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A Review on Diagnosis and Decision in MRI Analysis

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Abstract:
Automation has gained a large attention in recent past. The dependency of medical diagnosis on expert and limitation of available diagnose tool, has bound the medical analysis to manual level operation. In medical diagnosis, where the monitoring is critical, initial level diagnosis and alarming can save an individual from going to a critical level. In recent past developments were made on atomizing the preliminary and diagnosis analysis of medical data in early stage alarming, minimizing the cost and initial expert dependency. Towards improving the performance of such system, advanced learning and decision system such as the artificial intelligence is also been incorporated. This paper, outlines the development made in past with the objective of MRI analysis for diagnosis and alarming using automation tools and advanced learning system.

Keywords: *Medical image processing, segmentation, classification, diagnosis and MRI image analysis.*

I. INTRODUCTION

Brain tumor is a major concern in medical field due to its criticality of observing the tumor region and making a decision based on it. The diversity in tumor representation wrt. shape, size, texture with its random pattern of representation leads to making the diagnosis more complex. Due to higher level of observation and large factor of analysis for disease detection, time for diagnosis is increasing. As well, the accuracy of radiologist's detection is more dependent on the expertise of the individual. The approach of automation has given the significance of faster and accurate decision of suspicious region in brain tumor detection. The techniques in the field of medical diagnosis have evolved to many new developments in recent years. Computer aided designs are used as an effective tool in tumor detection and investigation. With rapidly changing lifestyle, the risk of various health hazards is increasing day by day. Brain tumor is one of them and can be defined as the unnatural growth and division of the cells in the body. However, tumors are detected or diagnosed at a later stage of their development, which reduces the chance of treatment and can be very critical in some cases. Early detection of tumor plays a very crucial role in their treatment possibilities. MRI gives the highest possible detail about the shape, size and location of tumor which helps in diagnosis. The advantage of automated MRI processing has given a possibility of early brain tumor detection. The constraint of time delay in processing, Feature representation, segmentation and decision making reduces the detection efficiency. The volume of features representation, and the accuracy of image data, effects the computation time and processing effort in automated MRI diagnosis. The overhead of feature representation and complexity of decision making, motivate in developing new approach for automated diagnosis of MRI sample.

Among various analyses of medical scan information, MRI analysis for brain tumor

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detection is observed to be an upcoming work. Whereas automated systems have an advantage of time-saving in diagnosis. The accuracy of detection and complexity of coding is still a concern of development. For processing of MRI sample using new advanced system for tumor detection various approaches were suggested in past. In [1] a magnetic resonance spectroscopy (MRS) was presented for brain tumor detection. The approach follows the grading of brain glioma using pathological data for the metabolic decision of brain tumor. In [2] a meta state analysis sot categorize tumor detection is presented. A deep learning is developed in distinguishing the brain tumor stage. New approaches of MRI analysis using quality improvement needs in MRI analysis is defined in [3.4].

The stage representation of tumor developments leads to the accurate training of the diagnosis system. The brain diagnosis and disorder for automated tumor detection is been presented in [23]. The comparative analysis of the present cancer detection and the advantages and limitation to the present system is been outlined. The presented approach also defines the feasibility of presented approaches for tumor diagnosis. The feature representation of brain tumor in spatial domain is presented in [24]. A

mutual information (MI) is presented for the computation and representation of the spatial feature. In [25] the spatial similar feature for 3-D MRI sample is presented. The process of image feature extraction and registration is outlined. the introduction of distortion in the registration process leading to mis-registration is outlined. In [26] the study of brain anatomy and its analysis for studies of tumor detection is presented. The approach gives an extensive study on the study of anatomy of brain structure, tumor character analysis and tumor diagnosis.

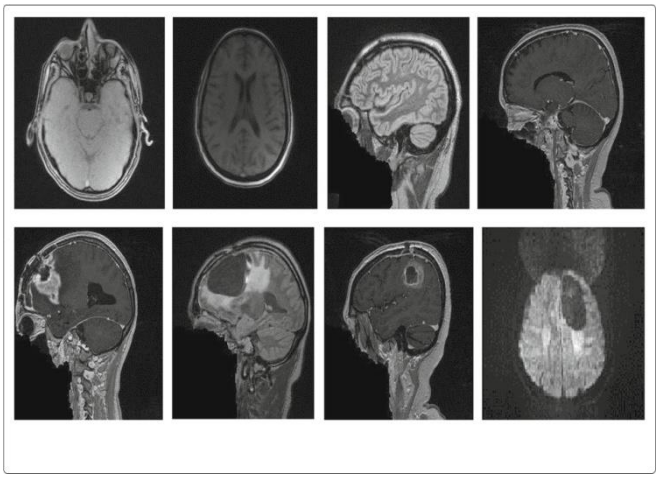

Fig3. [62] Representative Images from the MRIs database used in the tumour detection phase (a) Normal MRIs without brain tumours are in the top row (b) abnormal Images with brain tumours present are in the bottom row.

II. AUTOMATION SYSTEM

In recent years the effect of brain tumor has increased. The diagnosis of the brain tumor has demanded for huge number of expert and diagnosis tool in detection and analysis of the disease [3]. Brain tumor is defined as a non regular expansion of a brain cell. This growth could be a cancerous or non cancerous expansion. Human observations has a constraint of accurate observation leading to a misleading decision of detected region. The issue of similar resemblance of effected and non-effected detected region tends to the misclassification of tumor region. The problem becomes more complicated under cancer predictions, especially in brain cancer.

a) Region Segmentation

Region segmentation is the initial stage of a MRI image diagnosis. Here the MRI samples are processed for region marking and region segmentation. The regions are marked based on a predefined marking constraint. For the segmentation of the tumor region in a MRI sample, a watershed based segmentation approach is defined in [27]. The approach shows the ability of segmenting the required and non-required region in the tumor region segmentation based on the detection of pixel based coding using

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watershed approach. The method process on the surrounding region coding and the region involved in the process. For segmentation in [28], a graph based technique for region detection is presented. the proposed approach gives an approach of markovian approach to image segmentation using a pair wise coding of region segmentation and registration process. The approach is developed based on a pattern classification problem, where the registration process is performed using the maximization of similarity index among the region of segmentation.

Different methodologies for data analysis and decision making were developed outlined in [29], which process on large dataset for learning and making decision applicable to medical filed. In order to summarize and analyze the brain tumor's automatic detection methods through the magnetic resonance image (MRI), in [30] various steps of computer-detected detection (CAD) system are presented. Brain image classification was studied. [31] One way of rating in signal to detect primary brain tumors, combined with multiple wavelets and synthetic neural networks. EEG signal is processed using unconsciously almost energy. This observation leads to the detection of EEG analysis based tumor. In [32]. The images of the MRI scan of the brain exhibit Matlab procession to extract the exact region of the brain tumor. It also includes noise removal functions, side and therapeutic processes that are used for image coding of MRI. In [33] to analyze dose control of tumor detection of MRI, a automated MRI diagnosis using atlas-based coding (MRI-ABAS) is suggested. The MRI-ABAS procedure is developed based on grey matter ratings and atlas -based areas of interest approach.

b) Learning Approach

The autonomy of the study self-determination rating is described in this work. In [34-36] the artificial neural Network (NN) was used by the Progression Network (BPN) and the probabilistic neural Network (PNN). The outlined method developed a rank based analysis of MRI tested over different patient data having Astrocytoma brain tumor. Image processing techniques have up come detect tumor in medical images. Ground level shared matrix (GLCM) is used to exclude. In [35] Artificial Bee Colony algorithm is attempted to summarize the tumor using Fuzzy-C-Mine Clustering for noise free processing of MRI samples. A basic learning model for a automation system in MRI diagnosis.

In [36] an assessment of current research using data mining approach in diagnosis of brain tumors. The process of data mining using different intelligence logic is been developed for medical image diagnosis. The image has a reference clinical significance and used with high end intelligence approach such as the fuzzy-c-mean approach, multi-peripheral coding. The conventional data mining approach finds it suitability in performing the search and detection of tumor region in MRI sample.

c) Representation

For the MRI analysis, a rank based approach following DCT and DWT is outlined in [37]. The approach illustrates a transformation based approach in MRI image processing. As a brain tumor network in integration with probabilistic neural network (PNN) is different. The system was described in three stages for brain tumor diagnosis. In the first phase, MR images were captured and a pre-processing is carried out for noise removal and to improve the visual quality of the image. Secondly, a Feature extraction using DCT and DWT is developed and probabilistic neural network (PNN) using Radial basis function (RBF) is used for the classification of the brain effect. Finally, analysis of tumor detection using DCT and DWT and performance parameters using sensitivity and precision.

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Useful of pre-processing and post processing measures have been presented in a useful view in [38] for accurate operation in tumor detection. Six different modes of processing a large scale for measuring area is applied to MRI images. For an accurate detection of tumor region a hybrid approach of tumor diagnosis is outlined in [39-41]. The proposed approach attains 99.93% of accuracy for trained data and 99.16% for a new analysis. Different of type of tumor effects in human brain are used in diagnosis with slice images from MRI scanners, image processing techniques are used to use clear anatomy of brain tissue.

A new hybrid self-organizing map (SOM) applied with the Fuzzy K Means (FKM) algorithm, which offers good identification of tumor successful identification and tissue areas within brain tissue is outlined. In [42, 43] extensive literature on the approach of developed medical testing for existing methods on tumor detection and its cure is presented. New approach of analyzing tumor cell using image professing is outlined in [45,49]. A multi model approach of image coding based on multi scale coding is presented. A multi way tensor model for relatively smaller region called atoms is developed. In [48-51], focus on the surveillance of tumor detection algorithm that is suggested to detect Tumor's location is presented. The focus is being made on using the image acquisition of brain tumor detection for region of interest segmentation. These approach use MRI images in scanned format to detect tumor in a MRI image. The differences among some of the leading techniques were outlined. In [52-54] Magnetic resonance imaging using a signal-image post processing approach is developed using a intensity curvature measurement method.

The diagnosis of MRI sample using the curvature process is developed. The brain diagnosis is performed using the functions of the MRI's post processing models namely;

(i) Bivariate cubic polynomial,

(ii) Bivariate Lagrange polynomial,

(iii) Monovariatesinc, and

(iv) Bivariate linear.

The outcome shows that the conventional approaches of curvature function and signal resilient depends on the signal interpolation and severity to improve the additional information useful for diagnosing for MRI. In [55] DB-4 wavelet is used in extracting the characteristic of MR images. Due to the extraction of finer contrast, it easily reduces the signal variations of an image and reduces the overhead. PCA is applied for the selection of best features for rating. This PCA result is given as input into the SVM selected features for classification.

Two SVM kernel functions, linear and radial basis kernels are defined. These past developments have shown various significant results for automated diagnosis and recognition. However, the learning capability is yet low due to limited feature description, lower filtration efficiency and slower classification process. To overcome these issues, a new intelligent system is outlined. In the medical domain, no loss of information due to coding can be affordable, because conventional compression can distort some information needed during processing, or may include distortions which direct for a diverted reconstruction [56]. In medical image compression, lossless compressions are more preferred due to the need of diagnosis performance. The conventional wavelet transformation [57] approach for lossless mode, are unable to recover the actual image data back.

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The quantization error developed during the coding process minimizes the accuracy of the coding. The application of lifting schemes [59] certainly allows lossless integer-to-integer coding. In recent years, the new reversible coding developed using a wavelet-transform lifting scheme [58], was very popular for lossless image compression. The constraint of developmental transmission capabilities makes it less suitable for large applications like telematics for interactive applications in large network. Embedded coding [60] allows the development of compact databases, which immediately requires standard construction after the start of standard image coding. Embedded coding [61] development for streaming medical images are very important for compression, because an image can be stored by retaining the image integrity. In addition to compression, safe transmission improves the accuracy of diagnosis. The analysis of data bits by enquiry makes accurate evaluation a evaluating task. Medical researchers are putting inevitable efforts to provide valuable details with maximum degree of safe coding in medical image.

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III. OBSERVATIONS

Table 1: Summarized observation for the developed approaches MRI diagnosis

Reference	Approach	Method	Performance
[1][6]	MRS of brain tumor	Diagrammatic representations	**70-80%**
[2][5]	Identification of primary tumors	SIMCA Classification	70-75%
[7][8][9][10] [20] [21][11][19][34]	Treatment of Brain Tumors	Ultrahigh Field MRI	85%
[14][15]	Radiotherapy for primary brain tumors	Automated delineation of brain structures	75-80%
[28],[38],[39],[43]	Computer-aided diagnosis	Embedded Image coding	70-85%
[29],[36],[49],[53] [56],[60]	Classification of Tumors	Wavelet and Support Vector Machine	75-86%
[45],[52],[58],[59] [61]	Multichannel image processing	Vector median rational hybrid filters	70-88%
[3],[4]	Malignant brain tumor analysis	Invasion Precedes Tumor Mass Formation	75-85%
[12][13]	Tumor detection	EEG Signal Wavelet Transform	70-80%
[16][28]	Tumor Location and size Identification	Fuzzy C-Clustering and Artificial Bee Colony Algorithm	80-85%
[17][18][22]	Classification Of Brain Tumor	DWT, PCA and Probabilistic Neutral Network	75-88%
[23][24]	Classification Of Brain Tumor	Probabilistic Neutral Network	75-90%
[25][27]	Detection Of Brain Tumor	Mining fMRI Images	70-80%
[30][31][37]	Brain Tumor Detection	Deterministic And Probabilistic Method	65-75%

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IV. DISCUSSION

Among the developed research made on the development of automated brain tumor detection based on advanced image coding and signal processing techniques. To improve the accuracy in such coding, artificial intelligence is being incorporated wherein new developments were made towards brain tumor automation in detection, and intelligence logic was proposed following neuro modeling, fuzzy logic etc. Such methods are more accurate in decision- making. The accuracy of the system depends on the processing sample. Algorithms have been used for representation and approach of classification for decision making. To give an advantage of higher retrieval performance, an effective model of processing, representation and classification is required. The problem of system noise during testing, and the effect of spatial similar regions in the image observed to be difficult in detecting the actual region for diagnosis leading to misclassification.

This problem degrades the accuracy of estimation performance and hence minimizes the robustness of the automated processing unit. Medical images are to be processed for noise filtration before passing to feature extraction and decision-making. As the diversity in medical image is large, maintaining the accuracy of decision for noise reduction during filtration is needed. Image filtrations applied to medical images are effective to the content, however the edge regions are more effective at edge region. The degradation of image due to noise impact the feature extraction and minimizes the accuracy of the automation system. Different format of scan data such as CT, PET, MRI, fMRI etc., are used as an input data. These are highly variant and the feature extracted depends on the mode of capturing and filtration approach. The approach of filtration applied impact the compression performance. Current compression or processing approach introduces processing distortions which are to be eliminated for accurate processing. The variability of noise characteristics limits the image filters in removing all kinds of noises in variant environments. The noise impact increases the coefficient count, leading to high overhead over processing system, which demand for a large memory requirement and computation power.

Even with the effective processing of image coefficients, the non-effective representation of image coefficients lead to heavy representing coefficients which result in very low compression and demand high data rate to provide quality service in medical sample processing. For the remote usage of medical diagnosis, tools demand a large resource make the application incompatible to portable remote usage device. The offered quality of service (QoS) in this case is low, decreasing the decision accuracy. These problems need to be minimized for an effective processing of medical image sample in remote applications. A system architecture of the recognition approach for the tumor detection and classification is shown in figure 3.

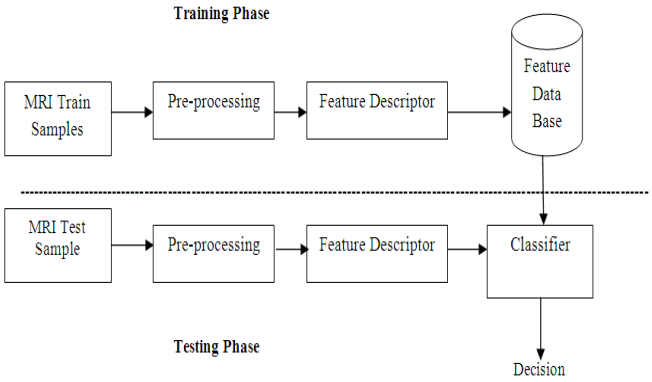

Figure 3. Automation MRI diagnosis framework

The suggested architecture constitute of a pre-processing, region localization, feature extraction, mapper and classifier unit. The pre processing unit process on the formatting of uniformity in image dimension and performing a gray level extraction from the MRI sample. The image is processed for filtration to eliminate noise in the preprocessing unit, so as to process on a distortion free sample. Wherein methods were focused for image segmentation, the localization of the suspected

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region in the MRI sample is less focused. Localization of region of interest is a critical task, and its accuracy of localization depends on the sample given and the process been followed.

The suspected region of interest are extracted using different image processing algorithm and the segmented regions reduces the processing overhead of feature extraction and classification unit. The classifier unit is used as a decision model, where the features extracted are pruned to given the most accurate decision on the test sample. In the classifier model, SVM classifiers are mostly used due to its simpler processing in implementation and accurate decision. This system interface has a advantage of minimizing the diagnosis time, and an early prediction of tumor regions in a MRI sample. The past development has focused on segmentation, representation and classification, however, the need of higher accuracy in the decision is an open challenge. The semantics representation gives the limitation of region identification and leads to a miss classification. Hence, the development of new approach for automation learning and decision system having higher accuracy and precision is needed. The future development of this work, extend in developing new approach of MRI segmentation and classification process in medical diagnosis.

V. CONCLUSION

The past development in the area of medical image processing is explored and the review reflects the development made towards MRI segmentation, representation and classification performance. The issue of tumor identification in brain are critical as a later stage detection or diagnosis is always a risk. The automation system developed were integrated with advanced mathematical and intelligence approach of segmentation and classification process. The advanced feature representation has a benefit of lower dimensional and accurate feature representation. However, the review reflects the limitation of overhead, accuracy and latency in terms of processing data, input approach and the decision models used in MRI diagnosis.

The limitation of the existing diagnosis system are to be focused onto the development of low complex, faster processing filtration operation in MRI processing. The accuracy of region localization and segmentation are to be focused. Feature representation has a crucial need, where a larger feature count leads to processing overhead, a lower feature value leads to lower decision accuracy. The bottleneck of feature representation and selection has to be overcome. The need of improved classifier is one more objective to be focused in medical image diagnosis. These limitations are to be improved for image segmentation, feature representation, and classification in automation of MRI image processing for improving the efficiency of decision making in tumor analysis.

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