iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56848

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

A Survey on Alzheimer's Disease Recognition in MRI Images Deep Learning Approach

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Abstract: ***Alzheimer's disease is a neurodegenerative condition that has a aging population. Early diagnosis and intervention are critical. A valuable tool for the detection .This research aims to develop a deep learning-based approach for the automatic recognition in MRI images. In this study, architecture is employed to extract meaningful features from MRI images. Alzheimer's and non-Alzheimer's MRI images is utilized. The proposed deep learning approach in Alzheimer's disease recognition. The model achieves a high level of accuracy, sensitivity, and specificity in classifying MRI images. Potential to assist medical professionals in the early diagnosis and monitoring of Alzheimer's disease, ultimately contributing to improved patient care and outcomes.***

Keywords: ***Alzheimer's disease, MRI images, deep learning, convolutional neural network, diagnosis, neurodegenerative condition.***

I. INTRODUCTION

The brain is considered one of the most important organs in our body. The brain controls and facilitates all the actions and reactions that enable us to think and believe. It also strengthens our senses and memories. Alzheimer's disease is a brain dysfunction that cannot be corrected and is progressive in nature. It intensifies slowly and destroys the memory cells, thus destroying the individual and the ability to think. It is a degenerative nerve disease that causes nerve cells to lose function or even die. Diagnosis of Alzheimer's disease is only about four to eight years. On average, one in ten people suffer from the disease, but it can sometimes strike at a younger age and has been found in several 20-year-olds. This disease is the main cause of dementia in the elderly. Dementia causes a decrease in cognitive abilities used in daily activities, 60-80% of dementia cases are Alzheimer's disease. This disease is associated with the accumulation of plaques and tangles in the brain, which involve brain cells and #039; injury and death. This was first noticed by Dr. Alois Alzheimer, where he saw a woman dying from internal changes in her brain tissue. After her death, the doctor scanned her brain and while doing so, he noticed the formation of various lumps.Therefore, people with this condition find it difficult to perform daily activities such as driving, cooking, etc. In the early stages, symptoms are not obvious and may include difficulty remembering names, misplacing important objects, and planning problems,things etc. The middle stage of Alzheimer's disease is the longest, and some symptoms can include severe mood swings, confusion, impulsivity, short attention span, poor object recognition, etc. The last stage is the most difficult. The most obvious symptoms are the inability to properly communicate with others, susceptibility to infections, poor judgment, poor sense of direction, short-term memory loss and visual disturbances. According to a recent study, there are about 50 million people worldwide with Alzheimer's disease. This disorder presents an enormous challenge to researchers and clinicians today, as it is often not recognized until patients reach the end stages of the disease, as their cognitive symptoms are often due to aging. Without better treatment, the risk of this disease will continue to increase. Therefore, the elderly have a high risk of contracting this disease. But early treatment can help slow the progression of dementia. Several factors have been linked to reducing the risk of Alzheimer's disease, including a healthy diet, physical activity, socialization, protecting the head from injury, reading, playing musical instruments and intellectual activity; Such activities can improve overall brain health and cognitive performance.

II. RELATED WORKS

A. *[Predicting cognitive decline from brain metabolism and amyloid imaging]*

The paper [1] proposes a Predicting cognitive decline from brain metabolism and amyloid imaging Alzheimer's disease (AD), it is important to identify those individuals most likely to experience rapid cognitive decline. Using fluorodeoxyglucose and florbetapir positron emission tomography (PET). PET images of 139 AD patients, 171 MCI patients, and 182 normal subjects obtained from the Alzheimer's Neuroimaging Initiative database were used. A deep CNN was trained using AD 3D PET volumes and normal controls as inputs.

Manually defined image feature extraction, such as quantification using predefined regions of interest, was not necessary for our approach. In addition, it used minimally processed images without spatial normalization, which is often used in conventional quantitative analyses. This network was used to predict cognitive outcomes in MCI patients. The predictive accuracy of conversion from mild cognitive impairment to AD was compared with a conventional feature-based quantification method. The predictive accuracy (84. 2%) for conversion to AD in MCI patients exceeded traditional feature-based quantification methods.

B. [Transfer Learning for Alzheimer's disease detection in MRI images]

The paper [2] proposes a focus on the detection of Alzheimer's disease using magnetic resonance imaging (MRI) using deep learning techniques. The lack of sufficient data to train a deep model is a major challenge for this line of research. From our literature review, we noticed that one of the current trends is the application of transfer learning to 2D convolutional neural networks to classify individuals with Alzheimer's disease . A pretrained 2D convolutional neural network can be retrained to classify image slices independently. However, one problem here is that a 2D convolutional neural network could not look at the relationship between the 2D image slices in the MRI volume and make decisions about them independently. The propose to use a recurrent neural network after a convolutional neural network to understand the relationship between image sequences of each object and make a decision based on all input slices instead of each slice. A recurrent neural network with features extracted from a convolutional neural network can improve the accuracy of the whole system.

C. [Automatic detection of Alzheimer's disease using deep learning models and neuroimaging]

The paper [3] proposes a Deep learning algorithms have a huge impact on research questions. An essential tool for radiologists to obtain accurate results for effective diagnosis of disease. Different deep learning methods used for AD detection. This study examines 103 scientific articles published in different scientific databases. These articles were selected based on specific criteria to identify the most important findings in the field of AD detection. The review based technique Recurrent Neural Networks (RNN) and Transfer Learning (TL) propose accurate methods for AD detection, segmentation and severity assessment, radiological features need to be further investigated. This review aims to analyse AD detection using neuroimaging techniques such as positron emission tomography (PET), (MRI), etc. The focus of this review is on radiological image data. Recognition of AD. There is little work using other biomarkers impact of AD. Articles in English were also included in the analysis. This work concludes by highlighting key research questions towards effective AD detection. Several promise in AD detection, the progression from mild cognitive impairment (MCI) to AD needs to be further analysed using DL models.

D. [Classification of Alzheimer's disease using the transfer learning method]

The paper [4] proposes a Alzheimer's is a slow-moving neurological disease that destroys a person's thinking process and consciousness. It directly affects the development of mental abilities and neurocognitive functions. Alzheimer's disease is increasing day by day, especially the elderly who are over 60 years old, and it is gradually becoming the cause of their death. In this study, we address magnetic resonance imaging (MRI) segmentation and Alzheimer's disease classification through transfer learning adaptation, specifically using grey matter segmented images. (GM) brain. Instead of training and calculating model from scratch, we used a pre-trained deep learning model as the base model and then applied transfer learning. Model was tested at different time steps, 10, 25 and 50. Recently, methods have been proposed to predict AD stages through self-regulated analysis of magnetic resonance imaging (MRI) images, providing effective and better diagnostic results for AD. The main factors or parameters that the researchers use are the thickness of the cerebral cortex of a person, the density of (GM), ventricles and the contraction. Many studies claim a correlation between loss of grey matter and certain brain diseases such as Alzheimer's disease .

E. [A deep extraction model for Alzheimer's disease diagnosis]

The paper [5] proposes a Alzheimer's disease (AD) is a neurodegenerative disease that causes the patient to lose cognitive abilities. Computational intelligence, specifically deep learning, has been an effective method for diagnosing AD. AD diagnosis model based on deep feature extraction for MRI-assisted classification. This model aims to classify AD vs. HC (health controls). The database used in this project is Alzheimer's disease and minimal interval resonance imaging (MIRIAD) to validate the proposed method. We select thirty slices from the top of the brain above the eyes to study this work. The convolutional neural network (CNN) architecture is designed with three convolutional layers to extract the best features of a selected region. We then put the selected attributes into a vector for learning and pattern recognition using another computational intelligence technique.

Finally, the data are split using a 10-fold cross-validation method and trained using Random Forest, Support Vector Machine (SVM), and K-Nearest neighbor (K-NN) algorithms with different parameters for evaluation. The accuracy results are 0.8832, 0.9607 and 0. 8745 for the mentioned algorithms. comparative analysis with other literature, we can prove the effectiveness and reliability of the Alzheimer's disease diagnosis model.

III. PROBLEM STATEMENT

Alzheimer's disease (AD) affects the elderly population, resulting in progressive cognitive decline and memory loss. Early and accurate diagnosis of AD is crucial for timely intervention and development of effective treatment strategies. MRI is a commonly used tool to study brain structure and identify abnormalities associated with AD. However, manual interpretation of MRI images is time-consuming, inter-observer variable, and often requires extensive expertise.

IV. EXISTING SYSTEM

The existing methods for AD detection using MRI images are limited by their reliance on traditional image processing techniques and lack the ability to capture subtle and complex patterns indicative of early-stage AD offers a promising avenue for improving the accuracy and efficiency of AD diagnosis through MRI images.

V. OBJECTIVES

The objective of this research project is to develop and evaluate a robust deep learning-based framework for the early and accurate detection of Alzheimer's Disease (AD) using MRI (Magnetic Resonance Imaging) images. The primary goal is to leverage state-of-the-art to AD diagnosis, ultimately contributing to early intervention and enhanced patient care.

VI. METHODOLOGY

A. *Collection and pre-processing of Data*

1) Collect a large data set of medical images (such as MRI or PET scans) of people with or without Alzheimer's disease.
2) Make sure information is labeled and labeled to identify Alzheimer's and #039 cases.
3) Preprocess images by standardizing sizes, orientations and pixel values to create consistent input to model.

B. *Sharing and Adding Information*

The training set is used for model training, hyperparameter tuning of the validation set and final evaluation of the test set.

1) Use data augmentation techniques such as rotation, translation, and scaling to increase the diversity of training data and improve model generalization.

C. *Choosing a Deep Learning Architecture*

Choose the right deep learning architecture for the job. Convolutional Neural Networks (CNN) are widely used in image-based medical diagnosis.

1) Try different pre-trained models such as VGG, ResNet or Inception or create a unique CNN architecture photographs.

D. *Model Training*

Model training involves using the training data to train a deep learning model with the correct loss function, optimization (like Adam or SGD) and set size.

1) Enable early transition and stopping of the model and save after validation.

E. *Evaluation and fine-tunin*

1) Performance on the validation using metrics such as accuracy, sensitivity.
2) Tune the model by adjusting hyperparameters, adding regularization techniques (such as termination or bump normalization), or exploring different architectures to improve performance.

F. *Interpretation and Clinical Integration*

1) Interpret the model and decisions by visualizing object maps or using techniques such as Grad-CAM to identify areas in images that affect the prediction.

2) Collaborate with healthcare professionals to assess the clinical relevance of the model and predictions and integrate the model into the diagnostic workflow, potentially developing decision support systems for the diagnosis of Alzheimer's disease.

VII. LITERATURE SURVEY

In the previously proposed system by Maria Garcia and Carlos Martinez provides an overview of the current challenges and future directions for the detection of Alzheimer's disease from MRI images, including dataset availability, interpretability, and model generalization issues. While this article does not necessarily provide specific methodological details or solutions to the identified problems. So in this project we are trying to improve the efficiency and accuracy to detect the stages of Alzheimer's Disease.

VIII. CONCLUSION

In conclusion, the use of deep learning methods to detect Alzheimer's disease (AD) in MRI images represents a significant advance in the field of medical imaging and neurology. This innovative approach has shown great promise for accurate and early diagnosis of AD, which is crucial for timely intervention and therapy. Through the analysis of MRI images, deep learning models have demonstrated their ability to detect subtle structural and anatomical changes in the brain associated with AD, often before clinical symptoms appear. This early detection can lead to better patient outcomes, allowing healthcare professionals to initiate appropriate interventions and treatment strategies early in the course of the disease, which can slow disease progression.

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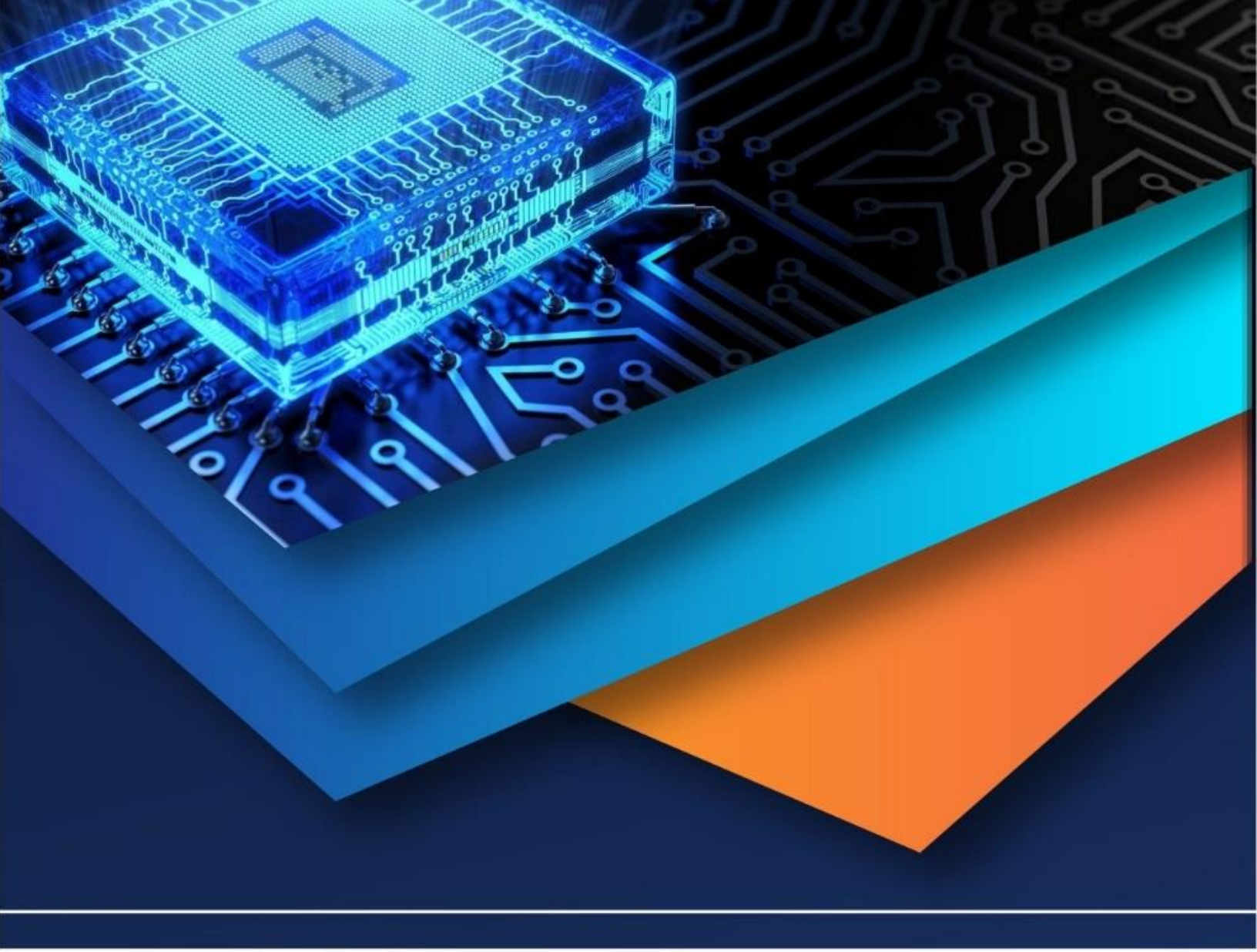

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