ALZHEIMER'S DISEASE DETECTION USING DEEP LEARNING

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***Abstract*— Alzheimer's disease, a leading cause of dementia, is characterized by memory loss and neurodegenerative disorders. Early diagnosis plays a crucial role in enhancing patient care and treatment outcomes. Traditional approaches for Alzheimer's disease diagnosis have limitations in terms of efficiency and learning time. Deep learning-based approaches, particularly Convolutional Neural Networks (CNNs), have shown promise in the classification of neuroimaging data related to Alzheimer's disease. In this presentation, we explore the use of a 12-layer CNN model trained on our datasets for early detection of Alzheimer's disease. Experimental results highlight the effectiveness of our proposed approach in improving accuracy and efficiency in Alzheimer's disease detection. Our research aims to contribute to the advancement of diagnostic techniques for Alzheimer's disease through the application of deep learning algorithms.**

Alzheimer's disease (AD) is a neurodegenerative disease and the most common cause of dementia in older adults. The part of brain that gets affected in this disease is hippocampus degeneration. Detection of Alzheimer's disease at preliminary stage is very important as it can prevent serious damage to the patient's brain. It becomes dangerous and sometimes fatal in case of people of 65 years of age or above. The main objective of this project is to use machine learning algorithms that is and feature extraction and selection to predict the Alzheimer's disease and build a useful model. The dataset is taken in the form of images. The proposed approach detects the Alzheimer's Disease such as moderate-demented and non demented using CNN algorithm.

I. INTRODUCTION

The Alzheimer's Disease (AD) is the most common cause of Dementia in people of the age 65 years and above. It is a progressive and irreversible neurological disease which follows a distinct pattern of brain damage as the disease progresses. Alzheimer's disease is a very common type of dementia. Dementia is an umbrella term describing a variety of diseases and conditions that develop when nerve cells in the brain (called neurons) die or no longer function in a normal way. The death or malfunction of neurons causes abnormalities in one's memory, behavior, and ability to think in a clear way. In Alzheimer's disease, these brain conditions eventually impair an individual's ability to perform even basic functions such as walking, speaking, and swallowing. Development of AD can be classified into three stages. First, is the asymptomatic stage, changes in the brain, blood, or cerebrospinal fluid (CSF) may begin to occur without the patient showing any particular symptoms. After the first stage comes the second stage, that is mild cognitive impairment (MCI) stage, memory complaints and other cognitive behaviour may start to be noticeable for the patients themselves and for close family or friends, which affects day to day activities but the symptoms are mild. In the final stage of the disease, or the dementia stage, memory, thinking, and behavioral symptoms are evident and significant, and it is noticeable. The neurons of brain starts degenerating and the synapses are slowly dissolved.

Alzheimer disease is caused by both genetic and environmental factors, those affects the brain of a person over time. The genetic changes guarantee a person will develop this disease. This disease breaks the brain tissue over time. It occurs to people over age 65. How ever people live with this disease for about 9 years and about 1 among 8 people of age 65 and over have this disease. MMSE (Mini Mental State Examination) score is the main parameter used for prediction of the disease. This score reduces periodically if the person is affected. Those people having MCI have a serious risk of growing dementia. When the fundamental MCI results in a loss of memory, the situation expects to develop to dementia due to this kind of disease. There is no treatment to cure Alzheimer's disease. In advanced stages of the disease, complications like dehydration, malnutrition or infection occurs which leads to death. The diagnosis at MCI stage will help the person to focus on healthy approach of life, and good planning to take care of memory loss.

II. LITERATURE REVIEW

Ronghui Ju et.al, suggested method of deep learning along with the brain network and clinical significant information like age, ApoE gene and gender of the subjects for earlier examination of Alzheimer's [1]. Brain network was arranged, calculating functional connections in the brain region by employing the

resting-state functional magnetic resonance imaging (R-fMRI) data. To produce a detailed discovery of the early AD, a deep network like autoencoder is used where functional connections of the networks are constructed and are susceptible to AD and MCI. The dataset is taken from the ADNI database. The classification model consists of the early diagnosis, initially preprocessing of raw R-fMRI is done [1]. Then, the time series data (90 ×130matrix) is obtained and that indicates bloodoxygen levels in each and every region of brain and changes a long period. Then, a brain network is built and transformed to a 90 ×90 time series data correlation matrix. The targeted autoencoder model is used which is a three layered model which gives intellectual growth of the nervous system then excerpts brain networks attributes completely [1]. When finite amount of data cases is taken, k-fold cross verification was implemented mainly to avoid the over fitting complication.

K.R.Kruthika et.al, proposed a method called multistage classifier by using machine learning algorithms like Support Vector Machine, Naive Bayes and K-nearest neighbor to classify between different subjects [2]. PSO (particle swarm optimization) which is a technique that best selects the features was enforced to obtain best features. Naturally image retrieving process requires two stages: the first stage involves generating features so that it reproduces the query image and then later step correlates those features with already gathered in database [2]. The PSO algorithm is used to select the finest biomarkers that show AD or MCI. The data is taken from Alzheimer's disease Neuroimaging Initiative (ADNI) database. The MRI scans are preprocessed first after taking from the database. The feature selection includes volumetric and thickness measurements. Then the optimum feature lists were obtained from PSO algorithm [2]. The Gaussian Naïve Bayes, K-Nearest Neighbor, Support vector machine was used to distinguish between the subjects. Here a 2 stage classifier was used where in the initial stage GNB classifier was used to classify the objects between AD, MCI and NC and in later stages SVM and KNN were used to analyze the object based on the performance of the initial one [2]. Control Based Image Retrieval was used for retrieving images from the database.

Ruoxuan Cuia et.al, proposed a model where longitudinal analysis is performed on consecutive MRI and is essential to design and compute the evolution of disease with time for the purpose of more precise diagnosis [3]. The actual process uses those features of morphological anomaly of the brain and the longitudinal difference in MRI and constructed classifier for distinguishing between the distinct groups. The MRI brain images of 6 time points that is for consecutive intervals in a gap of six months are taken as inputs from ADNI database [3]. Then feature learning is done with the 3D Convolutional Neural Network. The CNN is followed by a pooling layer and have many ways for pooling, like collecting mean value otherwise the maximal, or definite sequence of neuron in the section. But for studying the characteristics, the convolutional operation of 2×2×2 is applied so that a linear combination is studied for pooling of neurons [3].

III. PROPOSED METHODOLOGY

In proposed a model where deep learning CNN is used to train consecutive MRI and is essential to design and compute the evolution of disease with time for the purpose of more precise diagnosis. The actual process uses those features of morphological anomaly of the brain and the level of Alzheimer's in MRI and constructed classifier for distinguishing between the distinct groups.

Deep Learning Implementation using Convolutional Neural Network for Alzheimer's Classification Alzheimer's disease is the most common cause of dementia. Dementia refers to brain symptoms such as memory loss, difficulty thinking and problem solving and even speaking. This stage of development of neuropsychiatric symptoms is usually examined using magnetic resonance images (MRI) of the brain. The detection of Alzheimer's disease from data such as MRI using machine learning has been the subject of research in recent years. This technology has facilitated the work of medical experts and accelerated the medical process. In this study we target the classification of Alzheimer's disease images using convolutional neural network (CNN) and transfer learning (VGG16 and VGG19). The objective of this study is to classify Alzheimer's disease images into four classes that are recognized by medical experts and the results of this study are several evaluation metrics. Through experiments conducted on the dataset, this research has proven that the algorithm used is able to classify MRI of Alzheimer's disease into four classes known to medical experts.

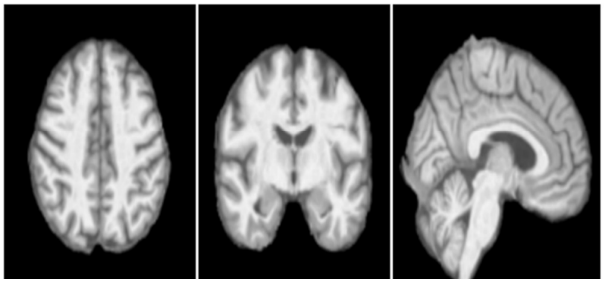

Fig 1: 2D-slices at key positions for three views from an original MRI scan.

MRI scans generate detailed images by capturing cross-sectional slices of the body. These slices, viewed from axial, sagittal, and coronal perspectives, offer critical insights into anatomical structures and abnormalities. Careful selection of key positions ensures relevant anatomical details are captured, aiding in accurate diagnosis and treatment planning.

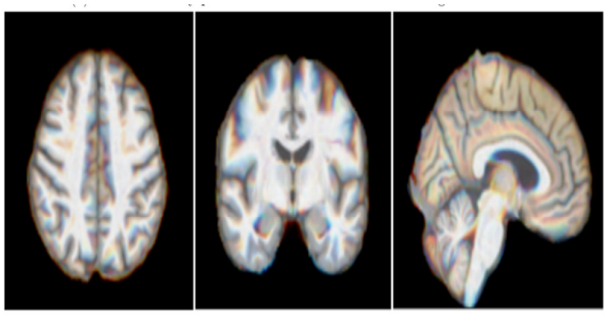

Fig 2: Synthesized 2D-image in RGB 3 channels for key positions for three views.

Synthesizing MRI data into RGB images combines information from axial, sagittal, and coronal views into a single representation. Each channel (red for sagittal, green for axial, blue for coronal) provides a distinct perspective, enhancing visualization and localization of abnormalities. This approach streamlines communication among medical professionals and facilitates comprehensive analysis, improving diagnostic accuracy and treatment outcomes.

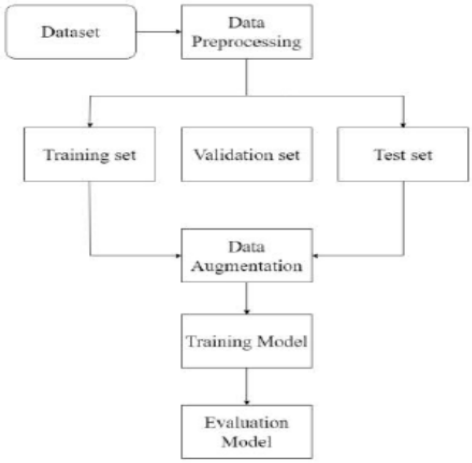

Fig. 3 Overview of system architecture

In this Bureaucracy design for Alzheimer's disease categorization starts with the purchase of a inclusive dataset sourced from Kaggle, holding 6400 countenances categorized into four classes: Temperate demented, Moderate insane, Non-insane, and Very mild insane. This dataset is therefore divided into preparation and testing sets, covering 5121 and 1279 representations, respectively. Pre-refine methods are employed to embellish concept quality, guaranteeing optimal recommendation for after analysis stages.

In the model incident time, three deep learning architectures are projected: Convolutional Neural Network (CNN), Optical Arithmetic Group (VGG16), and Visual Arithmetic Group (VGG19). These models influence different methods, to a degree convolutional layers, combining layers, and transfer education, to correctly classify Senility countenances. Augmentation policies further enrich the dataset by produce various image differences, through enhancing the model's skill to statement and improve categorization performance.

Bureaucracy design adopts a three-tier construction, promoting distributed alter and scalability. This architecture isolates performance from presentation, admitting for clear drawing of components and advancing maintainability. By leveraging persuasive network performance and helpful distributed alter, the three-level architecture embellishes bureaucracy's flexibility, scalability, and overall accomplishment in handling Senility representation classification tasks.

IV. RESULTS AND DISCUSSIONS

The results of the "Alzheimer's Disease Discovery Utilizing Deep Learning" project illustrated hopeful effects in early diagnosis. Through the exercise of a 12-coating CNN model prepared on neuroimaging datasets, the accuracy and effectiveness of Senility discovery were notably improved distinguished to normal methods. This progress means a important step forward in reconstructing patient care and situation outcomes by permissive former mediations and more accurate demonstrative methods. Moreover, the application of machine intelligence algorithms, specifically CNNs, confirmed effective in distinctive middle from two points various stages of Alzheimer's disease established neuroimaging dossier. By correctly classifying moderate-demented and non-insane things, the project reveal the potential of deep learning methods in embellishing demonstrative accuracy and adeptness. These results underline the significance of leveraging advanced sciences to address complex affecting animate nerve organs disorders like Senility, ultimately chief to better patient care and administration plans.

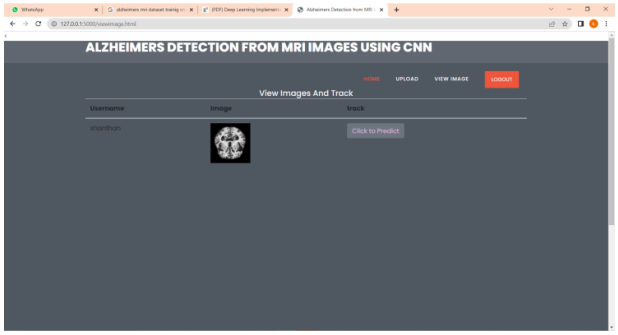

Fig 4: Visual Cortex

The View page provides users with a sophisticated neuroimaging viewer, allowing them to explore brain scans with ease. Users can zoom in and out, navigate through different imaging modalities such as MRI and PET scans, and utilize interactive tools for annotation and measurement. This page offers a user-friendly interface for researchers, clinicians, and enthusiasts to examine brain structure and function comprehensively.

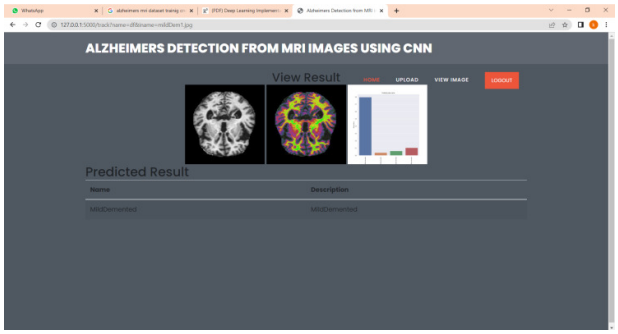

Fig 5: Alzheimer's Insights.

The page serves as the endpoint of the Alzheimer's Disease Detection process, presenting users with a comprehensive summary of their results. It includes detailed reports generated by deep learning algorithms, outlining diagnostic probabilities and disease progression trends. This page empowers users to make informed decisions about patient care and management, facilitating

collaboration among healthcare professionals and improving patient outcomes.

V. CONCLUSION AND FUTURE SCOPE

The decision division in a research project or paper serves as a inclusive summary of the study's main verdicts, significance, disadvantages, pieces of advice, and acknowledgments. It is the last section of the research document, bundling up the research journey and giving key takeaways. In this portion, the research verdicts are concisely paraphrased, and their fuller suggestions are discussed inside the framework of the appropriate field. Some restraints or disadvantages of the study are acknowledged to determine framework for the results, and pieces of advice for future research or useful requests are frequently contained. Closing remarks help to reinforce the basic meaning of the study, and some supplementary warnings are gave to ensure transparence.

This study intends a transfer education plan to discover Senility from structured MRI dossier. We acted various Senility classifications utilizing CNN, and VGG19 and confirmed that the method admits for diversified healing figure classifications that maybe used to identical fields. This study applies several algorithms (CNN, VGG16, VGG19) for the multi-categorization of Senility datasets. The results of various healing countenance classifications are completely good, but there is still range for bettering. VGG19 gets high-quality act accompanying a advantage of 80% for accuracy, 60% for accuracy, 60%. In another way, took better accomplishment results than the CNN handcraft act in accordance with all the depiction metrics secondhand. This study still has good healing countenance treat by utilizing several judgment versification that are having to do with disclose the restricted competency of the model.

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