ENHANCING THE EFFICIENCY OF DIAGNOSING AND MANAGING MENTAL DISORDERS USING MACHINE LEARNING

24-25J-322

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EARLY DETECTION OF PARKINSON'S: HARNESSING MACHINE LEARNING FOR PREDICTIVE RISK MODELING

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Project Proposal Report

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I. Declaration of the Candidate & Supervisor

I declare that this is my own work, and that this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma at any other university or Institute of higher learning, and that it does not contain any material previously published or written by another person, except where acknowledgement is made the text.

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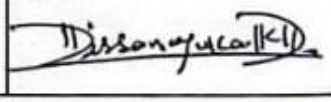
The supervisor/s should certify the proposal report with the following declaration.

The above candidate is carrying out research for the Undergraduate Dissertation under my supervision.

Name of the Supervisor	Signature	Date
Ms. Wishalya Tissera		22/08/2024
Dr. Kapila Dissanayake. (Co-supervisor)		22/08/2024.

II. Abstract

Parkinson's Disease (PD) is a chronic neurodegenerative illness with motor and non-motor manifestations that produces considerable distress to the afflicted individuals. PD is a progressive disease thus early staging is important even though it may not halt the progression, but it prepares the patient for management. This research will use elevated machine learning algorithms to create a model that can predict early stages of PD affected individuals. The model is going to be fine-tuned on a diverse dataset which contains physiological and behavioral data such as voice samples, handwriting samples or gait samples. To support the model and improve the efficiency and reliability of the early PD diagnosis, the authors have implemented biomarkers, which include tremor intensity, handwriting, and speech alteration. The inclusion of such parameters in the form of clinical measurements, lifestyle factors and patient's medical history makes the model even more robust. Moreover, the outcomes of this research will be the creation of the informational user-friendly web-app application for HC cost-net & a mobile-app application for patients. These tools shall help in constant follow-up, hence early detection and management and therefore the patient's condition will improve. The presented approach is useful in identifying the condition on time and has the added advantage of not overloading health care structures by encouraging extended physician encounters. Finally, this research subserves the development of predictive healthcare established in this paper through applying machine learning to one of the major difficulties of neurodegenerative disease management.

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V. List of Abbreviations

PD	Parkinson's Disease
ML	Machine Learning
SVM	Support Vector Machine
CNN	Convolutional Neural Network
RF	Random Forests

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1. Introduction

1.1. Background & Literature survey

Background Study

Parkinson is a chronic movement disorder that affects a person's movement, muscle control and coordination through the worsening of the dopa-mine manufacturing cells in the brain known as substantia nigra. In this sense, patients with PD present with variable motor and non-motor symptoms such as tremors, bradykinesia, rigidity, postural instability and various, cognitive and psychopathological changes. The exact cause of PD is still elusive though research shows that it is a disorder that results from genetic and environmental factors. To this day, it is still not known exactly what causes this disease, but some factors may have been identified and these are, Age, family history and chemicals in the environment.

It is important to diagnose PD at an early stage because the treatment outcome is usually effective in retarding the severity of the illness to enhance the well-being of the patients. However, the initial manifestations of PD are also equivocal and very similar to symptoms of other diseases and disorders belonging to the group of movement disorders. In the past, the mainstay of diagnosis has been based on clinical assessments carried out by neurologists comprising of patient history and a neurological assessment. However, this approach is unspecific and, depending on the severity of the symptoms and when motor symptoms are not apparent, diagnosis might be delayed.

Over the years, there has therefore been a rising trend in the use of machine learning (ML) to assist in the identification of PD at an early stage. An ML system can handle large datasets and flag changes, trends and correlations which might not be easily noticeable to entities in the environment. It would be easier to make this change with hard data to back up the argument and this means that this data driven approach has the potential of bringing about change in diagnosis of PD especially in the preclinical or early stage. The inclusion of the use of ML in diagnostic tools could also help lessen the load of healthcare systems through early detection that could put a faster and more precise diagnosis into action.

Physiological and behavioral signs that may be early signs of PD are changes in speech, writing, and walking. For instance, hypophonia, and dysarthria whereby the volume of the subpharyngeal voice diminishes and difficulty in producing well-articulated speech respectively are early signs of PD that can be identified by voice analysis. In the same way, micrographic and change in the way persons write spirals or waves have been noticed to be characteristic of early PD. Another clinical sign that

shows evidence of motor dysfunction Ing is gait because it is a study of how a subject walks. Thus, utilizing these characteristics, first indications of PD could be detected with a high level of accuracy by training ML models for early diagnosis and treatment.

Literature survey

Consideration of early detection of Parkinson's Disease using machine learning has been popular in recent years. There have been numerous papers which have investigated a variety of approaches and datasets for constructing analytical models for near-term forecasting and each of these is useful for deciding whether this field is suitable for application of ML.

Among a few initial works about using ML for PD screening, that of Little et al. (2007) is noteworthy, which aimed at screening PD in its early stages using voice samples. Using pitch, jitter and shimmer descriptors, the researchers used Support Vector Machine classifier to classify between healthy people and those with PD. This study showed the possibility of speaking voice becoming a non-ear, an effective and inexpensive method for PD identification.

Another major work was from Peker et al. (2015) who proposed a composite of well differentiated features such as voice, handwriting, and gait analysis for better identification of PD. The approach they employed to do data dimensionality reduction was through feature selection techniques to improve the model's performance. Acknowledging that one can have multiple manifestations of PD symptoms in their study was beneficial due to the application of various methodological tools, which showed that the combination of different types of data is essential to describe the richness of symptoms' expressiveness.

Sakar et al. (2019) continued from the previous study by applying deep learning methodology to explore spiral drawings of patients with PD. Here, the authors obtained high accuracy in the distinction between healthy persons and the ones with PD through training a Convolutional Neural Network (CNN) on these images. The study pointed out that the application of deep learning methods can be useful in handling difficult and large volume data like images which are today, common in PD research.

Besides these works, there are many reviews and meta-analyzes that analyze the efficacy of ML in the diagnosis of PD in general. For instance, Esmaeili et al (2021) conducted a review of different classification algorithms which include; Support Vector Machine-SVM, Random Forest- RF, and Neural Networks for the early screening of PD. Understanding the limitations and advantages of each of the approaches was also discussed; particular, substantial emphasis was made on the rationale for employing large-scale data sets and rigorous validation methods in building trustworthy models for wider applicability.

Despite the encouraging findings that have been realized by these studies, there are some limitations that present themselves as follows. One of these problems is determination of the appropriate datasets, an issue attributed by the variability of the datasets in the model. Moreover, most of the research work conducted to date has involved only one modality or another, for instance, voice or writing, which might possibly restrict the model's capacity to generalize the broad range of PD symptoms. A push for multiple data modalities, that is, using data from multiple sources to achieve higher accuracy.

Moreover, the problem of interpreting the trained ML models is one of the significant challenges, especially in health care where the rationale for entering prognosis must be comprehensible. Nevertheless, black-box models including but not limited to deep neural networks are potent but usually do not possess the required interpretability for clinical purposes. Consequently, the study of building 'explainable' models or the means of transforming 'black box' models into more understandable ones is a continuous process, and common tools that can be used include feature importance ranking and visualizations.

In conclusion, the studies on the use of machine learning for early PD detection are numerous and the literature is growing day by day. Open problems include data variation, cross-modality learning and generating models with good interpretability. Considering these challenges will be more important as more of the ML-based tools are to be implemented in the context of the clinic where they can offer a lot of support especially in early diagnosis and staging of Parkinson's Disease.

1.2. Research Gap

The early diagnosis of Parkinson's Disease (PD) using robust machine learning (ML) techniques has been achieved in the recent past. Nevertheless, the research still has significant deficits that must be addressed, even though the advancements in this line of study are quite promising. This paper has discussed various research gaps associated with the existing literature and outlined below as a way of showing the areas that the proposed research would seek to fill the gaps as follows:

Research	Research [1]	Research [2]	Research [3]	Proposed Solution
Combining voice analysis with emotional insights for precise early detection	✓	✗	✗	✓
Handwriting Images for PD Detection	✗	✓	✗	✓
Multimodal approaches to identify Parkinson's disease	✗	✗	✓	✓
Real-Time Application and Integration	✗	✗	✓	✓

Figure 1 - Research Gap Table

There is, nonetheless, one intriguing omission: voice analysis combined with emotion-detection for accurate, timely identification of PD. Although there is a body of work including Research [1] that aimed at investigating the possibility of diagnosing PD using only voice data, there is a lack of understanding of how to improve models using the data containing emotional information. Using this method in combination with changes in the voice, it is possible to have additional important markers associated with the early emotional changes related to PD. But as pointed out by Research [2] and Research [3], there is a strong missing link between this multiple focus approach. This gap is important because, at times, it can be hard to detect emotional dysregulation and when it is detected, it is likely to appear alongside motor symptoms which make it possible to increase the chances of getting high accuracy when using voice-based ML models.

One of the domains where prior literature is rather scarce is the use of handwriting images for PD's identification. Research [2] has focused on this area wherein through computer analysis of writings for features like kind of strokes and pression, the first signs of PD are detected. Nevertheless, this approach is not followed by everyone and, as has been illustrated in Research [1] and Research [3], this useful diagnostic tool is often ignored. Analysis of handwriting samples of patients with PD has been found to be quite helpful to identify the extent of motor deterioration. The lack of consistency in using this approach for the analysis of handwriting to enhance the great mystery of the predictive solutions that are on offer is quite apparent. To this end the proposed research aims at filling this research gap through the standardization of handwriting image biomarkers together with other biomarkers.

The largest limitation to evidence in the literature, nonetheless, is the fact that there are relatively few studies that use a multimodal approach to diagnose Parkinson's disease. Incorporation of information from more than one modality, for instance voice, handwriting and gait analysis, is likely to be a more accurate diagnosis than using a single modality. Still, as seen in Research [1], Research [2], and Research [3], most of today's investigations are based on single-modal datasets. This segmentation approach hampers the solidity of the techniques of prediction of PD since it does not take into consideration the complexity of the PD. The following study plan has been designed with the purpose of filling in the gap and building a robust multimodal ML model that integrates various physiological and behavioral features so that early PD diagnosis becomes more accurate.

Last but not the least; a rather critical shortfall in the existing research is the integration of real time application and data processing with these predictive models. To the authors' knowledge, no prior studies adequately capture the process by which these findings were implemented in practice, especially regarding how to create diagnostic tools that can be used in real time by clinicians in their daily practice. Thus, the proposed research aims to leave no gap in the knowledge of CVD risks for chronic high-risk patients, as it is going to present a model for decision-making not only as a written text but as an operational Web/Mobile application that will be easy to use. It

will also allow for real-time data analysis and decision-making for clinicians and patients for early diagnosis and further follow-up of the disease.

In view of this, there is promising work that has been done in the early detection of PD using machine learning techniques, but the following areas still present major research challenges. They are as follows; the incorporation of affective insight into the voice signal processing, the normalization of graphical handwriting images, the employment of MDA approach, and finally the creation of time-sensitive, clinically feasible tools. The lack of knowledge of these gaps is critical to the development of the field and the early diagnosis of Parkinson's disease and its management.

1.3. Research Problem

Early detection of Parkinson's disease is one of the most active areas of research in the field of neurodegenerative disorders. Since the symptoms of the disease are very subtle and progressive in their onset, despite improvements made in diagnostic technologies, delays in diagnosis can still be common, impeding the impact of subsequent interventions. In this paper, the authors attempt to answer some of the critical questions underlying the development of a robust machine-learning predictive model for the identification of people at risk of developing early-stage Parkinson's.

First, it shall try to uncover how machine learning algorithms can use optimum potential for identifying early-stage Parkinson's disease from physiological and behavioral data. Current methods of diagnosis are primarily based on clinical observation and patient reports, which might be present only at a very advanced stage of the disease. In this regard, the present research will employ ML algorithms to investigate complex data sets—such as voice recordings, handwriting samples, and gait patterns—for very small changes that may indicate a presymptomatic onset of PD. The second focus of the study is in identifying the most prominent features that are helpful in the development of Parkinson's disease and in learning how to effectively use them in a predictive model. The characteristics of early PD include tremor intensity, irregularities in handwriting, and speech changes, but the challenge is quantifying and weighting these features within an ML model for optimal predictive accuracy. The second part of this research will be focused on feature selection and engineering techniques so that this model, other than gaining high accuracy in identifying PD, will also provide insight into the features turning out to be most predictive of the disease.

A third critical aspect of the research problem is assessing how multi-source data integration—voice recordings, handwriting samples, and gait patterns—are going to improve the accuracy and reliability of the models used in predicting Parkinson's disease. The hypothesis is that while individual features give some predictive power, a multimodal approach will give a more comprehensive and accurate prediction model. This will include the evaluation of synergies between different data types, whose

integration is proposed to be able to overcome the limitations of single-modality analysis.

Another question this research work will answer is whether a predictive model built for the early detection of Parkinson's disease can be generalized across different populations. Generalizability of the predictive model is very important if it is to be applied in many different demographic groups because the presentation of the disease varies in different groups. The challenges that are related to model generalization will all be addressed, including variability in the presentation of symptoms, and another that requires a great deal of diversity in the training datasets, including persons with unique characteristics.

Finally, the advantages and limitations that can be expected if a machine learning-based early detection system for Parkinson's disease is clinically implemented. On the other hand, besides developing an accurate predictive model from the data at hand, its practical implementation in a real clinical setting is equally important. That includes evaluation of user experience by doctors and patients, understanding how the system integrates into current clinical workflows, and evaluating what kinds of ethical and logistical challenges might appear with its adoption. The research will provide insights into how such a system can be designed to maximize usability and effectiveness while minimizing potential drawbacks.

This study is thus effectively driven by a multidimensional question that not only relates to the construction of an early predictive model for Parkinson's disease but also to the very application itself. By answering these critical questions, the research thus holds the promise to deliver considerably to timely diagnosis with accuracy in Parkinson's and, consequently, contribute greatly toward better patient outcomes and the advancement of the management of neurodegenerative diseases.

2. Objectives

2.1. Main Objectives

The overall objective of the research is to develop a strong, accurate machine learning-based predictive model for the purpose of early detection of Parkinson's disease. Such a model will be designed to analyze physiological and behavioral data, containing voice recordings, handwriting samples, and gait patterns, for identifying those at risk of Parkinson's at its earliest stages. This research is therefore such that an early identification of Parkinson's disease could aid in timely intervention and management, improving outcomes in these patients and probably slowing down its advancement.

2.2. Specific Objectives

To detect and extract the most salient features for prediction in early onset Parkinson's disease, it includes features that are acquired to detect salient physiological and behavioral markers like the intensity of tremor, irregularities in handwriting, or changes in speech. Generally, this type of research intends to be concentrated in the

optimization of techniques for the selection of features to increase predictability along with the machine-learning model.

The fusion of various data sources to improve prediction: This goal is set to encompass the interaction of different types of data, such as voice recordings, handwriting samples, and walking stride. An attempt is being made in this work to develop a multimodal approach that may result in a broad and reliable model for the early detection of Parkinson's disease.

To evaluate the generalizability of the model prediction across diverse populations: this is an objective that will investigate performance of the developed model among different demographic groups to be able to set applicability in the varied clinical settings. Specifically, the research will scrutinize the difficulties of a model in generalization, considering the inclusion of diverse training datasets and characteristics of the population to which the model adapts.

To develop a user-friendly computer application for real-time clinical use: This is the sub-objective related to the implementation of the predictive model for use in the clinical workflow within a workable system. The research is focused on developing a web and mobile application tool that can provide both trained healthcare personnel and patients with real-time analysis and decision support. Easily accessible and efficient in clinical surroundings.

To enable an adequate assessment of potential gains and risks for the introduction of a machine learning-based system in the clinical practice: this will have to encompass a full-fledged assessment of the usability, efficacy, and ethical issues around using the system. The study will concentrate on how a predictive model could help enhance early diagnosis and patient management, while pinpointing possible challenges or drawbacks in clinical application.

3. Methodology

3.1. Component Diagram

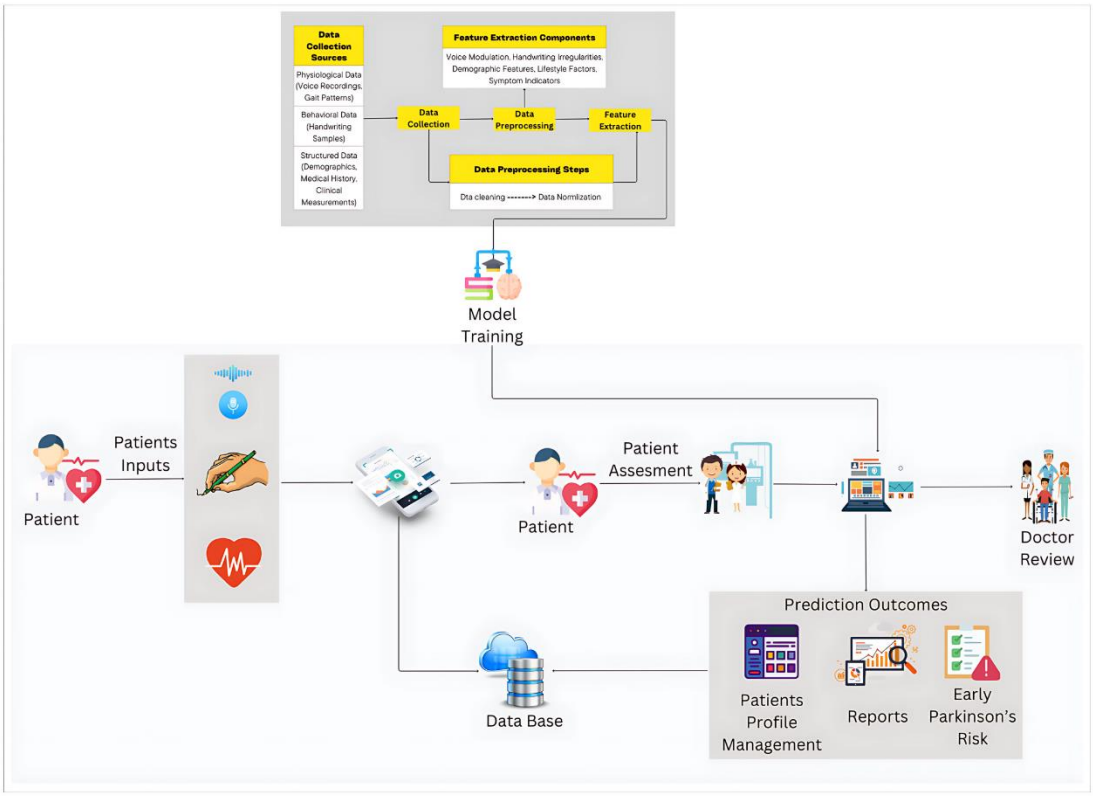

Figure 2 - Component Diagram

3.2. Requirement Analysis

1.Personal

The success of the research project will have to be based on the guidance and advice of a professional experienced in neurodegenerative diseases. In that sense, the team will be guided under the mentorship and supervision of Dr. Anuradha Baminiwatta, a reputed neurologist attached to the Ragama Hospital. Dr. Baminiwatta brings years of clinical experience in the diagnosis and management of Parkinson's disease, which will be of prime importance in shaping the objectives of this research, refining the predictive model, and ensuring that the findings remain clinically relevant. He will also be critical during the phase of data interpretation, more so on the validation of the accuracy and practicality of the machine learning model in a real clinical setting. Regular consultations with Dr. Baminiwatta would help to bridge this break between the theoretical aspect of the project and its practical application to patient care.

2.Functional

The functional requirements describe the minimum functionality that the proposed system shall achieve to meet the objectives of the research study effectively. These include:

Data Collection and Integration: The system shall be capable of capturing, processing, and integrating different data sources, including voice recordings, writing samples, and gait patterns. It shall support smooth input and preprocessing of these sources of data in a uniform and accurate manner for analysis.

In this regard, it must have powerful algorithms concerning feature extraction and selection to identify the most appropriate markers for early-stage Parkinson's disease from physiological and behavioral parameters. This is central to the development of a very accurate predictive model.

Designing a Machine Learning Model: The system is supposed to offer support for the development process, training, and validation of machine learning models. This should include tools for experimenting with different algorithms like support vector machines, random forests, and deep learning models to predict performance optimization.

Prediction and Diagnosis Interface: This should be based on a user-friendly interface for healthcare professionals to input data to receive predictions of the risk of Parkinson's disease for a patient. Such an interface needs to be designed to facilitate real-time analysis and result in clear, actionable insight.

Real-Time Data Processing: The system shall process data in real-time to provide immediate feedback to the clinicians and patients. This functionality is of utmost importance in terms of being able to integrate the predictive model into clinical workflows, guaranteeing practical utility.

Security and Confidentiality: The system shall be designed to ensure that all information about the patients is safe and confidential according to norms of concerned data protection. This shall further encompass characteristics such as encryption, access control, and data anonymization for protecting sensitive information.

3.Non – Functional

The non-functional requirements define the overarching qualities that the system must exhibit to ensure its effectiveness, usability, and sustainability. These include:

Scalability: The system must be designed to scale efficiently, accommodating an increasing volume of patient data and the potential expansion of functionality over time. This scalability is crucial as the system may need to be deployed across different healthcare settings or integrated with other medical systems.

Performance: The system must deliver high performance, particularly in terms of processing speed and response time. This is vital to ensure that clinicians receive timely and accurate predictions, which is essential in a clinical environment where quick decision-making can significantly impact patient outcomes.

Usability: The system must be intuitive and easy to use for both clinicians and patients. The user interface should be designed with simplicity and clarity in mind, ensuring that users can efficiently navigate the system and interpret its outputs without extensive training.

Reliability: The system must be highly reliable, minimizing downtime and ensuring consistent availability. Reliability is critical in clinical settings where the system's failure could delay diagnosis and treatment, potentially affecting patient health.

Maintainability: The system must be maintainable, allowing for easy updates and modifications as new research findings emerge or as technology evolves. This maintainability will ensure the system remains relevant and effective over the long term.

Compliance: The system must comply with all relevant healthcare regulations and standards, including those related to data privacy, patient safety, and software development. Ensuring compliance will be necessary for the system's deployment in clinical settings and for gaining the trust of healthcare professionals.

By addressing these personal, functional, and non-functional requirements, the research project will be well-positioned to develop a system that meets the needs of both clinicians and patients, ultimately contributing to the early detection and management of Parkinson's disease.

3.3. Tools & Technologies

1.Technologies

Flutter: Flutter will be utilized for developing the cross-platform mobile application that patients will use to input their data and receive predictions regarding their risk of Parkinson's disease.

Python: Python will serve as the primary programming language for implementing machine learning algorithms, data processing, and analysis tasks within the project.

ReactJS: ReactJS will be employed to develop the web-based interface for healthcare professionals, allowing them to access the predictive model and patient data seamlessly.

Firebase: Firebase will be used for real-time database management, authentication, and hosting, enabling secure and efficient storage and retrieval of patient data across platforms.

Docker: Docker will be employed for containerizing the application, ensuring consistent environments across development, testing, and deployment, thereby facilitating smoother integration and scalability.

Google Colab: Google Colab will be used as an interactive environment for developing and testing machine learning models, offering powerful computational resources and easy collaboration.

ChartJS: ChartJS will be utilized for visualizing data within the web and mobile applications, allowing both patients and clinicians to interact with the data through dynamic charts and graphs.

2.Algorithms

Support Vector Machines (SVM): SVM will be employed for classifying patient data into those at risk of Parkinson's disease and those who are not, based on selected features from voice recordings, handwriting, and gait patterns.

Random Forest: Random Forest will be utilized for its ability to handle large datasets and for providing robust predictions by combining multiple decision trees, thereby enhancing the accuracy of the predictive model.

Convolutional Neural Networks (CNN): CNN will be used primarily for image classification tasks, particularly for analyzing handwriting images and gait patterns to identify features indicative of Parkinson's disease.

Recurrent Neural Networks (RNN) / Long Short-Term Memory (LSTM): RNNs and LSTMs will be applied to sequential data, such as voice recordings, to capture temporal dependencies and improve the model’s ability to detect early signs of Parkinson's disease.

3.Techniques

Voice Classification: Voice classification techniques will be employed to analyze and categorize voice recordings, detecting subtle changes in speech patterns that are indicative of early-stage Parkinson's disease.

Voice Activity Detection (VAD): VAD will be used to identify and segment relevant parts of voice recordings, ensuring that only the most pertinent data is analyzed for early detection of Parkinson's disease.

Image Classification: Image classification techniques will be applied to handwriting and gait pattern images, extracting key features that can be used to predict the likelihood of Parkinson's disease.

Multimodal Fusion: Multimodal fusion techniques will be utilized to integrate data from various sources—such as voice recordings, handwriting images, and gait patterns—into a single, cohesive model, thereby improving the overall predictive accuracy and reliability.

4. Description of Personal and Facilities

Personal

Primary Researcher (Me):

The primary researcher is responsible for developing the predictive model aimed at identifying early signs of Parkinson's disease. This role involves tasks such as data collection and processing, feature selection, and the application of machine learning techniques. Additionally, the researcher will integrate the model into both web and mobile applications, ensuring they are practical and effective for healthcare professionals and patients alike.

Main Supervisor (Ms. Wishalya Tissera):

The main supervisor, a faculty expert in data science and machine learning, provides essential guidance throughout the research process. This role includes ensuring that the research is conducted with academic rigor and that the model developed is accurate and adheres to the highest standards. Regular progress reviews and feedback are part of the supervision process, helping to maintain the project's quality.

Co-Supervisor (Dr. Kapila):

The co-supervisor supports the project by offering general advice, assistance with research design, and feedback on the overall progress. Their role is to provide additional perspectives and ensure that the project stays on track, contributing to the successful completion of the research.

External Advisor (Dr. Anuradha Baminiwatta):

An external advisor, a doctor specializing in psychology, provides valuable input on the psychological and behavioral aspects of Parkinson's disease, which are crucial for early detection. This guidance ensures that the developed model is not only technically sound but also practical and relevant for use in clinical settings. The advisor's expertise helps to align the research with the needs of healthcare professionals working in the field.

Facilities

The research will be conducted using a range of appropriate computational resources and tools necessary for the project. High-performance computing systems will be utilized to run machine learning algorithms and process the data required for developing the predictive model. The software tools essential for data analysis and model development, including Python and R, will be employed throughout the research process.

Data storage and processing will be managed using cloud services, ensuring secure and scalable handling of large datasets. These platforms provide the flexibility needed to efficiently manage and analyze data, facilitating the development and testing of the predictive model.

Access to relevant datasets and online resources will support the research, allowing for thorough literature reviews, data acquisition, and model validation. The technical setup includes reliable internet connectivity and other necessary resources to maintain continuous progress and collaboration among the research team.

The facilities available for this project are well-suited to support the research objectives, enabling the successful development of an effective predictive model for the early detection of Parkinson's disease.

5. Budget and Budget Justification

Component	Description	Estimated Amount in USD	Estimated Amount in LKR
Data Collection	Cost of acquiring and preprocessing datasets from open sources	8.00	2400
Cloud Platforms	Cloud services for model training, storage and deployment (AWS, GCP)	40.00	13000

Table 1 - Budget & Budget Justification

6. Commercialization of the product

Mental health disorders affect a significant portion of the global population, making this a large and critical market to address. Traditional methods of diagnosing and managing mental disorders involve in-person consultations, which can be time-consuming and costly for patients. Our solution aims to bridge this gap by providing a convenient and cost-effective tool for diagnosing and managing mental disorders through a mobile application and web application. This approach not only reduces the challenges associated with traditional healthcare methods but also offers continuous monitoring and personalized insights.

We plan to introduce multiple subscription plans for different user segments:

- Monthly Subscription: Rs. 500
- Annual Subscription: Rs. 4,500

Our Target Market is General Practitioners of the MOH centers, Institutes who learn about mental disorders, General population who wish to take self-mental care. We will offer the initial mental disorders diagnosis feature free of charge, allowing users to assess their mental health at no cost. However, to access more detailed reports, continuous monitoring, and personalized treatment plans, users will need to subscribe to one of the available plans. This model ensures accessibility while also generating revenue to sustain and enhance the platform. By offering flexible pricing and targeting a wide range of users, including partnerships with community clinics, we aim to create a scalable and impactful solution in the mental health space, addressing a critical global need.

7. Appendices

Figure 3 - System Logo

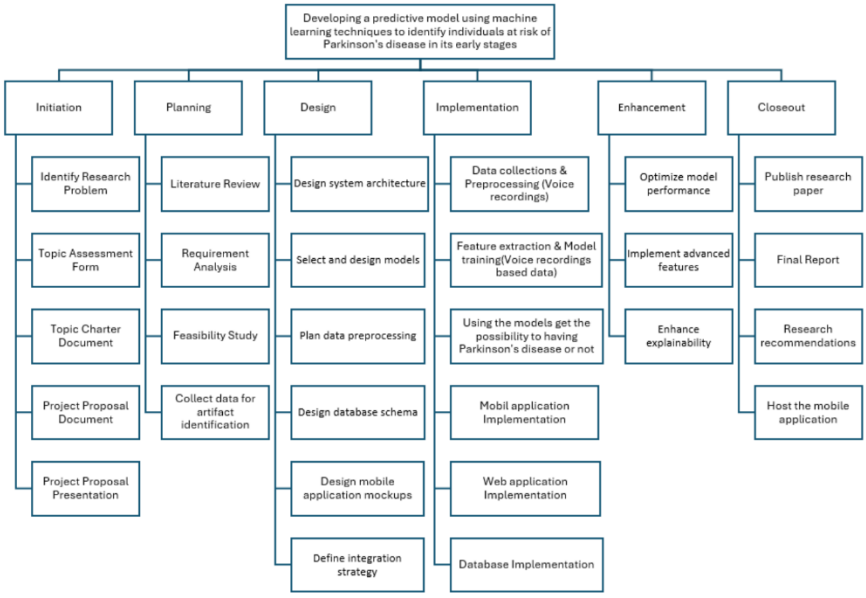

Figure 4 - Work Breakdown Structure

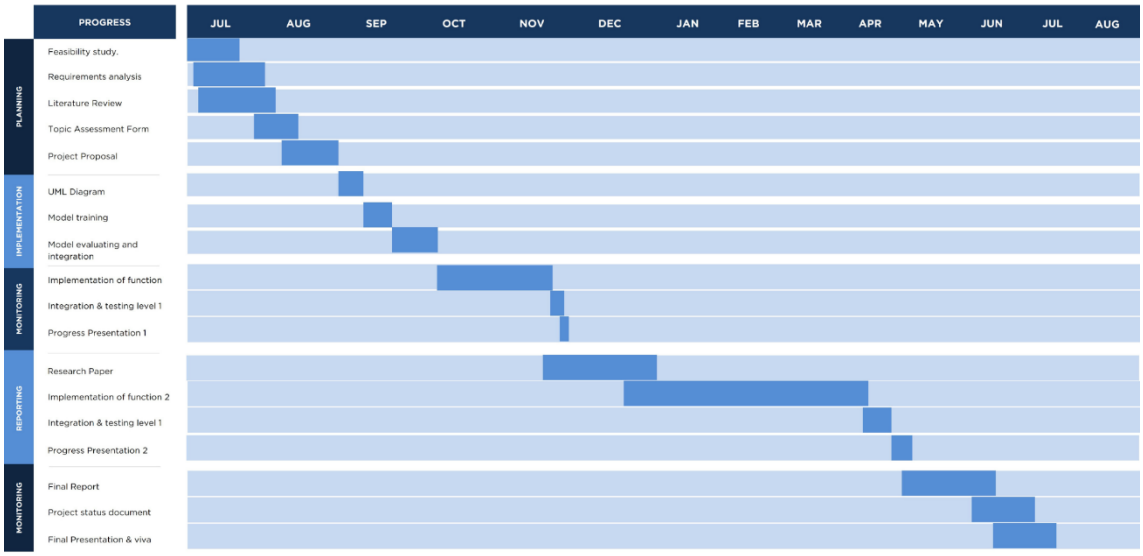

Figure 5 - Grantt Chart

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