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Brain-Storming to Detect Brain Disorders

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Abstract: Brain disorders represent a significant and growing global health challenge, encompassing a spectrum of conditions ranging from neurodegenerative diseases, like Alzheimer's and Parkinson's, to various neuropsychiatric disorders. Timely and accurate detection of brain disorders is crucial for enabling prompt interventions, tailoring appropriate treatments, and improving the overall quality of life for affected individuals. This research paper explores an innovative and interdisciplinary approach to enhance the process of brain disorder detection through the integration of brainstorming techniques and advanced machine learning algorithms.

The research delves into the adaptability and effectiveness of brainstorming techniques for brain disorder detection, leveraging diverse data sources such as clinical records, genetic information, and patient histories. The study presents various brainstorming techniques that are utilised to analyse, identify and arrive at the best possible methodology that can be used for the detection of brain disorders.

Keywords: Brainstorming, Parkinson, SWOT, Mind Map, Star-Bursting.

I. INTRODUCTION

Brain disorders, a diverse category encompassing neurodegenerative diseases, neuropsychiatric disorders, and various other conditions affecting the central nervous system, pose a substantial and ever-increasing global health challenge. These disorders, including Alzheimer's disease, Parkinson's disease, depression, and epilepsy, are characterised by a wide array of symptoms and etiological factors. Their complexity often hinders timely and accurate diagnosis, leading to delayed interventions and challenges in tailoring effective treatments.

The significance of early detection cannot be overstated. Early diagnosis offers several advantages, including the potential for timely therapeutic interventions that can slow the progression of diseases or mitigate symptom severity. Moreover, it provides individuals and their families with the opportunity to plan for future healthcare needs, access appropriate support systems, and engage in lifestyle modifications that may enhance their quality of life. Therefore, the development and refinement of diagnostic tools that enable early detection of brain disorders are central to advancing healthcare and improving patient outcomes.

Traditionally, the diagnosis of brain disorders has relied heavily on clinical assessments, neuroimaging modalities, and behavioural observations. While these methods have been valuable in providing insights into cognitive and neurological functioning, they also exhibit limitations in terms of accuracy, accessibility, and cost-effectiveness. In light of these challenges, this research paper embarks on an innovative path by exploring the integration of brainstorming techniques into the process of brain disorder detection (Parkinson’s Disease with respect to the scope of this paper). Brainstorming, a well-established methodology for stimulating creative thinking, generating ideas, and problem-solving in diverse contexts, has not traditionally been associated with medical diagnostics.

The premise of this research lies in the hypothesis that brainstorming, when applied strategically and systematically, can yield novel insights, patterns, and diagnostic markers that augment traditional diagnostic approaches. This paper examines the adaptability and effectiveness of brainstorming techniques in the context of brain disorder detection, focusing on multidisciplinary collaboration and data-driven insights. Moreover, we investigate the seamless integration of machine learning algorithms, which can process and analyse complex data patterns, into the brainstorming process, further elevating the potential for innovative diagnostic solutions.

II. LITERATURE REVIEW

1) Parkinson Disease Detection from Spiral and Wave Drawings using Machine Learning Algorithm: Zaki Ahmed Shaikh, Nitin R. Talhar in their work under the IJRASET Journal for Research in Applied Science and Engineering Technology proposed a model for the prediction of Parkinson’s disease using the medical data modalities like the spiral and wave patterns generated by the disease affected individuals. They took the use of CNN (Convolutional Neural Networks) for extracting the gradient features from the drawing for their prediction and testing. After training, the Spiral Model achieved an accuracy of 98% and a loss value of 0.0027. On the other hand, the Wave Model achieved an accuracy of 84.61% with a loss value of 0.4070.

2) Parkinson's Disease Detection from Spiral and Wave Drawings using Convolutional Neural Networks: A Multistage Classifier Approach: Chakraborty, Sabyasachi, Kim, Hee-Cheol from the Department of Computer Engineering/Institute of Digital Anti-Aging Healthcare proposed a system design for analysing Spiral drawing patterns and wave drawing patterns in patients suffering from Parkinson's disease and healthy subjects. The system developed in the study leverages two different convolutional neural networks (CNN), for analysing the drawing patters of both spiral and wave sketches respectively. The complete model was trained on the data of patients and has achieved an overall accuracy of 93.3%, average recall of 94%, average precision of 93.5% and average f1 score of 93.94%.
3) Early Identification of Parkinson’s Disease from Hand-drawn Images using Histogram of Oriented Gradients and Machine Learning Techniques: Ferdib-Al-Islam and Laboni Akter Khulna University of Engineering & Technology did their technological research in the domain of detection of this disease using the HOG (Histogram of Oriented Gradients) approach for mining the features out from the spiral data and then applying various machine learning techniques like decision trees, KNN, regression for identifying the model. In their research, the model combination using KNN and gradient boosting approach resulted as pioneer with respect to the disease prediction with an accuracy of approximately 89.33% and 86.33% respectively.
4) Parkinson Disease Prediction Using Machine Learning Algorithm under the Emerging Trends in Expert Applications and Security Proceedings of ICETEAS 2018: Richa Mathur, Vibhakar Pathak and Devesh Bandil under the proceedings of ICETEAS 2018 proposed their work on the disease detection using the voice dataset from the UCI machine learning library and used the concepts of Big Data Analytics in solving out the problem by making use of the WEKA tool for converting the unstructured data in structured format for easy interpretation. In the experiment, obtained accuracies using KNN, Random Forest, AdaBoost.M1, Bagging, MLP, and DT algorithms are 90.76%, 89.23%, 88.20%, 89.23%, and 89.74%, respectively.
5) Parkinson’s Disease Diagnosis: Detecting the Effect of Attributes Selection and Discretization of Parkinson’s Disease Dataset on the Performance of Classifier Algorithms: Gamal Saad Mohamed conducted a research study that evaluated four distinct classifiers: Naive Bayes, SVM, MLP neural network, and decision tree (j48). These classifiers were employed to categorize the PD dataset, and their performance was assessed under different conditions, including the original PD dataset, the discretized PD dataset, and a specific set of attributes selected from the PD dataset. When applied individually to the unfiltered PD dataset, the results were as follows: Naïve Bayes Algorithm achieved an accuracy of 58.6%, SVM achieved 86% accuracy, MLP neural network reached an accuracy of 94.8%, and the decision tree (j48) exhibited an accuracy of 74%.

III. BRAIN STORMING AND INTEGRATION WITH MACHINE LEARNING

The process of brainstorming is a creative and open-ended ideation technique that has found application in various domains, from business innovation to problem-solving. In the context of brain disorder detection, brainstorming offers a fresh and innovative perspective. Here, we delve into different brainstorming methodologies and their potential towards the early detection of brain disorders (Parkinson’s disease):

A. Star-Bursting Brainstorming Session

Star-bursting is a brainstorming technique that focuses on asking questions rather than generating ideas. In a star-bursting session, participants ask questions about a particular topic or idea. These questions typically start with "who," "what," "when," "where," "why," and "how." The goal is to explore all aspects and facets of the topic thoroughly.

With respect to the above aspects of the model, a star-bursting brainstorming session was conducted as a preliminary approach to the problem and following ideations were generated:

1) *Who:* In the context of Parkinson's disease detection, the "who" component emphasises the need to identify the situation and people who are likely susceptible to the disease. This study would help in the easy setting up of target audience for implementation and testing operations of the model.

In an article on Parkinson’s disease and its causes, the American Parkinson Disease Association (APDA) mentions that although there are other things that put an individual at higher risk for developing Parkinson’s. The main risk factor is age, because Parkinson’s disease is most commonly found in adults over the age of 50. Men also have a higher risk of Parkinson’s disease than women.

2) *What:* The next important aspect of discussion was to know what could be the possible symptoms of the disease and its significance so that the best possible evaluation metric could be prepared.

Some of the common symptoms of the disease include shaking, tremors, rigidity, bradykinesia, cognitive changes and many more.

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3) *When:* The "when" aspect considers the optimal timing for screenings and the integration of innovative technologies in Parkinson's disease management. It addresses questions related to when individuals should commence regular screenings and when emerging technologies should be integrated into healthcare practices.

Our research will aim to detect the onset of disease at the earliest in order to ensure the best possible treatment.

4) *Where:* The "where" element explores the likeness of ideal locations of parts where the disease is afflicted in foundation stages. The knowledge of the mostly affected part would help in answering the previous question along with fulfilling our objective of "early detection."

The research studies present that non-motor symptoms are the easiest and earliest one that appear on an individual during the onset of the disease. Hence, our research will focus on taking the help of non-motor symptoms as the markers.

5) *Why:* The "why" component investigates the rationale behind the adoption of brainstorming techniques and their fusion with machine learning in Parkinson's disease detection. It highlights the significance of early detection in improving patient outcomes and streamlining healthcare systems.

As researchers continue to explore the synergy of brainstorming and machine learning, it becomes clear that this innovative model has the potential to redefine the boundaries of medical diagnostics in the context of Parkinson's disease. It bridges the gap between traditional and innovative diagnostic paradigms, offering a dynamic and collaborative path toward early detection, improved treatments, and better patient outcomes.

6) *How:* The "how" component emphasises the nature of approach to the problem and also sets the path for moving forward in developing the research model.

The discussion here proposed that a model for the detection of the disease is to be made such that it focuses on the non-motor symptoms, uses a non-invasive approach, cost efficient and promotes early detection.

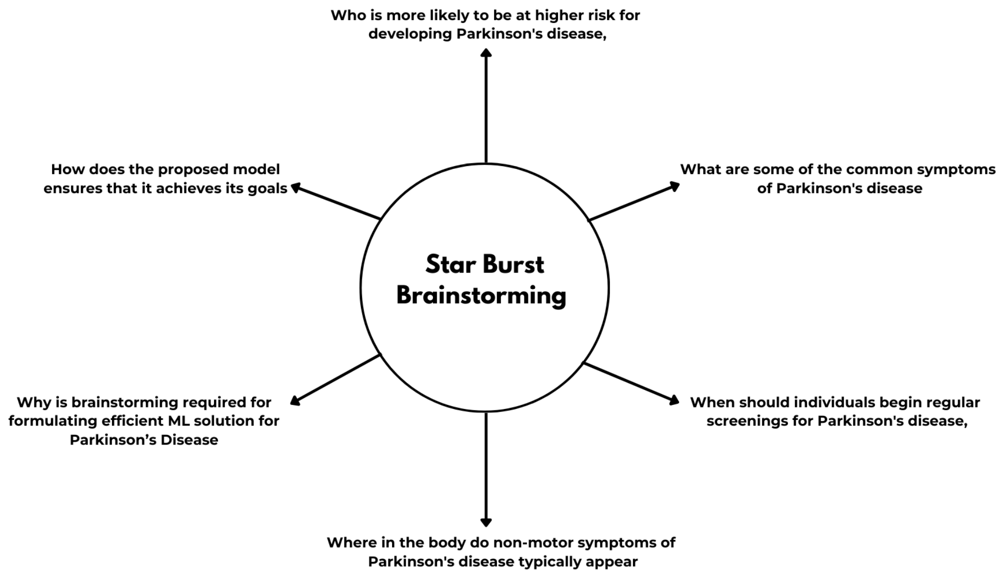

Fig 1. Star-Bursting brainstorming session.

B. *SWOT Analysis: Early Detection Methods for Parkinson's Disease*

The insights generated from the star-bursting session formed the foundation for a subsequent SWOT analysis of the proposed non-invasive model.

1) *Strengths (S):*

a) *Non-Invasive Techniques:* The use of non-invasive techniques, such as spiral imaging, represents a significant strength. It eliminates the need for invasive procedures, reducing patient discomfort and risks associated with invasive methods.

b) *Early Detection:* Non-invasive methods can potentially enable earlier detection of Parkinson's disease, leading to timely interventions and improved patient outcomes.

c) *Quantitative Data:* These techniques often provide quantitative data, allowing for precise and objective measurements, which is advantageous in diagnosis and monitoring.

2) *Weaknesses (W):*
a) *Sensitivity and Specificity:* Non-invasive techniques may have limitations in terms of sensitivity and specificity, leading to a risk of false positives and false negatives. Accuracy in early detection is critical.
b) *Data Analysis Complexity:* Processing and interpreting the data generated by non-invasive methods can be complex, requiring specialized software and trained professionals.
c) *Limited Diagnostic Information:* While non-invasive techniques can provide valuable information, they may not capture all relevant diagnostic markers, potentially missing subtle early-stage symptoms.

3) *Opportunities (O):*
a) *Advancements in Imaging Technology:* Rapid advancements in imaging technology offer opportunities to enhance the capabilities and accuracy of non-invasive methods for early detection.
b) *Integration with Machine Learning:* Integrating non-invasive techniques with machine learning algorithms can improve diagnostic accuracy by analyzing complex data patterns.
c) *Potential for Biomarker Discovery:* Non-invasive methods could lead to the discovery of novel biomarkers that improve early detection and provide valuable insights into the disease's progression.

4) *Threats (T):*
a) *Regulatory Hurdles:* Regulatory approvals and standardization of non-invasive methods can be time-consuming and pose challenges to their clinical integration.
b) *Data Privacy and Security:* As more patient data is generated through non-invasive methods, ensuring data privacy and security becomes crucial and may present threats if not properly managed.
c) *Patient Acceptance:* Non-invasive approaches must gain patient acceptance, as they may still be unfamiliar to some individuals. Public education and awareness campaigns are necessary.

In conclusion, non-invasive methods like spiral imaging offer significant strengths, including improved patient comfort and the potential for early detection. However, addressing weaknesses related to accuracy, technical challenges, and data analysis complexity is essential. Opportunities lie in technological advancements and the integration of machine learning, while potential threats include resource constraints and regulatory hurdles. Efforts to harness the strengths and opportunities while mitigating weaknesses and threats will be critical in advancing early detection methods for Parkinson's disease.

STRENGTHS	• Non-invasive techniques like spiral imaging reduce patient discomfort. • Early detection is enhanced with non-invasive methods. • These techniques provide precise quantitative data for diagnosis and monitoring.
WEAKNESSES	• Non-invasive methods can lead to false results in early detection. • Data analysis complexity often requires specialized software and expertise. • Non-invasive techniques may miss some early-stage symptoms.
OPPORTUNITIES	• Imaging tech advancements enhance non-invasive detection. • Machine learning boosts accuracy by analyzing data. • Non-invasive methods may discover new biomarkers for early detection and insights.
THREATS	• Regulatory hurdles delay clinical use. • Data privacy is crucial. • Patient acceptance needs awareness.

Fig 2. SWOT Analysis report.

C. Mind Map Development

Building upon the valuable insights gained from the SWOT analysis of our non-invasive approach to early Parkinson's disease detection, a final brainstorming session was conducted to develop a comprehensive mind map for the proposed model. This mind map serves as a visual representation of our approach, highlighting its key components and potential impact.

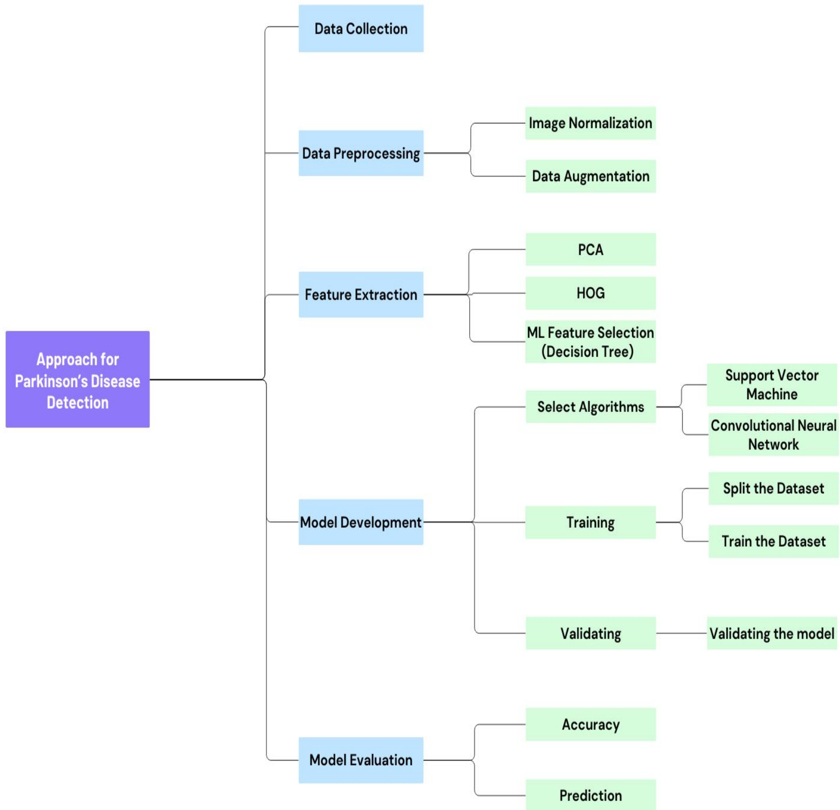

Fig 3. Sample Mind Map for the Methodology

IV. CONCLUSIONS

The integration of machine learning and brainstorming in our research has demonstrated the power of interdisciplinary collaboration. By combining the creativity and innovation of brainstorming with the analytical rigour of machine learning, we've made significant strides in the early detection of Parkinson's disease. This approach has the potential to revolutionize diagnostic methods and improve patient outcomes.

The iterative nature of this process allowed for the continual improvement of machine learning models and the exploration of non-traditional diagnostic markers. It showcased the importance of brainstorming sessions in guiding the direction of research and fostering creative problem-solving. Moreover, ethical considerations have been embedded in the research framework to ensure responsible and patient-centric practices.

In conclusion, our approach represents a promising path toward more accurate, accessible, and ethical early detection of Parkinson's disease. The integration of machine learning and brainstorming has opened new frontiers in the fight against this debilitating condition, offering hope for earlier interventions and improved quality of life for affected individuals. This research paves the way for future studies and the practical implementation of innovative diagnostic models.

V. ACKNOWLEDGMENT

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