach was performed more efficiently as compared to traditional techniques with regard to accuracy, sensitivity and specificity.

Gajendra Raut, et.al (2020) presented a CNN (Convolutional Neural Network) in order to detect the brain tumor [14]. At first, significant data was created for DL (deep learning) by augmenting the MRI images of brain. Thereafter, the pre-processing of images was done for eliminating the noise and making the images efficient for further phases. The pre-processed images were utilized for training the presented algorithm so that a newly input image was classified as having tumor or normal on the basis of attributes whose extraction was done during the training phase. Autoencoders assisted in producing the image for eliminating the irrelevant attributes. Additionally, the K-Means algorithm was implemented for segmenting the tumor region. The error rate was alleviated and outcomes were generated more accurately.

A. Comparison Table

Author	Year	Description	Outcome
G.S. Gopika, R.SRajasree	2018	Suggested a hybrid method in order to detect the brain tumors in MR (Magnetic Resonance) images with the help of gray scale and texture attributes.	The outcomes depicted that the suggested technique generated the accuracy up to 95% and higher efficiency in contrast to existing techniques.
Md. Abu Bakr Siddique, ShadmanSakib, Mohammad Mahmudur Rahman Khan, Abyaz Kader Tanzeem, Madiha Chowdhury, Nowrin Yasmin	2020	Intended a DCNN (deep convolutional neural network) algorithm to diagnose the brain tumor from MR images.	The outcomes revealed that the intended algorithm provided the precision of 0.93, Sensitivity around 1.00 as compared to the traditional algorithms.
R. Meena Prakash, R. Shantha Selva Kumari	2019	Projected an automated method on the basis of CNN (Convolutional Neural Network) to detect the tumor in brain images.	The projected algorithm had provided the accuracy around 100%. The projected algorithm was capable of enhancing the accuracy for classification.
Md. Ahasan Kabir	2020	Recommended a technique planned on the basis of SVM (support vector machine) and ANN (artificial neural network) for detecting the brain tumor.	The outcomes of experiment represented that the accuracy of the recommended technique was calculated 97.7% which was found superior to traditional techniques.

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Hein Tun Zaw, NoppadolManeerat, KhinYadanar Win	2019	Introduced NB (Naïve Bayes) classifier in order to detect a tumor region in accurate manner.	The outcomes validated that the DR (detection rate) on tumor images was obtained 81.25% and DR on non-tumor images was computed 100%.
A Jagan	2018	Designed an integrated segmentation model in order to detect the brain tumor from three-dimensional MR images.	The designed approach was performed more efficiently as compared to traditional techniques with regard to accuracy, sensitivity and specificity.
Gajendra Raut, Aditya Raut, Jeevan Bhagade, Jyoti Bhagade, Sachin Gavhane	2014	Presented a CNN (Convolutional Neural Network) in order to detect the brain tumor . At first, significant data was created for DL (deep learning) by augmenting the MRI images of brain.	The error rate was alleviated and outcomes were generated more accurately.

III. CONCLUSION

The MRI brain tumour images having malign and benign tumour are comprised in training data. The data in training samples is arranged as vectors in which the number of rows in each vector represents diverse observations with regard to medical images and the set of attributes are denoted using the number of columns. The training samples help the classification algorithm in distinguishing the tumour as malign and benign. The various techniques of brain tumor detection are reviewed in terms of certain parameters.

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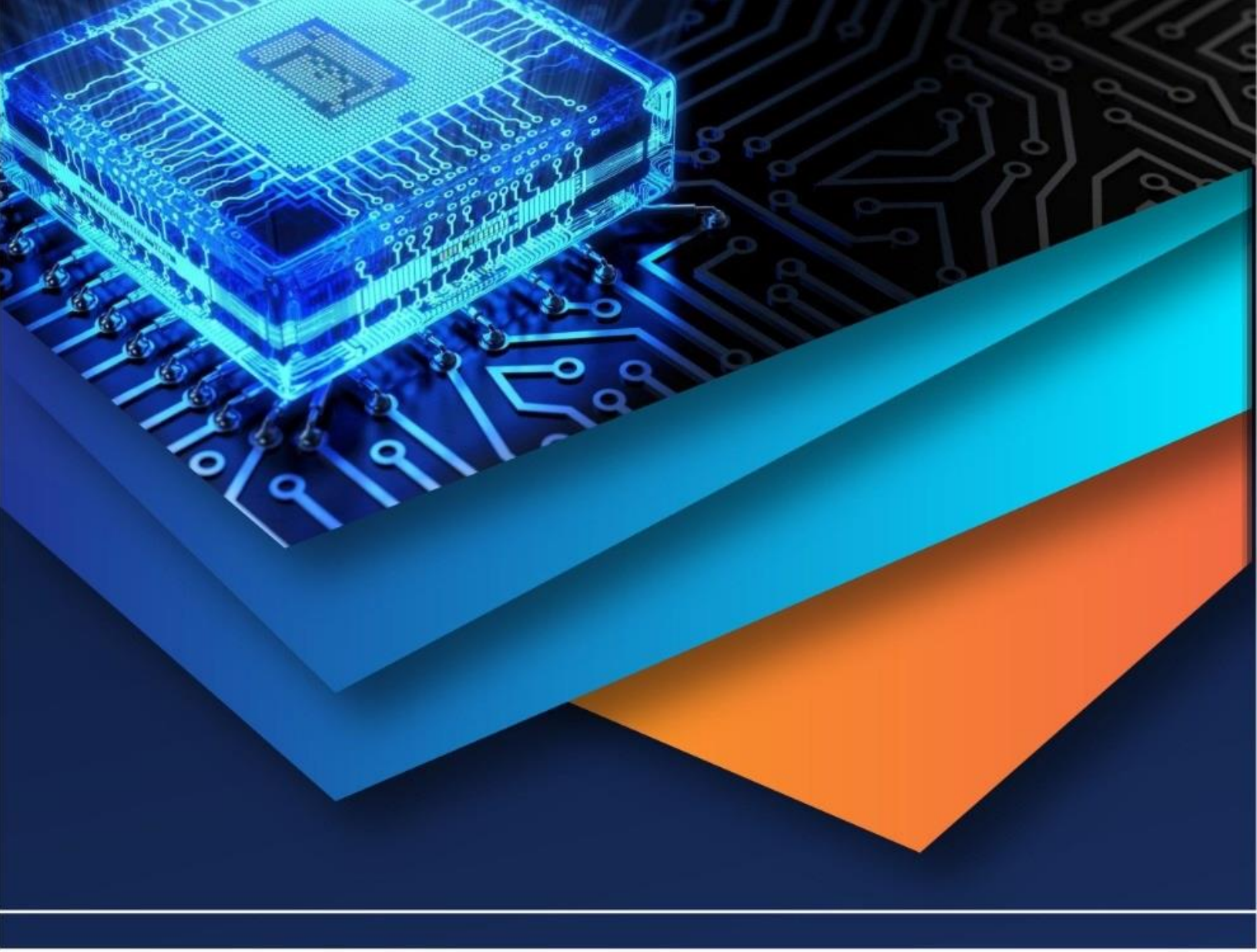

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