Evaluating Presence Strategies of Temporarily Required Virtual Assistants

Andrea Bönsch, Tom Vierjahn, and Torsten W. Kuhlen

Visual Computing Institute, RWTH Aachen University
JARA – High-Performance Computing
{boensch,vierjahn,kuhlen}@vr.rwth-aachen.de
http://www.vr.rwth-aachen.de

Abstract. Computer-controlled virtual humans can serve as assistants in virtual scenes. Here, they are usually in an almost constant contact with the user. Nonetheless, in some applications assistants are required only temporarily. Consequently, presenting them only when needed, i.e, minimizing their presence time, might be advisable.
To the best of our knowledge, there do not yet exist any design guidelines for such agent-based support systems. Thus, we plan to close this gap by a controlled qualitative and quantitative user study in a CAVE-like environment. We expect users to prefer assistants with a low presence time as well as a low fallback time to get quick support. However, as both factors are linked, a suitable trade-off needs to be found. Thus, we plan to test four different strategies, namely fading, moving, omnipresent and busy. This work presents our hypotheses and our planned within-subject design.

Keywords: Virtual Agent · Assistive Technology · Immersive Virtual Environments · User Study Design

1 Introduction

Computer-controlled virtual humans, so-called virtual agents, are often embedded into HMD and CAVE-like environments [1] to serve as assistants. In the resulting immersive, agent-based support systems, they can have various roles: guiding users through the scene, training them how to perform certain tasks, being interlocutors answering questions or executing scene commands given by the user [2].

To the best of our knowledge, in the majority of these agent-based virtual support systems the assistants are always present. As a key component they are in an almost constant contact with the user, facilitating quick and unhindered assistance. However, designing such an *omnipresent* agent is challenging: certain constraints like personal-space requirements and collision-avoidance strategies need to be met [3].

In contrast, this work focuses on applications where assistants are required only *temporarily*, i.e., as interlocutors. In this scenarios, omnipresent agents focusing solely on the user may annoy the users. Thus, having a low presence time (PT), i.e, presenting assistants only when needed, should be desired. Consequently, the question arises what the assistive agents should do in the meantime.

The follow-up question is, how users can fall back on the absent agent. Other common assistive interfaces like PieMenus [4] fade in after triggering a signal of necessity, e.g., by pressing a designated button on an input device. As a result, users can *instantly* access all available support functions. Such, a low fallback time (FT) should also be considered in agent-based support systems. By, e.g., calling the agent's name, the assistant may simply appear or walk by quickly.

Apparently, PT and FT are closely linked. Therefore, a good trade-off has to be found. Thus, we will test four different combinations of both parameters in our study.

2 Study Description

We plan to investigate the trade-off between PT and FT for temporarily required assistants serving as interlocutors in immersive virtual environments.

2.1 Experimental Design

To evaluate all combinations of low and high PT and FT, we designed four different strategies constraining the assistant's behavior:

Strategy	PT	FT	Description
Fading	low	low	The assistant fades in and out.
Moving	low	high	The assistant walks by and leaves when done.
Omnipresent	high	low	The assistant constantly follows the user closely.
Busy	high	high	The assistant self-reliantly works in the vicinity of the user, walks by and returns to work when done.

For evaluation, we designed two different tasks, in which the participants have to start a conversation with the assistant about certain notes distributed over the scene. In the first task, the notes' locations are known, resulting in goal-oriented navigation and thus a *go-to task*. Here, we expect users to be more willing to have the assistant nearby as the required fallback in a timely manner justifies the presence. In the second task, the notes need to be found via exploratory navigation resulting in a *search task*. In contrast to the go-to task, users might feel more comfortable without the assistant, since they first have to explore the scene on their own.

In summary, we plan to conduct a within-subject user study with two dependent variables: strategy and task.

2.2 Hypotheses and Evaluation

We expect the following hypotheses to be confirmed:

H1: ***Fading* is not preferred.**

Although, PT and FT are both low in fading, we expect users to consider it too unrealistic for virtual humans.

H2: ***Omnipresent* is preferred for the go-to task.**
When users know exactly that they will ask for support within the next moments, we expect them to accept a high PT, while still preferring a low FT.
H3: ***Moving* is preferred for the search task.**
When users have to fulfill certain tasks at first on their own, we expect them to prefer a low PT. As a consequence of *H1*, we expect them to accept also a higher FT.

During the evaluation we will examine the participant's short-term experiences in the study. Afterwards, a semi-structured interview will be used to figure out what participants might prefer for long-term usage. Results of both will allow us to give an advice for improved designs of virtual assistants.

2.3 Virtual Environment

The test environment will be a two-man apartment, shown in Figure 1(a). Four different notes will be placed inside the apartment: two notes with known positions and two notes which need to be found by the user. Participants will access the notes without support, then call the assistant and ask him or her a related question in order to have a short conversation. For example, users may ask the assistant to keep a shopping list located at the kitchen table in mind, shown in Figure 1(b). The text overlay in the figure illustrates the planned speech-based interaction.

The platform SmartBody [5] will be used to animate the assistant. The remaining program logic will be implemented with the library ViSTA [6].

2.4 Apparatus

We will use a five-sided CAVE with the size $5.25m \times 5.25m \times 3.30m$ $(w \times d \times h)$ providing a 360° horizontal field of regard [7]. Our participants will wear active stereo glasses, tracked at 60 Hz, and use an ART Flystick 2 for navigation. Since the CAVE is equipped with loudspeaker and microphone arrays as well as two security cameras, the supervisor can observe and converse with the fully immersed participant. Additionally, the hardware enables us to conduct the study with a Wizard of Oz paradigm by controlling the behavior of the agent.

(a) (b)

Fig. 1: Floor plan of the virtual apartment in which the participants will gather four notes (a) and the embedded assistant in a conversation with a participant (b).

2.5 Procedure

The study will be divided into seven phases: In the welcome phase, participants will be informed about the procedure of the study and define the appearance of their agent based on a limited set of features. By this, the assistant will be considered sympathetic, minimizing the feeling of having a complete stranger close by. Afterwards, the users will enter the CAVE to explore the apartment without the four notes in up to five minutes. In the four succeeding phases, participants have to gather the four notes and talk to the agent. In each phase the assistant will be using a different strategy. The order of strategies will be randomized between the participants. We expect each of the four phases to take approximately five minutes. In the final phase, participants will fill out a questionnaire and attended a semi-structured interview.

3 Conclusion

We have presented a study design to investigate user preferences on the trade-off between presence and fallback times of temporarily required assistants in immersive virtual scenes. After conducting the study, we will give design guidelines for agents embedded as interlocutors answering questions or executing scene commands given by the user. For other application types, individual studies have to be conducted as the preference of presence strategies and the user's task are likely correlated.

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