PhD position : Multimodal interaction in XR for the transmission of craft know-how

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Abstract

Keywords : virtual reality, 3D interaction, motion capture, gesture training, embodiment, multi-sensory cues, transmission of craft know-how, hand-material interaction, hand-tool interaction.

1 Context

This thesis is part of the European ReSource project, which aims to safeguard and pass on know-how in the arts and crafts, in response to the challenge of generational transition. The project mobilizes collaborative robotics, artificial intelligence, and virtual and augmented reality, to create tools for capturing the craftsman's expert gestures, preserving them, and passing them on to future generations of apprentices.

2 PhD thesis topic

Virtual and augmented reality (XR) is a powerful tool for learning. Its contribution has been demonstrated in the case of learning procedures, or object assembly [1]. However, few approaches consider the fine interactions between the hands, the operator's body and raw material. These interactions are frequent in craft trades, for example, when hands work on deformable material.

Learning a manual craft activity is based on a range of sensory information (haptic, visual, sound, and olfactory). How can we transmit to a learner, through immersion in virtual or augmented reality, the right gestures to perform when shaping molten glass, making pottery, or polishing jewelry?

The objective of the thesis is twofold : 1) Explore and choose the most appropriate real-time feedback to provide to inform the user of his action and enable him to improve it. 2) Create novel passive haptics techniques that transmit tactile and effort information in the absence of an active haptic system.

The doctoral researcher will conduct research in the field of 3D interaction and XR. She/he will seek novel ways to teach procedures, tasks, and gestures by using embodied XR. The literature has studied the role of avatars and point of view (first person vs. third person) in training and presence [3, 5, 6], the use of a virtual training environment registered on the actual task [4][7], and the use of 3D visual trajectories to display gestures [2]. The research conducted in this postdoctoral work will extend those ideas or propose novel approaches using multi sensory feedback (tactile/haptic) or sensori-motor illusions [8].

The PhD candidate will perform researches to :

- Explore ways for training people to perform complex tasks and gestures by using embodied interaction.

- Explore novel feedback methods for correcting postures and giving recommendations to operators.

- Combine visual feedback and passive props to explore how to provide fine grain haptic information on hand-matter contact

3 Requirements

- Masters degree in Computer Science, Virtual Augmented Reality or similar relevant fields

- Strong knowledge of programming languages, e.g. Python, C/C++, C#

- Motivation for working in a multidisciplinary research project at the interface between artificial intelligence, computer science and 3D user interfaces

- a good level in English language (written and spoken)

- Additional knowledge in the following areas would be appreciated: game engine programming (Unity, Unreal), machine learning, conducting user studies, UX design

4 Hiring conditions

- 36-month full-time doctoral contract

- The position is open to all, with accommodations available for candidates with disabilities

- Start date: Between September 2024 and December 31st 2024

- Assignments will be carried out in the Robotics Lab in Mines Paris PSL University, 60 Boulevard Saint Michel, Paris, France

Other advantages:

- Telecommuting up to 2 days a week

- 49 days annual leave

- Public transport costs reimbursed up to 50%

- Sustainable mobility package (for carpooling or cycling)

- School and departmental staff associations

- Stimulating innovation ecosystem (startups, students, research, companies)

5 How to apply

The position is currently open, we welcome applications as of now, until filled. Interested candidates are required to send their applications including a CV with a publication list if any, a brief motivation letter explaining interests and qualifications regarding the position, prior research/work experience - all within a single pdf file - and contact information of two professional references to alexis.paljic@minesparis.psl.eu. Feel free to contact us for any questions regarding the position.

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