Interacting with Light

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Abstract. Embedding lighting systems into architectural structures offers new interaction possibilities. They can be exposed to a large number of users, thus there is a demand for such interface solutions that fit the context of use. Using two examples of experimental, novel interaction methods with light, we propose that there are various potential approaches to using implicit and explicit control mechanisms. We share our implementations in hopes that they will inspire possible future projects and have applications in other contexts.

Keywords: Interactive Lighting Design, Interface.

1 Introduction

Lighting systems embedded in architectural structures are an emerging field of research because they offer new, ubiquitous interaction possibilities, as described by Seitiger et al. [3]. When designing these systems, one challenge is how to present the control mechanism to the user and how to determine what degree of participation is required. Verplank et al. [5] classified control mechanisms that affect the environment in terms of their degree of participation: (1) *Discrete controls* trigger pre-defined (semi-automated) actions, and (2) *continuous controls* leave the user in permanent (manual) command over the environment.

The use of lighting systems in the context of urban environments is strongly reflected in the choice of the interface technology. In our research, we want to raise the question of how we might design and implement new interaction types, ones that control lighting systems in ways that are beneficial to users, including having such systems be quickly learned through playfully discoverable interfaces

In the following work, we present two examples from recent implementations of novel interaction techniques that use lighting systems embedded in the interiors and exteriors of buildings. From these examples, we propose potential extensions of their input methods, allowing for (a) implicit interaction through an embodied approach, which is a form of discrete-control mechanism, and (b) explicit interaction through an augmented approach, an extension of a continuous-control mechanism.

1.1 Example: Implicit Interaction

Fig. 1. Different colors generated in response to various seating positions.

Concept

ColourVision, by Wiethoff et al. [6], is an interactive installation that allows users to engage in an intensive dialogue with colors. Seating postures, such as active, relaxed, or reflective positions, are captured and translated, triggering a rapid change of the room's color. In an article that analyzed the psychological effects of environmental colors on the human body, Stone et al. [4] claimed that "red and yellow are naturally experienced as stimulating and disagreeable," and that "these colors focus people on the outward environment," and that "they produce forceful, expansive behavior, whereas green and blue are experienced as quieting and agreeable, focusing people inward, and produce reserved, stable behavior. The embodied interface that is used in this installation corresponds to these circumstances and controls the room and the resulting colors. Red, for example, is activated as a response to an open, active seating position. Green is the color for introverted reflection and is generated if a person employs a thoughtful, closed position. A person sitting on the chair in a stretched, relaxed position plunges the room into a cool blue, the color for calm (figure 1). The environment incorporates a very subtle interaction mechanism that is controlled through implicit interaction. The explorative nature of this interaction invites users to learn, in a very playful manner, how the environment reacts. It is an example of a novel discrete-control mechanism, displaying predefined sequences (colors) in the system that are triggered by body postures.

Advantages and Limitations

The main advantage of using an interface solution with a tracking system is that no additional hardware is required for users to carry. Furthermore, there is no graphical interface or other tangible hardware visible in the environment. There is also no need for the user to focus on the system and actively interact with it. However, the invisible nature of the interface also leads to clear limitations: an accidental interaction can be triggered when, for example, users want to perform a completely different task that does not include interacting with the lighting system. A second limitation is that the type of trigger required for interaction with the system (such as signage, etc.) has to be viewable, which breaks with the simplicity of the invisibility.

1.2 Example: Explicit Interaction

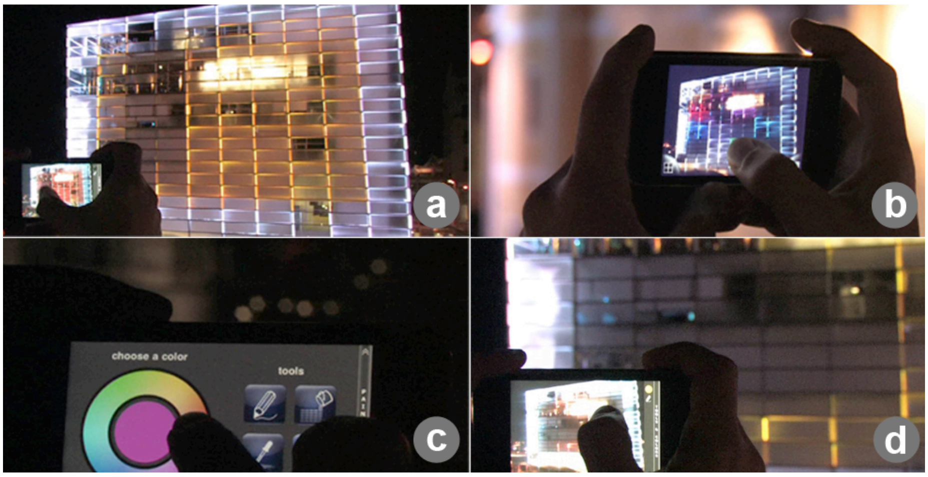

Fig. 2. The building's facade (a) is directly manipulated using a video image on a mobile device (b). A tool palette (c) allows users to paint the building in different colors at a distance (d).

Concept

iRiS, by Boring et al. [2], is a remote, direct-manipulation system that is meant to allow for ubiquitous interaction with media facades at a distance. An experimental setup was installed at the ARS Electronica building in Linz, Austria. Its 1087 windows contain about 40,000 LEDs that can be manipulated through digital multiplexing (DMX) signals. The size of the building allows for a viewing distance of up to 300 meters, with an optimal interaction distance being around 50 meters. To allow for interaction with and manipulation of the facade with *iRiS*, we adopted *Touch Projector*, a system introduced by Boring et al. [1], and combined it with the concept of interaction through live video *at-a-distance*. The system runs on a camera-equipped mobile device, turning the device into an interactive, see-through panel (see Figure 2).

Advantages and Limitations

The concept of *iRiS* relies on a device-based interaction in which the user is able to interact with the building directly using the display of his or her mobile device. The user points the camera of the mobile device at the building so that the building is displayed in the live video stream. By touching the mobile device's display, the user can interact with the building. In contrast to *ColourVision*, *iRiS* requires the user to interact explicitly by providing efficient continuous control. From the client side and from a usability perspective, one major appeal of this concept is the high availability and acceptance of smartphones and their corresponding usability concepts. Applications can easily be developed based on an existing infrastructure. As well, taking into account users' familiarity with apps and the usability aspects of smartphones, the application of a concept based on *iRiS* can be directed more focused on a specific area. The main disadvantage of such a concept is the requirement that users be equipped with devices. In the case of *iRiS*, a facade controller (such as a smartphone) needs to be available to allow the application to interact with the facade.

2 Discussion

An important aspect that must be dealt with when designing a novel control mechanism for lighting systems embedded in architectural structures is the mechanism's context of use. We described two exemplary projects that are both implemented in artistic contexts and therefore do not seek to provide task-oriented practical solutions. However, the novel interaction mechanisms proposed in this work have potential applications for industrial systems (e.g. controlling brightness levels on a façade), if modified effectively. We envision a combination of both approaches so that basic interactions are carried out though implicit mechanisms, and changes in the environment that are more detailed are applied through additional, explicit-control elements. After observing participants interacting with our prototypes, we have concluded that there is a great potential for multimodal input techniques that offer (a) interfaces based on familiar interaction paradigms and (b) extensions of the forms suggested in this work.

3 Conclusion and Future Work

In this work, we examined the use of an implicit and embodied interface as a mechanism for the discrete control of lighting as well as the use of a mobile device for continuous, explicit control. Both approaches provide new ways of interacting with light. In a follow-up project, we will again explore interaction forms such as those proposed in this work. However, we will employ them in a task-oriented context in order to investigate their transferability to everyday situations.

References

1. Boring, S., Baur, D., Butz, A., Gustafson, S., Baudisch, P.: Touch Projector: Mobile Interaction Through Video. In Proc. CHI'10.
2. Boring, S., Gehring, S., Wiethoff, A., Bloeckner, M., Schoening, J., Butz, A.: Multi-User Interaction on Media Facades through Live Video on Mobile Devices. In *Proc.* CHI'11.
3. Seitinger, S., Perry, D., Mitchell, W. Urban pixels: painting the city with light. In *Proc.* CHI '09.
4. Stone, N.J., English, A.J.: Task type, posters, and workspace color on mood, satisfaction, and performance. Journal of Environmental Psychology 18 (1998).
5. Verplank, B., Sapp, C., Mathews, M. A course on controllers. In *Proc.* NIME '01.
6. Wiethoff, A., Butz, A.: ColourVision Controlling Light Patterns through Postures. In *Proc. Symposium on Smart Graphics* '10.