**Machine Learning Model for the Detection and Prediction of Parkinson’s Disease based on Audio Signals**

**SYNOPSIS**

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**By**

**Kartikey Raghuvanshi [00718002020]**

**Saakshi Srivastava [01518002020]**

**Shubham Tiwari [02118002020]**

**Sanand Mishra [01718002020]**

**Under the supervision of**

**Ms. Ayasha Malik**

**Assistant Professor**

Delhi Technical Campus
GREATER NOIDA
(Affiliated by Guru Gobind Singh Indraprastha University)


**Delhi Technical Campus**

**GREATER NOIDA**

**(Affiliated by Guru Gobind Singh Indraprastha University)**

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1. **Problem statement**

The main aim is to predict the prediction efficiency that would be beneficial for the patients who are suffering from Parkinson and the percentage of the disease will be reduced. Generally, in the first stage, Parkinson's can be cured by the proper treatment. So, it’s important to identify the Parkinson’s Disease at the early stage for the betterment of the patients.

* 1. **Resting tremors:** As most motor symptoms of Parkinson’s Disease, rest tremor is often more pronounced unilaterally, and the upper limbs are usually more affected than the legs. Besides extremities, rest tremor also occurs in the tongue, lip or chin, but rarely involves the head. Other types like postural and kinetic tremor may also occur in Parkinson’s Disease.
  2. **Rigidity (Stiffness):** Stiffness and rigidity are common in Parkinson’s disease. Rigidity is when your muscles feel tense and tighten up without you wanting them to. Muscle rigidity can happen in different parts of your body, including your arms, legs, neck, back, and even smaller facial muscles. Stiffness can occur on one or both sides of your body. When your muscles and joints are stiff, it can lead to pain and discomfort.
  3. **Bradykinesia (Slowness of movement):** Bradykinesia means slowness of movement and speed (or progressive hesitations/halts) as movements are continued. It is one of the cardinal symptoms of Parkinson's disease. You must have bradykinesia plus at least either tremor or rigidity for a Parkinson's diagnosis to be considered.
  4. **Gait and balance problem:**  People with Parkinsonian gait usually take small, shuffling steps. They might have difficulty picking up their feet. Parkinsonian gait changes can be episodic or continuous. Episodic changes, such as freezing of gait, can come on suddenly and randomly.



**Figure 1: causes of road accidents**

1. **Objective**

The objective of this Machine Learning project is to build the detection of the disease by using the voice analysis of the people affected with Parkinson's disease. It is to recognize what is Parkinson’s sickness and to discover the early onset of the disorder.

1. **Introduction**

Parkinson’s Disease creates neural system disorder for various people. The disease affects the people at different age groups around the world. Medical research works collaborate with computational intelligence techniques for predicting Parkinson symptoms. Parkinson’s Disease has numerous types based on the human abnormalities.

Mostly it disturbs the nature of neural activities and the body movements. Researches evolved in recent years use Machine Learning and Deep Learning approaches for finding early stages of Parkinson’s Disease. The research works used different types of medical observations such as voice levels, handwriting variations, body movements, brain signal variations and protein aggregations. These kinds of observations are measured using various medical apparatuses.

Due to the fact that Parkinson’s Disease symptoms increase as the disease advances, more sensitive diagnostic techniques are needed for Parkinson’s Disease diagnosis. For example, a person with Parkinson's disease has a lack of intensity and monotony in pitch and loudness as well as a lowered level of stress (dysphonia). Because capturing speech data is non-invasive and easy to accomplish with mobile devices, the spectrum of voice-related symptoms appears promise as a possible screening technique. Early signs of Parkinson's disease are mild, making it difficult to identify.

Parkinson’s can have both motor and non-motor symptoms. The motor symptoms include slowness of movement, rigidity, balance problems, and tremors. If this disease continues, the patients may have difficulty walking and talking. The non-motor symptoms include anxiety, breathing problems, depression, loss of smell, and change in speech. If the above-mentioned symptoms are present in the person, then the details are stored in the records. It considers the speech features of the patient, and this data is used for predicting whether the patient has Parkinson’s disease or not.

Neurodegenerative disorders are the results of progressive tearing and neuron loss in different areas of the nervous system. Neurons are functional units of the brain. They are contiguous rather than continuous. A good healthy-looking neuron as shown in fig 1 has extensions called dendrites or axons, a cell body, and a nucleus that contains our DNA. DNA is our genome and a hundred billion neurons contain our entire genome which is packaged into it. When a neuron gets sick, it loses its extension and hence its ability to communicate which is not good for it and its metabolism becomes low so it starts to accumulate junk and it tries to contain the junk in the little packages in little pockets. When things become worse and if the neuron is a cell culture it completely loses its extension, becomes round and full of vacuoles.



**Fig-1.1 Structure of Neuron**

1. **Requirements**

This guide outlines the minimum software and hardware requirements for deploying our project. Requirements may vary based on utilization and observing the performance of pilot projects is recommended before scaling out.

* 1. **Software Requirements**

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* **HTML**

HTML stands for Hypertext Markup Language.HTML is used to create web pages and web applications.HTML is a widely used language on the web. We can create a static website by HTML only. Technically, HTML is a Markup language rather than a programming language.

* **CSS**

Cascading Style Sheets is a style sheet language used for describing the presentation of a document written in a markup language such as HTML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript.



* **Bootstrap**

Bootstrap is a free, open-source front-end development framework for the creation of websites and web apps. Designed to enable responsive development of mobile-first websites, Bootstrap provides a collection of syntax for template designs.

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* **JS**

JavaScript, often abbreviated JS, is a programming language that is one of the core technologies of the World Wide Web, alongside HTML and CSS. Over 97% of websites use JavaScript on the client side for web page behaviour, often incorporating third-party libraries.

* **PYTHON**

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together.

* + **PIP-** PIPis the package management system used to install and manage software packages returned in Python.
  + **Numpy-** Numpy is the general-purpose array processing package. It provides a high-performance multidimensional array object and tool for working with these arrays. It is a fundamental package for scientific computing with Python. It contains various features including these important ones:
  + A powerful n-dimensional array object
  + Sophisticated functions
  + Tools for integrating C/C++ and Fortran code
  + Useful liner algebra Fourier transform and random number capabilities
  + **Matplotlib –** For Creating creative interactive visuals, a Matplotlib named Python Library is used. Matplotlib makes simple things easy and hard things possible. Produce publication-quality plots. Create interactive characters that can zoom, pan, and update.
  + **Jupyter Notebook-** Anaconda distribution come with 1500 packages selected from PYPI as well as the condom package with virtual environment manager. Hit also include a GUI, Anaconda navigator, as a graphical alternative to the command line interface (CLI). A Jupiter notebook document is a GSON document, following a versioned schema, end containing an ordered list of input output cells which can contain code, text mathematics, plots and rich media, usually ending with the “.ipynb” extension.
  + **Seaborn-** Seaborn is a Python data visualization library based on matplotlib. It provides a high-level interface for drawing attractive and informative statistical graphics. For a brief introduction to the ideas behind the library, you can read the introductory notes or the paper.
  + **Pandas-** Pandas is a Python library used for working with data sets. It has functions for analyzing, cleaning, exploring, and manipulating data. The name "Pandas" has a reference to both "Panel Data", and "Python Data Analysis" and was created by Wes McKinney in 2008.
  + **Sklearn-** Scikit-learn is an open source data analysis library, and the gold standard for Machine Learning (ML) in the Python ecosystem. Key concepts and features include: Algorithmic decision-making methods, including: Classification: identifying and categorizing data based on patterns.
  + **FLASK**

Flask is a lightweight Python web framework that provides useful tools and features for creating web applications in the Python Language. It gives developers flexibility and is an accessible framework for new developers because you can build a web application quickly using only a single Python file. Flask is also extensible and doesn’t force a particular directory structure or require complicated boilerplate code before getting started.

**4.2 Hardware Requirements**

* OS: Window7
* Installed RAM: 4 GB
* Processor: Intel i3 or above
* System type: 64-bit operating system

1. **Literature review**

Technology has made a considerable impact on the way of living in recent years and will continue to do so with the increasing use of computers, controlled equipment, and the growth of information technology in general. Really in the last two decades, technology has become far more advanced and far more widely used throughout all types of industry. In this section, we consider and examine the work done by other scholars and researchers who have broached our particular topic which is shown in table 1.

Table 1: Summary of literature review

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No.** | **Year** | **Name** | **Contribution** |
| 1 | 2012 | A. Ozcift [1] | A new classification model based on support vector machine and rotation forest ensemble classifiers has been developed to improve Parkinson's disease diagnosis, achieving up to 97% accuracy in the best-performing classifier. |
| 2 | 2020 | Anila M et al. [2] | The paper presents a novel approach to diagnose Parkinson's disease using artificial neural network models, achieving high accuracy rates. |
| 3 | 2016 | Arvind kumar tiwari [3] | This paper uses feature selection algorithms to predict Parkinson's disease with a 90.3% overall accuracy using random forest with 20 selected features. |
| 4 | 2019 | Carlo Ricciardi et al. [4] | Gait analysis can be used to differentiate Parkinson's disease and Progressive Supranuclear Palsy, with data mining providing insight into subtle differences between the two conditions. |
| 5 | 2018 | Dr. Anupam bhatia et al. [5] | This project aims to detect Parkinson's Disease through data mining and statistical analysis of common symptoms such as gait, tremors, and micro-graphia, with the goal of finding the most accurate classification algorithm. |
| 6 | 2012 | Dr. R.GeethaRamani et al. [6] | This paper focuses on classifying the severity of Parkinson's disease using data mining techniques and biomedical voice measures, achieving 100% accuracy with the Random Tree classification algorithm and ReliefF algorithm. |
| 7 | 2016 | Dragana Miljkovic et al. [7] | This paper discusses the potential of machine learning methods in detecting and classifying tremors, gait patterns, and vocal impairment in Parkinson's disease patients. |
| 8 | 2013 | Farhad Soleimanian Gharehehopogh et al. [8] | This paper uses two types of artificial neural networks (MLP and RBF) to classify Parkinson's disease with high accuracy, which can assist neurologists in making better decisions |
| 9 | 2011 | Heisters D. [9] | Parkinson's is an incurable neurological condition causing slowness of movement, tremor and muscle stiffness, with medication being the main form of management; ongoing research is focused on finding a cure and developing new treatments. |
| 10 | 2018 | M. Abdar et al. [10] | This study compares the accuracy of SVM and Bayesian networks in diagnosing Parkinson's disease using PD data from UCI and found SVM with polynomial kernel function and C parameter to have the best performance with an average accuracy of 99.18%. The ten important factors involved in the SVM algorithm were also identified. |

1. **The expected outcome of the project**

Parkinson’s is a totally grave disease and has no cure till date. since it impacts the actions of the parts of the body, the speech additionally stands affected. here, the model tries to offer a way of detecting Parkinson’s ailment so one can bring about a quick action to reduce or even put off it from affecting the whole body. It aims to make this method of expertise a case of Parkinson’s on the earliest via each, the affected person as well as scientific experts. Even today prediction of Parkinson's Disease is one of the most difficult tasks for research engineers and doctors. In this project, using Machine Learning algorithms for the prediction of Parkinson's disease we found the Support Vector Machine Classifier model with the best accuracy score of 89.40%.

**Reference**

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