

## PhD Position F/M -

### Exploring the use of avatars in virtual urban environments

**Contract type:** Fixed-term contract (3 years)

**Level of qualifications required:** Graduate degree or equivalent

**Fonction:** PhD Position

**Level of experience:** Recently graduated

**Location:** PACCE team, Ecole Centrale de Nantes

**Starting date:** September/October 2024 (flexible)

#### Context

Offering the capacity to immerse users and provide strong illusions, Virtual Reality (VR) has already established a convincing usability for urban studies and design. This is especially true in the context of evaluating urban projects where the study of urban space perception by participants is a key aspect of the design phase [1]. In this context, questions related to the avatar, i.e. digital representation of a user in a Virtual Environment (VE), are becoming more and more important because of their potential influence on space and distance perception, especially as avatars have been demonstrated to improve immersion and the sense of “presence” in VEs [2]. Therefore, in the context of urban studies, the integration of virtual avatars during user experiences seems essential to improve immersion and perception of urban VEs. Yet, there is up to this day a gap of knowledge on the impact of being embodied in a virtual body on the perception of urban ambiances.

First, in order to have efficient experiences with avatars, users must feel strongly embodied in their virtual body, which is commonly characterized and assessed by studying the Sense of Embodiment (SoE) [3]. Moreover, it was shown that the perception of the avatar is altered by the type of task users have to perform in the VE [4]. It is therefore important to explore how tasks specific to urban spaces (e.g., large-scale navigation, negotiation of urban projects) may influence users' SoE. Furthermore avatars have rarely been studied in large outdoor VEs but rather in small controlled virtual rooms, reinvigorating the need to explore how such characteristics could influence one's own avatar perception. Second, while some works studied how visual cues in VR could impact the perception of urban ambiance, such as climate effects [5], it remains unclear how avatars could contribute in conveying a specific urban ambiance. Avatars' representations were also found to influence space perception in terms of distance or heights [6], but these works remain mainly limited to the perception of indoor virtual spaces, or only tackle the influence of size modulation of the avatar. On the one hand, we may wonder if such results extend to the perception of larger urban spaces? On the other hand, we can question if other avatar alterations rather than size change (e.g. change in the rendering from cartoon to realistic, etc.) might also influence the perception of urban spaces? Furthermore, it was demonstrated that seeing other users embodied in avatars in a VE could be taken as an evidence of one's proper existence in the VE, and could increase the sense of presence, engagement [7] and impact users behavior and perception of the VE by for instance

amplifying their reaction in the virtual experience. Yet, social interactions in VEs are often limited in these previous works, notably due to the technical challenges of tracking and giving feedback of users movements and facial expressions, and the context of urban space perception was rarely considered, leaving this question open: will social interaction in the VE enhance users' perception of urban ambiances?

## Supervision

The supervision will be handled by ECN and the PhD candidate will be physically located at ECN, in PACCE team of LS2N. The PACCE team has strong interests in Virtual Reality, human-computer interaction and Human Factors (<https://www.ls2n.fr/equipe/pacce/>). The team is composed of ~30 members including (12 permanent staff, 10 PhD students, 1 Postdoc, 1 VR/AR engineers).

The official supervisors of the PhD will be:

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## Assignment

In that context, the aim of this PhD is to explore how avatars can contribute to convey specific urban ambiances. In particular, we first want to create avatars that improve immersion in virtual urban environments. This requires understanding how avatars are perceived by users in this context. It is important to develop a new methodological approach to measure the perception of urban ambiances in VR in order to assess how they can be influenced by avatars' characteristics. We also want to develop avatar alterations (e.g., change in dimensions, rendering, etc.) that convey specific urban ambiances. This requires first to implement innovative avatar alterations that have either never been designed, or never used in the context of virtual urban spaces. We will then evaluate the influence of avatar alterations on urban ambiance perception. We also want to populate virtual urban environments with realistic virtual characters that would be either the virtual avatars of other users immersed in the same space, or the representation of agents driven by animations or artificial intelligence. Achieving a realistic population of such spaces requires understanding (i) how the virtual characters behave and (ii) how interacting with them may influence the perception of the urban space as well as the perception of one's own avatar.



Figure 1. Avatars in a virtual urban environment [8]

## Main activities

Therefore the main goal of the PhD will be to better understand the relation between avatars and the perception of virtual urban spaces. This implies, based on the embodiment research corpus as well as virtual urban environments literature, to study, design and quantify the specific relationship between avatar perception and urban ambiance perception in VR. More precisely, this will be done by designing and implementing immersive environments in Unity 3D (or Unreal Engine if preferred) to allow the immersion of users in virtual urban environments while being embodied in an avatar (see example figure 1), and then conducting user studies in order to evaluate different criteria, such as the sense of embodiment towards avatars with visual alterations (e.g., goosebumps), and how it may influence the perception of the environment (e.g., heat of a virtual place) and impact deeper societal dimensions (climate change sensibilization). In general, this PhD will aim to contribute in better understanding the psychological and societal implications of avatars in an urban context and their potential benefits for challenges such as climate change sensibilization or urban space lighting and danger perception.

## Bibliography

- [1] K. Lynch. The image of the city. MIT Press, Cambridge, Mass., 1960. doi
- [2] K. L. Nowak and F. Biocca. The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoper. Virtual Environ*, 12(5):481–494, 2003 doi
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- [4] R. Fribourg, F. Argelaguet, A. Lécuyer and L. Hoyet, "Avatar and Sense of Embodiment: Studying the Relative Preference Between Appearance, Control and Point of View," in *IEEE Transactions on Visualization and Computer Graphics*, vol. 26, no. 5, pp. 2062-2072, May 2020, doi: 10.1109/TVCG.2020.2973077.
- [5] T. Vigier, G. Moreau and D. Siret, "Impact of Visual Cues on Climate Perception in Virtual Urban Environments: A User Study," 2015 19th International Conference on Information Visualisation, 2015, pp. 500-505, doi
- [6] Aseeri S, Paraiso K and Interrante V (2019) Investigating the Influence of Virtual Human Entourage Elements on Distance Judgments in Virtual Architectural Interiors. *Front. Robot. AI* 6:44. doi
- [7] R. Fribourg, F. Argelaguet Sanz, L. Hoyet, A. Lécuyer. Studying the Sense of Embodiment in VR Shared Experiences. *VR - 25th IEEE VR*, Mar 2018, Reutlingen, Germany. pp.273-280, doi
- [8] F. Nosrat Nezami, M. Wächter, G. Pipa and P. König. (2020). Project Westdrive: Unity City With Self-Driving Cars and Pedestrians for Virtual Reality Studies. *Frontiers in ICT*. 7. 10.3389/fict.2020.00001.

## Skills

The candidate must have a master degree (or equivalent), with a preference in mixed reality or human computer interaction. In addition, the candidate should be comfortable with as much following items as possible:

Experience in 3D/VR/AR applications (e.g. Unity3D).

Experience in evaluation methods and controlled users studies.

Good knowledge in programming languages (e.g. C#, C++).

Good spoken and written English.

Good communication skills.

Benefits package

Subsidized meals

Partial reimbursement of public transport costs

Possibility of teleworking (90 days per year) and flexible organization of working hours

Partial payment of insurance costs

## Remuneration

Monthly gross salary amounting to 2100 euros.