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Alzheimer Disease Detection in MRI Image using Deep Learning Techniques

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Abstract- Deep learning has shown great potential in the field of medical image analysis, including the diagnosis of Alzheimer's disease (AD), a progressive brain disorder that affects memory and cognitive function. In this paper , a review of various deep learning algorithms for AD diagnosis was conducted, with a focus on the most widely used algorithm, Convolutional Neural Networks (CNN), for brain image analysis. The review can improve the prediction of AD at earlier stages using advanced deep learning techniques. This can lead to earlier diagnosis and intervention, which can potentially improve patient outcomes. It is important to note that while deep learning algorithms have shown promising results in medical image analysis, their clinical use is still in its early stages. Further research and validation are necessary before these techniques can be widely adopted in clinical settings. Overall, the use of deep learning in medical image analysis, including for the diagnosis of AD, has the potential to significantly improve patient outcomes and advance the field of medicine.

Keywords: AD, Convolutional Neural Networks (CNN)

I. INTRODUCTION

Alzheimer's disease (AD) is one of the most common progressive neurodegenerative dementias where neurofibrillary tangles and amyloid plaques (amyloid β-peptide (Aβ)) accumulation in the brain tissue trigger damages in neurons and synapses in the cortex (Hardy and Selkoe, 2002; Nestor et al., 2004). The disease is characterized by memory loss, neuronal atrophy, cell death and decline in cognition and language, resulting in cognitive and behavioral impairments that affect and limit normal daily activities (Karas et al., 2003; Delbeuck et al., 2003). In 2018, almost 5.7 million Americans have AD which is predicted to increase to 13.8 million people by 2050 in the United States (Alzheimer's Association et al., 2018). According to data reported in the 2017 report by the Alzheimer's Association, Alzheimer's disease is affecting 10% of the population over the age of 65 and the growing costs in managing the disease are estimated to be $259 billion[1].

The pathogenic mechanisms of this neurological disorder can be investigated using different imaging modalities that include: magnetic resonance imaging (MRI) to assess structural changes; functional magnetic resonance imaging (fMRI) to gauge the functional patterns of neuronal activities; electro and magnetoencephalography (EEG/MEG) to study the high-resolution temporal brain dynamics; positron emission tomography (PET) to assess functional and metabolic changes through radioactive tracers in order to delineate healthy brain regions from diseased or affected ones; diffusion tensor imaging (DTI), which is essential for determining the white matter fiber tracks and for elucidating any disruption in these tracks due to disease; and Computed Tomography (CT), although it exposes the subject to a moderate level of radiation (X-ray based technology), it is the fastest image acquisition modality that provides added information on density and texture of body organs and is less prone to subject movement during image acquisition (Li et al., 2016). Of course, the most effective approach to diagnosis, although costly, will be the multimodal neuroimaging approach that combines the individual strengths of these modalities, and consolidate structural measurements to functional and metabolic measurements[2].

In the recent decades, fMRI has been introduced as a noninvasive, radiation-free, and useful imaging analysis technique to diagnose, predict and classify different stages of a disease, cross-sectionally or through longitudinal studies. The fMRI modality is a reliable tool to investigate functional connectivity, study the spatiotemporal correlations between the different brain regions, and to assess brain dysfunction in terms of its neural connectivity networks (Ogawa et al., 1990)[3].

II. LITERATURE SURVEY

In 2019 U. Rajendra Acharya & Steven Lawrence Fernandes &V.Rajinikanth.It provides you with a better chance of benefiting from treatment. An opportunity to participate in clinical trials: An early diagnosis makes individuals eligible for a wider variety of clinicalthe factors it includes genetics, historyof head injury, depression, and hypertension[4].

In 2018 P. S. Jagadeesh Kumar.The Caregiver Outcomes of Alzheimer's Disease Screening (COADS) is a randomized controlled trial that will examine the potential benefits or harms of ADRD screening on family caregivers.Memory loss, difficulty processing language, communication challenges, and emotional changes[5].

In 2017 Rachna Jain.It can help people with dementia to have access to relevant information, resources and support, make the most of their abilities and potentially benefit.The non-memory aspect symptoms are difficulty in word finding, vision issue, impaired reasoning and impaired judgement. The biological sign are brain image[6].

In 2020 Jae Young Choi andBumshik Lee /by dpan.Rule Out Reversible and Treatable Causes of Dementia. More Opportunities to Participate in Clinical Trials. Medications Are Often More Effective in Early Alzheimer's. .Non-Drug Interventions Can Also Delay and Slow Progression. Alzheimer's disease has a gradual and irre-versible progression.In the terminal stages of the disease, patient may lose ability to perceive, think, speak or move,ultimately leading to loss of bodily functions and then finally to death[7].

In 2019 Nisha V M, Taeho Jo, Kwangsik Nho: Extended treatment with Alzheimer's disease frugs can significantly slow the rate at which the disorder advances, and combination therapy with two different classes of drugs is even better at helping patients. Problem can include wandering and getting lost trouble handling money and paying bills, repeating questions taking longer to complete normal daily tasks[8].

In 2021 Shuang Liang, In this paper we propose a WSL - based deep learning frame work consisting of a backbone network with attention mechanism. Connecting with others through support groups can allow people to share specific situations and suggestions and learn how other cope with the challenges of Alzheimer's[9].

In 2015 accepted for publication of current understanding of Alzheimer's disease diagnosis and treatment. It is generally accepted that the population rate of early onset alzheimer's disease is 1 - 2 % however the true population based rate of EOAD has never been verified by a systematic review and meta analysis. The systematic review and meta analysis was then to be conducted to calculate a pooled rate of EOAD and make comparisons between studies and geographic distribution[10].

In 2018 J.weller, A. Budson : Treatment is currently targeted towards symptomatic therapy although trails are underway that aim to reduce the production and overall burden of pathology within the brain. Here we discuss recent advances in our understanding of the clinical evaluation and treatment of alzheimer's disease with updates regarding clinical trails still in a progess[11].

In 1998 K.A. Johnaon, K. Jones, B. L. Holman, J.A. Becker, P.A. Spiers: Background regional cerebral perfusion measured by single photon emission computed tomography(SPECT) was examined as a preclinical predator of the development of Alzheimer's disease(AD). Regional decreases in perfusion were most prominent among converters in the hippocampal – amygdaloid complex the posterior cingulated the amterior thalamus and the anterior cingulated[12].

In 1996 M.C. Tierney, J.P. Szalai, W. G Snow, R. H. Fisher, A. Nores, G. Nadon,E. Dunn, P.H. St. George-Hyslop; Inception cohort of participants with symptoms suggestive of memory impairment by their family physicians were given baseline assessments including MMSE. Results suggests that the full or abbreviated MMSE in useful in predicting emergent AD in patients with positive test results[13].

In 2016 Andre's ortiz,jorgemunilla'juanM.gorriz and jovierramirez.Pros: Decreases the glutamate excitotoxicity ; possible other neuroprotective effect; well tolerated; FDA approved for moderate to severe AD but also helps mild to moderate AD.Cons: Possible neurotoxicity; some severe adverse effect : primarily recommended for moderate to severe AD high cost[14].

In 2021 Jiezhang,Xiojing long.Pros: Reduce inflammation ;may block ca2+ may reduce beta A and increase Ach.Cons: most human research on hypertensive individual and animals[15].

III. EXPERIMENT AND RESULT

Some of the output screen shots of the project execution are given below. This screen depicts the major role of the Alzheimer Disease Detection in MRI Image using Deep Learning Techniques.

- User Registration

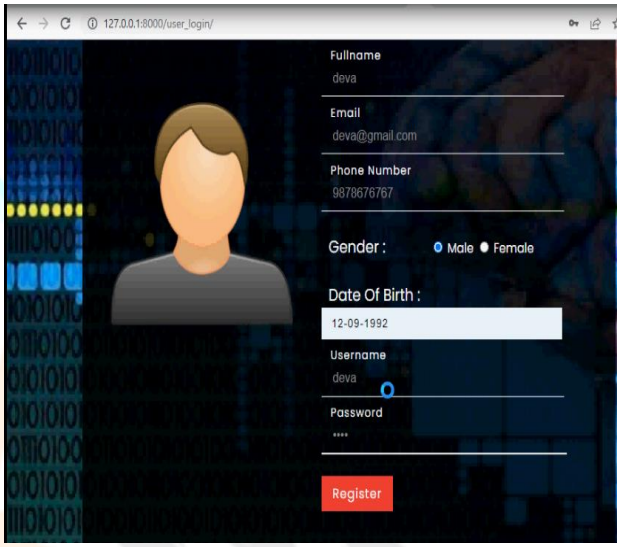

Fig 3.1. User Registration

This form is used for registering the overall details about the new Customer. During registration they need to submit following details are Name, User name, Password, Mobile number, email id, address for communication etc.

- User Login

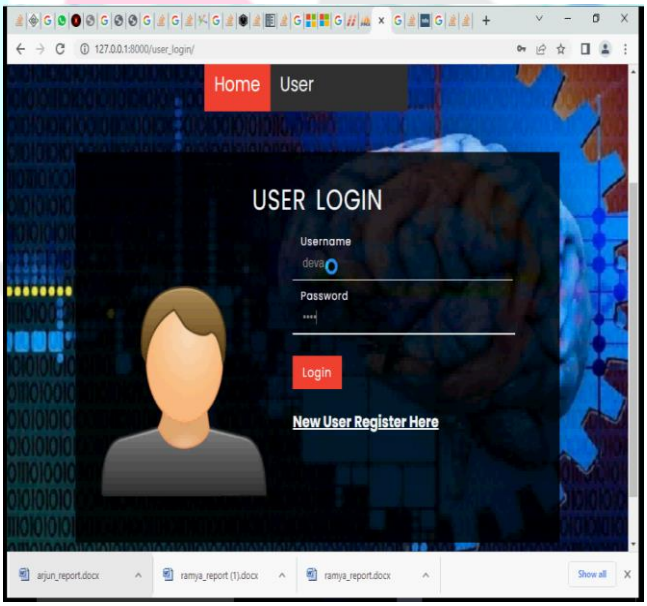

Fig 3.2. User Login

This form is used to control all the modules. Which contain admin username and password to control the admin section. The admin modules are given above

- Upload image

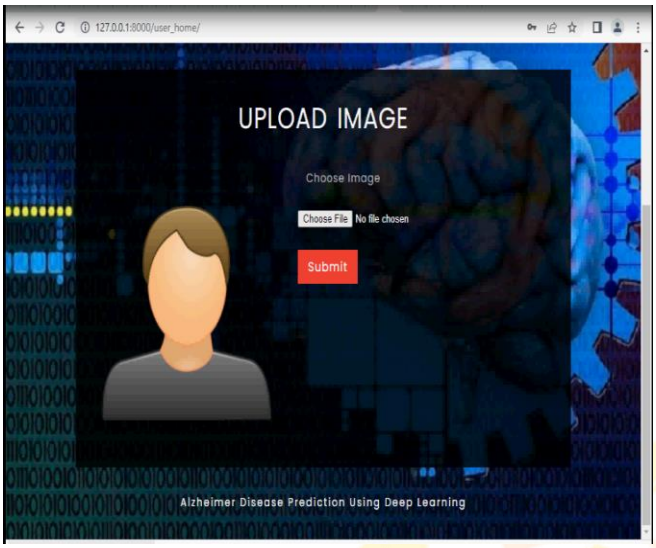

Fig 3.3. Upload Image

In this page user can upload image related to Alzheimer disease MRI Scan Copy.This disease related information can be stored in the My SQL database. CNNs algorithm can be implemented using Python and My SQL queries

- Image Choose

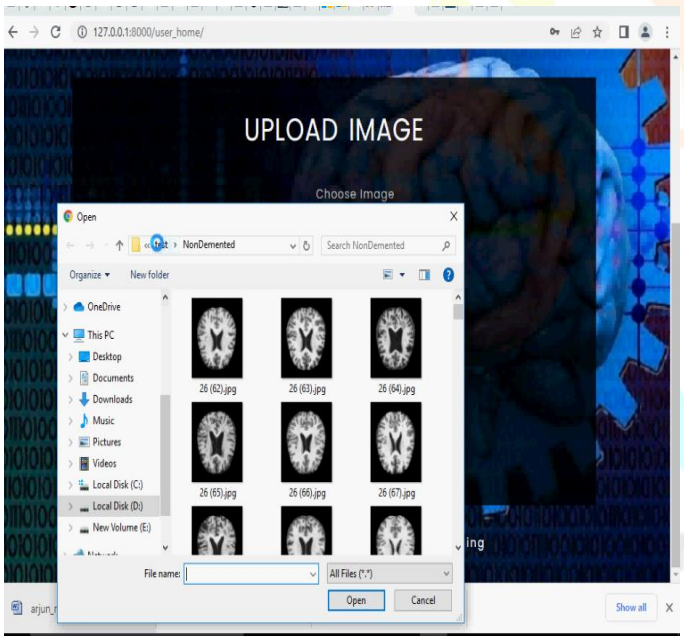

Fig 3.4 Image Chose

In this page chosen image will be compare to four more MRI Scan image to predict Alzheimer disease or not using image processing and deep learning techniques such as threshold, Gaussian, Erosion etc.

- Result Page

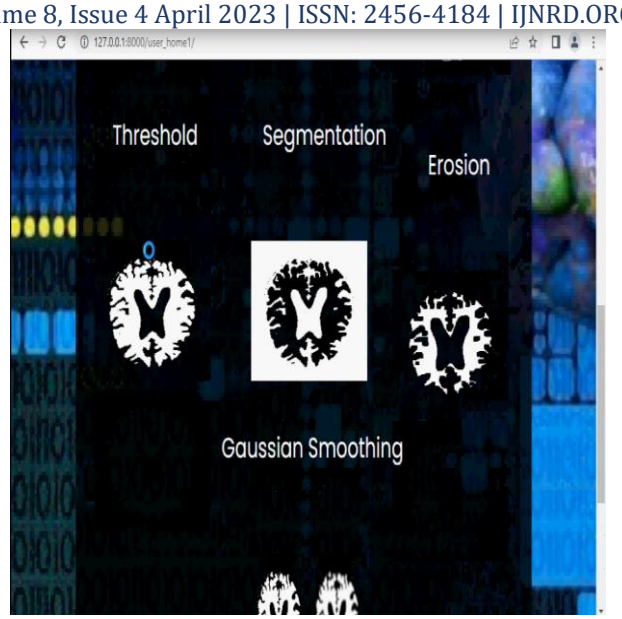

Fig 3.5 Result Page

In this page CNNs algorithm predict the Alzheimer disease affected or not in MRI Scanned copy uploaded by user comparing more trained images of Alzheimer disease stored in database.

- Disease Identified

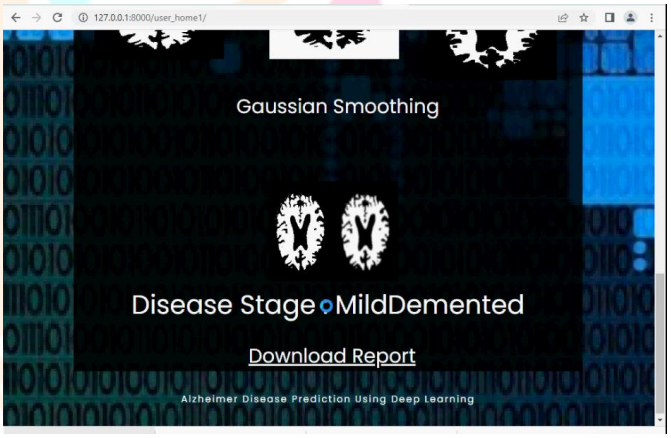

Fig 3.6 Disease Identified

The above screenshot shows that disease you identified from the imported image of human brain it also displays the disease stages whether it is in first stage, mid stage or last stage..Then click download the report to download the report instantly.

IV. CONCLUSION

This project is developed successfully and the performance is found to be satisfactory. This project is designed to meet the requirements of find out Alzheimer disease in early stages with low cost. It has been developed in Python and the database has been built in My SQL server keeping in mind the specifications of the system. The user will be able to predict in hospital by help of doctor in their hospital website.

This Project on developing an automated Alzheimer's disease detection and classification framework using deep CNN models. Early detection and treatment of AD is crucial, and this approach can be helpful in achieving this goal. The fact that your method does not require handcrafted features and can handle small medical image datasets is impressive. The proposed approach by working with other MRI AD datasets such as ADNI and applying transfer learning are excellent ideas. Exploring different hidden layers and convolution filters can help optimize the model and achieve better results. Additionally, exploring

semi-supervised and unsupervised deep learning methods for multi-class Alzheimer's disease detection and classification can be useful in detecting and classifying AD at different stages.

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