Chapter 76
Deep-Learning-Based Classification and Diagnosis of Alzheimer's Disease

Rekh Ram Janghel

NIT Raipur, India

ABSTRACT

Alzheimer's is the most common form of dementia in India and it is one of the leading causes of death in the world. Currently it is diagnosed by calculating the MSME score and by manual study of MRI scan. In this chapter, the authors develop and compare different methods to diagnose and predict Alzheimer's disease by processing structural magnetic resonance image scans (MRI scans) with deep learning neural networks. The authors implement one model of deep-learning networks which are convolution neural network (CNN). They use four different architectures of CNN, namely Lenet-5, AlexNet, ZFNet, and R-CNN architecture. The best accuracies for 75-25 cross validation and 90-10 cross validation are 97.68% and 98.75%, respectively, and achieved by ZFNet architecture of convolution neural network. This research will help in further studies on improving the accuracy of Alzheimer's diagnosis and prediction using neural networks.

INTRODUCTION

Convolution Neural Network (CNN) is a deep learning algorithm which helps in classification to extract low to high-level features. In this paper, various different architectures of Convolution Neural Network have been used to classify Alzheimer's Disease. This kind of medical data is classified to potentially develop a model which can predict or system that can recognize the type disease from normal subjects or to estimate the stage of the disease. Classification of Alzheimer's disease has always been a challenging task and most difficult task has been to select the most different features. CNN helps to extract low to high level features automatically by learning features

Alzheimer's Disease

Alzheimer's Disease(AD) is the most common type of dementia in 65 years and older, in which the mental ability of persons gradually declines and reaches a stage where it becomes difficult for them to lead a normal life. With the disease progressing gradually, patients find themselves more dependent on their immediate family member for survival. Its expectation is 1 in 85 people will be affected by 2050 and the number of affected people is double in the next 20 years. Alzheimer's disease was named after the German psychiatrist and pathologist Alois Alzheimer after he examined a female patient (post mortem) in 1906 that had died at age 51 after having severe memory problems, confusion, and difficulty understanding questions (Grady, McIntosh, Beig, Keightley, Burian, & Black, 2013). Alzheimer report two common abnormalities in the brain of this patient, "1. Dense layers of protein deposited outside and between the nerve cells. 2. Areas of damaged nerve fibres, inside the nerve cells, which instead of being directly had become tangled". Moreover, these plaques and tangles have been used to help diagnose AD.

There are 3 phases of AD: normal case, mild cognitive impairment(MCI), and dementia. MCI includes "mild changes in memory. Dementia means severity of the disease. The symptoms of AD different between patients. The following are common Symptoms of Alzheimer's:

- Memory loss that disrupts daily life.
- Challenges in planning or solving problems.
- Problem understanding visual images and spatial relationships.
- Decreased or poor judgment.
- Withdrawal from work or social activities.

The current state-of-the-art clinical diagnosis of AD requires a specialty clinic and includes a medical examination, neuropsychological testing, neuro imaging, cerebrospinal fluid (CSF) analysis and blood examination. This process is neither time nor cost-effective. Additionally, given the quickly aging global population with an expected striking increase of AD cases, there are insufficient numbers of specialty

Figure 1. Alzheimer's effect over age groups in India
Laske, Sohrabi, Frost, López-de-Ipiña, Garrard, Buscema... O'Bryant, 2015.
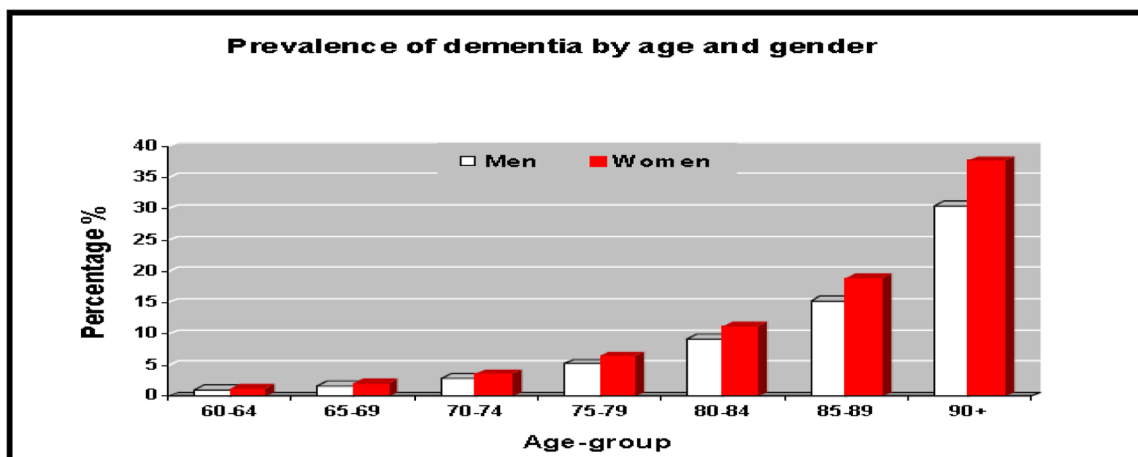
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