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Identification of Alzheimer Disease: A Literature Survey

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Abstract **- Medical imaging works an essential part in the area of medical science. In today scenario, image segmentation is utilized to extricate abnormal tissues from normal tissues directly in medical images. Noise in an image is unacceptable to us as it interrupts and deteriorates the condition of the image. Noise removal is perpetually a challenging responsibility so as of edge protection when the strength of the disturbing noise in the initial image is enormous. Alzheimer's disease is a neurological dysfunction in which the brain death causes cognitive decline and Memory Loss. A neurodegenerative kind of dementia, the condition begins with mild and grows increasingly severe. A crucial area of medical research is Brain image examination, ends to identify brain diseases. The leading causes of Alzheimer's diseases are Moderate blood flow and brain activity. In this paper, a framework has introduced for the exposure of Alzheimer disease and a literature survey on Image Processing for the AD. This framework optimally determines the Alzheimer field in the neurological disorder.**
Keywords: **Image Processing, Alzheimer Disease, Pre-Processing**

I. INTRODUCTION

In a nation, over 400 thousand people have Alzheimer's disease [1] (about 6% of the population). One in six countries above age 60 has identified with the AD, and it is the fourth preeminent reason for death in the nations. An ideal examination is not potential till medium to severe pallium damage has happened. By utilizing image processing methods [2], an Alzheimer area can be accomplished by employing a blend of classification, denoising, feature extraction, and segmentation techniques. The proposed method has the possibility of assisting in medical examination.

Alzheimer's disease (AD) is the common famous dementia in seniors worldwide. Its prospect is 1 in 85 people will be influenced by 2050, and the amount of affected physiques is twice in the following 20 years [3]. Alzheimer's disease [4] was titled after the German pathologist Alois Alzheimer and psychiatrist after he criticized a female subject (post-mortem) in 1906 that had expired at age 51 after becoming critical memory problems, difficulty in following questions and confusion. Alzheimer stated two widespread irregularities in the patient's brain, "1. Solid floors of protein collected outside and among the nerve cells. 2. Regions of broken nerve tissues, in the nerve cells, which preferably of doing good had converted complicated". Besides, these tangles and plaques have been utilized to support diagnosing AD [5]. There are three stages of the AD: Dementia, preclinical, and moderate cognitive impairment. Preclinical suggests the beginning step of the AD. MCI comprises "mild changes in memory." Dementia indicates the rigor of the disease. The indications of AD varied among patients. The following are general Signs [6] of Alzheimer's

1. Loss of memory that Memory loss that interrupts everyday life.
2. Difficulties in proposing or resolving issues.
3. The Confusion with place or time.
4. Struggle for interpreting spatial and visual images relationships.
5. Poor or Limited decision.
6. Detachment from social or work exercises.

II. ALZHEIMER DISEASE

Alzheimer's is a growing disease, where dementia signs increasingly aggravate over several years [7]. In its initial steps, memory loss is moderate, but with late-stage Alzheimer's, somebody suffers the capacity to take on a discussion and answer to his or her conditions. Alzheimer's is the sixth preeminent case of death in the United States. Those with Alzheimer's live an aggregate of eight years following their indications grow observable to others, but survival can vary from 4 to twenty years, reckoning on health situations and age. Alzheimer's has no contemporary remedy, but medications for signs are possible, and research proceeds. Although modern Alzheimer's medications cannot prevent Alzheimer's from growing, they can tentatively reduce the exacerbating of dementia signs and enhance the condition of living for those with Alzheimer's and their health care providers. Now, there is a global struggle underway to discover useful methods to manage the disease, slow its attack, and prevent it from growing.

Alzheimer is the total brain substance contracts, and the tissue has fewer nerve cells and connections increasingly. In general, the brain arrangement varies when we get older just like the body structure. As a consequence, this is the reason for occasional issues and lower thinking of identifying specific things. The Alzheimer's Association states in its primary origin data that physicians do not require to obtain Alzheimer's disease in adolescent people. For the adolescent

age groups, physicians will view for additional dementia reasons first [1][8].

From the level of individual molecules, visualization of brain structure to the whole brain [9]. Several imaging techniques are non-incursive and allow efficient processes to be observed over the duration. Imaging is enabling researchers to separate neural networks connected in cognitive rules; ensure disease tracts; identity and detecting diseases at the inception when they have most efficiently handled and ascertain how therapies work.

III. IMAGING MODALITIES

A. Single Photon Emission Computed Tomography (SPECT)

Practical imaging modalities including SPECT and Positron Emission Tomography (PET) have mainly used for getting an early review. For taking the reliable conclusions concerning the appearance of such exceptions, it is good to promote computer-aided diagnosis (CAD) tools that can give the meaningful comparison in the functional brain image in contradiction to standard cases (investigation of specific characteristics in the image), about the condition of the anomalies. These CAD tools have comprised of various steps in order to make the last classification conclusion from the primary operative image database as root data.

B. Positron Emission Tomography (PET)

PET is a non-invasive medical imaging modality that gives 3D diagrams illustrating the glucose utilizing the percentage of the brain. Since glucose depletion was associated with the activity of the brain, PET images can be applied for detecting various diseases, including the AD.

C. Magnetic Resonance Imaging (MRI)

The features have obtained of the structural MRI; the current classification techniques can be classified into three sections, using 1) volumes of hippocampal, 2) probability of voxel-wise tissue and 3) cortical thickness. It has utilized to get more useful features for MCI, or AD classification has obtained from the entorhinal cortex, cingulate, and hippocampus. It presents valuable data for identifying Cerebrospinal Fluid (CSF) level in brain images. The normalization of the image has produced by utilizing Statistical Parametric Mapping (SPM) producing normalized images. MRI segmentation comprises defining neuroanatomical tissues introduce on a healthy brain: Cerebrospinal Fluid (CSF), White Matter (WM), and gray matter (GM).

IV. LITERATURE SURVEY ON THE AD USING IMAGE PROCESSING TECHNIQUES

The authors in [10], generate an image noise filter fitting for MRI in present conditions (display and acquisition), which protects small hidden features and expeditiously eliminates environment noise without including patch, blur, or smearing artifacts. The authors in [11], presented a three-step structure for analyzing the images of multiclass radiography. The first level uses a de-noising method based on the Statistical Kolmogorov Smirnov (KS) and wavelet transform (WT) test to exclude insignificant and noise features of the images. An unsupervised deep belief network (DBN) is intended for getting the untagged features in the next level. The mixture of KS and WT test in the initial step supports to enhance the DBNs performance. Subsets of Discriminative feature got in the first two levels work as inputs for the classifiers in the third level for valuations.

The authors in [12], defined the Transradial Coronary Angiography (TRA) has combined with extended portions of radiations. The authors hypothesized that the present image transformation technique would reduce radiation doses in the catheterization lab of the cardiac in a usual clinical environment.

The authors in [13], the proposed algorithm includes two steps in which the first step detects whether pixels are corrupted by impulse noise and the second stage performs a filtering operation on the detected noisy pixels.

The authors in [14], explained an optimal adaptive global threshold selection by maximizing between-class standard deviation through histogram peak analysis to obtain a coarse segmentation. This paper investigates a new computer-aided approach to detect the abnormalities in the digital mammograms using a Dual Stage Adaptive Thresholding (DuSAT).

The authors in [15], an algorithm for multiple watermarking based on discrete wavelet transforms (DWT), discrete cosine transform (DCT) and singular value decomposition (SVD) has been proposed for healthcare applications. For identity authentication purpose, the proposed method uses three watermarks in the form of medical Lump image watermark, the doctor signature/identification code and the diagnostic information of the patient as the text watermarks.

The authors in [16], proposed a system which uses K Nearest Neighbour (KNN) and high impact filter. The KNN is used to chouse skin and non-skin pixel, and then a high impact filter is applied which can remove the noise and blur from the image.

The authors in [17], proposed a hybrid impulse noise filter, it is implemented in two phases, in the first phase, fuzzy rules are used to detect the pixels affected by impulse noise, and in the second phase, the artificial neural network is used to remove noise from the affected pixel.

The authors in [18], proposed the Medav Filter which is a combination of mean and adaptive median filter that optimally adjusts the level of mask operations according to the noise density. The median filter has good noise removal qualities, but its complexity is undesirable.

TABLE I LITERATURE REVIEW ON THE IMAGE PROCESSING TECHNIQUES IN AD DETECTION

Techniques	Advantages	Disadvantages	Importance of Selecting the specific technique
Magnetic Resonance Imaging (MRI) [19]	MRI is used for detecting and scanning of abnormalities in soft tissue like the cartilage tissues and soft organs like the brain or the heart.	MRI scanners are costly.	MRI used to find changes in Tissue Atrophy. It is more specific in grey matter.
Positron Emission Tomography (PET) [20]	Can help diagnose, treat, or predict the outcome for a wide range of conditions.	Radioactive material may cause allergic or injection-site reactions in some people	It is used to find Changes in cerebral perfusion.
Single Photon Emission Computed Tomography (SPECT) [21]	Tracing the blood flow and the metabolic activities are occurring and enabling of brain functions.	Radioactive compounds quite expensive.	It has used to find Changes in glucose metabolism.
Non-Negative Matrix Factorization (NMF) [22]	Reduce the large dimensionality of the input data	Non-negativity constraints can restrict correct clustering to only non-negative data.	NMF is used to find the reduced linear representations of non-negative data, being a useful decomposition tool for multivariate data.
Partial Least Squares (PLS) [21][23]	Feature extraction is a more effective for extracting the correct information from the data.	Measuring process more complex.	PLS yields a significant improvement in the out-of-bag error rate.
Gaussian Mixture Model (GMM) [24]	GMM requires less feature vectors and produce a good result.	GMM take time-consuming and more samples.	GMM mainly for classical clustering and also used intensively for density estimation
Neuropsychological And Functional Measures (NM) [25]	NM was performed using a filter method. NMs are very separable between NC and AD groups	Different assessment procedures for nearly every patient. Different assessment procedures across different examiners.	NM achieved better prediction performance and good accuracy.
Principal Component Analysis (PCA) [26]	Reduce the redundant features and large dimensionality of the data	PCA only takes into account pair-wise relationships between voxels of the brain images.	PCA used to extract the most significant features from a dataset.
Independent Component Analysis (ICA) [27]	The ICA transformation is used for capturing groupdifferences from high order voxel relations, generating from the original average images sources.	Don't exist criteria for determining how many components represent the dynamic of the data.	The basic concept is motivated by the theory of redundancy reduction.
Fuzzy C Means (FCM) [28]	It is used to partition a finite collection of elements into a collection of fuzzy clusters concerning given rules.	Segmentation is not clear, and the noise is present in the image.	FCM algorithm considered as the efficient clustering method.
Total Variation regularizer Fuzzy C Means (TVFCM) [29]	TV method eliminates the noise and makes the segmentation result better.	It has the stair casing effect, smooth, destroy small-scale structures with high bending edges.	The value of the regularizing parameter is select manually for the best segmentation result and also get the good visual quality of the image
Anisotropic Diffused Total Variation Fuzzy C Means (ADTVFCM) [30]	Mainly used to reduce image noise without removing the image content, edges, lines and other details of the image.	Clusters number specify first.	ADTVFCM is to eliminate the stair casing effect and reducing the time.
Constrained Gaussian Mixture Model (CGMM) [28]	It captures the complicated spatial layout of the individual tissues.	Time-consuming for taking the spatial information and decision making of data into consideration.	Each tissue Gray Matter, White Matter, CSF is modeled with multiple 4D Gaussians.
Dynamic NeuroFuzzy Technique [31]	The natural rules representation make natural interpretation of the results	It answers only to what is written in its rule base.	It is an effective method to segment the normal and mental tissues in the MRI brain images.

V. EVALUATION METRICS

To measure the performancequantitatively, the widely used quantitative measures peak signal-to-noise ratio (PSNR), root mean squared error (RMSE), and Structural Similarity Index Measure (SSIM) are considered.

A. Root Mean Squared Error (RMSE)

$$RMSE\left(f(x,y),\hat{f}(x,y)\right)^2 = \sqrt{\frac{1}{m*n}\sum_{y=1}^{n}\left(f(x,y),\hat{f}(x,y)\right)^2}$$

RMSE represents the cumulative squared error between restored and original image. Lower the value of MSE results in less error.

B. Peak Signal to Noise Ratio (PSNR)

PSNR, in decibels, is used as a quality measurement between $f(x,y)$, and $\hat{f}(x,y)$. Higher the PSNR results in improved quality of the image. The PSNR is computed by using the equation

$$PSNR\left(f(x,y),\hat{f}(x,y)\right) = 10 * \log_{10}\left(\frac{N^2}{RMSE}\right)^2$$

VI. CONCLUSION

We conclude that proper diagnosis of Alzheimer Disease(AD) at a time when people are beginning analyze for help being annoyed about diversity in behavior, cognition, or functioning not surely resulting in insanity, has the potential to decrease the impact of negative or delayed diagnosis or misdiagnosis. In the prodromal stage of the disease diagnosis in timely could offer many potential advantages to patients and caregivers, especially the opportunity to get treatment to avoid medications, control symptoms that may worsen symptoms, possibly in the future, access to interventions that slow or lessen the disease process. The findings of this literature review show that, at the current time, these ideas are mainly based on expert opinion and perhaps belief. Further studies are needed to demonstrate not only that a timely diagnosis is achievable, but also that it has benefits. Such evidence would support the developmental shift towards analysis at the pre-dementia stage of Alzheimer Disease.

REFERENCES

[1] Yang, Yuan-Han, *et al.* "Gender's Effects to the Early Symptoms of Alzheimer's Disease in 5 Asian Countries", *American Journal of Alzheimer's Disease & Other Dementias*, Vol. 32, No. 4, pp. 194-199, 2017.

[2] Zhang, Daoqiang, *et al.* "Multimodal classification of Alzheimer's disease and mild cognitive impairment", *Neuroimage*, Vol. 55, No. 3, pp. 856-867, 2011.

[3] Sitzer, D. I., Elizabeth W. Twamley, and D. V. Jeste. "Cognitive training in Alzheimer's disease: a meta-analysis of the literature", ActaPsychiatricaScandinavica Vol. 114, No. 2, pp. 75-90. 2006

[4] Duthey, Béatrice. "Background paper 6.11: Alzheimer disease and other dementias", *A Public Health Approach to Innovation*, pp. 1-74. 2013.

[5] W.Thies, and L. Bleiler. "Alzheimer's Association. 2011 Alzheimer's disease facts and figures, *Alzheimers Dement*, Vol. 7, pp. 208-44, 2011.

[6] Liang, Ying and Lei Wang. "Alzheimer's disease is an important risk factor of fractures: a meta-analysis of cohort studies", *Molecular neurobiology*, Vol. 54, No. 5, pp. 3230-3235. 2017.

[7] Bhardwaj and Deepshikha, *et al.* "Alzheimer's disease-Current Status and Future Directions", *Journal of medicinal food*, Vol. 20, No. 12, pp. 1141-1151, 2017.

[8] He, Hao, *et al.* "Co-altered functional networks and brain structure in unmedicated patients with bipolar and major depressive disorders", Brain Structure and Function, Vol. 222, No. 9, pp. 4051-4064, 2017.

[9] Klosowski, Jakob, and Jens Frahm. "Image denoising for real-time MRI", Magnetic resonance in medicine, Vol. 77, No. 3,pp. 1340-1352, 2017.

[10] Khatami, Amin, *et al.* "Medical image analysis using wavelet transform and deep belief networks", Expert Systems with Applications, Vol. 86, pp. 190-198, 2017.

[11] Gunja, Ateka, *et al.* "Image noise reduction technology reduces radiation in a radial-first cardiac catheterization laboratory", *Cardiovascular Revascularization Medicine*, Vol. 18, No. 3, pp. 197-201, 2017.

[12] Bhadouria, Vivek Singh, *et al.* "A novel image impulse noise removal algorithm optimized for hardware accelerators", Journal of Signal Processing Systems, Vol. 89, No. 2, pp. 225-242. 2017.

[13] J. Anitha, J. Dinesh Peter and S. Immanuel Alex Pandian. "A dual stage adaptive thresholding (DuSAT) for automatic mass detection in mammograms", *Computer methods and programs in biomedicine*, Vol. 138, pp. 93-104. 2017.

[14] Zear, Aditi, Amit Kumar Singh and Pardeep Kumar. "A proposed secure multiple watermarking technique based on DWT, DCT and SVD for application in medicine", *Multimedia Tools and Applications*, Vol. 77, No. 4, pp. 4863-4882, 2018.

[15] Singh, Vinay and DeepaAswani. "Face Detection in Hybrid Color Space Using HBF-KNN", *Proceedings of International Conference on Recent Advancement on Computer and Communication*, Springer, Singapore, 2018.

[16] Amitab, Khwairakpam, *et al.* "Impulse Noise Reduction in Digital Images Using Fuzzy Logic and Artificial Neural Network", *Proceedings of the International Conference on Computing and Communication Systems, Springer*, Singapore, 2018.

[17] Gupta, Sayantan and Sukanya Roy. "Medav Filter—Filter for Removal of Image Noise with the Combination of Median and Average Filters", *Recent Trends in Signal and Image Processing, Springer*, Singapore, pp. 11-19, 2019.

[18] Ortiz, Andrés, *et al.* "Automatic ROI selection in structural brain MRI using SOM 3D projection", *PloS one*, Vol. 9, No. 4,2014.

[19] Segovia, Fermín, *et al.* "A comparative study of feature extraction methods for the diagnosis of Alzheimer's disease using the ADNI database", *Neurocomputing*, Vol. 75, No. 1, pp. 64-71, 2012.

[20] J. Ramírez, *et al.* "Computer aided diagnosis system for the Alzheimer's disease based on partial least squares and random forest SPECT image classification", Neuroscience letters, Vol. 472, No. 2, 99-103, 2010.

[21] P. Padilla, *et al.* "Analysis of SPECT brain images for the diagnosis of Alzheimer's disease based on NMF for feature extraction", *Neuroscience letters*, Vol. 479, No. 3, pp. 192-196, 2010.

[22] Penny, William D., *et al.*, eds. "Statistical parametric mapping: the analysis of functional brain images", *Elsevier*, 2011.

[23] Freeborough, A. Peter, and Nick C. Fox. "MR image texture analysis applied to the diagnosis and tracking of Alzheimer's disease", *IEEE Transactions on Medical Imaging*, Vol. 17, No. 3, pp. 475-478, 1998

[24] Cui, Yue, *et al.* "Identification of conversion from mild cognitive impairment to Alzheimer's disease using multivariate predictors", *PloS one*, Vol. 6, No. 7, e21896, 2011.

[25] I. A. Illán, *et al.* "18F-FDG PET imaging analysis for computer aided Alzheimer's diagnosis", *Information Sciences*, Vol. 181, No. 4, pp. 903-916, 2011.

[26] Hyvarinen, Aapo, "Fast and robust fixed-point algorithms for independent component analysis", *IEEE transactions on Neural Networks*, Vol. 10, No. 3, pp. 626-634, 1999.

[27] Kalti, Karim, and Mohamed Ali Mahjoub, "Image segmentation by gaussian mixture models and modified FCM algorithm", *Int. Arab J. Inf. Technol.*, Vol. 11, No. 1, pp. 11-18.

[28] Selvy, P. Tamije, V. Palanisamy, and M. Sri Radhai, "A proficient clustering technique to detect CSF level in MRI brain images using PSO algorithm", *WSEAS Trans. Comput*, Vol. 7, No. 7, pp. 298-308, 2013.

[29] Segovia, Fermín, *et al.* "Combining PET images and neuropsychological test data for automatic diagnosis of Alzheimer's disease", *PLoS One*, Vol. 9, No. 2, e88687, 2014.

[30] Hussain, S. Javeed, T. SatyaSavithri, and PV Sree Devi, "Segmentation of tissues in brain MRI images using dynamic neuro-fuzzy technique", *International Journal of Soft Computing and Engineering*, Vol. 1, No. 6, pp. 2231-2307, 2012.