

# Gelapark: Parkinson's Diagnosis Support System

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## INTRODUCTION

Since the boom of computer science during 1990s, computer applications become useful resource on the discovery of new pathologies diagnosis, treatments and cures. That pursuit becomes one of the most important subject in medical informatics research and development (R&D). A type tool used for this purpose is Decision Support Systems (DSS), this kind of tool is very helpful, not only retrieve data, but help on processing it. These tools have been very important in prevention, and become the first line of defence against many diseases. However, nowadays exists a huge range of diseases which still become untraceable.

This chapter describes a decision support system for parkinson's disease diagnosis called Gelapark. The main goal of this system is tracing an evolution status on patient's disease.

Therefore, this system is split in five different tests, which evaluate the main symptoms of parkinson's disease, which include the daily basis activities of the patient, this is made through a questionnaire, usually this gets the most value information about the patient, and a reflexes test, voice analysis, these last two tests are done interacting with the computer, an eyelid blinking count and patient signature evolution. All these tests contain weights and the final result is based on the evaluation of the physician. The software have an algorithm running in the background, looking for patterns on the patients results, no matter if there are positive or negative results, if the patients result fit in a pattern, the patient will be marked and this could lead to an early detection of parkinson's disease.

Although this system current state is initial, with some enhancement this can be one of the main tools available to premature detection of Parkinson's disease (PD).

## BACKGROUND

The first clinical signs of PD are very discreet, when the symptoms become less discreet that usually means that parkinson's is already in an advanced state and that is a huge obstacle for premature detection. A premature detection can help prepare him to some life aspects during advanced stages of PD.

## Disease Description

PD has been known since ancient times, was first cogently described by James Parkinson (PD acquired his name) in 1817. In his words, it was characterised by “involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forward, and to pass from a walking to a running pace, the senses and intellect being uninjured.” (Ropper, Samuels, & Klein, 2014). James Parkinson, was an apothecary surgeon, who produced a monograph

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in 1817 entitled “An Essay on the Shaking Palsy” in which he described six people with a hitherto unrecognised neurological disorder (Whone, Abhinav, & Edwards, 2012). PD is a chronic and progressive neurodegenerative disorder characterised by slowness in the initiation and execution of movement (bradykinesia), increased muscle tone (rigidity), tremor at rest, and gait disturbance (Lewis, Dirksen, Heitkemper, & Bucher, 2014). It is estimated that approximately 5 million people in the world suffer from this disorder. PD affects men and women of all races, all occupations, and all countries. It is the fourth most common neurodegenerative disease.

The mean age of onset is about 60 years, but cases can be seen in patients in their 20s, and even younger (Olanow & Schapira, 2013). The diagnosis of PD increases with age, with the condition affecting about 2% of people over 60 years old. However, 15% of those diagnosed with PD are less than 50 years old. PD is more common in men by a ratio of 3:2 (Lewis, Dirksen, Heitkemper, & Bucher, 2014). The frequency of PD increases with ageing, and based on projected population demographics, it is estimated that the prevalence will dramatically increase in future decades (Olanow & Schapira, 2013).

PD etiology is unknown because scientists don't know what happens to the dopamine-producing cells in the brain, located in the substantia nigra, to die. The brain is no longer able to direct the muscles to perform in the usual manner. This lack of communication between the brain and the muscles can have a deep impact on the patient's ability to ambulate safely, perform daily tasks and job functions, or enjoy leisure activities. The symptoms may also have a significant negative impact on the patients self-esteem.

There are maybe genetic component, especially in younger patients. Certain environmental toxins may also influence. The increased risk of developing PD in non-smokers and low caffeine drinkers is not understood. Although the explanation could be that nicotine is neuroprotective, an alternative explanation is that PD occurs more commonly in people with low pre-morbid novelty seeking personality traits. Never smokers are twice as likely to develop PD. Low caffeine intake slightly increases the risk of developing PD (Abhinav, Edwards, & Whone, 2012). Certain environmental toxins, such as exposure to the drug MPTP, and carbon monoxide poisoning can produce a parkinsonian disorder, but this is not the same as idiopathic Parkinson's disease. Only a few environmental causes have been so far identified (Whone, Abhinav, & Edwards, 2012).

## Symptoms and Signs

Parkinson's disease has a gradual onset and symptoms progress slowly over a chronic, prolonged course. The three cardinal signs are tremor, rigidity, and bradykinesia. There also other important features in PD diagnosis (Hinkle & Cheever, 2014).

- **Tremor:** Although symptoms are variable, a slow, unilateral, resting tremor is present in 70% of patients at the time of diagnosis. Resting tremor characteristically disappears with purposeful movement, but is evident when the extremities are motionless. The tremor may present as a rhythmic, slow turning motion of the forearm and the hand and a motion of the thumb against the fingers as if rolling a pill. Tremor is present while the patient is at rest (Hinkle & Cheever, 2014). Tremor is typically asymmetric, present at rest and improved by action, increased by mental strain (Whone, Abhinav, & Edwards, 2012). The tremor most commonly involves the upper limb, producing either flexion/extension movements or pronation / supination or a combination of these (Perkin, 2004).
- **Rigidity (Muscular):** Muscular Rigidity is the increased resistance to passive motion when the limbs are moved through their range of motion. Parkinsonian rigidity is typified by cog wheel

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