**Project Design Phase-I**
**Proposed Solution**

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| Date | 20 October 2022 |
| Team ID | PNT2022TMID51528 |
| Project Name | Detecting Parkinson's Disease Using Machine Learning |
| Maximum Marks | 2 Marks |

## PROBLEM STATEMENT:

More than 10 million people are living with Parkinson's Disease worldwide, according to the Parkinson's Foundation. While Parkinson's cannot be cured, earlydetection along with proper medication can significantly improve symptoms and quality of life.Parkinson's disease disorder is a brain disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination. The researchers found that the drawing speed was slower and the pen pressure is lower among Parkinson's patients. One of the indications of Parkinson's is tremors and rigidity in the muscles, making it difficult to draw smooth spirals and waves. It is possible to detectParkinson's disease using the drawings alone instead of measuring the speed and pressure of the pen on paper.

## IDEA/SOLUTION DESCRIPTION:

There are many ways to solve a single problem. One of those methods is those to detect the specific symptoms that are found uniquely for the Parkinson's patients. This includes the detection of Parkinson's disease using the drawings alone instead of measuring the speed and pressure of the pen on paper. We can try to quantify the visual appearance of these drawings and then train a machine learning model to classify them. We can use the Histogram of Oriented Gradients (HOG) image descriptor along with a Random Forest classifier to automatically detect Parkinson's disease in hand-drawn images of spirals and waves. Another type of method is that the studies investigates signals from it sustained phonation and text dependent speech modalities for Parkinson's disease screening. Parkinson disease affect vocal chord so the motion of speech is detected and evaluated. This can also be a more appropriate method to detect Parkinson's.

## NOVELTY/UNIQUENESS:

According to a 2017 study by Zham et al., Parkinson's can be identifiedby having the patient draw a spiral and then tracking the drawings. A test that includes sketching a spiral on a piece of paper could be used to identify people who are at risk of gettingParkinson's disease, according to Australian researchers. A neuro-degenerative conditioncalled Parkinson's disease results in trembling, tight muscles, and trouble walking. Theresearchers created a specialized automated electronic system that measured writing speeds, pen pressures, and produced the Composite Index of Speed and Pen-pressure (CISP) score in Parkinson's patients. All three measurements were used to determine whether a participant hadParkinson's disease or not. With this we can create a unique model specific to Parkinson**.**

## SOCIAL IMPACT/CUSTOMER SATISFACTION:

Since it uses the machine learning model to identify these drawings based on their visual appearance (using the HOG approach), it is less prone to errors. In this research, we are utilizing a Random Forest classifier and the Histogram of Oriented Gradients (HOG) image descriptor to automatically identify Parkinson's disease in hand-drawn spirals and waveswhich can be easily implemented. It is convenient to use. It helps to detect without cost and helps to avoid travelling and the time taken.

## BUSINESS MODEL(Financial benefit):

The EBC Value of Treatment Initiative combined different stakeholders to identify unmet needs in the patients' journey according to Rotterdam methodology. The economic evaluationfocused on three major topics identified as major gaps: start of treatment; best treatment for advanced disease; and adherence to treatment. Two separate healthcare systems (Germany and the UK) were chosen. Cost-effectiveness was determined by using decision-analytical modelling approaches. Effectiveness was expressed as quality-adjusted life-years (QALYs) gained and incremental cost-effectiveness ratio. Treatment intervention in PD was found to becost-effective regardless of the initial health state of the patient receiving the treatment. Cost savings were between -€1000 and −€5400 with 0.10 QALY gain and -€1800 and -€7600 with
0.10 QALY gain for Germany and the UK, respectively. Treatment remains cost-effective within the National Institute for Health and Care Excellence thresholds. Availability of adequate treatment to more patients was also found to be cost-effective, with an ICER of
€15,000–€32,600 across country settings. Achieving the target adherence to treatment wouldgenerate cost-savings of €239,000–€576,000 (Germany) and €917,000–€2,980.000 (UK) forevery 1,000 patients treated adequately.

## SCALABILITY OF SOLUTION:

### UPDRS Subscale 1: Mentation, Behavior, and Mood

The examiner asks the patient about each of the following areas of cognitive function or mood and the rater scores the answers from 0 to 4, with 4 representing the greatest level of dysfunction, based upon the responses of the patient or a caregiver. The sum of these scores for this subscale can range from 0 (normal) to 16.

1. Intellectual impairment (the list of possible responses can be read to the patient andexamples provided as needed). Possible ratings of patient response:
    - 0–none
    - 1–mild consistent forgetfulness with partial recollection of events and no otherproblems

    - 2–moderate memory loss, with disorientation and moderate difficulty handling complex problems
    - 3–severe memory loss with disorientation with respect to time and often place; severe difficulty with complex problems
    - 4–severe memory loss with orientation preserved only to person; unable to make judgments or solve problems, cannot be left home alone
2. Thought disorder (read the possible responses for the patient). Possible ratings of patient response:
    - 0–none
    - 1–vivid dreaming
    - 2–benign hallucinations with insight preserved, that is, the patient is able to distinguish that the hallucinations are not real
    - 3–occasional to frequent hallucinations or delusions with preserved insight; could interfere with activities of daily living
    - 4–persistent hallucinations, delusions or florid psychosis, not able to care for self

**UPDRS Subscale 2: Activities of Daily Living**

The examiner asks the patient to describe his or her function separately in the ON and OFF state. The responses for each of the 14 items on subscale 2 are therefore scored twice, once forON and once for OFF. These ratings are done by the examiner based upon the responses of thepatient or caregiver. The total score for subscale 2 ranges from 0 to 56.

1. Speech:
    - 0–normal
    - 1–mildly affected, with no difficulty being understood
    - 2–moderately affected, occasionally asked to repeat statements
    - 3–severely affected and frequently asked to repeat statements
    - 4–unintelligible most of the time
2. Salivation:
    - 0–normal
    - 1–slight but definite excess of saliva; may have nighttime drooling
    - 2–moderate excessive saliva; may have minimal daytime drooling
    - 3–marked excessive saliva; some daytime drooling
    - 4–marked drooling; requires constant use of tissue or handkerchief
3. Swallowing:
    - 0–normal
    - 1–rare choking
    - 2–occasional choking
    - 3–requires soft food
    - 4–requires nasogastric tube or gastroscopy tube for feeding

**UPDRS Subscale 3: Motor Examination**

Subscale 3 is an examiner rating of the motor manifestations of PD. This is the most commonly used subscale and has 14 different types of ratings, with many of these ratings done

independently for the different limbs. Each of the ratings ranges from 0 to 4. The original UPDRS included only integers, but some use 0.5 increments; however, use of these 0.5 increments has not undergone clinometric testing or validation. The total score for subscale 3 ranges from 0 to 108, the sum of scores from 27 observations

**Proposed Solution :**

| S.No | Parameter | Description |
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| 1. | Problem Statement (Problem to be solved) | Parkinson's disease disorder is a brain disorder that causesunintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination.<br>Symptoms usually begin gradually and worsen over time. Asthe disease progresses, people may have difficulty walking and talking. |
| 2. | Idea / Solution description | Studies investigates signals from sustained phonation and text dependent speech modalities for Parkinson's disease screening. Phonation corresponds to the vowel voicing task and speech to the pronunciation of a short sentence, signal will be recorded through channel simultaneously through mobile phone or microphone. Parkinson disease affect vocal<br>cord so the motion of speech is detected and evaluated. |
| 3. | Novelty / Uniqueness | Testing 25 non impulsive patients with Parkinson's disease (PD) and 27 PD patients with impulsive compulsive behaviors(ICBs). Both patient groups were examined "on" and "off" dopaminergic medication in a counterbalanced order and their behavior was compared with 24 healthy controls. We found that PD patients with ICBs were significantly more prone to choose novel options than either non impulsive PD patients or controls, regardless of medication status. Our findings suggest that attraction to novelty is a personality trait in all PD patients with ICBs which is independent of<br>medication status. |
| 4. | Social Impact / Customer Satisfaction | Since it is based on the voice based detection it is very convenient to use. As it helps the people to detect theParkinson's disease in early stage, the loss of life is<br>prevented. It detects without cost and helps to avoidtravelling and time. |
| 5. | Business Model (Revenue Model) | A free platform with useful feature. Any adult and young people can use it and suggest it to others to increase the value |
| 6. | Scalability of the Solution | Additional features can be added anytime anywhere. Anynumber of users can access it all at once. |