Autism Spectrum Disorder Classification using Deep Learning

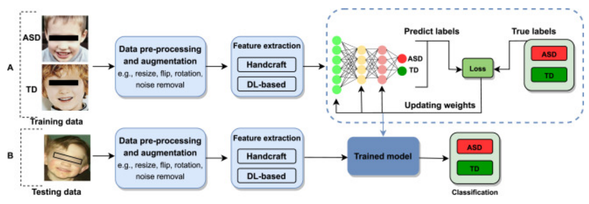
Divya Pariti

MSc Data and Computational Science
School of Mathematics and Statistics

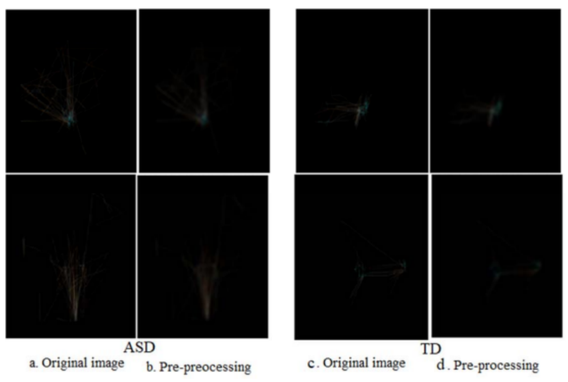
divya.pariti@ucdconnect.ie

Introduction - Motivation

This study leverages eye-tracking technology and advanced AI models to enhance the early detection of Autism Spectrum Disorder (ASD), a neurodevelopmental disorder affecting 1 in 160 children globally. By analyzing eye movement data, the study differentiates ASD from typical development (TD), using models like GoogleNet, ResNet, XceptionV3, DenseNet, Xception, and MobileNet. The research improves diagnostic accuracy through advanced image analysis techniques and hybrid deep learning approaches. These AI-driven methods hold promise for early diagnosis and better treatment outcomes for ASD.



Autism Spectrum Disorder vs Typical Development Classification Workflow



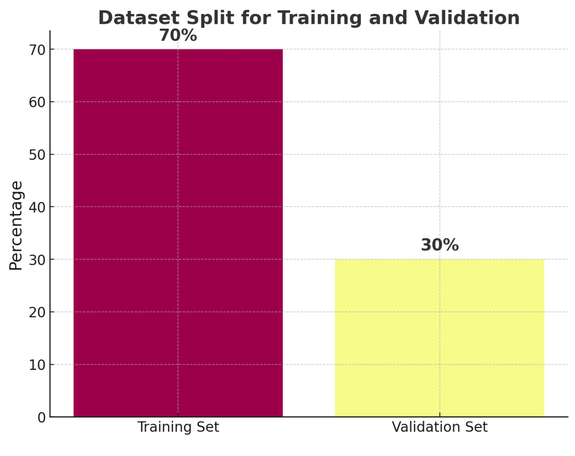
Comparison of ASD and TD Images Before and After pre-processing

Abstract

Autism Spectrum Disorder (ASD) is a developmental condition that can benefit significantly from early and accurate diagnosis, particularly through eye-tracking techniques. These techniques provide critical insights into children's visual behavior by analyzing eye movement patterns. In this study, we leveraged deep learning models, including GoogleNet, DenseNet, Xception, InceptionV3, MobileNet, ResNet, and a custom Hybrid model, to classify ASD using eye-tracking data. The results demonstrate the potential of combining advanced deep learning models with eye-tracking for accurate and early ASD detection.

Dataset Overview

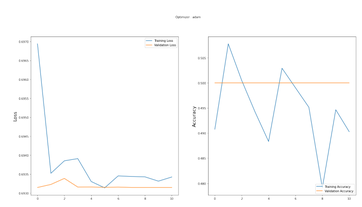
The dataset was preprocessed by splitting it into training and validation sets. The images were then augmented through rescaling, shearing, and zooming for the training set, while the test set images were only rescaled. The dataset was then loaded into the model pipeline using `ImageDataGenerator` with a target image size of 128x128 pixels. This setup enabled the effective training and evaluation of multiple deep learning models.



Methodology

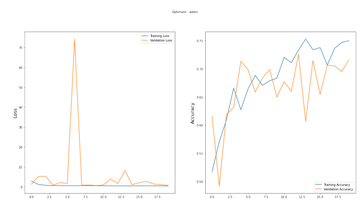
The following models are iimplemented for image classification:

1. **GoogleNet:**



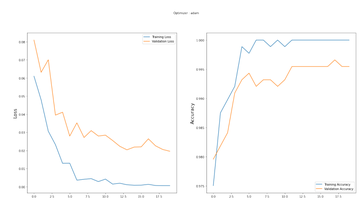
GoogleNet training and validation loss results.

2. **DenseNet:**



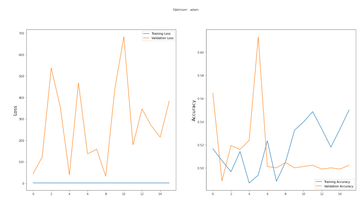
DenseNet training and validation loss results.

3. **Xception:**



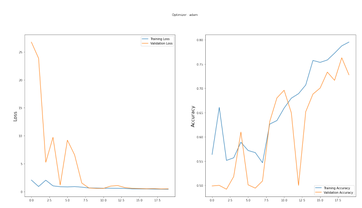
Xception training and validation loss results.

4. **InceptionV3:**



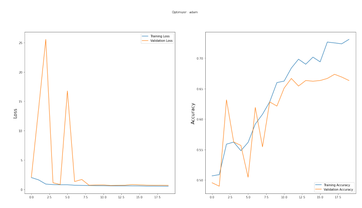
InceptionV3 training and validation loss results.

5. **MobileNet:**



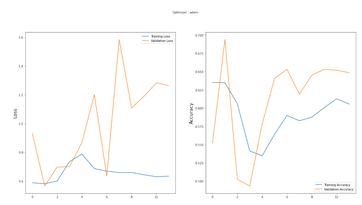
MobileNet training and validation loss results.

6. **ResNet:**



ResNet training and validation loss results.

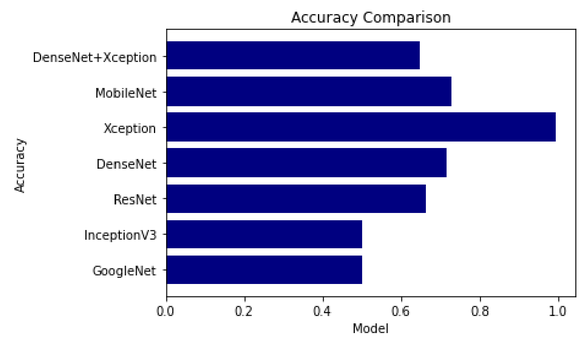
7. **Hybrid Model:**



Hybrid Model training and validation loss results.

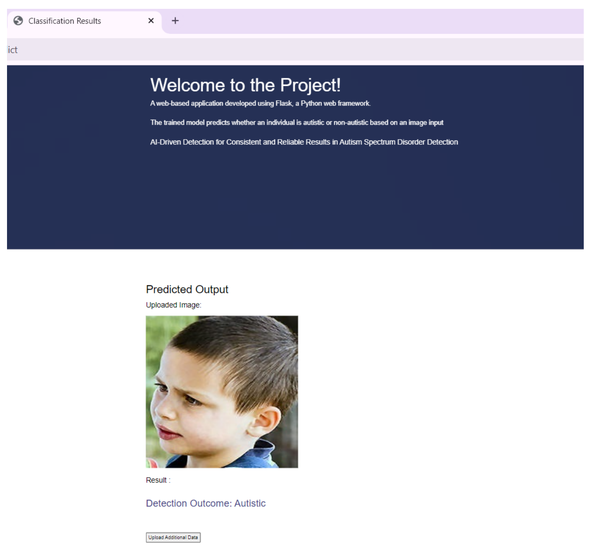
These models are trained, evaluated, and compared using techniques such as data augmentation, early stopping, and learning rate reduction to optimize their performance. The process also includes steps for data pre-processing, model visualization, and options for saving and loading models for future use.

Model Metrics



Model Comparisons

Real-Time Interface



User-Controlled Dashboard

Conclusion and Future Work

This project implemented and compared several deep learning models, with Xception and MobileNet showing the highest accuracy. An interactive dashboard was developed to visualize and explore model performance. Future work includes refining models, enhancing the dashboard, and deploying the system in a real-world application. Ensemble techniques could also be explored to further boost accuracy.

References

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