Vocal biomarkers collected through conversational agents for diagnosis assistance and follow-up of sleep and mental disorders

Location : Bordeaux, France

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Co-supervisor : Pierre Philip, PU-PH, Sanpsy

Duration : 36 mois
Starting date : 01/10/2022
Gross salary : 2 135,00 € / month

Detailed subject:

The SANPSY and the Labri teams have demonstrated their ability to identify new vocal biomarkers to measure excessive daytime sleepiness both subjectively and objectively in patients suffering from sleep disorders [1]–[5]. SANPSY demonstrated the validity of autonomous numeric solutions (I.e. smartphone based virtual agents) to diagnose sleep/mental disorders in the general population [6]– [10]. We plan now to develop new virtual agents collecting biomarkers (i.e. from speech) in our healthy subjects and patients cohorts for diagnostic, treatment and follow-up (ADDICTAQUI, KANOPEE and AUTONOMHEALTH(PEPR) projects).

The PhD thesis project "Vocal biomarkers collected through conversational agents for diagnosis assistance and follow-up of sleep and mental disorders" relies on 4 stages:
1) developing new virtual agents to collect vocal markers:
        The objective is to design new scenarios targeting behavioral interventions to improve fatigue, mood and excessive daytime sleepiness. Moreover, the scenarios will be designed so that the agent interacts with the subject in order to engage a discussion (spontaneous speech). This will lead to more ecological conditions that should increase the acceptability.
2) switching from high-quality controlled recordings made at the hospital to in-the-field unsupervised recordings using smartphones.
        Our current vocal biomarkers are defined using a reading task and using high-quality microphones. The new interaction scenarios from task 1) will lead us to record spontaneous speech with smartphone microphones. This task will tackle the differences in recording conditions and their impact on our feature extraction pipeline.
3) verifying the relevance of the existing vocal markers when used with the new data and propose new features that could be used as high-level biomarkers such as lexical, syntactic and semantic cues.
        Our features will have to be adapted to consider the versatile nature of

spontaneous discourse which is a completely different speaking style from read speech. Spontaneous speech will however provide additional cues that could be used as high-level biomarkers such as lexical, syntactic and semantic markers.
4) studying the sensitivity and specificity of the selected biomarkers on diagnostic and follow up of symptoms and disorders with respect to other medical measures.

This final part of the PhD project will be addressed jointly by LaBRI and SANPSY and includes the clinical validation of the proposed approaches.

References:

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[6] L. Dupuy, J.-A. Micoulaud-Franchi, and P. Philip, 'Acceptance of virtual agents in a homecare context: Evaluation of excessive daytime sleepiness in apneic patients during interventions by continuous positive airway pressure (CPAP) providers', J. Sleep Res., vol. n/a, no. n/a, p. e13094, 2020, doi: https://doi.org/10.1111/jsr.13094.

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[9] P. Philip et al., 'Virtual human as a new diagnostic tool, a proof of concept study in the field of major depressive disorders', Sci. Rep., vol. 7, 2017.

[10] P. Philip, S. Bioulac, A. Sauteraud, C. Chaufton, and J. Olive, 'Could a virtual

human be used to explore excessive daytime sleepiness in patients?', Presence Teleoperators Virtual Environ., vol. 23, no. 4, pp. 369–376, 2014.

Work environment:
The PhD student will be hosted at LaBRI in the Image and Sound (I&S) department with frequent visits to SANPSY where he/she will interact with the clinicians and the designers of the virtual agents.

The I&S department conducts research in acquisition, processing, analysis, modeling, synthesis and interaction of audiovisual media. It works on the entire acquisition chain from data collection to information extraction or restitution of digital data with the user at the center of the chain. The spectrum of manipulated data is very wide: 2D and 3D images, video, speech, music, 3D data, EEG, pysiological data, etc. The different steps of the processing chain integrate modeling phases for analysis or synthesis. The targeted application domains are: health, medical, education, gaming, etc.

The SANPSY unit has a recognized expertise in sleep restriction studies and in the evaluation of countermeasures to sleep deprivation. The team is also specialized in sleep disorders, especially obstructive sleep apnea diagnostic and treatment. The SANPSY unit is located on the neuro-psychopharmacological research platform (PRNPP). This platform is recognized nationally and internationally for its expertise in clinical research, simulation and virtual reality. It has been labeled IBISA in 2015. In 2011, SANPSY obtained an EquipEx project (PHENOVIRT) that aimed to improve phenotyping using simulation and virtual reality technologies. Part of this project, SANPSY has initiated, in particular, the development of Embodied Conversational Agents (virtual doctors and patients). Several scenarios for the diagnosis of drowsiness, depression and addiction to tobacco and alcohol have already been developed and tested in patients.

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