

# Mobile-based multi-dimensional data collection for Parkinson’s symptoms in home environments

Gent Ymeri<sup>1</sup>, Dario Salvi<sup>1</sup>, Carl Magnus Olsson,<sup>1</sup> Thanasis Tsanas,<sup>2</sup> and Per Svenningsson<sup>3</sup>

**Abstract**—We extended the Mobistudy app for clinical research in order to gather data about Parkinson’s motor and non-motor symptoms. We developed 5 tests that make use of the phone’s embedded sensors and 3 questionnaires. We show through data collected by healthy individuals simulating PD-symptoms that the tests are able to identify the presence of symptoms.

**Index terms**— mobile health, Parkinson’s disease.

## I. INTRODUCTION

Parkinson’s disease (PD) is a neurological degenerative disease that affects over 6 million worldwide [1]. Its assessment is based on subjective and infrequent clinical observations, however mobile phones and sensors can be used to measure symptoms at home and objectively. In this paper we propose a smartphone “app” to gather motor and non-motor PD symptoms.

## II. METHODS AND RESULTS

The app is an extension of Mobistudy, a mobile-based platform for clinical research [2]. Through a number of “tasks”, participants in clinical studies are invited to collect data from the mobile phone embedded sensors or Bluetooth-connected wearable devices. We designed 8 new tasks based on literature review and by consulting experts in the field:

- Timed up and go test. Is a standard test that measures balance and mobility, in which subjects are asked to rise from a standard armchair, walk to a marker 3m away, turn, walk back, and sit down again.
- Hold the phone test. Subjects are asked to hold the phone in three positions to measure three types of tremor: at rest, kinetic, postural.
- Finger tapping. Consists of tapping the screen of the phone with two fingers alternating. It is used to measure motor speed and lateralized coordination.
- Drawing test. Patients are asked to draw two shapes (a square and a spiral) using their fingers on the phone.
- Vocalization test. Collects voice samples during a guided vocalization exercise. It quantifies how much voice is affected by PD.

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<sup>1</sup>Gent Ymeri, Dario Salvi, Carl Magnus Olsson are with Internet of things and People, Malmö University, Sweden [gent.ymeri](mailto:gent.ymeri@mau.se), [dario.salvi](mailto:dario.salvi@mau.se), [carl.magnus.olsson@mau.se](mailto:carl.magnus.olsson@mau.se)

<sup>2</sup>Thanasis Tsanas is with Usher Institute, The University of Edinburgh, UK [athanasios.tsanas@ed.ac.uk](mailto:athanasios.tsanas@ed.ac.uk)

<sup>3</sup>Per Svenningsson is with the Department of Clinical Neuroscience, Karolinska Institute, Sweden [per.svenningsson@ki.se](mailto:per.svenningsson@ki.se)

- Questionnaires. We implemented the “Beck Depression Inventory” (BDI) to assess depression in PD, the “Parkinson’s disease sleep scale” (PDSS) to quantify sleep quality, and the “Parkinson’s Disease Questionnaire” (PDQ-8), to assess symptoms in 8 dimensions.

As a proof of concept we show signals collected from healthy subjects simulating PD symptoms. Figure 1 shows a) the distribution of the time between finger taps for a healthy vs a simulated PD test and b) acceleration signals from a healthy vs a simulated PD hold-the-phone test.

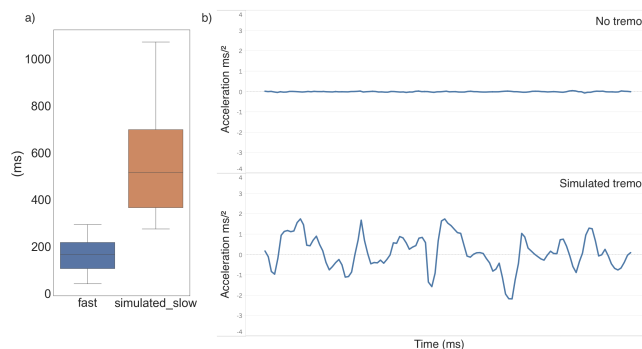


Fig. 1. a) Difference between taps, b) 2 seconds window: acceleration

## III. DISCUSSION AND CONCLUSIONS

We developed a number of mobile-based PD symptoms tracking tasks. Our results are partially similar to the ones proposed in the mPower study [3], although in mPower less tasks were implemented, 4 tests (memory exercise, finger tapping test, vocalization test and 20-step walk test) and 2 questionnaires (PDQ-8 and a subset of the Universal Parkinson Disease Rating Scale, MDS-UPDRS). We are currently designing a clinical study where 40 PD patients will use the app for 2 months with the aim to identify links between the data produced by the app with clinically assessed MDS-UPDRS.

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