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Machine Learning Approaches for ADHD Detection

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Abstract: *This report explores the application of deep learning convolutional neural networks (CNNs) for analyzing brain MRI scans to assist in the diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) syndrome. ADHD is a neuro developmental disorder that affects millions of individuals worldwide, characterized by difficulties in attention, hyperactivity, and impulsivity. Traditional methods of diagnosis rely on subjective assessments and behavioral observations, leading to inaccuracies and delays in treatment. Leveraging the power of deep learning CNNs for MRI analysis offers the potential for more objective and efficient diagnosis, facilitating timelyintervention and personalized treatment strategies*

Keywords: convolutional neural networks

I. INTRODUCTION

The internet has revolutionized the way we live, work, and communicate, offering unprecedented convenience and connectivity. However, this digital landscape is not without its dangers. One of the most pervasive threats facing internet userstoday is phishing, a form of cyberattack where malicious actorsimpersonate legitimate entities to deceive users into providing sensitive information such as usernames, passwords, and creditcard details. Phishing attacks have become increasinglycommon and sophisticated, putting internet users at risk ofidentity theft, financial loss, and other forms of cybercrime.

Recent advancements in medical imaging and machine learning techniques have opened up new possibilities for enhancing the accuracy and efficiency of ADHD diagnosis. Brain MRI scans provide valuable insights into the structural and functional abnormalities associated with ADHD, offering potential biomarkers for objective diagnosis. Deep learning, particularly convolutional neural networks (CNNs), has demonstrated remarkable capabilities in image recognition and analysis tasks, making it a promising tool for automated MRI- based diagnosis of ADHD.

II. EXISTING SYSTEM

In the Existing work, the missing value filling algorithm has a significant impact on the accuracy of the trained models. In theprevious system we have studied different naïve bayesalgorithm under supervised machine learning algorithms. They have analysed different attributes related to ADHD syndrome from brain signals in patients and predicted accuracy for different Machine learning algorithms like Logistic regression and Naive bayes

III. RELATED WORK

The Early Detection of ADHD's Disease Using Deep Learningand Machine Learning Authors: Wu Wang, JUNHO LEEL, FOUZI HARROU Published On: IEEE Access 2020 Abstract: Accurately detecting ADHD's disease (PD) at an early stage is certainly indispensable for slowing down its progress and providing patients the possibility of accessing to disease- modifying therapy. Towards this end, the premotor stage in PDshould be carefully monitored. An innovative deep learning technique is introduced to early uncover whether an individual is affected with PD or not based on premotor features. Specifically, to uncover PD at an early stage, several indicatorshave been considered in this study, including Rapid Eye Movement and olfactory loss, Cerebrospinal fluid data, and dopaminergic imaging markers. A comparison between the proposed deep learning model and twelve machine learning andensemble learning methods based on relatively small data including 183 healthy individuals and 401 early PD patients shows the superior detection performance of the designed model, which achieves the highest accuracy, 96.45% on average. Besides detecting the

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PD, we also provide the feature importance on the PD detection process based on the Boosting method. Advantages: PD patients shows the superior detection performance of the designed model, which achieves the highest accuracy, 96.45% on average. Disadvantages: Works only for test based clinical data , doesn't work for scan data.

ADHD's Disease Detection by Using Machine Learning Algorithms and Hand Movement Signal from Leap Motion Sensor
Authors: Anastasia Moshkova, Andrey Samorodov, Ekaterina Ivanova, Ekaterina Fedotova
Published On: Authorized licensed use limited to: Auckland University of Technology. Downloaded on June 06,2020 at 15:46:20 UTC from IEEE Xplore
Abstract: This work is devoted to the detection of ADHD's disease (PD) by the kinematic parameters of hand movements using machine learning methods. Hand movements of PD patients (N16) and control group (N16) were recorded using a Leap Motion sensor. Three motor tasks were chosen based on MDS-UPDRS part 3: finger tapping (FT), pronation – supination of the hand (PS), opening-closing hand movements (OC). For the signal received from the sensor, 25 kinematic parameters were calculated by key points. The key point determination was carried out with maximums and minimums finder algorithm, as well as manual marking, using a specially designed user application. For the binary classification (PD or non-PD), for each motor task separately and for three combined, various feature extraction options were used. Four classifiers: kNN, SVM, Decision Tree (DT), Random Forest (RF) were trained. Testing was carried out in the 8-fold cross-validation mode. The best results were obtained using the combination of the most significant features of both hands. The results for eachtask were the following: for FT 95.3%, for OC 90.6%, for PS 93.8%. The combined features result of all motor tasks was 98.4%.
Advantages: The results for each task were the following: for FT95.3%, for OC 90.6%, for PS 93.8%. The combined features result of all motor tasks was 98.4%.
Disadvantages: Accuracy depends on the quality of the data.
With large data, the prediction stage might be slow.

Organ Risk Prediction for ADHD's Disease using DeepLearning Techniques
Authors: Sandali Raizada, Yashita Verma, Shuchi Mala Sadek, Published On: Authorized licensed use limited to: East CarolinaUniversity. Downloaded on June 19,2021 at 01:45:32 UTC fromIEEE Xplore
Abstract: ADHD's Disease is a kind of nervous system disorder whose symptoms start gradually. The signs and symptoms can be different for everyone with no specific diagnosis. Neurological disorders are identified as global threat with ADHD's Disease being the second most common. More than 10 billion people are living with ADHD's around the world. Thisdisease is most common in countries of the US and Canada.Deep learning an essential part of Artificial Intelligence provides an uncanny power to systems to construct a complex network using layers of perceptrons that mimic the human neurons. This network Combined with algorithms of Machine Learning and Prognostic Modeling may serve as one of the mostpowerful tools in healthcare to classify and analyze hugeamount of medical data and predict future trends through Supervised Learning. In the paper, we focused on the effective prediction of the organ at risk for ADHD's Disease (Multi-label Classification). We have examined and refined our model over data collected across data collection of over 300 features. We have put forward an Artificial Neural Network organ risk prediction algorithm using contrasting data. To our finest understanding, none of the previous works have centered on contrasting data in the area of analysis of medical data. The prediction accuracy of our suggested ANN algorithm is 76%. Advantages: Accurate results. Fast & efficient in text type ofdata.
Disadvantages: Only work well with test results medical data.

A Knowledge Base Data Mining based on ADHD's DiseaseAuthors: Md. Redone Hassan et
Published On: IEEE–2019
Abstract: The approaches to detecting ADHD's disease in the human body from voice data by using Classification techniques apply three different algorithms for finding the growth rate of this disease. Unified ADHD's disease rating scale deals with motor fluctuations and changes over voice after a certain periodand that can measure the people affected by this disease and the difference with healthy people. Hoehn & Yahr scale measures the symptoms which are being

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working through the improvement of ADHD's disease in the human body. Classifier algorithms used to detect the factors and symptoms which are involved in the advancement of this disease in the human bodyusing voice data. From the distinctions of all algorithms measures the growth rate and find out which algorithm gives the best result for several approaches to diagnosis ADHD's diseaseand chances of had this disease in the human body.
Advantages: Increased Accuracy and Robust modeling.
Disadvantages: Potential of misidentificat-ion of what issupposed to be categorized.

ADHD's Detection Using Machine Learning
Authors: Surekha Tadse, Muskan Jain, Pankaj Chandankhede Published On: Proceedings of the Fifth International Conference on Intelligent Computing and Control Systems(ICICCS 2021) IEEE Xplore
Abstract: Advance technology such as Data Science can be usedto find solutions to medical science problems, by using its data and implementing Machine Learning Algorithms on to it, to draw the insights and patterns from the data and spot out the possibilities. This is our approach to find out a way to detect ADHD's disorder at an early stage; to provide necessary treatment early using Machine Learning with Data Science. Data Science processes and its methods for extracting knowledge and insights from large volumes of data would be witnessed in the project. Machine Learning algorithms are applied onto patient's data-set and accuracies of the algorithmsare compared. The model with the highest accuracy fits the bestto predict target values for unknown data values. In this way, integrating Medical Science and Data Science with Machine Learning, PD could be detected earlier and necessary treatmentwould suffice a patient to recover at a good rate.
Advantages: PD could be detected earlier and necessary treatment would suffice a patient to recover at a good rate.
Disadvantages: Sensitive to the scale of the data and irrelevant features.

IV. PROBLEM STATEMENT

The traditional methods of diagnosing ADHD rely heavily on subjective assessments and behavioral observations, leading to inconsistencies and inaccuracies in diagnosis. Additionally, the reliance on clinical expertise and manual interpretation of MRI scans for identifying structural and functional brain abnormalities associated with ADHD can be time-consuming and prone to human error. There is a pressing need for objective, efficient, and accurate methods for diagnosing ADHD to facilitate early intervention and personalized treatment approaches.

V. METHODOLOGY

The proposed system receives MR images as input, which is eventually labeled as PD or HC. The model contains a total number of 8 major layers. The order of these layers are as follows, convolution 1, max-pool 1, convolution 2, max-pool 2,convolution 3, dense layer 1, dense layer 2, and an output layer.The kernel size of all convolutional layers (Convt 1, Convt 2, Convt 3) and Max-pooling layers (Max pool 1, Max pool 2) are3x3 which generate 32 feature maps. The CNN learns these feature maps, which enable CNN to discriminate between PD and HC in MR images. Usually, in CNN the convolutional layers are followed by pooling layers. In the proposed model, two max-pooling layers of Max-pool 1 and Max-pool 2 come after Convt 1 and Convt 2 convolutional layers with stride 1 and padding 0. Optimize hyperparameters using techniques like grid search, random search, or Bayesian optimization to improve model performance.
Preprocessing Techniques Image augmentation is a technique of altering the existing data to create some more data for the model training process. In other words, it is the process of artificially expanding the available dataset for training a deeplearning model image.
In this picture, the image on the left is only the original image, and the rest of the images are generated from the original training Proposed Classification Methods and Techniques Feature extraction, feature reduction, and classification are three essential stages where traditional machine learning methods are composed. All these stages are then combined in standard CNN. By using CNN, there is no need to make the feature extraction process manually. Its initial layers' weights serve as feature extractors, and their values are improved by iterative learning. CNN gives higher performance than other classifiers.

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Deep learning

Deep learning is a kind of AI where a model figures out how to perform the classification problems directly from the given dataset, which might be pictures, text, or sound. Deep learning is typically actualized by neural network architecture. As the number of layers turns out to be more, the network will be deeper. As contrasted with the conventional neural networks containing 2 or 3 layers, the deep neural networks can have many layers. Deep learning models are particularly appropriate to identification applications of artificial intelligence such as computer vision, face recognition, natural language processing, voice recognition, social media filtering, and bioinformatics. It has delivered results equivalent to and now and again better than human experts.

Accuracy makes deep learning state-of-the-art as compared to other machine learning tools. This high degree of accuracy has been enabled by the advancements in the three technological areas.

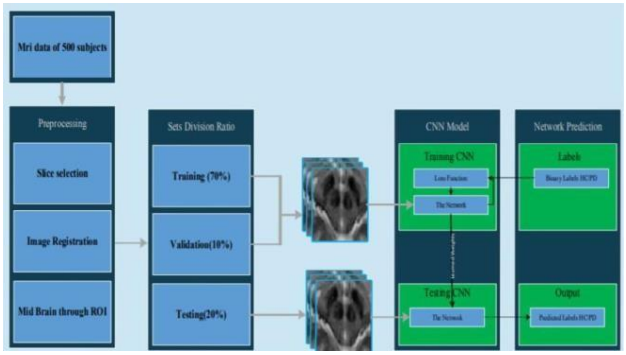
- Easy and free availability of large datasets (such as ImageNet, Caltec101, MNIST), gave access to massive sets of labeled data.
- High computing power with the help of high- performance GPUs. It will boost the training of a large set of data needed for deep learning and reducing the training time.
- Pre-trained deep neural network models. With the help of the transfer learning technique, the pre-trained deep neural network models (such as AlexNet, VGG-16, Resnet-50) can be retrained to perform new classification and pattern recognition tasks.

DNN architecture & transfer learning models

The sufficient resources for the functioning of the deep learning model have provided as:

- The labeled data of functional Magnetic Resonance Images (fMRI) from the ADNI database.
- The high-performance GPU supported by CUDA– Python platform.
- Pre-trained deep neural network models such as AlexNet, VGG-16, VGG-19, and GoogleNet.

The dataset of MR images contains several images of one of the three categories: AD (ADHD's disease), MCI (Mild Cognitive Impairment), and NC (Normal Control) and the deep neural network needs to automatically recognize a random MR Image is in which category. The images are labeled for training the network. With the help of this training data, the deep neural network would then be able to start to comprehend the MR Image's specific features and partner them with the respective group of data. Each layer in the network takes the data from the past layer, transforms it, and finally passes it on to the next layer. The network will increase the complexity and detail of what it is learning from layer to layer. The most important characteristic of the deep learning model is its self-learning capability. i.e., the network will learn directly from the data given. Therefore, what features are being learned and the number of such very minute features do not influence the human.



VI. CONCLUSION

In this study, we proposed a customized CAD based CNN architecture to classify MRI patches of ADHD and healthy patterns. The proposed network with 3 convolutional layers learns the patterns from training samples of benchmark PPMI dataset in an ecient way which subsequently improved the accuracy. The results demonstrate that our network is

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capable oflearning accurate features of ADHD disease automatically. During the experimentation, we found that the limited dataset was a major issue, leading the CNN model towards overfitting.However, with proper design and use of dropout layers in the network, we avoided the overfitting problem.

VII. FUTURE SCOPE

This report focuses on the development and evaluation of a deep learning CNN model for analyzing brain MRI scans specifically for the diagnosis of ADHD. The scope encompasses data collection, preprocessing, model development, training,validation, testing, and performance evaluation. The study aimsto contribute to the growing body of research on leveraging advanced computational techniques for improving the diagnosis and understanding of neurodevelopmental disorders like ADHD. However, it is essential to acknowledge the limitationsand challenges inherent in the complexity of ADHD diagnosis and neuroimaging analysis, which may influence the generalizability and applicability of the proposed CNN-based approach.

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