**Autism Spectrum Disorder Classification Using Deep Learning Models**

This project employs a deep learning model that uses facial images to classify autism spectrum disorder (ASD). VGG16, VGG19, and Alex Net are the models that were trained and evaluated for subtle features that define facial expressions of ASD.

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**Introduction**

Autism Spectrum Disorder (ASD) is a developmental condition characterized by difficulties with interpersonal communication, communication, and routine behaviour. Early diagnosis is essential for effective intervention, but current diagnostic methods can be subjective and resource intensive. This project uses a deep learning model to analyse facial images and automate ASD detection.

**Dataset**

The dataset includes images of faces labelled "autistic" or "non-autistic." VGG16, VGG19, and Alex Net are pre-processed and customized to match the required input dimensions.

**Model Architectures**

* **VGG16**: A deep convolutional neural network with 16 layers known for its accuracy in image classification tasks.
* **VGG19**: An extended version of VGG16 with 19 layers, offering additional depth.
* **Alex Net**: A CNN architecture with 8 layers, optimized for faster training but less accurate in this application.

**Preprocessing and Augmentation**

* **Normalization**: Scales pixel values to a [0, 1] range.
* **Augmentation**: Enhances data diversity and reduces overfitting through transformations such as rotation, zoom, and flips.

**Training and Evaluation**

Models were trained using categorical cross-entropy losses and tested on a separate test dataset. Performance metrics include accuracy, precision, recall, and F1-score, which help measure the effectiveness of each model.

**Results**

| **Model** | **Accuracy** | **Precision (ASD)** | **Recall (ASD)** | **F1-Score (ASD)** |
| --- | --- | --- | --- | --- |
| VGG16 | 72% | 82% | 57% | 67% |
| Alex Net | 50% | 50% | 50% | 50% |
| VGG19 | 75% | 67% | 73% | 70% |

**Observations**:

* VGG19 achieved the highest accuracy (75%) and balanced performance across metrics.
* VGG16 demonstrated good recall and precision for ASD classification.
* Alex Net performed similarly to random guessing, suggesting limited suitability for this task.

**Conclusion and Future Work**

This project demonstrates the potential of deep learning in automating ASD detection through non-invasive facial analysis. Future improvements may include:

* Integrating multi-modal data such as MRI or EEG.
* Applying advanced explainability techniques.
* Testing on larger, diverse datasets to improve model robustness.