A Review on Parkinson’s Disease Detection

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Abstract. Parkinson's Disease affects hundreds of thousands of people . Even with today's many sciences and advances, detecting this disorder in early stage remains a challenge. The detection of any neurological disorder could be critical. Various tools and techniques are now available on a global scale. These strategies are primarily built on mobile ,web-based utility .These strategies are also user-friendly because disease caregivers can use them while sitting at home and can display disease progression. Clinicians and researchers who want to conduct research also use these applications to display disease progressions. According to the current information review, certain algorithms have been used to obtain good results, In this case, the difficulty is defining the utmost effective classifier for Parkinson’s Disease detection. Also emphasises a organized assessment of several styles of programmes employed globally for Parkinson's disease detection , prognosis, proposes a Parkinson's disease detection system that is entirely based on mobile and internet utility.

Keywords: first keyword, second kekyword, third keyword.

1. Introduction

Parkinson's disease (PD) is a nervous system neurodegenerative disorder which affects our body movements, including speech. Neurodegenerative diseases are genetic , sporadic conditions characterised by modern nervous system malfunction [1]. Among many neurodegenerative illnesses,"Parkinson's Disease" is regarded as second best common neurodegenerative disorder. Although there are some viable signs and symptoms, Parkinson's disease is frequently correlated with progressive bradysinesia,, tremors, and muscle stiffness, all of which can get worse across time.

Parkinson's disease impacts nearly 60,000 Americans today [2]. As shown in Figure 1, Parkinson's disease is caused by modern lack of dopamine neurons found in the midbrain known as the substantia nigra – the "movement control centre" of the brain. The hallmark of Parkinson's disease is a decrease in dopamine levels in the brain. Dopamine regulates a person's movement. A person suffering from Parkinson's disease produces far less dopamine in their brain. As a result, the person loses coordination between his brain and muscle tissue. The link between the motor cortex and the brain stem or spinal cord is severed. Detectable abnormalities called Lewy bodies are available in neurons of patients. They are the unusual protein that appears as a reddish-pink cytoplasmic inclusion. At the higher stage, Parkinson's disease will be easily, correctly identified, but efficient treatment is a difficult mission. Furthermore, if treatment is initiated at an advanced stage, it will be less useful in reducing the progression of

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Parkinson's disease [3]. Currently, there is no specific blood, laboratory test that can be used to detect Parkinson's disease and progression of it.

Paper is arranged as follows. Section 2 presents the current work used to perform this review. Section 3 presents several technologies applied for PD detection, and Section 4 discusses the web- based studies for PD detection. Finally, Section 5 declares conclusions, future leanings.

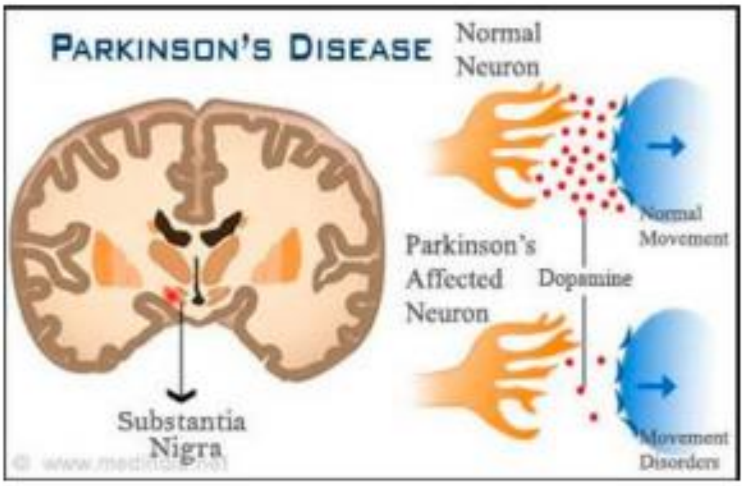

Figure 1. Parkinson’s Disease

2. Literature review

Several studies have also mentioned a secondary form of Parkinson's disease called Idiopathic Parkinson's Syndrome (IPS). IPS can also cause neurodegenerative disorder sequelae [4]. Typical Parkinsonian Syndromes (APS), which include Progressive Supranuclear Palsy and Multiple System Atrophy, vary from Parkinson's disease (PD) in that they have more extensive neuronal participation, consequential in more clinical signs, faster disease progression, and poor answer to dopamine replacement therapy [5]. Another effective treatment for Parkinson's disease is DBS, which affects the grafting of a device like a cardiac pacemaker to electrically stimulate some target brain regions. The authors also created a dataset called "HandPD" that contains all of the photos and abilities extracted from the handwriting checks. In 2018, [6] used Convolutional Neural Networks to analyze data related to handwritten dynamics in the framework of the popularity of computer-assisted PD. Reference [7] compared the Internet-of-Things in the perspective of healthcare to Parkinson's disease as a representative disease model. [8] investigated the output of Support Vector Machines with Radial Basis Function in Parkinson's disease patients to investigate the arrival of tremor.

According to the literature, numerous gadgets mastering procedures were used for PD classification by using task the vocal and gait features. Among the four methods, the multi-layer feed-ahead neural network with Levenberg–Marquardt algorithm produced the best overall performance of 92.9%. The authors also assessed the outcomes to kernel–SVM effects and determined that the obtained outcomes outperformed the kernel SVM approach [9].

In [10], the overall performance of LS-SVM, SVM, MLPNN, and GRNN within the distant monitoring of PD development is compared. When mapping vocal abilities to UPDRS data, it was discovered that LS-SVM outperforms the other methods. [11] suggested a low-cost data mining-driven method based entirely on gait variations to model and predict a Parkinson's disease patient's observance to medication protocols. By means of whole-body motion record interpretations from patients, it is far likely to distinguish PD patients who are "on" or "off" medication obtaining an accuracy of 97 percent when using a specifically tailored model, and precision of 78 percent when using a generalized model containing a couple of patient gait statistics.

Table 2.1 compares the various techniques used by researcher for better likelihood of Parkinson's disease detection.

Table 1. Machine Learning Techniques

Sl. No	Dataset	Results
1	Parkinson's Disease Handwriting Database [12].	SVM with RBF kernel yielded an accuracy of 81.30%.
2	Data from 15 patients with a wide range of spectral properties [13].	With SVM, a leave-one-out cross-validation error around 7% was obtained.
3	Data from 49 Parkinson's disease patients and 41 age-matched healthy controls [14].	Accuracy of 78.00%.
4	Parkinson's Data Set was taken from the University of California, Irvine Machine Learning Repository [15]. '	ANN had an accuracy of 94.28% and CVANN had an accuracy of 98.12 %.

3. Enabling technologies

This phase describes the works in greater detail, divided by their primary utility domain, i.e., Internet software, sensors, digital and augmented reality, smart-smartphone devices, signals analysis, photo processing, and gadget learning.

3.1. Machine learning

Machine Learning is a division of computational intelligence that focuses on developing methods that allow computer software to enhance its overall performance purely based on previously learnt data. Since the birth of "Perceptron," new mathematical models of the mind's operational mechanism have been researched daily. A spate of projects targeted at using device-learning approaches to aid in identification of Parkinson's disease have sprung up as a result of this extensive research.

Figure 3.1 depicts the analysis of neurodegenerative diseases using machine learning methods, which include data acquisition, feature selection, feature subset selection, training, and validation of the classifier's performance.

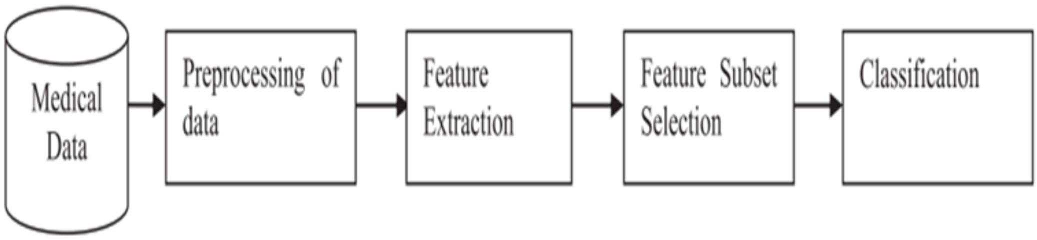

Figure 2. Machine Learning Process

3.2 Applied methods

3.2.1 ANN. Because of the way organic neurons process information, ANN forms a parallel structure. Although there are many different types of ANN topologies, the MLP (multi-layer feed-forward neural network) is the most generally used structure, as shown in Figure 3 [16]. Backpropagation is exemplified by Levenberg–Marquardt, Gradient descent scaled conjugate gradient, and Resilient returned propagation. According to academics, the Levenberg–Marquardt set of rules is green and firmly recommended for neural network education for small and medium-sized networks; so, similar technique has been used here.

3.2.2 SVM. SVM is a type of algorithm that is supervised. SVM for binary type was first proposed by Vapnik [3]. The binary class is largely based on the concept of employing a hyperplane to divide information into training. To address linear classification issues, SVM is employed as an extension of the perceptron [17].

3.2.3 KNN. KNN is a system learning technique that uses a nonparametric classification strategy. The type of output required for the individual applications determines the outcome of the KNN approach. The item with the most common of the K nearest neighbors is given the elegance.

3.3 Mobile devices

Smartphone-based applications have become widely used for disease diagnosis. Smart smartphone apps can track the various statuses and conditions of neurodegenerative diseases such as Parkinson's disease. In the scientific community, these cell phone-based totally structures are called mHealth (mobile fitness), which is a wifi method. MHealth makes usage of mobile devices to instruct consumers about several extents of healthcare. For disease analysis, various programmes are built into smart phones to analyze various types of parameters of that specific ailment. Customers can watch their sickness progression while remaining in a faraway place using these characteristics [4]. There are many folks who are helpful and friendly. Mobile health care gadgets include the Palmtop, Personal digital assistant, Pocket PC, Smartphone, Tablet, Smart watch, and Bluetooth headset.

Parkinson's disease is also detected using various cell strategies such as smart cellphone based and internet packages. Various signs of Parkinson's disease, like tremor, rigidity, postural instability, despair, disorder severity, and many others, can be detected using various programmes that include specific sickness diagnosis parameters. A person with Parkinson's disease and their caregivers will be easily monitor the disorder's progression wherever and whenever it is needed.

4. Web application for PD detection

There are several web-based studies that use web applications to detect Parkinson's disease. It can track the progression of the disease. A web application is a programme that is hosted on a remote server and distributed via the internet using a browser. Self-help manuals, homework assignments, inquiries, and advice from an online expert are common features of web-based programmes. The goal of DAPHNE is to leverage information , communication technologies (ICTs) including mobile health (mHealth) apps and Internet of things (IoT) protocols to diagnose Parkinson's disease (PD) early. Through Ambient Assisted Living, this technology was created to assist clinicians in the early detection of sickness (AAL). It also included a patient-friendly home monitoring service that aided them in establishing a precise therapeutic approach. In terms of tests and hospitalization, it lowers the costs of disease identification.

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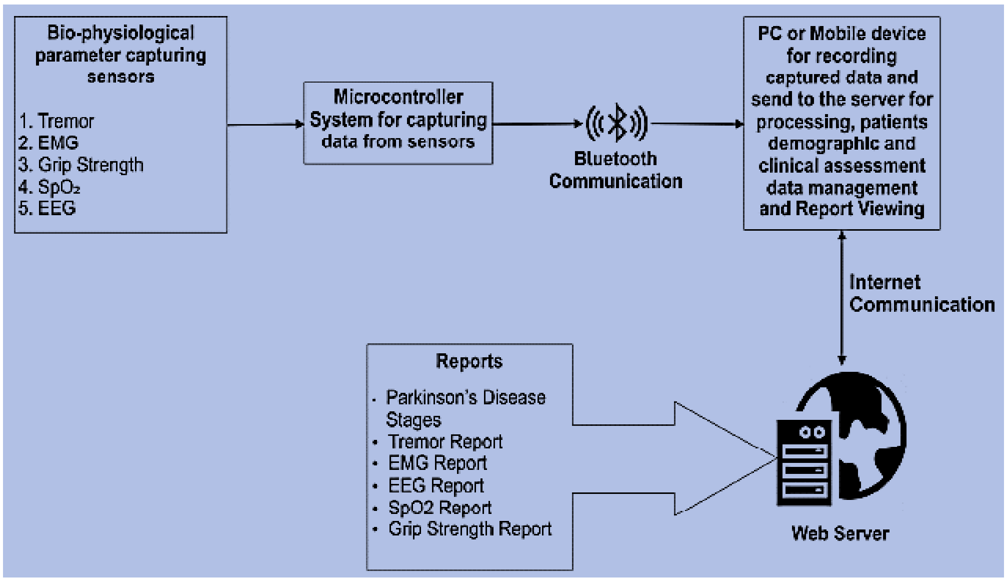

Figure 3. Architecture

4.1 Advantage of web and mobile applications

The following are some of the advantages of using this type of sickness analysis system: Efficient coordination, continuous information flow, effective patient control, improved health practitioner performance Effective diagnostic method and precision, provides convenience and allows for customization. This type of detection device could be extremely useful for disease diagnosis. This allows for a smooth prognosis of illness and reduces the likelihood of developing various scientific conditions. They can access their own fitness conditions at the tip of their fingers and receive routine tests and treatments. In hospitals and various health facilities, cellular software/internet programmes are used to save various patient information, allowing clinicians access to the disorder development of each patient.

5. Conclusion

Parkinson's disease and other neurodegenerative diseases are incurable. Parkinson's disease patients suffer throughout their lives, and as the disease progresses, various motor and non-motor symptoms become more prominent. In the final stages of Parkinson's disease, a patient will become completely bedridden and not able to perform his daily necessities, making the affected person more structured to his or her family. Because Parkinson's disease is incurable, the best approach is to prevent it and detect it early, before it becomes severe. Some studies also show that using a completely drug based on Levodopa accelerates the rate of neuronal degeneration. As a result, at some point in medicine, patient monitoring becomes more critical. Smartphones will soon become an indispensable part of our daily lives. As a result, monitoring Parkinson's disease patients will become easier. The internet-based utility also helps in these situations by making doctors easily accessible to patients over long distances. The overall performance of ANN, KNN, and SVM classifiers is evaluated in this paper. Now, one patient can be continuously screened with these advanced instruments. The utility of gadget research also aids us in predicting the symptomatic correlation with Parkinson's disease, which opens a new avenue for identifying PD patients in their early stages. Finally, each of the devices developed has its own mission basis capable of detecting one or more signs of Parkinson's disease such as tremor of various roles such as hand or finger, postural instability, rigidity, and so on. Similarly, we believe smartphones and capsules will perform an important part in the future, as e-health research kits are constantly evolving, and displaying patients at home appears to be the most promising route toward Parkinson's Disease understanding. As a result, similar upgrades may be required to enhance the accuracy of CAD algorithms. In the future, we

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will try to detect and classify Parkinson's disease using other evolutionary algorithms such as the Genetic algorithm and the Extreme Learning Machine.

References

[1] A Samii, J. G. Nutt, and B. R. Ransom, "Parkinson's disease," Lancet, Vol. 363, no. 9423, pp. 1783–93, 2004.

[2] Burke RE. Evaluation of the braak staging scheme for Parkinson's disease: introduction to a panel presentation. Mov Disord 2010;25(S1):S76–7.

[3] Fundation PD. Statistics on Parkinson's: who has Parkinson's? 2016 [Online; accessed on 15-July-2016] http://www.pdf.org/en/parkinson_statistics.

[4] W. Zeng and C. Wang, "Classification of neurodegenerative diseases using gait dynamics via deterministic learning," Inform. Sci., Vol. 317, pp. 246–58, 2015.

[5] Y.-Y. Chen, et al., "A vision-based regression model to evaluate parkinsonian gait from monocular image sequences," Expert Syst. Appl., Vol. 39, pp. 520–6, 2012.

[6] P. Piccini, and A. Whone, "Functional brain imaging in the differential diagnosis of Parkinson's disease," Lancet Neurol., Vol. 3, pp. 284–90, 2004.

[7] Shahbakhi M, Far DT, Tahami E. Speech analysis for diagnosis of Parkinson's disease using genetic algorithm and support vector machine. J Biomed Sci Eng 2014;07(04):147–56.

[8] Benba, A. Jilbab, and A. Hammouch, "Voice assessments for detecting patients with Parkinson's diseases using PCA and NPCA," Int J. Speech Technol., Vol. 19, no. 4, pp. 743–54, 2016.

[9] Zhang L, Wang M, Sterling N, Lee E, Eslinger P, Wagner D, Du G, Lewis M, Truong Y,Bowman D, Huang X. Cortical thinning and cognitive impairment in Parkinson's disease without dementia. IEEE Trans Comput Biol Bioinform 2015:1.

[10] Connolly AT, Kaemmerer WF, Dani S, Stanslaski SR, Panken E, Johnson MD, Denison T. Guiding deep brain stimulation contact selection using local field potentials sensed by a chronically implanted device in Parkinson's disease patients. 7th international conference on neural engineering 2015:840–3.

[11] Wahid F, Begg RK, Hass CJ, Halgamuge S, Ackland DC. Classification of Parkinson's disease gait using spatial-temporal gait features. IEEE J Biomed Health Inform 2015;19(6):1794–802.

[12] Tucker CS, Conrad S, Behoora I, Nembhard HB, Lewis M, Sterling NW, Huang X. Machine learning classification of medication adherence in patients with movement disorders using non-wearable sensors. Comput Biol Med 2015;66:120–34.

[13] Procházka A, Vysata O, Valis M, Tupa O, Schätz M, Marík V. Bayesian classification and analysis of gait disorders using image and depth sensors of microsoft kinect. Digit Signal Process 2015;47:169–77.

[14] L. M. de Lau and M. M. Breteler, "Epidemiology of Parkinson's disease," Lancet Neurol., Vol. 5, pp. 525–35, 2006.

[15] C. G. Goetz, et al., "Movement disorder society-sponsored revision of the unified Parkinson's disease rating scale (MDS-UPDRS): Scale presentation and clinimetric testing results," Mov. Disord., Vol. 23, no. 15, pp. 2129–70, 2008.

[16] B. Rana, A. Juneja, M. Saxena, S. Gudwani, S. Senthil Kumaran, R.K. Agrawal, and M. Behari, "Regions-of interest based automated diagnosis of Parkinson's deeeeee using T1-weighted MRI," Expert Syst. Appl., Vol. 42, pp. 4506–16, 2015.

[17] R. Armananzas, C. Bielza, K. R. Chaudhuri, P. Martinez Martin, and P. Lar rañaga, " Unveiling relevant non-motor Parkinson's disease severity symptoms using a machine learning approach," Artif. Intell. Med., Vol. 58, pp. 195–202, 2013