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A Novel Hybrid Unet-RBF and CNN-RBF Algorithm for Autism Spectrum Disorder Classification

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ABSTRACT

The 2021 CDC report indicates that Autism Spectrum Disorder affects 1 in 44 children, necessitating advanced classification methods. This article proposes a hybrid deep learning approach for ASD classification, merging U-net and Radial Basis Functions for medical image segmentation and integrating Convolutional Neural Network with RBF for ASD classification. Achieving 94.79% accuracy surpasses previous studies, highlighting deep learning's potential in neuroscience. Future research should explore diverse algorithms, validating them across varied datasets with different hyperparameters to enhance ASD classification efficiency.

Keywords: autism spectrum disorder, convolutional neural network, deep learning, radial basis function, U-Net

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1 INTRODUCTION

Autism Spectrum Disorder (ASD) signifies a complex disorder, and it is challenging to diagnose and detect (Eslami et al., 2019; Hammed & Albahri, 2023). People with ASD have difficulty speaking, social interaction problems, repetitive habits, and motor skill impairments because of the dysfunction of the neurological system that it causes (Kang et al., 2020). Current diagnostic methods can often diagnose this disease starting at age three (Khodatars et al., 2020). In general, boys are about 4 or 5 times more likely than girls to get ASD. According to the Centers for Disease Control and Prevention (CDC), the prevalence of ASD increased from 2004 until 2021. States may be able to estimate the number of adults with ASD (both diagnosed and undiagnosed) based on prevalence and case estimates (Dietz et al., 2020). In 2021, the prevalence rate of ASD increased to 1 in 44 children. The ASD prevalence rate is shown in Figure 1. Many children were still being diagnosed beyond the age of four, even though autism may be reliably identified as early as two (Maenner et al., 2021). For those with ASD, early identification in the first few years of life may have dramatically improved outcomes, yet there is frequently a delay in detecting and diagnosing ASD. In addition, ASD has wide-ranging effects on the brain, affecting many different regions. ASD is difficult to diagnose and detect due to lacking pathophysiological markers. Instead, only psychological criteria may be used (Yazdani, 2020).

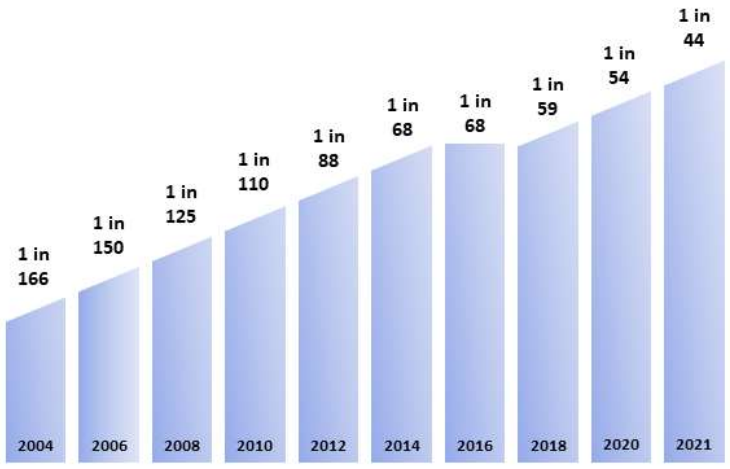

Figure 1. ASD prevalence rate from 2004 to 2021.

Furthermore, deep learning is a subfield of machine learning called artificial neural networks. Deep learning represents a type of machine learning that expands traditional machine learning by adding more complexity to the model (Kamilaris & Prenafeta, 2018). It is a large neural network that uses the model data with a complex structure that combines distinct non-linear transformations. Deep learning algorithms improved the latest artificial intelligence tasks such as object detection, speech recognition and machine translation (Al-Fraihat et al., 2024). In addition, deep learning has seen