Diagnosis The Neurodegenerative Diseases Using Graph Based Visual Saliency (GBVS) With SVM Classifier

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Abstract— Medical diagnosis, treatment, follow-up and research activities are strongly supported on different types of diagnostic images, whose main goal is to provide an exchange of medical knowledge. Anatomical variability of patient’s brains limits the statistical analyses about presence or absence of a pathology. An approach for classification of brain Magnetic Resonance (MR) images from healthy and pathology subjects builds up a saliency map, extract regions of relative change in three different dimensions: intensity, orientation and edges. Bottom-up information comes from a multi scale analysis of different image features, while top-down stage includes learning and fusion strategies formulated as a max-margin multiple-kernel optimization problem. Feature values are extracted by kmeans, PCA, GLCM. The feature values are used as suitable patterns for subject classification using support vector machines.

Keywords— Alzheimer’s Disease (AD), Magnetic Resonance Imaging (MRI), Support Vector Machine (SVM).

I. INTRODUCTION

The brain is the part of the central nervous system located in the skull. It controls the mental processes and physical actions of a human being.

Neurodegeneration is the progressive loss of structure or function of neurons. Neurodegenerative diseases including Alzheimer’s, ALS, Huntington’s and Parkinson’s occur as a result of neurodegenerative processes. Discovering these similarities offers hope for therapeutic advances that could ameliorate more diseases simultaneously. There are many parallel between different neurodegenerative disorders including atypical protein assemblies as well as induced cell death. Neurodegenerative can be found in many different levels of neuronal circuitry ranging from molecular to systemic.

Alzheimer’s disease is the most probably form of dementia. Early symptom is difficulty in remembering recent events. Alzheimer’s disease advances, symptoms can include aggression, confusion, irritability, trouble with language, mood swings and long-term memory loss. As a patient condition declines they often withdraw from family and society. Gradually total body functions are lost, finally leading to death. Alzheimer’s disease is characterised by loss of neurons and synapses in the cerebral cortex and sub cortical regions. The loss results in gross atrophy of the affected regions, including degeneration in cingulate gyrus, parietal lobe, temporal lobe and parts of the frontal cortex.

II. EXISTING WORK

In Existing System for analysing the Discriminative Anatomical pattern voxel-based morphometry (VBM) and deformation-based morphometry (DBM) methods were used for neurodegenerative diseases. In VBM, the patterns were examined by local differences between them and found in brain tissue segmentations, are voxel-by-voxel statistically. In DBM compared information which from the deformations obtained after registration to the template and one-to-one correspondences between subjects are assumed and statistics are computed for the same voxel across all subjects. The recent approach for Brain Pattern were diagnosed with feature-based morphometry (FBM) technique, In FBM is represented by scale-invariant saliency features, along with a probabilistic framework that together permit to evaluate the significance and differentiation degree of saliency features, Which established differences between normal controls and probable AD patients. These sets of features are considered as group-related anatomical patterns. Neuroimaging may become an important tool in the early analysis of diseases. By separating structure arrangement and explain hidden relationship from basic magnetic resonance (MR) images. An automate intellect morphometric search that do behavior this measure to give very little to the apprehension of the neurodegenerative 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 using this Feature Extraction values classify the values by the SVM Classifier. The constant checking system is achieved by radiologists or neurologists, who are able to figure out complicated structural patterns and slight changes with clinical context. Finally identify the Alzheimer’s disease and necessity of arriving to accurate diagnoses.
II PROPOSED WORK

A. SALIENCY MAP

The saliency map combines information from each of the feature maps into a global measure where points corresponding to one location in a feature map project to single units in the saliency map. Saliency at a given location is determined by the degree of difference between particular location and its surround. Saliency detection is the context of the visual system, but similar mechanisms operate in other sensory systems. Markovin process is used in saliency map. The proposed that the different visual features that contribute to attentive selection of a stimulus (color, orientation, movement etc) are combined into one single topographically oriented map, the Saliency map which integrates the normalized information from the individual feature maps into one global measure of conspicuity. There is no logical necessity that it arises in one particular location and it could be understood as a functional map whose components could be distributed over many brain areas. It is also possible that there are more than one topographically organized saliency maps.

Markovin approach

Define dissimilarity of $M(i,j)$ and $M(p,q)$ fully connected directed graph of $G$ obtained at every node of $M$

$$d((i,j), (p,q)) \triangleq \log \frac{M(i,j)}{M(p,q)}$$

The directed edge weight from node $(i,j)$ to node $(p,q)$ will be assigned by weight

$$w_1((i,j), (p,q)) \triangleq d((i,j), (p,q)) \cdot F(i-p, j-q)$$

$$F(a,b) \triangleq \exp\left(-\frac{a^2 + b^2}{2\sigma^2}\right)$$

Weight of the edge from node $(i,j)$ to node $(p,q)$ is proportional to their dissimilarity and to their closeness in the random of $M$. Note that the edge in the opposite direction has exactly the same weight. A markov chain $G$ by normalizing the weights of the outbound edges of each node to 1 and drawing an equivalence between nodes & states and edges weights & transition probabilities the equilibrium distribution of their chain, reflecting the fraction of time a random walker would spend at each node/ state naturally accumulate mass at nodes that have high dissimilarity with their surrounding nodes since transition into such subgraphs is likely and unlikely if nodes have similar $M$ values the result is an activation measure which is derived from pairwise contrast.
B. NORMALIZATION

To changing the Intensity, Coordinates values, etc in image processing, normalization is a process that changes the range of pixel intensity values. Applications include photographs with poor contrast due to glare, for example. Normalization is sometimes called contrast stretching or histogram stretching. In more general fields of data processing, such as digital signal processing, it is referred to as dynamic range expansion. Auto-normalization in image processing software typically normalizes to the full dynamic range of the number system specified in the image file format.

C. FEATURE EXTRACTION

Feature extraction is the process to identify the image details and it helps to train the image for data mining and classification etc. The feature extraction is one of the transformation method. In original image, the matrix format is huge and matrix would not be classified easily and so, we extract the details of the image for classification and the details are so called features. Three feature extraction Kmeans,PCA,GLCM.

Kernel methods have received major attention, particularly due to the increased popularity of the Support Vector Machines. Kernel functions can be used in many applications as they provide a simple bridge from linearity to non-linearity for algorithms which can be expressed in terms of dot products. Each measurement has its own wavelength range of the light spectrum, some of which may be outside the visible spectrum. If the set of possible color values is sufficiently small, each of those colors may be placed on a range by itself; then the histogram is merely the count of pixels that have each possible color. Most often, the space is divided into an appropriate number of ranges, often arranged as a regular grid, each containing many similar color values. The color histogram may also be represented and displayed as a smooth function defined over the color space that approximates the pixel counts. Kernel methods have received major attention, particularly due to the increased popularity of the Support Vector Machines. Kernel functions can be used in many applications as they provide a simple bridge from linearity to non-linearity for algorithms which can be expressed in terms of dot products.

Kmeans clustering is method of vector quantization, originally from signal processing, that is popular for cluster analysis. $k$-means clustering aims to partition $n$ observations into $k$ clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. These are usually similar to expectation-maximization algorithm for mixtures Gaussian distributions via an iterative refinement approach employed by both algorithms. Additionally, they both use cluster centers to model the data; however, $k$-means clustering tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components. The principal components are orthogonal because they are the eigenvectors of the covariance matrix, which is symmetric. PCA is sensitive to the relative scaling of the original variables.

A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. The texture filter functions, described in Texture Analysis cannot provide information about shape, i.e., the spatial relationships of pixels in an image.

D. CLASSIFICATION

Multi class SVM classifier for classifying the brain image Red egions associated to pathology and blue regions to normality. Support vector machines (SVMs, also 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, SVM model is a representation of points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. Support vector machines (SVMs, also 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.
E. ANATOMICAL INTERPRETATION

Red regions are pathology and blue regions are normality identifying the diseases in brain. The discipline of anatomy is divided into macroscopic and microscopic anatomy.

F. PERFORMANCE ANALYSIS

The performance of the process is measured by measuring the accuracy, sensitivity and specificity of the segmentation process

\[
\text{Accuracy} = \frac{(TP + TN)}{(TP + FP + TN + FN)}
\]

\[
\text{Sensitivity} = \frac{TP}{(TP + FN)}
\]

\[
\text{Specificity} = \frac{TN}{(TN + FP)}
\]

\[
\text{Balanced accuracy} = \frac{(\text{sens} + \text{spec})}{2}
\]

where TP is the number of positive samples correctly classified. FN is the number of positive samples incorrectly classified as negative. TN is the number of negative samples correctly classified and FP is the number of negative samples incorrectly classified as positive.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>ACCURACY</td>
<td>94.285</td>
</tr>
<tr>
<td>SENSITIVITY</td>
<td>91.428</td>
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<tr>
<td>SPECIFICITY</td>
<td>97.142</td>
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<tr>
<td>BALANCE ACCURACY</td>
<td>94.285</td>
</tr>
</tbody>
</table>

Table 1 Performance analysis

IV CONCLUSION

In this paper diagnosis the neurodegenerative diseases. K Means, PCA, GLCM are used for feature extraction. Feature values are classify red region are pathological and blue region are normal using multi class svm classifier. Analysis performance measures are accuracy, sensitivity, specificity.

REFERENCES


