Master Internship in Computer Science - University Paris-Sud

# Study on bio-physiological sensors to analyse cybersickness

**VENISE group** (http://www.limsi.fr/venise/) at LIMSI/CNRS
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The cybersickness remains a central issue in immersive experiments that Virtual and Augmented Reality (V&AR) technologies make them possible. Many works have been conducted on the occurrences of this trouble. However, methods of analysis are mainly based on subjective questionnaires which inform on the users state regarding symptoms supposed to characterize this sickness, such as: dizziness, nausea, cold sweats, disorientation, eye strain... This internship aims to study the potential contribution of bio-physiological sensors to analysis in real time this phenomenon.

The expected outcome of this internship is to define a model that allows to dynamically adapt the behavior of immersive interfaces, particularly in terms of virtual navigation control, according to the level of cybersickness detected in real time on users. As said above, the most current methods to evaluate cybersickness are based on the motion sickness susceptibility questionnaire (MSSQ) and the simulator sickness questionnaire (SSQ) performed after each task, or even at the end of the immersive experiment.

**Virtual navigation metaphor based on the 6DoF tracking of the user head**

Thus, users relate retrospectively, physical state in which they were during the experiment in terms of cybersickness. The only objective measurement of the cybersickness is its significant impact on reaction time of the users. Our hypothesis is that bio-physiological sensors could measure more finely and objectively the physiological status of individuals throughout a virtual experience. Actually, answering to questionnaires during a task disturbs the immersive experience of subjects. Conversely, the bio-physiological sensors should allow both to determine more accurately the physiological variables associated with cybersickness but also, to anticipate when such feeling is close to occur. Like previous studies [1], we will use the skin conductance level (SCL), the electrocardiogram (ECG), as well as the respiration rate and the reaction time of the users, as criteria to measure the cybersickness severity. However these studies have been carried out only with immersive headsets (HMD) and never within large immersive rooms (such as CAVE-like system).

The proposed approach starts from previous researches conducted within the VENISE team. We have demonstrated that a virtual navigation control that stimulates the vestibular system of the subject (such as the paradigm proposed in [2] – see figure) can significantly reduce the cybersickness compared to the techniques that do not stimulate it [3]. We therefore propose to revisit these experiments to study the signals from the various bio-physiological sensors that we will consider. The scenarios of these previous experiments are interesting because they oblige the subjects to achieve local objectives, perfectly identifiable in time and space for the data analysis, whatever the visual perceptual context (with or without spatial referents) and regardless of the navigation control technique.

CONTEXT: BlenderVR or MiddleVR/Unity, CAVE-like system (http://www.limsi.fr/venise/EVEsystem), Bio-physiological sensors.
MANDATORY SKILLS: Python or C# Programming.

REFERENCES

[1] Eugene Nalivaiko, Simon L. Davis, Karen L. Blackmore, Andrew Vakulin, Keith V. Nesbitt. Cybersickness provoked by head-mounted display affects cutaneous vascular tone, heart rate and reaction time. Elsevier, Physiology & Behavior 151 (2015) 583–590.
[2] Patrick Bourdot, and Damien Touraine. Polyvalent display framework to control virtual navigations by 6DoF tracking. In Virtual Reality, 2002. Proceedings. IEEE, pages 277–278, 2002.
[3] Weiya Chen, Anthony Plancoulaine, Nicolas Férey, Damien Touraine, Julien Nelson, and Patrick Bourdot. 6DoF navigation in virtual worlds: Comparison of joystick-based and head-controlled paradigms. In Proceedings of the 19th ACM VRST, pages 111–114, New York, NY, USA, 2013.