Pre-thesis Report-II

Detecting Autism Spectrum Disorder in children using Deep Learning

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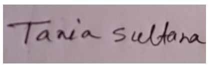
Declaration

It is hereby declared that

1. The thesis submitted is our own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. We have acknowledged all main sources of help.



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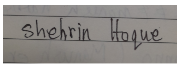

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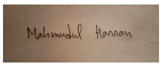

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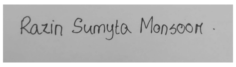

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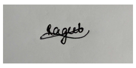

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Abstract

Autism Spectrum Disorder (ASD) is a complex and enduring condition characterized by challenges related to communication and behavior. It is a complex neurological disorder related to an individual's psychological difficulties, which eventually impact their behavior or reactions to the outside world. While it is feasible to detect autism symptoms at any stage of an individual's life, there is a greater likelihood of detection within the first two years after birth, as differences in typical activities, communication gaps, or a lack of understanding typically become more noticeable during this early developmental period. This paper aims to identify children on the autism spectrum using various techniques, including machine learning, image processing and deep learning involving Convolutional Neural Networks (VGG16, VGG19, Efficient NETB3) and Logistic Regression. Identifying autism at a younger age offers several advantages, including the opportunity for the individual to lead a better life, enabling preparation for their future and that of their close family members, and contributing to increased awareness and understanding of various medical conditions. Our objective is to utilize data sets from the ASD Tests program as a primary data source involving different modern methodologies and algorithms. We have also integrated different confusion-matrix in our paper. This will help in evaluating and fine-tuning the performance of our detection model. Our plan also involves utilizing a facial feature dataset collected from autistic patients to identify and discern symptoms of autism. Autistic children often display unique patterns of facial features that distinguish them distinctly from neurotypical children, so we want to utilize a deep learning-based web application for the detection of autism. This application will rely on experimentally tested facial features, employing techniques like Convolutional Neural Networks (CNNs) to aid in the detection process which is commonly used by researchers to analyze autism-related data. We have acquired facial images from a publicly available dataset, from a platform called Kaggle. Our primary goal is to improve the accuracy of autism detection or contribute to research by developing a comprehensive research paper. This paper aims to facilitate model comparisons and streamline the autism detection process using advanced deep learning techniques available today.

Introduction

Autism Spectrum Disorder (ASD) represents a lifelong condition that is associated with the development of the human brain. It's a rapidly growing category of disabilities characterized by repetitive behavior patterns, specific interests, and challenges in social interactions. Autistic individuals often encounter difficulty in expressing themselves, whether through verbal communication or non-verbal means such as gestures, facial expressions, and physical touch. Individuals with autism may experience difficulties in the learning process, and their skill development may occur unevenly, with some areas progressing at a different pace than others. This variability is a characteristic feature of autism. Now, individuals with autism can also exhibit remarkable abilities in various memory-intensive activities, excelling in areas such as mathematics, art, and more. These exceptional talents can be a unique aspect of their cognitive profile. These specialized areas of strength are sometimes referred to as "splinter skills" or "special talents" and can be a notable aspect of autism. The classification of autism as high-functioning or low-functioning is contingent upon the individual's level of severity. The high-functioning autistic individuals may excel in communication, have higher IQ levels, or demonstrate slightly more proficiency in typical daily activities compared to their low-functioning counterparts.

Autistic individuals typically exhibit symptoms that differ from those seen in neurotypical individuals. The symptoms of autism can include lack of eye contact, a limited range of interests or intense focus on specific topics, repetitive behaviors, heightened sensitivity to sensory stimuli, difficulty in social engagement, aversion to physical touch, and challenges in adapting to changes in routines. Occasionally, individuals with autism can become overwhelmed in certain situations, leading to what is known as a meltdown, they may express their distress by crying, screaming, or engaging in physical behaviors or they might completely withdraw and become unresponsive.

A considerable amount of research has been dedicated to enhancing the accuracy of autism detection through the utilization of various algorithms. Many research studies employ K Nearest Neighbors (KNN) and Linear Discriminant Analysis (LDA) for detecting autism in children aged between 4-11. Additionally, researchers frequently utilize deep learning techniques with datasets like the Autism Brain Imaging Data Exchange (ABIDE) to analyze autism-related data. Again, neuroscientific research has the potential to bridge the gap by providing a clearer understanding of the intricate relationship between the wide spectrum of alterations in autism behavior and the corresponding neural patterns. Many existing research merges machine-learning approaches with brain imaging data which has facilitated the categorization of mental states related to the processing and representation of semantic categories in the context of learning (Bauer and Just, 2015). Research studies utilizing neuroimaging techniques like magnetic resonance imaging (MRI) or positron emission tomography (PET) have yielded numerous insights into the neurodevelopmental features that underlie Autism Spectrum Disorder (ASD). One of the challenges in brain imaging studies of brain disorders is replicating findings across larger and more diverse datasets that accurately represent the varied demographics. We can also apply machine learning algorithms to brain images and these algorithms have the capability to extract consistent and resilient neural patterns from data obtained from individuals with psychiatric disorders (Pereira et al., 2009).

Our paper aims to integrate machine-learning techniques with facial features data and utilize artificial intelligence (AI) models which have been proven valuable in the early diagnosis of (ASD) to make more improvements in the autism detection sphere. We have collected facial feature images from both autistic patients and neurotypical individuals from the available online source Kaggle, conducted preprocessing and testing of the data, and then applied deep learning algorithms like CNN which involves VGG16, VGG19, Efficient NetB3, and Logistic Regression to analyze and extract valuable insights from the dataset. We will obtain our predictions from the deep learning model, which will enable us to identify and ascertain symptoms of autism based on the analysis of facial feature data. Here we have employed the Convolutional Neural Network (CNN) algorithm to train datasets, facilitating the extraction of components associated with human facial expressions. We also incorporated a confusion matrix into our approach to enhance the accuracy of our results. Recently, there has been a focus on analyzing data related to physical biomarkers and assessing clinical data through the application of machine-learning approaches. Early detection of Autism Spectrum Disorder (ASD) can benefit not only the individual with ASD but also their close family and support network, as it allows for better preparation and planning for the future. Advancements in modern technology and the application of AI models have indeed made early detection of Autism Spectrum Disorder (ASD) more accessible and streamlined.

A) Problem Statement

Early onset of the autism spectrum disease causes issues with social, academic, and occupational functioning later in life.People with ASD frequently show the following symptoms, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), a manual established by the American Psychiatric Association that healthcare professionals use to identify mental disorders: 1.Having trouble communicating and interacting with others 2.Limited interests and recurring patterns of behavior 3.symptoms that interfere with their ability to perform in job, school, and other aspects of their lives.The diagnosis of autism is crucial since living without one can be challenging, upsetting, and perplexing in a variety of ways. This may lead to challenging behaviors, social isolation, and young people performing poorly in school. Once a condition is identified, the young person can better understand themselves and realize they are not alone in how they feel.The behavior and development of a patient are assessed by medical professionals to make an ASD diagnosis. Typically, ASD can be accurately identified by age 2. The earliest possible evaluation should be sought for. The sooner ASD is diagnosed, the sooner assistance and treatments can start .The lengthy and laborious process of diagnosing a typical ASD is the problem here. By the time they receive the required counseling and treatment, the patient may have less opportunities to lessen the severity of any symptoms they may be experiencing. The main goal of this research is to speed up the diagnosis of autism by introducing a machine learning system that makes use of different machine learning algorithms to provide the most accurate predictive model.The suggested remedy comprises creating a predictive algorithm that can correctly identify whether or not a child has autism based on their images.However, utilizing machine learning to detect autism can present some significant challenges.The following sub-problems are possible divisions of the research problem:

Data gathering and integration

We need a significant amount of data to train our model, thus acquiring this data will be challenging for us. As a result, the first sub-problem of this study is around the effective acquisition and integration of images of autistic or non-autistic patients from numerous sources. Again, finding datasets for the medical sector is challenging because they are not permitted to disclose.This sub-problem focuses on the difficulties and factors to be taken into account while assuring data quality, reliability, completeness, and consistency for efficient analysis.

Selected and Represented Features

For the purpose of diagnosing autism, we must identify the relevant attributes and features from the dataset.This sub-problem tries to address the difficulty of feature selection and representation, ensuring that the chosen features accurately capture the crucial components of autism detection.

Evaluation and Prediction

This study's third sub-problem focuses on the evaluation and prediction of autism.The suggested approach comprises creating a predictive model based on the image of children to identify whether a child has autism or not.The ultimate goal is to take the standard approach to diagnosing autism and turn it into a machine learning model that can efficiently use the enormous quantity of data gathered for making predictions and observations.This subproblem addresses the difficulties in reliably diagnosing and forecasting autism, as well as the need to build acceptable evaluation metrics and procedures for judging the precision, dependability, robustness, and generalized potentiality forecasts.

B) Research Objective

The goal of detecting autism from images is to identify if someone has autism by looking at their pictures. This research of autism detection will help in:

1) Early Identification: We can find out if a child has autism when they are young, which helps them get special help early on.

2) Understanding Behaviors: We can learn more about how people with autism behave and express themselves through their facial expressions and actions.

3) Objective Diagnosis: It helps doctors make a clear and certain diagnosis based on pictures, which is more accurate than just talking to someone.

4) Different Types: We can discover if there are different types or ways that autism shows up in pictures, which could lead to more personalized treatment.

5) Equality: Using pictures can make sure that everyone, no matter where they come from or who they are, gets a fair chance at being diagnosed with autism.

6) Helpful Tools: We can create tools and technology that make it easier and less scary for children to go through the diagnosis process.

7) Tracking Progress: We can see how a person's expressions and behaviors change over time, helping us understand how well interventions are working.

8) Privacy and Safety: We can learn how to protect people's privacy and keep their images safe while still using them to help with autism diagnosis.

9) Training AI: By using images, we can teach computers and artificial intelligence to recognize autism, which can be very helpful in the future.

10) Raising Awareness: Detecting autism through images can help people understand autism better and be kinder to those who have it, reducing stigma and making the world a more inclusive place.

The main goal of this research is to detect autism with the help of images and to alert them and their families for early treatment and make sure that they get special care from the society. They should get all the opportunities to learn and grow like a normal child.

2. Literature Review

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder that impacts people's learning, behavior, communication, and social skills. This can lead to further problems like social isolation, mental health problems, and not being able to find or maintain employment. The lifetime cost of supporting an ASD-affected person, including his or her medical care, special education, and lost productivity, can amount to 2.4 million USD, while those without intellectual disabilities require only about 1.4 million USD [9]. In recent decades, ASD has become more prevalent. According to a report generated by the CDC, in 2020, 1 in 54 children in the US were diagnosed with ASD, while the previous record of 2000 shows only 1 in 150 children were affected [11]. This clearly highlights how this issue is becoming more concerning each year. The reason why this alarming health condition is not being treated as successfully as it should be is also due to the fact that most people with ASD do not receive early intervention. The importance of early diagnosis is paramount since studies [10] have shown that early intervention can reduce the severity of ASD by improving communication and adaptive behavior skills, reducing repetitive behaviors and so on. So, we can understand the crucial need for efficient and precise ASD detection methods. This literature review mainly concentrates on the existing study on face image analysis and machine learning methods for diagnosing ASD. It seeks to highlight both their possible advantages and disadvantages in relation to the detection of ASD. Additionally, this review highlights our proposed strategy, which involves hybrid models combining VGG16, VGG19, EfficientNetB3, and Logistic Regression (LR), along with a dataset containing 2940 face images. This across-the-board approach is intended to successfully tackle the noted shortcomings found in the available approaches for ASD identification. [16] looked into a number of deep learning models, such as DNNs, for the purpose of detecting ASD using face features. Although their results point to the possibility of increased accuracy, the study's lack of information on dataset size and ethical issues, as well as the opaque nature of deep learning, raise questions regarding interpretability. Our proposed hybrid model, while incorporating LR, targets to better model interpretability by offering perceptions into the process of making decisions. Furthermore, [5] improved accuracy (76.2 percent) and provided interpretability by combining CNN features with XGBoost and Random Forest algorithms. Nevertheless, the study lacked a thorough examination of the particular facial traits that contribute to the prediction of ASD. Plus their dataset size was likewise somewhat limited. Our larger dataset can provide higher statistical power. This can help us obtain possibly more broadly applicable results . Also, since we are combining pre-trained CNNs (VGG16, VGG19 and Efficient NetB3) we can make in-depth use of CNN's feature extraction capabilities. Also, [7] got an accuracy of 84 percent utilizing VGG16 and VGG19 (focusing solely on CNNs). We can improve the overall functionality of such approaches by incorporating LR. Although the accuracy of earlier research has shown promise, interpretability is still a problem. By combining VGG16, VGG19, EfficientNetB3 and Logistic Regression, our hybrid model seeks to overcome these drawbacks by improving interpretability and making use of pre-trained CNNs' feature extraction powers. Also, it is known how important a larger dataset is, as it provides more statistical power for conclusions that are more widely applicable. Our suggested strategy aims to progress the field of ASD identification by improving upon current approaches and integrating interpretability, which will ultimately lead to more successful interventions.

2.1 Related Work

Many researchers have already done work on detection of autism spectrum using image processing. All of them used different methods to detect autism by using pictures. Image processing played a crucial role in identifying autism in children early.According to Rad and Furnanello, their research was based on the communication and social problems of the young teens having ASD. Besides, while doing their research the characteristic movement of the young patients stood out noticeably. Children with autism have SMMs as an important part of their life. So, it was very important for the researchers to develop a technique that will be effective for locating the changes of the young patients with abnormal behavior[6]. In another case, researchers utilized AI for developing the sequence of repetitive examples of strolling. This research was established by applying the motor and kinematic characteristics of strolling. For detecting the problem, they used linear analysis of learning classification. The negative and positive part of linear analysis helped in regulating the research. DSM-IV was used as an ASD screening tool and it was consistent in its result. With the help of tomography of the cerebrum, they observed significant control of autism [4]. Data sets from the ASD Tests program were used as a source for another Artificial Neural Network in other research. So, 10 questions were used for collecting information. With those questions including the age and gender of the member, research was conducted. In [8] , a prediction system was created by using the previous records of long time patients for distinguishing the signs of ASD. Both traditional and rare types of ASD were detected using this prediction system. For creating a matrix, machine learning and colloquy theory were applied together to establish the system. It utilized all sets of associations to create rules for better results. It must be noted that their ASD system consumed more limited memory for conducting the research. Also, because of single time database access, the system was faster [15]. For another work, K Nearest Neighbors (KNN) and Linear Discriminant analysis (LDA) were utilized for the detection of autism in kids aged between 4-11. So, they used 70 percent of the data for the training and the rest 30 percent were used for testing. As a result, those algorithms helped in getting more accurate results for prediction and reduced predictions that were biased [18]. Deep learning techniques were utilized by researchers in the Autism Brain Imaging Data Exchange (ABIDE) dataset because of analyzing ASD in [12]. They discovered that the result of accuracy of classification was 70 percent better compared to other state art techniques . Another research [13] suggests a deep learning model for early ASD identification using eye-tracking scan path data. The model was trained and assessed based on eye-tracking data from kids with and without ASD. However, the authors acknowledged that more study is required to verify the model on a bigger, more varied dataset since they had a relatively small sample size. Since this is such an important tool for early ASD diagnosis, we can substantially improve the detection accuracy through longitudinal analysis, using more advanced machine learning models and a more diverse and larger dataset.In [14], the authors used VGG16 as their model for facial recognition of autism in children. Thus,they applied VGG16 for transfer learning as a pre-trained model. In the case of training and testing, they divided the dataset into 80 percent and 20 percent respectively.Moreover, the dataset was composed of East Asian children's facial features. As a result, after training they got 93 percent accuracy rate which was a good percentage. Xception and VGG16 were applied as a pre-trained model in another work [16]. Both models, after going through training and testing, classified children as autism or normal. The accuracy rate for Xception and VGG16 models was 91 percent and 78 percent respectively. Xception had the highest accuracy rate while VGG16 had the lowest accuracy rate So, Xception performed better than VGG16 in terms of performance level. In another work [3], VGG19, Xception and NASNETMobile were enforced for classifying between autism and non-autism in children.These three models were trained and tested for extracting traits from facial image of children for classification purpose. As a result, the Xception model had the highest accuracy among the three models which was 91 percent. On the other hand, VGG19 and NASNETMobile had the accuracy rate of 80 percent and 78 percent respectively. .So, the accuracy rate of NASNETMobile and VGG19 was too low compared to the Xception model. The authors in [17] proposed using MobileNet, InceptionV3, Xception, EfficientNetB0, EfficientNetB7 and VGG16 for their research. Models were trained and tested using a dataset from kaggle. After testing, the accuracy rate of MobileNet, Xception, InceptionV3, VGG16, EfficientNetB0, and EfficientNetB7 was 88 percent, 87.7 percent, 86.1 percent, 86.3 percent, 85.6 percent and 82.6 percent respectively. Therefore, MobileNet performed better than other models because of having a higher accuracy rate than other models. Conversely, the performance level of EfficientNetB7 was low.

From the above research works, we can see that accuracy rate of the model was not good. We plan on improving the accuracy rate by using some of the models mentioned above. As a result, we have to improve the performance level of the models we are planning to use. So, our goal is to achieve a high accuracy rate.

3.Methodology

The proposed deep learning-based autism detection model suggests techniques that employ facial analysis to diagnose autism in children.To do this, the model needs to be designed using a process that accepts an image as input, processes it, and outputs predictions that may be classified as "autistic" or "non-autistic."An overview of the model's design is given in Figure 1.

1.Data gathering and preparation phrase

1.1 determine the relevant data sources.
1.2 collect pictures of patients with and without autism so that the model can be trained and tested.

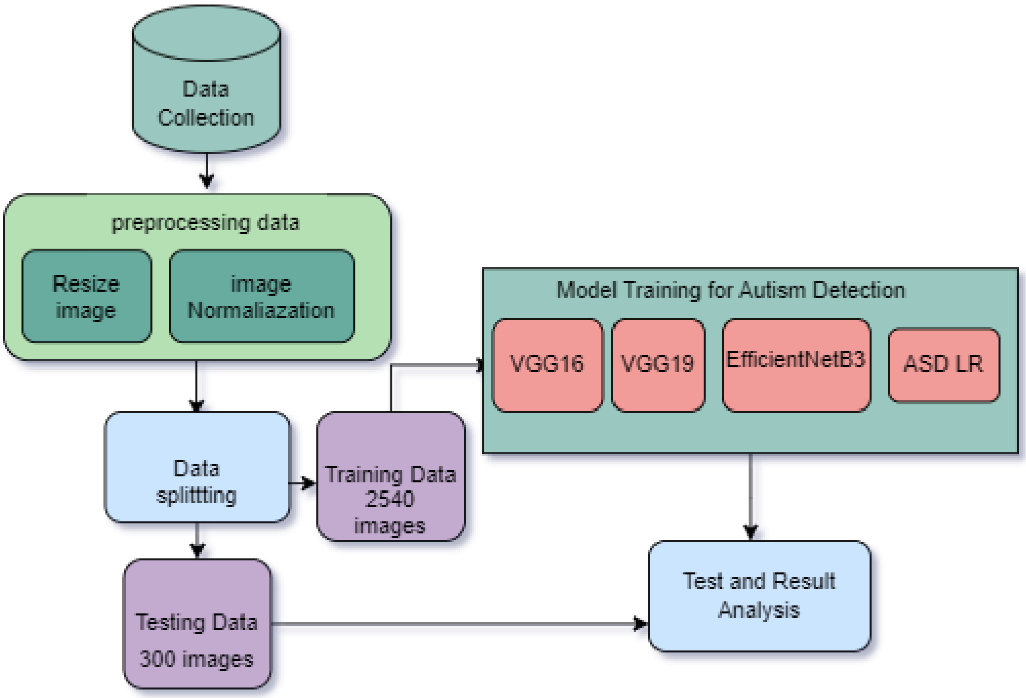

Figure 1: Step by step work plan of the proposed autism detection model

1.3 The dataset folder images are of varying sizes and contain some noise so we have to apply certain preprocessing techniques to the photos to make same size image and smooth the dataset.
1.4 The dataset was divided into 2,540 images for training, 100 for validation, and 300 for testing.

2.Apply Deep Learning Algorithm and models

2.1 To determine the image's class, deep learning algorithms use the input image and prioritize learnable weights and biases. Then, in order to create predictive models, we will select the deep learning algorithms (VGG16,VGG19, EfficientNetB3, and ASD LR).These models will be used in our research.

3.forecast the outcome

3.1The result could be either non-autistic or autistic, depending on the image. Next, we computed each model's accuracy result and compared it.

4.Input Data

4.1 Input Data

In our pursuit of detecting autism in children, we concentrated on four models, and to facilitate this, we adopted preprocessing techniques that were largely uniform across all the models. After collecting data from the Kaggle website, a total of 2940 images were obtained. Among these, 2540 were chosen for training purposes and 300 images were chosen for testing purposes. The input data undergoes a sequence of steps, starting with the organization into a directory structure, followed by division into training and testing datasets. Subsequently, it undergoes splitting, image read, and display processes, resizing, augmentation, validation, and conversion to arrays. These preparatory steps are essential to render the data ready for testing with various algorithms.

0.1 Source

This is the primary source of our dataset collection: https://www.kaggle.com/datasets/cihan063/a image-data

fig 2: Reading image

4.2 Data preprocessing

In our pursuit of detecting autism in children, we concentrated on four models, and to facilitate this, we adopted preprocessing techniques that were largely uniform across all the models. After collecting data from the Kaggle website, a total of 2940 images were obtained. Among these, 2540 were chosen for training purposes and 300 images were chosen for testing purposes. In the preprocessing pipeline for various models, including VGG16, VGG19, EfficientNet B3, and Logistic Regression, the initial step involved reading and resizing all images. For the first three models (VGG16, VGG19, and EfficientNet B3), images were read in RGB format, while for Logistic Regression, the images were converted into grayscale. Subsequently, each image was resized according to a specific target size.

After resizing, the images were flattened into one-dimensional arrays, transforming images into arrays provides a structured representation of pixel values, enabling seamless processing of our models as the array maintains the spatial information inherent in the image. this step helps in normalization, resizing, and other steps. Now, the pixel values were normalized to a range between 0 and 1 to ensure numeric stability. This normalization was achieved by dividing each pixel value by the maximum pixel value. These steps were consistently applied across all models in the preprocessing phase.

fig 3: Resizing

Following the normalization, data was organized into DataFrames, namely train-df and test-df. The subsequent labeling step assigned binary labels, with "1" indicating autistic and "0" indicating non-autistic. In the training phase, data augmentation was employed to artificially increase the size of the training dataset. The goal is to expose our model to a more varied set of examples, making these more robust and improving the ability to generalize well to unseen data. The labeled data was then separated into different training datasets to store the flattened images.

A crucial preprocessing step involved splitting the training and testing datasets, facilitating the training and evaluation of the respective models. This systematic preprocessing approach ensured uniformity in data representation and set the stage for effective model training and evaluation across the diverse set of models employed.

5.Description of the Model

5.1 VGG16(Visual Geometry Group 16)

VGG16 is a deep neural network architecture designed for image classification. It has 16 layers. They are 13 convolutional layers and 3 fully connected layers.It is effective for capturing hierarchical features in our images. VGG16 is a widely used CNN model and effective at the same time. VGG16 is easy to understand and memory efficient. Besides, it is good for transfer learning. We can deal with pre-trained models of large data to do some specific tasks. Also, VGG16 has less computational cost. In our code, from the pre-trained VGG16 model we tried to freeze its learning to check the knowledge it gained. Binary classification is being used. New learning system(Custom Model) being implemented to make the system adjust its understanding based on the mistakes. Data augmentation was implemented for making a small set of pictures more diverse. The system undergoes training for 40 learning sessions (epochs), getting better each time. We check its performance on a different set of pictures to ensure it's not just memorizing, but truly understanding.

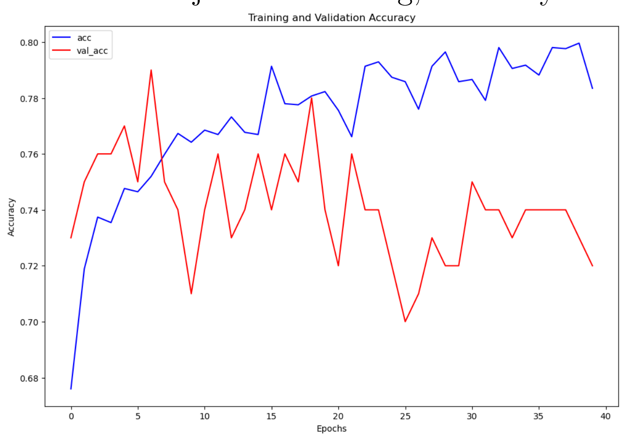

figure 2.4 VGG16 accuracy

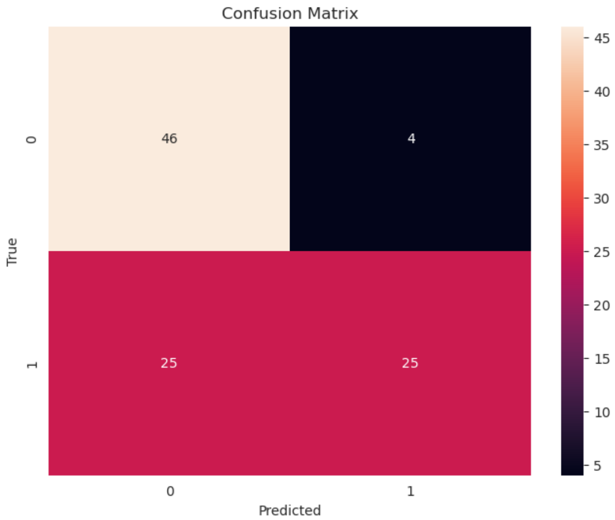

figure 2.5 VGG16 confusion matrix

5.2 VGG19(Visual Geometry Group 19)

VGG19 is the extended version of VGG16. VGG16 works with 16 layers and VGG19 has 19 layers. Additional 3 layers help to understand more complex images. Additional 3 layers are also convolutional layers which helps to understand images more deeply. It is effective for capturing hierarchical features in our images. VGG19 also has higher accuracy and versatility. Like VGG16, VGG19 is also good for transfer learning. In our code, we customize the model by choosing include-top=False for working with small datasets. The inclusion of pre-trained weights from ImageNet enriches its ability to recognize diverse visual patterns without extensive training on our dataset. The input-shape parameter allows us to adapt the model to the size and color details of our specific images. The use of global max pooling (pooling='max') efficiently extracts important features from the images.

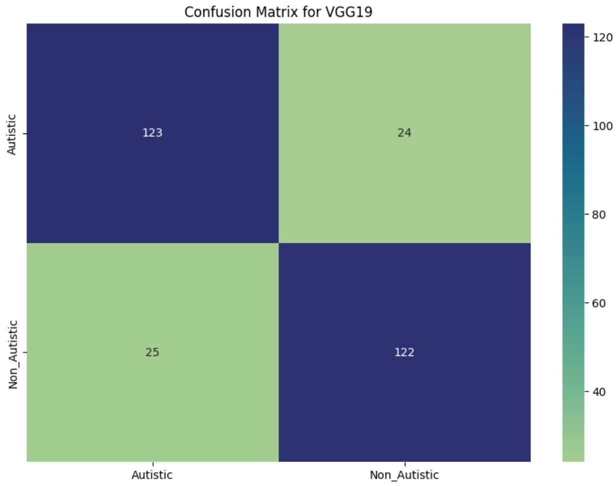

figure 2.3: VGG19 confusion matrix

5.3 EfficientNetB3 With Transfer Learning

Among the convolutional neural network architectures in the EfficientNet family is EfficientNetB3. They are effective for both training and inference since these designs were created to deliver high accuracy at cheap computing cost. Within the EfficientNet series, EfficientNetB3 specifically denotes a larger variation.The EfficientNet family of models is built around an innovative way to scaling CNN models. It uses a simple yet effective compound coefficient. Particularly, EfficientNet scales every feature of an organization with an appropriate set of scaling coefficients consistently, in contrast to traditional systems that scale aspects like purpose, profundity, and width. While scaling specific elements improves model performance, modifying every organizational element in relation to the available assets improves overall performance[1]. EfficientNet is significantly smaller than other models with comparable ImageNet accuracy. For instance, the ResNet50 model underperforms the smallest EfficientNet, known as EffecientNet-B0, with just 5,330,564 parameters overall, while having 23,534,592 parameters in total, as you can see in the Keras application[2]. We offer an effective technique in this study that is built on the CNN model EfficientNet-B3. Because it offers a fair balance between processing resources and accuracy, we have chosen this specific variant of the Efficient Net family. For the other more potent variations, the concepts we outline here are also applicable.

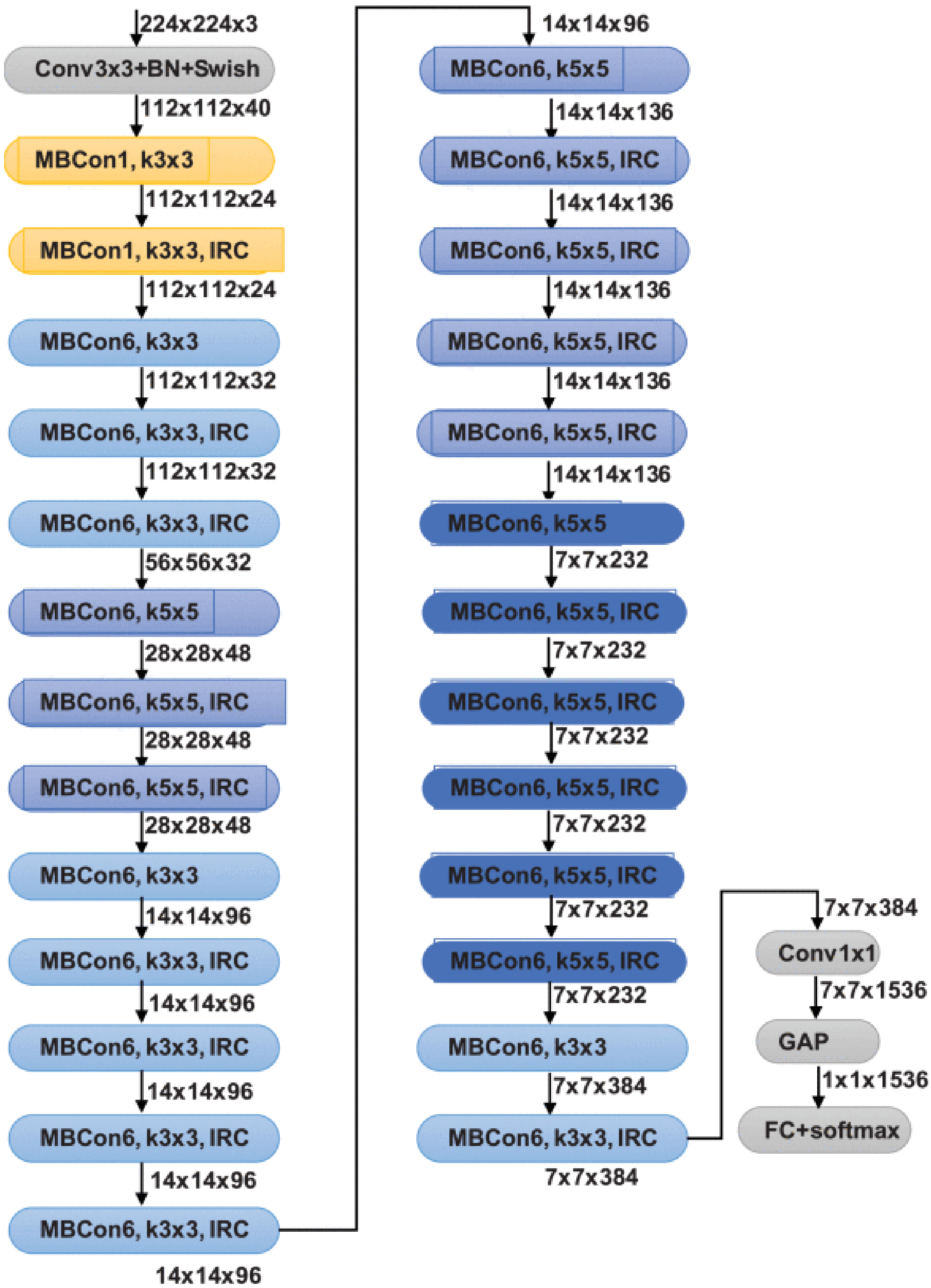

figure 2.2: Illustration of the EffecientNet-B3 architecture

We will use efficientNetB3 with Transfer Learning for our research. EfficientNetB3 with transfer learning is the process of using the EfficientNetB3 architecture as a pre-trained model for a specific job by leveraging the knowledge it gained by training on a large dataset (often ImageNet). Transfer learning is the process of fine-tuning a pre-trained model using a smaller dataset or an alternative goal. There are various benefits to this strategy. EfficientNetB3 is well known for achieving high accuracy on image classification tasks with less parameters than some other designs. Gaining from the generalization skills acquired during pre-training on a sizable dataset is possible with transfer learning.Here is confusion matrix for our code:

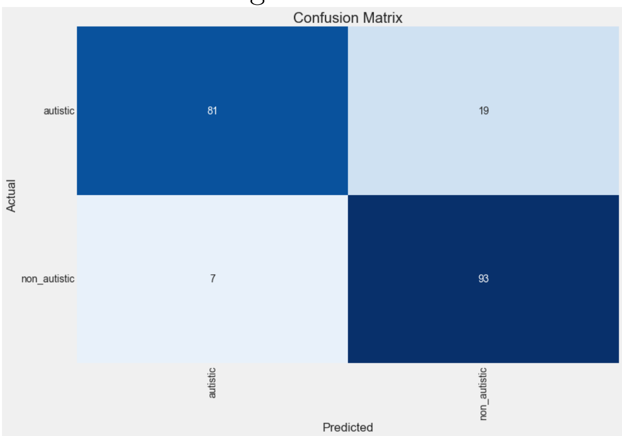

figure 2.3: EfficientNet-B3 confusion matrix

5.4 LR(Logistic Regression)

Logistic regression is a type of machine learning technique which is very effective in detecting autism in children. It is a type of technique which helps in determining the relationship between two data factors with the help of mathematics. Besides, the outcome of prediction is finite. Sigmoidal function is used to express logistic regression.Also, Logistic regression creates multi response for normal variables. Logistic regression model is applied to create a relationship between facial features extracted from the dataset and probability of a child being autistic. A probability score is given as an output to determine whether the child is autistic or not with the help of extracted facial features. Moreover, the logistic function of the logistic regression model helps in mapping the linear combination of features provided between 0 and 1. AUC-ROC which is a characteristic curve helps in assessing the performance level of the model based on how well it performs on differentiating children being autistic or not. Logistic regression is a very simple model and extensive computation resources are not needed for implementation. Since coefficients are allocated to each feature of children,it becomes very easy to distinguish children having autism.

6.Result Analysis

Among all the models Efficient NetB3 gave us the highest accuracy of 87 percent. It is clear that logistic regression is bad for image data. All three CNN models gave us accuracy above 70 percent. VGG16 is the most commonly used model for our dataset and it has accuracy of 71.33 percent. Better version VGG19 has accuracy around 80 percent and Efficient NetB3 has the best accuracy of 87 percent. We believe using Efficient NetB3 or updated versions like Efficient NetB4 or Efficient NetB5 with the collection of new data by ourselves we can improve the accuracy and do significant research for our medical science.

7.Result Comparison

We used VGG16(Visual Geometry Group 16), VGG19(Visual Geometry Group 19), Efficient NetB3 and ASD LR(Logistic Regression) models for our prediction to detect autistic children. Each model represents different accuracy. Below table compares the accuracy we got from these models.

Models	VGG16	VGG19	Efficient NetB3	ASD LR
Accuracy	71.33	80	87	61

Table 1: Result Comparison

CNN models(VGG16, VGG19, Efficient NetB3) autistic classification report are given below:

Model	VGG16	VGG19	Efficient NetB3
Precision	0.66	0.83	0.92
Recall	0.88	0.84	0.81
f1 score	0.75	0.83	0.86

Table 2: Autistic Classification Report

8.Conclusion

The aim of this research project is to identify autism in young children more accurately by using facial image processing. We tried to create a data-driven framework that will help in classifying the characteristics of the spectrum of autism in children effortlessly. The research focuses on knowing in detail about the characteristics of autism by studying the facial features thoroughly. We tried to ensure that there were less chances of misdiagnosis by proper training of deep learning algorithms. Confusion matrix assesses the performance of models we are using in this research which helps in evaluating the negative and positive classes. Also, with the help of ASD features gathered from individual modalities of data will help us in boosting the rate of accuracy. Application of different deep learning models like VGG16, VGG19 and Efficient NetB3 along with a classification model named LR, helped us detect the characteristics of ASD beneficially. Our result analysis revealed that Efficient NetB3 performs way better than other models and yielded a higher accuracy of 87 percent. As we continue further data collection, training and testing we believe our research will be able to make a way towards the advancement of ASD research, by achieving our main goal which is to achieve more accuracy in the prediction of ASD.

Future Work

Our data collection process involved obtaining datasets from Kaggle, which primarily consisted of images of children from various Western countries. However, the dataset lacked representation of Asian facial features. Due to current circumstances in the country, we were unable to personally collect additional data within the given timeframe. Our future plans include gathering more data as primary sources to address this gap and enhance the accuracy of our models.

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