Welcome to the fifth of the six monthly newsletters for the CuPiD project.

CuPiD Validation Phase Started

The two clinical partners involved in the CuPiD project, Tel Aviv Sourasky Medical Center (Israel) and KU Leuven (Belgium), have started with the validation phase of the CuPiD project. In this phase, two smartphone applications for gait training will be evaluated. Both apps collect data from wireless sensors attached to the patient’s body, the data is analyzed in real-time in order to determine if feedback has to be given to the patients.

1. The freezing of gait (FOG) app requires patients to perform a series of FOG provoking exercises. Based on the clinician’s evaluation the system can be set to start an auditory rhythm (cue) if a FOG-event is detected or it can be set to cue during the exercise, but stop the cues when a FOG-event is detected.

![Patient during exercise using the FOG app](image)

2. The Audio-Biofeedback (ABF) app continuously compares the patient’s ongoing gait during the training with their optimal performance. The optimal performance is determined and saved in the app under the clinician’s supervision. Based on the clinician’s evaluation of the specific patient, the most important gait parameters (e.g. step length, cadence) are set for future training sessions.

Partners:

- Università di Bologna (Italy)
- Tel-Aviv Sourasky Medical Center (Israel)
- Eidgenössische Technische Hochschule Zürich (Switzerland)
- KU Leuven (Belgium)
- Oxford Computer Consultants (UK)
- ST Microelectronics (Italy)
- EXEL (Italy)
- Fundació Illes Balears Innovació Tecnològica (Spain)

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In order to evaluate the efficacy of the CuPiD enhanced training, each clinical center will train 10 patients with the CuPiD system and another 10 patients with the current standard of gait training. Standard of gait training is a weekly follow up by a therapist who gives guidelines on what aspect of gait to focus and the amount and duration of training. All participants will be evaluated in a series of gait and balance tests before and after the 6 weeks training period and again 4 weeks after the end of the training period. This way the CuPiD enhanced training can be compared with the current standard of gait training.

In the beginning of April the Tel Aviv Sourasky Medical Center started with the first tests and training sessions. Pieter Ginis from KU Leuven joined them to finalize the details of the testing and training protocol and to perform the study in the same manner in Belgium.

All clinicians were happy about the immediate effect the feedback had on the first training performance of the patients. Also, the first patients and their spouses reported high satisfaction with the CuPiD enhanced training.

Technical Review Report for Year 2
The Cupid project had its 2nd Technical Review in December 2013. Overall, the Report is very favourable saying that most of the project’s objectives and technical aims had been achieved; good progress had been made in technical and clinical issues.

The most innovative feature to date is the biofeedback module and preliminary clinical results show that the system has value. The Report found that the team had defined the niche market it is aiming for – the proposed system representing a significant move forward for PD patients, especially in the field of FOG and FOG training.

The report for the Freezing of Gait Development and Assessment, mentioned that the multimodal dataset collected is a definite plus, the Android-based portable platform is well developed and was used with good results in the clinical studies.

All the Milestones and deliverables for this period were approved.
CuPiD Videos

CuPiD consortium member, Tel-Aviv Sourasky Medical Center, (TASMC) have produced a series of videos from their home pilot study of the CuPiD system. The videos show Parkinson’s disease patients from the trial in their home setting, using the technology developed for the CuPiD project, including sensors, audio feedback devices and smartphone app. All the videos can be seen on the CuPiD blog.

Published Papers

Members of the consortium have contributed to a number of full published papers:

*Engineers Meet Clinicians: Augmenting Parkinson’s Disease Patients to Gather Information for Gait Rehabilitation* (S. Mazilu, E. Gazit, U. Blanke, D. Roggen, J.M. Hausdorff, G. Tröster; ACM; October 2013), introduces for the first time the idea of prediction of FoG, using wearable accelerometers, as well as a first set of approaches.

*Technical and clinical view on ambulatory assessment in Parkinson’s disease* (M.A. Hobert, W. Maetzler, K. Aminian, L. Chiari; JohnWiley & Sons; April 2014), looks at progress of technologies of recent years, methods have become available that use wearable sensors and ambulatory systems to measure aspects of - particular axial - motor function. As Parkinson’s disease (PD) can be considered a model disorder for motor impairment, a significant number of studies have already been performed with these patients using such techniques. In general, motion sensors such as accelerometers and gyroscopes are used, in combination with lightweight electronics that do not interfere with normal human motion. A fundamental advantage in comparison with usual clinical assessment is that these sensors allow a more quantitative, objective, and reliable evaluation of symptoms; they have also significant advantages compared to in-lab technologies (e.g., optoelectronic motion capture) as they allow long-term monitoring under real-life conditions.


*A wearable system for gait training in subjects with Parkinson’s disease* (F. Casamassima, A. Ferrari, B. Milosevic, P.Ginis, E.Farella, L. Rocchi; MPDI; March 2014). In this paper, a system for gait...
training and rehabilitation for Parkinson’s disease (PD) patients in a daily life setting is presented. It is based on a wearable architecture aimed at the provision of real-time auditory feedback. Recent studies have, in fact, shown that PD patients can receive benefit from a motor therapy based on auditory cueing and feedback, as happens in traditional rehabilitation contexts with verbal instructions given by clinical operators. To this extent, a system based on a wireless body sensor network and a smartphone has been developed. The system enables real-time extraction of gait spatio-temporal features and their comparison with a patient’s reference walking parameters captured in the lab under clinical operator supervision.

Feedback is returned to the user in form of vocal messages, encouraging the user to keep her/his walking behavior or to correct it. This paper describes the overall concept, the proposed usage scenario and the parameters estimated for the gait analysis. It also presents, in detail, the hardware-software architecture of the system and the evaluation of system reliability by testing it on a few subjects.

Postural strategies assessed with inertial sensors in healthy and parkinsonian subjects, (C. Baston, M. Mancini, B. Schoneburg, F. Horak and L. Rocchi; Elsevier; March 2014) introduces a novel instrumented method to characterize postural movement strategies to maintain balance during stance (ankle and hip strategy), by means of inertial sensors, positioned on the legs and on the trunk. The paper evaluated postural strategies in subjects with 2 types of Parkinsonism: idiopathic Parkinson’s disease (PD) and Progressive Supranuclear Palsy (PSP), and in age-matched control subjects standing under perturbed conditions implemented by the Sensory Organization Test (SOT).

Book Chapter

CuPiD has a chapter in Telehealthcare Computing and Engineering: Principles and Design edited by Fei Hu and published in April 2013. The chapter is called Tele-rehabilitation System Based on Augmented Feedback for People with Parkinson’s Disease: Design Principles. The book, Telehealthcare Computing and Engineering: Principles and Design focuses on computing science and engineering design rather than the conventional medical and social aspects of design and explains in detail telehealthcare engineering system and individual hardware components.

Israel Neurologic Societies Annual Meeting

TASMC gave a presentation at the Israel Neurologic Societies annual meeting on freezing of gait in patients with Parkinson’s disease.
Telemedicine Technical Workshop

Oxford Computer Consultants (OCC) held a technical workshop at their offices in the centre of Oxford on the 14th April and invited projects building similar systems to attend. They demonstrate the CuPiD system and the exercises, and talked openly about what they found had gone well and what hadn’t. They also discussed their plans to provide the telemedicine on an open source basis at the completion of the CuPiD project.

The workshop was an open discussion for a technical audience enabling the exchange ideas and information. Representatives from StrokeBack, CogWatch and George Centre for Healthcare Innovation, Oxford University attended.

Smart Action SLAM

In October, Eidgenössische Technische Hochschule Zürich (ETHZ) presented a paper on a stand-alone Android app. Fully wearable, it has been designed to accurately track people at home in their daily life, with the potential of location aware support, at the Fourth IPIN International Conference which is world-wide the largest conference on indoor localization.

Digital Health

Reynold Greenlaw (OCC) attended a series of talks at the Digital Health Oxford events in December 2013 and February 2014. The speakers were Dr Chris Paton (The George Institute, University of Oxford), James Turnbull (co-founder at Incuna), Prof John Powell (Oxford Internet Institute and Dept. of Primary Health Care Sciences, University of Oxford), Dr Chris Hinds (lead software developer in the Dept. of Psychiatry, University of Oxford), Dave Fletcher (founder and managing director of Oxford-based White October) and Russell Brown (senior software engineer at Basho), covering a number of topics including mobile apps and on-line self-management systems.

ST Technology Days

ST Microelectronics, Università di Bologna (UNIBO) and EXEL presented work done by CuPiD through videos, posters and demonstrations at the National Museum of Science and Technology in Milan in October 2013 for the ST Technology Days (hosted by ST Microelectronics).
Monument Discovery Award: Open Afternoon

In 2009 Parkinson’s UK awarded their largest ever funding of £5million to the Monument Discovery Award at the University of Oxford. Over 1,200 people are now taking part in the study. Andrew Muddiman from OCC attended their open afternoon in Oxford where Dr Richard Wade-Martins and his team presented the projects progress and its plans for the future.

American Society of Neurorehabilitation

Lorenzo Chiari, the CuPiD Project Manager from lead consortium member, UNIBO attended the American Society of Neurorehabilitation (ASNR) Annual Meeting. Lorenzo presented a CuPiD Poster on Wearable Audio-Biofeedback System for Gait Rehabilitation of Persons with Parkinson’s disease at The ASNR Annual meeting which was held in San Diego on 7th and 8th November 2013.

MEDICA 2013 Trade Fair

A delegation from UNIBO and EXEL participated at the MEDICA 2013 trade fair in Dusseldorf. MEDICA is by far the most attended trade fair in the area of medical devices with around 135,000 people attending the event. Live demonstrations and presentations (via oral discussion, posters, videos, internal journal, banners, leaflets, etc.) of CuPiD projects main results were provided to a variety of professionals coming from all over the world.

ICT2013 Conference

A delegation from UNIBO participated at the ICT2013 conference and at the co-located F2F networking event. The CuPiD project was presented to several academic and industry attendees during both formal meetings and informal networking sessions.
eHealth and the Brain

Laura Rocchi (UNIBO) and Reynold Greenlaw (OCC) presented at eHealth and the Brain - ICT for Neuropsychiatric Health, held in Brussels on the 5th November 2013. Reynold’s presentation was on Telemedicine and eHealth for Neurology, and Laura presented on Neurological Conditions – Parkinson’s & Alzheimers, CuPiD Project. Both of these videos can been on the CuPiD Blog.

Awards

Alberto Ferrari from CuPiD lead UNIBO, has recently participated in a local competition for young researcher and won an award for the Audio-Biofeedback software developed within the CuPiD project. Innovators Under 35 Italy is the Italian Section of a global Reward by MIT Technology Review, the historical US magazine, that promotes the spread of emerging technologies and analyses their impact from many points of view: scientific, commercial, social and political.

At the IEEE international Conference on Pervasive Computing and Communications in March, members of the CuPiD project won Best Demonstration Award for their demonstration Gait Assist: A Wearable Assistant for Gait Training and Rehabilitation in Parkinson’s Disease.

Upcoming Events

ETHZ are hosting the 2014 International Conference on Wearable and Implantable Body Sensor Networks, in Zurich on the 19th June. UNIBO are co-organizing a Workshop named: Wearable Body Sensor Networks for Motor and Cognitive Rehabilitation.

On June 17th OCC is running a workshop in Oxford for the Cure Parkinson’s Trust (CPT), CPT were active in the SensePark project establishing the importance of wearable monitoring for people with PD in understanding their condition.

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