Chapter 14
Case Studies and Real-World Application of Deep Generative Models in Alzheimer's Research

Manoj Kumar Pandey
https://orcid.org/0000-0002-2880-4997
Chandigarh University, Mohali, India

Triveni Lal Pal
Pranveer Singh Institute of Technology, Kanpur, India

Priyanka Gupta
Guru Ghasidas Central University, Bilaspur, India

ABSTRACT

Deep generative models have been arisen as powerful tools in the area of Alzheimer's research that offers innovative solutions for early diagnosis, progression prediction and therapeutic interventions. These models include Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs) and their variants that excels in generating realistic synthetic data, enhancing data augmentation and addressing the challenges of limited clinical datasets. There are several related case studies and one notable case involves the use of GANs to generate synthetic MRI scans that closely mimic Alzheimer's patients which enables researchers to augment existing datasets and improve the accuracy of diagnostic models. The integration of deep getting to know with generative fashions consisting of GANs, RNNs and VAEs has revolutionized the evaluation of complicated scientific data. This chapter explores the case studies and packages of deep learning fashions and illustrates their effect on

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prognosis, development prediction and remedy techniques for Alzheimer's ailment.

INTRODUCTION

The most prevalent kind of dementia, accounting for 60–70% of cases, is Alzheimer's disease (AD). It is a neurological condition that worsens over time, possibly culminating in the inability to react to stimuli or carry on a conversation (Philip et al., 2016). It begins with mild memory loss. Older adults are the main target audience. Alzheimer's disease first damages the connections between neurons in the entorhinal cortex and hippocampus, which are responsible for memory, and then moves on to the cerebral cortex, which is in charge of language, reasoning, and social behaviour (Ávila-Villanueva et al., 2022). The main symptoms of Alzheimer's disease (AD), a chronic neurological illness that mostly affects the elderly, are a progressive loss of memory, cognitive function, and behavioural abnormalities. It is the most common cause of dementia, responsible for 60–80% of cases worldwide. Deterioration of thinking, learning, remembering, and organising abilities is a result of Alzheimer's disease. It mainly affects those over 65 and is the most prevalent cause of dementia. Alzheimer's has no known cure, however some drugs and treatments can help temporarily moderate symptoms. The buildup of amyloid-beta plaques and neurofibrillary tangles made of hyperphosphorylated tau protein in the brain, which cause extensive neuronal death and brain atrophy, are two of the disease's characteristic clinical symptoms (Lopez et al., 2019; Scheltens et al., 2021). For many years, society has been gravely concerned about Alzheimer's disease.

The early symptoms often include difficulty remembering recent events and confusion, which gradually worsens, including language problems later on, disorientation, mood swings, and loss of motivation (Scheltens et al., 2021). The disease progresses through various stages, from mild cognitive impairment (MCI) to moderate and severe stages, where individuals lose the ability to carry out basic daily activities (Veitch et al., 2022). The primary sign of Alzheimer's disease is memory loss. Memory loss from recent discussions or experiences is one of the early warning signals. But when the illness advances, memory deteriorates further and additional symptoms appear. Alzheimer's patients may: (i) Repeat inquiries and comments repeatedly. (ii) Ignore meetings, talks, and occasions. (iii) Misplace objects, frequently putting them in odd locations. (iv) Become lost in areas they once knew well. (v) Gradually lose the ability to recall commonplace objects and family member names. (vi) Find it difficult to articulate ideas, describe objects, or take part in conversations.

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