An integrated system for Parkinson's disease patient management and follow up

Supervisors:
José Maria Amaral Fernandes , IEETA/Universidade de Aveiro (jfernan@ua.pt)
João Paulo Silva Cunha, FE/Universidade de Porto (jpcunha@fe.up.pt)

Hosting Institution:
IEETA/ University of Aveiro

The context

Parkinson's disease (PD) is a relatively disabling disorder with a worldwide footprint that affects a wide age range. It is the second most common neurodegenerative disorder, with a prevalence of 1-2% in the population older than 60-65 years. Disease prevalence is expected to escalate in the next decades as the population ages [1]. The motor impairments of PD are known as parkinsonism (bradykinesia, rest tremor, rigidity, postural and gait impairment). Motor complications emerge during disease, being a major source of disability and decreased quality of life.

Clinical practice is based on empirical observations with limited ability to provide effective management of PD patients. The scales used to classify the PD stage are based on standard protocols and qualitative assessment of a set of task that generates an index (e.g. CAPIT, UPDRS) performed in clinical environment. Despite the fact that a wealth of information can be gathered and analysed (e.g. clinical clues, video) and clinical expertize exists a systematic quantitative assessment to support PD patient management and the choice of the best therapeutic still does not exist. A combination of several factors contributes to this situation:1) lack of motor impairment characterization, 2) no integrated solution of patient management that combines the multimodal information and/or 3) the impossibility of assessing the real impact of PD stage on the quality of life of patients on day to day environment (e.g. ambulatory solution).

This proposal is within the context of ongoing projects/ collaboration with the Unit of Movement disorders lead by professor Rui Vaz at Hospital de S. João, Porto. An Ethics committee approval has been issued to this team to carry the proposed (an other) studies in clinical, surgery and ambulatory PD follow up context.

The motivation

Based on our team experience, the information extracted using motion quantification solutions namely motion tracking can be valuable in motion related disorders characterization as illustrated by our team contributions in neurological diseases [2, 3], namely on new technical contributions such as 3D movement quantification in the hospital ward [4] and in an fMRI environment [5].

Simultaneously new mobile devices offer a realistic solution to support 1) data gathering, 2) data pre-processing and 3) integration with IT systems namely in ambulatory scenarios resourcing to wearable technologies namely in cardiology [6] and first responders monitoring [7].

In PD context, both movement quantification and wearable/mobile technologies have the potential to provide some solutions needed to implement a systematic quantitative assessment for PD patient management: 1) to quantify PD motor impairments, 2) provide an integrated IT ambulatory solution for gathering and querying obtained information to 3) support clinical decision.

Objectives and challenges

The objective of this proposal is the inception, design and implementation of **an integrated system for PD's patient management and follow up** including an ambulatory setup and online clinical decision support system.

We envisage the following challenges in the following areas:

- Computer vision and motion tracking for motor impairment characterization based on motion tracking techniques over video and/or through the use of accelerometer, gyroscopes and magnetometers and posture information namely those provided on new mobile devices or wearable devices;
- Data reduction in the process of identifying patterns that characterize motor impairments not only allows capturing relevant information but also makes more plausible online decision support methods ;

- Mobile computing technology to support ambulatory setup either at home or in operation room environment to provide online feedback and support in clinical diagnosis and therapeutic process;
- Definition of a quantitative counter part of qualitative scale of PD stages as a human understandable representation of a specific PD ontology / set of rules;
- Data mining and decision support systems to identify or suggest clinical evidences critical to clinical decisions namely quantified cost-benefit estimation based on both PD historic records (personal and/or population) or personal evolution;
- Ontology or data model to support the patient related information namely integrating data (e.g. with different formats, time and space scales) and knowledge (codify/manage the PD findings at patient and population level).

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