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A Novel Hybrid Feature Selection and Classification Approach for Medical Brain Tumour MRI Images.

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ABSTRACT

Nowadays healthcare industry acts as an important role in human life. This paper presents a new and complete framework for medicinal dataset analysis scheme for the brain tumour feature selection and classification process of MRI images, it play a vital role in radiotherapy. Brain tumours are large variety in shape and appearance with various intensities. Normally medical images are noisy and complex in nature, to pre-process it like, de-noising, segmentation, feature extraction, selection and classification processes. However, the medical images may bring a lot of replica information, so it leads to extra processing time and even degrade the classification accuracy. The biggest challenge for the research community is how to make utilize of the complex images. The reviews tell, computer aided tumour prediction system of human brain images are quiet an open problem. Based on the review we proposed a new hybrid modified machine learning method with integrated feature selection for detecting the tumour in MRI images. The expected results will give accurate, robust and possible to give proper direction for medication within short span of time.

Keywords: *Healthcare, framework, segmentation. Feature selection, classification, machine learning.*

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INTRODUCTION

Brain is very sensitive, complex in nature and it control the overall functionality of the human body. If any injure in the brain will affects the human body functions very badly. Human brain is protected from the direct view of the skull; it gives protection from severe injuries. Normally brain can be heavily affected by a tumour, which causes damage in structure of the brain from its normal and behaviour. Brain tumour is unwanted growth of anomalous cells, which are there in the brain. The unwanted growth of the tumour cells affects the normal functions of the brain, which causes the tumour cancer death among human beings. The brain tumour diagnosis is very challenging task because erroneous diagnosis will leads to severe trouble. Each brain cells of human body surrounded together in complex way and structure of the brain internally highly complicated. In most of the research developed countries shows that the number of people passes away due to brain tumour, survey says. Early prediction of the brain tumour is very important and motivated task.

The various medical sources gives huge amount brain tumour affected medical images for processing. In medical brain images, there are three types are familiar, such as magnetic resonance images (MRI), computed tomography (CT) and positron emission tomography (PET) images which helps the doctors and the researchers for analysing the human brain functionalities. Among those, MRI images gives clear and contrast view of the brain tumour but it need to predict the amount of affected area in the brain, so that by using computerized image processing methods will provide enormous help for analysing the tumour area and for giving proper medication in right time. Past few decades, to predict the brain tumour by the help of computer-aided detection (CAD) is growing rapidly.

The research studies say that technology and CAD systems provide improved results in predicting the brain tumour by the radiologist. The computerized medicinal image study and machine learning methods gives great help for fast diagnosis of brain diseases. Normally, there are three types of CAD system result lies such as, normal, benign and abnormal. There are many techniques used for developing a CAD system. To create such a system it require various integration of image processing operations like, image de-noising, segmentation, feature extraction, feature selection and classification are very important. There are numerous techniques available to perform brain tumour detection. The classification of medical brain image is vital role in research, in which it requires different image features for grouping the given input image like, normal, benign and malignant.

RELATED WORKS

The medical image acquisition made from mammography image analysis culture and screening mammography image's database is digitized. The pre-processing, median filter used for noise removal, segmentation process region growing methods helps in great way and features extracted using gray level co-occurrence matrix and the appropriate features are extracted with help of genetic algorithm [1]. The breast tumour was detected and classified based on the region growing with genetic based algorithm and artificial neural network, which give accurate result significantly.

The noise removal from a brain image was made by the help of fast discrete curve-let transform and image features are extracted by help fuzzy c-means with the help of hypothesized number of clusters. Additionally, these features are compared with first order histogram and co-occurrence matrix's extracted features [2]. Finally, the brain tumours are classified by using the proposed methods of genetic algorithm with support vector machine they give accurate diagnosis of the diseases.

The authors [3] proposed, local independent projection-based classification algorithm for efficient classification of human brain images in to different groups. Intensity based methods like contour, graph-based global optimization approach; k-means are used to segment the brain images in an efficient way for further process. A patch-based technique helps to extract the image feature and selected the correct features from extracted which gives perfect result in classification.

Computer-aided detection helps to enhance the diagnosis of brain tumour and it reduce the time required for diagnosis. The author [4] discussed various methodology used in previous research, from those methods feedback pulse coupled neural network used for segmentation process and the discrete wavelet transform helps for feature extraction process of medical brain images with principle component analysis

helps dimensionality of the wavelet coefficients get reduced. To classify the brain images either normal or abnormal by using feed forward back-propagation neural network techniques and it gives significantly good.

There are two significant aspects of feature selection, first one is to minimize the redundancy of the extracted features and second is to maximize the relevance of the selected features. [5] The researchers are use this for dimensionality reduction and feature minimization for various kinds of learning, improving diagnosis efficiency and increasing the directness of the process. The classification process is highly depends with feature selection, which selects a subset of highly relevant features from the extracted original feature set. Sometimes feature extraction process creates new features based on the combinations or transformations of the original features set, those features also considered for features selection process.

The author [6] says, prioritization means interestingness over the medical images for analysis, which gives better outcomes. This approach can help clinical experts to easily determine the required information of the brain image. Due to this method the amount time required for image acquisition and processing time get reduced greatly.

The brain images are huge diversity in shape and intensity look, multi-spectral methods provides complementary data to determine some of the ambiguities. For labelling the brain tumour in images are highly time taken process and different experts have different opinion on the brain structure. A lot of supervised and unsupervised learning methods are used to classify the brain tumours images into various groups. [7] The criterion based on kernel group the data, can be non-linearly mapped into a high dimensional kernel space, which are more expected are grouped into different classes.

The proposed projected classification (PROCLASS) algorithm [8], which classify the brain images into three different classes of labels little bit accurately like, normal, benign and malignant of the identified diseases. Various features are extracted from brain images using spatial gray level difference method and those features are listed out. By using correlation based feature selection algorithm helps to select the highly relevant features are taken out from the extracted features list with the aid of feature subset selection algorithm.

The author proposed the new approach based on content based image retrieval technique for efficient image classification [9]. The global image features extracted using gray level co-occurrence matrix and discrete wavelet transform, which gives all kinds of features within less amount time. Finally, the outcomes are compared with all methods which exist; it gives better results in terms of classification.

The images are generated in CT is higher in tissue variance and it have fewer artifacts. The brain tumor images are efficiently segmented based on region of interest. Image features are extracted by using the combinations of discrete wavelet transform and principle component analysis and feature selection process gets removed the irrelevant features from the extracted features. The k-nearest neighbors with support vector machine based machine learning algorithms are used to classify the given input images in efficient, accurate and fast manner [10].

The machine learning based probabilistic neural network-radial based function [11] helps to predict the brain tumor area accurately and labeled it. Medical brain images are segmented based on morphological filter with the help region of interest for reducing the computational time. The features extracted using multi level discrete wavelet transform and the extracted features are selected based fisher discriminant ratio which gives highly relevance to detect the brain tumor.

PROPOSED SYSTEMS

Problem Statement

Classifying the brain tumour images from the medical database is a challenge, as these images pertained complex features in nature. This project work proposes a new method to improve a method of classification by selecting the optimal features based on relevant for identifying tumour area accurately.

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System Architecture

The overall system architecture consists of the following components, image acquisition, de-noising the images, segmentation, feature extraction, feature selection, classification and performance analysis of the medical brain images, which are shown in Figure 1.

The image that is acquired is totally natural and is the after effect of whatever equipment was utilized to create it, which can be imperative in a few fields to have a reliable gauge from which to work. There two different ways to do this process, first is to acquire the images directly from medical equipment and second is to acquire images from medical repository. The images are acquired from The Cancer Imaging Archive. But, these images are not quality one for processing so, it need to pre-process it using curve-let transform.

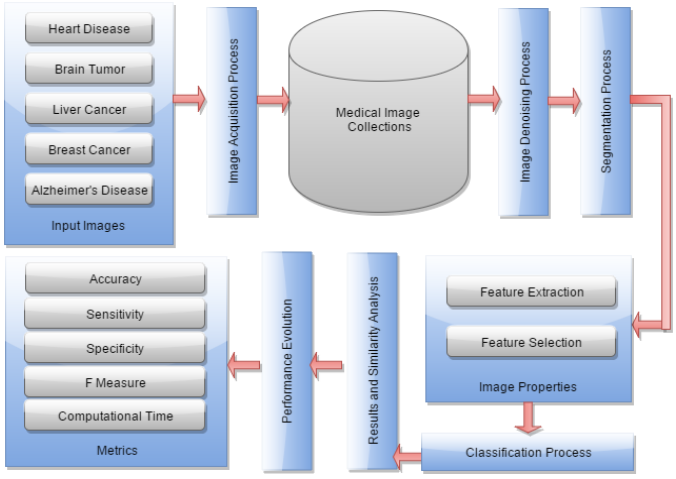

Fig. 1 Overall system architecture

Algorithm

Begin

Initiate feature vectors generation

For (Each feature vector) do

Calculate the fitness value for each feature in vector space

$$Fitness\ value(\alpha,\beta) = \sum_{\alpha}\sum_{\beta} pdf(\alpha,\beta)\ log\left(\frac{pdf(\alpha,\beta)}{mp(\alpha) * mp(\beta)}\right)$$

If (Fitness value >= 0.002) then

Select the best feature in vector space

Apply cross and mutation over operator among selected best features

End if

End for

If (best features) then

Classify the feature vector space into different classes

End if

End

Algorithm 1. Hybrid Technique

The research is being done since decades still there is no significant methods that can be connected to each sort of images or which is generally acknowledged. There are different elements that influence the image

segmentation process, for example, homogeneity of images, spatial qualities of the picture progression, composition, image content. Because of all the above elements this segmentation issue still remains a noteworthy worry in the image handling and PC vision fields. But region of interest based segmentation technique will give promising result.

The feature extraction is a process for extracting all kinds of features from brain images. This process was done by the combination of discrete wavelet transform, Gabor wavelet and gray level co-occurrence matrix which gives better results. The objective of feature selection or dimensionality reduction is to isolate the unessential and excess properties from an information set. The measurement of the element vector will be lessened impressively. The many-sided quality is lessened and the execution can be expanded. We discover guidelines that have enough bolster worth and high certainty esteem we can dispense with a few inputs by the help of genetic algorithm.

The real worry of classification approach in imaging is the detachment of group construct exclusively with respect to basic properties of the image is very difficult. The classification of brain affected images from normal is challenging research; it will do by the help of k-nearest neighbour with support vector machine based neural network algorithms, which gives efficient outcome compared to active methods.

EXPERIMENTAL RESULTS AND DISCUSSION

The proposed hybrid technique was implemented successfully which is given in Algorithm 1 and it gives significant classification results compared to existing technique. The real time brain image database was taken for this experiment which consists of 50 normal, 50 benign, and 50 malignant images. Loading image sample for processing are shown in Figure 2. The pre-processing of dataset was done image de-nosing for enhancement, segmentation based on region growing and region of interest, relevant features are extracted using gray level co-occurrence matrix, dimensionality reduction was done using genetic algorithm and finally classification were did by the help of support vector machine which are shown in Figure 3 and Figure 4.

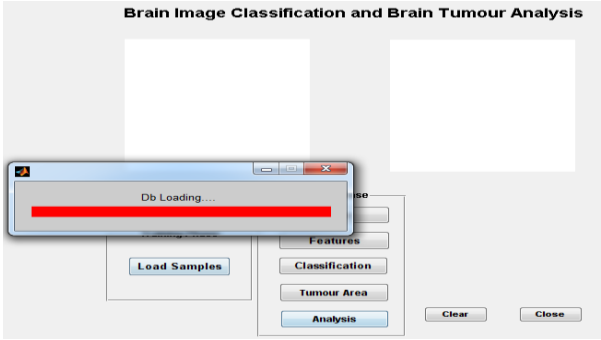

Fig. 2 Sample dataset loading

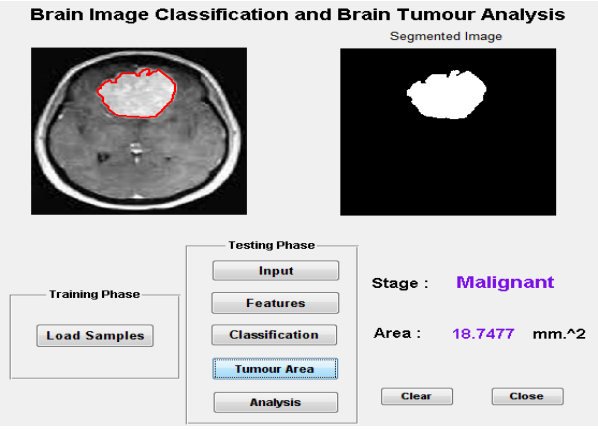

Fig. 3 Brain tumour identification and classification

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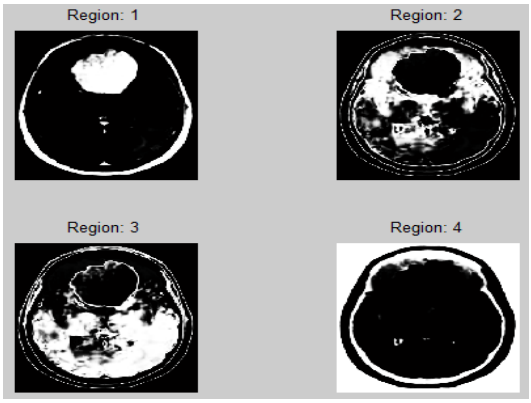

Fig. 4 Segmented tumour regions

PERFORMANCE ANALYSIS

Similarity measures helps to give the accurately classified and predicted brain images based on the performance metrics like, sensitivity, specificity and accuracy respectively,

$$Sensitivity = \frac{True\ positive}{True\ positive\ with\ False\ negative}$$

$$Sensitivity = \frac{True\ negative}{True\ negative\ with\ false\ positive}$$

$$Sensitivity = \frac{True\ positive\ with\ true\ negative}{True\ negative\ with\ false\ positive\ \&\ true\ positive\ with\ false\ negative}$$

Those classification values are calculated and tabulated in Table 1. The experimental results are shown clearly the about the classification accuracy in terms of normal, beginning and abnormal stages.

Table 1 Classification accuracy comparison

Methods	Accuracy (%)	Sensitivity (%)	Specificity (%)
k-NN	95.2	98.1	99.3
SVM	95.5	98.6	99.6
k-NN with SVM	95.7	98.9	99.4

The accuracy of k-NN with SVM gives 95.7% compared to k-NN's 95.2% and SVM's 95.5% which is shown in Figure 5. The sensitivity or recall value of the k-NN with SVM gives 98.9% compared to k-NN's 98.1% and SVM's 98.6% which is shown in Figure 6. The specificity or precision value of the k-NN with SVM gives 99.4% which is better result compared to k-NN and significant result compared to SVM's 99.6% which are shown in Figure 7. In overall our work will give considerably better solutions.

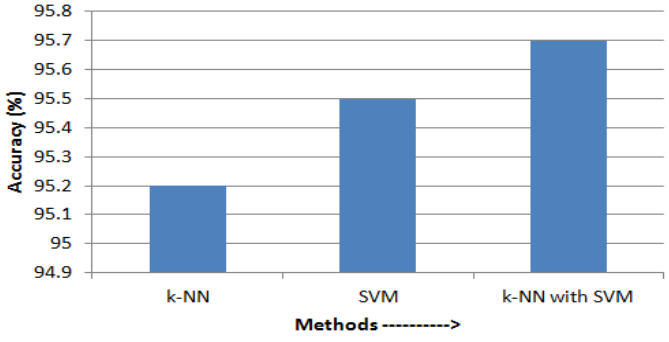

Fig. 5 Accuracy

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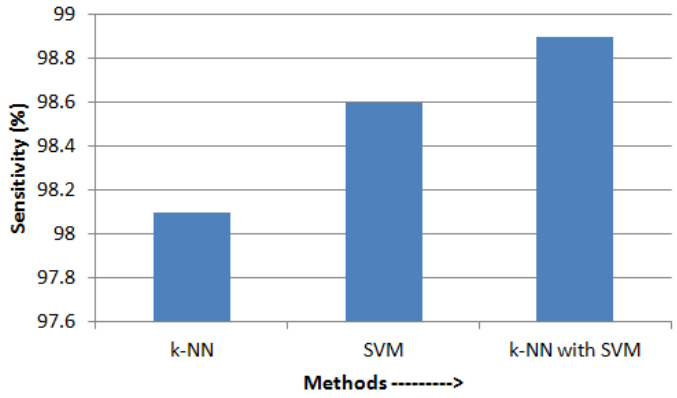

Fig. 6 Sensitivity

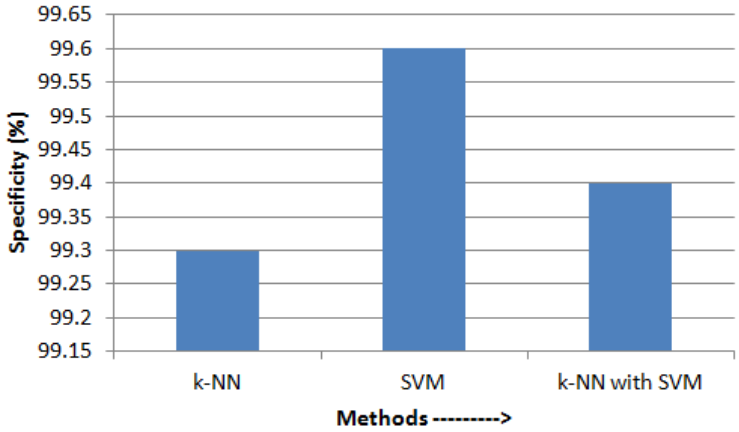

Fig. 7 Specificity

CONCLUSION

The classification of brain images was made based of optimal feature subset procedure which gives fundamentally better result for anticipating the tumour in brain and arranged into various stages such as, normal, benign, malignant. Brain images are segmented based on region growing and region of interest and dimensionality reduction is a important process will give highly relevant features from extracted. The early determination of the brain infections is conceivable by utilizing this new hybrid neural network technique and it is possible to detect, diagnosis the brain tumour in early stage itself.

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