A Novel Deep-Learning Based Classification Of Alzheimer's Disease In Adults

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***Abstract*—Alzheimer's Disease (AD) is a neurodegenerative disease that is the cause of impairment of cognitive abilities and deterioration of memory. AD is most often observed in people beyond the age of 65. Diseases like AD are best treated by starting the treatment early. Delaying the treatment due to minor uncertainty can accelerate the deterioration. Using AI, medical professionals can confirm the presence or absence of the condition and immediately start the treatment.**

In this paper, Sequential Deep Convolutional Neural Network was used to perform a 5-way classification. Data from two varied sources was combined. The data was oversampled using Synthetic Minority Over-Sampling technique from imblearn. The Deep CNN model was able to achieve a maximum of 93.57% accuracy while being tested on data from both data sources. Thus, Deep CNNs are able to classify brain MRI images from varied data sources with sufficient accuracy.

Keywords— Classification, Brain MRI, Alzheimer's Disease, Deep CNN, Deep Learning

I. INTRODUCTION

Alzheimer's disease (AD) is a neurodegenerative disease, which means that it causes a progressive loss of structure and functions of neurons, slowly leading to death. It is most commonly caused by dementia which is progressive impairment in memory. It most often affects the short-term memory. People affected by AD may have problems understanding the language; this neurological syndrome is called dementia. "AD is a brain disorder that slowly destroys memory and thinking skills and, eventually, the ability to carry out the simplest tasks" [1]. "Alzheimer's is the most common cause of dementia, a general term for memory loss and other cognitive abilities serious enough to interfere with daily life" [2]. Persons affected with AD are said to be disoriented and lose the capability to understand time, directions, people, and place. The symptoms may include mood swings, which means that AD will frequent change in the person's mood. The patient may lose his/her confidence. Their condition deteriorates further as they neglect themselves. A patient who has AD exhibits abnormal behaviour. Apolipoprotein [3] is a sub-type of AD. Some factors like head injury, depression, and high stress may be causes for AD. "Research supports the theory that an imbalance in the production and clearance of amyloid-beta is central to the development of AD" [3]. In the brain of a person affected with AD, protein builds up around the brain cells. Due to AD, "there is a loss of neuron connection in the brain" [1] where an electrical or chemical signal passes to another neuron.

AD patients may benefit from exercise programs. It helps the patients recover or reduce the symptoms of the disease. Due to abnormal behavior and impairment of memories in the brain may cause problems in daily living and lead to an earlier death (3-10 years after the disease [4]). Often AD begins in people more than 65 years of age. Due to short-term severe memory-loss and dementia, the neuron cell dies in the brain. AD is a disease wherein the earlier stages are just mild memory loss. In the final stage of AD, the patient fails to remember the conversations he/she was having.

There may be problems in understanding the language, worsening of vocabulary, decreased word frequency, and gradual deterioration of reading and writing skills [5]. Difficulty in speech increases. In the middle stages, frequent use of unrelated vocabulary is noticed. In the advanced stages, they require round-the-clock care to perform daily tasks [6]. AD does not affect all memories equally. Essential memories like long-term memory, general knowledge, and episodic memory are not affected by AD in earlier stages. AD is characterized by the loss of neurons and the inability to pass electrical or chemical signals to other neurons. Altered cholesterol metabolism seems to play a fundamental role in the formation of amyloid plaques and tau hyperphosphorylation [7].

There is tremendous research being conducted all over the world to find a definitive cure for AD, but none have been identified yet. However, methods have been identified to

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