Early detection of autism spectrum disease in children

Asst .T. Rasha Rokan Ismail

Abstract : Autism Spectrum Disorders (“ASD”) is a neurodevelopmental disorder whose symptoms appear in the first years of a child's life. These symptoms are characterized as a lack of communication skills (verbal and nonverbal) used in social interaction and a way of responding to sensory and environmental stimuli that manifest as restricted and repetitive behavioral patterns.

In this research, the focus will be on diagnosing the disease through a set of tests in which a foreground-backward neural network is trained and taught.And through the results obtained, the disease is diagnosed for the affected person. The tests are based on diagnostic information about the parents as well as information about the child.

From the results obtained, it was found that the success rate of the diagnosis is up to 90%.VB Net (Visual basic.Net) was used to configure the neural network .

Keywords— UTISM Spectrum Disorders ,Artificial neural networks, Prediction **.**

1-INTRODUCTION

One of the significant neurodevelopmental disorders, “autism spectrum disorders (ASD)” is characterized by deficits in social communication and interaction as well as limited repetitive behavior patterns. Its symptoms first appear during the early stages of development and can clinically impair social or other crucial areas of functioning [1]. Symptoms may first appear between the ages of 6 and 12 months, although a typical age of diagnosis is 24 months or later [2]. Researchers have shown that the incidence of “autism spectrum disorder (ASD)” is on the rise, however the exact rate of increase differs from country to country and with different diagnostic criteria [3, 4]. The incidence is estimated to be between 1% and 5% in industrialized nations [4]. The prevalence of “ASD” in China was found to be 1% lower than that in western nations [5].

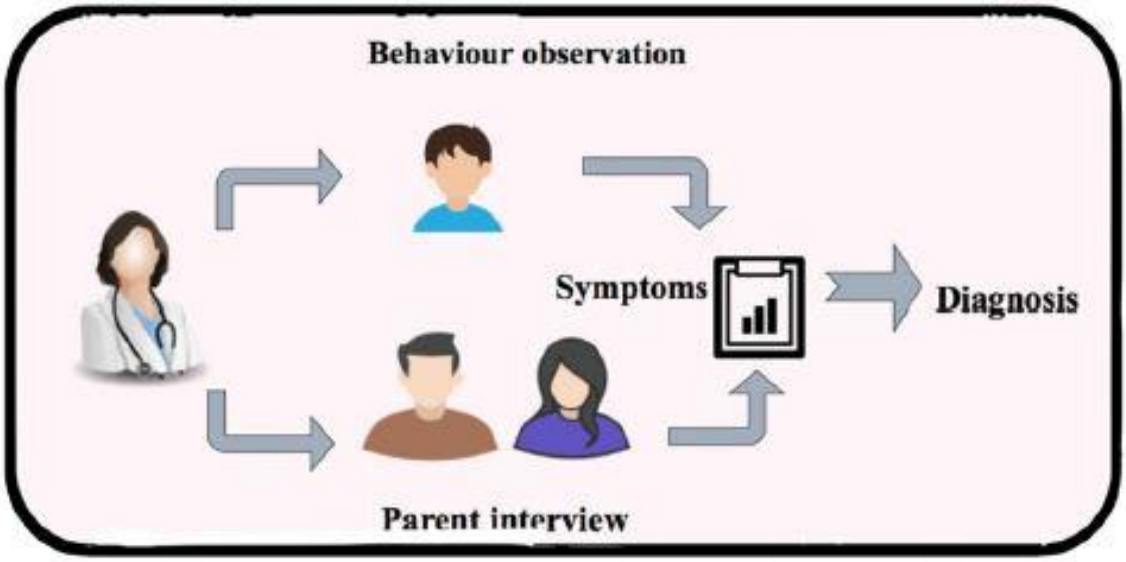
Due to the alarming rise in “ASD” incidence, it is crucial to understand what factors might trigger the disorder. The cause is unknown, however a number of variables have been suggested. Tick et almeta-analysis .'s study[6] highlighted the fact that “ASD” is hereditary at a rate of 64-91%, and that environmental influences, in addition to genetic traits, have a substantial impact on the growth in “ASD” prevalence [7]. Prenatal features have been demonstrated to be one of the most critical environmental variables in the etiology of “ASD”. Risk factors for autism spectrum disorder (“ASD”) have been identified by a meta-analysis conducted by Gardener et al. [8]. These risk factors include maternal age, prenatal drug usage, gestational diabetes, maternal hemorrhage, and having a first-born child [9].

The importance of early detection of people with (“ASD”) and early intervention greatly contributes to setting the appropriate treatment mechanism for the affected individuals, treating them, improving their condition, and leading their lives normally.[10]

There are many criteria that can be used in diagnosing a disorder of Autism, starting with the standards that were set by the scientist “Leo- Kanner” in 1943 and passing through many standards that were set from Before scientists, specialists, international centers, and organizations, end to standards Diagnostics contained in the fifth statistical and diagnostic manual, (V5-DSM) issued by the American Psychiatric Association in 2013, which can be referred

to below because it is characterized by being the most accurate, most widely used and accepted in clinical and educational circles, the traditional approach, that is outlined above, is illustrated in figure (1) [11] [12].

"Machine learning (ML)" is a sub-field of artificial intelligence, and machine learning has spread in many different fields and disciplines, which has the ability to enhance the role of computational methods in simulating the work of the nervous system, which has contributed greatly to solving many complex problems and problems in All fields and specializations, and in this research, machine learning was used to diagnose and discover those who suffer from autism spectrum disorder and those who are not affected by the use of the artificial neural network (ANN) algorithm.[13]



Figure(1) conventional techniques for identifying brain disorders

2. RELATED WORK

- Ucuz, A. Uzun Cicek, 2020[14] The purpose of this study is to establish that Autism Spectrum Disorders ("ASD") are among the most significant neurodevelopmental diseases. Using prenatal-perinatal variables, family history, and developmental traits that are highlighted in the literature as risk factors for "ASD", this study sought to do artificial intelligence-based modeling. Materials and Methods: The research was designed utilizing retrospective management, and data from 136 children with

A.S.D and 143 healthy children were included. Results: According to the MLP model's findings, the average age of the first words (months), average age of head control (months), average age of unassisted sitting (months), average age of autism in the family history (years), and average paternal age at conception were the five variables that were most important (months). The overall percentages for the testing and training samples were 88.0% and 91.4%, respectively. The model's AUC for separating the autism and control groups was 0.922. In conclusion, the proposed model can distinguish autistic spectrum disorder patients from healthy people and pinpoint the risk factors for the condition.

- Dr. Raju., Dr. J. Senthil, 2021[15], the aim of this research: Autism is often described as a pervading disorder. The word "pervasive" suggests an acute condition. People with autism spectrum disorders (“ASD”) have trouble engaging with others. They also struggle with hyperactivity and behavioral problems while reacting to activities. Numerous technical developments have improved the ability to anticipate the characteristics of autism. The emphasis of this study is on several machine learning techniques for categorizing an autistic youngster. It primarily focuses on classification models utilizing OpenCV, CNN, and Haar Cascade with the VGG16 algorithm of the SVM classifier. Using these models, more accuracy was obtained in comparison to other categorization methods.
- Lakhwinder K., Vikas K., 2017 [16], In this study, we covered the definition of autism, its symptoms and indicators, diagnosis, and the many technologies used in the evaluation and treatment of autistic children. Many artificial neural networks (ANNs) and fuzzy-based systems have been applied to the task of diagnosing autism's severity. Diagnosing whether or not a kid has autism using ANNs and a fuzzy system is feasible.
- Avishek C., Christopher M., 2018 [17], In this study, a data set that is used for autism screening was used. It consists of 10 personal characteristics and 10 behavioral traits that may be used to distinguish cases of A.S.D from controls in behavioral science. The procedure of diagnosing A.S.D is costly and time-consuming. Rapid and low-cost screening tools are needed since the number of people diagnosed with “ASD” is rising rapidly across the globe. An artificial neural network

(ANN) using the Levenberg–Marquardt algorithm for autism spectrum disorder (“ASD”) identification and evaluation of prediction accuracy. Next, we must create a clinical decision-making support system for early autism spectrum disorder (A.S.D) characterization.

- Nguyen V., Ngo L., 2018 [18], This paper details the systematic exploration of using this combination to facilitate early "ASD" diagnosis. The presented data suggests that this approach may form the basis of the decision-support system employed in "ASD" research and diagnosis.

3. Artificial neural networks (ANNs):

Artificial neural networks (ANNs) are computerized computing platforms designed to automatically carry out data samples according to the capabilities and characteristics of the human brain, such as creating new knowledge via learning and finding new information [19]. An artificial neural network (ANN) is a kind of mathematical model that is based on a network of basic processing units (artificial neurons) that is linked and changes its connections as it gains experience (weights).

To adapt to new environments, brains must have the capacity to alter their own behavior. Neural networks effectively mimic human brains and this learning feature by adjusting network parameters based on available data “D = z (1)... z (N)”, enabling the building of large models capable of handling complex cognitive duties. By changing the network settings, learning is continued until the output starts to more closely resemble the objectives of the agent in question. This is formalized via the cost function J (), which measures how far an agent strays from its objectives. A neural network is performed in forward mode (from input to output), and J is calculated by comparing the intended and predicted outcomes. The agent acquires data from its surroundings during its lifespan by collecting from a data producing distribution called pdata [20]. Connections (weights) are allocated in Training. In the majority of training procedures, the weight matrix is typically filled with random numbers. Next, the reliability of the neural network is examined. The weights are then adjusted in accordance with the validity of the neural network. Until the validation error falls below a predetermined threshold, this procedure is repeated [21]. As seen in the diagram, artificial neurons are organized in layers (1). Each Layer is made up of a collection of neurons that perform similar tasks. Three different

types of layers exist. Between the input and output layers, there may be one or more hidden layers that the user program communicates with.

The neurons of the hidden layer never communicate with the outside world [22]. Not all neural networks have this many layers. Optionally, you can use a hidden layer. Though separate input and output layers are typically required, a single layer can serve both purposes [22]. When a neural network is trained, the next step is to validate the model to see whether it is any good. Validation data for a neural network must have distinct features from training data. In this investigation, we trained and validated our networks using around 20% of the sample data. The primary objective of this study is to develop a neural network for identifying autistic individuals. For this, a dataset from the "“ASD” Tests" application for autism screening was utilized. The aim of the paper is to detect UTISM using ANN ,Figure (2).

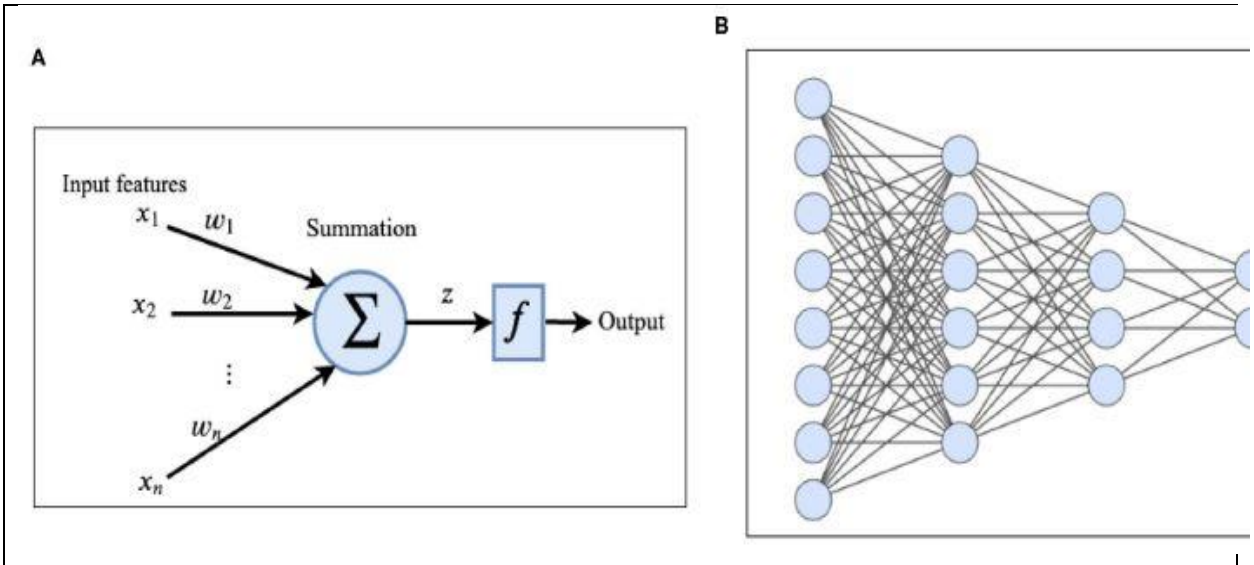


Figure 2 | (A) “Architecture of an artificial neuron”	(B) “a deep feed forward network with two hidden layers”

4. Relevant Information:

For Further information about the attributes/feature see below table

Attribute	Type	Description
Age	Number	years
Gender	String	Male or Female
Ethnicity	String	List of common ethnicities in text format
Born with jaundice	Boolean (yes or no)	Whether the case was born with jaundice
Family member with PDD	Boolean (yes or no)	Whether any immediate family member has a PDD
Who is completing the test	String	Parent, self, caregiver, medical staff, clinician etc.
Country of residence	String	List of countries in text format
Used the screening app before	Boolean (yes or no)	Whether the user has used a screening app
Screening Method Type	Integer (0,1,2,3)	The type of screening methods chosen based on age category (0=toddler, 1=child, 2= adolescent, 3= adult)
Question 1 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 2 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 3 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 4 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 5 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 6 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 7 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 8 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 9 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Question 10 Answer	Binary (0, 1)	The answer code of the question based on the screening method used
Screening Score	Integer	The final score obtained based on the scoring algorithm of the screening method used. This was computed in an automated manner

5. THE PROPOSED WORK AND RUESELT

In this case will using adaptive neural network depend on the number of testing that put it as input layer and the testing of parents and put it as hidden network.

In this research it takes 150 were selected between an autistic child and a normal child.

So, our NN contain 4 layers (input layer, 2 hidden layer, output layer), this design need 2 hidden layer because one layer for the taste of parents and the second layer for random weights.

The numbers of nodes are also different between input layer and first hidden layer.

In this search takes many cases:

a. The first case:

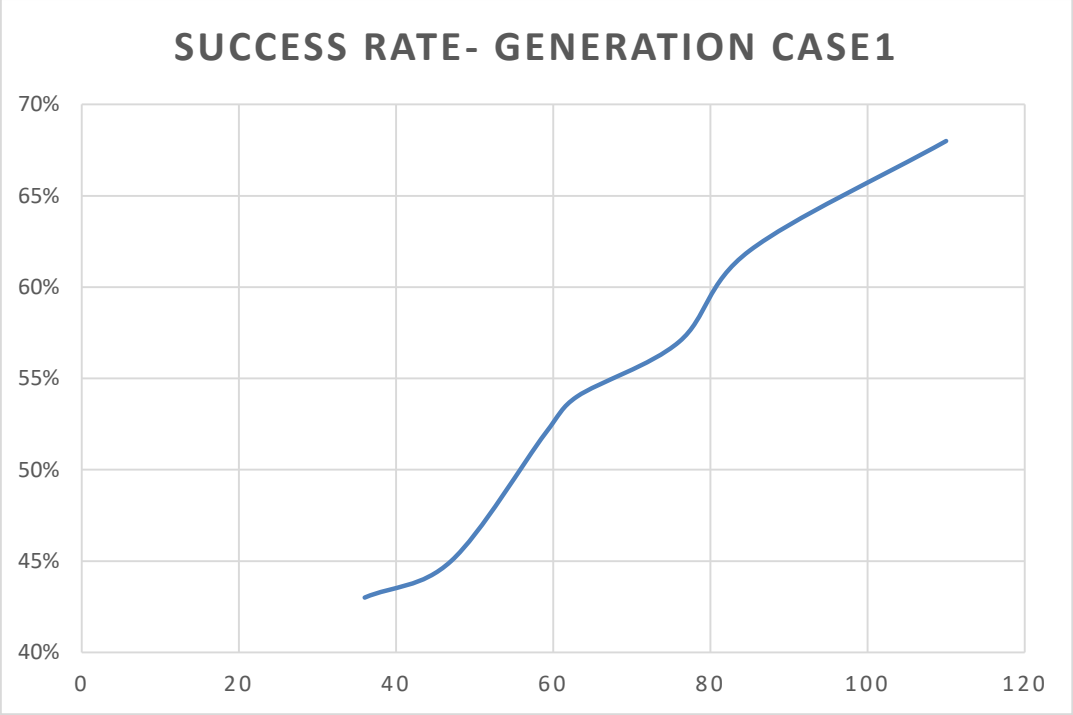
In this were taken 3 symptoms of the disease that the child suffers from, along with three of the characteristics of the test for the parents, so the network parameters are as shown table below:

Table 1: shows the different values of parameters applied on NN.

The parameters	values
The node of input layer	2
The node of hidden1 layer	3
The node of hidden2 layer	3
The node of output layer	1
The connection between input and hidden layers	6
The connection between hidden1 and hidden2 layers	9
The max-generation (max-iteration)	125
“The range of initial weights (wg).”	[0,1]
The error factor (alfa)	0.1

generation	error	time	effort	Success rate

10	0.1534	0.1 sec	1100	30%
25	0.0925	0.3 sec	1400	42%
30	0.0539	0.6 sec	1600	45%
45	0.0183	0.8 sec	1640	51%
60	0.00962	1.06 sec	1743	55%
73	0.00653	2.543 sec	1762	57%
96	0.00492	2.895 sec	1784	60%



b. The second case:

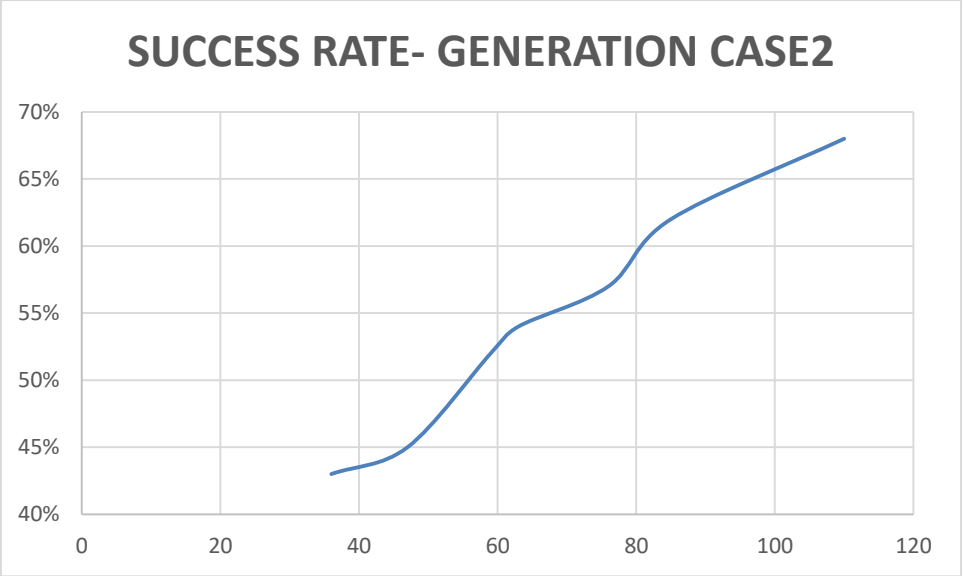
In this were taken 4 symptoms of the disease that the child suffers from, along with four of the characteristics of the test for the parents, so the network parameters are as the following table shows:

Table 1: shows the different values of parameters applied on NN.

The parameters	values
The node of input layer	4
The node of hidden1 layer	4
The node of hidden2 layer	4
The node of output layer	1
The connection between input and hidden layers	16
The connection between hidden1 and hidden2 layers	16
“The max generation (max iteration)”	154
“The range of initial weights (wg)”	[0,1]
The error factor (alfa)	0.1

The result for Appling the second case:

generation	error	time	effort	Success rate
36	0.0539	0.9 sec	1100	43%
47	0.0183	1 sec	1400	45%
59	0.00962	1.066 sec	1600	52%
63	0.00857	1.543 sec	1640	54%
76	0.00717	1.895 sec	1743	57%
85	0.00656	2.764 sec	1762	62%
110	0.00649	2.877 sec	1784	68%



c. The third case:

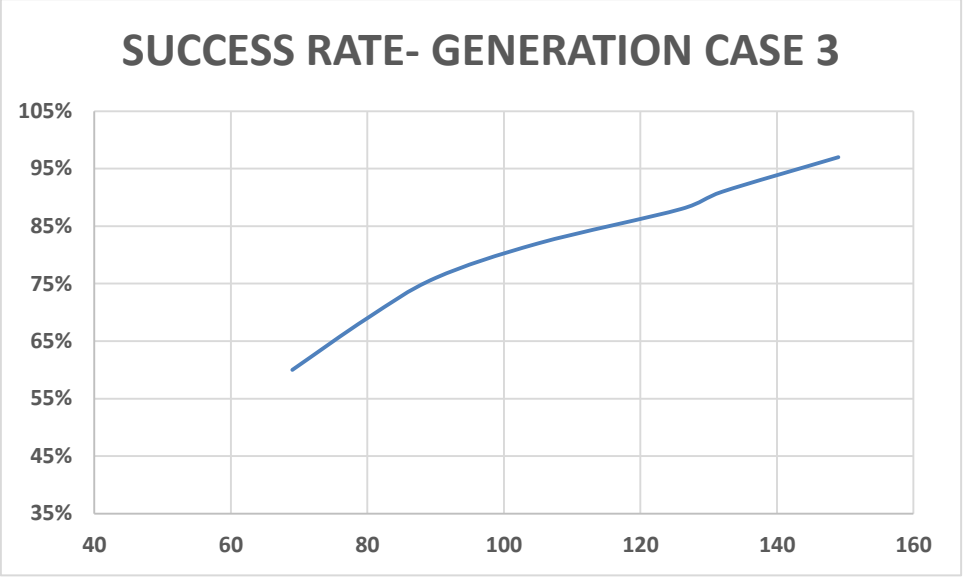
In this were taken 6 symptoms of the disease that the child suffers from, along with five of the characteristics of the test for the parents, so the network parameters are as illustrated in the table below:

Table 1: shows the different values of parameters applied on NN.

The parameters	values
The node of input layer	6
The node of hidden1 layer	5
The node of hidden2 layer	5
The node of output layer	1
The connection between input and hidden layers	30
The connection between hidden1 and hidden2 layers	90
“The max generation (max iteration)”	200
“The range of initial weights (wg)”	[0,1]
The error factor (alfa)	0.1

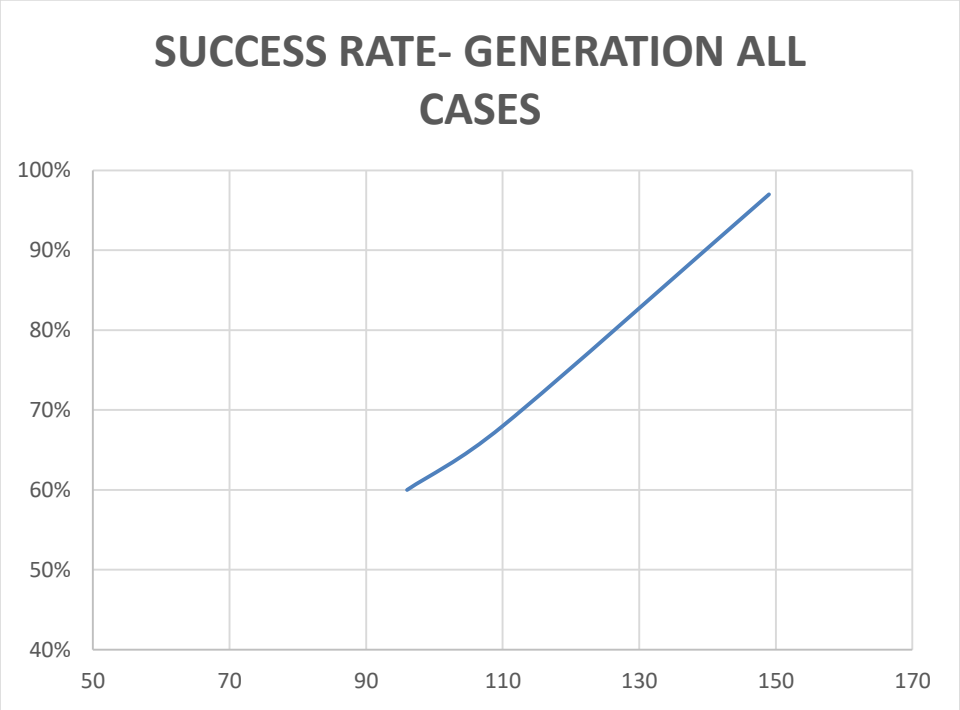
The result for Appling the third case:

generation	error	time	effort	Success rate
69	0.00657	2.567 sec	1640	60%
80	0.00517	2.764 sec	1876	69%
90	0.00356	3.087 sec	1987	76%
105	0.00249	3.165 sec	2076	82%
126	0.00085	3.398 sec	2156	88%
132	0.00062	4.005 sec	2854	91%
149	0.00038	5.876 sec	3176	97%



The final result:

	generation	error	time	effort	Success rate
Case 1	96	0.00492	2.895 sec	1784	60%
Case 2	110	0.00649	2.877 sec	1784	68%
Case 3	149	0.00038	5.876 sec	3176	97%



Through the above tables and graphics, it is clear that the best results for diagnosing cases of autism are by entering several symptoms and a number of parental tests into the neural network, and after the training and learning process, the success rate were high, reaching 97 percent . This network can be applied to various other tests and to other people with other symptoms.

6. conclusions

The study presents an approach for diagnosing autism using an adaptive neural network that takes into consideration both the symptoms of the disease and the characteristics of the parents. The approach was tested on 150 cases and the

results show that the best performance was achieved by using several symptoms and parental characteristics as inputs to the neural network. The study found that the approach can achieve a high success rate of 97% in diagnosing autism. This approach can be applied to other tests and individuals with different symptoms, making it a promising tool for autism diagnosis.

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