DETECTING PARKINSON'S DISEASE USING MACHINE LEARNING

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Machine Learning and Data Science Project Management From an Agile Perspective: Methods and Challenges

Successful implementations of Machine Learning (ML) and Data Science (DS) applications have enabled innovative business models and brought new opportunities for organizations. On the other hand, research studies report that organizations employing ML and DS solutions are at a high risk of failure and they can easily fall short of their objectives. One major factor is to adopt or tailor a project management method for the specific requirements of ML and DS applications. Therefore, Agile Project Management (APM) may be proposed as a solution. However, there is significantly less study that explores ML and DS project management from an agile perspective. In this chapter, we discuss methods and challenges according to the background information and practice areas of ML, DS, and APM. This study can be viewed as an initial attempt to enhance these knowledge and practice domains in view of APM. Therefore, our future research efforts will focus on the challenges as well as the experimental implementation of APM methods in real industrial case studies ML and DS.

Contemporary developments in cutting-edge technologies, along with the advances in artificial intelligence (AI), have paved the way for various integrated and sophisticated systems. The proliferation of AI systems has enabled new business models and brought opportunities for organizations. The successful implementations of AI can have a great impact on the activities and competitiveness of an organization. On the other hand, there is also an overestimation of their benefits, opportunities, and return on investment of AI projects. How to realize AI as a long-term and stable solution is difficult, and defining the required procedures is not clear. To that aim, Bughin et al. (2017) indicate the factors for transforming the capabilities of AI", effective and efficient AI environment, techniques and tools, solid data ecosystem, and organizational

culture. Ransbotham et al. (2017) report the challenges in the adoption of AI systems as follows:

• Difficulties in the Acquisition of AI-related skills and knowledge,

• “Competing of AI projects with other projects in the company”

• Safety and security aspects of systems using AI,

• Cultural and organizational barriers in the AI adoption.

Data Science: a literature review

Data Science:

The term big data refers to the collection of large and complex data sets that are difficult to process by using traditional data management methods, tools, and techniques. Volume (size of data), variety (diversity and types of data), velocity (speed of data generation), and veracity (accuracy of data) are the main characteristics of big data. Therefore, it becomes more and more difficult to use big data resources for a maximum advantage when the amount of data grows, variety, and velocity increases. The types of data may be structured, unstructured, machine-generated, graph-based, streaming, and in the forms of audio, video, or image. DS has evolved from the traditional data management and statistics disciplines (Cielen et al. 2016). As being multidisciplinary, it borrows some of its techniques from computer science, uses complex algorithms, and includes the processes to build predictive models The main steps of a DS project are as follows:

• Problem definition,

• Data acquisition,

• Data processing (cleansing, transforming and integrating data)

Parkinson disease onset detection Using Machine Learning:

A person diagnosed with Parkinson's disease can have other symptoms that include-

1. Depression

2. Anxiety

3. Sleeping, and memory-related issues

4. Loss of sense of smell along with balance problems.

What causes Parkinson's disease is still unclear, but researchers have research that several factors are responsible for triggering the disease. It includes –1. Genes- Certain mutation genes have been found by research that are very rare. The gene variants often increase the risk of Parkinson's disease but have a lesser effect on each genetic marker.

2. Environment- Due to certain harmful toxins or chemical substances found in the environment can trigger the disease but have a lesser effect

Although it develops at age of 65 15% can be found at young age people less than 50.

An effective Parkinson's disease prediction using logistic decision regression and machine learning with big data :

Background:

Medical data is conducive to early identification of diseases, patient treatment, and community service. Parkinson's disease prediction by Machine Learning (ML) in large data and reliable study of biomedical and healthcare community

develop big data; medical data is conducive to early detection of diseases, patient care, and community service. The machine learning algorithm is being used to successfully forecast the prevalence of chronic illness populations. Proposed Methodology: Parkinson's disease is a serious neurodegenerative disease that affects people when they become older (mostly past the age of 50). It is the most serious and harmful of the non-curable neurodegenerative diseases. Parkinson's disease is challenging to diagnose at an early level and the origin of subtle early signs is difficult to identify. Due to the heavy responsibility of the condition on the Parkinson disease patient, a clinical care scheme has been developed. To classify Parkinson's disease and overcome this complicated challenge, the suggested Machine Learning (ML) induced Logistic Decision Regression (LDR) algorithm is used. Early diagnosis of Parkinson's disease will contribute to improved care and disease control, thereby enhancing the quality of life of patients. To create such successful decision support, an automatic prediction system focused on machine learning was developed and presented. Result and Findings: This data collection would be used to classify possible biomarkers of Parkinson's disease using Machine Learning (ML) and Big Data (BD) technologies. The organization's disease prediction technology, which is focused on machine learning and large data, enhances human wellbeing while further promoting the big data industry of disease prediction. In comparison to other current approaches, the simulation findings indicate a strong reliability

Parkinson’s disease: etiopathogenesis and treatment

Historic milestones:

Major milestones in PD etiopathogenesis include the identification of intracytoplasmic inclusion bodies (‘Lewy bodies’) as a pathologic hallmark by Frederick Lewy in 1912 and the discovery of dopamine deficiency and its

involvement in the parkinsonian animal models. The pioneering work of Arvid Carlsson and Oleh Hornykiewicz starting in 1957 established the link between dopamine deficiency and PD. The latter was supported by the proof of concept demonstrating clinical rescue in the first trial in PD patients with intravenous levodopa in 1961 and the introduction of high dosage levodopa therapy by George Cotzias in 1967.8

In 1982, William Langston, a neurologist, described seven patients in the San Francisco Bay Area who were using 'synthetic heroin' and developed parkinsonian features.9 Subsequent investigations revealed the cause of this drug-induced parkinsonism, 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine, which is toxic to substantia nigra dopaminergic neurons. The discovery had a remarkable impact on research into the etiopathogenesis of PD and experimental therapeutics, leading to drug trials in animal models and large-scale epidemiological studies on occupational exposure to potential toxins.

In 1996, Polymeropoulos and colleagues found genetic markers on chromosome 4q21-q23 to be linked to the PD phenotype in an Italian kindred and 3 Greek families with autosomal dominant PD, and the following year they reported a mutation in the α-synuclein gene (SNCA), highlighting for the first time that PD may have a genetic aetiology.10 11 This landmark discovery launched a highly productive period of successful gene hunting during which many more PD genes and genetic risk loci were identified. These findings facilitated the generation of genetic animal models which subsequently identified new therapeutic targets for clinical trials

Classification of Parkinson's disease and its stages using machine learning:

Methods:

Disease staging scales:

Parkinson's Disease rating scales are a means of assessing the symptoms of the condition by providing information on the course of the condition and/or assessment of an individual's quality of life. Disease severity was collected in accordance with the Hoehn and Yahr Scale (H&Y)31 (i.e., an internationally used PD progression rating method for clinical practice) and the MDS-Unifed Parkinson's Disease Rating Scale (MDS-UPDRS)32 (i.e., a scale developed to incorporate elements from existing scales to provide an ef-cient, fexible, and comprehensive means to monitor both motor and non-motor PD symptoms)33.

Due to its strong clinometric performance for motor assessments, a high correlation with MDS-UPDRS scores while minimizing intra-subject variance, in addition to providing a concise means of summarizing patient status, the H&Y staging scale was used in the classification of individuals in this preliminary work to maintain heterogeneity and efciency30,33,34. The stages of the H&Y scale are listed below:

• Stage 1: Symptoms are present on one side only (unilateral).

• Stage 2: Symptoms are present on both sides but no impairment of balance.

• Stage 3: Balance impairment and mild to moderate disease progression.

• Stage 4: Severe disability, but still able to walk or stand unassisted.

• Stage 5: Needing a wheelchair or bedridden unless assisted.

Rasagiline as Adjunct to Levodopa for Treatment of Parkinson's Disease: A Systematic Review and Meta-Analysis

Rasagiline is a selective, irreversible monoamine oxidase type B inhibitor used as monotherapy in early Parkinson's disease and as an adjunct therapy to

levodopa in Parkinson's disease with motor fluctuations. Objectives. This meta-analysis aimed to provide updated evidence on the efficacy for motor and nonmotor symptoms and the safety of rasagiline/levodopa versus levodopa in patients with Parkinson's disease experiencing motor fluctuations. Methods. A systematic literature search was conducted (January 18-19, 2021) using PubMed, Cochrane Library, EMBASE, Web of Science, and Google Scholar to identify randomized controlled trials comparing rasagiline/levodopa versus placebo/levodopa in patients with Parkinson's disease experiencing motor fluctuations. Outcomes included change in wearing-off time, Unified Parkinson's Disease Rating Scale (UPDRS)/Movement Disorder Society-UPDRS (MDS-UPDRS) II and III scores, treatment-emergent adverse events (TEAEs), and Parkinson's Disease Questionnaire (PDQ-39) summary index score. A random effect model was used to estimate the treatment effects. Results. Six studies were included (1912 patients). Significant improvements in wearing-off time (standardized mean difference [SMD]: −0.50, 95% confidence interval [CI]: –0.92 to –0.09,), levodopa dosage (SMD: −0.18, 95% CI: −0.35 to –0.01,), UPDRS/MDS-UPDRS II (SMD: −0.39, 95% CI: −0.52 to –0.25,), UPDRS/MDS-UPDRS III (SMD: −0.30, 95% CI: −0.44 to –0.16,), and PDQ-39 summary index score (SMD: –0.21, 95% CI: –0.37 to –0.04,) were observed with rasagiline/levodopa versus placebo/levodopa. The incidence of TEAEs did not differ between treatments (risk ratio: 1.13, 95% CI: 0.98–1.30).

Telerehabilitation: A Practical Remote Alternative for Coaching and Monitoring Physical Kinetic Therapy in Patients with Mild and Moderate Disabling Parkinson's Disease during the COVID-19 Pandemic

The COVID-19 pandemic imposed social/physical distancing, lockdown measures, and forced reorientation of the rehabilitation programs for people with Parkinson's disease (PD). Epidemiologic safety measures boosted remote exercise-based treatment. Objectives. Remote delivery of rehabilitation care services is not typically used in our department. Therefore, this study aimed to assess and implement a telehealth physical rehabilitation program tailored for outpatients with idiopathic PD and slight or medium functional limitations. Methods. A prospective study was performed on a group of outpatients with idiopathic PD, selected from the database of the neurorehabilitation clinic of the Emergency Teaching Hospital "Bagdasar-Arseni." We studied 17 patients (5 women and 12 men), aged between 54-70 years (average 65.9 ± 4.87), with a disease history of 7.3 ± 3.6 (years), with mild or moderate disabling clinical forms, quantified by an average Hoehn and Yahr score of 2.3 ± 0.35 (limits 1.5-3). All patients underwent pharmacologic treatment with unchanged doses throughout the study. No patients had disabling osteoarticular problems (all could walk independently) and had no significant psycho-cognitive dysfunction. Patients were supervised and coached online in tandem by the therapist and physician. In addition, a family member assisted and supervised the patient's performance and coordinated the technical electronic procedures. Walking biodynamics was assessed by timing "6-meters walking" and "Get up and walk 3 meters" (TUG) tests. Each person attended ten sessions of motor telerehabilitation procedures (2 per week) lasting 50 minutes each during social distancing (October-December 2021). Results. None of the patients was at increased risk of falling. They all improved their locomotor performance, reflected in a significant decrease in TUG duration (the initial average time improved from 13.50 seconds to 10.57). The telerehabilitation program also significantly improved the average walking speed (initially, 44.5 cm/sec and finally, it raised to 56.8 cm/sec). Discussion. The TUG and "6-meters walking" tests are helpful tools for a global biodynamic remote assessment of PD patients.

Limitations of the study: a small group of selected patients, restrictive working conditions (due to epidemiological social/physical restrictions and no direct physiotherapist-patient contact), and need for supervision by an attendant to assist the subject and perform the audio-video transmission. Further studies are necessary to identify the optimal web-based model of care and boost the implementation of this modern neurorehabilitation concept. Conclusions. Telemedicine turned the virtual space into a new reality and may compensate for the restrictions imposed on face-to-face meetings in pandemic conditions. Moreover, with modern telecommunication techniques, a regular and individualized physical kinetic rehabilitation program can be performed even in pandemic conditions. Remote delivery of kinetic motor programs was appropriate for selected groups of PD patients.

Central Aortic Pressure and Arterial Stiffness in Parkinson's Disease: A Comparative Study

Cardiovascular autonomic dysfunction, which leads to hemodynamic disorders, is commonly observed in patients with Parkinson's disease (PD). Central aortic pressure (CAP) is the systolic blood pressure (SBP) at the root of the aorta. In young people, CAP is lower than peripheral arterial blood pressure. In older people, the difference between CAP and peripheral arterial blood pressure decreases depending on the extent of arterial stiffness (AS). In patients with AS, CAP increases. CAP is thus regarded as an indicator of AS. Objective. To compare CAP and other hemodynamic parameters for AS between patients with Parkinson's disease and control group. We also aimed to evaluate changes in these hemodynamic parameters after the levodopa (LD) intake. Methods. We included 82 patients with PD and 76 healthy controls. Age, sex, disease duration, disease subtype, Hoehn–Yahr stage (H&Y), and nonmotor symptoms (NMS)

were documented. TensioMed Software v.3.0.0.1 was used to measure CAP, peripheral arterial blood pressure, pulse pressure (PP), heart rate (HR), mean arterial pressure (MAP), augmentation index (AI), pulse wave velocity, and ejection time. All patients were being treated with LD, and measurements were performed 1 h before and 1 h after LD intake. Results. Baseline peripheral arterial blood pressure and CAP values were significantly higher in the PD group than in the control group (and , respectively). Most cardiac hemodynamic parameters, including peripheral arterial blood pressure and CAP, decreased significantly (and , respectively) after LD intake in the PD group. Disease subtype, duration, and severity did not affect any of the hemodynamic parameters. When NMS were evaluated, patients with psychosis and dementia showed higher baseline parameters. Conclusion. Loss of postganglionic noradrenergic innervation is well-known with PD. Several cardiac hemodynamic parameters were affected, suggesting cardiac autonomic dysfunction in these patients. The data obtained were independent of disease severity, duration, and subtype. After LD intake, most of these parameters decreased, which might have a positive effect on the vascular burden

Parkinson's Disease and Its Management

General Approach To Management

The primary goal in the management of PD is to treat the symptomatic motor and nonmotor features of the disorder, with the objective of improving the patient's overall quality of life. Appropriate management requires an initial evaluation and diagnosis by a multidisciplinary team consisting of neurologists, primary care practitioners, nurses, physical therapists, social workers, and pharmacists.14,132 It is also important that the patient and his or her family have input into management decisions.

Effective management should include a combination of nonpharmacological and pharmacological strategies to maximize clinical outcomes. To date, therapies that slow the progression of PD or provide a neuroprotective effect have not been identified.135,135 Current research has focused on identifying biomarkers that may be useful in the diagnosis of early disease and on developing future disease-modifying interventions.