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ENHANCEMEMNT OF ACCURACY DURING BRAIN TUMOR DETECTION AFTER FEATURE EXTRACTION

Mrs. Pragati

Research Scholar BMU Rohtak HR, uietpragati@gmail.com

Dr. Banita

Assosiate Professor, BMI, Rohtak, HR, banita861023@yahoo.com

***Corresponding Author:** Mrs. Pragati

*Research Scholar BMU Rohtak HR, uietpragati@gmail.com

Abstract:

The detection of brain cancers was aided by the application of deep learning technology. There is no doubt that progress has been achieved in the fields of deep learning and tumour detection. It was chosen to include edge detection into a preexisting deep learning system for the identification of brain tumours. Finding a tumour takes a lot less time using pre-trained networks. The MRI scans were processed using deep learning. The human brain, as shown in a deep learning dataset, is shaped like a timepiece. The dish form of certain tumours may make them more visible for diagnosis. Following edge detection, brain cancer diagnosis makes use of deep learning and reinforcement learning. The purpose of this paper is to investigate and analyse current approaches for medical imageclassification and feature extraction in order to suggest hybrid feature extraction, feature selection, and classificationstrategies. It was agreed that study would be conducted to determine how successful the offered solutions were. The accompanying illustration illustrates the four stages of the proposed technique. The images are pre-processed before they are ever taken. At this point, we scale the image and convert the colour space to grayscale using RGB2. The photographs would next undergo extraction to remove unwanted elements, followed by database matching. The aspects of a picture are used to learn characteristics that are used to detect tumours. Next, the pictures will be classified by a synthetic neural network into tumour and normal subsets. Next, the tumor's profile would be extracted using features. The last step in assessing the value of the proposed effort is comparing the results to those of existing research.

Keywords: Deep Learning, Image Processing, Feature Extraction, Brain tumor Detection, edge detection, edge extraction, canny edge detection.

[1] Introduction

By using edge extraction, in recent research, deep learning has been utilized to improve identification of brain tumors. Brain tumor detection and deep learning have both been studied, however poor results have continued despite the efforts of researchers Edge detection was added to the deep learning technique for the identification of brain tumors in order to speed up the procedure. Additionally, a pre-trained network decreases tumor detection time by half. To enhance the MRI pictures, deep learning was used. According to a dataset built using deep learning, the brain seems to have the form of a wall clock. Tumors with a dish-like form may be identified. Deep learning and reinforcement learning were employed in this study to diagnose brain tumors. Researchers have compared their findings to what is known now in the area. As artificial intelligence grows more widespread, it will be necessary to improve medical imaging devices that employ deep learning. It's hard to tell whether the patient has a tumor in their brain since the pattern is so hazy. In the deep learning technique, abnormal brain MRI patterns are detected using a neural network. You'll need a pre-trained neural network if you want to do this. Neuronal networks are taught using reinforcement learning. In differential graphic games, a number of agents working together control the exploration of the environment. Reinforcement learning is used in these games. There are many other abstraction approaches that may be used to construct an intelligent artificial system, and this one is only one of them. Machine learning has never been used this way before. Deep learning, on the other hand, is meant to address specific problems. Reinforcement learning is a term used to describe the process of machine learning. Basically, it's a kind of artificial intelligence. This is the first time machine learning has been used in this way. This is the first time machine learning has been used in this manner. They have a defined purpose: to deal with a certain set of issues. Machine learning uses the phrase "reinforcing learning" often.

1.1 Image processing and Edge Detection

Picture processing is the process of altering the content of an image, such as scaling, rotation, cropping, and edge detection. Efficient efficiency and precision may be achieved by implementing an edge detection system. Images may be processed to identify the edges of objects by using an image processing method known as edge detection. Consequently, it is able to carry out its tasks without any mistakes. Image processing, computer vision, and machine vision all make use of edge detection to segment and extract data from images. As an element of image analysis, it's necessary since it allows for picture splitting, identifying the target area and deciding on the region's shape. When it comes to digital image processing, edge detection plays a critical role. To tell the difference between the goal and the background, we need to construct a clear line. Using an image gradient to determine the size and direction of an image's edges is an essential image processing technique. There are a variety of applications for image gradients in computer vision, including line detection, feature recognition and image categorization. A Canny Edge Detector training session is the most efficient and effective method to utilise the device.

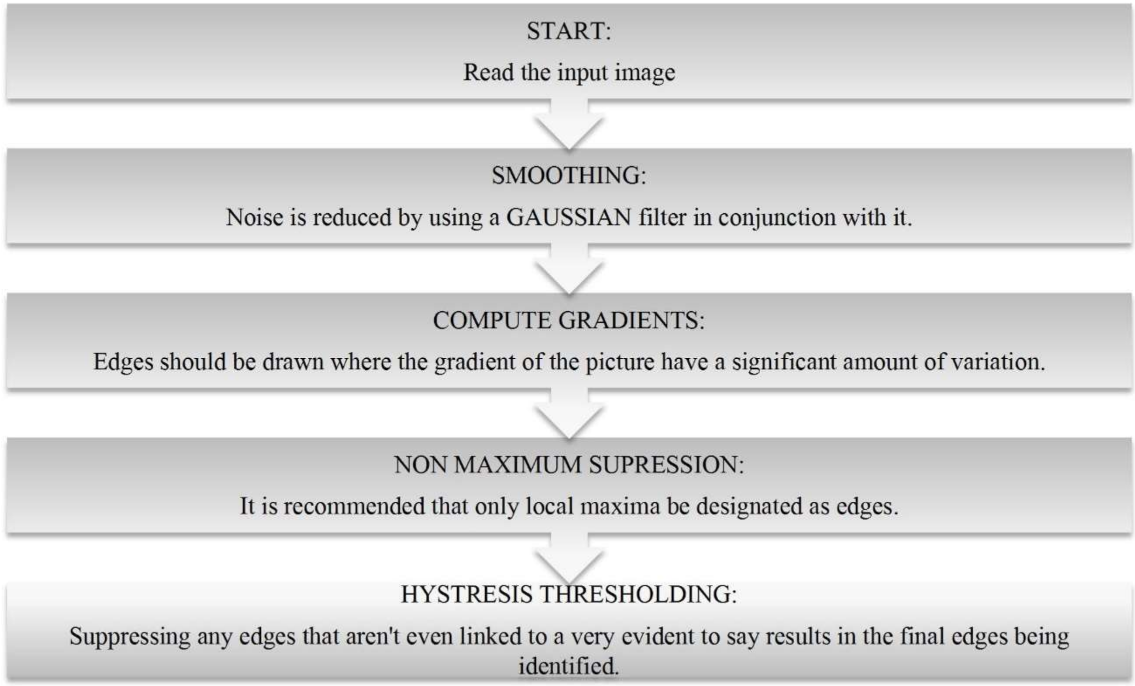

Fig. 1. Edge Detection

1.2 Social Applications of Edge Detection

Images may be processed to identify the edges of objects by using an image processing method known as edge detection. Consequently, it is able to carry out its tasks without any mistakes. The demand for this detection method may be shown by seeing how it is used in Macao society. Using a car as a source of transportation is now as commonplace as recognizing a moving license plate. As a result, smart traffic control systems will be increasingly used. When it comes to identifying license plates, this detection method works well. License plate recognition technology is often used at toll plazas and parking garages. With a few tweaks, this method has shown to be effective. Image grey scalability and QDPA edge detection in sample new information may be discovered by analyzing previously viewed medical photos. Traditional edge detection techniques are compared with phase-based detection methodologies. Older techniques could only detect information on an object's edges, but the new approach can identify information on an object's whole, as scientists were able to discover. Objects like this are difficult to discern from the surrounding region because of their remarkable resemblance in hue.

1.3 Canny Edge Detection

A multi-stage method is used by the Canny edge detector to identify a broad variety of edges in pictures. In 1986, John F. Canny created it. A computer theory of edge detection developed by Canny explains how and why the approach works. Edge detection is a method for extracting meaningful structural information from a variety of visualobjects and reducing the quantity of data that must be analysed. Various computer vision systems have made use of it. Edge detection can be used to a wide range of vision systems, according to Canny's research. These criteria may be met by an edge detection system that can be used in a broad variety of circumstances. A method known as the calculus of variations was employed by Canny in order to meet these criteria. The first derivative of a Gaussian may be used to approximate the optimum function in Canny's detector, which is defined by the product of four exponential terms. The Canny edge detection algorithm is one of the most precisely specified approaches yet created for edge identification that delivers excellent and dependable results. It quickly rose to the top of the list of the most often used edge detection algorithms due to its high performance in terms of meeting the three edge detection criteria and its ease of implementation.

1.4 Brain Tumor Detection

In order to become a tumor, abnormal cells in the brain must first arise and then spread to other regions of the body. Cancerous and non-cancerous tumors may be found everywhere in the body. Either of these classes is a viable alternative to the current system of categorization. It is possible to suffer from a variety of symptoms because of the tumor's size and placement in your brain. Headaches, seizures, blurred vision, nausea, and changes in mood are all possible side effects. Other symptoms include difficulty walking, speaking, experiencing feelings, or passing out. The majority of malignancies in the brain have no recognized origin. The brain is seen as a complex organ in everyone. The neurons in the brain are responsible for storing, retrieving, and analyzing data. It's growing in an unique way. Glial cells and astroglial cells are two kinds of brain cells. All of a person's organs and systems develop from a single brain cell. Uncontrolled brain cell development might cause injury or do no harm. They move in the opposite direction from the rest of your cells because of this.

1.5 Deep Learning

In deep learning, neural networks are used to learn from unstructured or unlabeled data without any prior knowledgeof the subject matter. 'Deep neural learning' and 'deep neural network' are two phrases used to describe this process. Machine learning, which includes deep learning, is a subset of artificial intelligence. This machine learning class uses nonlinear processing units to extract and alter data. So on and so on, sending the preceding layer's output into the next. To tackle the dimensionality issue, deep learning models rely on the programmer's instruction to focus on the most accurate features on their own.

1.6 Need of research

In a recent study, researchers used deep learning technology to enhance the diagnosis of brain tumors. Tumor identification and deep learning have made significant strides in recent years, but there is still more work to be done.This new technique for identifying brain cancers uses edge detection in conjunction with current deep learning algorithms. Using a pre-trained network reduces the time required to find a tumor by half. Deep learning was used totrain the MRI images. A deep learning dataset suggests that the brain is shaped like a wall clock. With its dish-like shape, malignancies may be more easily seen. After edge detection, deep learning and reinforcement learning are used to identify brain cancers. To arrive at this result, new findings and features were compared to those found in prior research. Current research restrictions have made it difficult to identify brain cancers. This assessment is asolid starting point for additional research. It has been shown that system edge detection is crucial to boosting efficiency. Research's future stages have been mapped out in advance. There have been discussions concerning the difficulty of diagnosing brain cancers in light of current research constraints.

[2] Literature review

An appraisal of the present state of knowledge is provided through a literature survey or literature review. This also includes theoretical and methodological contributions. It is through this study that logs come to be. In addition to Sobel and Canny, they looked at other edge detection techniques. A variety of edge-detection techniques were testedin this study. In order to identify people, algorithms like Canny and Sobel are employed to extract the edges from face photos. More than a handful of the most successful strategies have been presented. Haar Discrete Wavelet Transform (HDWT) or GLCM may be used to dissect images (GLCM). In order to extract edge points from diverse document pictures, six distinct edge detection techniques, such as Laplacian (zero cross) and Gussian's Laplacian, may be used (LOG). Even the Laplacian functions of Gaussian and Prewitt were extensively explored. With the helpof the MRI scans supplied, we were able to find the tumor in the brain quickly and easily There was a brief discussion of edge detection techniques and their comparison. Using this novel technology, it is feasible to construct point representations from low-resolution point clouds. Those who are new to deep learning-based recommendation systems would benefit from this detailed analysis. It has been proposed by the authors of this research that MRI images may be automatically recognized using this novel method. Investigate Image Retrieval Based on Content (CBIR). There are just a few set ways in which gradient edge detection can work. As a result, it misses out on valuable information in other directions. making an assessment based on images of blind people To meet all of the criteria, an image with a fixed wavelet transform was used. Urine Raman spectroscopy was used to conduct the test. As part of the process, they employed a support vector machine, grey wolf optimization, and an image extraction model. They utilized FT-IR spectroscopy to demonstrate how SVM may benefit from this strategy. You may see a computer-aided design they create for you. This section contains previously published research. For this subject, there are a number of periodicals and online resources. In the following sections, you will find a quick summary of some of the articles.

Log Sobel edge detection was introduced by Guowei et al in 2011. It is the logarithm of luminosity that is used by this operator, rather than the luminosity itself. It has a short response time and is well-suited for monitoring the internet. In addition, the detection result is affected by the brightness of the image. In addition, it is used for online detection. Predecessor algorithms such as Roberts, Prewitt, and Sobel have been found to be inferior to the Log Sobel operator's image processing effect. [1]

Several image processing techniques for edge detection were compared by Pinaki et al. in 2012. Mathematica has been used as a programming language. Two years later, Rashmi et al. Many edge detection techniques were investigated, including those by Prewitt, Robert, Sobel, Marr Hildrith, and Canny operators, to name just a few. For example, Canny's flexibility, its ability to handle noisy pictures, and its ability to give sharp and low-probability edges outperform all other edge detectors. [3]

To recognise faces, Vijayarani Mohan et al. employed the Canny Edge Detection and Sobel Edge Detection algorithms that were developed in 2013. Canny edge detection has been shown to perform better in tests than the Sobel edge detection approach. As Suma et al. reported in 2014, they conducted a thorough review of various tacticsand identified some of the most successful approaches from all prior research.. It is becoming more necessary to compress medical images; yet, research has demonstrated that it confronts higher dimensionality and complexity of difficulties in order to fulfil the increasing demands of medical science. [5]

In 2015, Ekta Gupta and colleagues For image decomposition, a great deal of effort was put into HDWT and GLCM.The classification algorithm in this work makes use of an SVM. The results of the tests show a significant improvement over previous methods. To improve recovery accuracy and performance, this work provides a computation that combines the advantages of many different computations. [6]

Vijayarani Mohan et al. published their findings in 2016. Six distinct edge detection approaches, namely Roberts, Sobel, Prewit, Canny, Laplacian, and LOG, may be used to extract edge points from various kinds of document pictures. In order to determine which method was the most effective, they had compared them all. The Structural Similarity metric is used to quantify the speed and accuracy of processors. Laplacian and Roberts were shown to be the most effective edge detection algorithms in our experiments. [7]

Mohd. Aquib Ansari et al. published their findings in 2017 Prewitt, Sobel, Canny, Roberts, and the Gaussian Laplacian were all carefully investigated as possible edge detection algorithms. Canny edge detector outperforms competition, according to the findings of the experiments. It was possible for us to finish this project using Matlab R2015a. When Priya Patil et al. published their findings in 2017, [8] they made headlines.

It was possible to find the tumor in the brain since they presented us with MRI scans. Any aberrant tissue or blood vessel development in the nervous system may be detected by an MRI scan. First, the brain's symmetry and asymmetry must be checked to identify whether there is an abnormality. There are two methods of segmentation that follow this step. Methods include morphological and F-Transform operations. [9]

A comparison of cutting-edge edge detection methods was conducted in 2018 by Rehan Mehmiod et al. The feature vector, which contains information about the edges, only contains key point descriptions. To ensure the success of the whole process, it is essential to identify and locate the boundaries of items. [10]

If Giang et aldeep .'s learning-based technique is successful in 2018, point renderings created from low-resolution point clouds might be available in 2018. High-quality, co-registered images will be used to train the deep neural network for point-based rendering. Recommended technique may rapidly and efficiently build high-quality point rendering images for interactive exploration of vast 3D environments and image-based localization. Analysis of synthetic and real data shows that the suggested approach outperforms existing techniques in every way possible. [11]

This year, Zeynep Batmaz et al. For the benefit of newbies, they published and prevalence across recommendation domains, and the purposive characteristics are all examined in our study. A quantitative analysis of important studiesis also presented. Finally, lessons gained and suggested options for future study are discussed. are discussed. [12]

Table 2.1: Literature Survey

S. No.	Title / Author	Methodology used	Future Scope	Conclusion
[1]	Research and analysis ofImage edge detection algorithm Based on the MATLAB / Guowei Yang, et al.	Edge detection	Real life application could be developedin future	Edge detection is crucial part of image processing
[2]	Study and Comparison ofDifferent Edge Detectorsfor Image Segmentation / Dr. Pinaki Pratim Acharjya, et al	Edge detection, imageprocessing	Future research might considersmart approach	Canny edge detection is found better than other techniques.
[3]	Algorithm and Techniqueon Various Edge ,et al.	Canny edge detection.	Work might be used for health careapplication in future.	PSNR ratios of canny edge detection make it better as compare to other edge detection techniques.
[4]	Performance Analysis ofCanny and Sobel Edge Detection Algorithms in Image Mining / Vijayarani Mohan, et al.	Image mining, Face detection, Edge detection, Canny, Sobel.	Accuracy and performance could be improved in future	Canny is found better than sobel
[5]	A Review of the Effective Techniques of	Medical Image Processing,Compression Techniques,	More technical workcould be made inarea of	Need of image processing in medical has been elaborated.

	Compression in Medical Image Processing / Suma, V Sridhar et al.	Lossy and Lossless Compression	medical using image processing technique.	
[6]	Combination of Global and Local Features using DWT with SVM for CBIR / Ekta Gupta et al.	CBIR; Similarity Matrix;DWT; SVM; GLCM; Global feature;Local feature; Color Correlogram; Color Histogram.	Feature extraction might be useful in health care sector	Use of feature extraction allows object identification
[7]	A Performance Comparison of Edge Detection Techniques for Printed and Handwritten Document Images / Vijayarani Mohan et. al.	Roberts, Sobel Prewitt, Canny, Laplacian (Zero Cross) and Laplaican of Gaussian (LOG).	Edge detection mechanism could beused with deep learning approach infuture.	Canny is better as compared to other edge detection technique.
[8]	A Comprehensive Analysisof Image Edge Detection Techniques / Mohd. Aquib Ansari et.al.	Image segmentation, Edgedetection, Prewitt, Sobel,Laplacian of Gaussian, Canny, Roberts, PSNR, SNR	Future work would make use of edge detection to reduce image size before training operation.	Edge detection plays crucial role in pattern detection and PSNR and SNR are consider able during such operation.
[9]	A Review Paper on BrainTumor Segmentation and	Brain Tumor, MRI Images,FuzzyTransform,	Future work might considermore	There are several issues such as
	Detection / Ms. Priya Patilet. al.	Morphological operation.	technical work during feature detection.	performance and accuracy during brain tumor detection.
[10]	A Comparative Study of Various Edge Detection Methods / Rehan Mehmood Yousaf et. al.	Edge detection technique, image processing applications, morphological operation.	Deep neural networkmight be integratedwith edge detection mechanism.	Edge detection is the best part of Image processing to eliminate useless part during network training
[11]	Point-based rendering	Point-based rendering , Deeplearning , Super	Future work may take less time	Research presented role of deep learning in

	enhancement via deeplearning / Giang Bui et. al.	resolution		point based rendering.
[12]	A review on deep learning for recommender systems: challenges and remedies / Zeynep Batmaz et. al.	Recommender systems , Deep learning	Future work may provide betteraccuracy.	Training and testing operations are time consuming.
[13]	An Approach for PCA andGLCM Based MRI Image Classification / Sheetal S.Shirke et al.	PCA and GLCM based MRI, and imageclassification	Future work may take less time	PCA and GLCM is used to classify the MRI images.
[14]	Content Based Image Retrieval by Using Color Descriptor and DiscreteWavelet Transform / R. Ashraf et al.	CBIR, Color Descriptor andDiscrete Wavelet Transform	Accuracy and performance could be improved in future	CBIR is performing by using Color Descriptor and Discrete Wavelet Transform
[15]	Research on Edge Detection Operator of a Convolutional NeuralNetwork / Chenxing Xue	Edge Detection, CNN	Future work would make use of edge detection to reduce image size before training operation.	Edge detection is operating with the help of CNN to get better performance

2.1 Research Gap

In image processing, edge detection has been explored by many researchers who worked on it and compared several edge detectors. Because they didn't focus on performance, the breadth of these studies was restricted. Sobel & Canny-based edge detection is still a viable option for performance analysis, but other algorithms and approaches have emerged to include compression to minimize time consumption and picture size. Previous studies on picture compression did not include edge detection into real-world applications. The study on brain tumor segmentation and identification, on the other hand, neglected mechanisms for edge detection and compression. Previous studies in the area of brain tumors have failed to tackle the problem of time and space consumption, as has been noted. Furthermore, the pattern detection accuracy has to be improved. In order to develop an effective brain tumor detection system, further research is required that makes use of compressed and edge-detected images using convolutional neural networks.

[3]Problem Statement

There have been a number of studies conducted in the field of detecting brain tumours and feature extraction. There is a pressing requirement to boost the efficiency of the feature extraction process. When attempting to extract characteristics from photos, many methods such as GLCM are used. There is a pressing need to develop a method that is more dependable and which is also able to extract information from pictures of brain tumours. The suggested work has presented a way to obtain characteristics from brain tumour pictures, taking into consideration this need.

[4]Proposed Work

The methodology used in research has been represented in this section where image of brain tumor is considered andresizing and RGB 2 gray conversion is made. Image features are extracted using either GLCM to perform the matching of images with database using above features. Detection of the tumor based upon the feature extracted from the image is made. Classification using ANN to find out tumor and normal is performed. Detection of circular, elliptical, irregular shapes is performed to evaluate results.

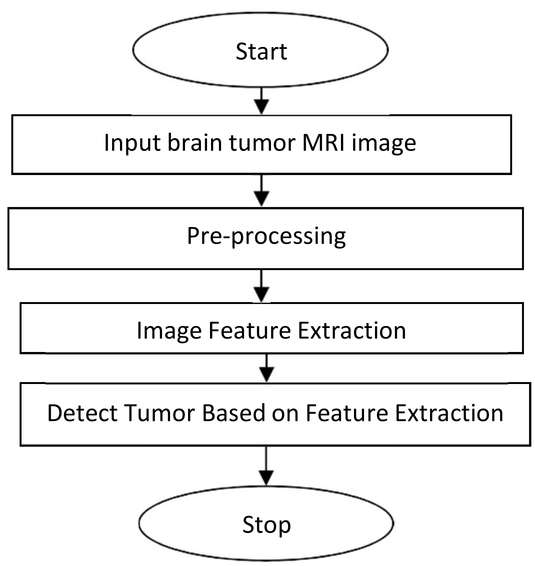

Fig 1 Process flow of Proposed Work

[5]Result And Discussion

In this research the data set of 20 brain MRI with tumour and 20 brain MRI without tumor are considered. The proposed work has been implemented in 4 phases.

Phase 1 : In first face the images are captured from dataset and RGB2GRAY is applied on these image sets. Then canny edge detector has been implemented in order to extract edges from the MRI brain image dataset. The dataset of brain MRI having brain tumour and without brain tumour is shown in fig1 and fig 2.

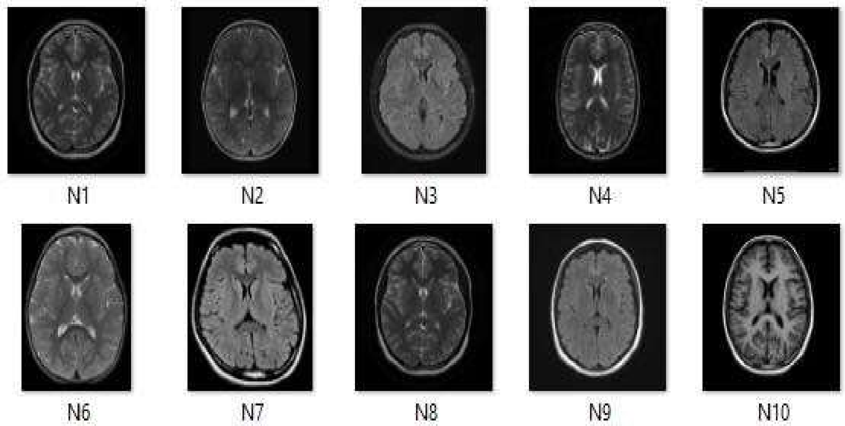

Fig 1 Brain MRI without tumour

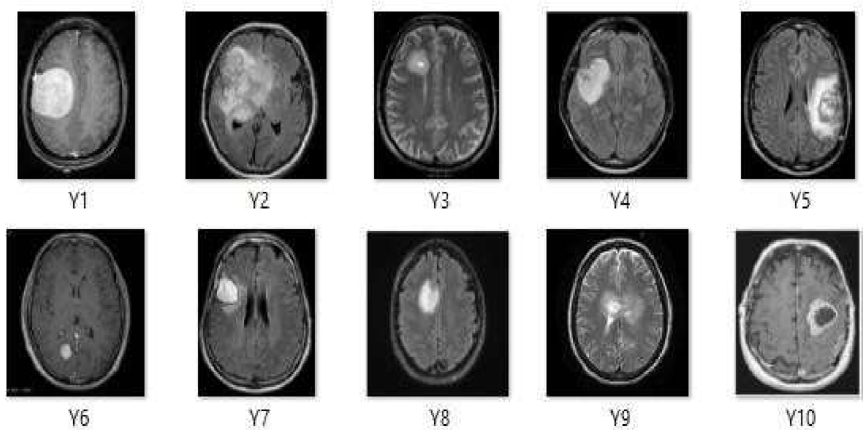

Fig 2 Brain MRI having tumour

During first face the RGB2GRAY has been applied and edges are detected. After applying these techniquesfollowing Brain MRI are generated:

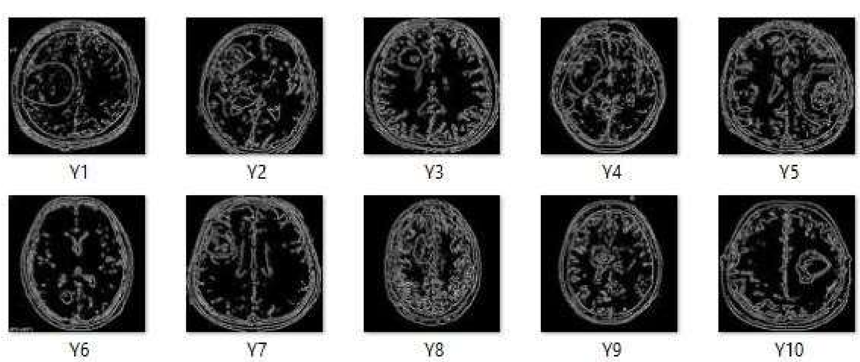

Fig 3 Edge based brain MRI with tumour

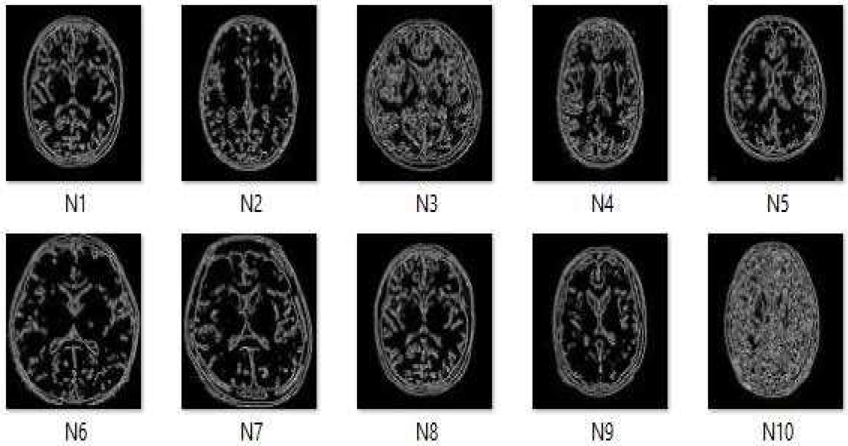

Fig 4 Edge based Brain MRI without tumour

Phase2: The image features have been extracted using GLCM. The following tables are representing the features of Brain MRI with tumour and without tumour. Table 1 is representing the contrast, correlation, energy, homogeneity, smoothness, kurtosis, skewness and IDM for the dataset where features have been retrieved using GLCM from Brain MRI having tumour.

Table 1 Feature extraction from Brain MRI with tumour GLCM

Sno	Contrast	Correlation	Energy	Smoothness
1	0.435764	0.09285	0.607125	0.890527
2	0.453993	0.054151	0.639083	0.729169
3	0.434896	0.036505	0.582949	0.914822
4	0.489583	0.113039	0.613877	0.904511
5	0.398438	0.131882	0.614567	0.810567
6	0.413194	0.129255	0.624048	0.744646
7	0.482639	0.0762	0.601862	0.906426
8	0.548611	0.153019	0.639896	0.922648
9	0.516493	0.116365	0.668942	0.871464
10	0.408854	0.115762	0.605243	0.874947

Table 2 is representing the contrast, correlation, energy, homogeneity, smoothness, kurtosis, skewness and IDM for the dataset where features have been retrieved using GLCM from Brain MRI having no tumour.

Table 2 Feature extraction from Brain MRI without tumour using GLCM

Sno	Contrast	Correlation	Energy	Smoothness
1	0.473958	0.09768574	0.664634	0.766670859
2	0.530382	0.05298304	0.661743	0.857257546
3	0.543403	0.09175557	0.595465	0.936908263
4	0.489583	0.14450487	0.689084	0.883616588
5	0.473958	0.11352982	0.664047	0.858787796

6	0.428819	0.09053886	0.58456	0.937423155
7	0.453125	0.09263842	0.604219	0.885049689
8	0.473958	0.09768574	0.664634	0.766670859
9	0.446181	0.16177939	0.675531	0.7940044
10	0.530382	0.10846907	0.645493	0.903948458

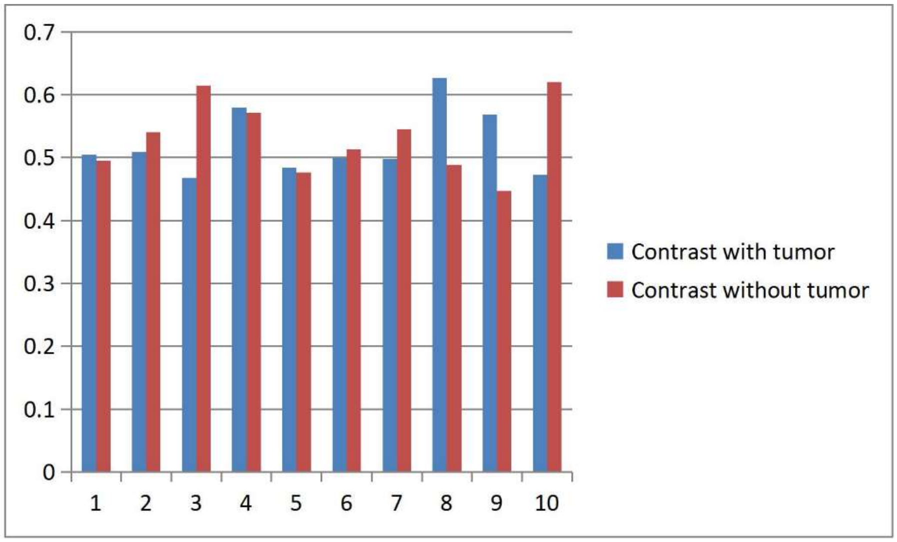

Fig 5 Contrast comparison in case of tumour and without tumour brain MRI

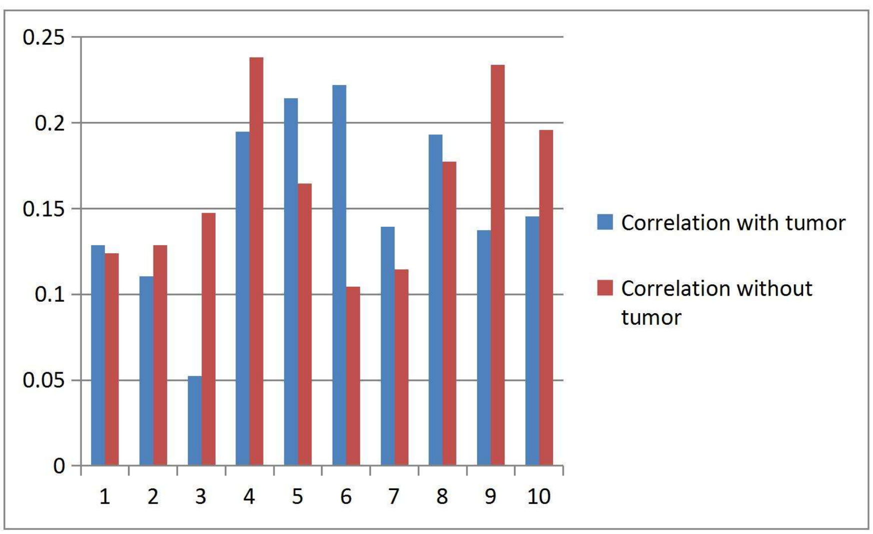

Fig 6 Correlation comparison in case of tumour and without tumour brain MRI

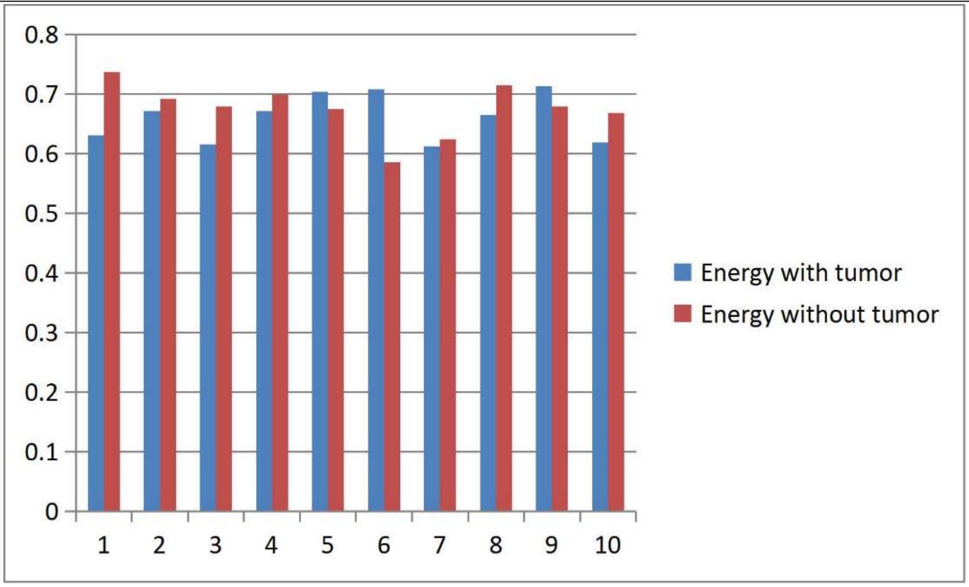

Fig 7 Energy comparison in case of tumour and without tumour brain MRI

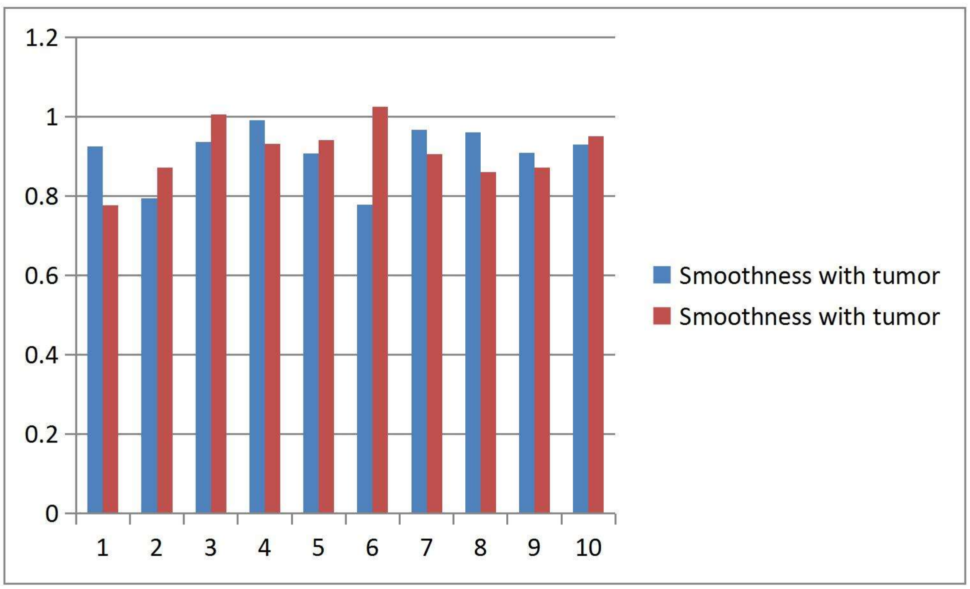

Fig 9 Smoothness comparison in case of tumour and without tumour brain MRI

It has been observed that the homogeneity, energy in case of tumour is low as compare to homogeneity, energy in case of no tumour maximum times.

Phase 3: After matching image image datset the classification is performed using neural network.

Phase 4: Tumor shape has been detected using SVM

[6] Conclusion

There has been a lot of study done in this field, but all of them have issues. Everything is on the line, from processing speed to data storage capacity to precision. It takes a lot of time and money to train a deep neural network. Developing a method that improves both training time and feature detection performance is essential. Learning and identifying patterns need an acute sense of edge detection. Because of their shortcomings, it can be argued that there have been many research in this field. Everything from performance to storage capacity to accuracy is at stake. A deep neural network requires a lot of time and resources to train. Feature detection performance must be improved while training speed must be increased. Canny edge detection must be implemented to improve performance while learning and identifying patterns. Based on the findings, we may draw the conclusion that the process of extracting features is fairly difficult, and that neural networks have offered a flexible solution to the task of performing picture classification. It has been shown that the energy, homogeneity, contrast, and correlation characteristics retrieved from brain pictures are lower in the case of brain tumour images compared to normal brain MRI. This is the case for all four of these aspects. Therefore, feature extraction could play a key role inthe diagnosis of brain tumours.

[7] Future Scope

In a recent study, researchers used deep learning technology to enhance the diagnosis of brain tumors. Tumor identification and deep learning have made significant strides in recent years, but there is still more work to be done.This new technique for identifying brain cancers uses edge detection in conjunction with current deep learning algorithms. Using a pre-trained network reduces the time required to find a tumor by half. Deep learning was used totrain the MRI images. A deep learning dataset suggests that the brain is shaped like a wall clock. With its dish-like shape, malignancies may be more easily seen. After edge detection, deep learning and reinforcement learning are used to identify brain cancers. To arrive at this result, new findings and features were compared to those found in prior research. Current research restrictions have made it difficult to identify brain cancers. This assessment is asolid starting point for additional research. It has been shown that system edge detection is crucial to boosting efficiency. Research's future stages have been mapped out in advance. There have been discussions concerning the difficulty of diagnosing brain cancers in light of current research constraints.

References

1. Guowei Yang, Fengchang Xu, (2011). Research and analysis of Image edge detection algorithm Based on the MATLAB. (School of Information Engineering, Nanchang Hangkong University, Nanchang 330063, China).
2. Pinaki Pratim Acharjya, Ritaban Das & Dibyendu Ghoshal (2012). Study and Comparison of Different Edge Detectors for Image Segmentation. Volume 12 Issue 13 Version 1.0 Year 2012. Type: Double Blind Peer Reviewed International Research Journal.
3. Rashmi, Mukesh Kumar, Rohini Saxena, (2013). Algorithm and Technique on Various Edge

Catalyst Research Volume 23, Issue 2, September 2023 Pp. 1348-1364

Detection : A Survey. June 2013Signal & Image Processing An International Journal 4(3):65-75. DOI:10.5121/sipij.2013.4306

4. Vijayarani Mohan, (2013). Performance Analysis of Canny and Sobel Edge Detection Algorithms in Image Mining. October 2013International Journal of Innovative Research in Computer and Communication Engineering.
5. Suma, V Sridhar (2014). A Review of the Effective Techniques of Compression in Medical Image Processing. International Journal of Computer Applications (0975 – 8887) Volume 97– No.6, July 2014.
6. Ekta Gupta and Rajendra Singh Kushwah, "Combination of Global and Local Features using DWT with SVM for CBIR", PAPER: 978-1-4673-7231-2/15/$31.00 ©2015 IEEE
7. Vijayarani Mohan, (2016). A Performance Comparison of Edge Detection Techniques for Printed and Handwritten Document Images. Vol. 4, Issue 5, May 2016. ISSN(Online): 2320-9801, ISSN (Print) : 2320- 9798
8. Mohd. Aquib Ansari1 , Diksha Kurchaniya2 and Manish Dixit, (2017). A Comprehensive Analysis of Image Edge Detection Techniques. International Journal of Multimedia and Ubiquitous Engineering Vol.12, No.11 (2017), pp.1-12 http://dx.doi.org/10.14257/ijmue.2017. 12.11.01
9. Ms. Priya Patil, Ms. Seema Pawar, Ms. Sunayna Patil, Arjun Nichal, (2017). A Review Paper on Brain Tumor Segmentation and Detection. DOI:10.17148/IJIREEICE.2017.5103.
10. Rehan Mehmood Yousaf; Hafiz Adnan Habib; Hussain Dawood; Sidra Shafiq, (2018). A Comparative Studyof Various Edge Detection Methods. 2018 14th International Conference on Computational Intelligence and Security (CIS).
11. Giang Bui, Truc Le, Brittany Morago, Ye Duan, (2018) Point-based rendering enhancement via deep learning. © Springer-Verlag GmbH Germany, part of Springer Nature 2018.
12. Zeynep Batmaz1 • Ali Yurekli1 • Alper Bilge1 • Cihan Kaleli(2018). A review on deep learning for recommender systems: challenges and remedies. Springer Nature B.V. 2018.
13. Sheetal S. Shirke, Jyoti A. Kendule and Samata G. Vyawhare,"An Approach for PCA and GLCMBased MRI Image Classification", © Springer International Publishing AG 2018, P.M. Pawar et al. (eds.), Techno-Societal 2018, DOI 10.1007/978-3-319-53556-2_26
14. R. Ashraf et al., "Content Based Image Retrieval by Using Color Descriptor and Discrete Wavelet Transform,"J. Med. Syst., vol. 42, no. 3, 2018, doi: 10.1007/s10916-017-0880-7.
15. Chenxing Xue; Jun Zhang; Jiayuan Xing; Yuting Lei; Yan Sun, (2019). Research on Edge Detection Operator of a Convolutional Neural Network. 2019 IEEE 8th Joint International Information Technology and Artificial Intelligence Conference (ITAIC).
16. A. Sadiq, I. F. Nizami, S. M. Anwar, and M. Majid, "Blind image quality assessment using natural scene statistics of stationary wavelet transform," Optik (Stuttg)., vol. 205, p. 164189, 2020, doi: 10.1016/j.ijleo.2020.164189.
17. C. Chen et al., "Urine Raman spectroscopy for rapid and inexpensive diagnosis of chronic renal failure (CRF) using multiple classification algorithms," Optik (Stuttg)., vol. 203, p. 164043, 2020, doi: 10.1016/j.ijleo.2019.164043.

18. S. Hosseini and B. M. H. Zade, “New hybrid method for attack detection using combination of evolutionary algorithms, SVM, and ANN,” Comput. Networks, vol. 173, p. 107168, 2020, doi: 10.1016/j.comnet.2020.107168.
19. D. B. Renita and C. S. Christopher, “Novel real time content based medical image retrieval scheme with GWO-SVM,” Multimed. Tools Appl., 2020, doi: 10.1007/s11042-019-07777-w.
20. J. Liu et al., “Use of FT-IR spectroscopy combined with SVM as a screening tool to identify invasive ductal carcinoma in breast cancer,” Optik (Stuttg)., vol. 204, no. January, p. 164225, 2020, doi: 10.1016/j.ijleo.2020.164225.
21. A. Shakarami, H. Tarrah, and A. Mahdavi-Hormat, “A CAD system for diagnosing Alzheimer’s disease using 2D slices and an improved AlexNet-SVM method,” Optik (Stuttg)., vol. 212, p. 164237, 2020, doi: 10.1016/j.ijleo.2020.164237
22. Shahriar Sazzad, T. M., Tanzibul Ahmmed, K. M., Hoque, M. U., & Rahman, M. (2019). Development of Automated Brain Tumor Identification Using MRI Images. 2nd International Conference on Electrical, Computer and Communication Engineering, ECCE 2019, 0–4.

    https://doi.org/10.1109/ECACE.2019.8679240
23. B, P. K., Bocheva, N., & Nedelcheva, S. (2020). STDP Plasticity in TRN Within Hierarchical Spike Timing Model (Vol. 1). Springer International Publishing. https://doi.org/10.1007/978-3-030-49161-1
24. Zahid Junejo, A., Memon, S. A., Zameer Memon, I., & Talpur, S. (2018). Brain Tumor Segmentation Using 3D Magnetic Resonance Imaging Scans. 1st International Conference on Advanced Research in Engineering Sciences, ARES 2018.