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An Efficient Method Of Classifying MR Image Using Image Mining Techniques

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Abstract

Everyone know that today's world is digital world and we have use digital data such as video, audio, images, etc in various fields for various purposes. Generally, the word 'image' plays a major role in all aspects such as Engineering, Medical, Business, Research & development and Arts. Unfortunately, there are certain difficulties to process those data in a correct way. Several kinds of images are being generated at regular intervals in the field of medicine in order to diagnose human diseases. Especially, Magnetic Resonance Images (MRIs) are used very effectively. The main aim of this paper is to merge Image Mining and CBIR technique in order to support and assist the medical field. Both SVM and KNN have been merged to derive a hybrid KNNSVM algorithm to diagnose the MR Images in an effective manner with high accuracy rate and low error rate.

Keywords

Image Mining, CBIR, MRI,Image Classification and Clustering,SVM,KNN

INTRODUCTION

In Medical field, MRI plays a dominant role to diagnose tumor conditions in human brain. In general, the tumor stages are "Normal", "Benign" and "Malignant"(Fig 1.0). Physicians find it very difficult to identify the formation of tumor conditions and they try to consult the experts and specialists in the field to take necessary remedial actions. They are completely dependent on other experts. They can't act independently without the consultant opinion of third party. Hence, there is a need to develop a computerized system which can automatically analyze the stages of tumor conditions and can assist the physicians to take necessary remedial actions without delay. In this research work, the concepts of Image Mining and Content Based Image Retrieval (CBIR) have been merged to support and assist the medical field. Both of these two concepts are distinct in general. Image mining deals with the extraction of potential hidden information from large collection of general digital images. The CBIR is used to retrieve the desired image from the image database based on the selected contents of given query image. In order to examine the tumor conditions, MR Images are to be classified in a better way using certain classification algorithms. K-Nearest Neighbor (KNN) and Support Vector Machine (SVM) are two major classification algorithms utilized in the concept of image mining. Though they are very popular and effective algorithms, they have their own drawbacks. To overcome these drawbacks, these two algorithms are combined together to form a new hybrid KNNSVM algorithm.

The K-NN measures the distance between the given query sample and set of training samples. That is, it finds the 'k' closest training samples according to some metric distance equations such as Euclidean, Manhattan or City Block etc. SVM acts as a binary linear classification model since it takes input data and predicts for each input data to identify the concerned member of the two supervised classes**.** In the existing techniques, MR Images have not been taken into account to diagnose tumor conditions in the brain of human beings. Further, binary SVM1 and SVM2 classification techniques have not yet been implemented. Moreover, the concepts of CBIR and Image Mining methodologies have not yet been combined so far. The hybrid KNNSVM has been designed to identify the tumor conditions in human brain with high reliability and less time consumption.

Finally, a CBIR system is designed to retrieve homogeneous and heterogeneous tumor condition MR Images using this hybrid and Nearest Neighbor (NN) algorithms based on the user's choice. So, this research work will be of very high use in the field of medical more benefits can be attained in a shorter period of time.

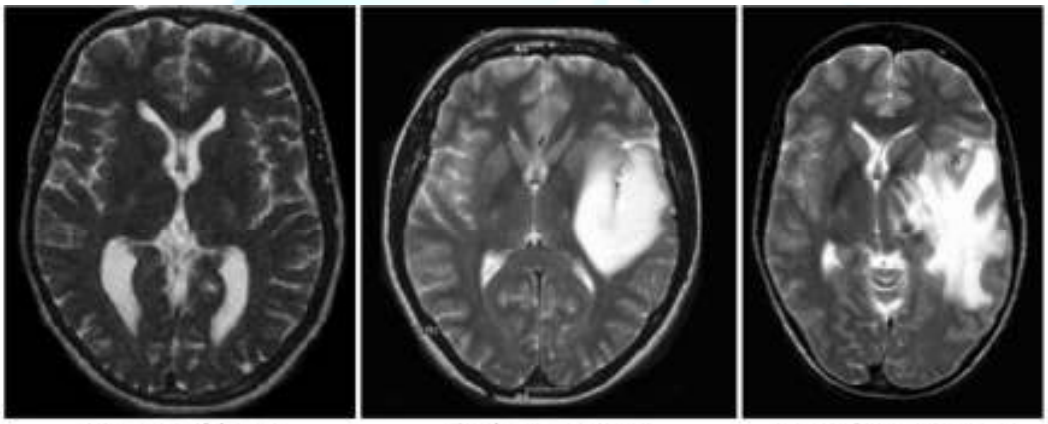

Fig 1.0 MR Images in axial plane

Problem Description

There are two popular diagnostic imaging techniques Computed Tomography (CT) scan and Magnetic Resonance Imaging (MRI) are being implemented in the field of medical to diagnose any abnormal changes in tissues and organs for the early recover of the patients. Among these, MRI is very useful technique to locate the size of the brain tumor very efficiently. MRI is a kind of test in which a magnetic field and the radio wave energy pulses are combined to make pictures of organs and structures inside the body.This creates good contrast between the various soft tissues of the body by which the physicians can move to the right locations to identify the problematic tissues especially in brain, heart, cancer and muscles[2].The Hybridized KNNSVM algorithm is being effectively used to identify the condition of the brain tumor in human brain. It is highly feasible to process MR Images to classify the type of brain tumor of a person based on the GLCM texture as described in [6]. K-Nearest Neighbour (K-NN) is one of the supervised learning methods that can be used in

many applications in the field of data mining and statistical classification and pattern recognition. This is based on learning by correlation. That is, the given test tuple is to be compared with training tuples that are similar to it. The training tuples that already have been described with 'n' number of attributes. The tuples are represented as individual points in an n-dimensional space. When an unknown tuple is received, the K-NN classifier tries to search the pattern space for the 'k' training tuples that are closest to the given unknown tuple. The 'K-nearest neighbours' are called as 'k' training tuples for the given unknown tuple [4]. SVM acts as a binary linear classification model which takes input data and predicts for each input data to identify which of two supervised classes the input is a member of which. In other word, SVM classification algorithm builds a model which tries to predict whether the type of given input data belongs to one of the two training categories or not [4]? This is based on the principles of Structural Risk Minimization (SRM) from statistical learning theory [3]. SRM is an inductive principle for model selection used from learning finite data set and provides a method for controlling the generalization ability learning machines that uses a small size training data [7].The implementation of SRM helps to seek an optimal hyper plane and which guarantees the lowest classification error. It is known that several MR images are being generated in routine processes in the field of medicine for brain tumour. Physicians may want to compare the existing concluded identified diseases with newly arrived patient's MR Image, so that they can decide suitable remedial actions early for the same. The HKNNSVM designed in the work[6] is very useful to identify the type of the brain tumour from a patient's MR Image. However, physicians may wish to classify the existing identified MR images to retrieve the details of similar conditioned MR images such as collections of 'benign' conditioned images, 'Malignant' conditioned images otherwise heterogeneous collections. In connection with this, a CBIR system is designed in association with the concepts of image mining to fulfil the above said needs. Here, the Nearest- Neighbour (NN) method is implemented in addition to the proposed hybridized KNN SVM method discussed in [6]**.**
Hence, the CBIR system is aimed to retrieve either homogenous or heterogeneous tumour conditioned MR images from the database based on the user's need. The NN method is used to retrieve heterogeneous MR Images from the database, whereas the HKNNSVM algorithm is used to retrieve homogenous MR images from the database. Consequently, the medical staff can compare the results of the given query MR image with the pre-existing tumour conditioned images and necessary remedial solutions can easily be identified to save the patients very earlier.

Proposed Solution

In this paper, there are two kinds of levels such as training and testing process. The MR images have been collected in the training set in the form of gray scale format. The images are collected from DICOM. The DICOM has already concluded the results of the categories of MR images concerned based on certain criteria. The Grey Level Co-occurrence Matrix (GLCM) has to be calculated from those images to identify texture contents later. The GLCM is used to extract second order statistics from an image. GLCMs have been used very successfully for texture calculations [11] and the GLCM is also used to identify the images in rotation invariants. Since images are collected in different dimension variants, these calculations will be very useful to classify the images in a right way. The GLCM will provide the information about the positions of pixels those have similar gray level values. The matrix will be in the form of two-dimensional array 'C' in which the possible image values will be

defined as rows and columns. Then, the texture features will be extracted from the collected stored supervised MR images (training) based on the values of the co-occurrence matrix and those features will be kept in a database for future processes.
The patient's query MR image will be received from the user. The GLCM will be calculated from the given query image. A number of texture features may be extracted from the GLCM [10]. As mentioned earlier, the 12 prominent features such as 'Contrast', 'Correlation', 'Cluster Prominence', 'Cluster Shade', 'Dissimilarity', 'Energy', 'Entropy', 'Homogeneity', 'Homogeneity Probability', 'Maximum robability', 'Sum of Squares' and 'Auto Correlation' are to be extracted from the query image.

Implementation and Result Details

The query MR image will be selected by the user from the database. Then, the user can either selectNearest Neighbour (NN) method or the hybridized KNNSVM method discussed in the work [6] will retrieve nearest images from the database. The user can specify the number of required nearest images such as 5, 10, 15 and 20. Once the number is selected, the neighbours will be selected and the neighbour IDs of each sample will be displayed to the user for reference. In this research work, 150 MR Images have been taken for testing purpose.

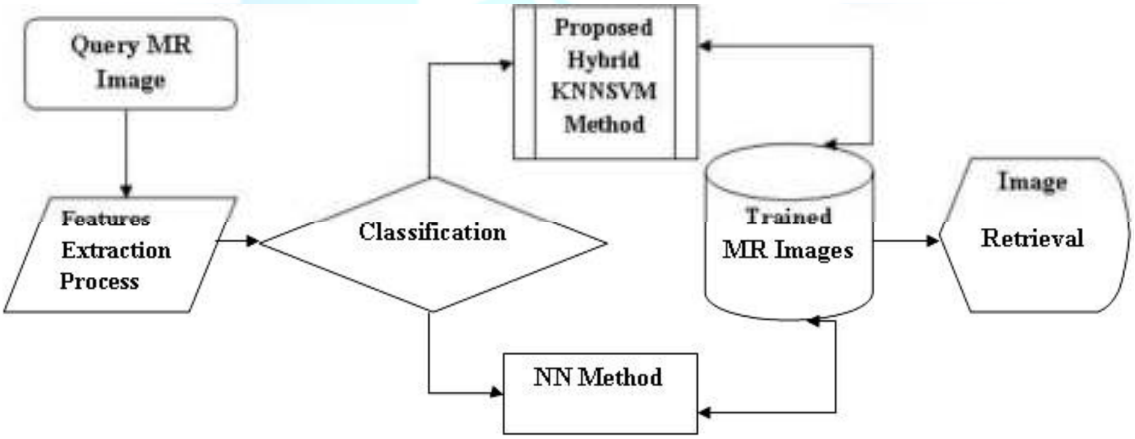

Figure 2.0 Block-Diagram of Proposed CBIRSystem

As pointed out earlier, the NN method will retrieve heterogeneous tumour categorized images from the database. The NN method acts as similar as the KNN method. The NN method in other terms called as proximity search and closest search. This is an optimization problem used to find closet neighbours in the given metric space. A feature space will be formed

based on the prominent features of the given images. The query image will be processed to obtain the concerned prominent features and it will be located in the feature space. The distance between given query image and the training set samples will be computed using Euclidean Distance method and the result will be sorted out. The top concerned numbers of images will be picked out as the result. Here, image25 has been given as a query image for the NN classification. The figures 2.1 and 2.2 show the neighbours locations of the given query image and its corresponding distance measurement graph of its neighbour images in the NN classification. It just locates the different neighbours of the given query image. The rounded circle with 'X' indicates the given query image. The distance measurements of each neighbour are sorted out and displayed in the distance measurement graph. The distance measurement graph is a bar graph used to identify the distanced level of each neighbour. Here, the choice for number of neighbours selected is 20. The distance measurement graph shows the distances of each MR image. Finally, the CBIR system retrieves discrete categories of tumour formation of MR images which are clearly shown in Figure 2.3. Hence, the physician can compare these results with the given query image in order to take certain remedial actions for the identified problem.

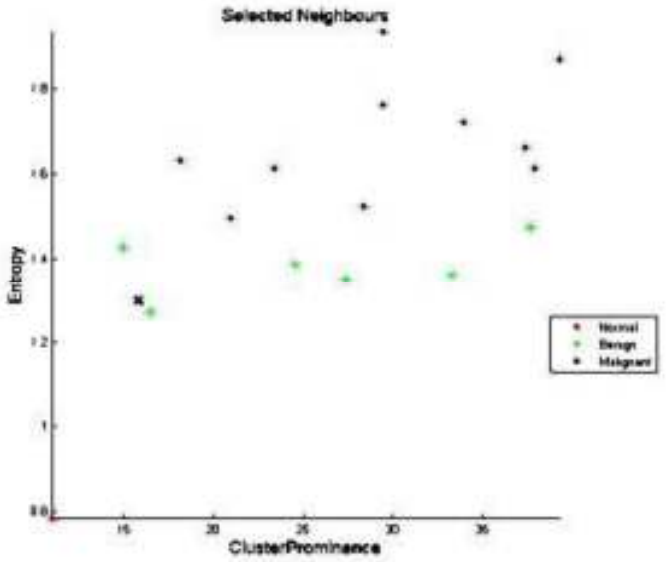

Figure 2.1 Neighbours locations in Feature Space using NN Method

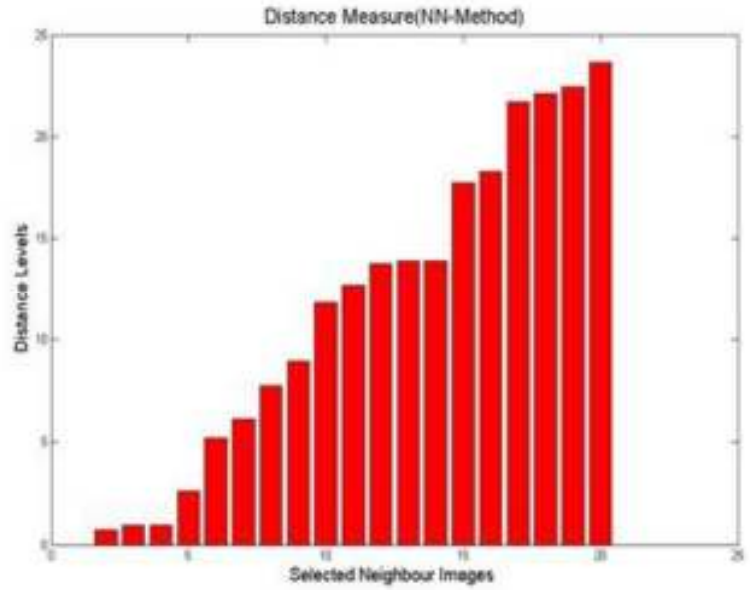

Figure 2.2 Distance Measurement of Neighbours using NN Method

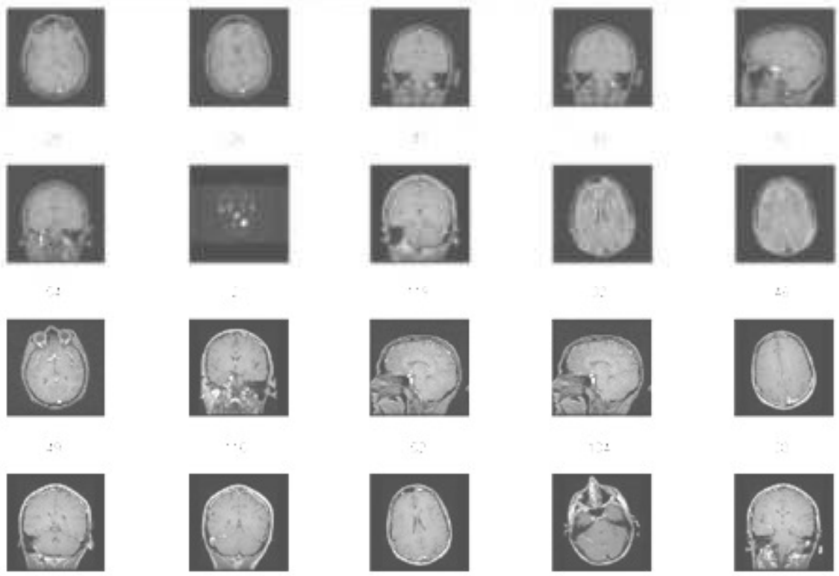

Figure 2.3 Images Retrieval using NN method

Next, the hybrid KNNSVMM has been employed for the given query image25 and it classifies the given query image. The procedures for processing hybrid are similar to the NN method as discussed above. The results of the hybrid algorithm are presented from the Figures 2.4 to 2.6. This hybrid method will retrieve either of 'Benign', 'Normal' and

'Malignant' formation of images from the database according to the given category of query image. The given query MR image25 belongs to 'Benign' category. So, the hybrid algorithm here has retrieved all the similar conditioned 'Benign' categorized MR images from the database according to the classification procedure of the hybrid algorithm discussed in the paper [6]. Secondly, the query image25 is again applied. The Green pixels show the category of 'Benign' which are very close to the given query image25

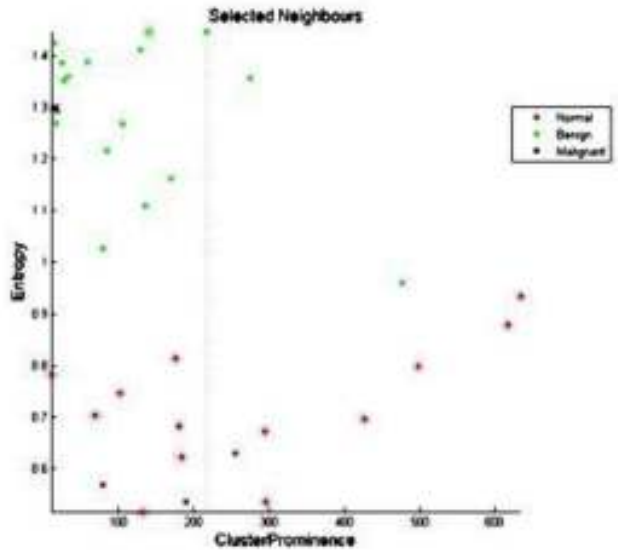

Figure 2.4 Neighbour IDs selection in CBIR System using Hybrid KNNSVM Method

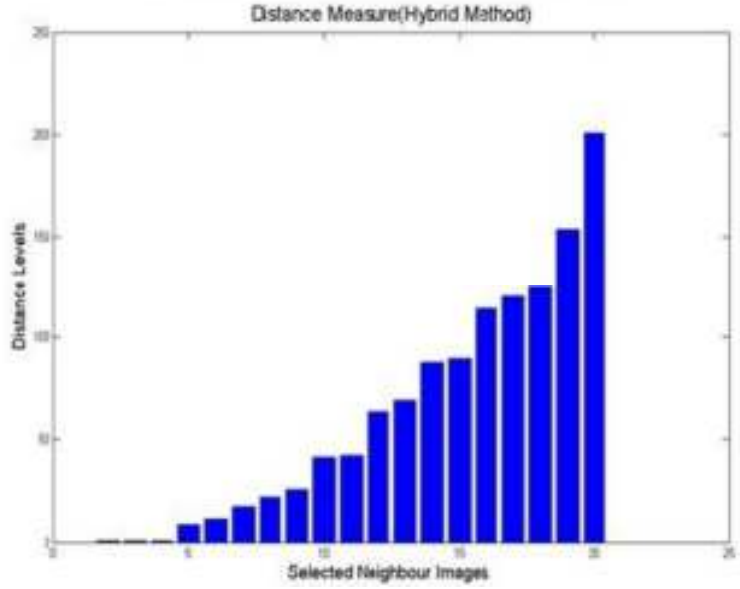

Figure 2.5 Distance Measurement of Neighbours in CBIR System using Hybrid Method

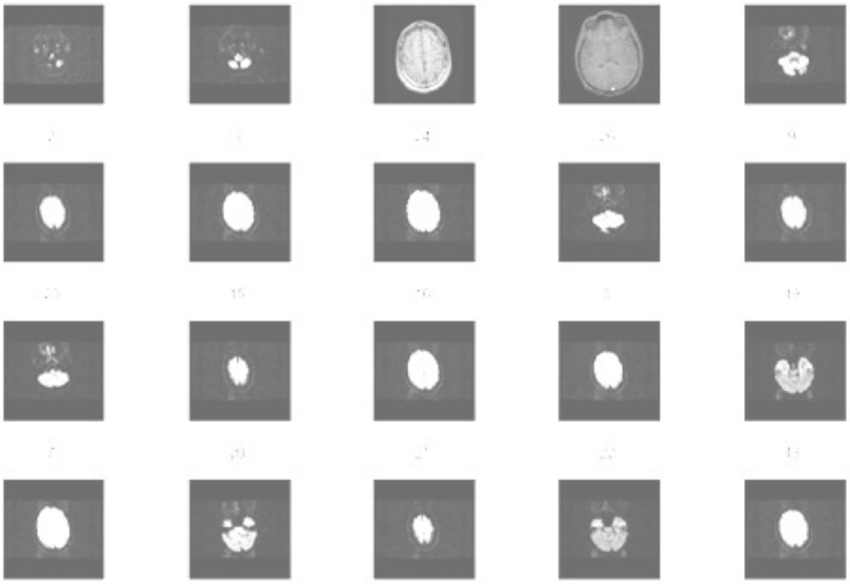

Figure 2.6 Image Retrieval using Hybrid KNNSVM method

Conclusion

The concepts of Image mining and Content Based Image Retrieval have been combined in this phase in order to classify the MR images to identify and retrieve tumour formation images. Normally, these two concepts are in distinct areas. But, for this research, a platform is created to combine these two methodologies in an effective manner. The hybridized algorithm discussed in the paper has been adapted here in addition to NN method to design a CBIR system to assist medical staff to take relevant action for the tumour conditioned patients earlier. Over 150 patients' MR images have been taken from DICOM and classified for the research. All the images taken are supervised images since those are already concluded as tumour affected images and labelled each one. The central objective of this paper is to diagnose the given query MR image in a better manner with high accuracy rate and low error rate compared to earlier approaches. The CBIR designed in this phase is to act as a medical decision support system to support the physicians in much more level to the welfare of the patients. This research work will be very much useful to the physicians to take immediate remedial actions for patients without consultation of expert and also the time consumption for taking remedial actions will be consistently low.

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