

Analysis and visualization of physiological and behavioral data to support reflexivity in Virtual Reality

LIRIS lab, SICAL team, CNRS, Lyon

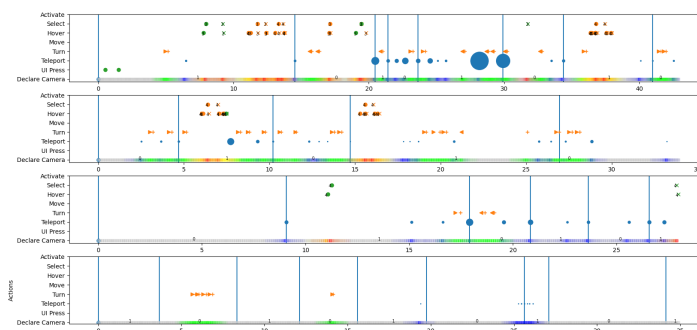
A PhD position is opened in the SICAL team of the LIRIS lab (INSA Lyon) on the analysis and visualization of physiological and behavioral data to support reflexivity in Virtual Reality, within the framework of the **ANR RENFORCE project** “Reflexive Multisensory Immersive Environment for Chemical Risk Training” (website: <https://renforce.projet.liris.cnrs.fr>).

Context. Current chemical risk training for chemistry students and professionals is mainly based on theoretical educational activities using e-learning platforms. After this theoretical training, learners are then directly confronted with real situations in the laboratories, which can be dangerous and stressful. They lack practical situations where they can develop the behavioral skills needed to prevent or react in case of emergency situations, for instance be attentive to the quality of the equipment, anticipate a risk of accident, and interpret implicit information (e.g. smell). Many studies have shown the benefits of Virtual Reality (VR) for training but **creating efficient Virtual Environments (VEs) for training behavioral skills is still raising scientific and technological issues**. In particular, existing studies report results on the acquisition of behavioral skills that consider isolated, short VR experiences. However, we argue that the immersive experience should be embedded in a more extended learning process, including self-reflection processes during and after the VR experience.



(a)

(a) XREcho Unity plug-in allows to record user interactions



(b)

(b) First prototype of visualization of behavioral data

Scientific objective: In this context, one of the main objectives of the RENFORCE project is to understand how the **visualization of behavioral and physiological indicators** during and after the embodied experience can improve learner reflexivity to ensure the acquisition of behavioral skills. We aim to **analyze multimodal data** collected while experiencing the virtual learning situations to identify and evaluate a set of relevant visual indicators both in the VR and in the debriefing environments.

The PhD student work will rely on an iterative process, by dealing first with the behavioral data collected through interaction traces and eye-tracking, and then the physiological basic indicators that will be produced using the sensors developed by the INL lab. The PhD student will conduct lab experiments to evaluate whether the visual indicators implemented in the VR environment provide a good balance between immersion and reflexivity; and how suggestive the experience needs to be in the debriefing environment to support reflexivity. Experiments in real-settings will also be conducted in an integrative perspective.

S/he will benefit from the strong expertise of the SICAL team in the analysis of users' behaviors from their interaction traces with interactive systems (Bouvier et al. 2014; Loup et al. 2016; Lavoué et al. 2021). A framework to aggregate and visualize multimodal data collected from a virtual environment

(questionnaires, interaction traces, eye tracking) has already been developed (see (b) above), as well as XREcho (Villenave et al. 2022), a Unity package that allows for the recording and replaying of users' behaviors and interactions during VR sessions (see (a) above).

A **first prototype of VE**, implemented by two interns during a preliminary cooperation between project members from INL and LIRIS labs is available at <https://www.youtube.com/watch?v=zGYqpc7nX6o>

The PhD student will work in close collaboration with researchers of the LIRIS-ORIGAMI team who have expertise in virtual reality, visual perception and subjective quality evaluation; the INL lab who has an expertise in the development of wearable sensors for psycho-physiological evaluation in real-life situations; and the ECP lab who has expertise in embodied cognition and the evaluation of learning processes and environments.

Skills:

- Good level in programming.
- Basic knowledge in statistics.
- Good level of English.
- Experience in programming virtual environments (C#, Unity) would be appreciated.
- Interest in disciplines related to human-computer interaction, data visualization, and cognitive sciences

Quality: Autonomy, ability to work in a team, appetite for research with end-users in the Education domain

Academic background: MSc degree in Computer Science (Engineering School or University)

Period: from September 2023 to August 2026

Duration: 3 years

Location: SICAL team, LIRIS, INSA Lyon

Salary: Approx. 2135€ gross

Applications:

- grades of the 1st and 2nd year of the Master's program
- a letter of motivation
- letters of recommendation

Deadline: July 1st 2023

Contact:

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Some references

Bouvier, P., Sehaba, K., Lavoué, É. (2014). A trace-based approach to identifying users' engagement and qualifying their engaged-behaviours in interactive systems: application to a social game. *UMUAI*, 24, 413–451. doi : 10.1007/s11257-014-9150-2

Lavoué, É, Ju, Q., Hallifax, S., Serna, A. Analyzing the relationships between learners' motivation and observable engaged behaviors in a gamified learning environment. *International Journal of Human-Computer Studies*, 154, 102670, 2021.

Loup G., Serna A., Iksal S. & George S. (2016). Immersion and Persistence: Improving Learners' Engagement in Authentic Learning Situations. *11th European Conference on Technology Enhanced Learning, EC-TEL 2016*, 16 septembre 2016, Lyon (France), pp. 410-415.

Villenave, S. Cabezas, J., Baert, P., Dupont, F., Lavoué, G., XREcho: A Unity plug-in to record and visualize user behavior during XR sessions, *ACM Multimedia Systems Conference (MMSys)*, June 2022.