Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Special Issue 4, April : 2024

DIAGNOSIS OF ALZHEIMER'S DISEASE USING CONVOLUTIONAL NEURAL NETWORK

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ABSTRACT
Alzheimer's disease (AD), a progressive neurodegenerative disorder, affects millions worldwide. Early and accurate diagnosis is critical for effective management and improved patient outcomes. This system analysis explores the development of a diagnostic tool that integrates the Mini-Mental State Examination (MMSE), a standardized cognitive assessment, with Magnetic Resonance Imaging (MRI), a non-invasive brain imaging technique. We aim to leverage the strengths of both approaches to enhance diagnostic accuracy for AD. The proposed system will analyze data from [Target Population, e.g., 100 patients aged 65-80] who will undergo both MMSE and [Specific MRI modality, e.g., structural MRI] scans. The system will identify potential patterns and biomarkers in the combined MMSE scores and MRI data associated with AD. This analysis will provide valuable insights into the feasibility of developing a comprehensive diagnostic system for AD.
Keywords: Alzheimer's Disease, Mini-Mental State Examination, Magnetic resonance imaging, Convolutional neural network.

INTRODUCTION

Alzheimer's disease (AD) stands as one of the most challenging and prevalent neurodegenerative disorders affecting millions of individuals worldwide. Magnetic Resonance Imaging (MRI) has emerged as a pivotal tool in the quest for early Alzheimer's disease detection, offering insights into structural changes within the brain. The deterioration of physical and neurological functions in persons is part of the aging process. Although deterioration is natural, it can significantly influence some persons due to certain risk factors. Alzheimer's disease is a neurocognitive disorder occurring in people in their middle or old age, and it affects 46.8 million people globally and can impact a person's quality of life. Alzheimer's disease populations are estimated to increase to 106.8 million by 2050. The estimated cost of long-term health care for dementia patients is about
$290 billion. Research towards early Alzheimer's disease diagnosis is ongoing to slow down the abnormal degradation of neurons in the brain. It also produces emotional and financial benefits for the patient's family.

LITERATURE SURVEY

[1] Dubois B, Padovani A, Scheltens P, Rossi A, DellAgnello G. Timely diagnosis for Alzheimers disease: a literature review on benefits and challenges. Journal of Alzheimer's disease. 2016 Jan 1;49(3):617-31. Researchers believe diagnosing Alzheimer's disease earlier, when people first notice changes in memory or thinking, could offer many benefits. This includes better symptom management, planning for the future, and potentially even slowing the disease's progression. However, more studies are needed to confirm these potential benefits and ensure earlier diagnosis is truly feasible.

[2] Jin K, Simpkins JW, Ji X, Leis M, Stambler I. The critical need to promote research of aging and aging-related diseases to improve health and longevity of the elderly population. Aging and disease. 2015 Feb;6(1): With

populations aging worldwide and a growing burden of chronic diseases, research on aging and related illnesses is crucial to promoting healthy and productive lifespans for older adults. We propose these policies: 1) Increase research funding specifically aimed at improving aging processes and extending healthy lifespans. 2) Provide incentives to encourage collaboration in research and development across commercial, academic, public, and government sectors. 3) Establish and strengthen coordination structures for aging research, development, and education at all levels.

[3] Padilla P, Lpez M, Grriz JM, Ramirez J, Salas-Gonzalez D, Alvarez I. NMF-SVM based CAD tool applied to functional brain images for the diagnosis of Alzheimer's disease. IEEE Transactions on medical imaging. 2011 Sep 12;31(2):207-16. This paper proposes a new computer-aided diagnosis (CAD) system for early Alzheimer's disease (AD) detection. It leverages Nonnegative Matrix Factorization (NMF)

and Support Vector Machines (SVMs) with confidence bounds for enhanced classification. The system analyzes functional brain images from SPECT and PET databases of AD patients and healthy controls. It employs Fisher Discriminant Ratio (FDR) and NMF to extract the most relevant features, leading to a reduced feature set. Finally, an SVM-based classifier with confidence bounds classifies the data for improved decisionmaking in AD diagnosis.

[4] Song S, Lu H, Pan Z. Automated diagnosis of Alzheimer's disease using Gaussian mixture model based on cortical thickness. In2012 IEEE Fifth International Conference on Advanced Computational Intelligence (ICACI) 2012 Oct 18 (pp. 880-883). IEEE. Studies on brain tissue (neuropathology) show Alzheimer's disease (AD) involves a loss of nerve cells and connections in the brain's outer layer (cortex) and other areas. This can be detected by measuring cortical thickness using magnetic resonance imaging (MRI). We propose a new method for automatically diagnosing AD based on cortical thickness. This method uses a statistical model called a Gaussian Mixture Model (GMM) within a Bayesian framework. To find the best fit for the model, we employ an algorithm called the EM algorithm. Our experiments show this method performs well compared to traditional machine learning approaches.

EXISTING SYSTEM

Diagnosing Alzheimer's disease (AD) often involves a multi-step process. Doctors primarily rely on manual analysis of patient data, such as magnetic resonance imaging (MRI) scans. These scans can reveal changes in brain structure associated with Alzheimer's disease, like shrinkage in the hippocampus, a region crucial for memory. However, this analysis is time-consuming and subjective, as different doctors may interpret the scans slightly differently. In some cases, doctors may also utilize unsupervised machine learning techniques like cluster analysis. This approach groups MRI scans with similar characteristics together, potentially helping identify patterns indicative of Alzheimer's disease. However, these techniques aren't specifically designed for diagnosis and may not be as accurate as newer methods.

Disadvantages

- Manual analysis of MRI scans requires significant expertise and can be slow. Additionally, interpretation can vary between doctors, leading to potential inconsistencies in diagnosis.
- Traditional methods may struggle to accurately diagnose Alzheimer's disease, particularly in the early stages of the disease when brain changes are subtle.

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PROPOSED SCHEME

This study proposes a new system that leverages a combination of machine learning (ML) techniques for a more automated and potentially more accurate approach to diagnosing Alzheimer's disease (AD). The system utilizes two data sources MMSE Dataset which contains results from the Mini-Mental State Examination (MMSE), a common cognitive screening test and MRI scans these scans provide detailed images of the brain structure.

- Random Forest (RFC) algorithm is trained on the MMSE dataset to identify patterns in cognitive test results that are associated with Alzheimer's disease. RFC addresses overfitting, a common issue with decision trees, by training a collection of them, leading to improved accuracy.
- CNN is used for recognizing patterns in images, making them ideal for identifying subtle changes in brain structure that might be indicative of Alzheimer's disease. By analyzing the scans, the CNN learns to differentiate between healthy brains and those affected by Alzheimer's disease.

ADVANTAGES

- Combining RFC (cognitive data) and CNN (MRI scans) offers a comprehensive approach that led to more accurate diagnoses compared to traditional methods.
- Machine learning algorithms rely on objective data analysis, minimizing potential bias that can occur with subjective human evaluation.

System Block Diagram

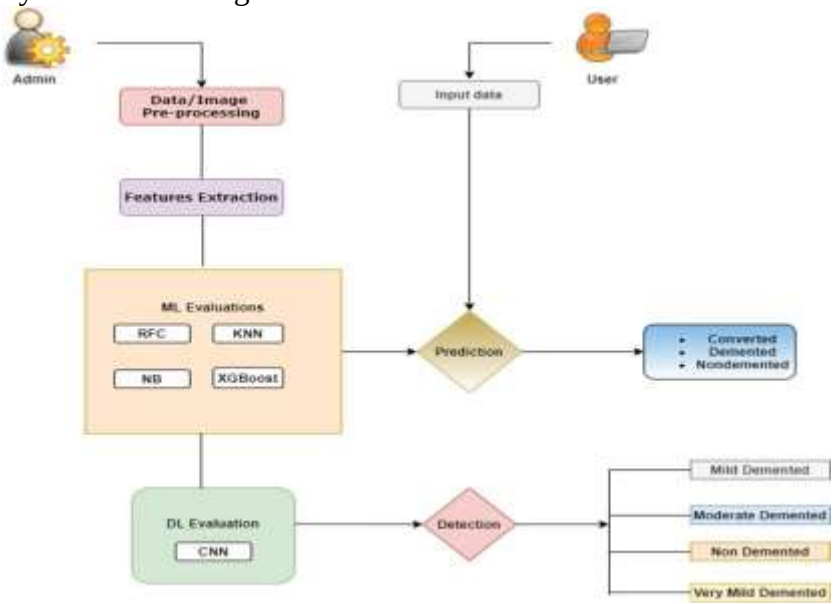

Fig1: System Architecture

Industrial Engineering Journal
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OUTPUT SCREENS

Fig1: Admin Login Page

Fig2: User Login Page

Industrial Engineering Journal
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Volume : 53, Special Issue 4, April : 2024

Fig3: Registration Page

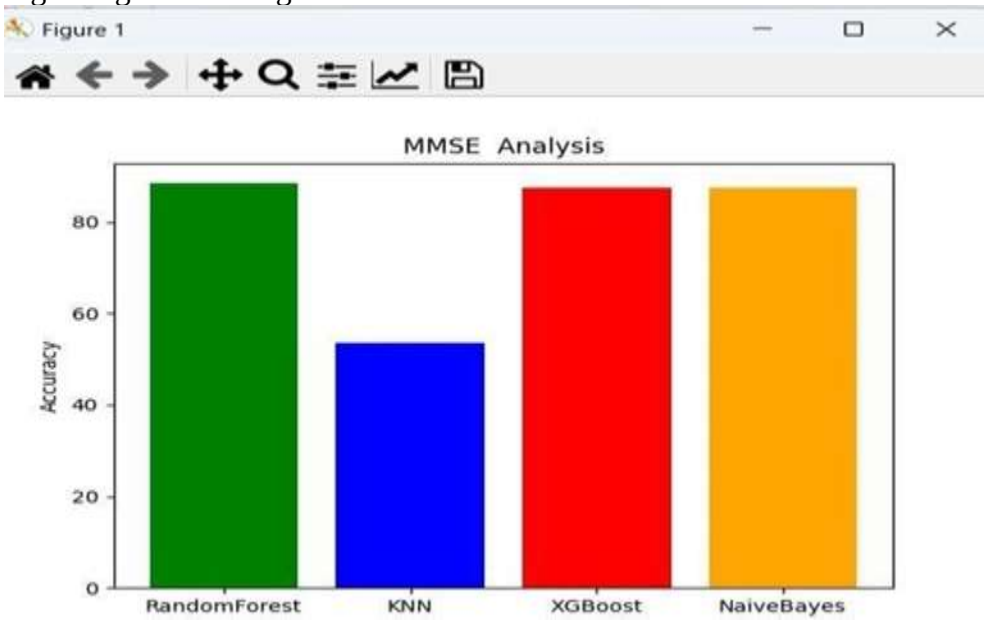

Fig4: MMSE Analysis

Industrial Engineering Journal
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Fig 5: MMSE Detection

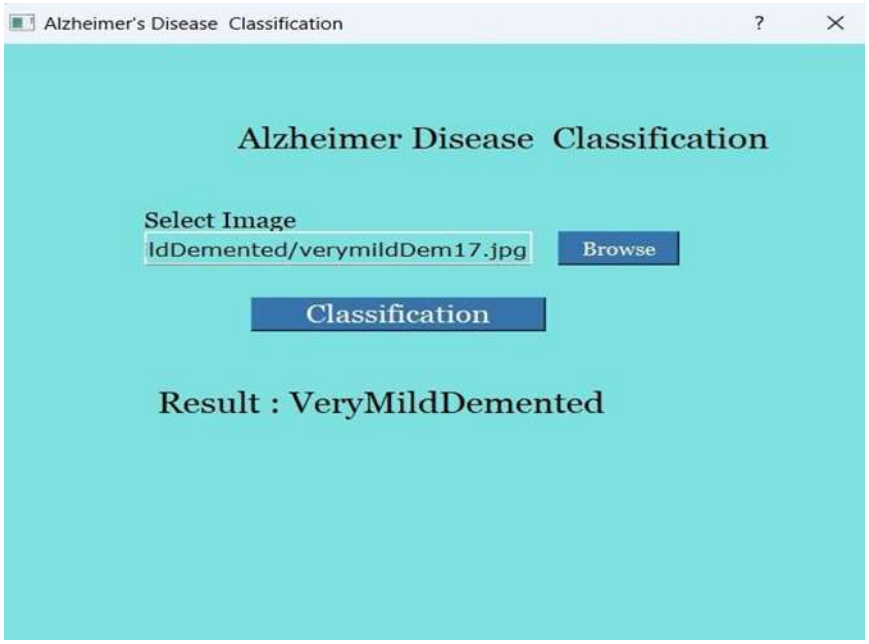

Fig 6: Alzheimer's Disease Classification

CONCLUSION

This study proposes a machine learning system for more accurate Alzheimer's disease (AD) diagnosis. The system analyzes both MMSE cognitive test scores and MRI brain scans through a Random Forest model. By combining these data sources, the system aims to identify patterns that differentiate healthy

brains from those affected by AD, potentially leading to improved diagnostic accuracy, reduced bias, and earlier detection - all crucial steps towards better patient outcomes.

REFERENCES

[1] Dubois B, Padovani A, Scheltens P, Rossi A, DellAgnello G. Timely diagnosis for Alzheimer's disease: a literature review on benefits and challenges. Journal of Alzheimer's disease. 2016 Jan 1;49(3):617-31.

[2] World Health Organization. World health statistics 2010. World Health Organization,2010.

[3] Jin K, Simpkins JW, Ji X, Leis M, Stambler I. The critical need to promote research of aging and agingrelated diseases to improve health and longevity of the elderly population. Aging and disease. 2015 Feb;6(1):1. [4] Padilla P, Lpez M, Grriz JM, Ramirez J, Salas-Gonzalez D, Alvarez I. NMF-SVM based CAD tool applied to functional brain images for the diagnosis of Alzheimer's disease. IEEE Transactions on Medical Imaging. 2011 Sep 12;31(2):207-16.

[5] Song S, Lu H, Pan Z. Automated diagnosis of Alzheimer's disease using Gaussian mixture model based on cortical thickness. In2012 IEEE Fifth International Conference on Advanced Computational Intelligence (ICACI) 2012 Oct 18 (pp. 880-883). IEEE.

[6] Reynolds D. Gaussian mixture models. Encyclopedia of biometrics. 2015:827-32.

[7] Bui DT, Hoang ND. A Bayesian framework based on a Gaussian mixture model and radial-basis-function Fisher discriminant analysis (BayGmmKda V1. 1) for spatial prediction of floods. Geoscientific Model Development. 2017;10(9):3391.

[8] Armaanzas R, Iglesias M, Morales DA, Alonso-Nanclares L. Voxelbased diagnosis of Alzheimer's disease using classifier ensembles. IEEE journal of biomedical and health informatics. 2016 Mar 4;21(3):778-84.

[9] Zhu X, Sobhani F, Xu C, Pan L, Ghasebeh MA, Kamel IR. Quantitative volumetric functional MR imaging: an imaging biomarker of early treatment response in hypo-vascular liver metastasis patients after yttrium-90 transarterial radioembolization. Abdominal Radiology. 2016 Aug 1;41(8):1495-504.

[10] Kurth F, Gaser C, Luders E. A 12-step user guide for analyzing voxelwise gray matter asymmetries in statistical parametric mapping (SPM). Nature protocols. 2015 Feb;10(2):293.