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Research Article

Machine Learning based novel Autism Spectrum Disorder Screening

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Abstract: Man tries to learn his surroundings by showing tendencies such as discovering, researching, asking questions, and noticing the relationships between objects. In other words, he tends to understand the world he lives in with various judgments. Therefore, it is important to raise individuals with advanced reasoning skills, mathematical thinking skills, proofing skills, problem solving skills, metacognitive knowledge, skills or qualifications. It can be said that this can only be possible with the right teaching models, methods, techniques and teachers who can use them in the most efficient way. In this context, the aim of the study is; To determine the difficulties in the preparation process for LGS, which has been implemented in our country since 2018, and the reflections of LGS on mathematics education applied in schools within the framework of the opinions of mathematics teachers and make suggestions accordingly. In the study, the screening model was adopted because it was tried to portray the thoughts of a certain group of participants on a subject. The sample of the study; It consists of 110 mathematics teachers who attended 8th grade classes in the 2018-2019 academic year. The data obtained from teachers' opinions were analyzed by content analysis method. According to this; The predominant opinion is that students have problems in understanding, interpreting, thinking and reasoning in the new examination system, however, because the textbooks and the exam are not parallel, teachers have various difficulties. In this direction, various activities can be organized to increase students' motivation and to gain reading habit. In addition, it is thought that it would be beneficial to provide teachers with in-service training for the exam.

Keywords: Artificial Intelligence, Machine Learning, Autism Spectrum Disorder.

1. Introduction

Machine Learning, a subfield of Artificial Intelligence, has emerged as one of the most significant and fastest-growing areas of computer science and technology. Today, computers are able to learn and complete tasks with relative ease. In the past, machine learning was applied only to dealing with datasets that could be understood by people.

The research in machine learning can be used in healthcare to improve patient diagnostics and delivery of needed treatments. The goal is to reduce the time it takes to diagnose illness, reduce the work necessary to find diseases, and also to stop disease progression through early detection. big data analysis using artificial intelligence techniques allows the prediction of disease more precisely.

Many disease classes were better represented using classifiers like ML Heart conditions and Autism Spectrum Diagnosis (ASD). On the basis of deficits in social and communication, this developmental disorder is also known as childhood disintegrative disorder, which appears in the first few years of life and impacts behaviour and speech. The majority of individuals show symptoms between two and four years of age. If you have ADHD, you could struggle with it throughout your life, but it may get better. Unfortunately, some of the children with ASD make progress in developmental skills from age 18 months to two then stagnate. Some with ASD have more assistance in their day-to-to-day lives; others don't. Affected people will have problems in forming relationships and communicating, and may display certain quirks or mannerisms. Toddlers do not pay attention and turn their heads away from their mothers and pretend not to care when their interests are not the same as those of others between 12 months and 3 years old. They all use delayed speech and vocabulary, and can point or only point to things, but do not go or respond over and over say what has been mentioned, and others are completely illiterate. There are considerable differences in the way children with ASD show their abilities, though most will exhibit several. Although the precise cause of ASD remains unclear, health care professionals are doing everything they can to better understand it. Recent research indicates that having a sibling with ASD, having genetic conditions, or being born small in the first year of life, could be risk factors for ASD.

With machine learning, we can detect these behaviours that are associated with ASD. Thus, health services

help meet both the developmental needs of infected toddlers and prevent delays, and early intervention can improve and assist with communication and overall mental development. Early diagnosis and intervention, as well as behaviour and speech and occupational therapy, may be useful in providing the essential treatment for children on the autistic spectrum. Autism, therefore, could be said to offer advantages to a child. The goal is to assist kids in developing their communications, recreation, self-discipline, learning and wellness.

2.Theoretical Background

Over the last 30 years, several autism assessment measures have been created to help detect ASD at an earlier stages [1]. To detect it at an earlier level, psychologists and neuroscientists have created a variety of techniques and approaches [2]. The majority of the tools are designed to diagnose users using screening approaches [3].

Autism Behavior Checklist (ABC): which is focused on detecting ASD in children at an early stage, is one of the strategies [4] The checklist utility has the advantage of evaluating the user's present autism symptoms with the assistance of caregivers in a variety of cases and circumstances. It includes a series of questions designed to assess the user's overall health [5]. The approach incorporates many scales, including vocabulary, object perception, body, sensory, social, and everyday living skills.

Child Behavior Checklist (CBCL): is one of the most commonly used systematic tests in child psychology for assessing unusual behavioral and emotional difficulties[6] and Its questionnaire focuses on internalizing and externalizing habits such as fear, hyperactivity, and over-control.

Social Communication Questionnaire (SCQ): This screening questionnaire measures the degree of autism spectrum disorder over the age of 4 with a mental age over 2 years[7]

Autism Spectrum Quotient (AQ): It is one of the most commonly used scales in the general community for measuring autistic characteristics. The AQ is a self-administered test used to assess how autism traits manifest in people with average intelligence [8].

Comparison of ASD Diagnosing Methods

The study compared various ASD diagnosis approaches presented in table 1.

Table 1.compares the ASD screening approaches.

Diagnosing Methods	Questionnaire	target	Specificity	Sensitivity
ABC	57	Children	91%	77%
CBCL	118	Children &Adolescents	82%	75%
SCQ	40	Children &Adolescents	93-100%	58-62%
AQ-10	10	Children	74%	77%

Sensitivity relates in ASD screening methods to the true positive rate which is to classify an individual with autism Specificity refers to the true negative rate, which is to classify an individual regulated by the screening method. As regards validity, nearly all the test methods have a reasonable sensitivity range of 70% to 100% and specificity of 80% to 100%.

3.Review of literatures

This study [9] revealed the extensive feasibility of the ADOS behavior scale in research for the diagnosis of autism spectrum disorders. For an identified group of individuals, it has four modules. The order fulfillment time may take between 30 and 60 minutes. The makers of ADOS used a variety of machine learning algorithms to analyses the underlying cognitive module of genetic autism. Autism can be diagnosed with 100% accuracy using ADOS-R.

While genetic factors may play a significant role in the development of autism, it can also be diagnosed through observable behaviors. Diagnosing autism may show through use of language and/lack of speech and action. The ADOS test battery is made up of various tests on autism symptoms. ADOS are administered by clinical professionals, and it is between 30 and 60 minutes long. ADOS exams are long because of the length of time required for diagnosis. Families may have to wait as long as 13 months before discovering their newborns have a speech, language, or hearing problem. Speech and behavior therapy will be held up by these delays. As well as a search-and-and-and-diagnose methodology the research studied the ADOS (Autism Diagnostic Observation Schedule) questions which could result in an abbreviated and simplified method for diagnosing the disorder.

These findings support the use of the behavioural assessment of autism but necessitate significant efforts on the part of study time.

This research investigated recent studies that used artificial intelligence in classifiers for ASD diagnosis Autism Spectrum Revised (ADI-R)[10] available (ADI). Classification of ASD problems using effective and efficient machine learning methods can help reduce the screening time and improve detection of ASD As part of a new study that sought to address ASD issues, we talked about recent studies that took an imaginative approach to developing new methods of screening and classifying it, here are a few thoughts

Once a dataset of previous cases is prepared, Machine Learning algorithms can be applied to learn patterns and present results. The results of this phase are used to rank the different methods for diagnosis. Based on this study, new DSM-5 criteria were suggested for ASD screening.

ADOS-R is the most popular among clinicians for its reliability, validity, and ability to screen for ASD due to specificity, and sensitivity. To administer the ADOS-R, the test administrator spends about 30 to 45 minutes to examine and record responses. Typically, ADI does interviews parents who are at least 18 years old. For this interview, the child is subjected to 93 questions regarding his behavior. It takes one to two hours to conduct the investigation, and is intended to cut down on the amount of time needed for kids. Fewer features may be required to solve the problem through the use of decision trees rather than ADOS-R may result in less effort. To reduce the length of the time needed for medical diagnosis, this process takes around 30 to 120 minutes.

Using machine learning to identify ASD by predicting delay in speech and social interactions were presented in [11] According to previous research, ASD is found in children at 18 months if found using 2 different stages of screening, ASD can be detected as early as early as 3 years and 6 months. ASD is detectable by 18 months, so there will be a gap between diagnosis and developmentally appropriate use. Estimation of the child development is preferable because it allows physicians to create the best decision support system for their cases. Another study found that babies who weighed less than 1500 grams (nearly 4 pounds) had a 3.2 times the risk of having autism, whereas babies who were born at a normal weight had only 1.6 times the risk.6 times the risk of being autistic. Due to being born prematurely, 2.3 times higher odds of having an autism spectrum disorder. Asperger's Syndrome results in preterm birth, infantile autism, and fragile babies.

Many classifiers that include Naive Bayes, Random Forest, and Support Vector machine are used in the process to make sure the outcomes are valid. The objective was to determine whether they had ASD, and to obtain a diagnosis and what degree it could be of, so that physicians could rely on those findings with this, detection is far easier, and occurs at an earlier point in the process.

In this paper, ML has a notable role in data analytics, as indicated in [12]. Large data analysis and processing will result in big improvements in ML implementation. By the use of mathematical-machine learning it can predict and identify ASD. Automation is required to streamline and reduce expenses in all fields. Here, too, one must take into consideration many areas, such as how one looks, how one feels, whether one is mentally sharp, and whether one needs to be getting daily exercise. Diagnosing the time makes recently more difficult for many conditions, especially that of autism. While there is generally a six-month lag time between the onset of autism and its diagnosis, accelerating the process helps to speed the diagnosis for Autistic children. Predictive modeling offers huge amounts of health and medical information. Teaching systems of this experiment used supervised learning it enables computers to use data to learn on their own without the assistance of human intervention.

This research showed that the ML dealing mechanism on restriction the time of the diagnosis, and increasing ASD disability diagnosis. To expedite and accurate out diagnosis of ASD, it used k-neighbors (k-Nearest Neighbor Trees), SVM (k-Nearest Neighboring Vector Machines), and random forest (RNNF)[13] methods. Some people may have autism for a shorter period of time while others might develop it over the course of a lifetime. Prior to now, the prevalence of autism was considered extremely rare. There are 4 times as many occurrences of boys as girls among the clients. Though language and intelligence play important roles in determining who will be affected by ASD, an individual's experiences have a huge impact as well. There are alternative and non-medically

based methods, and besides alternative methods, there are autism-spectrum parenting practices (AQ). ML is well-suited to screening and medical diagnosis so that more help gets to the patients that need it The first stage of this study aims to provide a fast diagnosis using open-ended questions and managed by healthcare workers.

Data scientists employ SVM, KNN, and RF machine learning algorithms to answer a questionnaire that has shown to be effective in discriminating the cases of ASD. Accuracy, sensitivity, and specificity, as well as model performance metrics the 95% and 89% and 100% classification accuracy was obtained as a result of using SVM, and kNN methods. The lowest performance category in the ASD proficiency test consists of the k-Nearest Neighborhoods classifier. With the results obtained from RF methods, this method was able to correctly identify ASD cases.

4.Proposed system model

4.1Overview

The goal of the proposed model is to create and implement machine learning algorithms and applications to speed up the prediction of the ASD diagnosis. For the purposes of study, this model is created by looking at six- to 24-month-old children who've been diagnosed with autism as well as those who present no longer than two years of age and their initial descriptions of their traits. By using supervised machine learning techniques, datasets, the model will be used to generate correct and accurate results, thereby shortening screening time while also helping the child to replace or correct their undesirable behaviour. Since the system was developed, various state-of-of-the-the-the-the-art machine learning methods and models are included to address the particular challenges associated with autism. When deploying this model that will save healthcare providers time and reduce the burden of finding potential problems as well as helping toddlers, then it will enable them to provide support and use it more efficiently.

This figure 1 depicts the Proposed Working Flow diagram. It shows the design and the visual components of the model. It shows components connected by lines that indicate their relationship to show relationships.

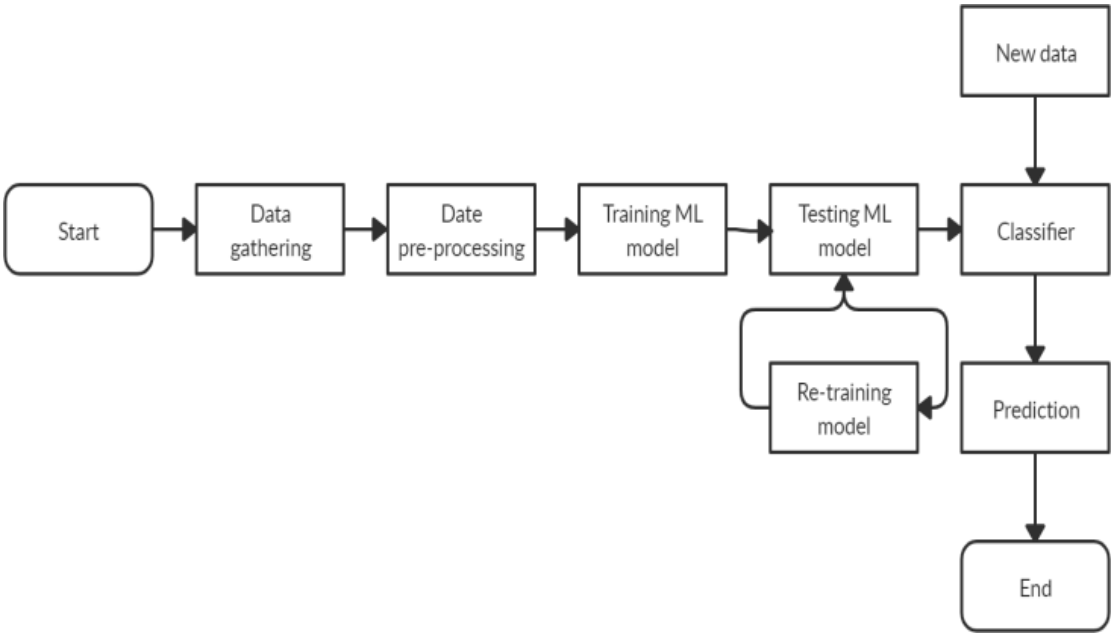

Figure.1 Proposed Working Flow diagram

• Data collection: Data collection is an important part of addressing the issue because it allows for the record of prior autism events. Since the classifier will be based on the dataset from which it was created, it will be more powerful.

• Data pre-processing: Data pre-processing is an essential phase in machine learning; the data must be pre-processed in order for the algorithms to gain valuable insight into it. To improve the model's performance, this phase involves data cleaning, data reduction, and data transformation.

• Training model: A supervised learning approach is used to train the model using a training dataset, which usually includes examples or samples used to suit the model that learns from these data.

This entails the use of machine learning algorithms to build a predictive model.

• Testing model: The testing model is used to assess performance and determine how well the model has been educated and how well it works. Typically, this is the last calculation for validating the model.

• Re-training model: re-training occurs during testing if the model does not match the data well and the dataset needs to be re-trained to fulfil the objectives and tasks. As a result, selecting the appropriate prediction and classification data models aids in the development of a precise and reliable model.

• New data: This is the real data that has to be classified. These data are fed into the classifier, which uses historical and qualified data to make the right prediction.

• Classifiers: Classifiers are algorithms that attempt to predict the type of data. Labels/targets or categories are the groups, and supervised learning is used to determine which data is learned from the input data.

• Prediction: This is the final step in the process, and it is supposed to provide accurate predictions of the input data, as well as predict labels and generate the desired classifications for each piece of data entered.

5.System flowchart

Flowchart is presented in figure 2, which provides a simplified representation of the modeling process so as to be easily understood by people that may give people the information necessary to build an efficient model.

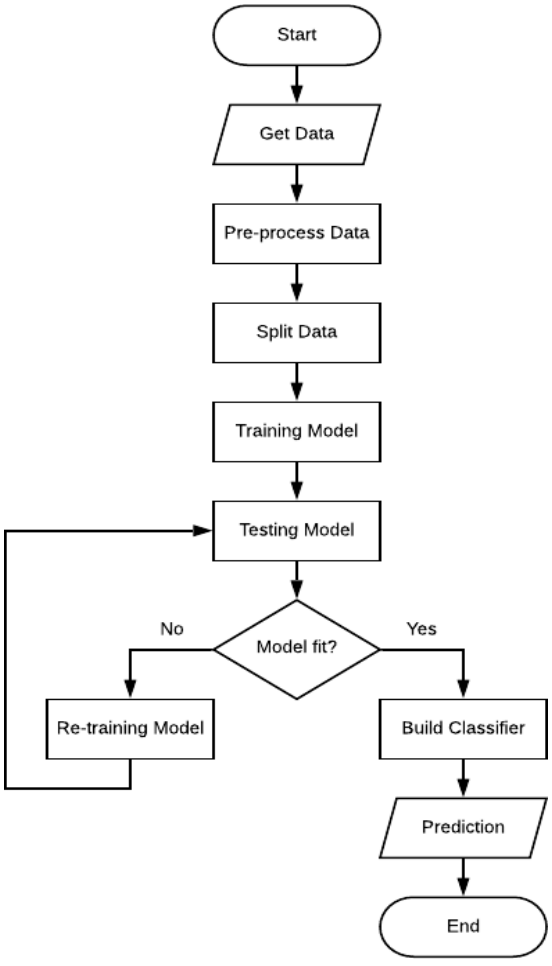

Figure.2: Flowchart of system model

The proposal is based on building a new model to help identify ASD. With the capabilities of machine learning, autism can be diagnosed early, and treated in an efficient and reliable manner. The model was expected to show results both highly accurate and fast.

First, we must locate the dataset on the ASD repository or sources, which will lead to the creation of new models that identify ASD symptoms. Before starting the fitting process, these data must be analysed. For supervised learning in ML, the dataset will be split into training and test sets. The training set is used to test the individual model algorithms and usually includes between 75% and 80% of the results. The research dataset is used to assess the accuracy of the model algorithms and usually comprises 20% to 25% of the data.Re-training the model would be completed once more appropriate algorithms are found. Once the classifier is complete, it will check whether the child has ASD. Finally, the model must be able to correctly and precisely classify the result.

6.System Design and Implementation

6.1.Proposed machine Learning Model

In the illustration, the machine learning approach for classifying autism as seen in Figure 3. The machine learning algorithm makes prediction for each test case (each individual) based on the close-fitting Logistic Regression model. There are a wide range of people who can use the ASD Tests.

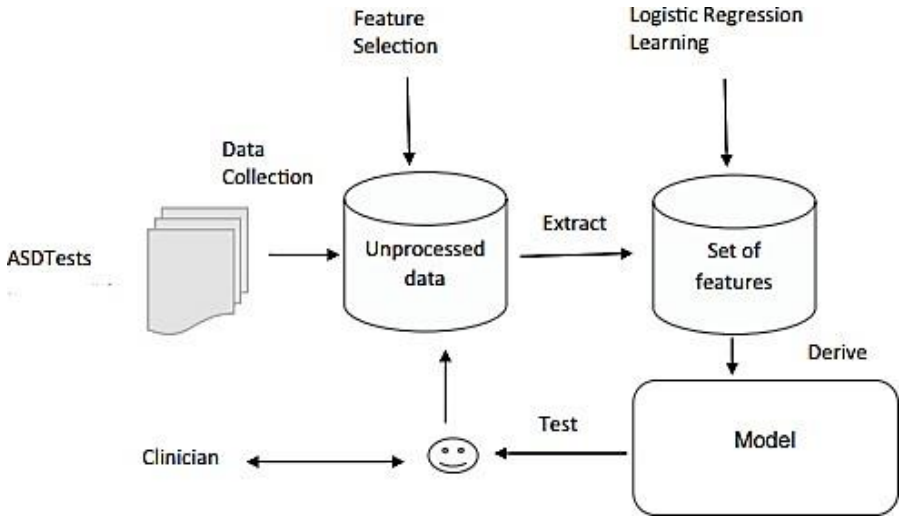

Figure 3: Block diagram

Although the dataset contains more than 20 variables (notably, the class variable), only three of these have been processed to aid in the tests (the screening questions and questions from the brief versions of the survey included in that dataset only). The data was brought up to date by approaches such as discretization of continuous variables (age), and if that was the case, various pre-processing steps were employed including substitution of values, conversion of screening questions into binary format. The dataset is initially filtered using filtering techniques to distinguish redundant and unused functions. Furthermore, during the feature selection process, significant features would be used by the machine learning algorithm to train the algorithm.

This algorithm uses a multinomial logistic regression in the construction of classification schemes. If the c group set of a dataset has n variables, the matrix parameter can be computed as n*(c-1) matrix[14].

The likelihood for class j with the exception of the last class is calculated as

$$P_j(X_i) = \exp(X_i B_j) \Big/ ((sum[\, j = 1...(k-1)] \exp(X_i * B_j)) + 1) \qquad \text{-------(1)}$$

Initially, the logistic regression model was used to evaluate the relationships of one or more independent and dependent variables in the statistics. In prediction issues the input date range normally contains two possible values for the dependent variable where this technique is used (target class). In order to model relations between the independent and class variables, certain logical functions probabilities as described in Eq–(1) have to be used. [17] The new version is now available. Includes more detail about how multinomial logistic regression is performed. When a test case (person) has been screened, our method logistic regression model assigns the class according to the input variable value (independent variables values). This system is used rather than the scoring framework found in a domain specialist's screening technique. The proposed method replaces the scoring process with a more precise model that has been learned from screened and classified cases and controls. The association

between these and the dependent variable (ASD/No ASD) can be found and used for the precise detection of ASD characteristics when screening. In addition, the validity of the investigation would be placed in the hands of medical practitioners and doctors in order to verify the decision as appropriate in the proposed machine learning framework that uses supervised learning, the dependent variable must be binary as the result should be in the form of 0 or 1, Yes or No. It also used to calculate the probability. The implementation will be as following in figure 3:

Figure.4: Model sequence

This framework will not only improve the effectiveness of autism evaluation; it will also speed up the acceptance process for comprehensive care for autism diagnosis. As a result, adults with autism and their family will receive appropriate care as soon as they wait long for autism to be diagnosed.

7. The datasets and feature descriptions

Dataset: Autistic Spectrum Disorder Screening Data for Adult. Dataset has 1054 instances and 21 features. 11 of them are int, 9 are objects and 1 is float. It's a Multivariate data type, total number of attributes used for this dataset is 22 .The dataset presented in table 2 is a screening for a subset of toddlers with autism that had similar characteristics or habits that could be included in research and were identified as autistic. Ten observed behaviors in this dataset demonstrate the usefulness in evaluating the ASD. The purposes of this classification are to determine when a child will develop ASD diseases and to help in early intervention. The dataset includes 1054 cases, 18 properties, and no missing values.

Table 2: ASD dataset variables with description

Variable	Description
A1-A10	YES/NO
Age	Age of Individual
Gender	Male/Female
Ethnicity	List: White Middle Eastern White European Asian Black Latino Mixed Others
Jaundice	YES/NO
Family history	YES/NO
Nationality	List (All the worlds' counties)
Target class	YES/NO

8. Result and Analysis

This section is concerned with the result and analysis for implementation hardware and software specifications that are needed to operate the model efficiently. Operating system: Windows 10 64-bit, Processing speed: Intl (R) Core (TM) i5-7200U CPU @ 2.50GHz 2.71 GHz, Random Access Memory: 8.00 GB, Network (Wi-fi): 802.11b WLAN.

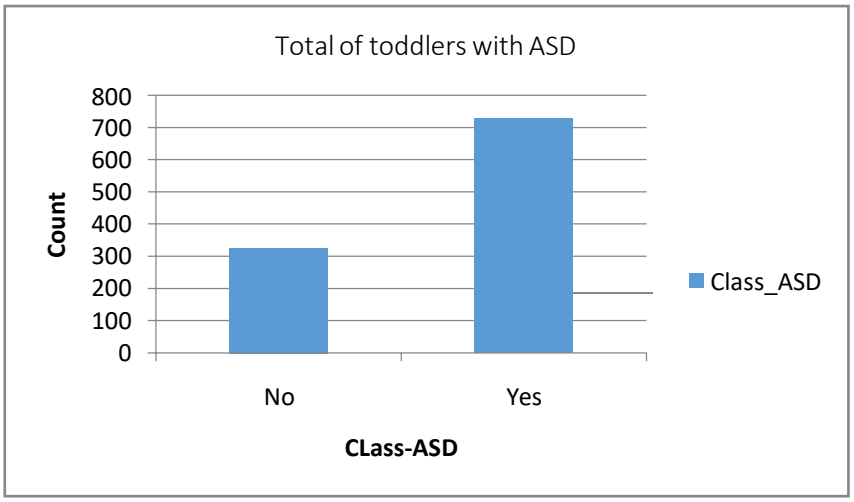

Figure.5: Total of toddlers with ASD

Figure 5 depicts the visualization of the grouping or target class of ASD toddlers in the dataset. Yes or No is used to describe this classification. The statistic reveals 728 toddlers with ASD and 326 toddlers who do not have autism spectrum disorder

Figure 6 depicts whether or not the toddlers' families have more than one parent with ASD. This classification aims to identify and assess the risk factors for this disorder and whether or not they are linked to the standard feature. From the graph, it is apparent that the number of families of which one or more members have autism varies greatly. The role has 884 families with no more than one member of which there are 884 or more families that have one or more than one member, each of which has ASD. It suggests that autism may not be a hereditary of nature.

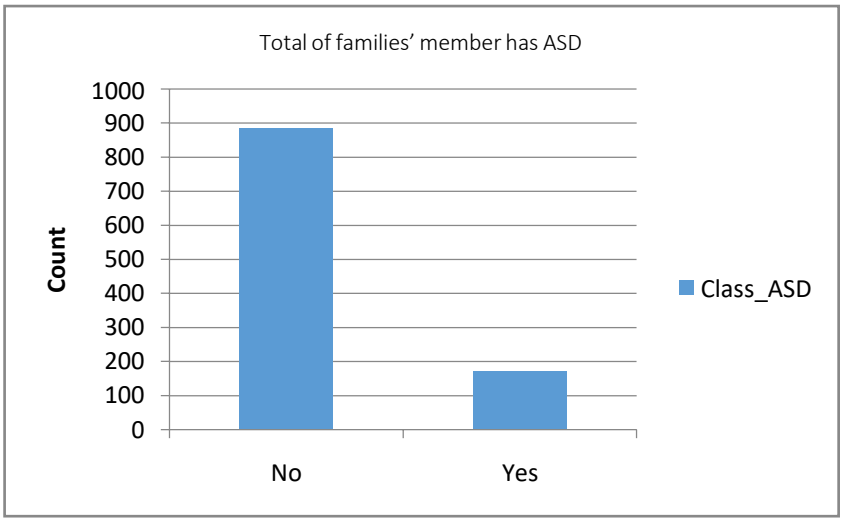

Figure.6: Total of families' member has ASD

According to the data in figure 7, the ratio of female- to-male ASD diagnosis is less than the ratio of 4:1.According to new studies in the United States, the ratio has risen to one case in every 42 males and 189 females. As a result, the figure's statistics confirm that males have a greater chance of infection with ASD than females (337 vs. 717).

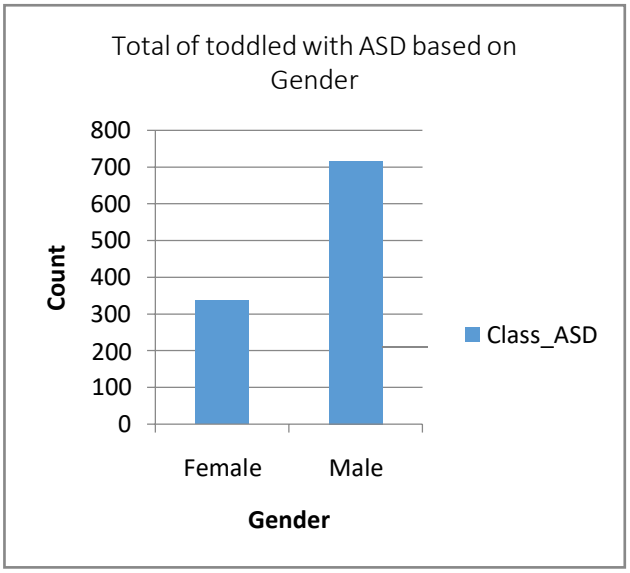

Figure.7: Total of toddled with ASD classified byGender

Figure 8 represents the tainted toddlers by age in months. If shown, toddlers above the age of 30 months are more likely to be afflicted with ASD than children below 2 and 3 years. The researcher discovered that the risk of autism spectrum signs and activities appears in toddlers within their first two years of life. According to the graph, screening for toddlers is critical owed to the high likelihood of autism.

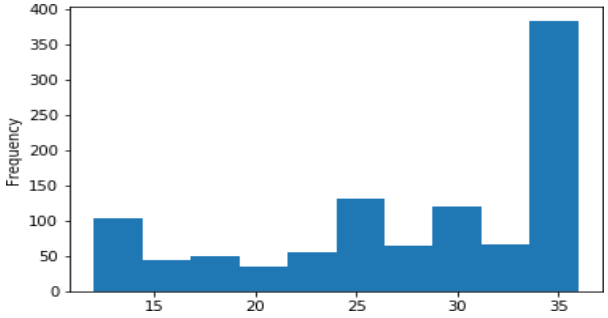

Figure.8: Total number of autistic toddlers classified by age

The data should be analyzed to ensure that it is free of null values, accurate, and safe before to create a model. This move is significant to maximizing the machine learning model's precision and predicting the classifier's performance. The model was trained on a dataset of 1054 rows and 19 columns. Figure 9 shows that the dataset is complete and has no null values.

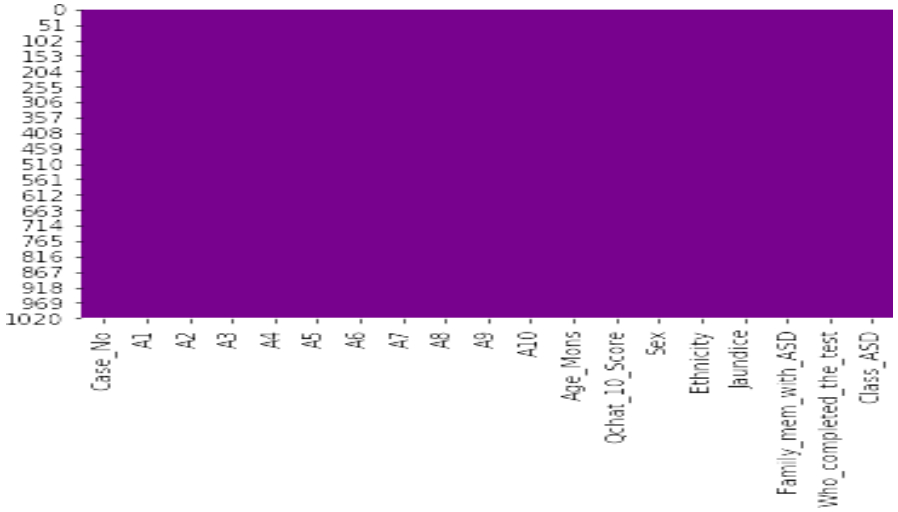

Figure.9: Plotting of dataset

Equation 2 depicts the precision of the deep learning algorithm depends on the Toddler Autism dataset. The model reaches an accuracy of 1, suggesting that it is accurate and reliable in evaluating autism conditions. As a result, this paradigm is highly advantageous to both people and healthcare practitioners.

The ML model was translated into an Application Programming Interface (API) using to forecast new findings using Flask as a web service, as seen in table 3. The classifier would indicate if long as the child has ASD here we let the model fill in the new data and transfer it on to the model's prediction feature; it includes 10 questions about typical autism behaviors; the responses must be 1 or 0, and the prediction displays these answers' outcome.

Table:3 Q-10 Toddler Screening Features

Variable	Toddler screening features
A1	She/he often looks at you when you call his/her name
A2	She/he often can easily get eye contact with you
A3	She/he can easily point to indicate that she/he wants something
A4	She/he can easily point to share interest with you
A5	She/he can easily pretend
A6	She/he is good at social chit-chat
A7	She/he can easily follow where you are looking
A8	When you or someone in the family is upset, she/he can show sings of wanting to comfort them
A9	She/he first words was typical ones
A10	She/he finds it easy to use simple gestures

Figure.10: API home page of model

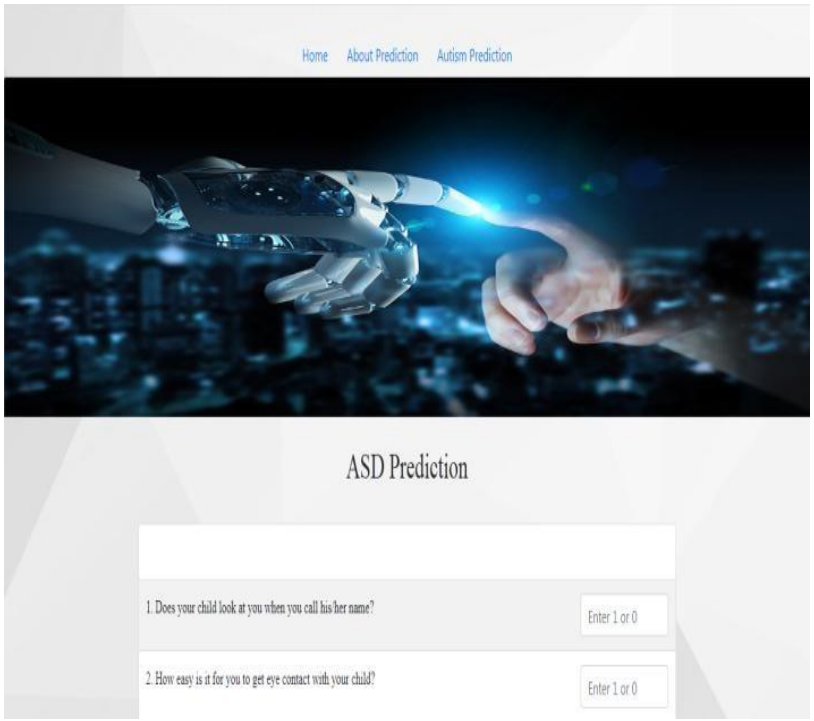

Figure.11: Predictor of ASD

Figures (12, 13) show the outcomes of 2 examples. It is quantitatively determined by the number of questions answered correctly; if the number is more significant than three, the child has ASD; otherwise, the child does not have ASD. This is based on a prior training patient history dataset used to classify risk factors. The estimated accuracy of the model is 1.0.

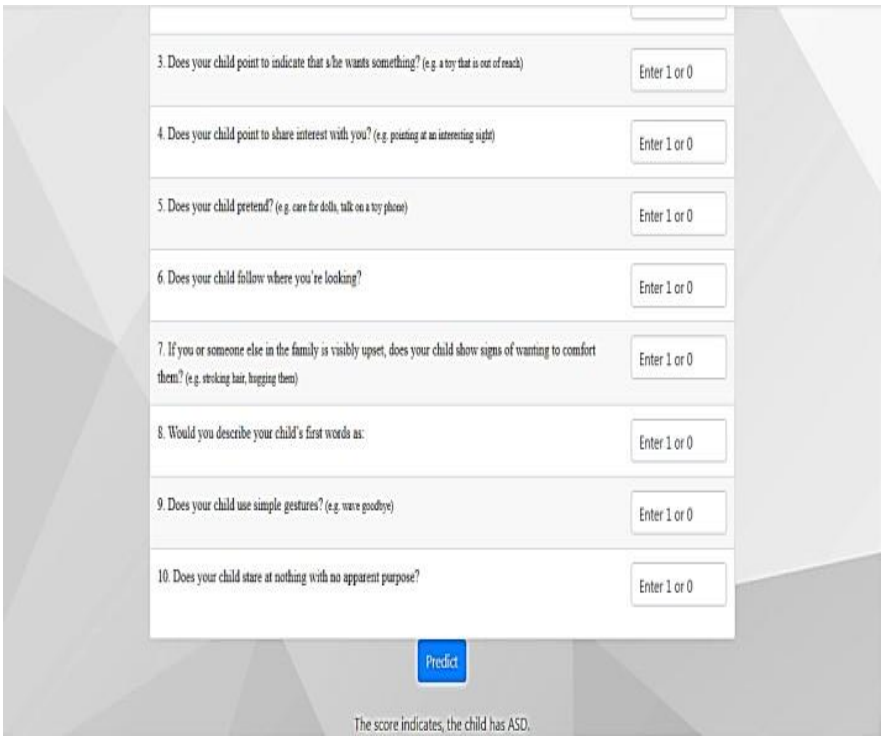

Figure.12: Case with ASD

Figure.13: Case with no ASD

9. Conclusion and future work

This paper aims to establish a screening model using ML techniques for identifying and evaluating ASD- related behaviors in toddlers aged 12 to 30 months. Early diagnosis of ASD will limit the problems that children face, such as communication, social skills, learning disabilities, everyday issues, etc. The aim is to use supervised learning algorithms on a dataset of past medical cases to simulate autism in toddlers. The use of innovative selection approaches for autism will promote the use of technologies in clinical backgrounds to provide physicianswith resources that provide practical insight for improved decision making. The future work will concentrate on Prediction using improved techniques and classification algorithms. Furthermore, more data and functions, including more familiar habits, are being used to diagnose ASD effectively.

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