Sensory Design for Virtual Environments

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Abstract

The Sensory Environments Evaluation (SEE) Project seeks to formulate a new design methodology for virtual environments that utilize multiple sensory inputs to induce presence. Deviating from virtual reality's twenty-year focus on photo-realism, our "feels-real" design alternative aims directly at understanding the interdependencies of sensory stimuli in their creation of mental constructs, and the subsequent degree of realism perceived.

1 Introduction

At the University of Southern California's Institute for Creative Technologies (ICT) we are developing a series of virtual environments for training, art, and education entitled "SEE":

- *DarkCon* – simulated reconnaissance of a life-threatening environment by a single participant
- *Memory Stairs* – allegorical navigation through an artist's memory associations by a single participant
- *Coral Reef* – pedagogical experience of the ocean's most fertile communities by multiple participants

Interest in embarking on such a project resulted from a deep dissatisfaction with the state of current virtual environments. Research has proven the cumulative effects of visual, aural, and olfactory stimuli increase presence induction [Dinh et. al., 1999], but their relation to one another beyond additive measure remains undetermined. SEE proposes to create a design approach that will help identify effective orchestrations of these multiple sensory stimuli, and thereby further the bounds of virtual realism.

2 Exposition

Our prototype environment for this design approach is *DarkCon*, a scenario in which the participant is asked to make their way through an unfamiliar hostile environment at night without being discovered. While "there," the participant is also tasked with making a number of observations whose accuracy is purported to be the gauge by which their success will be measured.

These conditions stem from SEE's scenario-specific goal of increasing the participant's emotional engagement. Research has shown that experiences with emotional attachment are retained longer than those without [Tulving, 2000]. Creating this engagement with multiple sensory inputs is where our design methodology becomes necessary.

We first describe the environment in terms of its sensory inputs, and then filter according to scenario parameters, expected degree of emotional response, and available technology. A number of these elements might seem incidental (ambient sounds, shadows, reflections), but their inclusion is essential towards providing realism. SEE currently employs real-time delivery hardware capable of textured graphics, spatialized sounds, infrasound, and low-level haptics, and is in development of a proprietary scent technology. These tools allow for a relatively large number of identified elements to be incorporated, but resource management demands selective inclusion in all cases.

These elements are then woven into a "story," compressing the scenario down to its essential events. This type of interactive narrative is challenged by the participant's free will, defying a contiguous event structure and increasing the likelihood of a perplexing experience. To confront these conditions while preserving autonomy, we further enhance the scenario with techniques we collectively term "coercive narrative," constructing psychological cues with available elements to persuade a desired course of action.

Having identified the most likely path the participant will follow within the environment, a corresponding "emotional score" can be developed. Given the order of desired emotional responses, selected elements from each of the sensory inputs can be utilized to increase and decrease the participant's state of arousal based on their location in the environment. This orchestration of emotions can serve to ensure increased engagement of the participant for the duration of the experience.

The presiding goal of SEE is to scientifically test our design methodology with evaluation studies. In regard to *DarkCon*, questionnaire information will be coupled with data retrieved from a physiological monitor. This data will allow us to determine degrees of emotional arousal and potentially differentiate between specific emotions. Follow-up questionnaires administered at a subsequent date will determine if the degree of emotional engagement was great enough to increase memory retention, and if differentiated, the respective effect of identified emotions on retention.

This model will be applied to further testing of memory association and learning within virtual environments. These studies will help specify the most effective components in eliciting presence, and the effect presence has on potential uses of virtual reality.

References

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