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Implementation of Alzheimer's Disease using MRI Image

Vasanth Nayak[1], Mahendra Shetti[2], Karthik Nayak[3], Sujith Shridhar Naik[4], Adithya M Nayak[5]
Assistant Professor, Department of Information Science and Engineering[1]
Students, Department of Information Science and Engineering[2,3,4,5]
Canara Engineering College, Bantwal, Karnataka, India

Abstract: *As the global population ages, the prevalence of dementia caused by Alzheimer's disease is expected to increase, posing a significant healthcare challenge. Dementia is a leading cause of disability and dependency among older people, and it also has broad physical, psychological, social, and economic impacts on individuals, their caregivers, families, and communities. Despite the existence of treatments to manage dementia symptoms, a lack of awareness and understanding of the condition often leads to stigmatization and difficulties in accessing diagnosis and care. Neuroimaging is a viable method for reaching this objective because early Alzheimer's disease detection is essential for successful intervention. Although dementia cannot be cured, controlling symptoms can enhance the quality of life for those who have the condition. The objective is to employ structural magnetic resonance imaging (sMRI) information to examine deep learning algorithms for the identification of significant biomarkers related to Alzheimer's disease. The suggested method employs Convolutional Neural Networks (CNNs) to classify brain images into one of categories of Alzheimer disease as Non Demented, Very Mild Demented, Mild Demented and Moderate Demented.*

Keywords: Artificial Intelligence, Alzheimer disease, Deep learning, Accuracy, Classifier models

I. INTRODUCTION

Alzheimer's disease is a type of neurodegenerative disorder that leads to the death of brain cells and a reduction in overall brain size. It is the primary cause of dementia, and its symptoms include a gradual decline in cognitive, behavioral, and social functioning, which may impair an individual's ability to live independently. In its early stages, Alzheimer's disease can cause difficulty in remembering recent conversations or events, and as the disease progresses, memory loss can become more severe, and activities of daily living can become more challenging. Unfortunately, there is currently no known cure for Alzheimer's disease, and there are no interventions that can fully stop the progression of the disease in the brain. As the disease advances, severe cognitive impairment can lead to complications such as dehydration, malnutrition, and infections, which can ultimately result in the patient's death.

Individuals with Alzheimer's disease commonly exhibit a range of neuropsychiatric symptoms, which can include apathy, depression, aggression, agitation, sleep disturbances, and psychosis. These symptoms may persist throughout the course of the disease as it progresses. These symptoms have a profound impact not only on the patients themselves but also on their families, resulting in increased stress, strain, and social isolation. Nurses are instrumental in providing care for individuals with Alzheimer's disease, and it is crucial to develop care strategies that consider the unique needs of both patients and caregivers. It is essential to include interventions that help reduce caregiver burden, as this can ensure effective care for individuals with Alzheimer's disease.

Detecting Alzheimer's disease at an early stage can bring significant advantages for both the patient and their family. Thanks to advancements in neuroimaging techniques, machine learning has become increasingly utilized for automating Alzheimer's disease classification and early detection. Our project seeks to leverage these techniques to enhance the accuracy of Alzheimer's disease detection and provide valuable information to patients. To achieve this, we will collect patient data through the use of Petite Ent and compare it to a dataset of patients already diagnosed with Alzheimer's disease. Based on the results obtained, patients can promptly seek medical assistance and obtain appropriate treatment to manage the disease effectively.

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II. METHODOLOGY

A proposed approach for detecting and categorizing Alzheimer's disease involves the use of a deep learning model and Keras classification algorithm. This method involves utilizing a dataset of preprocessed MRI image sets that have been split into training and test sets. The Keras Classification algorithm is a supervised machine learning technique that is employed to predict categorical labels. It's employed in a deep learning neural network layout. They work together to learn the relationships in the data and provide accurate identification and categorization of Alzheimer's disease.

In the project aimed at detecting and classifying Alzheimer's disease, the employed model includes data augmentation techniques. The purpose of these techniques is to improve the accuracy of the model by artificially increasing the size of the training dataset. The data augmentation process involves modifying the original training data using techniques such as rotation, flipping, and scaling to create new and varied images. The resulting images are then added to the training dataset, enabling the model to learn from a more comprehensive range of examples and improving its ability to identify patterns in new images. The effectiveness of the model in detecting and classifying Alzheimer's disease is significantly enhanced by the data augmentation techniques that have been utilized.

The process of detecting and categorizing Alzheimer's disease involves splitting the dataset into training and test sets. Utilizing a convolutional neural network (CNN) approach, convolutional and pooling layers are applied to the image data to extract potential biomarkers of Alzheimer's disease. These layers simplify the data and preserve important functionality for effective learning. The Keras classification algorithm was used to classify the severity of Alzheimer's disease according to potential biomarkers obtained by the CNN method. The output layer produces a classification label indicating whether the input image is demented or not.

III. IMPLEMENTATION

Implementation of proposed system is done in two segments as:

1. Image pre-processing.
2. Recognition and diagnosis.

Each of the segment performs the intended task and used to generate the desired result with greater accuracy.

The proposed system's architecture design is displayed below.

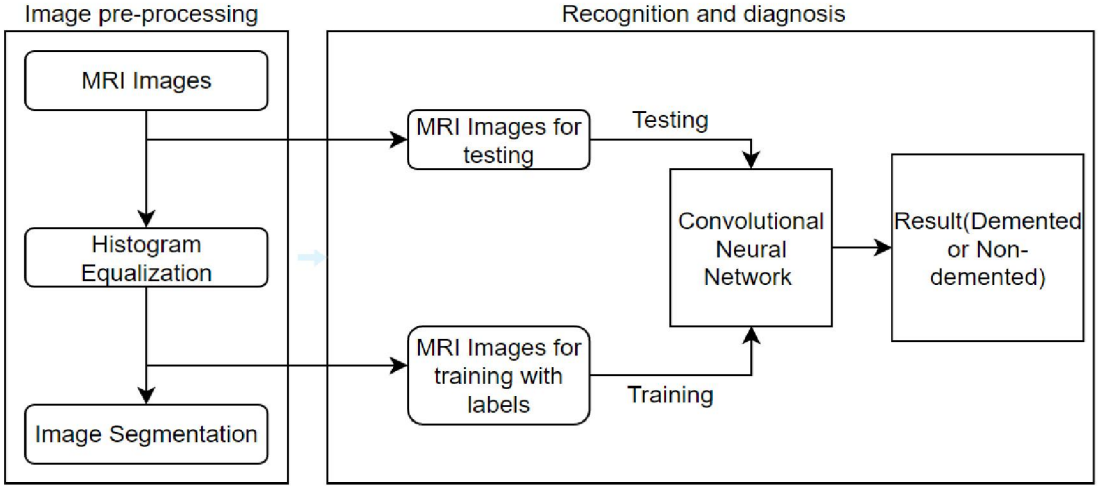

Figure 3: Architecture Design.

Each segment is explained below with steps included in them:

1) Image pre-processing: It is the first step in detecting Alzheimer disease. It is done to collect the data of MRI images and cleaning of collected image for any noises and unwanted details. The detailed pre-processing is explained below.

i) Collect MRI Image Dataset:

We start our approach by collecting a dataset of MRI images containing both healthy individuals and individuals with Alzheimer's disease. The dataset used in our project includes four distinct categories of Alzheimer's disease of various categories that are classified on the severityor stage in which the disease is present.

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ii) Histogram Equalization

To prepare the collected dataset for training, we apply a common image processing technique called Histogram Equalization. This technique enhances the contrast of the MRI images, which makes it easier for the model to recognize features and patterns effectively. Histogram Equalization works by redistributing the pixel intensities of an image to adjust its contrast.

iii) Image Segmentation

Image Segmentation is performed to extract the brain tissue from the images. It is done to remove any noise or unnecessary information from the image. This step is essential to make sure that the model focuses on the relevant features. Image Segmentation can be achieved through various techniques, including thresholding, region growing, and clustering.

2) Recognition and Diagnosis: A CNN model was developed with the aim of categorizing the stages of Alzheimer's disease into four distinct categories. The primary goal of this phase is to accomplish an elevated degree of precision in the model's output. The following steps are involved in this phase:

i) MRI images for testing and training:

In order to train and evaluate the model effectively, the pre-processed MR images are partitioned into two groups: training and testing. The training dataset is utilized in developed model for training, whereas the test dataset is used to assess the performance of the model. It is typical to assign roughly 80% of the dataset as the training dataset and the remaining 20% for testing of the model.

ii) Implementing CNN model:

We use the CNN architecture as it is a widely used Deep Learning model for image recognition and characterization. The training process involves feeding the pre-processed MRI images into the CNN model, which is designed to learn and recognize patterns and features associated with Alzheimer's disease.

iii) Model training:

Pre-processed MRI images from the training dataset are fed into the model to adjust its parameters and minimise the deviation among both anticipated and actual outputs. The model weights are iteratively adjusted during training based on the calculated error between the anticipated and observed outputs. The gradient descent methodology is typically used to minimize this error and adjust the model weights.

iv) Model evaluation:

Trained model's effectiveness is assessed using a different experimental dataset that was not observed throughout learning. This process helps to evaluate the model's generalization ability and assess its performance on new, unseen data. The model takes pre-processed MRI images as input, and the output is a predicted classification label indicating the likelihood of Alzheimer's disease.

v) Displaying output:

Presenting the results, which identifies Alzheimer's disease, is end of step. The output is a categorical label indicating whether the input image is Alzheimer's disease positive or negative. This output can be further used to take necessary actions for the treatment of the patient. The output can be displayed as a binary classification result or as a probability score, indicating the likelihood of Alzheimer's disease.

IV. RESULTS AND DISCUSSION

A standard machine learning process was used including data preprocessing, training, and testing to build the model. TheKeras classifier and CNN architecture were used for the implementation of the model. Pre-processing techniques such as histogram equalization and image segmentation were used to enhance the contrast of the images and extract brain tissue from them. The model is trained on a training dataset using deep learning methods, specifically CNN

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algorithms, and then optimized to improve its performance. Further research is needed to assess the model's performance on larger datasets and to investigate factors that may affect its performance.

V. CONCLUSION

To detect Alzheimer's disease, the system that this paper outlines employs algorithms that use deep learning and MRI scans. The approach that we are proposing involves standard machine learning procedures and utilizes the Keras classifier algorithm to classify the MRI images, with the CNN architecture being applied to implement the model.

The proposed system has shown promising results in accurately identifying Alzheimer's disease in patients, providing a more efficient and reliable alternative to traditional diagnostic methods. Utilizing deep learning techniques, it becomes feasible to analyze vast amounts of MRI images and detect even the slightest deviations and patterns that might be imperceptible to the human visual system.

Future advancements in deep learning methods, such as generative adversarial networks (GANs), which might enhance feature extraction and problem-solving capabilities, may make it possible to enhance the suggested system. Additionally, combining the system with additional diagnostic tools and databases can deliver more thorough and precise assessments of the course of Alzheimer's disease.

The suggested technology offers a non-invasive, quick, and accurate replacement for current approaches, which has the potential to transform the diagnosis of Alzheimer's disease.

REFERENCES

[1]. Emtiaz Hussain, Mahmudul Hasan, Syed Zafrul Hassan, Tanzina Hassan Azmi," Deep Learning Based Binary Classification for Alzheimer's Disease Detection using Brain MRI Images", IEEE Xplore, December 21,2020.

[2]. Wenyong Zhu, Liang Sun, Jiashuang Huang, Liangxiu Han, and Daoqiang Zhang," Dual Attention Multi-Instance Deep Learning for Alzheimer's Disease Diagnosis with Structural MRI", IEEE Xplore, June 07,2021.

[3]. Abol Basher, Byeong C. Kim, Kun Ho Lee ,Ho Yub Jung," Volumetric Feature-Based Alzheimer's Disease Diagnosis From sMRI Data Using a Convolutional Neural Network and a Deep Neural Network", IEEE Access, February 25, 2021.

[4]. Srinivasan Aruchamy, Amrita Haridasan, Ankit Verma," Alzheimer's Disease Detection using Machine Learning Techniques in 3D MR Images" IEEE Xplore, June 28,2020.

[5]. Guilherme Folego , Marina Weiler , Raphael F. Casseb , Ramon Pires," Alzheimer's Disease Detection Through Whole-Brain 3D-CNN MRI" ,The journal Frontiers in Bioengineering and Biotechnology, 30 October 2020.

[6]. V.P. Subramanyam Rallabandi, KetkiTulpule, MahanandeeshwarGattu,"Automatic classification of cognitively normal, mild cognitive impairment and Alzheimer's disease using structural MRI analysis", Elsevier Lt,4 December 2019.

[7]. Suhad Al-Shoukry 2, Taha H. Raseem 1, N Asrin M. Makbol," Alzheimer's Diseases Detection by Using Deep Learning Algorithms: A Mini-Review", IEEE Access, February 3, 2020.

[8]. Chiyug Feng, Ahmed Elzab , Peng Yang, Tianfu Wang, Feng Zhou , Huyou Hu, XI Aohua Xiao , Baiying Lei," Deep Learning Framework for Alzheimer's Disease Diagnosis via 3D-CNN and FSBi-LSTM", IEEE Access, April 30, 2019.

[9]. Lin Liu , Shenghui Zhao , Haibao Chen , Aiguo Wang," A New Machine Learning Method for Identifying Alzheimer's Disease", Elsevier , 10 November 2019.

[10]. Saman Sarraf, GhassemTofighi," Deep Learning-based Pipeline to Recognize Alzheimer's Disease using fMRI Data", IEEE Access, 7 December 2016.