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GLCM Based Feature Extraction of Neurodegenerative Disease for Regional Brain Patterns

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Abstract—An accurate diagnosis of Alzheimer's diseases (AD) based on saliency map and gray level co-occurrence matrix (GLCM). Extracting salient features of input brain magnetic resonance image (MR) and the region of interest is identified using grey level co-occurrence matrix (GLCM). In GLCM method, the matrix is converted into vector that can be used in classification process. This paper gives fully automatic image analysis method and endeavor an approach for classification of brain images to find out pathology and normality part of brain. A support vector machine (SVM) a supervised learning process is used for classification of AD, which is identified as blue color is associated with normal part and red color is associated with pathology related.

Keywords— gray-level co-occurrence matrix (GLCM), Alzheimer's disease (AD), support vector machines (SVMs), saliency map, Anatomical patterns, normal controls (NC).

INTRODUCTION

Neurodegenerative diseases mainly affect central nervous system. Neurodegenerative is combination of two words; they are Neuro means 'nerve cell' and Degeneration means 'progressive losses' .Overall definition of Neurodegenerative diseases is progressive loss of memory that includes loss of neurons and death of neurons that intern leads to loss of structure of nerve and functions of nerve. Examples of Neurodegenerative diseases are Parkinson's, Alzheimer's and Huntington's disease. An Alzheimer's diseases start as small or mild and progressively it will get worse. The symptom of Alzheimer's diseases includes loss of thinking skills, memory and behavioral changes.

The diseases is characterized under three stages based on functional differences, those are pre-dementia, moderate and advanced. In pre-dementia, those are like short time memory loss; in this it shows that difficult to remember the recent happened facts. In early stage the patient faces difficulties with perception and language. In moderate stage the performance of most common daily living activities is forgotten and speaking difficulties also occurs. In advanced or final stage the patient is completely depend upon others or caregivers and language is reduced to phrases or even single word this leads continuous loss of speech.

Neuroimaging may become a valuable tool in the early diagnosis of neurodegenerative disorder such as Alzheimer diseases. By separating structural arrangement and explain hidden relationship from basic magnetic resonance (MR) images. Neuroimaging include the extraction of anatomical patterns is based on visual saliency maps. Those saliency maps are used to differentiate between Normal controls (NC) and Alzheimer's diseases (AD)

RELATED WORK

The previous methods used for classification of Neurodegenerative diseases are fully automatic segmentation method is carried out by "Chupin M, Geradin E and Boutet C" [1].The results are compared with eight patients with Alzheimer disease (AD). The classification method proved accuracy is 60 to 80 percentages. In second method uses different learning parameters and maximum like hood method "Zhang D, wang Y"[2]. This method is to classify the data images and the accuracy is 74 percentages on classification process. In third method "Christos Davatzikos, Yong Fan"[3] proposes that cross validation of Alzheimer diseases differentiation via pattern classification method using mci group images uses a detection of pattern of brain diseases that leads to 90 percentage of classification accuracy.

In existing system for analyzing the Discriminative Anatomic pattern Voxel-based morphometry (VBM) and Deformation-based morphometry (DBM) methods were used. In VBM, the patterns were examined by local differences, found in brain tissue segmentations, are voxel-by-voxel statistically analysed. In DBM compared information which from the deformations fields obtained after registration to the template, in these methods one-to-one correspondences between subjects are assumed and statistics are computed for the same voxel across all subjects. Finally the recent approach for Brain Pattern were diagnosed with feature-based

morphometry (FBM) technique, In FBM approach is represented by scale-invariant salient features, along with a probabilistic framework that together permit to evaluate the significance and differentiation degree of salient features, Which established differences between normal controls and probable AD patients. These sets of features are considered as group-related anatomical patterns. It recommends neuroimaging may become an important tool in the early analysis of neurodegenerative disorder. By separating structure arrangement and explain hidden relationship from basic magnetic resonance (MR) images. An automated intellect morphometric search that do behave this measure to give very little to the apprehension of the disease. In preceding ROIs portrait are highly time-exhausting and expert-reliant. This approach is able to graph any intellect to a set of optical designs that previously have been studied as they related to the medicinal or normal position. By applying the Voxel Based Morphometry (VBM) for feature selection and extraction of the most relevant features. Finally using this Feature Extraction values classify the values by using the SVM Classifier. The constant checking system is achieved by expert neurologists or radiologists, who are able to figure out complicated structural patterns and slight changes with clinical context. Finally they identify the Alzheimer's disease.

PROPOSED WORK

The proposed method contains two sections, trained section and test section. In trained section first all the images to be trained and stored in database as database brain images. After that test one by one brain image for further classification process of Alzheimer diseases.

Brain images from the database are given as input then the given input image is converted into Gray image so that computation in mat lab is reduced. All images should be processed in Gray format. The converted Gray image is passed through saliency method to get saliency map. After getting saliency map it compares with some predefined threshold values which is stored in dot mat file and gives saliency map of input image. After getting saliency image the normalization process is carried out so that range of pixel intensity values changes. After saliency calculation the fusion method is carried out to get master saliency of each scaled images. Using Gray-level co-occurrence matrix (GLCM) method depending on feature values the relevant information is extracted, classified using SVM classifier and anatomical pattern analysis is done. Support vector machines are supervised learning model that associated with learning algorithms that used to analyze the data and identify the patterns which are used for classification process and map the trained data to classify accurately. Red regions are associated with pathology and blue regions are associated with normality for identification of brain diseases. In this way anatomical interpretation is done. Performance analysis is based on accuracy, sensitivity and specificity is done.

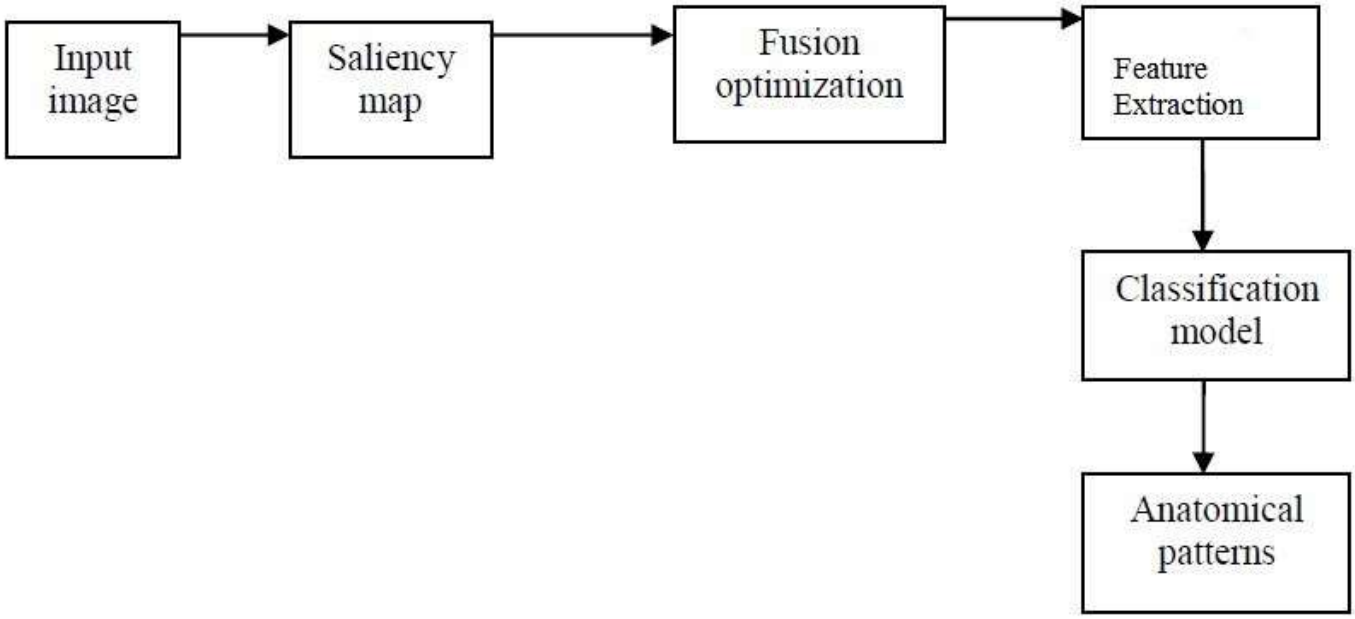

Figure A: Block diagram of proposed system

From the figure itself, it is very well understood that the proposed system is consisting of mainly six steps.

1. Saliency map
2. Normalize
3. GLCM based Feature Extraction
4. SVM classifier
5. Anatomical interpretation
6. Performance analysis

1) Saliency Map

An Automatic estimation of regional (salient) object regions across brain image without any prior knowledge of the contents of the corresponding scenes. Introduce a contrast based salient object extraction algorithm which simultaneously evaluated global contrast different and spatial weighted coherence scores. Proposed algorithm is simple, efficient, and naturally multiscale and produces full resolution high-quality saliency maps.

This saliency map module gives the saliency map of given input brain image that maps the each feature into its neighboring pixel feature so that degree of difference is calculated using Euclidian function. Each feature maps into a complete measure using saliency map that combines related information from single information into a global measure. Saliency typically calculated from contrasts between the given location and their neighborhood. There are three methods for calculation of saliency maps first one is feature extraction second one is activation maps and third is combination.

In figure B the saliency map construction is shown. The input brain image is divided into multiple of three scales and based on intensity orientation and contrast the features are extracted of each scaled images and saliency calculation is done using above three methods and kernel k-means method and all three images summed together to get master saliency map. The main method is to get saliency map of given input image, based on orientation, intensities and contrast as shown in figure B.

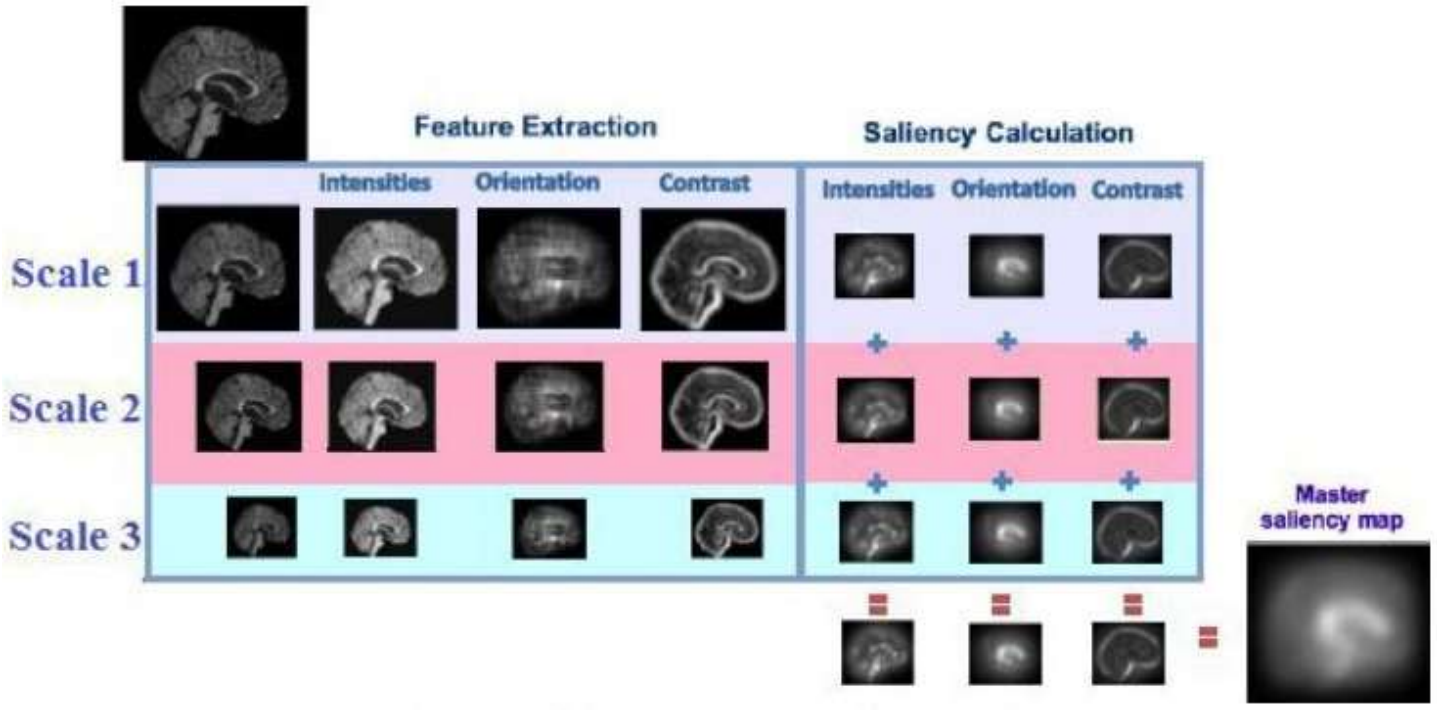

Figure B: Saliency map construction

2) Normalize

This normalize module, a process that changes the range of pixel intensity values In normalization process same constant dimensions are identified and differentiated, so that it is used to produce anatomical regions. Applications of normalization process include photographs with poor contrast due to glare. Sometimes normalization process also called contrast or histogram stretching. General Fields of data processing such as digital signal processing it is referred to as dynamic range expansion. To changing the Intensity, Coordinates values etc.….In image processing, normalization is a process that changes the range of pixel intensity values. In image processing auto-normalization software typically normalizes to the full dynamic range of the number system specified in the image file format.

3) Gray Level Co-occurrence Matrix (GLCM) based Feature Extraction

A feature is an image characteristic that can capture certain visual property of the image. Texture is an important feature of many image types, which is the pattern of information or arrangement of the structure found in a picture. A co-occurrence matrix, also referred to as a co-occurrence distribution, is defined over an image to be the distribution of co-occurring values at a given offset. It represents the distance and angular spatial relationship over an image sub region of specific size. The GLCM is calculates how often a pixel with gray-level (grayscale intensity or Tone) value i occurs either horizontally, vertically, or diagonally to adjacent pixels with the value j. GLCM contains the second-order statistical information of neighboring pixels of an image. Textural properties can be calculated from GLCM to understand the details about the image content. Gray Level Co-occurrence Matrix is a tabulation of how often different combinations of pixel brightness values occur in an image. GLCM contains the information about the positions of pixel having similar gray level values. GLCM calculation units receive pairs of gray level values as input. The GLCM calculation unit consists of the different combinations of gray values. This gives the deviation present in the image when compared with original image by predictive image.

4) SVM Classifiers

Support vector machines (SVMs) also called support vector networks are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible.

5) Anatomical interpretation

Red regions are pathology and blue regions are normality for identification of brain diseases. The discipline of anatomy is divided into macroscopic and microscopic anatomy. Macroscopic anatomy, or gross anatomy, is the examination of an animal's body parts using unaided eyesight. Gross anatomy also includes the branch of superficial anatomy. Microscopic anatomy involves the use of optical instruments in the study of the tissues of various structures, known as histology and also in the study of cells. The history of anatomy is characterized by a progressive understanding of the functions of the organs and structures of the human body. Methods have also improved dramatically, advancing from the examination of animals by dissection of carcasses and cadavers (corpses) to 20th century medical imaging techniques including X-ray, ultrasound, and magnetic resonance imaging. Anatomy is the study of the structure of animals and their parts, and is also referred to as zootomy to separate it from human anatomy. The discipline of anatomy is divided into macroscopic and microscopic anatomy. Macroscopic anatomy, or gross anatomy, is the examination of an animal's body parts using unaided eyesight. The history of anatomy is characterized by a progressive understanding of the functions of the organs and structures of the human body. Red regions are pathology and blue regions are normality identifying the diseases in brain. In this way anatomical interpretation is done.

6) Performance analysis

Performance analysis is based on accuracy, sensitivity and specificity is done. Result analysis of our process accuracy, sensitivity, specificity. To avoid the possible inflated performance estimation on the unbalanced datasets, the balanced classification accuracy was also computed, a simple arithmetic mean of the sensitivity and specificity. The balanced accuracy (BAC) removes the bias that may arise by imbalanced datasets. In a binary classification problem, if the classifier performs equally well on either class, BAC reduces to the ordinary accuracy. If, however, the classifier has taken advantage of an imbalanced dataset, then the ordinary accuracy will be inflated, whereas the BAC will drop to chance (50%), as desired. The time is set aside during the training phase and then classified using the SVM model trained with the remaining subjects. To avoid the possible inflated performance

estimation on the unbalanced datasets. The balanced accuracy (BAC) removes the bias that may arise by imbalanced datasets. The balanced classification accuracy was also computed, a simple arithmetic mean of the sensitivity and specificity. Result analysis of our process accuracy, sensitivity, specificity.

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CONCLUSION

In this paper the accuracy of 96% is achieved using saliency map characterization and gray level co-occurrence matrix(GLCM) method is adapted which is very useful in differentiation of Neuro degeneration diseases with better accuracy. The thesis has introduced and adapted biologically inspired methods for identification of diagnostic-relevant image regions in a very complex and challenging problem, the Alzheimer's disease (AD). The automatic strategies herein developed have included prior anatomical and medical knowledge within the morpho-metrical analysis. The set of proposed tools constitute an innovative framework in the context of anatomical studies: sparse-based representations and visual attention methods, together with machine learning techniques, provide efficient representations of the image content in terms of visual features, leading to the discovery of visual patterns directly related with a specific pathology. The present investigation has included an extensive validation and parameter study, evaluating both its accuracy for discriminating different experimental groups and its capacity of determining the relevant anatomical regions together with their weights. Regarding discriminative power, different parameters involved in the top-down and bottom-up information flows, were assessed in terms of classification accuracy, allowing identifying the influence of the different visual features and image scales in the final discrimination between AD and NC classes. The simpler version of our proposal (combining a single saliency-based kernel with SVM learning) has reached an equivalent performance to a state-of-the-art approach. Finally, we want to highlight that the quality of the model is not only given by the quantitative performance measures, but by its aptness to automatically detect highly discriminative brain regions, consistent with those regions that have been described as important in the progression of the disease.

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