A COMPREHENSIVE ANALYSIS OF AUTISM DETECTION IN PEDIATRIC HEALTH CARE

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Abstract

In order to identify autism spectrum disorder (ASD) in children at an early age, the study presents a machine learning architecture. For a comprehensive approach to ASD identification, it integrates structured questionnaire data with picture data. Four distinct techniques—Max Abs Scaler, Normalizer, Power Transformer, and Quantile Transformer—are employed to produce the questionnaire data. Eight different machine learning algorithms—Linear Discriminant Analysis, Support Vector Machine, Logistic Regression, Gaussian Naïve Bayes, K-Nearest Neighbors, Decision Tree, Random Forest, and Ada Boost—are then used to classify the data. These algorithms were picked because they have been thoroughly researched for the detection of ASD and perform well with structured data. Furthermore, visual data is analyzed using Convolutional Neural Networks and Deep Neural Networks since they are effective at identifying

Keywords: - ASD, ML, DL, Identifying.

1. INTRODUCTION

Children with autism spectrum disorder (ASD) have difficulties interacting with others. Because of its varied and occasionally severe symptoms, ASD can be difficult to diagnose. Although it is usually discovered around age two, the intensity of the symptoms may cause it to be discovered later. Even if there are a number of therapy choices, early detection is essential for an effective intervention. The diagnosis of ASD and other illnesses including diabetes, stroke, and heart failure has become more common thanks to machine learning approaches. In this paper, a machine learning-based approach for early ASD identification is presented. The study's main goal is to collect standardized data on ASD in children, prepare it by filling in any gaps, and arrange it. The data is processed using four techniques: Quantile Transformer, Power Transformer, Normalizer, and Max Abs Scaler. Afterward, the information

2. RELATED WORK

Autism spectrum disorder is a developmental disorder that describes certain chal lenges associated with communication (verbal and non-verbal), social skills, and repetitive behav iors. Typically, autism spectrum disorder is diagnosed in a clinical environment by licensed spe cialists using procedures which can be lengthy and cost-ineffective. Therefore, scholars in the medical, psychology, and applied behavioral science fields have in recent decades developed screening methods such as the Autism Spectrum Quotient and Modified Checklist for Autism in Toddlers for diagnosing autism and other pervasive developmental disorders. The accuracy and efficiency of these screening methods rely primarily on the experience and knowledge of the user, as well as the items designed in the screening method. One promising direction to improve the accuracy and efficiency of autism spectrum disorder detection is to build classification systems using intelligent technologies such as machine learning. Machine learning offers advanced tech niques that construct automated classifiers that can be exploited by users and clinicians to signifi cantly improve sensitivity, specificity, accuracy, and efficiency in diagnostic discovery https://www.semanticscholar.org/paper/Exploring-the-pattern-of-Emotion-in-children-with Abirami-Kousalya/731d6d6647d41da9cb64598798371a90 08f813ea. This article proposes a new machine learning method called Rules-Machine Learning that not only detects autistic traits of cases and controls but also offers users knowledge bases (rules) that can be utilized by domain experts in understanding the reasons behind the classification. Empirical results on three data sets related to children, adolescents, and adults show that Rules-Machine Learning offers classifiers with higher predictive accuracy, sensitivity, harmonic mean, and specificity than those of other machine learning approaches such as Boosting, Bagging, decision trees, and rule induction.

Autism Spectrum Disorder (ASD) is found to be a major concern among various occupational therapists. The foremost challenge of this neurodevelopmental disorder lies in the fact of analyzing and exploring various symptoms of the children at their early stage of development. Such early identification could prop up the therapists and clinicians to provide proper assistive support to make the children lead an independent life. Facial expressions and emotions perceived by the children could contribute to such early intervention of autism. In this regard, the paper implements in identifying basic facial expression and exploring their emotions upon a time variant factor. The emotions are analyzed by incorporating the facial expression identified through CNN using 68 landmark points plotted on the frontal face with a prediction network formed by RNN known as RCNN-FER system. The paper adopts RCNN to take the advantage of increased accuracy and performance with decreased time complexity in predicting emotion as a textual network analysis. The papers proves better accuracy in identifying the emotion in autistic children when compared over simple machine learning models built for such identifications contributing to autistic society.

3. PROBLEM STATEMENT

This initiative will equip healthcare providers to take into account the most significant factors while screening ASD cases, boosting the accuracy and efficacy of diagnosis. Additionally, it will provide insightful information about the early identification and management of ASD in clinical settings. Because standard screening procedures are subjective and time-consuming, autism spectrum disorder (ASD) frequently goes undetected in early childhood. In order to increase the precision, speed, and dependability of ASD detection, this project intends to assist medical professionals by offering an AI-powered diagnostic tool that integrates behavioral questionnaire data with face picture analysis. The method improves clinical decision-making and fosters better results in pediatric healthcare by emphasizing important diagnostic traits and facilitating early intervention.

4. PROPOSED SYSTEM

A complex neurodevelopmental illness, autism spectrum disorder (ASD) presents difficulties in early detection because of its wide range of symptoms. Our initiative, "A Comprehensive Analysis of Autism Detection in Pediatric

Healthcare," attempts to address this pressing issue by recognizing the fundamental importance of proactive intervention. Children with undiagnosed ASD may experience complex social and developmental issues. Our goal is to improve diagnostic accuracy by utilizing a novel combination of image analysis and extensive questionnaires. A more thorough evaluation is ensured by our multi-modal method, which integrates behavioral characteristics and facial clues. Inspired by the potential benefits of early detection, our research aims to provide insightful viewpoints that will benefit medical practitioners. It has the ability to support informed decision-making by possibly providing supplemental diagnostic findings. This project

5. SYSTEM ARCHITECTURE

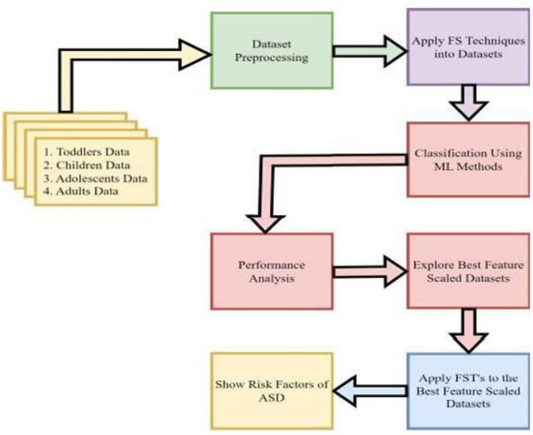


Fig:-1 System architecture

6. MODULES

1) Image Pre-processing

To make sure the autism picture dataset is appropriate for deep learning model training, this module manages its preparation. The actions consist of:

• Reading the dataset: Pictures are taken from the directory that has data that has been tagged (such as autistic versus non-autistic).

• Image resizing: To ensure uniformity, all images are downsized to a standard size (such as 128x128 or 224x224).

• Converting to array format: To enable deep learning models to use images, they are transformed into NumPy arrays.

• Label encoding: Label encoders convert text-based class labels, such as "autistic" and "non-autistic," into a numeric format.

• Data splitting: To facilitate model training and evaluation, the dataset is separated into training and testing subsets.

2) DL Model Evaluations

Using the preprocessed data, this module is in charge of training and assessing deep learning models. Important jobs consist of:

• Model training: The training data is used to train a CNN or other deep learning architecture. Metrics including accuracy, precision, recall, and F1-score are used to evaluate the model's performance.

• Model saving: For future use in prediction, the trained model is saved in.h5 or a comparable format.

• Label encoder saving: For decoding predictions, the label encoder that was utilized for preprocessing is also saved.

3) Performance Evaluations

In order to better comprehend the usefulness of the trained model, this module uses graphical charts to show its performance. It consists of:

• Plotting accuracy and loss curves: Matplotlib is used to plot training and validation accuracy/loss in order to identify patterns and identify overfitting or underfitting.

• Confusion matrix: To illustrate how well the model classifies each class, a visual confusion matrix can be shown.

• Additional metric plots: For in-depth analysis, precision, recall, and F1-score can also be presented.

4) Autism Detection

Real-time prediction on fresh or unknown photos is done with this module. It consists of:

• Picture selection: A user chooses a picture to be analyzed.

• Image preprocessing: Similar to training, the chosen image is scaled and transformed into an array.

• Model prediction: The image's class is predicted using the deep learning model that has been developed.

• Label decoding: Using the label encoder that was saved, the numeric prediction is transformed back into a legible label (such as "Autistic" or "Non-Autistic").

• Presenting the result: The user is presented with the outcome, potentially accompanied by the confidence score.

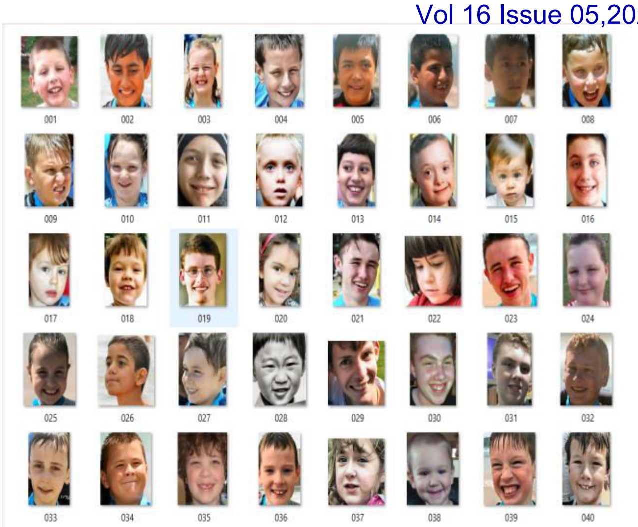
Algorithms Used

1) EfficinetNetB0 2) EfficientNetB1 3) EfficientB2 4) CNN 5)VGG16 6)MOBILENET

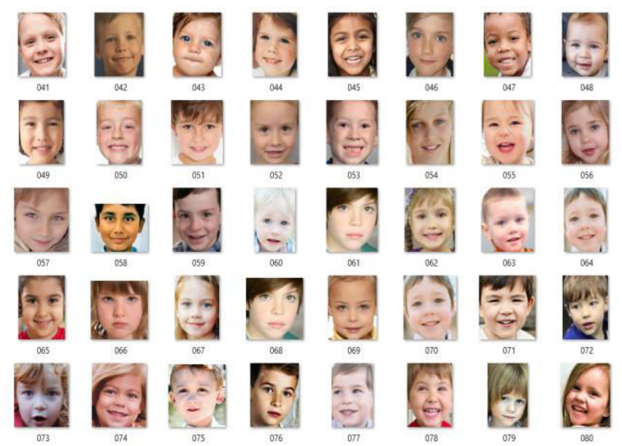
Dataset

We gathered this dataset from the Kaggle website, and this has two classes they are 1) Autistic and 2) Non Autistic

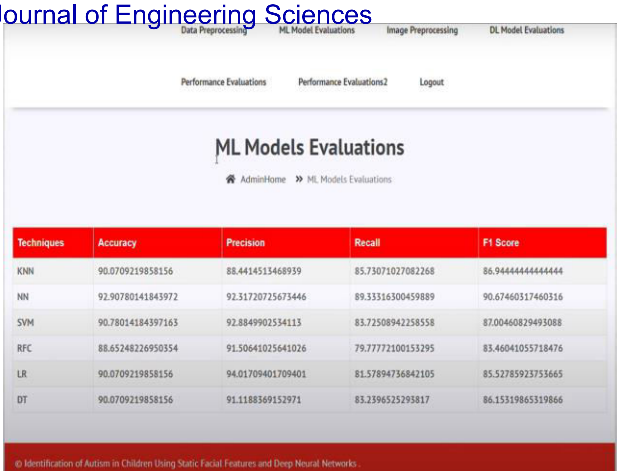
Autistic



Non Autistic



RESULTS



Data Preprocessing ML Model Evaluations Image Preprocessing DL Model Evaluations
Performance Evaluations Performance Evaluations2 Logout

ML Models Evaluations

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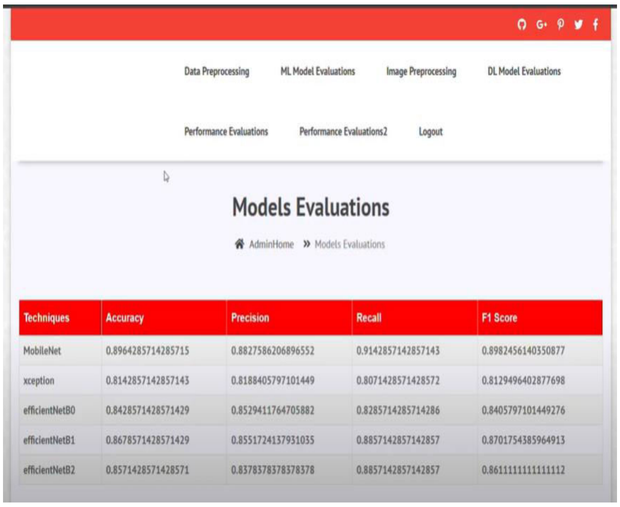
Techniques	Accuracy	Precision	Recall	F1 Score
KNN	90.0709219858156	88.4414513468939	85.73071027082268	86.94444444444444
NN	92.90780141843972	92.31720725673446	89.33316300459889	90.67460317460316
SVM	90.78014184397163	92.8849902534113	83.72508942258558	87.00460829493088
RFC	88.65248226950354	91.50641025641026	79.77772100153295	83.46041055718476
LR	90.0709219858156	94.01709401709401	81.57894736842105	85.52785923753665
DT	90.0709219858156	91.1188369152971	83.2396525293817	86.15319865319866

© Identification of Autism in Children Using Static Facial Features and Deep Neural Networks .



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Models Evaluations

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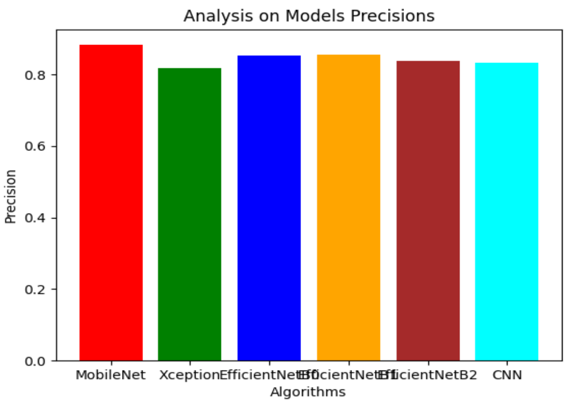
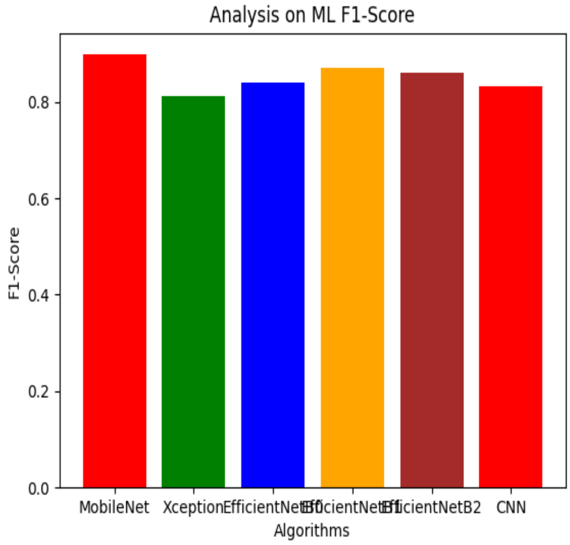
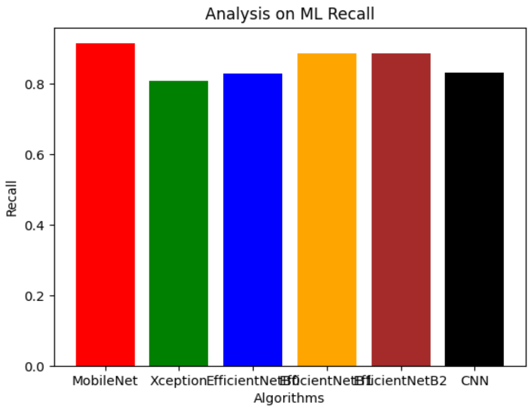
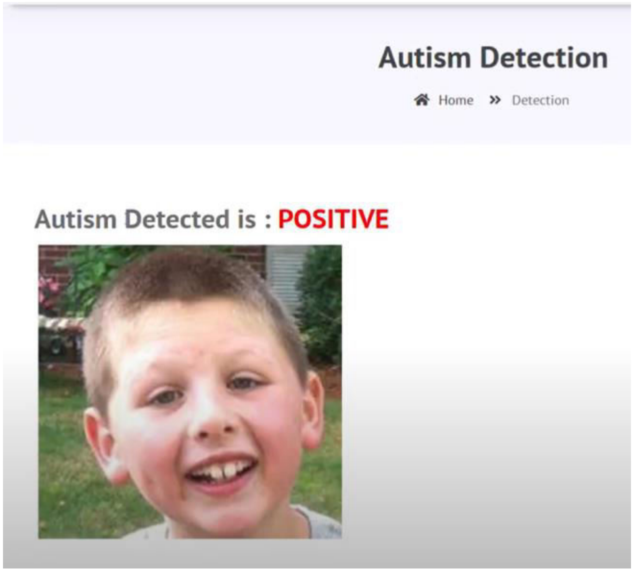
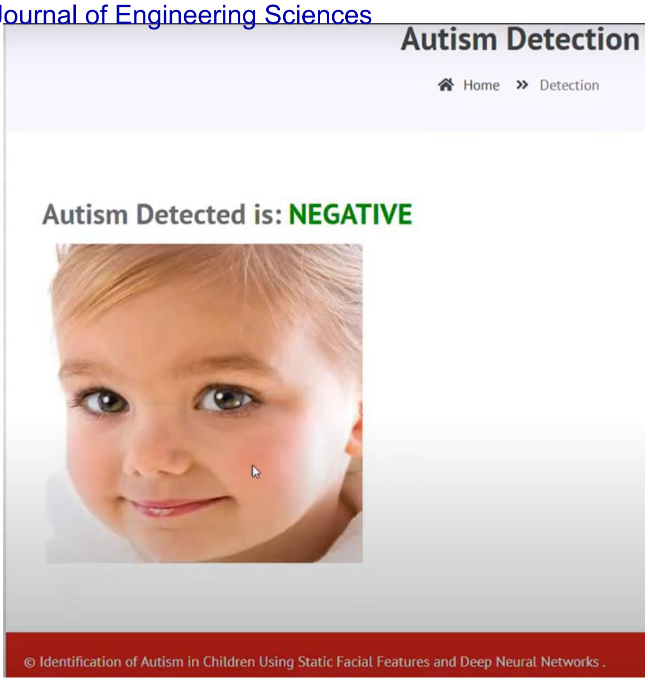
Techniques	Accuracy	Precision	Recall	F1 Score
MobileNet	0.8964285714285715	0.8827586206896552	0.9142857142857143	0.8982456140350877
xception	0.8142857142857143	0.8188405797101449	0.8071428571428572	0.8129496402877698
efficientNetB0	0.8428571428571429	0.8529411764705882	0.8285714285714286	0.8405797101449276
efficientNetB1	0.8678571428571429	0.8551724137931035	0.8857142857142857	0.8701754385964913
efficientNetB2	0.8571428571428571	0.8378378378378378	0.8857142857142857	0.8611111111111112











7. CONCLUSION

We presented a machine-learning approach in this study that is especially designed to identify ASD in children. We demonstrated the effectiveness of ML-based predictive models for this purpose. We used four distinct feature scaling methods to modify ASD datasets for children: The eight machine learning classifiers—Linear Discriminant Analysis, Support Vector Machine, Logistic Regression, Gaussian Naïve Bayes, K-Nearest Neighbors, Decision Tree, Random Forest, and Ada Boost—were used to classify Max Abs Scaler, Normalizer, Power Transformer, and Quantile Transformer. After evaluating each dataset's performance, we identified the most effective feature scaling and classification techniques. Our findings were supported by a number of statistical metrics, including log loss, kappa score, MCC, recall, precision, and F1-Score. Our machine learning-based prediction models can offer an additional means of precisely identifying

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