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Research Paper

Facial Emotion Recognition Based Prediction of Affective State Of Children with Autism Using Ml

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Abstract: Nonverbal communication is important in everyday interactions, and its contribution to communication can be as high as 93%. Video surveillance, expression analysis, paralinguistic communication, and detection all benefit from the application of facial emotion analysis. We provide a thorough description of FER (Facial Emotion Recognition), which is based on traditional machine learning (ML), in our suggested system. In-depth research is required to make learning problems detection simpler because it is still laborious and time-consuming. Dyscalculia is characterised by difficulties counting, comparing numbers, and adding mathematical operations. This learning disability is thought to affect between 3 and 6% of school-aged youngsters. One of the special learning disabilities (SLD) with a mathematical impairment is dyscalculia. As the results of these individual tests alone are insufficient for identification, a variety of tests must be administered and analysed manually in order to discover dyscalculia. When analysing complex medical data, artificial intelligence (AI) for healthcare uses Random Forest algorithms to simulate human cognition. The screening procedure for these particular learning problems makes use of machine learning techniques. Counting accuracy, time spent per question during the counting phase, number comparison accuracy, time spent per question during the number comparison phase, arithmetic addition accuracy, and time spent per question during the addition phase were the six inputs used to develop the model. The model, which categorises children as dyscalculic or not, was constructed using the Random Forest method.

Keywords: Facial emotion recognition (FER), Artificial intelligence, Random Forest, and dyscalculia.

1. Introduction

This Proposed System focuses on a medical diagnostic problem - finding the relationship between Intellectual Intelligence and Emotional Intelligence using an artificial neural network with data mining. However, these studies do not provide any clear combination decisions. The literature is compiled from a variety of prominent studies that have been released in the last ten years. In the world of medicine, an artificial neural network is a potent instrument. Because doctors can utilise this technology in many different areas of medicine, including medication research, biological analysis, image analysis, and diagnostic systems and also for monitoring many health problems. The current method available for diagnosing dyscalculia in children is based on a checklist of symptoms and signs of dyscalculia. This traditional method is time-consuming, inaccurate and also outdated. There are far fewer such dyscalculia identification facilities in schools or even in cities. Parents either do not know or may not be willing to take their children for such an evaluation. Although, as teachers advise, parents may hesitate to make such an assessment due to society's ignorance of dyscalculia, as they might think that the child may be mentally retarded. If a dyscalculia screening facility is linked to schools and screenings are organized as a routine process, dyscalculia can be identified at an early stage. We analyse the performance comparison of various algorithms in the final section and suggest the top method for diagnosing dyscalculia. It will help in the early

identification of students with dyscalculia and reduce the time of diagnosis.

2. Objective

The main objective of this research was the intervention of dyscalculia in school children through facial recognition methods based on information technology and assistance tools. Therefore, this work focuses on the identification of elements that contribute to a better prediction, and subsequently on the creation of a suitable prediction model. We noted the problem that some attributes in the checklist have less benefit in predicting dyscalculia. Therefore, to enhance the effectiveness of the classifier, we must decrease the amount of attributes.

3. Literature Review

There are datasets with behavioural information for children between the ages of 4 and 11, adolescents between the ages of

12 and 16, and adults between the ages of 18 and older. The Autism Spectrum Quotient, or AQ-10, is used to determine whether a person needs to be referred for a thorough autism evaluation. The AQ-10 screening questions concentrate on a variety of skills including social interaction, communication, imagination, and attention to detail. There is just one point available for each of the 10 questions in the scoring system. Depending on their responses, candidates can receive 0 or 1 points for each question. The research therefore suggested a technique that offered a focal point for communication between eye-tracking and ML models. This study's major goal was to visualise the screen data in a way that would illustrate the scanning process of view creation. The investigation also made it abundantly evident that the dataset had a built-in clustering strategy that depended on visualising eye-tracking scan patterns [1]. Through text mining, the paper discovered an odd correlation between calcineurin and ASD. In addition, the authors arranged sets of exceptions from at least two order calculations that were associative and dominant. These findings show how text mining might be useful for identifying the small subset of content that unites different areas of study, making such research efforts less cumbersome [2]. Launched a deep learning-based system with ResNet-50 design and carried out the test for identifying ASD (Autism Spectrum Disorder) from face images. The effective deep learning technique also identified the precise anticipated time to remove the highlights from each image from the stored data [3]. Some dyscalculic kids have deficiencies in executive control or higher-order processing. They also suffer from visual attention impairments, which seriously impair their capacity to read [4]. They might also struggle to recognise letters and have memory issues. Therefore, phonological processing, verbal working memory, and communication speed both exhibit significant deficiencies in children and adults [5].

4. Existing System

- The scores were manually calculated from the test results, and the scores were then used to evaluate whether the patient had dyscalculia.
- Patients had to wait a long time for evaluation results since scoring is a laborious and time-consuming activity that, when done manually, renders the system susceptible to manual errors that might result in inaccurate ratings by doctors.
- The information presented here represents the patient's accessible, physically kept files from the hospital.

5. Proposed System

- Data collection, preprocessing, feature extraction and selection, system training and classification, and performance evaluation are the four phases used in the detection of developmental dyscalculia using machine learning approaches.
- A set of features included in this suggested work can be used to build a precise dyscalculia prediction model. The method by which we can choose information or characteristics that contribute more to a prediction or an output variable is known as feature selection.
- The accuracy of the predictive model can be decreased by duplicated and irrelevant features. This research focuses on discovering the factors that improve prediction, followed by the development of an appropriate prediction model. Fixations are important for predicting dyscalculia.
- Facial recognition that recognizes the student's facial expression will help better identify the problem in the student.

5.1 ADVANTAGES

- Machine learning is able to analyse enormous amounts of data and spot distinct patterns and trends that people might not notice right away.
- You don't need to constantly check on your planned system when using ML. Giving robots the ability to learn enables them to make predictions and independently enhance algorithms.

6. Architecture Design

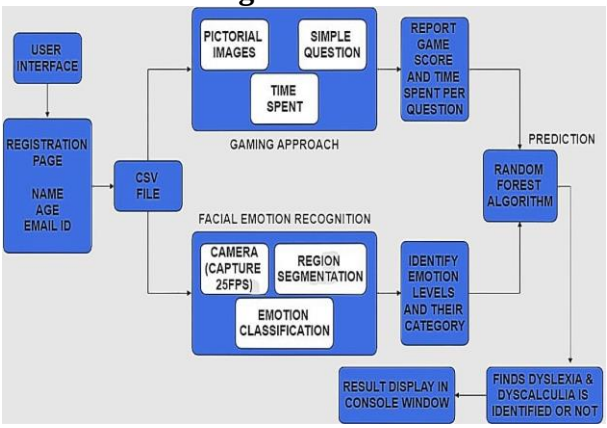

Figure 1: Architecture Design

7. Implementation

System is made up of modules,

UI Module:

In this module when a candidate runs a program a welcome page will get appears. Then candidate should click on next to move to the next page. On this page, candidates should register some of their details like their name, age and mail. Entered details will be stored in a CSV file. Registered details are saved for checking how many numbers have students played the game.

Data Collection Module:

The registered candidates will be saved in a CSV file because the data tables are given in the comma-separated format of candidates who have registered for the game which will be saved in CSV text file format. Although this file format makes it simple to load the data table into a number of programmes, it is best read in one that enables simple manipulation of the data in a columnar style for gathering information on candidates who have registered for the game. A CSV file contains candidate records, where each record is stored as a row of data. The fields within a record are separated by commas. These files have many uses, as the file format is extremely suitable for data transfer (import and

export) in Excel spreadsheets as shown in the Figure 2. Candidate registration will be saved in a CSV file for future verification.

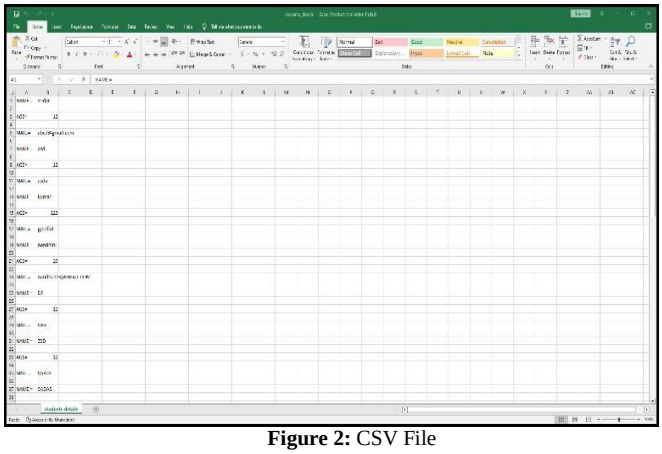

Figure 2: CSV File

Gaming Module:

After completing the registration details. The Gaming approach screening for dyscalculia page will appear. In which candidate should play a game. In this game there are four stages. In stage one pictorial image gaming will appear in ascending order, the candidate should enter the number in the correct order to get a full score. In stage two candidate should enter a value in descending order and the score for this also be appeared on the console page. In stage three candidate should enter answers in basic arithmetic order and in stage four audio will ask the candidate to enter numbers one, two, and three etc., by listing this audio candidate should enter the correct number and the results will have appeared on the console page for each stage of the game.

PICTORIAL IMAGES

Pictorial images provide flat cues to solid objects, and many visual tricks can be played with the transition from three- to two-dimensional image displays and candidates for playing with a visual way of playing. These image images are displayed for visual display to facilitate the candidates to play in a fun and happy mode.

An educational article called a picture essay seeks to give both a verbal and visual representation of a current problem affecting students. A short unstructured abstract, a succinct introduction, subheadings to group the information, and a summary are typically included.

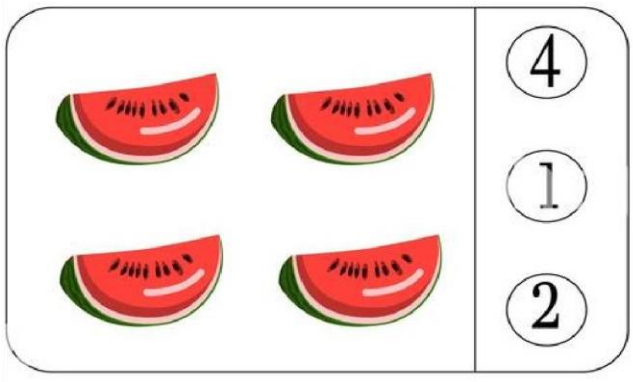

Figure 3: Pictorial Images

Face Detection Module:

In the Face detection module. When a candidate completes his/her game a camera will be opened to detect the candidate's facial expression. A live video camera will record facial expressions in this video processing 25 fps will be converted into a single frame per second, with this pure image will be extracted for the segmentation processes. In the segmentation process, background of the image will be ignored and the facial expression of the human will be only extracted for accurate output of the face expression of the candidate. The random forest algorithm is trained with a database for identifying the facial expression of the candidate after completing his/her game.

DATA SET TRAINING

The primary and most crucial data that enables machines to learn and make predictions is the training dataset. The machine learning engineer used this dataset to create your algorithm, and the recommended system uses more than 70% of your complete data. Provide an accurate facial expression of the candidate. It helps them recognize and classify the similar facial expression of the candidates, so the training data is very important for such classification to recognize each facial expression of the candidates playing the game. And if the training dataset is not accurate, it will have a bad effect on the model results, which can become the main reason for AI project failure. To train the model at the optimum level and produce the best outcomes, a massive amount of data sets are utilised.

FACE EXPRESSION

A person's feelings and intentions in a particular situation can be seen by their facial expressions as captured on video. The level of scrutiny of the trial game played by people's facial expressions depends greatly on them. Facial expressions are the primary type of non-verbal communication that, if used correctly by teachers, can improve students' understanding of concepts taught in the classroom by understanding what kind of problem they have and can treat students accordingly. When a face was emotionally consistent with the emotion shown on the candidate comprehension console page, facial expression categorization was quicker and more accurate than when it wasn't. Specifically, the expression of happy faces can be identified if candidates score well in the exam, amplitudes in positive than in negative scenes if they score poorly in the exam, and fearful faces in negative scenes as shown in the Figure 4.

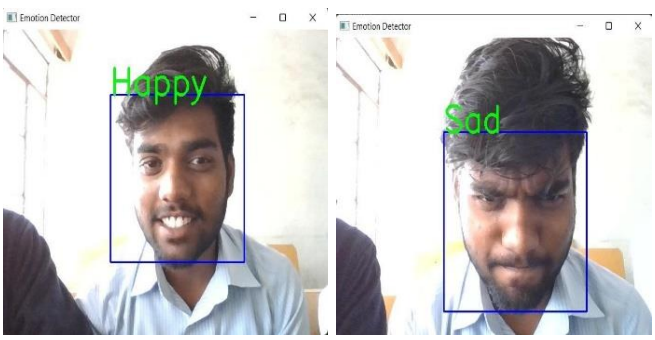

Figure 4: Face Expression

Game Score Module:
In game score module the total score obtained by the candidate will be displayed in the console window and the facial expression of the candidate will also be displayed in the console window by marking the frame in the candidate's face in video processing.

Prediction Module:
In the final output this proposed system will identify the problem in candidates whether they have dyscalculia this process happens by predicting the face expression of the candidate after the game score results. If the candidate scores well and well in game then face expression will be happy and the scores obtained by a candidate will also be good, then the results will be shown if they don't have any problems and they are normal. If suppose a candidate did not score good marks in this game then face expression will be sad and their marks will be low, we can find what problem they have by looking at their results.

A model was created with 6 inputs of questions that can be related to basic arithmetic operations in which each question corresponds to an individual mark and record the time spent upon each question through their facial emotion based upon the assessment evaluation we come up with an accurate result and prediction. By evaluating the test results, time spent per question and captured facial emotion has been recognized and counted upon emotions on the graph and compare both assessment score and facial emotions have been predicted through the random forest algorithm and finds the child has been affected with dyscalculia or not.

8. Results

The proposed system for identifying and treating students with dyscalculia has the potential to be a valuable tool for educators and students. By assessing students' mathematical abilities and identifying any areas of weakness or difficulty, the system can provide tailored interventions and support to help the student overcome their difficulties. The interventions could take a variety of forms, such as additional practice with number bonds or activities that focus on visualizing mathematical concepts. The system could also track students' progress over time and adjust its approach as needed. This approach can help educators bring up students according to their individual needs and help them achieve academic success.

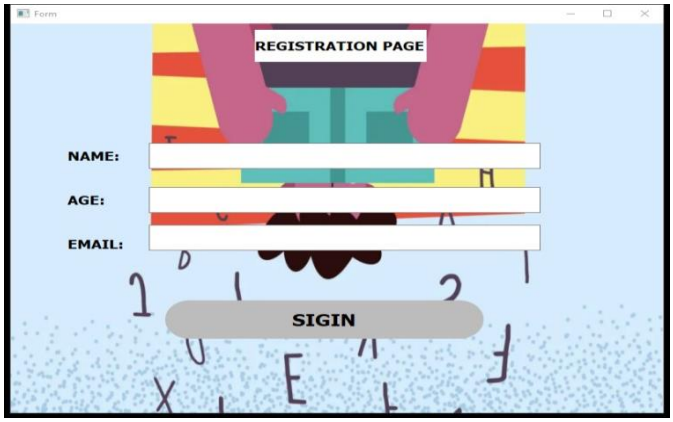

Figure 5: Registration Page

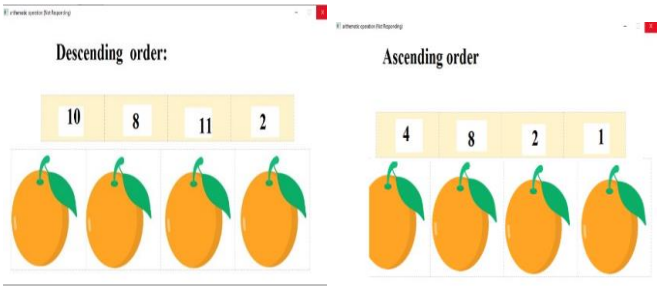

Figure 6: Ascending & Descending order

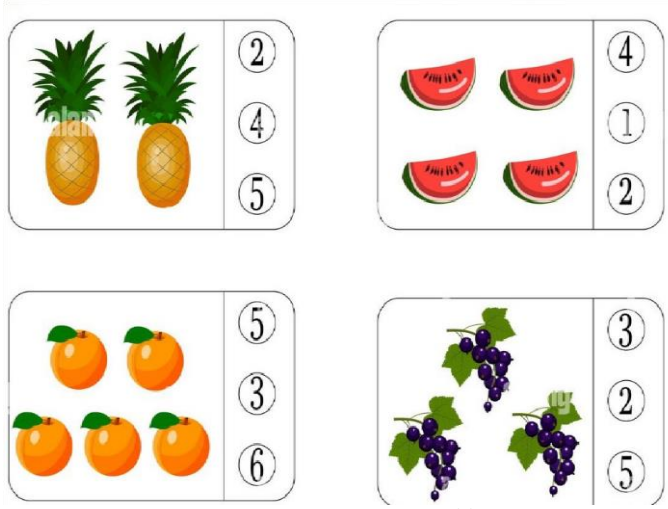

Figure 7: Counting the number of fruits

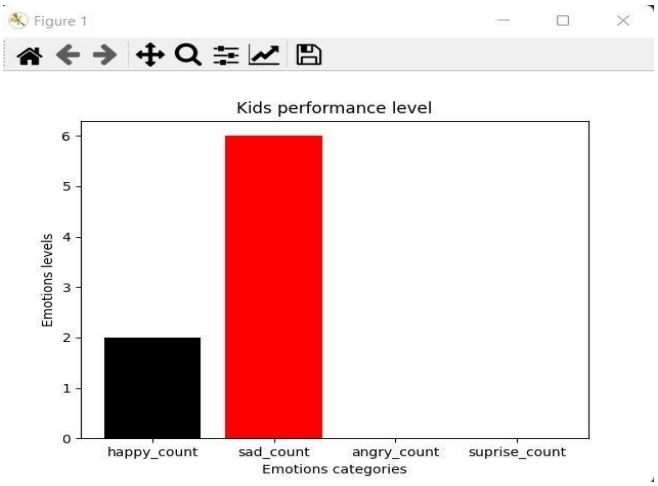

Figure 8: Emotion Classification

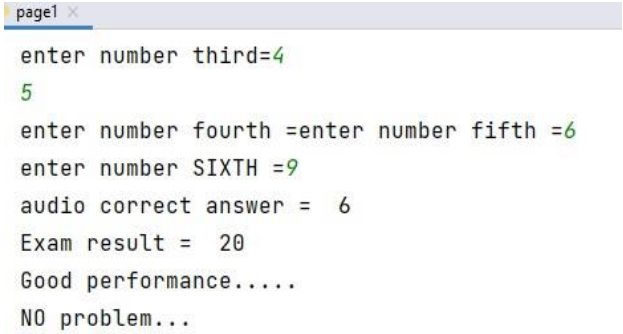

Figure 9: Results of Output

9. Performance Evaluation

In recent times, various sectors have witnessed significant developments, but the field of psychology has been confronted with new disorders such as dyslexia, dyscalculia, and dysgraphia. In light of this, efforts were focused on developing solutions for patients with dyscalculia. The accuracy of the model was determined by predicting the assessment outcomes and capturing the emotions of the patients during the assessment process. Diagnostic tools such as laboratory tests and imaging are typically utilized to diagnose such conditions, and there are numerous tests available for this purpose. However, tests that are more accurate and have fewer errors are preferred. The accuracy and diagnostic value of a test are determined by its ability to differentiate between healthy individuals and those with the condition. However, in practise, a test's accuracy performance can change based on the condition and the disease. In low-risk patients, a test may show high accuracy, whereas in high-risk patients, it may show reduced accuracy. Accuracy, sensitivity, specificity, positive and negative predictive values, and positive and negative probability ratios are traits of a test that show its capabilities. We define and compute the accuracy, sensitivity, and specificity of a fictitious test in this review.

PARAMETERS:

The Performance which is evaluated through parameters are,

Definitions:

Patient: disease-positive(dyscalculia)

Healthy: disease-negative(dyscalculia)

True positive (TP) = the number of patients that the test successfully identified.

False positive (FP) = the number of healthy people who were mistakenly classified as patients during the test.

True negative (TN) = the percentage of healthy people who were misclassified as sick by the test.

False negative (FN) = how many patients were misclassified as healthy by the test.

Accuracy: A test's capacity to distinguish between sick and healthy people is referred to as its accuracy. We must figure out the percentage of true positives and true negatives among all cases in order to assess the accuracy. This can be written mathematically as:

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

Sensitivity: The capacity of a test to accurately identify patients is referred to as its sensitivity. We must ascertain the fraction of true positives among all patient cases in order to evaluate the sensitivity. This can be written mathematically as:

$$\text{Sensitivity} = \frac{\text{TP}}{\text{TP}+\text{FN}}$$

Specificity: The capacity of a test to recognise healthy people with accuracy is referred to as specificity. We must figure out the percentage of true negatives among all healthy cases in order to assess specificity. This has the following mathematical expressions:

$$\text{Specificity} = \frac{\text{TN}}{\text{TN}+\text{FP}}$$

Accuracy: The test accurately identified 50 patients and 25 healthy persons out of the 100 cases evaluated, yielding an accuracy of (50 + 25)/100 = 75%.

Sensitivity: The test correctly identified all 50 patients, resulting in a sensitivity of 50/50 = 100%.

Specificity: The test correctly identified only 25 out of 50 healthy individuals, resulting in a specificity of 25/50 = 50%.

EMOTION CLASSIFICATION AND ACCURACY

Several samples, including contempt, fear, and sadness, were mistakenly labelled as emotions other than anger. All samples of fear were correctly labelled as such, while some samples of disgust and melancholy were. This may be as a result of these emotions' similarities in physical characteristics.

EMOTIONS AND THE ACCURACY

Table 1: Emotion Count

ANGER	82%
CONTEMPT	75%
DISGUST	70%
FEAR	100%
HAPPY	93%
SADNESS	72%
SURPRISE	66%

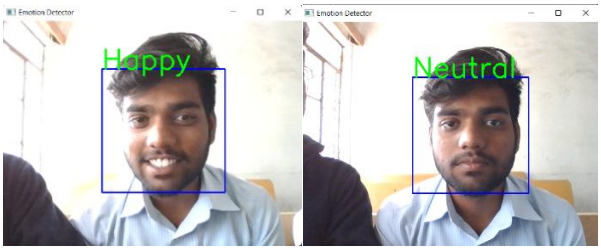

Figure 10: Emotion Classification and Accuracy Percentage

We adjusted our model in order to improve the results. In particular, we raised the cross-validation folds to 6 and changed the data split to 80:40. To be sure the divide was accurate, we used stratified sampling. We also added new characteristics to our dataset by extracting them from the landmarks.

ACCURACY COMPARISON

We used basic mathematical operations to conduct the dyscalculia assessment, and we noted how long each question took from a sample of normal schoolchildren between the ages of six and seven. Our CNN model achieved an average precision of 59%, a training accuracy of 86%, and a testing accuracy of 66%. With the help of ANN, we were able to predict dyscalculia with an accuracy rate of about 89%. After testing a total of 65 kids, we were able to find 25 real positive instances, 4 false negative cases, and 36 true negative cases. There were notably no false positives, demonstrating the effectiveness of our screening procedure.

COMPARATIVE FINDINGS

Table 2: Algorithm Comparison

ALGORITHM	TRAINING ACCURACY	TESTING ACCURACY	AVERAGE PRECISION
CNN	86%	66%	59%
ANN	95%	85%	95.4%
RANDOM FOREST	88.2%	86%	88.6%

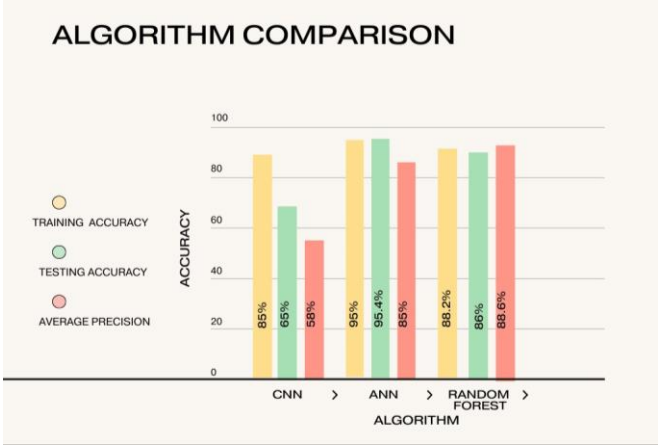

Figure 11: Comparison of Different Algorithms

10. Conclusion

In this study, machine learning and deep learning methods that have been used to identify dyscalculia will be reviewed. Dyscalculia is an incredibly complex brain developmental problem that has recently gained a lot of attention from the fields of neuroscience and machine learning.

Data were gathered from a variety of diverse sources for the identification and study of dyscalculia. Although a lot of machine learning techniques have been used in this area of research over the past 20 years, facial emotion recognition using deep learning algorithms is still in its early stages. Our analysis also suggests that (FER) is the most used machine learning technique for the identification and forecasting of dyscalculia.

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