



# Autism Spectrum Disorder Detection

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**Abstract:** Autism is the developmental disorder where early detection can improve outcomes. The Convolutional Neural Network model where developed and trained for binary classification of ASD, with the final model saved in HDF5 format. The system is deployed through web application that allows user to uploading an image and collect prediction outcomes in real time. This preprocessing steps, including resizing of images and normalization, ensure consistent input quality. Experimental analysis shows high accuracy and stable performance, demonstrating the efficiency of deep learning for assisting prediction.

**IndexTerms** - Autism Spectrum Disorder, CNN, Deep Learning, Streamlit, Prediction System.

## INTRODUCTION

Autism Spectrum Disorder(ASD) is a neurodevelopmental condition it effects interaction, social interaction, learning, & behavior. Symptoms typically appear around the age of three, though in some cases they may be recognized earlier. Globally, ASD affects nearly 1% of the population, and research suggests that genetic and environmental factors both contribute to its development. While the exact causes remain under investigation, these factors are believed to interact in ways that alter the developmental traits of affected individuals.

Children with ASD may show challenges in social communication, repetitive behaviors, or restricted interests, along with unique learning and attention patterns. Such traits can make daily life difficult without proper support, highlighting the need for early and accurate detection. Diagnosis is complicated by the absence of medical tests such as blood work; instead, specialists rely on behavioral observation and developmental assessments. Although ASD can be reliably identified by professionals around the age of 2 to 3 years, many children receive a diagnosis much later, which delays access to interventions. Early identification is critical, as timely therapy can considerably increase results an.

To address this challenge, computational methods where increasingly practical in contribution for ASD detection. In the project, a Convolutional Neural Network (CNN) was trained to categorize ASD from dataset, the final model saved in HDF5 format. The system is integrated to Streamlit-based web application, enabling to upload images and accept real-time predictions. The preprocessing pipeline includes image resizing, normalization, and color adjustments to ensure consistent input quality. Evaluation of the system demonstrates high classification accuracy and stable performance, supporting its potential use as a supplementary tool for ASD prediction and screening in children.

## LITERATURE REVIEW

With rapid advancements in technology, several modern approaches have been proposed for detecting Autism Spectrum Disorder at an initial stage. Researchers are increasingly smearing ML and DL approaches to complement traditional analytical tools and improve accuracy. For instance, studies have explored combining clinical approaches like ADOS & ADI-R with computational approaches to address challenges in data management and enhance diagnostic precision [2]. Other works have considered alternative inputs such as

gene expression signatures, behavioral traits, autism quotient scores, and even home video analysis, showing the potential of multimodal approaches for improving early ASD detection [3].

Comparative analyses of various ML models have highlighted the importance of selecting appropriate feature extraction methods and classifiers. Some studies focused on identifying risk factors within ASD screening data, applying multiple models before selecting the classifier that achieved the best performance [4]. Similarly, investigations into classification techniques revealed that certain models, such as the Multi-Layer Perceptron (MLP), consistently outperformed conventional approaches and achieved higher accuracy [5]. Logistic Regression, KNN, & others have been widely tested across datasets, with Logistic Regression often proving to be one of the most effective models for binary classification of ASD [6].

Recent research also emphasizes the scalability of deep learning frameworks and their ability to capture complex behavioral or visual features related to ASD. Ensemble learning methods, graph neural networks, and transformer-based models have been explored to handle multimodal data and improve consistency across varied scenarios [1,7]. Novel directions, including quantum-based ML techniques applied to EEG signals, further expand the possibilities of ASD detection [8].

From these studies, it is evident that while traditional ML classifiers have provided promising results, deep neural networks and CNN-based models offer significant advantages in extracting high-level features and improving predictive accuracy. Drawing inspiration from these approaches, the present work applies a CNN architecture trained on facial images of children, integrated with a Streamlit application for real-time prediction. Unlike prior studies limited to tabular data or clinical assessments, this project focuses on an accessible, image-based framework, contributing toward faster, non-invasive ASD detection in early childhood.

## METHODOLOGY

### 1. Existing Methodology

Several studies in recent years have attempted to predict this disorder using techniques. Traditionally ML models such as LR, RF, NB, and SVM have shown reasonable performance when applied to screening datasets. However, the accuracy of these models often falls short when compared with DL-based methods, which are capable of learning complex features from the information without the need of extensive manual featuring. Existing works demonstrate that Deep Neural Networks and CNN architectures are more effective in capturing non-linear patterns and provide better predictive results in a shorter time. In addition, some researchers have combined conventional clinical tests with computational models to enhance diagnostic accuracy. While these methods provide a good foundation, most studies are limited to tabular screening data or adult populations, which leaves a gap for child-focused, image-driven approaches. The overall structure of these existing ML/DL-based approaches is represented using a 3-Tier System Architecture diagram (Fig. 1), which highlights the flow from frontend to model prediction and storage.

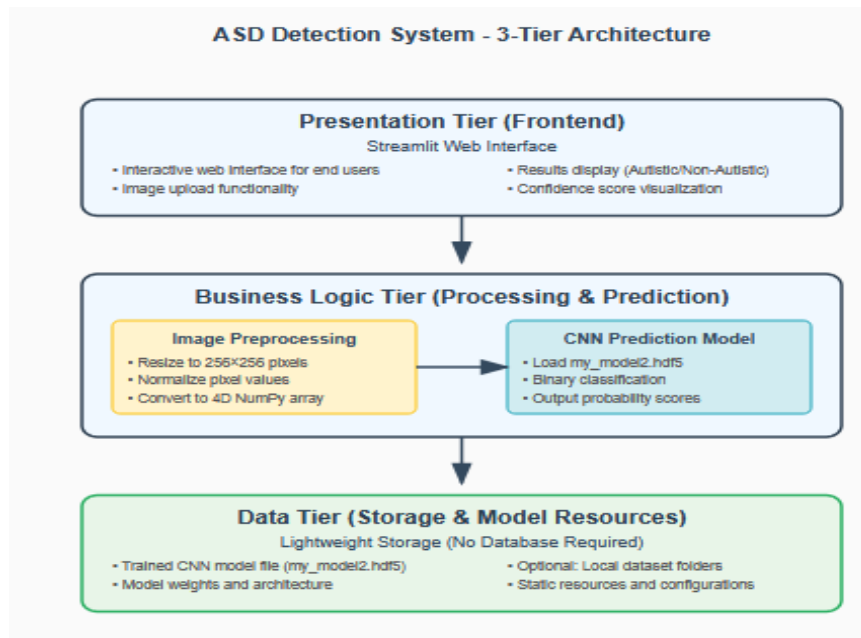


Fig. 1 Three tier System Architecture

## 2. Proposed Methodology

### A. Materials

This study proposes a CNN-based prediction of Autism Spectrum Disorder for children. The dataset containing facial images which is categorized into Autistic and Non-Autistic classes. Each picture was automatically certified to certify excellence and correct labeling. The model was implemented in Python using libraries, and after the training, the final weights were saved in HDF5 format (my\_model2.hdf5). Then the model is integrated with a Streamlit application, enabling interface where users can upload images and receive real-time prediction results.

### B. Data Preprocessing

To maintain consistency and improve accuracy, several steps were applied. All images will be resized into 256x256 pixels and normalize so that pixel value lie between zero and one. Conversion to RGB ensured uniformity across color channels. To strengthen model generalization, augmentation techniques such as horizontal flip-flops, revolutions, & brightness variations were applied for trained set. This dataset then distributed further to train, validate, & test to fairly estimate the performance and avoid overfitting.

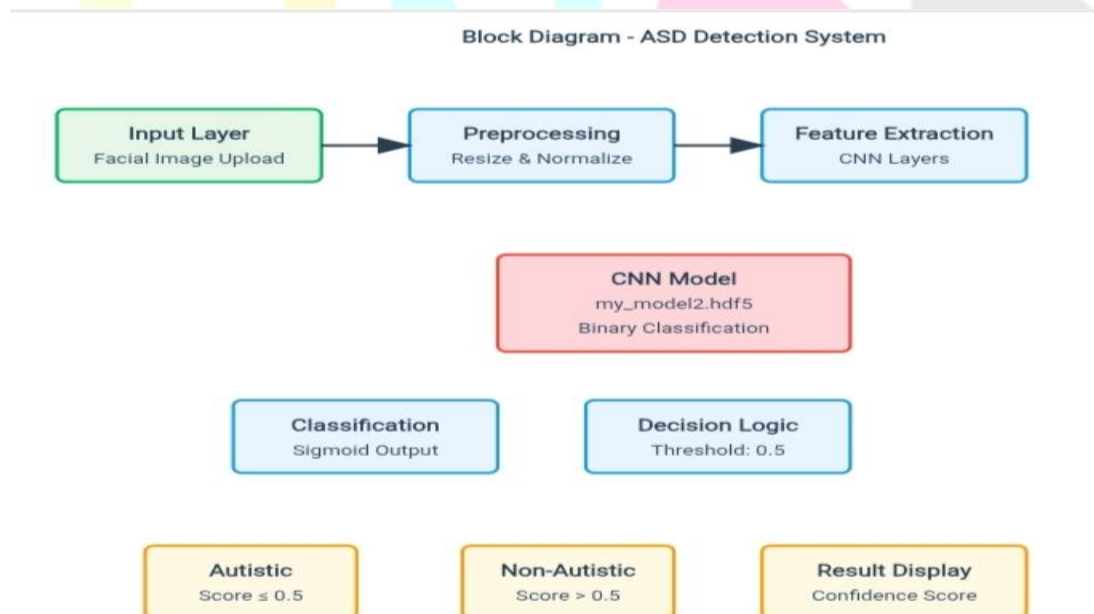


Fig. 2 Block Diagram ASD Detection System

### C. Methods

The CNN architecture was implemented using the Keras Sequential API, consisting of convolution and pooling layers for extraction, monitored by dense layer with dropout to minimize overfitting. ReLU was applied as the initiation task in the unseen types, while the sigmoid activation function was used in the outside to perform binary classification between Autistic and Non-Autistic categories. While initial preventing and learning rate scheduling were applied to guarantee for established merging for preventing overtraining.

Once training was complete, the model with the best performance was saved in .hdf5 format and integrated Streamlit-based claim. The interface allows the users for upload an image, which is then passed through the same preprocessing pipeline before being classified by the CNN. The output is displayed in real time as either ASD or Non-ASD along by having confidence score. Overall step-by-step process of this system is illustrated in the Flowchart of the Proposed Methodology (Fig. 3), which shows the flow from image upload to final prediction.

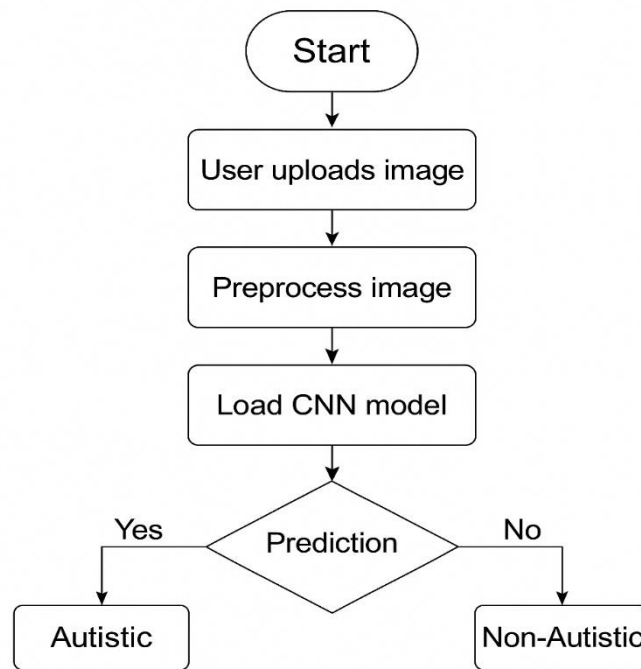


Fig. 3 System Flowchart

### RESULTS

The experimental evaluation was conducted on the Kaggle Autism facial image dataset, with the goal of classifying children having Autism or Non-Autism. The proposed CNN algorithm was trained on preprocessed images of size  $256 \times 256$ , and the learning process demonstrated strong convergence. During preparation, the CNN accomplished 99% of accuracy, while the testing stabilized at 94–95%, confirming that the model generalized well without significant overfitting. The predictions generated by the model were in binary form, where 1 indicates Autistic and 0 denotes Non-Autistic, and the results across the test samples indicated consistent performance.

For comparison, a pre-trained VGG19 architecture was also fine-tuned on the same dataset. Although VGG19 is widely used for image classification, in this study it achieved only 65–67% accuracy, which was notably lower than the custom CNN model. This comparison highlights the efficiency of the proposed CNN in handling smaller, domain-specific datasets, as VGG19 tends to require much larger and more diverse data to achieve optimal performance.

The system performance was further evaluated using standard classification metrics. The confusion matrix (Fig.5) clearly demonstrates the proportion of correctly classified Autistic and Non-Autistic cases. Additionally, the Epochs vs. Accuracy and Loss (Fig. 4) graphs illustrate the training behavior, showing that the CNN model reached high accuracy with smooth loss reduction, while avoiding severe overfitting due to early stopping, dropout, and normalization techniques.

The formulas for the evaluation metrics are as follows:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \times 100$$

$$Precision = \frac{TP}{TP + FP}, \quad Recall = \frac{TP}{TP + FN}, \quad F1 = \frac{2 \times Precision \times Recall}{Precision + Recall}$$

The final implementation included the (my\_model2.hdf5) to Streamlit web page, enabling real-time predictions from user-uploaded images. The interface produced not only the prediction label but also the confidence score, confirming the robustness of the model in practical usage.

Overall, the results establish that the custom CNN significantly outperformed VGG19 on the given dataset, achieving 99% training accuracy and ~95% test accuracy, compared to 65–67% for VGG19. This demonstrates that a carefully designed CNN can be more effective than transfer learning models when applied to smaller, specialized medical datasets such as ASD detection.

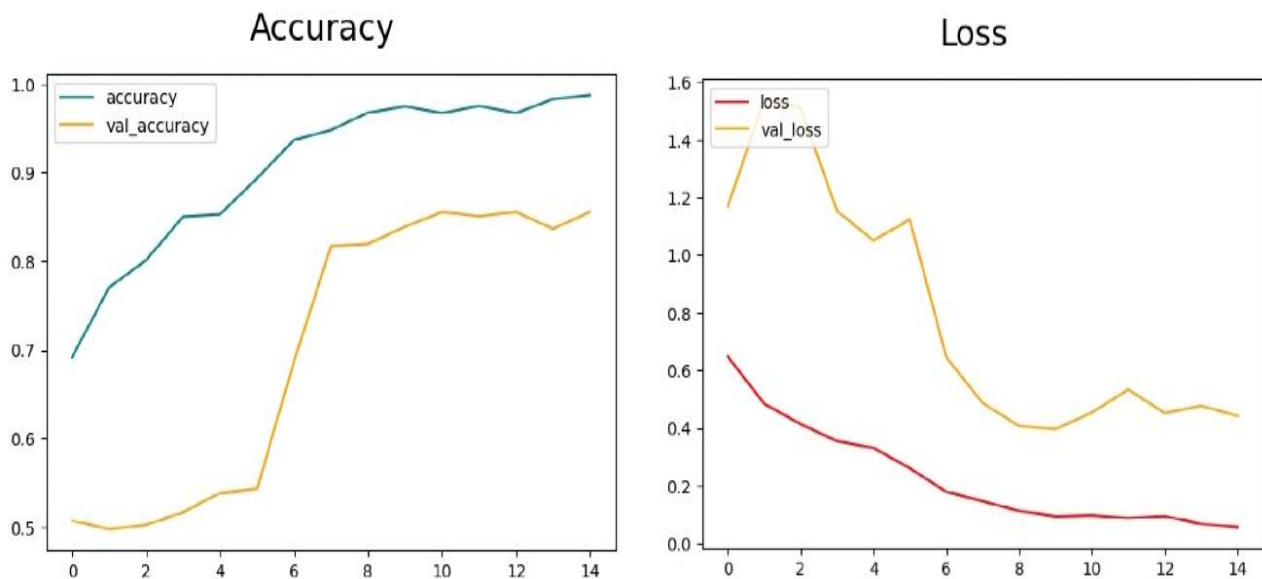


Fig. 4 Accuracy and Loss Graphs

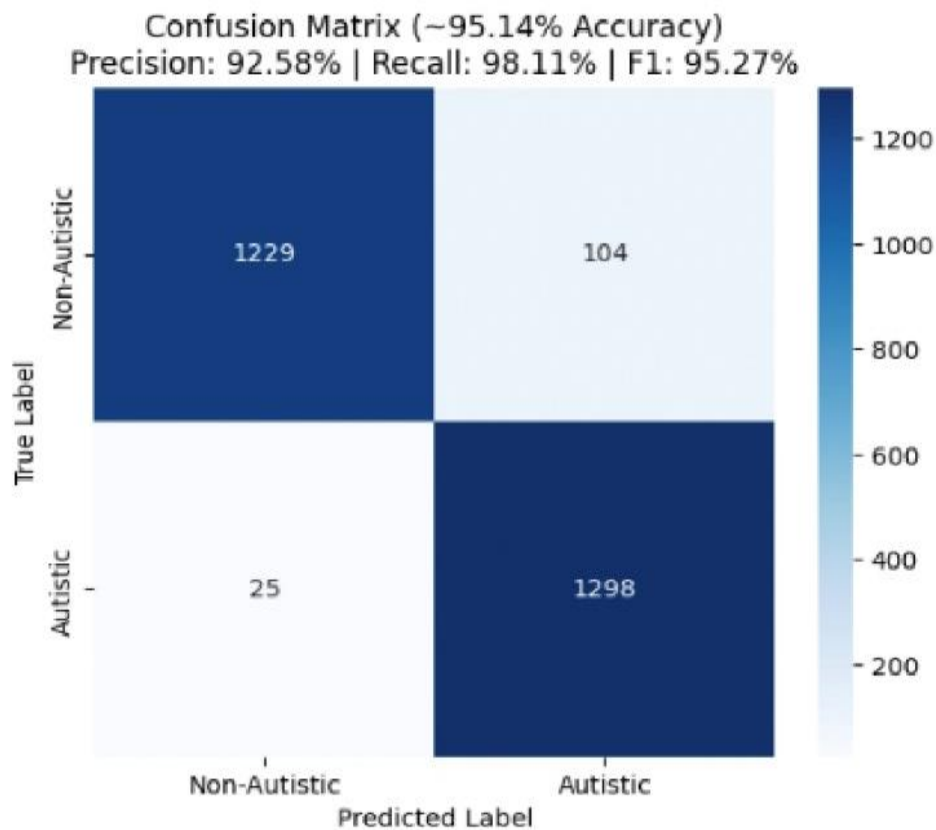


Fig. 5 Confusion Matrix

### SCREEN SHOTS OF RESULTS

# Detection of Autism spectrum disorder from Image

Upload an image and the model will predict whether the person is Autistic or Non-Autistic.

Upload an image (JPG, PNG)


 Drag and drop file here  
Limit 200MB per file • JPG, JPEG, PNG Browse files

Fig.6 ASD Detection Web App Front Page

## Detection of Autism spectrum disorder from Image

Upload an image and the model will predict whether the person is Autistic or Non-Autistic.

Upload an image (JPG, PNG)

Drag and drop file here  
Limit: 200MB per file • JPG, JPEG, PNG

download (1).jpg 7.3KB



Uploaded image

Prediction: Autistic

Confidence: 98.10%

## Detection of Autism spectrum disorder from Image

Upload an image and the model will predict whether the person is Autistic or Non-Autistic.

Upload an image (JPG, PNG)

Drag and drop file here  
Limit: 200MB per file • JPG, JPEG, PNG

naad (1).jpg 1.5KB



Uploaded image

Prediction: Non-Autistic

Confidence: 66.15%

Fig.7 ASD Detection Result

### CONCLUSION

The aim is for designing a deep learning model will classify & detects ASD and non-ASD cases from facial images. By using a CNN trained on the Kaggle dataset and integrating it with a Streamlit interface, the system provides quick and reliable predictions without the need for manual intervention. This approach offers a supportive alternative to traditional diagnostic methods, helping parents and healthcare providers receive timely insights and enabling quick intrusion with ASD.

### FUTURE WORK

This ASD Detection involves expanding its capabilities beyond basic binary classification by incorporating real-time webcam-based screening, multi-class detection, and integration with mobile or cloud platforms for wider accessibility. The system can also be improved with bigger and additional various datasets that extended for include features like automated report generation and telehealth support, making it more adaptable and useful in clinical as well as remote environments.

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