JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Autism Detection: Comparative Evaluation of Machine Learning Approaches

[1]Dr. P. Sruthi, [2]Mrs. K. Navaneetha, [3]Veerla Harinithya, [4]Kancharla Swathi, [5]Yerra Pardhasaradhi,
[3,4,5] B. Tech Students, Department of CSE (Artificial Intelligence & Machine Learning), CMR College of Engineering & Technology, Hyderabad, Telangana State, India.
[1]Associate Professor, Department of CSE (Artificial Intelligence & Machine Learning), CMR College of Engineering & Technology, Hyderabad, Telangana State, India.
[2]Assistant Professor, Department of CSE (Artificial Intelligence & Machine Learning), CMR College of Engineering & Technology, Hyderabad, Telangana State, India.

Abstract: Autism Spectrum Disorder is a neuro-developmental disorder, which may have lifelong consequences on the verbal communication, speech, cognitive, and social capabilities of a person. It is estimated that about 1 of 100 people worldwide are affected by it, and as a rule, developmental disorders manifest within the first two years after their birth. Notwithstanding the fact that the environmental and genetic aspects determine the actual disease, an early diagnosis and support are usually beneficial to the patients. In the present time, only assessing tools used during the sessions with the expert can contribute to the diagnosis of ASD. Besides taking diagnostic time, diagnosing ASD carries with it an increase in the costs of healthcare. To aid early identification, intervention, address concerns of delayed diagnosis and to improve the quality of life for individuals on autism spectrum, development of an efficient and accurate model for predicting autism spectrum disorder is required. This paper shows the approach of Machine Learning (ML) techniques to aid Autism detection. In this paper, we attempt to investigate the potential of how Naïve Bayes, Support Vector Machine, Logistic Regression, KNN, Artificial Neural Networks, and Convolutional Neural Networks can be utilized in ASD predicting and analyzation. The article will use behavioral data for research purposes as herein the paper looks at the performance of different machine learning algorithms used in ASD detection and a general comparison of the algorithms used.

IndexTerms - Artificial Intelligence, Machine Learning, Behavioral Data, Autism Spectrum Disorder.

I. INTRODUCTION

Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) have revolutionized the way we interact with technology, solve challenging problems in a variety of fields. In the past few years, however, AI and machine learning technologies rapidly integrated with our daily lives. AI, ML, and DL today affecting almost every aspect of modern living, including personalized recommendations on the internet, or self-driving vehicles moving along our highways, this data is all around us. Statistics on these methods are very impressive showing the ability to deal with large volumes of data, detect patterns and predict the future. In the course of time, these innovations have managed to bring about the most significant changes that have resulted in massive changes in whole industries and, in conjunction, have contributed to productivity in a myriad of tasks.

Autism Spectrum Disorder (ASD) being a neurological development condition is marked by difficulties in social interaction, communication, and exhibiting repetitive behaviors. ASD symptoms usually appear during early years in a child's life often by the age of 2 or 3 years old. The fact that the true origin of ASD continues to be unclear, yet people who suffer from the condition may benefit from the prompt discovery and care, is a revelation on its own. Therefore, in order to make it possible for the people with ASD to fulfil themselves and develop the hidden potential, it is essential to recognize the symptoms and signs of the disease, and to organize a proper care and support for them.

The other diagnostic methods for ASD indeed take a long time, and they need the professionals that monitor the signs, listen to the persons with ASD, and provide the explanations using known standards. Nevertheless, these approaches could easily take too much time, be imprecise, and not always provide accurate outcomes as predicted. At present, there is an increasing demand for the improvement of the diagnostic tools that would provide accurate and immediate detection, hence early intervention for the individuals afflicted with the disorder.

In an attempt to fulfil this demand, researchers have resorted to using machine learning approaches, as they get to utilize the techniques to process and extract helpful knowledge from the large datasets. Through training the algorithms on diverse datasets, covering areas such as behavioral observations, medical records and genetic markers can be a helpful tool for the models to identify patterns suggestive of ASD and assist in the diagnosis process. Access to numerous datasets of large scales and the advances in ML algorithms have paved the way for new improvements in ASD diagnosis accuracy and productivity.

Here, this paper is essentially about analysis and uncovering an ASD based on the machine learning methods. We strive to discover the best function of different ML algorithms in detecting features contributing to ASD and contrast their outcomes with other machine learning algorithms. By leveraging state-of-the-art ML models and comprehensive datasets, our objective is to contribute to the development of more accessible and accurate tools for diagnosing ASD, ultimately improving outcomes for individuals on the autism spectrum.

II. RELATED WORK

1. "A novel computational intelligence methodology for identifying autistic traits in autism screening."

Autism spectrum disorder (ASD) is one of the most common classifications for developmental disorders that is growing most rapidly. General practitioners and family physicians are typically the first to be consulted when a patient or family member displays symptoms of autism spectrum disorder (ASD). Some adult patients and their families are unaware of the potential characteristics of ASD and, as a result, do not seek out diagnostic services or get in touch with their medical practitioner. Therefore, giving these families access to a brief, user-friendly tool that makes use of objects connected to ASD is crucial to the early detection and treatment of ASD. Additionally, this will increase the likelihood that families will seek out expert evaluation. This study aims to identify fewer but important elements in common ASD screening approaches in order to accomplish effective screening, as there is a pressing need to assess the items' influences on ASD within the present tools. To this end, a computational intelligence method called Variable Analysis (Va) is proposed, which accounts for feature-to-class correlations while reducing feature-to-feature correlations. In order to validate the Va results, two machine learning techniques have been applied to create automated categorization systems based on specificity, sensitivity, positive predictive values (PPVs), negative predictive values (NPVs), and anticipated accuracy. The findings showed that although pulling less variables from adult, adolescent, and child screening techniques, Va maintained competitive prediction accuracy, sensitivity, and specificity rates.

2. "Rapid quantitative evaluation of social impairment associated with autism by classroom educators."

Since teachers regularly see students in the genuine social settings of their classrooms, they play a crucial role in the assessment of many mental conditions. They have never before been shown to be reliable in identifying and quantifying autism symptoms. In this study, we compared teacher evaluations with those for autistic indicators from parents, expert doctors, and trained reviewers.

3. "Utilizing machine learning for streamlining autism diagnostics: challenges and potentials."

Machine learning can be very helpful to the behavioural sciences in their study on interventions and diagnostics. This is particularly true for research on the well-recognized and incredibly diverse illness known as autism spectrum disorder. However, the implementation of machine learning may be unstable and produce inaccurate results in the absence of clinical domain knowledge. To shed light on this concern, the present study aims to replicate and critically evaluate the results of two studies (Wall et al. in Trans Psychiatry 2(4):e100, 2012a; Plops One 7(8), 2012b) that claim a notable decrease in the amount of time needed for autism diagnosis by machine learning. Inability to get results equivalent to those reported by Wall and colleagues using bigger and more balanced data highlights several conceptual and methodological problems with our study. At the intersection of computational and behavioural science, we highlight some particularly intriguing topics for collaborative study. Finally, we offer recommended best practices for applying machine learning to autism research.

III. SYSTEM REQUIREMNTS

Software Requirements:

1. Cross Platform (windows, mac, Linux, ubuntu)
2. Python
3. NumPy
4. Pandas
5. Tkinter
6. Matplotlib
7. Scikit-learn
8. PyCharm
9. Seaborn
10. Pickle
11. Keras

IV. METHODOLOGY

In order to execute out this project, we have created the following modules.

1. Dataset Uploading and Preprocessing

The Kaggle's ASD dataset is the focus of machine learning studies aiming to detect ASD and it contains critical attributes needed for execution. These data include demographic elements such as age, gender, ethnic population, and family history revealing information about ASD prevalence and distribution. Furthermore, in this dataset the scores from psychological tests are included, by means of which can determine social, communication and behavioural traits on the scale of autism. Moreover, data from individual gene patterns or brain activity, can help in explaining ASD biological features. In particular, this dataset provides an excellent opportunity for investigation to researchers, providers and policy makers in the field of autism diagnostics and interventions. Steps of dataset preprocessing includes, managing missing values, normalizing numerical features, and feature selection to make the model most reliable while avoiding loss of essential information for correct ASD detection.

2. Autism detection

After preprocessing the dataset, we'll split it into two parts: Out of a total 80% reserved for training, the rest (20%) will be dedicated to testing. First we put the processed trained data into the SVM algorithm. Second the SVM algorithm trains the data after which the model will be used to calculate the SVM predictions accuracy on the 20% test data. Then, we will also run the same process with K-NN algorithm, Naïve Bayes algorithm, Logistic Regression algorithm, ANN algorithm, and CNN algorithm. Each algorithm will learn each different task in our system just by training this algorithm on the processed data to predict the outcome. The regression will run on 80% of the data as the training model and will be validated on the remaining 20% of the data to look into prediction accuracy. This method of assessment will be helpful to us to judge the performance of different machine learning algorithms, which can diagnose autism spectrum disorder.

3. All algorithms performance

In the progress of our voyage through autism spectrum disorder, this module provides us with a way of detecting autism from data with the help of CNN predictions. Through this functionality, we enter the diagnostic dataset and CNN determines whether it has normal state or is related to autism disorder. Additionally, our tool provides clarity through visual representations. The graph of my "All Algorithms Performance Graph" exhibits the algorithm accuracy and assists in understanding the algorithms efficacy. Additionally, we head into the CNN training with its outstanding performance which is depicted in the "CNN Training Graph" through the comparison of accuracy and loss during training. Through this comprehensive approach, not only our knowledge of autism diagnosis is improved, but also, we can create criteria for evaluating and improving algorithm performance.

Block Diagram

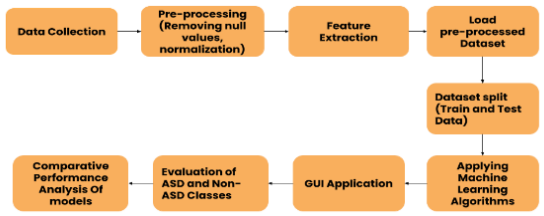

Figure 1 Block Diagram

V. RESULTS AND DISCUSSIONS

During the uploading process of the ASD dataset and performing our analysis, we discover something interesting.

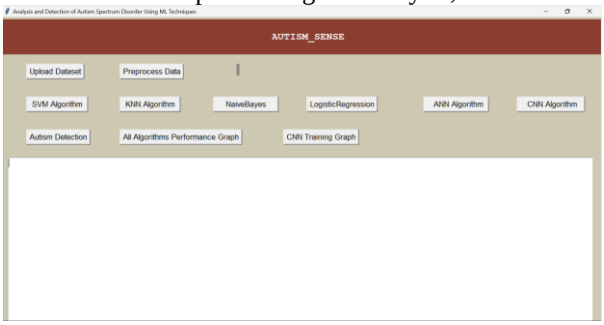

Figure 1 Graphical User Interface

The graph exhibits the trend in accuracies and loss through training epoch. On this axis the x means one is and y denotes both accuracy and loss. The green curve represents the accuracy level, which gradually increases with each Epoch replacing the red line of the past record, which has been a steady progression towards better performance. In fact, the yellow line compares to loss and so it demonstrates a steady decrease that ultimately implies the benefits of the model in terms of minimizing the mistakes. To understand, in the machine learning the capacity of a model showing a decreasing loss and an increasing accuracy is thought as an optimal model. As such, this visualization is an important instrument for choosing the most appropriate calculations that discover the presence of autism spectrum disorders. By conducting such analysis, the performance and types of algorithms become understandable, and this thereby contribute to the improvement of autism diagnosis.

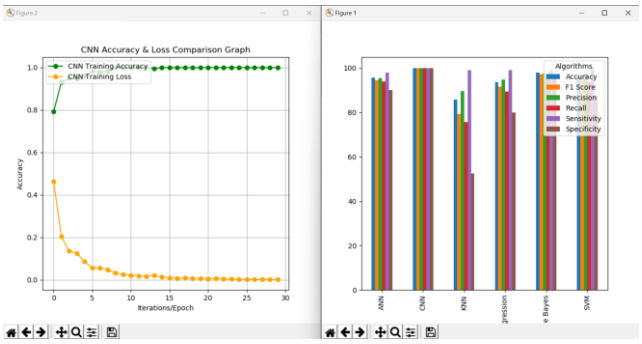

Figure 2 Comparison Graph & CNN Training Graph

VI. CONCLUSION

The principal aim of our project is to detect autism using behavioural data with the aid of diverse machine learning models. Additionally, we have designed a user-friendly Graphical User Interface (GUI) application that operates on desktop platforms. This GUI facilitates easy interaction with the ASD detection system, enhancing usability and accessibility for users. Additionally, web-based technologies can be integrated which makes the application for ASD Detection accessible for everyone from anywhere online. Our application is designed to be scalable, allowing for future integration with databases and deployment in hospital settings, thereby enhancing its potential impact and usability within clinical environments.

VII. REFERENCES

[1] Thatch, Fadi. "Machine learning in autistic spectrum disorder behavioural research: A review and ways forward. (2018) " Informatics for Health and Social Care: 1-20.

[2] Thatch, Fadi, Firuz Kamalov, and Khaira Rajab. (2018) "A novus computational intelligence approach to detect autistic features for autism screening." International journal of medical informatics 117: 112-124

[3] Vaishali, R., and R. Sasikala. "A machine learning based approach to classify Autism with optimum behaviour sets. (2018) " International Journal of Engineering & Technology 7

[4] Constantino, John N., Patricia D. Lesser, Y. I. Zhang, Anna M. Abacha, Teddi Gray, and Richard D. Todd. (2007) "Rapid quantitative assessment of autistic social impairment by classroom teachers." Journal of the American Academy of Child & Adolescent Psychiatry 46(12): 1668-1676.

[5] Daniel Bone, Matthew S. Goodwin, Matthew P. Black, Chi-Chun Lee, Kartik Adhikari, and Shrikanth Narayanan. (2015) "Applying machine learning to facilitate autism diagnostics: pitfalls and promises." Journal of autism and developmental disorders 45(5): 1121-1136.

[6] Dennis Paul Wall, J. Kosmicki, T. F. Deluca, E. Harstad, and Vincent Alfred Fusaro. (2012) “Use of machine learning to shorten observation-based screening and diagnosis of autism.” Translational psychiatry, 2(4): e100.

[7] Dennis P. Wall, Rebecca Dally, Rhiannon Luyster, Jae-Yoon Jung, and Todd F. DeLuca. (2012) “Use of artificial intelligence to shorten the behavioural diagnosis of autism.” Plops one, 7(8): e43855.

[8] Fadi Thatch. (2017). “Autism spectrum disorder screening: machine learning adaptation and DSM-5 fulfilment.” In Proceedings of the 1st International Conference on Medical and Health Informatics, pp. 1-6. ACM.

[9] Daniel Bone, Chi-Chun Lee, Matthew P. Black, Marian E. Williams, Songbook Lee, Pat Levitt, and Shrikanth Narayanan. (2014). “The psychologist as an interlocutor in autism spectrum disorder assessment: Insights from a study of spontaneous prosody.” Journal of Speech, Language, and Hearing Research, 57(4): pp.1162-1177.

[10] Fadi Thatch. (2017) “ASD Tests. A mobile app for ASD screening.” www.asdtests.com [accessed December 20th, 2017].