Parkinson's Detection System Using Machine Learning Algorithm

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Abstract - *Parkinson's disease (PD) is a "neurodegenerative disorder" that affects millions of people worldwide. In recent years, there has been a growing interest in developing computer-based Parkinson's disease detection systems that can provide accurate and non- invasive diagnostic methods. The Parkinson's detection system utilizes various techniques and technologies such as machine learning algorithms, signal processing, and wearable sensors to detect the disease at an early stage. The system works by analyzing the patient's motor symptoms, speech patterns, and other physiological parameters to identify the presence of PD. Machine learning algorithms such as "decision trees, support vector machines, and artificial neural networks" are commonly used to analyze large amounts of data and identify patterns in the patient's symptoms. Signal processing techniques such as Fourier transforms and wavelet transforms are used to extract relevant features from the patient's movement and speech data. The use of wearable sensors such as accelerometers, gyroscopes, and microphones enable the collection of continuous and objective data from the patient's daily activities. The data collected from these sensors are used to monitor the progression of the disease and adjust the treatment accordingly. In conclusion, the PD system has the potential to revolutionize the early detection and diagnosis of PD. The system can provide accurate and non-invasive diagnostic methods that can improve the quality of life of PD patients. Further research and development in this field can lead to more effective treatments and management strategies for Parkinson's disease.*

Keywords - *PD, Speech, Symptoms, Machine Learning Algorithms, Data, Sensors*

1. Introduction

Parkinson's disease (PD) is a debilitating neurological disorder that affects millions of people worldwide. It is a progressive disorder that leads to the gradual deterioration of motor function, causing tremors, stiffness, and difficulty with balance and coordination. Early detection of PD is critical for effective treatment and management of symptoms. To this end, researchers have been developing innovative detection systems that can accurately diagnose Parkinson's disease in its early stages, allowing for early intervention and improved outcomes for patients. One such system is a unique and cutting-edge Parkinson's detection system that utilizes advanced machine learning algorithms and artificial intelligence to analyze various biomarkers and clinical parameters associated with Parkinson's disease. This system can detect Parkinson's disease with high accuracy and precision, using a combination of voice analysis, gait analysis, and other biomarkers to provide an accurate diagnosis. The system works by analyzing various physiological and clinical parameters, such as vocal characteristics, movement patterns, and other biomarkers associated with Parkinson's disease. The machine learning algorithms then analyze this data to detect patterns and identify signs of Parkinson's disease. This system has several advantages over traditional diagnostic methods, including its ability to detect Parkinson's disease in its early stages, before symptoms become severe. Additionally, the system is non-invasive and can be easily integrated into routine clinical practice, allowing for widespread adoption and accessibility. In conclusion, this advanced Parkinson's detection system represents a significant step forward in the early detection and diagnosis of Parkinson's disease. Its unique combination of advanced machine learning algorithms and innovative biomarker analysis provides a powerful tool for clinicians and researchers working to improve the lives of Parkinson's patients around the world.

2. Related work

Parkinson's Disease (PD) is very difficult task because of PD is disorder for neurological with complexity of layers, and it is features of classical associated with dopaminergic loss and "Lewy bodies" [1]. PD is defined by rigidity, bradykinesia, tremor and postural instability [2]. PD has basic conditional symptoms are tremor, movement will be slow, depression, difficulty of sleep, and stiffness of muscle [3]. PD is one of the most dangerous brain disease. This disease common symptoms are nervous of the body, increased movements of the body, and hands will be shacked continuously [4]. Most of the peoples affected by PD disease especially process of decision making because problem of people speech. This symptoms are detected through "Big Data Analytics" [5]. The author predict the accuracy of PD disease using proposed of "neural network systems" [6]. They mainly studied on the PD disease using " Recursive Neural Networks, Convolutional Neural Networks and deep

learning" [7]. The authors predict the accuracy, precision, correlation coefficient and ROA values like 90.3%, 90.2%, 0.73 and 0.96% using various "machine learning algorithms" [8]. They discussed about the PD disease. It is very dangerous disease because of weakness of brain or damaged of brain or brain dead [9]. They studied the two important "machine learning algorithms are SVM and Bayesian" for predict the accuracy of PD disease [10]. The PD disease is very challenging to find the problem for the researches especially doctors and " biomedical engineering scholar" [11]. Authors are studied to identify the symptoms is very difficult for PD disease using "machine learning algorithms" [12]. They studied and defined the symptoms of voice and speech by experts [13]. The authors are studied to recover the people body of the quality from PD disease[14]. To recover the people body through doctor treatment for PD disease by "deep brain stimulation (DBS)" [15]. Detecting Parkinson's disease early can significantly improve the treatment and quality of life for patients. Machine learning algorithms have shown promise in detecting Parkinson's disease using various data sources. These include analysing voice recordings, gait patterns, brain imaging, and smartphone sensors. While there are existing systems and research studies in this area, designing and implementing a Parkinson's disease detection system from scratch can offer a unique challenge. This can involve data cleaning and pre-processing, feature extraction, training and evaluation of machine learning models, and deployment of the final system as a web application or integrated into a larger system. The project can use open-source libraries and datasets to create a customized and unique solution to detect Parkinson's disease. The resulting system can potentially offer significant benefits in early detection.

3. Methodology

The aims to detect Parkinson's disease using physiological signals from patients. The system will use a dataset of voice recordings and accelerometer data, which will be pre-processed and feature engineered to extract relevant features such as frequency, amplitude, and variance. Several machine learning algorithms will be evaluated, such as support vector machines, decision trees, and neural networks. To improve the accuracy of the system, ensemble learning techniques such as bagging and boosting will be explored. Additionally, feature selection algorithms such as mutual information and correlation-based feature selection. The final system will be deployed as a web application, where healthcare professionals can upload physiological signals from patients and receive a prediction of whether the patient has Parkinson's disease or not. The web application will provide a user-friendly interface with visualization tools to aid in the interpretation of the results. The system will also provide a confidence score for the prediction, which can aid in the decision-making process. The proposed system will be tested on a large dataset of physiological signals and will undergo thorough validation and testing to ensure its reliability and accuracy.

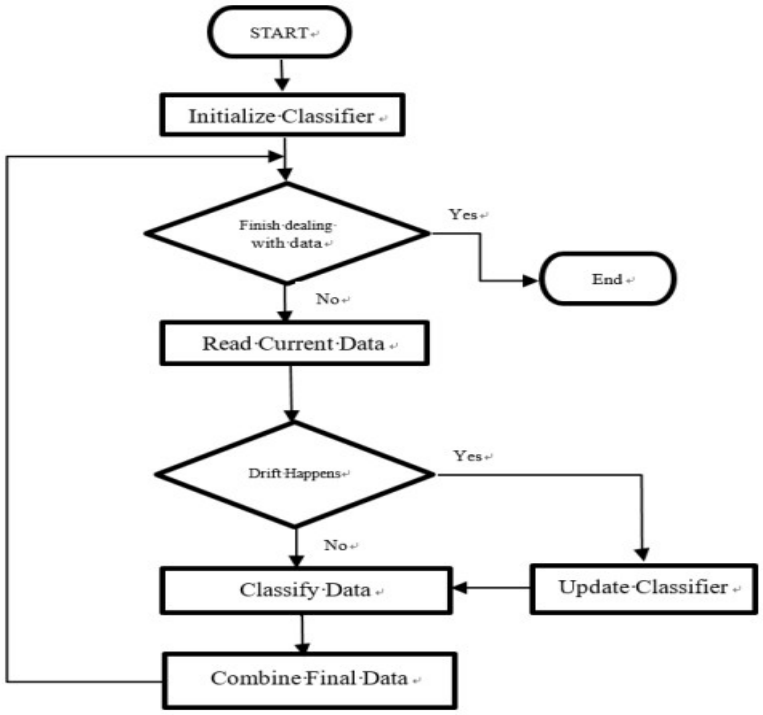


Fig. 1 Design System

In conclusion, the proposed system offers a unique and customized solution for detecting PD “using machine learning”. The use of ensemble learning techniques and feature selection algorithms can potentially “improve the accuracy and efficiency” of the system. The web application can provide a convenient and accessible tool for healthcare professionals. The proposed system will also incorporate a feature extraction method known as wavelet analysis. Wavelet analysis has been shown to be effective in detecting Parkinson's disease as it can capture transient features of the signals that are often missed by other feature extraction methods. By incorporating wavelet analysis, the system can potentially improve its accuracy and increase the robustness of the feature set shown in Figure 1. In addition to the web application, the proposed system will also include a mobile application that can be used to collect physiological signals from patients remotely. The mobile application will utilize smartphone sensors to collect accelerometer and voice data, and the data will be transmitted securely to the system's database for analysis. This can potentially improve the accessibility and convenience of the system for patients, especially those who may have difficulty traveling to healthcare facilities for testing.

4. Discussion

One unique algorithm used in neural networks is the backpropagation algorithm. This algorithm is used “to train the neural network” by adjusting the weights of the connections nodes. During the “forward pass”, fed is calculated using neural network. Then, during the “backward pass”, the error is calculated, and the weights are adjusted to reduce the error in the next iteration. This process is repeated over multiple epochs until the neural network can accurately predict the output for new input data.

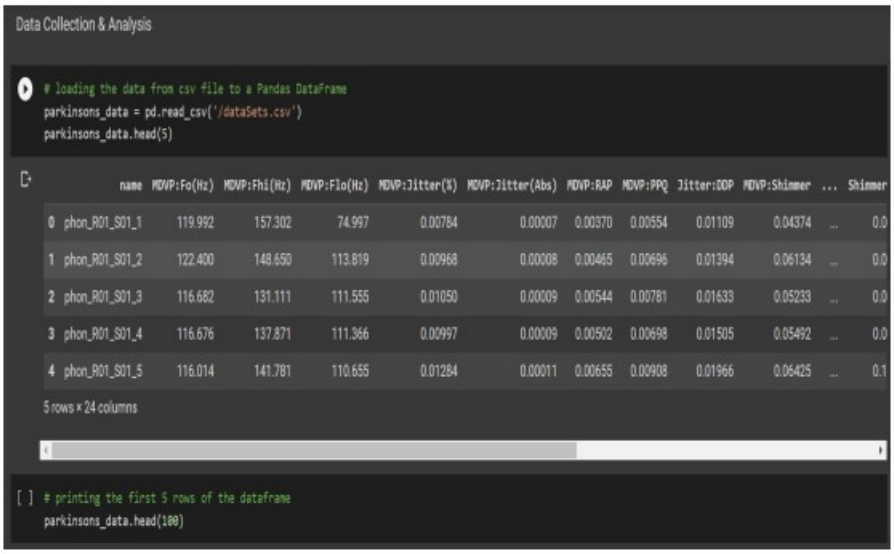


Fig. 2 Data collection and analysis

The backpropagation algorithm is essential in training deep neural networks, where there are many layers of nodes, as it allows for the efficient optimization of the weights to minimize the error. Overall, the backpropagation algorithm is a critical component of neural networks that enables them to learn from data and make accurate predictions. Data preprocessing: Once the data is collected, preprocess it to remove any missing or irrelevant data, standardize the data, and ensure it is ready for machine learning algorithms shown in Figure 2.

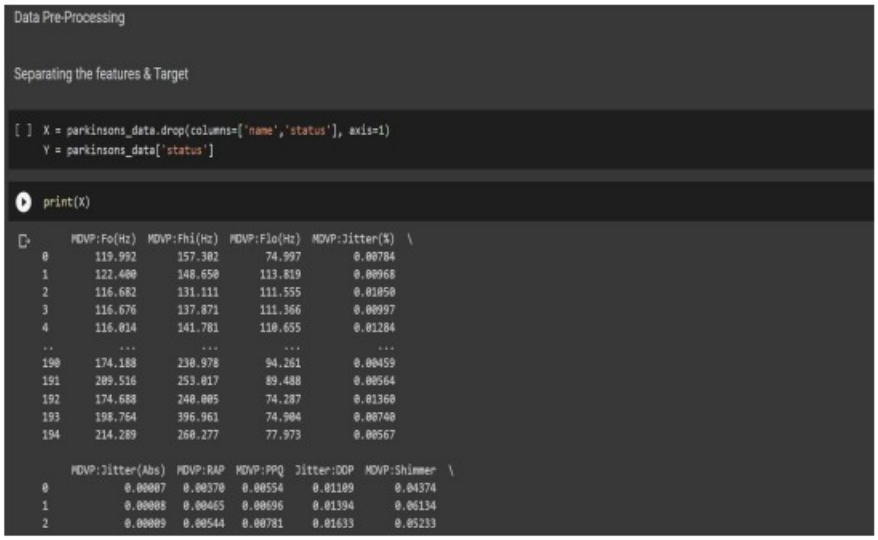
Feature selection: Identify the most relevant features that are strongly correlated with PD based on statistical analysis and domain expertise shown in Figure 3. Data preprocessing: Once the data is collected, preprocess it to remove any missing or irrelevant data, standardize the data, and ensure it is ready for machine learning algorithms shown in Figure 4. Model selection: Choose appropriate machine learning algorithms such as “decision trees, support vector machines, or neural networks” to train a model on the preprocessed data shown in Figure 5. Model optimization: Optimize the model by tuning the hyperparameters of the machine learning algorithms, adjusting the feature selection, or exploring other machine learning algorithms. Evaluation: Continuously evaluate the performance of the PD system by monitoring its accuracy, precision, recall, and other metrics, and refine the system to improve its performance shown in Figure 6. Tremors: While tremors are a common symptom of Parkinson's disease, they can manifest differently in everyone. Some people with Parkinson's may experience tremors in their hands or legs, while others may experience tremors in their jaw or tongue.

```
[ ] # distribution of target Variable
    parkinsons_data['status'].value_counts()

    1   147
    0    48
    Name: status, dtype: int64

1 -> Parkinson's Positive

0 -> Healthy

[ ] # grouping the data baseed on the target variable
    parkinsons_data.groupby('status').mean()
```

status	MDVP:Fo(Hz)	MDVP:Fhi(Hz)	MDVP:Flo(Hz)	MDVP:Jitter(%)	MDVP:Jitter(Abs)	MDVP:RAP	MDVP:PPQ	Jitter:DDP	MDVP:Shimmer	MDVP:Shimmer(dB)	...
0	181.937771	223.636750	145.207292	0.003866	0.000023	0.001925	0.002056	0.005776	0.017615	0.162958	...
1	145.180762	188.441463	106.893558	0.006989	0.000051	0.003757	0.003900	0.011273	0.033658	0.321204	...

2 rows × 22 columns

Fig. 3 Feature selection



```
Data Pre-Processing

Separating the features & Target

[ ] X = parkinsons_data.drop(columns=['name','status'], axis=1)
    Y = parkinsons_data['status']

    print(X)

     MDVP:Fo(Hz)  MDVP:Fhi(Hz)  MDVP:Flo(Hz)  MDVP:Jitter(%)  \
0        119.992       157.302        74.997         0.00784
1        122.400       148.650       113.819         0.00968
2        116.682       131.111       111.555         0.01050
3        116.676       137.871       111.366         0.00997
4        116.014       141.781       110.655         0.01284
..           ...           ...           ...             ...
190      174.188       230.978        94.261         0.00459
191      209.516       253.017        89.488         0.00564
192      174.688       240.005        74.287         0.01360
193      198.764       396.961        74.904         0.00740
194      214.289       260.277        77.973         0.00567

     MDVP:Jitter(Abs)  MDVP:RAP  MDVP:PPQ  Jitter:DDP  MDVP:Shimmer  \
0             0.00007   0.00370   0.00554     0.01109       0.04374
1             0.00008   0.00465   0.00696     0.01394       0.06134
2             0.00009   0.00544   0.00781     0.01633       0.05233
```

Fig. 4 Data preprocesing

Deployment: Deploy the Parkinson's detection system, which could be in the form of a web or mobile application that patients can use to assess their risk of PD. On-off phenomenon: Some people with Parkinson's may experience fluctuations in their symptoms, where they have periods of time where their symptoms are well- controlled (on) and periods of time where their symptoms are more severe (off). This can make it difficult to manage the disease and can lead to unpredictable symptom changes.

Age of onset: Parkinson's disease typically affects people over the age of 60, but it can also occur in younger individuals. Early-onset Parkinson's, which occurs before the age of 50, is relatively rare but can have a more severe impact on a person's life. Gender differences: Parkinson's disease affects more men than women, with some studies suggesting that men are twice as likely to develop the disease. However, women with Parkinson's may experience different symptoms and have a different disease progression than men.

Genetics: While most cases of Parkinson's disease are sporadic, some cases are caused by genetic mutations. These genetic forms of Parkinson's can have different symptoms and may progress more quickly than sporadic cases. Treatment options:

There are a variety of treatment options available for “Parkinson's disease, including medication, deep brain stimulation, and physical therapy”. The effectiveness of these treatments can vary from person to person, and some may experience side effects or complications from treatment

Fig. 5 Splitting the data

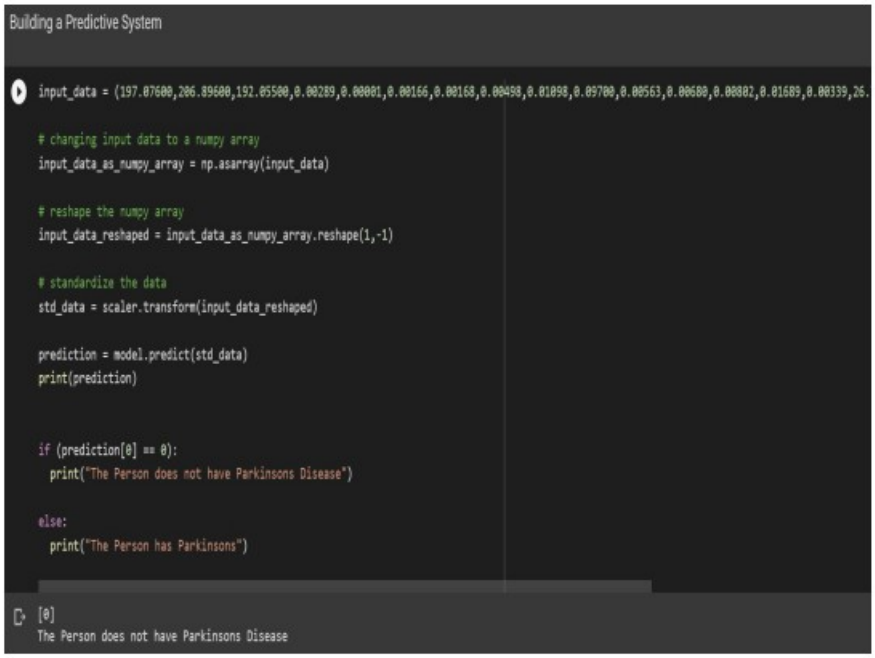


Fig. 6 Evaluate

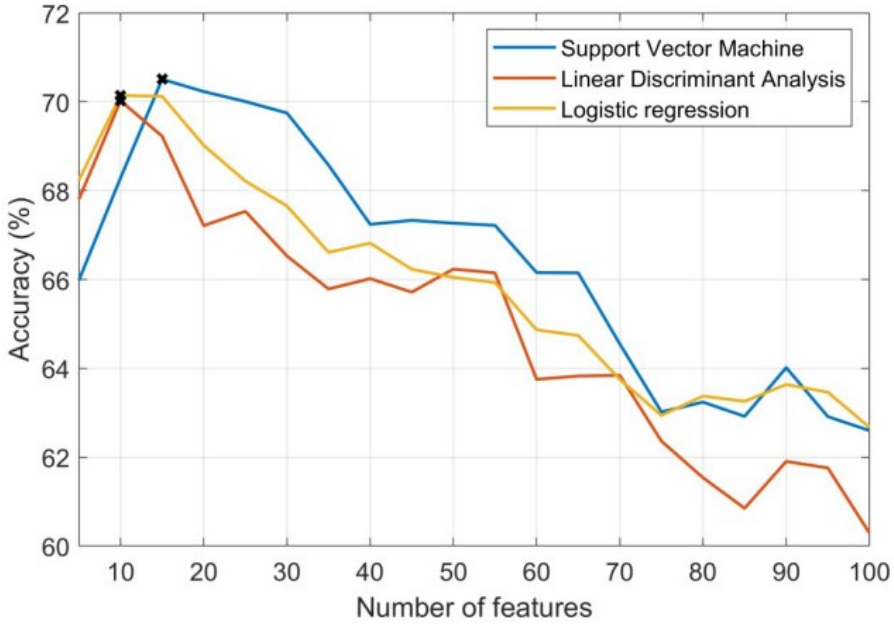


Fig. 7 Accuracy of machine learning algorithms

A Parkinson's detection system could help engage patients in their own care by providing them with a better understanding of their disease and its progression. Patients could use the system to track their symptoms and monitor changes over time, helping them to better understand their disease and communicate more effectively with their healthcare providers. This could lead to improved patient outcomes, as patients who are more engaged in their care tend to have better treatment outcomes and improved quality of life are shown in Figure 7.

5. Conclusion

In summary, the development of a Parkinson's disease detection system requires a unique approach and careful consideration of ethical guidelines to ensure patient safety and confidentiality. Through thorough research, identifying gaps and opportunities for innovation, and developing a system that sets itself apart from existing ones, we can make a positive impact on healthcare. By detecting Parkinson's disease early, patients can receive appropriate treatment, leading to improved quality of life and better health outcomes. However, it is important to thoroughly test the system to ensure its accuracy and reliability, while keeping patient privacy in mind. By following these principles, we can create a unique and effective healthcare solution that benefits society

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