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Detection and Classification of Tumor using SVM and ANN with GLCM features in CBIR

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Abstract

Proposed research has focused on content-based image retrieval in medical field where the tumor is detected from the given dataset. The objective of the research is to reduce the tumor detection time. This research is considering canny based edge detection, GLCM, ANN, SVM techniques to achieve the objective. The objective of research is to study and analyze various medical image retrieval techniques and propose hybrid technique using feature extraction, feature selection, and classification techniques. Then the performance of proposed technique is evaluated and validated. In this research work, the proposed method comprises four stages. Initially, pre-processing of the images is done. During this stage, the image is resized and RGB to gray conversion is applied. The edge detection mechanism is applied afterward. In the second phase, the image features would be extracted using GLCM, then matching of images with the database is done. Then the tumor is detected according to the features extracted from the image. The third phase is to perform classification using an artificial neural network to detect the tumor and normal image. Then SVM would be applied to detect the shape of the tumor. Finally, the results of the proposed work would be compared to previous research for evaluation.

Keywords: CBIR, Edge Detection, GLCM, ANN, SVM.

1. Introduction

Research work is presenting content-based image retrieval in the medical field where the tumor is detected. The goal is to reduce the time taken to get a score case of brain MRI. To achieve this objective edge-based detection has been used. The research work has made using GLCM for feature extraction. On other hand, ANN has been used to train network to increase the accuracy during a testing phase where the classification operation has been performed. SVM has been used to detect the shape of a tumor. In this way, the proposed research has made using of Edge detection mechanism, GLCM, ANN, and SVM.

1.1 Gray-level Co-occurrence Matrix

A GLCM generates a pixel-centered matrix of distances and orientations. Surface properties are then retrieved from the matrix as a key statistic. Typically, academics focus their attention on four major characteristics: power, dissimilarity, connectedness, and consistency.

Consistency - It is a property of a grayscale picture that governs the distribution of pictures grayscale regularity of weight and texture.

Dissimilarity - The primary transverse near inertia is dissimilarity.

1.2 Artificial Neural Network

Image recognition is an operation where deep neural networks play a significant role. Neural networks have been considered as computing systems. These systems have been designed to find patterns. The architecture of these systems is influenced by human brain structure. They are consisting of three different layers. Their layers are output, input, and hidden layers. Input layer is capable to receive a signal while the hidden layer performs process sing. On the other hand, the output layer is making a decision as well as predication regarding input data. Every network layer is consisting of nodes that are interconnected to perform computation.

1.3 Support Vector Machine (SVM)

It is widely spread and used for a purpose not only for classification problems but also for regression problems. In the initial stage, it is only applied to problems that are related to the organization in the technology of Machine Learning.

The main intention behind the invention of this algorithm is to form the decision boundary. This boundary separates n-dimensional space into classes. Due to these new data points are placed in the exact category. It selects excessive points that assist in the formation of the hyperplane. These cases are known in the form of support vectors. Due to this reason, the algorithm is known in the form of SVM.

1.4 Organisation of Research

In this paper section 1 is introduction for the research work and techniques used for the research. In section 2, literature review of previous work is explained. In section 3, methodology of research work is defined. Then in section 4, results of proposed work are shown. Then in section 5, discussion section consists of future work and conclusion for the research work.

2. Related work

For research work, it is essential to review existing researches/papers/articles to know the limitation of existing work and the scope of more research work.

In 2015, Ekta Gupta [1] proposed a combination of Global and Local Features using DWT with SVM for CBIR. In this paper, the author worked on HDWT. It has been done for achieving the purpose of image broken-down. Images are decomposed into the straight, smooth, & GLCM & diagonal region. Images are decomposed to remove their characteristics. Here Support Vector Machine (SVM) is applied for the work of grouping. It has been bringing in to notice from the trial performance that the method which is presented here shows good efficiency in comparison to earlier methods. A computation is presented in this paper which affiliates the advantages of other calculations to implement improvement and development of accuracy.

In 2018, Sheetal S. et_al [2], introduced a method which has been used for the grouping of MRI Image. These images are obtained from principal component analysis & GLCM. This method beat disadvantage of earlier methods. Earlier methods can identify and categorize magnetic resonance imaging of the brain only into normal and abnormal. In the whole universe, the disease of brain tumors is considered in the form of a serious disease. For the treatment of a brain tumor, it must be detected in its primary stage. The method which was presented here displays how magnetic resonance imaging of the brain is categorized into simple, harmless, and deadly tumor images. For this purpose, a potential Neural Network is used in company of function which is based on radial. The system which was presented here identifies the brain tumor based on this magnetic resonance imaging. In addition to this, it also examines its composition. Based on this examination it makes conforms to the stage of brain tumor. The research work which has been done here provides good opportunities not only in the favor of medical images but also in the face detection system. When brain cells are expanded in an uneven way it causes a brain tumor. Therefore, its identification is very essential. The method which was presented here displays how MRI Images of the brain are categorized into simple, harmless, and deadly tumor images. For this purpose, it uses the technology of automatic classification. For the removal of image characteristics, algorithms of principal component analysis and GLCM are used. These algorithms are used for feature extraction. For image sorting, PNN-RBF classifiers are used. It has been bringing in to notice from the trial performance that the method which is presented here shows good efficiency in the classification of magnetic resonance imaging.

In 2020, D. B. Renita et al. [3] combined a content-based medical image retrieval design in company of GWO and SVM. For the removal of valuable information from a database of medical images, FBMIR systems are utilized. For the removal of the medical image, they introduced a new method in the company of GWO and SVM. In this technology, the input image is an image that has been created after a CT scan. In the primary step, the images are carefully measured for extraction. In this step scaling and steady characteristics are removed. For this purpose, parallel color moments are used. In the next step, surface characteristics are removed. For this purpose, principal GLCM features are used which contain correlation, contrast, energy, etc. Different qualities are put in the form of a layout by using Bag of Words (BoW). GWO-SVM technique is achieved from the introduction of this work. At first, the related category of the query image is detected by this technique. In addition to this, the work which has been carried out for image extraction is prepared by the datasets of query images. The algorithm of GWO gives not only static parameters but they are also the best. Due to this, they provide clear and best value for the SVM classifier.

In 2020, S. Hosseini et al. [4] mentioned a composite method for attack recognition. This method was formed by integrating various developing algorithms. In the safety of computer networks Intrusion detection systems (IDS) has played a significant function. This system is very capable and it can identify those attacks and spiteful operation which cannot be detected. According to machine learning algorithms, various IDS have been amplified. These amplified systems organized network traffic in the form of standard or unusual. A composite intrusion detection method was introduced here. It has two stages. In the primary stage, qualities are selected and in the secondary stage, attacks are identified. In the primary stage technology of MGA-SVM, is used. It is a covering technique. It is a type of technique in which the characteristics of the SVM and the genetic algorithm are integrated into company of multi-parent crossover. In the second stage for attack identification ANN is used. For the training of the classifier, a mixture of a composite gravitational search and a PSO is used. This will enhance its efficiency. It has been bringing in to notice from the trial performance that the method which is presented here shows detection accuracy of ninety-nine point three percent dimension reduction of NSL-KDD from forty-two to four characteristic, & only requires three seconds in the form of maximum learning time.

In 2020, C. Chen et al. [5] investigated Urine Raman spectroscopy. The basic intention behind this investigation is to provide a fast and economical treatment of constant renal failure (CRF). For the achievement of this purpose, several sorting methods are used. Chronic renal failure (CRF) is a warning sign which came into observation when the kidney is damaged. It gets worse into uraemia if treatment is not provided in time. Due to which the lifetime of the patient reduced. For that reason, new methods of treatment like urine spectroscopy for CRF become very important. Earlier they examine the possibility of Raman spectroscopy for the classification of CRF patient's urine and organize subjects in the company of standard renal function. Near about forty-eight samples from the patient of CRF and forty-four samples from organized subjects were accumulated. It is shown by a spectrum that a comparatively low amount of hydroxybutyrate and a high amount of alanine, creatinine, and porphyrin are present in the patient of CRF. After that for removal extraction principal component analysis (PCA) was applied.

In 2020, A. Sadiq, I. F. Nizami et al. [6] examined the quality of Blind images. For this purpose, the normal picture data of the stationary wavelet transform was used. End-user of an image is a human. Therefore, examination of image quality from the human point of view is necessary. When the quality of an image is examined by a human it takes a lot of time. The methods which are examined the quality of blind image determines the apparent quality of twisted images. For this purpose, information related to perfect version of image is not required. Methods which are based on normal picture data determines the quality score by the removal of characteristic either in three-dimensional or alter domain. An up to date BIQA technique was presented by them. It removes characteristics both in three-dimensional or alters fields. The human optical system and NSS of SWT, morphological gradient, and discrete Laplacian are analogous. Therefore, it is possible to implement them in favor of BIQA. The most important benefit of Morphological gradient is that it provides a simplified view of all types of feature space. The most important benefit of discrete Laplacian is that it preserves the natural structural information of image. SWT provides edge and high-frequency information while keeping level of the image. Weakness which was present in the middle of the extracted characteristic is eliminated by them. For this purpose, a flexible joint standard support was used. The BIQA method which is presented here has been tested on five publicly available records.

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It has been bringing in to notice from the testing output that the BIQA technique has higher accuracy in terms of image quality prediction in comparison to latest BIQA and IQA techniques.

This will be shown by J. Liu et al. [7] in 2020 as a screening device for persistent canalicular carcinoma in breast cancer by combining FT-IR spectroscopy with SVM. As a result of their research, they have developed a rapid screening approach for IDC and acute ductal carcinoma (ADC). There were differences in biomolecular composition between the two groups, according to preliminary assignments of the FT-IR peak locations in the serum spectra. The diagnostic model rate was improved by reducing the spectral dimension using principal component analysis (PCA). SVM models were constructed for retrieved features using kernels. The polynomial kernel produces best results with accuracy of 95%, comprehension of 95%, and specificity of 100%. Serum FT-IR spectroscopy, according to findings, have significant promise for screening IDC in breast cancer. Using this technique, a portable fast screening device may be developed to tell apart people with IDC from those who don't.

A CAD system was supplied by A. Shakarami et al. [8] in 2020. It was meant to treat Alzheimer's disease. The AlexNet-SVM approach and two-dimensional slices were used for its treatment. Alzheimer's is a mental illness that affects the elderly. Up to this point in time, no treatment is available which can stop its growth. At present, it a disease due to which most people lost their lives. It was expected that the cost of its treatment will rise dramatically. Therefore, its treatment in earlier stages becomes very important. Here a computerized system was represented by them for the treatment of this disease. This computerized system is known in the form of a Computer-Aided Diagnosis system (CADs). The method which was proposed here uses two-dimensional slices. Hence two-dimensional convolutional neural network (CNN) is brought in to use. In this method, half of the slices whose qualities are better to have been picked and the remaining are eliminated. In addition to this, for feature removal and its grouping AlexNet-SVM method is proposed in an improved version. It reduces the quantity of evaluation data and increases accuracy and efficiency. PET images are kept in mind in this research because their capabilities in demonstrating body organic process are very good. It has been highlighted by practical outputs that the proposed model is very good in comparison to the earlier models. It increases efficiency and accuracy up to ninety-six point three nine percent and reduced the quantity of evaluation data.

In 2020, Z. Yan et al. [9] identified the harmless and deadly pancreatic tumor in a very quick way. To achieve this goal serum Raman spectroscopy in the company of classification algorithms was used by them. For a person who is suffered from a pancreatic tumor the survival time of this patient completely depends upon the tumor type. If a person who is suffered from a deadly pancreatic tumor gets treatment in the early stages, then it is possible to increase his survival time. The method which was presented in the work assists in the treatment of pancreatic tumors. Initially, information related to the Raman spectrum of a person who is suffered from a pancreatic tumor was removed by them. For this purpose, a partial least squares method was used by them. This study practically removed ten eigenvalues. The collective difference of the first six PLS elements are 97.045 %, after that information that was removed via PLS has been organized. For the conduction of this experiment LDA, SVM, and KNN methods were used. Out of these three organized methods, the greatest organized results are produced by the cubic kernel of SVM. Its organization precision is 96.4 %. It has been considered by practical outputs that serum Raman spectroscopy may be used in the form of a supporting method for medical treatment of pancreatic cancer.

In 2020, Z. Karapinar Senturk et al. [10] provided timely treatment of paralytic disease. For this purpose, they bring the algorithms of machine learning into use. This type of disease comes into existence when dopamine becomes disorganized. Dopamine is a type of brain cell that produces chemicals. These chemicals permit us to communicate with each other. The cells by which this chemical generates are liable for the organization, adjustment, and ease of activities. When sixty to eighty percent of these cells vanish, then the production of dopamine is reduced and paralytic symptoms come into existence. Due to this, researchers want to invent a new method by which this disease can be identified in the early stages. If this happens, it is considered that the growth of the disease was stopped. This paper presented a treatment in the support of this disease based on machine learning. The method of treatment which is presented here includes feature selection and organization processes. For the purpose of selecting features, logical feature removal techniques and feature value were taken into account. Classification and regression trees, ANN, and SVM are used to identify paralysed patients for experimentation. Compared to other approaches, support vector machines perform better when used in conjunction with logical feature elimination methods. Treatment of paralytic illness had a 93.84 percent success rate.

R. Arora et al. [11] used Deep feature-based automated classification of mammograms in 2020, and their results were published in the journal Radiology. The number of women who died from breast cancer has been shown to be in second place. The early phases of the illness are very hard to avoid because of unknown reasons. It is possible to better treat women by using photographs of the breast that are obtained based on distinguishing indicators like a large bulk of breast tissue or tiny wounds. It is very difficult to work for a radioactive specialist to give manual treatment on regular basis. For assisting in support of this radioactive specialist some computerized methods of treatment have been urbanized. These methods removed feature mechanically. The structures which are based on deep learning are normally unskilful on the breast images which are taken by computer help directly. As an alternative, the images are defined in advance, and after that, they are provided in the form of input to the assembly of the model which was proposed here. Based on extracted features strength, they are maximized into a feature vector where they are organized by the neural network. The network was made skillful and experienced so that harmful and deadly tumors are categorized.

Using a novel radial basis function classifier and SIFT–LBP features merged, D. Giveki et al. [12] presented Scene classification in 2020 [12]. An incident's description from a computer's point of view is a complex and crucial task. For the description of an incident, and up to date method was presented by them. For this purpose, in addition to a bag of optical information, an artificial neural network organizer was used. This organizer was formed based on particle swarm optimization (PSO). From the support of this research, a fresh method for feature combination is presented. For the presentation of this method, they use a SIFT and LBP. It has been detected from their study that if LBP and SIFT is used in the integrated form then the efficiency of organization work will be improved. In addition to this, the practical work which has been done by them on the Proben1 dataset shows that the efficiency of the organization will be improved up to six points per four percent. They compared the suggested organizer's performance to that of a multi-way SVM organiser. They found the latter to be more efficient. The organiser presented here is better to the current organiser on three records, according to the practical results.

In 2018, R. Ashraf et al. [13] researched the topic of Content-Based Image Retrieval. For this research, they bring Color Descriptor and Discrete Wavelet Transform in use. Due to latest growth in technology, the complication of broadcasting is increased in a very dramatic way Due to this, the removal of analogous broadcasting content becomes an open research problem. In this process, a structure for the detection of image is provided. THE optical qualities whose level is very low are frequently used for the extraction of images from image database. In process of any image extraction, it is necessary to arrange images whose optical aspects are parallel. The shade, form, and surface quality are examples of low-level image features. In process of any image extraction, a considerable part is played by features. To obtain useful features by which images are organized and identified the technique of feature extraction is used. The performance of an image is defined by its features, due to this, their position concerning storage area, the performance of the organization, and time consumption are very important. In this paper, they not only considered various types of characters but also consider the methods which are used for their removal. In addition to this, they also explain the situation in which the working of these methods is good. Based on extracted features, the efficiency of the CBIR method is determined. Main objective of CBIR is that it can search only the genuine contents of the image from a set of records. For this purpose, distance metrics were bringing in to use. ANN is applied for image recovery. They are used on usual records in the domain of Content-Based Image Retrieval. Working of optional details has been assessed by the determination of accurate and recollected values. A comparison was made in the middle of these values and the values which have been obtained from various other methods. This comparison shows that their method is very powerful. The competence and success of this method beat the performance of present research from the perspective of average accurate and recollected values.

Table 1 shows comparative analysis of previous researches and proposed work.

Sno.	Author name/Year	Topic	Advantages	Limitation
1	Ekta Gupta/2015	Proposed use of DWT and SVM to combine global and local features for CBIR	Practical outputs show good efficiency in comparison to earlier methods. A computation is presented in this paper which affiliates the advantages of other	There is a need to do more work on processing time.

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			calculations to develop the accuracy and implementation of improvement.	
2	Sheetal S. Shirke/2018	Introduced a for PCA and LCM Based method which has been used for the grouping of MRI Image Classification	The proposed method delivers appropriate output in a grouping of MR images.	The research has ignored the edge detection mechanism to reduce the size of the dataset
3	D. B. Renita and C. S. Christopher / 2020	GWO and SVM collaborated on a content-based medical picture retrieval strategy.	Research is beneficial for real-time CBIR in medicals.	Research ignored the benefits of artificial Neural networks.
4	S. Hosseini / 2020	Using a mix of evolutionary algorithms, the composite technique for assault recognition has been proposed.	This approach has increased security.	Complex to implement.
5	C. Chen et al. / 2020	Detection of CRF in urine using Raman spectroscopy and various classification methods.	Multiple classification algorithms are supposed to provide a better approach.	Limited work is made for feature extraction and selection.
6	A. Sadiq / 2020	Examined the quality of Blind image by using normal picture data of stationary wavelet transform	Wavelet transform has been proven better of approach.	Need to enhance the performance of the system.
7	J. Liu et al. / 2020	illustrate application of FT-IR spectroscopy when it is combined in the company of SVM in the form of a screening device to recognize persistent canalicular carcinoma in breast cancer	SVM is a proven better approach for screening.	Research lacks feature extraction.
8	A. Shakarami / 2020	Detection of CRF in urine using Raman spectroscopy and various classification methods.	The improved AlexNet-SVM method has played a significant role in diagnosing.	Working is limited to diagnosing, no work is done on image feature selection.
9	Z. Yan et al. / 2020	Identified harmless and deadly pancreatic tumor rapidly by using serum Raman spectroscopy in the company of classification algorithms	Useful to detect tumors quickly.	Research is focused only on the classification algorithm
10	Z. KarapinarSenturk / 2020	provided timely treatment of paralytic	The role of machine learning made the system intelligent.	Need to introduce a neural network to increase efficiency.

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		disease by using machine learning algorithms		
11	R. Arora / 2020	Mammograms are automatically classified based on a rich set of features.	The deep feature mechanism is supposed to improve the classification	The concept of feature extraction is missing
12	D. Giveki / 2020	New radial basis function classifier and integrated SIFT–LBP features for scene categorization	The integrated approach seems to be impressive for classification	Research seems to be complex to implement in a real-life scenario.
13	R. Ashraf et al. / 2018	New Color Descriptor and Discrete Wavelet Transform for Content-Based Image Retrieval	The use of DWT is playing a significant role in CBIR.	Research is not playing any significant role in medicine.

Table 1: Comparative analysis of previous researches to proposed work

3. Methods

The following is an illustration of the research methodology:

1. Load an image.
2. Perform preprocessing on input image using resize, RGB 2 gray conversion, and edge detection.
3. Extract the image features using either GLCM.
4. Perform the matching of images with the database using the above features.
5. Detect the tumor based upon the feature extracted from the image.
6. Perform classification using ANN to find out the tumor and normal. Image.
7. Detect the shape (circular, elliptical, irregular) of the tumor
8. Evaluate the results.

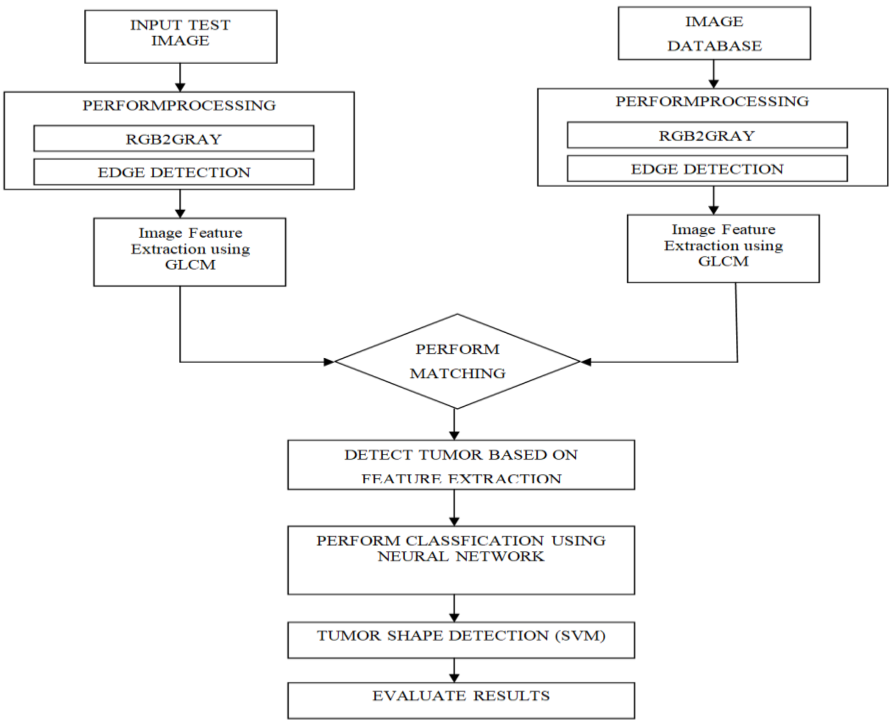

Fig 1 Proposed methodology of research

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4. Results

In this research the data set of 20 brain MRI with tumour and 20 brain MRI without tumor are considered. Figure 1 shows proposed methodology for research. 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 figure 2 and figure 3

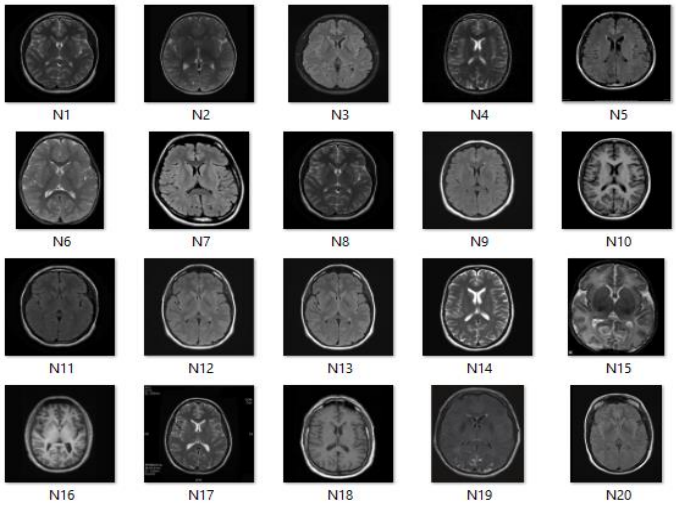

Fig 2 Brain MRI without tumour

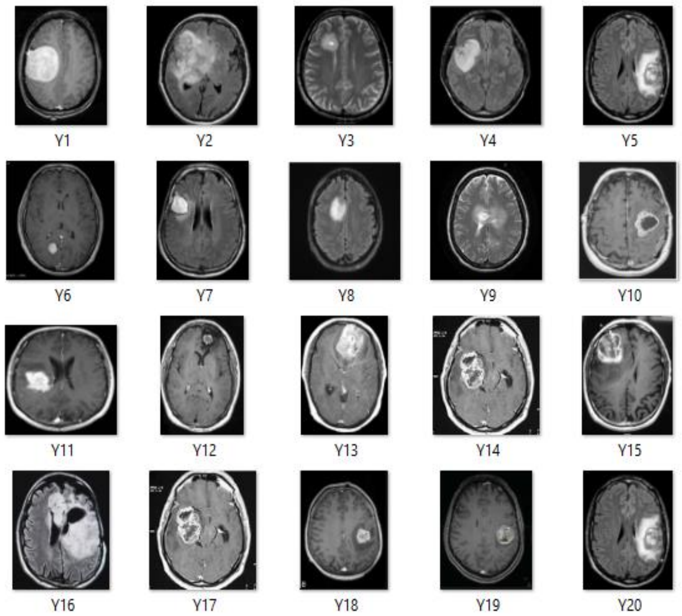

Fig 3 Brain MRI having tumour

During first phase the RGB2GRAY has been applied and edges are detected. After applying these techniques on images of figure 2 and figure 3 we get images of figure 4 and 5.

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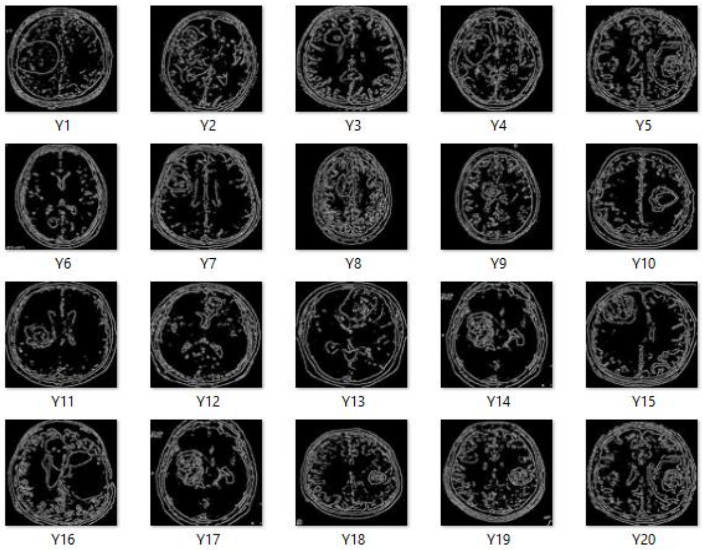

Fig 4 Edge based brain MRI with tumour

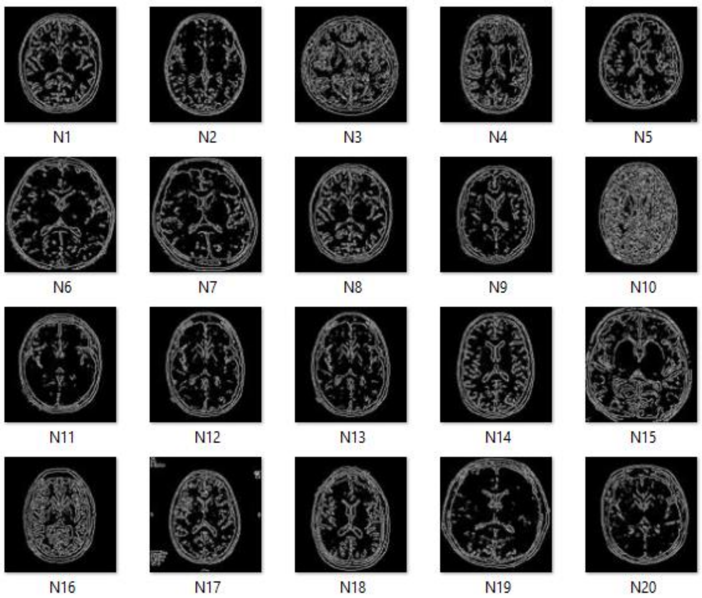

Fig 5 Edge based Brain MRI without tumour

Phase 2: The image features have been extracted using GLCM. The following tables are representing the features of Brain MRI with tumor and without tumor. 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 a tumor.

S.no.	Contrast	Correlation	Energy	Homogeneity	Smoothness	Kurtosis	Skewness	IDM
1	0.435764	0.09285	0.607125	0.883709	0.890527	4.694404	0.460843	-0.15898
2	0.453993	0.054151	0.639083	0.888296	0.729169	6.304705	0.501829	0.680174
3	0.434896	0.036505	0.582949	0.874638	0.914822	4.168461	0.396202	0.557832
4	0.489583	0.113039	0.613877	0.883174	0.904511	6.070685	0.69595	0.746885
5	0.398438	0.131882	0.614567	0.8852	0.810567	4.446784	0.444649	0.543984
6	0.413194	0.129255	0.624048	0.88928	0.744646	5.3691	0.529718	-0.5588
7	0.482639	0.0762	0.601862	0.878819	0.906426	4.830921	0.489745	0.894666

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8	0.548611	0.153019	0.639896	0.892115	0.922648	7.030279	0.773392	-0.00937
9	0.516493	0.116365	0.668942	0.898987	0.871464	6.66069	0.634977	0.352666
10	0.408854	0.115762	0.605243	0.886357	0.874947	4.856608	0.462817	-0.4731
11	0.451389	0.101732	0.581639	0.872352	0.93279	4.228783	0.367035	1.574925
12	0.486979	0.012166	0.627812	0.885692	0.902467	4.958986	0.554056	0.819571
13	0.46441	0.040003	0.586806	0.874219	0.890359	4.451043	0.347426	-0.69701
14	0.479167	0.056007	0.551716	0.860388	0.937585	4.3748	0.314446	0.997018
15	0.383681	0.151259	0.610757	0.888817	0.836894	4.521791	0.447669	0.934466
16	0.381076	0.131485	0.616312	0.890871	0.755755	4.820272	0.361828	0.525676
17	0.479167	0.056007	0.551716	0.860388	0.937585	4.3748	0.314446	0.997018
18	0.513889	0.052263	0.613257	0.881698	0.891827	5.395167	0.4981	0.311243
19	0.469618	0.108938	0.606091	0.880917	0.915269	4.805843	0.59786	0.311147
20	0.407118	0.108444	0.608698	0.88248	0.800853	4.65404	0.561991	-0.05706

Table 2 Feature extraction from Brain MRI with tumour using GLCM

Table 3 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.

S.no.	Contrast	Correlation	Energy	Homogeneity	Smoothness	Kurtosis	Skewness	IDM
1	0.473958	0.09768574	0.664634	0.898958	0.766670859	6.226466	0.624682	-1.31968
2	0.530382	0.05298304	0.661743	0.89673	0.857257546	7.306129	0.531203	0.31381
3	0.543403	0.09175557	0.595465	0.879485	0.936908263	5.744429	0.727869	0.55489
4	0.489583	0.14450487	0.689084	0.904528	0.883616588	6.64706	0.619116	-0.30281
5	0.473958	0.11352982	0.664047	0.901953	0.858787796	7.011935	0.584335	0.332117
6	0.428819	0.09053886	0.58456	0.876693	0.937423155	4.812347	0.317022	0.806933
7	0.453125	0.09263842	0.604219	0.88478	0.885049689	4.91021	0.493317	1.068364
8	0.473958	0.09768574	0.664634	0.898958	0.766670859	6.226466	0.624682	-1.31968
9	0.446181	0.16177939	0.675531	0.901707	0.7940044	6.720621	0.479124	0.649678
10	0.530382	0.10846907	0.645493	0.893996	0.903948458	7.188458	0.771313	0.625273
11	0.460938	0.09859494	0.664138	0.90217	0.853055531	6.849489	0.543263	0.00655
12	0.53559	0.06803016	0.649652	0.89294	0.863690443	6.746246	0.708508	0.727544
13	0.496528	0.08314209	0.659056	0.896238	0.728962804	6.784294	0.663605	0.098081
14	0.421007	0.17126269	0.654393	0.897815	0.88749887	6.354147	0.280156	-0.30688
15	0.476563	0.07470926	0.615179	0.884592	0.908529999	4.854403	0.512486	1.061627
16	0.512153	0.15866173	0.662955	0.897642	0.925658361	7.38174	0.816865	-0.08601
17	0.479167	0.09004879	0.607304	0.881481	0.92151214	5.748976	0.572516	1.437846
18	0.420139	0.22065862	0.67586	0.905787	0.889175503	7.071135	0.595961	0.393421
19	0.453993	0.04682749	0.598565	0.876389	0.895628576	5.043267	0.45476	0.971465
20	0.485243	0.10516169	0.624989	0.889149	0.880555485	6.21319	0.465925	0.029384

Table 3 Feature extraction from Brain MRI without tumour using GLCM

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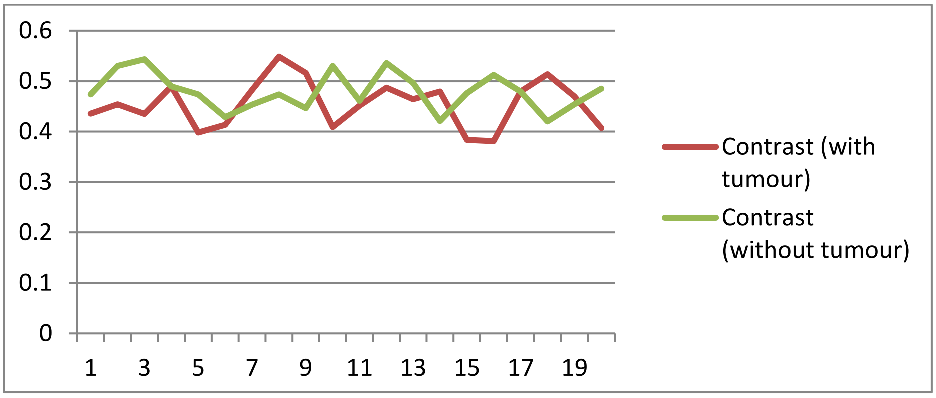

Fig 6 Contrast comparison in case of tumour and without tumour brain MRI

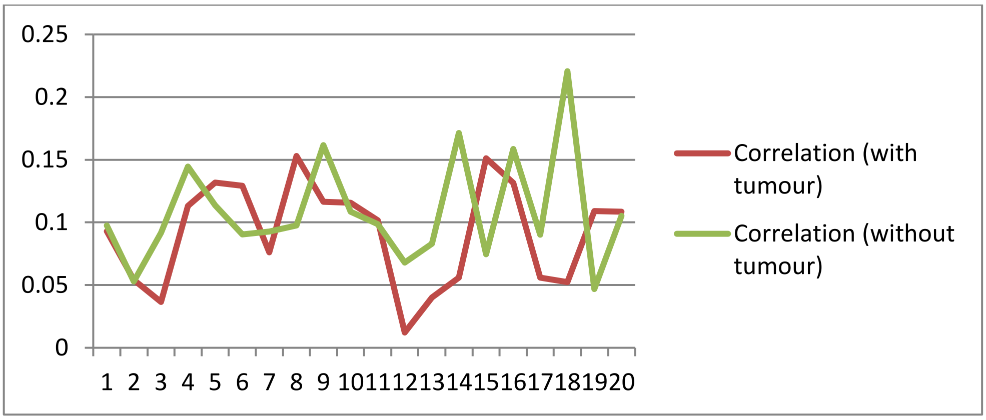

Fig 7 Correlation comparison in case of tumour and without tumour brain MRI

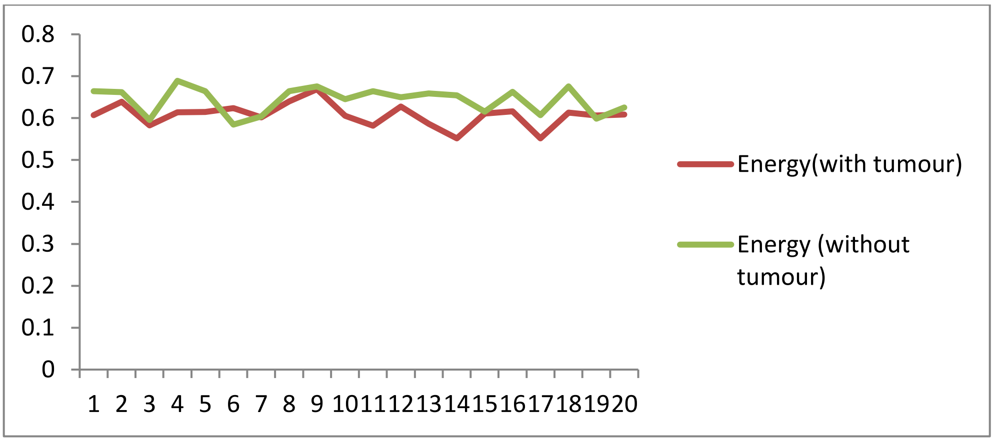

Fig 8 Energy comparison in case of tumour and without tumour brain MRI

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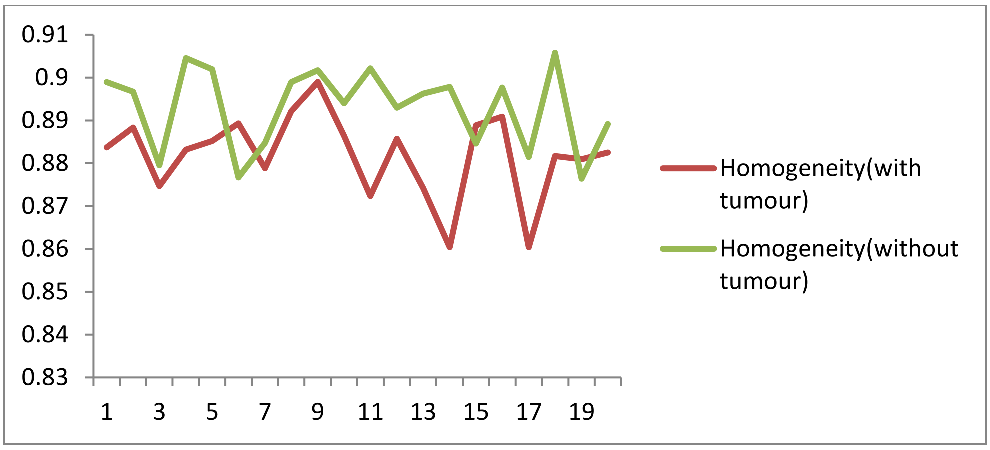

Fig 9 Homogeneity comparison in case of tumour and without tumour brain MRI

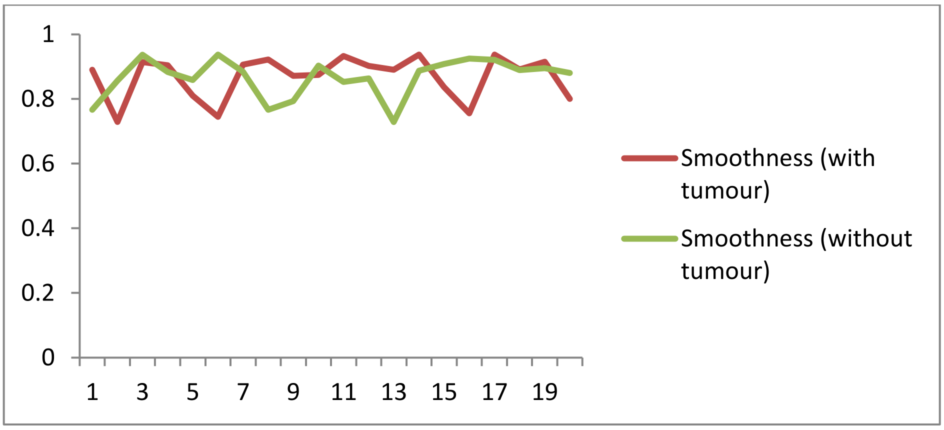

Fig 10 Smoothness comparison in case of tumour and without tumour brain MRI

In figure 6 to 10 various features are represented. On the x-axis image number is shown and on y-axis value of feature is represented. Figure 6 represents comparison of contrast between images having tumour and without tumour brain MRI. Figure 7 represents correlation between images having tumour and without tumour brain MRI. Figure 8 represents energy between images having tumour and without tumour brain MRI. Figure 9 represents Homogeneity between images having tumour and without tumour brain MRI. Figure 10 represents Smoothness between images having tumour and without tumour brain MRI.

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

Phase 3: After matching score is get by classification using a neural network.

A. Classification using Artificial Neural network

After performing edge detection and feature extraction using GLCM, the ANN was used in the study. An ANN classifier was used to determine the final score. Using score, we find the prediction rate. The amount of time it takes to classify is also taken into account. A comparison of time and score is shown in the following graphs, where ANN is applied directly to the MRI Brain data and ANN is applied to an edge-detected MRI Brain dataset. The classifier is used to calculate the score during this face. There are three stages to the score extraction process:

Part 1: Using an ANN classifier to get the MRI time and score

1. Select the appropriate 15 samples of brain MRI to get a score using neural network classifier
2. Capture sample one by one to step 10.

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3. Start timer
4. Set net = googlenet to check score
5. Set inputSize = net.Layers(1).InputSize(1:2)
6. Set image im = image(loop) from brain MRI data set where tumor exists
7. Resize image im as per input size
8. Get [label,score] using classify(net,im) function available in deep learning box
9. Set myData(loop)=max(score)
10. Stop timer and get time in time1(loop)

Part 2: A neural network classifier for edge-based Brain MRI

1. Select the appropriate 15 samples of edge-based brain MRI to get a score using a neural network classifier
2. Capture sample one by one to step 10.
3. Start timer
4. Set net = googlenet to check score
5. Set inputSize = net.Layers(1).InputSize(1:2)
6. Set image im = image(loop) from edge-based brain MRI data set where tumor exists
7. Resize image im as per input size
8. Get [label,score] using classify(net,im) function available in deep learning box
9. Set myData1(loop)=max(score)
10. Stop timer and get time in time2(loop)

Part 3: logging performance data in text files and displaying it graphically

1. Open the score.txt file in append mode by double-clicking on the file's icon.
2. MyData1, myData2, and image columns should be added to the score.tex file.
3. In append mode, open the file time.txt.
4. Type in time.txt the picture and the time1 and time2 columns.
5. Compare the scores in the two scenarios using a graph.
6. Draw a graph comparing the two instances of time.

Using the ANN classifier on MRI brain samples and edge-based MRI brain samples, the time spent for score identification is shown in table 4. When the score is derived using edge-based brain MRI, the amount of time it takes is reduced.

Image name	Time in case of brain MRI	Time in case of edge based brain MRI
1	3.011161	0.707244
2	1.045297	0.749927
3	0.89026	0.964407
4	0.886319	0.767049
6	1.055714	0.705567
7	0.748711	0.804787
8	0.795062	0.716111
9	0.796956	0.702643
11	0.896469	0.857854
13	0.767683	0.704331
15	0.721191	0.803197
16	0.732868	0.70397
18	0.739694	0.77072
19	0.714569	0.740143
20	0.783288	0.710614

Table 4 Time in case of Normal brain MRI and edge based brain MRI

Figure 11 shows the findings of Time for a normal brain MRI and an edge-based brain MRI, respectively.

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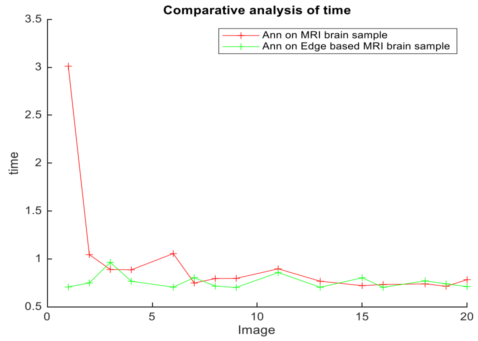

Fig 11 Time taken to get score case of normal brain MRI and edge based brain MRI

The score detected using ANN has been shown in table 5 in both cases. Edge-based brain MRI has shown that the score is constant.

Image name	Score in case of brain MRI	Score in case of edge based brain MRI
1	0.432402	0.290696
2	0.522135	0.290696
3	0.593821	0.290696
4	0.760772	0.290696
6	0.671561	0.290696
7	0.40286	0.290696
8	0.236506	0.290696
9	0.360588	0.290696
11	0.405508	0.290696
13	0.760421	0.290696
15	0.741908	0.290696
16	0.292378	0.290696
18	0.379015	0.290696
19	0.322316	0.290696
20	0.290696	0.290696

Table 5: Representing Score in case of normal and edge based brain MRI

Figure 12 plots the findings of the Score in normal and edge-based brain MRI cases, as shown in the graph.

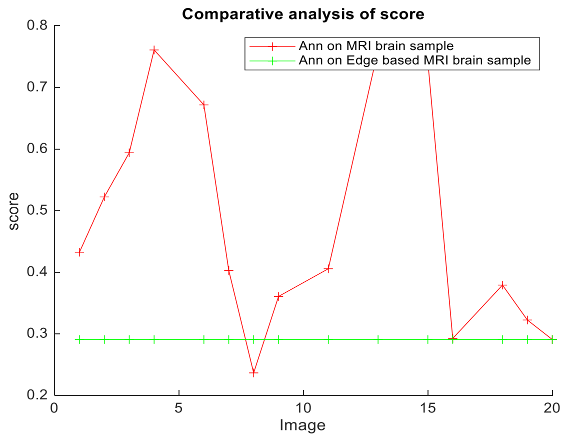

Fig 12 Comparative analysis of score in Normal Brain MRI and Edge Based Brain MRI

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The neural network has considered a mixture of 29 brain samples to perform classification.

The algorithm used to produce a list of shape, score and time corresponding to the image has been being as follow

Step 1: Start loop for 29 images where loop =1 and increment loop by 1 until it is not reached to 29 to step 10.

Step 2 start timer

Step 3 connect to google net and get layers in net

Step 4 Get input Size from net by getting Input Size (1:2) from. Layers

Step 5 read image im from mix normal directory

Step 6 Resize the image as per inputs

Step 7 get label and score using classy by passing input parameter im to net [label, score] = classify (net, im)

Step 8 store maximum score in myData(loop)

Step 9 if label is'Petri dish' then set label1 (loop) =1 otherwise set label1 (loop) =0

Step 10 Stop timer and store the time is taken to perform classification in time1 (loop)

Step 11 Write the label1 (loop), my Data(loop), time1(loop) in “neuraloutput1.txt” file

Table 6 represents values for score and time.

Image	**Shape**	**Score**	**Time**
1	0	0.321572	4.099466
2	1	0.432402	1.250955
3	0	0.299647	1.029706
4	1	0.522135	0.887103
5	0	0.531118	1.1573
6	1	0.593821	0.864274
7	0	0.639293	0.882844
8	1	0.760772	0.950518
9	0	0.388132	0.8362
10	0	0.671561	0.83694
11	0	0.430716	0.720237
12	0	0.40286	0.785333
13	1	0.366704	0.906765
14	1	0.803899	0.779148
15	1	0.846202	0.769962
16	0	0.194801	0.74991
17	0	0.935769	0.788355
18	0	0.746501	0.88989
19	0	0.354763	0.835564
20	0	0.503564	0.758429
21	0	0.236506	0.808028
22	0	0.360588	0.794799
23	1	0.405508	0.812468
24	0	0.760421	0.782395
25	1	0.741908	0.772224

26	0	0.292378	0.840777
27	0	0.379015	0.721751
28	0	0.322316	0.833845
29	0	0.290696	0.742628

Table 6: Represents values for score and Time

Phase 4: Tumor shape has been detected using SVM

After getting neuraloutput1.txt the SVM mechanism would plot the svm vector after detecting tumor shapes. The algorithm for SVM would get the score of tumor based and nontumor based images is discussed as follow:

Step 1: Open file 'neuraloutput1.txt' and get data in fid;

Step 2: Get column 1,2,3,4 from fid to C and Set the first column of C in a,

Set Second column of C in b, set third column of C in c, set the fourth column of C in d

Step 3: Define the input range x from 1 to 29

Step 4 set i=1 and perform increment in I by 1 to 29

Step 5 set y_orig(i)=i;

Step 6 plot considering y_orig(i) as y-axis considering x(i) as x-axis in blue color.

Step 7 if b(i)== 1 then set y_td(i)= y_orig(i)- (10*c(i)) then

plot considering y_td(i) as yaxis and x(i)as xaxis in red color to show tumour based images.

Otherwise sety_tnd(i)= y_orig(i) + (10*c(i))

plot considering y_tnd(i) as yaxis and x(i)as xaxis in green color to show non tumour images.

Step 8: Set title 'SVM based shape detection (Score)'

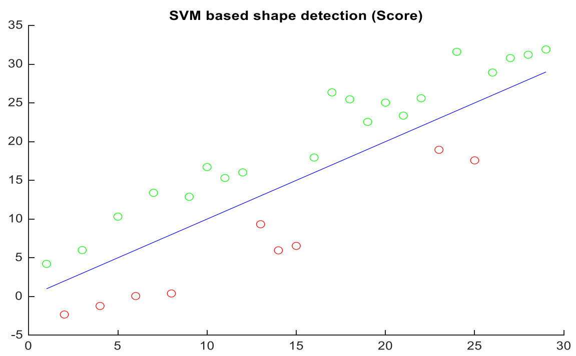

Fig 13 Plotting for score using SVM

Figure 13 shows the result of score using SVM

The algorithm for SVM would get the time of tumor based and non-tumor based images is discussed as follow:

Step 1: Open file 'neuraloutput1.txt' and get data in fid;

Step 2: Get column 1,2,3,4 from fid to C and Set the first column of C in a,

Set Second column of C in b, Set the third column of C in c, Set the fourth column of C in d

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Step 3: Define the input range x from 1 to 29

Step 4 set i=1 and perform increment in i by 1 to 29

Step 5 set y_orig(i)=i;

Step 6 plot considering y_orig(i) as y-axis considering x(i) as x-axis in blue color.

Step 7 if b(i)== 1 then set y_td(i)= y_orig(i)- (10*d(i)) then

plot considering y_td(i) as yaxis and x(i)as xaxis in red color to show tumour based images.

Otherwise sety_tnd(i)= y_orig(i) + (10*d(i))

plot considering y_tnd(i) as yaxis and x(i)as xaxis in green color to show non tumour images.

Step 8: Set title 'SVM based shape detection (Time)'

Figure 14 shows SVM based shape detection considering time.

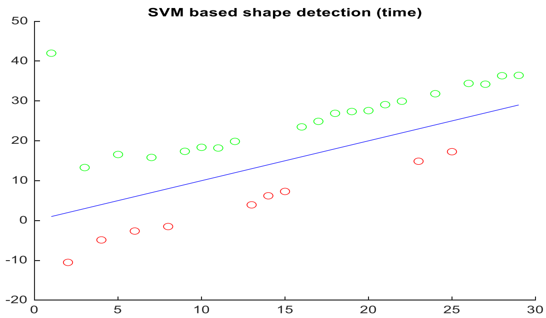

Fig 14 SVM based shape detection considering time

5. Conclusion

The result concludes that the process of extracting features using GLCM is quite challenging and the neural network has provided a flexible approach to perform image classification. It has been observed that the homogeneity, energy in case of the tumor is low as compare to homogeneity, energy in case of no tumor maximum times. The edge-based images took less time during the classification process. The classified image having their score and classification time are stored in a list to allow the SVM mechanism to detect shapes and plot them accordingly. The distance of plots is depending on the time taken and their score. It has been observed that the homogeneity, energy in case of the tumor is low as compare to homogeneity, energy in case of no tumor maximum times.

6. Future Scope

Such research would be significant in the field of medical image processing. This research has proposed a flexible approach to classification and shape detection. The use of GLCM, neural network, and SVM is found quite challenging work. Still, research has improved performance of shape detection. Use of neural network with edge detection is allowing the fast decision making considering image shapes. This research could be useful in projects where quick detection and identification of a graphical image is done on frequent basis.

Conflicts of Interest

There is no conflict of interest.

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