Calibrated voxel data from fMRI for the detection of developmental dyslexia using hybrid CNN-SVM model

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Dyslexia, one of the most prevalent learning disabilities among children, is a neurological syndrome that impacts children's literary proficiencies. In the present study, we calibrate the complex voxel information present in functional magnetic resonance imaging using normalising, reducing and flattening techniques, employ dimensionality reduction over the flattened voxel data using principal component analysis and linear discriminant analysis, and then apply artificial neural network and support vector machine (SVM) for classifying into dyslexic and non-dyslexic. In the second methodology, we directly hand over the normalised voxel data to our hybrid convolutional neural network (CNN) and SVM model and acquire an accuracy of 94.44% an average precision of 95%, an average recall of 94.5%, and an F1-score of 94.5%. The CNN-SVM model continues to perform robustly when validated on an independent dataset.

Keywords: ANN, CNN, dyslexia, fMRI, SVM, voxel.

Detecting neurological disorders using machine learning is an immersive field, and when it comes to the classification of dyslexia, researchers have used many machine learning methods. Among them, support vector machine (SVM) is being selected by many as their preferred algorithm[3]. SVM has been found useful in many applications like data clustering, classification, and pattern analysis, and it has been used to solve many problems like face detection, character recognition, disease diagnosis, and genetic classification[5-7]. Algorithms like convolutional neural networks (CNNs) also solve a variety of medical image analysis problems. For instance, the categorisation of disorders[8], segmentation of tumors[9], detection and classification of lesions[10], prognosis of survival[11], and creation of medical images[12]. The ability of CNN to combine machine learning with feature extraction, feature selection, and location correlation provides remarkable classification performance in medical imaging[13].

Literature review

Researchers have used many machine-learning methods to classify dyslexia using diverse strategies to achieve accurate results. Examples include using children's handwriting