Recommended System For Wellness Of Autistic Children Using Data Analytics and Machine Learning

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Abstract: Autism is a mental condition which hinders social and communication skills. It’s a lifelong disability which makes the child’s day to day life very difficult. But in most of the cases early intervention has helped the children to develop the skills which are needed to the fullest to overcome autism. As early the intervention, better the development of the child. Most of the research has been carried out to detect the autism using various machine learning algorithms which consider autistic diagnostic tools such as ADI-R, ADOS or CARS. Once autism is detected, different areas which need to be developed are considered and recommendations are given to the child. In this paper, a system is proposed which uses multi dimensional data collected from facp, DST and Diet to perform analytics using machine learning and provide recommendations to the child.

Keywords: Autism, Functional Assessment Checklist for Programming (fapc), Developmental Screening Test (DST), Diet.

1. Introduction

Autism is a spectrum condition which hinders with the daily activities. The child will not be able to communicate properly, lack of fine motor skills and poor eye contact. They will be more interested in rotating objects such as fans, wheels etc. It’s a lifelong disability but the early intervention plays a major role. If the disease is detected early, the child can develop the skills required and overcome the symptoms of autism. Most of the research has been carried out to detect autism is in the direction of developing machine learning algorithms which uses autistic diagnostic tools such as ADI-R, ADOS and CARS to check the accuracy of the machine. But there can be other factors which can be the cause for the existing condition. So, In this paper we are considering multi dimensional data collected from facp, DST and Diet to do the analysis. The rest of the paper is organized as follows: Autism, Machine learning in autism, facp, DST, Diet, Recommended system, Conclusion and Future scope.

2. Autism

Autism is a spectrum condition which causes different disabilities such as lack of communication skills, social skills and fine motor skills. The symptoms include unable to utter a word by the age of 2, not responding to name calling, strict compulsion of daily routine, repetitive movements like head banging, spinning, and hand flapping, no sitting tolerance, not aware of danger, and echolia. The child will be assessed by the pediatrician during their regular visit and if any of the symptoms are found will be referred to the experts. The psychologists will examine the child behavior and use various screening tools like Ages and Stages Questionnaires (ASQ)(1 month to5.6 years), Communication and Symbolic Behavior Scales (CSBS)(6 months and 24 months), Parents’ Evaluation of Developmental Status (PEDS)(birth to 8 years), Modified Checklist for Autism in Toddlers (MCHAT)(16 to 30 months of age), Screening Tool for Autism in Toddlers and Young Children (STAT) (24 and 36 months of age) to initially check for the...
symptoms of autism. If these screening tools test results are positive, then the child will be referred to be assessed by the various diagnostic tools like CARS, ADI-R, ADOS. If the result of the diagnostic tool is positive, then the psychologist will suggest for early intervention programs if the child is below 3 years and for special education if the child is above 3 years[1]. The intervention plays a major role in the life of the child to develop necessary skills and overcome the symptoms of autism.

3. Machine Learning in Autism

The machine learning algorithms have been used extensively in various aspects of identifying and diagnosing autism.

X Yang, MS Islam, AMA Khaled in 2019 has applied machine learning algorithms such as logistic regression, SVM, and ridge to collocate autism spectrum disorder patients by analyzing rs-fMRI data from ABIDE (Autism Brain Imaging Data Exchange) data repository[2]. They have achieved an accuracy of 71.98%.

Tanu and Deepthi Kakar in 2019 has applied machine learning algorithm SVM to classify ASD from typical development by the use of co-morbidities and risk perception of ASD[3]. They have achieved an accuracy of 99%.

Sakib Mostafa, Lingkai Tang and Fang-xiang Wu in 2019 has used Eigen values on fMRI and feature selection to discriminate ASD from typical developing by creating 264 features of human brain. The experiment has been done using the machine learning algorithms like KNN, SVM, LR and has achieved an accuracy of 77.74%[4].

Mahmoud Elbattah, Romuald Carette, Gilles Dequen, Jean-Luc Guérin, Federica Cilia in 2019 has used unsupervised learning neural networks algorithm using Autoencoders and decoders to extract features from Figshare data repository and applied clustering to find the correlation in the gaze behavior of the ASD patients. It is compared with the CARS detailed list of ASD patients[5].

Alanoud Bin Dris, Abdulmalik Alsalman, Areej Al-Wabil and Mohammed Aldosari in 2019 has developed an Arabic automated intelligent screening system using SVM which successfully classified ASD from non ASD with an accuracy of 88.6%[6].

Shadi Sartipi, Mahrokh G. Shayesteh and Hashem Kalbkhani in 2018 has converted region of interest ROI of resting-state functional magnetic resonance imaging (rs-fMRI) multisite data into frequency bands by using double- density dual-tree discrete wavelet transform (D3TDWT) and then extracted the features by using generalized autoregressive conditional heteroscedasticity (GARCH). The features are selected by t-test and classified by SVM (support vector machines). They achieved an accuracy of 71.6% for males and 93.7% for females to be classified as ASD[7].

Sridhari Iyer ; Rupesh S. Mishra ; Snehal P. Kulkami ; Dhananjay Kalbande in 2017 has developed a game to assess the levels of autism from slight to severe by using fuzzy logic[8]. They have achieved an accuracy of 85%.

Elizabeth Stevens, Abigail Atchison, Laura Stevens, Esther Hong, Doreen, Granpeesheh, Dennis Dixon, Erik Linstead in 2017 has used K-means cluster analysis for determining the challenging behavior in autistic children. They have identified a dominant challenging behavior in all the ASD members[9].
Sushama Rani Dutta, Soumyajit Giri, Sujoy Datta, Monideepa Roy in 2017 has used machine learning association rule, minimum redundancy maximum relevance method to identify the ASD patients[10]. They have achieved an accuracy of 83%.

Halim Abbas, Eric Glover and Dennis P Wall in 2017 has developed 2 machine learning autism screeners of which one is a questionnaire to be filled by the parents and the other is to filled by the trained analyst after watching the home videos. Random forest has been used for the algorithm and the questionnaire is based on ADI-R and ADOS. They have achieved a specificity of 95% by combining questionnaire and video autism screener[11]

Khalid Al-jabery, Tayo Obafemi-Ajayi, Gayla R. Olbricht , T. Nicole Takahashi, Stephen Kanne and Donald Wunsch in 2016 has used k-dimensional clustering with univariate and multivariate analysis on ADI-R and ADOS data for identifying heterogeneity in ASD[12].

Most of the research carried out to detect the autism using machine learning algorithms focus only on the symptoms identified by the autistic diagnostic tools but there can also be other conditions which can contribute to the disease. So, here the multidimensional data collected from facp, DST and Diet will be considered. A Correlation between the factors has to be established so that appropriate recommendations can be given to the child.

4. Functional Assessment Checklist For Programming (facp)

It is prepared by National Institute of Mental Health, Secunderabad, INDIA in 2004[13]. It has been composed by vijayalakshmi myreddi, Jayanthi Narayan, Shaik saleem, K.Sumalini, V.Padma with the intention to provide appropriate education to the mentally retarded children. They have divided the children into 5 groups and are evaluated on the basis of Personal, Social, Academic and Occupational skills. If the scores are more than 80% in each of these skills, then they are promoted to next group. The details of the group are as follows:

The first group is Pre-Primary consisting of the children from age 3-6 years. If these children scores above 80% in all the skills then they are promoted to Primary-I group.

The second group is Primary-I group consisting of the children from age 7-10 years. If these children scores above 80% in all the skills of their age then they are promoted to Secondary group.

The third group is Secondary group consisting of the children from age 11-14 years. If these children scores above 80% in all the skills of their age, then they are promoted to Prevocational-I group.

The fourth group is Prevocational-I group consisting of the children from 15-18 years. If these children scores above 80% in all the skills of their age, then they are promoted to Vocational training.

The fifth group is Vocational training group which consists of the children over 18 years. If they score above 80%, then they are eligible for supported self employment or sheltered employment.

In addition to above groups, the children who scores less than 80% in the preprimary group are placed in primary-II group up to 9-14 years. These children after scoring more than 80% in the primary-II group are placed in Secondary group.

If the children in Primary-II have not scored above 80% till the age of 15, then they are placed in Prevocational-II group consisting of 15-18 years. The children who did not score more than 80% in
secondary group are also placed in this group. These children after 18 years will be sent to Vocational training group.

There is another group called as Care group with very low abilities who has to be trained to perform their basic tasks like eating, drinking and toileting.

The children will be assessed quarterly and their progress will be noted down based on the improvement in performing each task of their category.

The skills on which the children are assessed are basically personal, academic, social and occupational from which we can derive the autistic symptoms of social, communication and motor skills.

5. Developmental Screening Test (DST)

The Developmental screening test is developed Bharath Raj, India. In this, age levels ranges from birth to 15 years. From birth to 1 year milestones are monitored for every 3 months. From 1 year to 2 years, milestones are monitored for every 6 months. After 2 years, milestones are monitored for every one year up to 15 years. The milestone includes various aspects covering fine motor skills, language, social and personal skills [14]. The more details can be found from [15].

6. Diet

Diet plays a very prominent role in the life of the autistic children. They should be given gluten free food items. It has shown positive effect on the behavior of these children [16]. These children prefer to eat only certain foods due to sensory issues [17] and introducing right food would improve their behavior. Casein free diets also play a prominent role in the treatment of autism [18].

7. Recommended System

Now-a-days, Data analytics plays a major role in all the fields such as marketing, sales, transport, education and medical sectors. Various tools are available to perform analytics such as text analytics, video analytics, audio analytics and social analytics. They help us to analyze the existing data and develop useful insights which can be used for better decision making [19]. The Recommended system is developed as follows:

Step 1: From functional assessment for checklist programming (facp), the data of the pre-primary group whose age varies from 3-6 years is collected. It has questionnaire related to personal (19 questions), social (22 questions), academic (44 questions), occasional (4 questions), Recreational—in door (7 questions) and outdoor (10 questions). For each question related to all the aspects except the recreational, the scores are given as:

- Yes, if the child is able to perform the task.
- C, if the child is able to perform the task based on clues.
- NA, if not applicable to that child.
- NE, if the child does not know about it.
• PP, if the child is able to perform the task by prompting physically.
• VP, if the child is able to perform the task by prompting verbally.
• GP, if the child is able to perform the task by gesture prompting.
• M, if the child is able to perform the task based on some kind of model developed.

Step 2: From developmental screening test (DST), the data of the children from 3-6 years is collected. It has questionnaire which has to be divided into personal, academic, social and occasional activities. The data from facp is termed as F1. The data collected from DST is termed as F2. The information about diet is termed as F3.

The Figure1 below shows the overall recommended system.

![Figure 1: Recommended System for Wellness of Autistic Children](image)

Step 3: Correlation is calculated between F1, F2 and F3 to determine which factors are dependent on each other and which factors does not contribute to each other.

Step 4: Based on the correlation calculated, recommendations are given to the children related to various therapies, food and medication which can improve their health.

8. Data Collection and Procedure

The data for facp, DST and Dietis collected from Autism care and Research centers of Smiles Foundation, India supported by World Autism Society and National Institute of Mental Health, India. Here the therapists have evaluated the children using facp and DST.

Based on the questionnaire of facp[13] whichever questions have answer as ‘yes’ will be
considered for each aspect of personal, academic, social and occasional activities. The result is calculated as percentage of number of answers as ‘yes’ divided by the total number of questions in each aspect i.e.

\[
\text{personal} = \frac{\text{number of questions with answers as 'yes')}}{\text{total number of questions}}
\]

\[
\text{Social} = \frac{\text{number of questions with answers as 'yes')}}{\text{total number of questions}}
\]

\[
\text{Academic} = \frac{\text{number of questions with answers as 'yes')}}{\text{total number of questions}}
\]

\[
\text{Occupational} = \frac{\text{number of questions with answers as 'yes')}}{\text{total number of questions}}
\]

Only the children whose percentage is less than 80 will be considered. For these children, the milestones of DST[14] will be calculated as the percentage of number of days/total number of milestones*milestones achieved for the appropriate age.

\[
\text{DST}= \frac{\text{number of days}}{\text{total number of milestones}} \times \text{milestones achieved}
\]

F3 is based on the data collected from the diet. We try to perform multivariate analysis to find the relationship between these parameters.

9. Conclusion

Autism is spectrum disorder which affects the social, communication and motor skills of the children. There is no test to detect autism and lot of research is being carried out in this domain. Most of the research is based only on the identification of the problem and not on the factors which can improve the health condition of the child. The system recommended above can be used to find if there exists any correlation between other factors such as diet, fine motor skills and special skills. And if the correlation exists, possible recommendations can be given to the child.

10. Future Scope

The Recommended system includes only the children of the age group from 3-6 years. But it can be extended to different age groups mentioned in functional assessment for checklist programming (faacp) to find various factors which can affect the child. Here faacp,DST and diet are used to collect the data, but other data such as type of therapies and speech can also be included to find the correlation among various factors.

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