

Development and Evaluation of a Virtual Crowd Platform for Augmented Reality Applications

Type d'offre : **Master Recherche**

Lieu de travail : **Rennes, équipe VirtUs**

Thème de recherche : **Perception, cognition, interaction**

Responsable scientifique : **Ludovic Hoyet**

Subject

Interactions with other persons are ubiquitous in our daily lives, ranging from social interactions in personal and professional situations, to physical interactions, e.g. in sports. For this reason, researchers have striven for years to understand, model, and replicate humans to include them in digital replicas, with impressive advancements made in topics such as capturing, rendering, animating, etc. Realistic virtual humans are therefore now common in entertainment applications (e.g., movies, videogames), but have also demonstrated their value in other fields such as architecture, training, education, etc.

Recently, realistic virtual humans have also started to be more and more used in immersive Virtual Reality applications in order to study human behaviours. Because of the complexity of studying human behaviours in controlled real situations, being able to immerse users in virtual replicas populated with interactive virtual humans provides a novel paradigm to explore such questions. For instance, VR was used to compare pairwise interactions between real and virtual situations [Olivier et al. 2018], to explore when pedestrians choose to go through or around groups of characters [Bruneau et al. 2015], to explore the relation between gaze activity and collision avoidance during pedestrian interactions [Berton et al. 2019, 2020], or to explore exit choices during evacuations [Ríos and Pelechano 2020]. It was even recently used to crowd datasets by immersing only one single user, successively embodying several virtual agents by him/herself [Yin et al. 2022].

However, immersive VR applications can have limitations in the level of realism and variety of scenarios that can be explored, because of the time and budget constraints required to develop a variety of scenarios. Instead, Augmented Reality could provide an interesting alternative to automatically deploy out-of-the-lab and in-the-wild applications directly in real situations. For instance, one could imagine using Augmented Reality to plan the organization of real events and evaluate the effects of specific arrangements on various crowd-related characteristics (e.g., evacuation, bottlenecks, flows), by automatically populating real places with virtual characters. Nevertheless, including virtual characters in AR applications, in particular involving large virtual crowds, is still challenging. It requires to include them in appropriate locations, depending on the topology of the environment that varies depending on the real scene. This becomes even more difficult when these characters are animated, as they should act according to the environment, and potentially interact with real humans that will be also present. While some attempts have been made at simulating virtual crowds in AR [Akaydin et al. 2013, 2014 ; Hürst and Geraerts 2019], these have only targeted extremely simple setups, and not complex real world situations, or for specific studies (e.g., pedestrian interaction with a virtual car in AR [Maruhn et al. 2020]).

The goal of this internship is therefore to explore novel applications for using virtual characters in AR applications. The first objective will consist in developing a virtual crowd framework to facilitate the inclusion of large numbers of virtual characters in augmented reality applications. The framework will be based on some of the tools already developed in the Virtus team for crowd simulation, character animation, and immersive virtual crowds, such as CrowdMP¹ and Umans². Then,

¹ <https://project.inria.fr/crowdscience/project/ocsr/crowdmp/>

² <https://project.inria.fr/crowdscience/project/ocsr/umans/>

dedicated applications will be developed to evaluate this framework, starting with an AR application for visualizing various crowd densities in real scenarios using virtual characters.

This internship therefore involves

- Developing a framework for simulation virtual crowds in AR applications
- Developing a number of simple scenarios of increasing complexity involving virtual crowds in AR (e.g., static characters only, dynamic characters reacting to the environment, etc.), based on a Vive Elite XR or on lighter devices.
- Evaluate the framework and how users perceive virtual crowds in AR situations.

Environment

The candidate will work in the joined Inria / IRISA research centre located in Rennes. Inria (www.inria.fr) and IRISA (<http://www.irisa.fr>) are amongst the leading research centres in Computer Sciences in France. The work will be supervised by members of the VirtUs team, internationally recognised in the fields of Computer Graphics, Virtual Human Simulation, and Virtual Reality.

The student will be paid at the standard legal minimal rate of 3.90€/h (gratification).

Important: starting and ending dates are only indicative and can be arranged depending on the candidate's constraints.

Requirements for candidacy

- Master in Computer Sciences, with proficiency in C++ or C#
- General background in Virtual Reality or Computer Graphics
- Experience with Unreal or Unity would be beneficial

Main advisor

We are looking for motivated candidates. Please send CV, motivation letter and any relevant material to Ludovic Hoyet (ludovic.hoyet@inria.fr – [website](#))

Keywords

Virtual Crowds, Character Animation, Augmented Reality

References

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