

# Detection of Neurodegenerative Disease Using Salient Brain Patterns

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**ABSTRACT:** Neurodegenerative illness include distinctive of mental manifestations whose advancement is not specifically identified with the visual examination made by radiologists, who can scarcely evaluate orderly contrasts. In addition, programmed mind morphometric examinations, that do play out this measurement, contribute next to no to the understanding of the sickness, i.e., large portions of these techniques arrange however they don't create valuable life structures utilitarian relationships. Another completely picture examination technique that uncovers discriminative cerebrum designs related to the nearness of neurodegenerative sickness, mining precise contrasts and accordingly reviewing impartially any neurological issue. The capacity of finding discriminative anatomic patterns was evaluated using the Alzheimer's disease (AD) as the use case. A automatic image analysis method and attempts an approach for classification of brain images to find out disease and normality part of brain by using saliency map for extraction of features of input brain image. Support vector machine (SVM) a supervised learning process is used for classification of Alzheimer's disease part denotes in red color, and normal part which is identified as blue color.

**KEYWORDS:** Alzheimer's disease (AD), automated pattern recognition, magnetic resonance imaging (MRI).SVM classifier.

## I. INTRODUCTION

Neurodegenerative infections influence focal sensory system. Neurodegenerative is mix of two words those are Neuro signifies 'nerve cell' and Degeneration signifies 'dynamic misfortunes'. General meaning of Neurodegenerative infections is dynamic loss of memory that incorporates loss of neurons and passing of neurons assistant that prompts loss of structure of nerve and elements of nerve. An Alzheimer's sicknesses begin as little or gentle and continuously it will deteriorate. The side effect of this infection incorporates loss of intuition aptitudes, memory and behavioral changes. It begins in late middle age around 45 to 65 age bunches or in maturity and even it can influence any age bunch also. The illnesses is described under four phases in light of useful impedance or contrasts, those are Pre-dementia, direct and progressed. In Pre-dementia, those are more detectable like brief time memory misfortune; in this it demonstrates that to hard to recollect the late happened realities. In early stage the patient confronts challenges with recognition and dialect. In moderate stage the execution of most regular exercises of day by day living is overlooked and talking troubles likewise happens. In cutting edge or last stage the patient is totally rely on others or parental figures and dialect is decreased to phrases or even one single word this leads consistent loss of discourse. Neuroimaging is a profitable mat lab apparatus for analysis of this kind of neurodegenerative sickness, for example, Alzheimer ailments. Neuroimaging incorporates the extraction of anatomical examples of database pictures; the extraction of anatomical examples depends on visual saliency maps. Used to separate between ordinary controls (NC) and Alzheimer's ailment (AD). A way to deal with model gathering contrasts in basic cerebrum MR pictures taking into account visual saliency maps. Visual saliency strategy [9] is utilized to create saliency maps that highlight specific areas, which can be related to ailment related examples that permit further subject arrangement, specifically Alzheimer's malady. Highlight that the development of the saliency maps did exclude any from the earlier data with respect to the pathology. The visual saliency maps are utilized to manufacture a picture piece (ascertained with two diverse measures), which is encouraged to a bolster vector machine to convey a sufficient Separation between typical controls (NC) and plausible Alzheimer's sickness (AD) subjects. None of the current techniques have tended to the

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issue of programmed characterization of MR volumes utilizing visual saliency districts as elements, which end up being anatomically steady with mind locales known not amongst AD and NC bunches.

## II. RELATED WORK

ChupinM , Geradin E and boutet C 2009[1] propose an algorithm fully automatic segmentation method based on simultaneous region deformation driven by both anatomical and probabilistic priors. Using local Anatomical patterns anatomical information is derived that are stable in controls and patients, around landmarks automatically detected during the deformation. The registration of manually segmented Hc and Am Probabilistic information is derived from an atlas built for 16 young healthy subjects. Initialization is reach from global information and deformation is constrained by local anatomical and probabilistic information. The results are compared with eight patients with AD. The accuracy is reach upto 60 to 80 percentages.

Zhang D, wang Y [2] proposes a method that uses different learning parameters and uses “maximum like hood method to classify the data images”. Correct diagnosis of AD especially for its early stage also called as amnesic mild cognitive impairment (MCI), is very important that somehow reduces danger stage. It is known that AD is related to the structural atrophy, pathological amyloid depositions, and metabolic alterations in the brain and the accuracy is reach upto 74 percentage.

Christos Davatzikos.,Yong Fan proposes a method that leads to cross validation of Alzheimer diseases differentiation via “pattern classification method” using mci group images uses a detection of patterns of brain diseases. In propose method investigate the added value of combing structural MRI & PET images of regional cerebral blood flow in discriminating between MCI & normal control. Applying techniques of adaptive regional feature extraction, feature selection & multivariable support vector machine classification. 90 percentage of classification accuracy.

In the proposed paper which include the saliency mapping is new concept. saliency map calculated by using the GBVS(graph based visual saliency) for the high accuracy. Features extracted using this saliency map like edge saliency map, orientation saliency map, intensity saliency map. In the year 2014 work by Andrea Rueda, Fabio A. González, Senior Member,and Eduardo Romero the accuracy of 97% is achieved using “Extracting Salient Brain Patterns for Imaging-Based Classification of Neurodegenerative Diseases. EXISTING studies suggest neuroimaging may become a valuable tool in the early diagnosis of neurodegenerativediseases by extracting anatomical patterns and revealing hidden relations from structural Magnetic Resonance (MR) images. The value of neuroimaging against clinical, neuropsychological and biochemical analysis remains to be demonstrated in large representative populations, yet there exists sufficient evidence in small series of patients with different states of neurodegenerative disorders. The usual examination workflow is performed by expert neurologists or radiologists, who are able to figure out complex anatomical patterns and subtle changes with clinical meaning. The process that an expert follows when examining a particular case involves two different kinds of tasks: those related with image perception, such as visual search or exploration paths, and others associated with cognitive skills, mainly related to diagnostic.

A. Rueda, F.A. An expert structures a diagnosis by using contextual knowledge and fusing information from different sources, a process that has been recently under study [1]. At analyzing structural brain MR images, a main aim is to find anatomical changes, either local or global, related to functional disturbances. In particular, radiologists examine images by looking at distinctively regions and compare them by searching differences [1]. In the computational attempt of emulating the human vision process –a synchronized collaborative work between the brain and low level visual mechanisms– the concept of visual attention has introduced a generation of techniques that are able to transform an image into a hierarchy of relevant regions, known as salient regions. Relevant regions in radiological terms may be defined as those image areas that are visually altered and are entailed with a certain degree of clinical interpretability. Nevertheless, most methods used to compare brains establish local rather than regional (salient) differences.

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J. Ashburner and K. Friston Currently, a morphometric brain analysis consists of a set of strategies aimed to extract and quantify anatomical differences between groups of subjects. Commonly, this analysis comprises two main processes: first, all images are warped or registered together to a common reference frame or template, and second, a quantification of the estimated local deformation required to register is computed, producing specific measurements of interest. Voxel-Based Morphometry (VBM) [2] and Deformation-Based Morphometry (DBM) [3] are currently the most used techniques to compare populations. In VBM, local differences, found in brain tissue segmentations, are voxel-byvoxel statistically analyzed, while DBM statistically compares information coming from the deformations fields obtained after registration to the template. With these methods, one-to-one correspondences between subjects are assumed and statistics are computed for the same voxel across all subjects. However, conclusions are limited when the same structure may be partially present, or when a single anatomical region may exhibit multiple shapes across the population. On the other hand, some pathology may affect not only a unique anatomical structure or even contiguous regions, but localized structures separated from each other. These kinds of patterns are difficult to find and analyze with these classic morphometric techniques. A recent proposal, the Feature-Based Morphometry (FBM) [4], copes with these issues by modeling the image as a collage of local scale-invariant features and by learning, from them, a probabilistic model that reflects group-related anatomical characteristics. However, these approaches disregard the local statistical dependences, and then subtle changes are hardly detected; exactly the opposite strategy used by the radiologists, who analyze regions rather than pixels [5].

### III. OBJECTIVES

1. A new fully automatic image analysis method that reveals discriminative brain patterns associated to the presence of neurodegenerative diseases mining systematic differences and therefore objectively any neurological disorders.
2. To Study and analyses the proposed method for detection of neurodegenerative disease.
3. To Study and analyses different method for feature extraction and suggestion of appropriate method with higher accuracy to assist the doctor.
4. Analysis and detection by radiologist should be accurate.

### IV. METHODOLOGY

#### 4.1 Block Diagram Description:

The proposed method contains two sections one is trained section another one is test section. In trained section all the images to be trained first and stored in database as

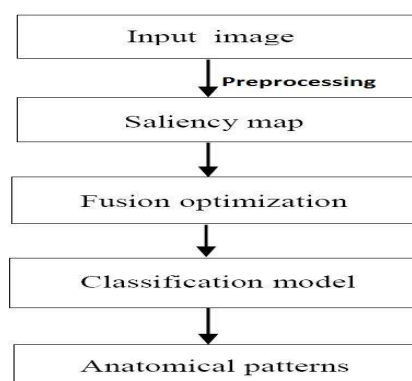


Fig 1 Block diagram of proposed system

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After that test one by one image for further classification process of Alzheimer diseases. Figure 3 shows the proposed system. 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 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 kernel K-means clustering 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 analyse the data and identify the patterns which is used for classification process and map the trained data to classify accurately. Red regions are pathology and blue regions are normality for identification of brain diseases. In this way anatomical interpretation is done. Performance analysis is based on accuracy, sensitivity and specificity is done.

## V. IMPLEMENTATION APPROACH

### 1. Saliency map

This module gives the saliency map of given input 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.

### 2. Normalization

To changing the Intensity, Coordinates values, etc....., Normalization is process of changing the pixel intensity values. It is also called contrast stretching or histogram stretching. In normalization process same constant dimensions are identified and differentiated, so that it is used to produce anatomical regions.

### 3. Kernel Feature Extraction

Due to the increased popularity of the learning method which is known as Support Vector Machines uses kernel method for feature extraction. It is calculated in terms of kernel k-means method so that features can be extracted.

### 4. SVM Classifiers

Support vector machines are supervised learning model that associated with learning algorithms that used to analyse the data and identify the patterns which is used for classification process and map the trained data to classify accurately.

### 5. Anatomical interpretation

Red regions are pathology and blue regions are normality for identification of brain diseases. In this way anatomical interpretation is done.

### 6. Performance analysis

Performance analysis is based on accuracy, sensitivity and specificity is done

## VI. SALIENCY BASED PATTERN EXTRACTION

**Require:**  $N$  structural brain volume  
( $N_{NC}$  : number of normal subjects,  $N_{AD}$  : number of pathological subjects).

**Step 1** : calculation of saliency maps.

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**Step 2** : bottom – up saliency fusion.

**Step 3** : top-down learning.

**Step 4** : anatomical interpretation

### Calculation of Saliency Maps

The search of particular patterns among the anatomical areas in structural brain MR images can be considered as equivalent to figure out a preferential information flux through a net of nodes belonging to a fully-connected graph, being each node a particular anatomical region and each edge a similarity (or dissimilarity) measure between regions. If an image is partitioned and its parts are somehow related together as a fully-connected graph, the interaction process between an user and the image can be modeled as a privileged path of that graph. Some approaches have taken into account the possibility of using graphs and induced Markov chains to model saliency and attention fixations in natural images.

Calculation of saliency map is done by using the Graph-based visual saliency method (GBVS). This GBVS method encodes dissimilarity between feature pixels by a closeness

measure in the graph connection i.e., salient pixels are the most dissimilar in a local context, a closer approximation to the visual analysis made by radiologist when studying a medical image.

The edge weight between graph nodes  $g_{i,j}^A$  and  $g_{p,q}^A$  is calculated as

$$w_A(g_{i,j}^A, g_{p,q}^A) = d(g_{i,j}^A, g_{p,q}^A) \times F(i - p, j - q) \dots\dots\dots(1)$$

Where encodes the dissimilarity  $d(g_{i,j}^A, g_{p,q}^A)$  (in terms of the respective feature information) and  $F(i-p, j-q)$  represents the spatial closeness between nodes.

### VII. EVALUATION PARAMETER

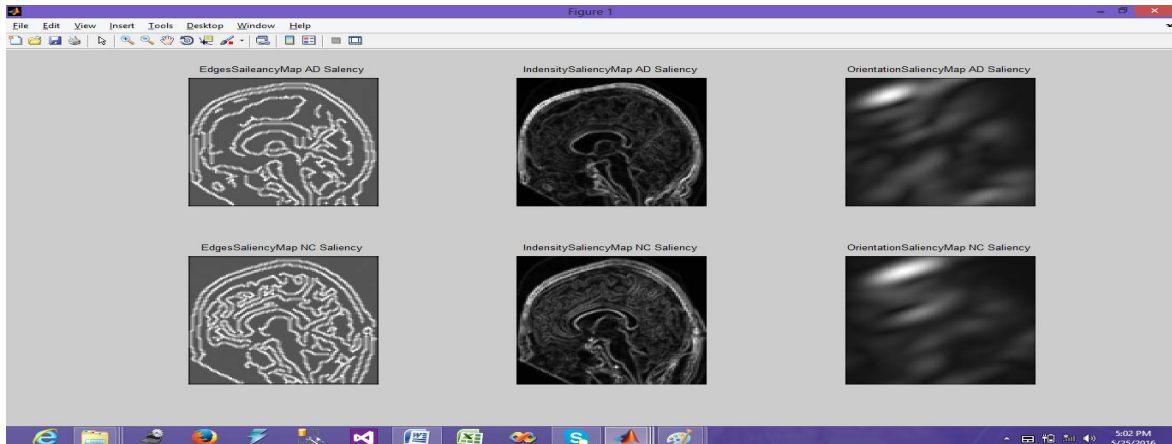
$$\text{Accuracy (Acc)} = (TP + TN) / (TP + TN + FP + FN)$$

$$\text{Sensitivity (sens)} = TP / (TP + FN)$$

where TP stands for true positives (AD individuals correctly classified), TN for true negatives (NC individuals correctly classified), FP for false positives (NC individuals misclassified) and FN for falsenegatives(AD individuals misclassified).

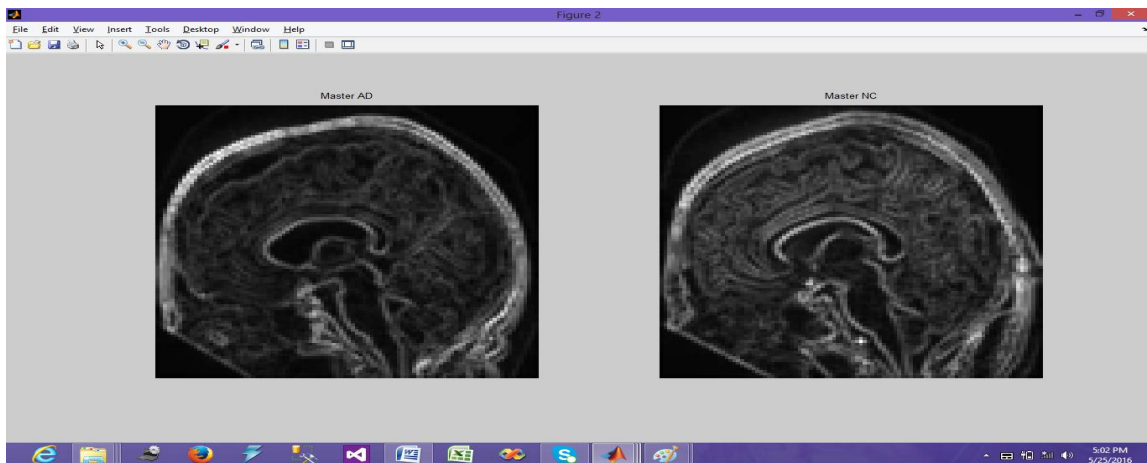
### VIII. EXPERIMENTAL SET UP

The following fig 6.1.A shows different saliency maps for different features like edge saliency map, intensity saliency map, orientation saliency map. Total six maps present their first row maps shows for AD and second row maps shows for NC. Saliency maps are generated using GBVS algorithm.



**Fig 2 Saliency maps of different feature**

In following fig 6.1.B shows the fusion output. In this step all generated maps are combine or fuse for optimization to create master maps. Two master maps are generated one for AD in that all feature maps of AD combine and second is master NC in that all feature maps of NC combine.



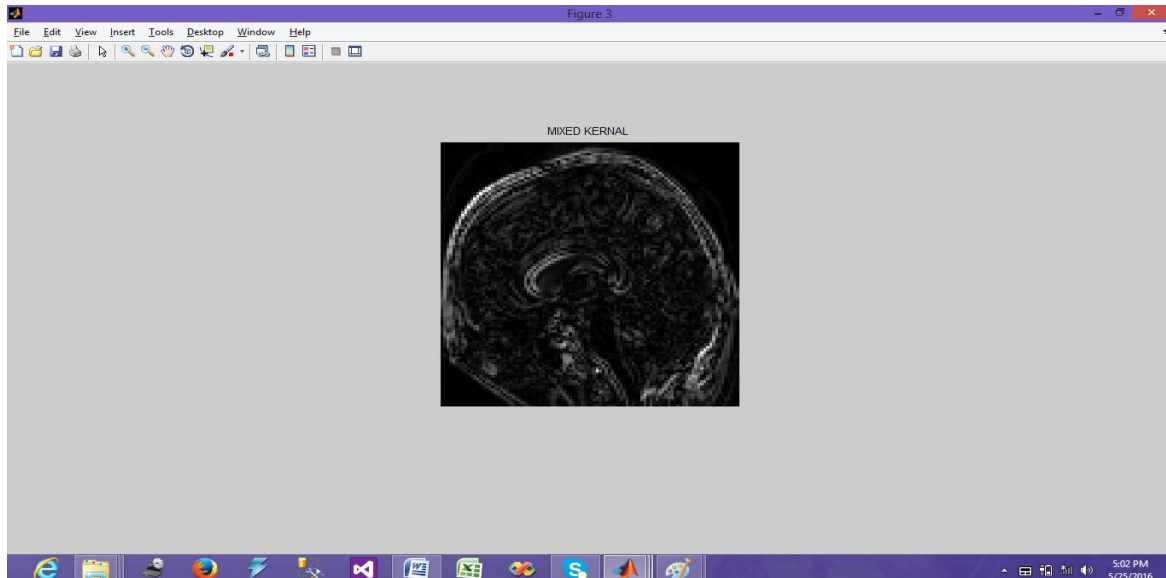
**Fig 3 Master maps**

In following fig 6.1.C shows mixed kernel map. In that master map of AD subtracted from master map of NC to generate mixed kernel. Mixed kernel is compared with test image.

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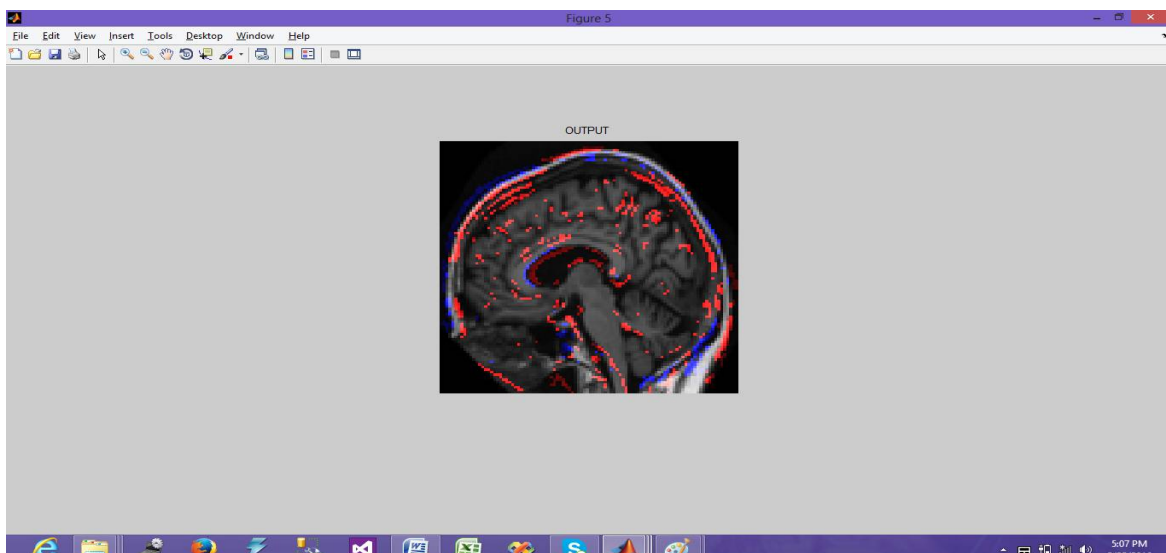
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**Fig 4 Mixed kernel**

In following fig 6.1.D shows anatomical patterns representation. In that according to test image and mixed kernel patterns for pathology represent in red color and patterns for normal represent by blue color.



**Fig 5 Anatomical patterns representation**

## IX. CONCLUSION

Saliency map figured by utilizing the GBVS (diagram based visual saliency) for the high exactness. By utilizing the GBVS can't misfortune any data. This procedure gives a subject characterization into ordinary control or Alzheimer

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infection patients, in light of bolster vector machines, which was contrasted and the analysis beforehand given by master radiologists. Saliency maps permit us to distinguish districts of relative change in force, introduction and edges, connected with every class (maniacal or non-unbalanced), portraying essential provincial examples appropriate for subject characterization. The precision of 80-90% is accomplished utilizing saliency map portrayal and bit k-implies technique is adjusted which is extremely helpful in separation of Neurodegeneration illnesses with better exactness (6).

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