Advanced hybrid deep learning methodology for Alzheimer's disease detection

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The neurological condition known as Alzheimer's disease (AD) is typified by amyloid buildup, neuronal atrophy and mental, behavioural and cognitive changes. The complex prodromal period of moderate cognitive impairment (MCI) has been the focus of recent research on a variety of machine learning (ML) and deep learning (DL) techniques for AD identification. The present study shows a hybrid deep learning model combining convolutional neural networks (CNN) and long short-term memory (LSTM) for early detection of AD using magnetic resonance imaging (MRI), positron emission tomography (PET), and neuropsychological test scores. Using a test set including 60% of all the data, m = 512 MRI scans and 112 PET images, the suggested DL methods are evaluated. The model is optimised using the Adam optimiser, achieving a classification accuracy of 98.5% in distinguishing early mild cognitive impairment (EMCI) from cognitively normal. Results demonstrate the model's effectiveness in identifying early-stage AD through automated imaging biomarker extraction.

Keywords: Adam optimiser, Alzheimer's detection, convolutional neural network, deep learning, long-short term memory

resonance imaging (MRI), positron emission tomography (PET), and computed tomography (CT) scans are among the various neuroimaging modalities available for detecting and predicting dementia; nonetheless, MRI[4,5] is the most commonly used modality for AD patient diagnosis. Earlier, several machine learning (ML) and deep learning (DL) techniques have been applied together with MRI-based categorisation methods for diagnosis[6]. Our study aims to create the best prediction with the help of doctors, and implementing optimised detection technologies can reduce diagnostic delays and improve outcomes for patients with Alzheimer's condition[7–9]. Modern DL techniques are well known to begin with a deep convolutional neural network (CNN) model[11–12]. Especially long short-term memory (LSTM), recurrent neural networks (RNN) are efficient models for sequential data processing[13,14]. The modification of the DenseNet CNN architecture to extract interslice features is achieved by reducing the number of parameters, enhancing feature propagation, and addressing the vanishing gradient problem[15,16].

A new method for prospective AD detection called voxel-based layered feature extraction (VHFE) was proposed by Kang *et al.*[16]. An unsupervised technique was initially employed, segmenting the data by categorising people into clusters and reorganising the photos, thereby facilitating the collection of their final representation[2]. They presented classified statistical