Systematic Survey on Alzheimer's (AD) Diseases Detection

Preeti Deshmane
Research Scholar, dept.of E&TC
G. H. Raisoni College of Engineering and Management
Pune
topannavarp@gmail.com
Dr. D. M. Yadav
Professor, dept.of E&TC
G. H. Raisoni College of Engineering and Management
Pune
topannavarp@gmail.com

ABSTRACT:

ADNI- Alzheimer's Disease Neuroimaging Initiative is a continuing,multicenter, longitudinal study that aims to create biomarkers for Alzheimer's disease that canbe used for early monitoring and detection (AD). Alzheimer's-Disease affects thinking and memory while also causing the overall size of the mind to decrease, ultimately leading to death. The development of more effective treatments for AD depends on an early diagnosis of the condition. A subset of artificial intelligence known as machine learning (ML), uses a number of probabilistic and optimization techniques to help computers learn from huge and complicated datasets. In order to diagnose AD in its early stages, researchers typically use machine learning.The work that has recently been done towards the early identification of AD using ML approaches is reviewed, analysed, and critically evaluated in this publication. Although several approaches showed potential prediction accuracies, it was challenging to compare them fairly because their evaluations were based on diverse pathologically untested data sets from various imaging modalities. The evaluation of prediction accuracy is also significantly influenced by a number of additional variables, including preprocessing, the quantity of crucial attributes for Feature's selection, and Class-Imbalance.The most effective classifiers currently integrate the best features from a variety of imaging techniques, including fluorodeoxy glucose-PET, MRI, clinical testing and CSF biomarkers. We discuss the various detection techniques in this article.

Keywords: neurodegeneration; Alzheimer's disease; protein; disease-modifying therapy;risk factors; chaperons;

DOINumber:10.14704/nq.2022.20.8.NQ44718 **NeuroQuantology2022;20(8):6918-6929**

1. INTRODUCTION-

The most ubiquitous form of Dementiais Alzheimer's disease (AD), called after German Psychiatrist Alois Alzheimer and characterised by Neurofibrillary tangles and Neuritic Plaques which is outcome of Amyloid Beta Peptide (A) buildup in brain's most exaggeratedregion. AD is gradual, degenerative clause that affect on brain's neurons and causes memory loss, language abilities andloss of thinking, and behavioral changes. It is a neurological condition that disproportionately affects those over sixty-five and whose frequency rises by age.

When Alois Alzheimer examines brain of their1st serene, that experiences memory loss, change in individualityprior to passing away, he founds the incidence of Amyloid Plaques,note worthy losses of Neuron's. Then, he defined this illness as a dreadfulinfection of Cerebral-Cortex.In his psychiatry handbook's eighth edition, Emil Kraepelin for the first time referred to this illness as Alzheimer's Disease. AD and other brain's disorders, abnormalities, infections, in the circulatory and pulmonary systems that reduces the amount of Oxygen delivered to Brain, vitamin B12 deficiencies, Nutritional deficiencies, tumours, and other situation can all contribute to the progressive loss of cognitive abilities.

One of the biggest cause of death in Developed Country is Alzheimer's Disease (AD). Although computer-aided algorithms have produced outstanding results from a research standpoint, there is currently no clinically useful diagnostic approach. Deep models have gained popularity recently, particularly when it comes to working with Images.From 2017, the numerous publications in this field are dramatically increased. DL-Deep Learning has started to receive significant interest in AD Detection researches since 2013. When compared to typical machine learning methods, deep models are reportedly found more accurate at detecting AD. Even so, detecting AD remains difficult, and to classify it, it needs a higher discriminative feature's representations to distinguish between related brain patterns. Their study evaluates state of deep learning-based AD-detection at the moment.We present recent findings, trends after conducting a thorough literature evaluation of more than hundreds of articles. With regard to handling Neuro-imaging data arising from Single-Modality toMulti-Modality investigations, we go through some useful biomarkers and features (genetic information, brain scans and personal information), the necessary preprocessing stages, and various approaches. In-depth descriptions of deep models' performance are provided. Although Deep Learning has shown secure in diagnosing AD, it still has certain drawbacks, particularly in terms of training methods and dataset accessibility.

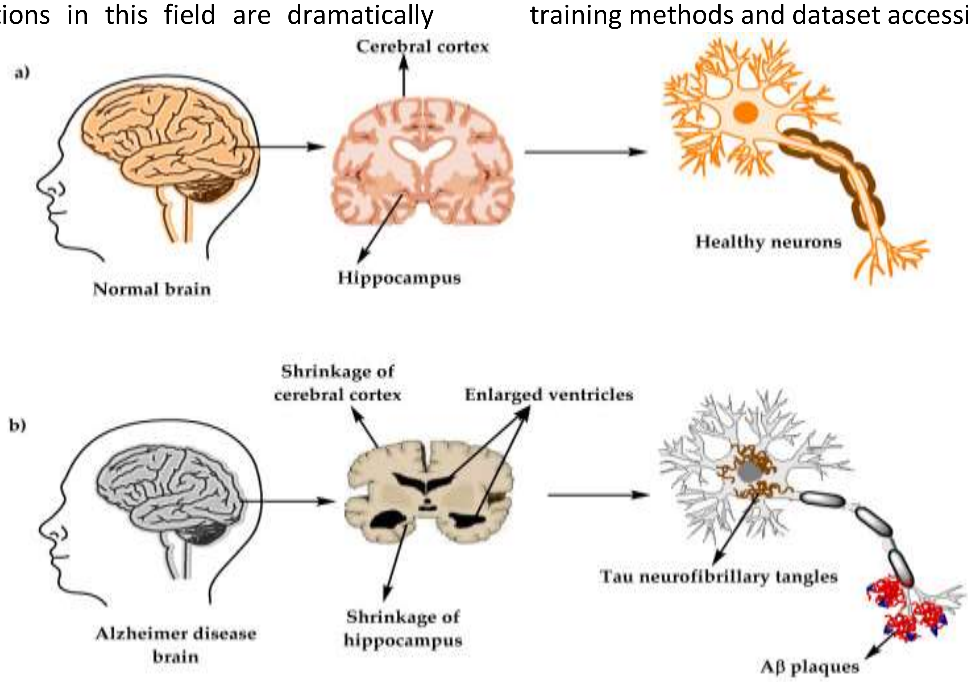

Figure 1- Neuronsand Brain physiological structure (a) hale and hearty Brain, (b) AD diseased Brain

We Performs brain scans to verifyAlzheimer's Diagnosis or other potential causes of symptoms, such as MRI by NagareShweta et al,CT , or PET. Seven Early Symptoms are-

- Memory loss that affects daily life. ...
- Loss of problem-solving ability. ...
- Confusion about times and places. ...
- Limitations with language. ...
- Misplacing things. ...
- Poor judgment. ...
- Personality changes.

These Alzheimer's Disease cannot be accurately diagnosed by a blood test, brain scan, or physical examination. A typical medical test for AD frequently involves structural imaging using MRI by NagareShweta et al or computed tomography (CT). The numbers of tests are performed to rule out other Diseases that may present with symptoms similar to Alzheimer's but called for another medical care.

In the later stages, AD patients completely rely on caregivers for even basic daily activities like eating, washing, and clothing. Additionally, patients' motor skills are impacted, making them more susceptible to infections. Generally, common direct causes of death is pneumonia, an infection of the lungs.

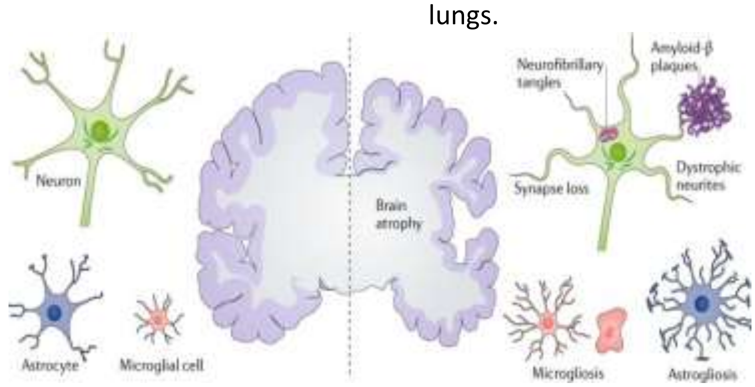

Figure 2- Figure Showing effect of Alzheimer's Disease on Human Brain (Ref:www.nature.com/articles/s41582-018-0013-z)

According to the literature, there are now more potential to automate the detection of AD as a result of advancements in medical imaging, increasing accessibility of neuroimaging data sets, and growth in computer capacity. Neuroimaging techniques have been used widely in numerous research studies over the few decades to learn more about the morphological and functional changes in the brain caused by AD. The clinical value of neuroimaging modalities utilised in individuals with probable AD is listed in Table 1.

Table 1- Lists the abnormalities discovered using various neuroimaging techniques.

Neuroimaging Techniques	Finding of Abnormalities
CT	Tissue atrophy
MRI	Tissue atrophy. It is more specific about grey matter.
SPECT	Changes in cerebral perfusion
CT	Changes in glucose metabolism
MEG	Measures magnetic fields & yields information about brain electrical activity

As it is used to examine changes in brain structure and volume, MRI is one of the crucial neuroimaging methods. There are numerous ways to identify the crucial aspects of the brain's structure and categorise them to distinguish between healthy and diseased brains.

2.LITERATURE SURVEY:

The first step in the procedure is Features extraction, which involves taking the most significant features from a brain MRI. After feature extraction, the feature vector has a high degree of dimension, which makes calculation difficult. Therefore, we must choose only the pertinent qualities, rejecting the rest. Feature selection is the term for this. After this, classification is used to differentiate between AD and healthy brain. Figure 2 displays the procedure's overall structure.

Some of the publications make comparisons between dementia patients and healthy controls, while others make distinctions between the various stages of Alzheimer's disease. Although some research, such as those by Herholz, K. et al., used other imaging techniques such diffusion tensor or radioisotope approaches, the majority of investigations used structural imaging. Because of this, it is challenging to get a clear picture of the accuracy, cost, and system complexity at now. There has been study on a number of feature extraction, feature reduction, and feature classification techniques over the past ten years. From there, some are concentrated on processing thePET/MRI scans, and a smaller number are concentrated on improving classification. Only a few of the papers mentioned are further addressed.

Machine learning was employed by Javier Escuderoet al. to provide a precise and affordable diagnosis of AD. It computes the sequence of biomarkers that is most instructive or economical for diagnosing patients using a customised classifier model for each patient. This approach takes each biomarker into account one at a time as needed. This lowers the cost of diagnosis from person to person, but the system's performance cannot be as effectively demonstrated as when all the parameters are taken into account at once.

The Hippocampus ofMRI Image is segmentizedand processedby a variety of MLalgorithms, including SVM (Support Vector Machines)by manual selection of features,hierarchical AdaBoost, AdaSVMhierarchical SVM with programmed Features selections. This advanced method was presented by Jonathan Morra et al. The segmentations using AdaBoost and Ada-SVM compared well. NMF-SVM based technique for diagnosis of AD was given by P. Padilla, M et al.. Their suggested method based on the combination of SVM for classification and Nonnegative Matrix Factorization (NMF) for Features selections and reductions.Two brain functional image datasets are used to validate the NMF-SVM CAD tool: a Dataset for learning of brain blood flow, and a Dataset for learning of Glucose metabolism. Hence, suggested

NMF-SVM method's validation findings show up to 91% classification accuracy for both data sets, together with specificity values andhigh sensitivity (higher than 85%). SPECT and PET scans are more expensive in comparison.

AD was suggested by DebeshJha et al. using PCA, Feed-Forward NNNetwork and Dual-Tree (DTCWT) ComplexWavelet Transform in 2017. Said automated diagnosis method distinguishes AD from healthy controls using MRI scans (HC). Its testing makes use of the OASIS database. For feature extraction, DTCWT, one of the most effective and cutting-edge techniques, is applied. The size of the feature vector grows when DTCWT is used; this size can be decreased by employing Principal Component Analysis. To separate AD and HC from the input MRI images, a Feed-Forward Neural Network (FNN) is used. With 10-fold cross-validation statistical analysis, this method generated high accuracy rates of 90%, sensitivity of 92.0%, specificity of 87.8%, and precision of 89.60%.

Using Complex LDA and DTCWT Principal Coefficients, by Saruaret al suggested TwinSVM-Based taxonomy of AD (Alzheimer's Disease) in 2017. This method uses MR scans to show morphometric variations, structural alterations to the brain, and a noninvasive biomarker to identify AD from HC. It uses DTCWT to extract features from MRI scans. Although PCA for the DTCWT-obtained coefficients decreases the data size and, to some extent, solves the overfitting problem, LDA is still applied on the principal coefficients for a more distinct classification of the two classes. The accuracy is increased by using SVM-based classification. For ADNI Dataset, projected accuracy using said methodology is 92.65, with a specificity of 92.19 and a sensitivity of 93.11.The prediction accuracy over the OASIS Dataset is 96.68. This method's accuracy, sensitivity, and specificity are equivalent to those produced by different established AD prediction techniques.

In 2013, B. S. Mahanand et al developed a technique for using MRI scans to identify development of Alzheimer's disease (AD). Based on three class classification, this algorithm. NC-Normal-control, Mild AD, AD are three classification classes employed. For the purposes of feature extraction, classification, and reduction, this technique combines the GA-ELM-PSO algorithms. The high dimensional features required for classification are reduced using the genetic algorithm GA and the volumetric analysis that a Voxel-Based Morphometry (VBM) technique uses to extract features from MRI data. For the 10 fold cross validation approach, the GA ELM PSO classifier has antypical training precision of 94.57% and an average testing precision of 87.23% for all classes. From the findings, it is clear that the new algorithm is capable of comparing MRI scans for normal control (NC), mild AD, and AD. Numerous additional papers were examined; the summary of them is provided in Table 2.

Table 2- summary of researches on feature extraction, reduction, and classification.

S.N.	Author & Year	Methodologies Used	Dataset Used	Parameters	Highlights of paper
1	Rigel Mahmood et al. (2020)	Feature extraction: diffeomorphism which generates a mapping from one MRI to another. and reduction - PCA, Classification - feed forward multi-layer Neural Network	OASIS Dataset 78 Subject HC 44	Correct classification of 89.22%.	Enhanced automated Alzheimer's Disease detection algorithm accurately determines the severity of AD Compared the performance with varing no. PCA & Neuron size
2	Dan Pan, A Zeng et al (2020)	convolutional neural network (CNN) Ensemble Learning (EL)	ADNI Dataset 200 Subjects, AD=100, HC =100	Accuracy=92.4%,	Deep learning process has limitations of accuracy because of datasize
3	S. Saraswathi et al. (2018)	Feature extraction-VBM, Feature Selection=GA, Feature Optimization-Particle Swarm optimization (PSO), classification-ELM	OASIS Dataset subjects =198, AD=109, HC=98	Average training accuracy =94.57% Testing accuracy= 87.23%,	Proposed system formulates AD as three category problem (normal vs. mild AD vs. moderate AD). Better classification performance due to cost effective learning approach. Smallest training error and better generalization performance

4	Saruar Alam et. al in (2017)	Feature Extraction-DTCWT Feature reduction – PCA & LDA Classification KSVM	OASIS Dataset 95 Subject AD=44 HC=51	Accuracy=90.181%, Sensitivity=90.276 %, Specificity=90.101 % Precision=89.31%	5fold cross validation is used Compared classification with TSVM
5	M.Evanchalin Sweety et al. (2017)	Feature extraction-PCA, Feature Reduction-Particle Swarm optimization (PSO), classification-SVM	Virgen de las Nieves Hospital (Granada, Spain). Subjects=79, NC = 41, AD= 38	SPECT: Accuracy=91.89%, Sensitivity=91.24%, Specificity=93.10% PET: Accuracy=86.89%, Sensitivity=88.10%, Specificity=85.16%	Efficient feature selection which reduces the computation time, Simple and fast leaning and classification steps
6	Debesh Jha et al. in (2017)	Feature Extraction-DTCWT Feature reduction - PCA Classification – FNN	OASIS Dataset 126 Subject AD=28 HC=98	Accuracy=90.06%, Sensitivity=92.00%, Specificity=87.78% Precision=89.6%	10-fold cross validation is used
7	Saruar Alam et. al in (2017)	Feature Extraction-DTCWT, Feature reduction – PCA & LDA Classification –TSVM	OASIS Dataset =95 subjects, AD=44, HC=51, Total Database =172 subjects, AD=86, HC= 86	Accuracy=92.65%, Sensitivity=93.11%, Specificity=92.11%	Used LDA after PCA 10-fold cross validation is used
8	Luis Javier Herrera et al. (2016)	Feature extraction-Discrete Wavelet Transform (DWT), Feature Reduction-PCA, Classification-SVM	ADNI database, subjects=1350, AD=459, NC=443	Accuracy=83.63%,	Compared the performance of various wavelet filters.
9	Qi Zhou et.al (2014)	Feature extraction: Volumetric analysis using free surfur Classification: SVM	Not Mentioned	Accuracy=92.4%,	MRI and CSF analysis
10	B. S. Mahanand et al. [13]	Feature Extraction-VBM Feature reduction - PCA Classification – SRAN	OASIS Dataset,60 Subject AD=30 NC=30	Mean testing efficiency - 91.18% (with 20 PCA reduced features)	The number of samples are reduced by using SRAN which avoids overtraining, Offers better generalization performance relative to other classifiers, Reduced learning time, minimized computational effort and compact classifier

3.BLOCK DIAGRAM

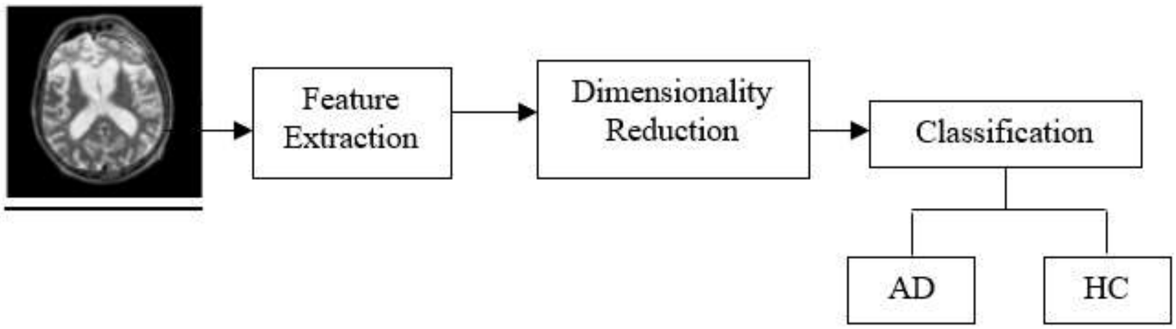

Figure 3- Block Diagram of System

Since the last 20 years, there has been substantial research being done in world to diagnose early identification of Alzheimer's (AD) and to address the primary problem of inference. The process of automating brain image analysis has been tried numerous times. Neuroimaging-based digital image processing techniques offer an automated computer-aided diagnostics tool. They report less than 100% categorization accuracy despite their accomplishment. For a reliable patient diagnosis, it is highly desirable to have precise classification. To create a CAD tool for iterative AD detection, coupled with a thorough explanation of how it is formed, including feature selection, extraction, and categorization of neuroimages to enable physicians in making an early and more accurate diagnosis.

4. CONCLUSION-

To create a CAD tool for AD detection, coupled with a thorough explanation of how it is formed, including feature selection, extraction, and categorization of neuroimages to enable physicians in making an early and more accurate diagnosis. Examine current techniques for spotting changes connected to Alzheimer's disease detection, and gather and research reliable datasets. This study introduces feature extraction and reduction strategies that produce compact feature vectors after preprocessing the dataset.This research aids in the development of an effective classifier for the classification of data samples related to HC and AD. According to literature, there are now more potential to automate the detection of AD as a result of advancements in medical imaging, increasing accessibility of neuroimaging data sets, and growth in computer capacity. Neuroimaging techniques have been applied broadly in numerous researcher studies from few decades to learn more about the functional and morphological changes in the Neuron caused by Alzheimer's.

REFERENCES-

1. Khan and M. Usman, "Early diagnosis of Alzheimer's disease using machine learning techniques: A review paper," *2015 7th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (IC3K)*, 2015, pp. 380-387.
2. Michael W. Weiner, Dallas P. Veitch, Paul S. Aisen, et al, "The Alzheimer's Disease Neuroimaging Initiative: A review of papers published since its inception", *Alzheimer's & Dementia*, 2013, Volume 9, Issue 5, pp. e111-e194, https://doi.org/10.1016/j.jalz.2013.05.1769.

3. Amir Ebrahimighahnavieh, SuhuaiLuo, Raymond Chiong, "Deep learning to detect Alzheimer's disease from neuroimaging: A systematic literature review", *Computer Methods and Programs in Biomedicine*, 2020, Volume 187, 105242, https://doi.org/10.1016/j.cmpb.2019.105242.
4. M. Tanveer, B. Richhariya R. U. Khan, et al., "Machine Learning Techniques for the Diagnosis of Alzheimer's Disease: A Review", *ACM Transactions on Multimedia Computing, Communications, and Applications,* 2020, Vol 16, Issue 1s, pp. 1–35. https://doi.org/10.1145/3344998
5. Breijyeh Z, Karaman R.,"Comprehensive Review on Alzheimer's Disease: Causes and Treatment". *Molecules*. 2020, 25,(24):5789. doi: 10.3390/molecules25245789.
6. AlberdiAramendi, Ane and Aztiria, Asier and Basarab, Adrian,"On the early diagnosis of Alzheimer's Disease from multimodal signals: A survey", *Artificial Intelligence in Medicine*, 2016, vol. 71. pp. 1-29.
7. Javier Escudero , John P Zajicek , Emmanuel Ifeachor, "(CTs) in Alzheimer's Disease (AD) and Mild Cognitive"
8. Herholz, K. Pawlik, G. et al , "Neurologic aspects of cerebral diagnosis by radio-isotope methods",
9. Jonathan H. Morra, ZhuowenTu, Liana G. Apostolova, Amity E. Green, et al, "Automated mapping of hippocampal atrophy in 1-year repeat MRI data from 490 subjects with Alzheimer's disease, mild cognitive impairment, and elderly controls",*Neuroimage.* 2009,Vol45 Issue 1 Suppl, pp. S3–15.. doi: 10.1016/j.neuroimage.2008.10.043
10. Javier Escuderet all, "Machine Learning-Based Method for Personalized and Cost-Effective Detection of Alzheimer's Disease". *IEEE Transactions On Biomedical Engineering*, 2013, Vol. 60, issue 1.
11. P. Padilla M. López et all, "NMF-SVM Based CAD Tool Applied to Functional Brain Images for the Diagnosis of Alzheimer's Disease",*IEEE Transactions On Medical Imaging*,2012, Vol. 31, Issue 2.
12. Jonathan H et all. "Comparison of AdaBoost and Support Vector Machines for Detecting Alzheimer's Disease through Automated Hippocampal Segmentation" *IEEE Transactions On Medical Imaging,* 2010, Vol. 29, Issue. 1.
13. Qi Zhou et all, "An Optimal Decisional Space for the Classification of Alzheimer's disease and Mild Cognitive Impairment" *IEEE Transactions On Biomedical Engineering,*2014, Vol. 61, Issue 8, pp. 0018-9294.
14. SaruarAlam , Goo-Rak Kwon, Ji-In Kim , Chun-Su Park , "Twin SVM-Based Classification of Alzheimer's Disease Using Complex Dual-Tree Wavelet Principal Coefficients and LDA", *J.Healthc. Eng.* 2017, DOI: 10.1155/2017/8750506
15. DebeshJha, Ji-In Kim, and Goo-Rak,"Kwon Diagnosis of Alzheimer's Disease Using Dual-Tree Complex Wavelet Transform, PCA, and Feed-Forward Neural Network", *Data Mining for Biomedicine and Healthcare,* 2017, https://doi.org/10.1155/2017/9060124
16. J Sirisha Devi, Mr. B. Sreedhar, et al, "A path towards child-centric Artificial Intelligence based Education", *International journal of Early Childhood special Issue*, 2022, Vol 14, Issue 03, pp. 9915-9922.
17. Dan Pan, An Zeng,LongfeiJia, et al, "Early Detection of Alzheimer's Disease Using Magnetic Resonance Imaging: A

Novel Approach Combining Convolutional Neural Networks and Ensemble Learning", *Front. Neurosci.*, 2020 https://doi.org/10.3389/fnins.2020.00259

18. Miss A.J. Dixit, et al, "Iris Recognition by Daugman's Method", *International Journal of Latest Technology in Engineering, Management & Applied Science*, July 2015, Vol 4, Issue 6, pp 90-93.
19. S. Saraswathi et.al "Detection of onset of Alzheimer's Disease from MRI images Using a GA-ELM-PSO Classifier", *2013 Fourth International Workshop on Computational Intelligence in Medical Imaging (CIMI)*.
20. Ms. ShwetaNagare, et al., "An Efficient Algorithm brain tumor detection based on Segmentation and Thresholding", *Journal of Management in Manufacturing and services*, Sept 2015, Vol 2, Issue 17, pp.19-27.
21. RigelMahmood, BishadGhimire "Automatic Detection and Classification of Alzheimer's Disease from MRI Scans Using Principal Component Analysis and Artificial Neural Networks", *20th International Conference on Systems, Signal and Image Processing (IWSSIP).* 2013
22. M.Evanchalin,Sweety,G.WiselinJiji, "Detection of Alzheimer Disease in Brain Images Using PSO and Decision Tree Approach", *IEEE International Conference on Advanced Communication Control and Computing Technologies (ICACCCT),* 2014
23. Ms. ShwetaNagare, et al, "Different Segmentation Techniques for brain tumor detection: A Survey", *MM-International society for green, Sustainable Engineering and Management*, Nov 2014, Vol 1, Issue 14, pp.29-35.
24. Qi Zhou, Mohammed Goryawala, Mercedes Cabrerizo, Jin Wang, Warren Barker, David A. "An Optimal Decisional Space for the Classification of Alzheimer's Disease and Mild Cognitive Impairment", *IEEE Transactions on Biomedical Engineering* , 2014, Vol 61, Issue 8, pp.: 2245 – 2253, DOI: 10.1109/TBME.2014.2310709
25. B.S.Mahanand, S.SureshN.SundararajanM.Aswatha Kumar, "Identification of brain regions responsible for Alzheimer's disease using a Self-adaptive Resource Allocation Network", *Neural Networks,* 2012, Vol 32, Special Issue, pp. 313-322.
26. Kulkarni P.R., Mulani A.O. and Mane P. B., "Robust Invisible Watermarking for Image Authentication", In Emerging Trends in Electrical, Communications and Information Technologies, *Lecture Notes in Electrical Engineering*, vol. 394,pp. 193-200, Springer, Singapore, 2017.
27. Luis Javier Herrera, Ignacio Rojas, H. Pomares, A. Guillén, O. Valenzuela, O. Baños. "Classification of MRI Images for Alzheimer's Disease Detection", *2013 International Conference on Social Computing*, 2013, DOI: 10.1109/SocialCom.2013.127
28. MsMachhaBabitha, C Sushma, et al, "Trends of Artificial Intelligence for online exams in education", *International journal of Early Childhood special Issue*, 2022, Vol 14, Issue 01, pp. 2457-2463.
29. Mr D. Sreenivasulu, Dr. J. Sirishadevi, et al, "Implementation of Latest machine learning approaches for students Grade Prediction", *International journal of Early Childhood special Issue*, June 2022, Vol 14, Issue 03, pp. 9887-9894.
30. M. Tanveer, B. Richhariya, R. U. Khan, A. H. Rashid, P. Khanna, M. Prasad, C. T. Lin. "Machine Learning Techniques for the Diagnosis of Alzheimer's

Disease", *ACM Transactions on Multimedia Computing, Communications, and Applications,* 2020
31. Rahul Shinde and A. O. Mulani, “Analysis of Biomedical Image using Wavelet Transform”, *International Journal of Innovations in Engineering Research and Technology*(IJIERT), July 2015
32. "Machine Learning in Healthcare Informatics",*Springer Science and Business Media LLC,2014*
33. Mahmood, Rigel, BishadGhimire."Automatic detection and classification ofAlzheimer's Disease from MRI scans usingprincipal component analysis and artificialneural networks", *2013 20th InternationalConference on Systems Signals and ImageProcessing (IWSSIP)*, 2013.
34. HalebeeduSubbarayaSuresha, SrirangapatnaSampathkumaranParthasarathy."Probabilistic Principal Component Analysisand Long Short-Term Memory Classifier forAutomatic Detection of Alzheimer’s Diseaseusing MRI Brain Images", *Journal of TheInstitution of Engineers (India): Series*
35. A.O.Mulani and Dr.P.B.Mane, “An Efficient implementation of DWT for image compression on reconfigurable platform”, *International Journal of Control Theory and Applications,* Vol.10 No.15, 2017.
36. AneAlberdi, AsierAztiria, Adrian Basarab. "Onthe early diagnosis of Alzheimer's Diseasefrom multimodal signals: A survey", *ArtificialIntelligence in Medicine*, 2016
37. Mr Amir Ebrahimighahnavieh, SuhuaiLuo,Raymond Chiong. "Deep learning to detectAlzheimer's disease from neuroimaging: Asystematic literature review", *ComputerMethods and Programs in Biomedicine,* 2020
38. A. O. Mulani and G. N. Shinde, “An approach for robust digital image watermarking using DWT- PCA”, *Journal ofScience and Technology,* Vol.6, Special Issue 1, 2021
39. Rania Chokri, WasmaHanini, Wided BenDaoud, SamiaAllaouaChelloug, AmelMeddebMakhlouf. "Secure IoT Assistant-BasedSystem for Alzheimer’s Disease", *IEEE Access,*2022
40. Robert Logan, Brian G. Williams, MariaFerreira da Silva, AkashIndani, NicolasSchcolnicov, Anjali Ganguly, Sean J. Miller."Deep Convolutional Neural Networks WithEnsemble Learning and GenerativeAdversarial Networks for Alzheimer’s DiseaseImage Data Classification", *Frontiers in AgingNeuroscience,* 2021
41. BijenKhagi, GooRak Kwon, Ramesh Lama."Comparative analysis of Alzheimer's diseaseclassification by CDR level using CNN, featureselection, and machinelearning techniques",*International Journal of Imaging Systems andTechnology,* 2019
42. S. Saraswathi, B. S. Mahanand, A.Kloczkowski, S. Suresh, N. Sundararajan."Detection of onset of Alzheimer's diseasefrom MRI images using a GA-ELM-PSOclassifier", *2013 Fourth International Workshop on Computational Intelligence in Medical Imaging (CIMI),* 2013
43. A.O. Mulani and G. N. Shinde, “An approach for robust digital image watermarking using DWT- PCA”, *Journal of Science and Technology,* 2021,Vol.6, Special Issue 1.
44. U. P. Nagane and A. O. Mulani, “Moving Object Detection and Tracking Using Matlab”, *Journal of Science and Technology,* 2021, Vol.6, Special Issue 1.
45. E R Amulya, SoumyaVarma, Vince Paul. "Classification of brain images for Alzheimer's disease detection", *2016 IEEE International Conference on*

Computational Intelligence and Computing Research (ICCIC), 2016.

46. Priyanka, Dharmendra Kumar, “Meta Heuristic Techniques to Train ANN for Medical Image classification:A Review”, *Recent Advances in Comp. Sci. and Comm.* 2022
47. SurabhiAdhikar, et al ,”A Comparative study of Machine Learning and NLP Tech for uses of stop words by Patients in diagnosis of AD”, *Int Joint confon Neural network (IJCNN),* 2021,
48. Mr Amir Ebrahimghahnavieh, et al , “Deep learning to detect AD from neuroimaging: A systematic literature review”, *Comp methods and Prog in Biomedicine,* 2020.