ROCKITUI - Rock It, To Unlock It

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ABSTRACT
While wearable devices are playing a larger and larger role in HCI, particularly commercial HCI, there are also increasing opportunities for designing new physical interactions with technologies that do not require any additional component on the individual. Our research focuses on converting passively captured information about emotional states and energy levels in one space and converting that information to actions taken by a user in another physical space. In particular, we limit our case study to developing a system at UC Berkeley's South Hall. This prototype only permits entry from a hallway to a student lounge when the participant matches the energy level and emotional state of the lounge, as directed by embedded devices in the hall. We demonstrate through this case study that tangible interfaces in the built environment can not only inform users but also drive changes in users' emotional states.

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INTRODUCTION
Doorways provide a way for a person to physically transition from one space to the next, yet at the same time can serve as a barrier separating two spaces -- a person on one side is prevented from seeing the other side. This is purposeful in some doorways, but in other spaces, this may limit visitors from preparing themselves to enter a different environment.

For example, at UC Berkeley's South Hall, home of the School of Information, the masters student lounge is a unique space with an especially dynamic atmosphere: it may be filled with students studying and working quietly, or a noisy social gathering may be taking place. By contrast, the adjoining hallway outside is a quiet and unused space, and visitors do not know what to expect when approaching the lounge. As a result, School of Information graduate students have often experienced an awkward disconnect in the emotional energy levels and mood between visitors opening the door and students already in the lounge.

Our prototype, which we dub ROCKITUI (Rock it, To Unlock It!) only permits entry from a hallway to the student lounge when the visitor matches the energy level and emotional state of the lounge, as directed by embedded devices in the hall. We demonstrate through this case study that tangible interfaces in the built environment can not only inform users but also drive changes in users' emotional states.

SYSTEM OVERVIEW AND TECHNICAL IMPLEMENTATION
The current prototype described in this paper only implements the "hallway" side of the system. A LED light strip (the AdaFruit NeoPixel) follows the walking path on either side, invoking a metaphorical runway. Under the path are steps with force-sensitive resistors embedded in white foam squares -- these form "stepping stones" indicating the path a visitor should walk upon.

The system currently has two modes, manually selected via the Arduino serial input: an active and a quiet mode (reflecting the activity level within the lounge, which is currently not implemented). The LEDs next to the next step the visitor should step on are lit up. As the visitor walks on each step in turn, a short delay occurs before the next step is lit up. The mode determines the color of the LEDs, as well as the delay. This creates a scenario where the visitor has to match his speed to the activity level within the lounge. Moreover, if the visitor walks too quickly or too slowly, the entire strip flashes several times before resetting, and the system is reset, as the visitor was approaching at an incorrect speed.

After the visitor has walked on all the steps at the correct speed, they must either whisper (in the quiet mode) or yell (in the loud mode) into a microphone embedded into the door. To further encourage a physical engagement and transition with the energy level within the lounge, we have separated our door into two segments. In the active mode, the top half of the door opens (using servo motors), encouraging the visitor to leap over the bottom half (which remains closed) into the lounge. In the quiet mode, the bottom half of the door opens, encouraging the visitor to quietly crawl into the new space.

BRIDGING THE GAP BETWEEN CENTRAL AND PERIPHERAL MEDIA

HCI research in the late 90s saw a greater interest in opportunities in ambient media. In 1995, Mark Weiser described "calm technology as "[engaging] both the center and the periphery of our attention, and in fact moves back and forth between the two." [1]

In Hiroshii Ishii and Brygg Ulmer's often cited paper "Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms, " they contrast devices that allow users to "grasp & manipulate" foreground bits and devices that are embedded as "ambient media" of which users are aware of in the background. [3]

Since then, there has been significantly more focus and research within HCI on ambient, soft and peripheral technologies. However, the dichotomy that Ishii and Ulmer identified between foreground objects and peripheral media has persisted. ROCKITUI seeks to bridge that divide, using media traditionally associated with peripheral attention to the forefront and forcing the user to fully engage with their physical environment, rather than an object that he or she could manipulate directly.

METAPHORS AND PHYSICALITY

As ROCKITUI ties together central and peripheral media it is critical to suggest the appropriate response and feedback mechanisms to the user. Traditional, passive peripheral media like MIT Media Lab's Ambient Room or Xerox PARC's Dangling String give the user space and time to learn their meanings- there are no immediate required actions from the user. On the other end of the spectrum, a tangible user interface that can be readily grasped and manipulated lets the user actively explore the experience.

ROCKITUI does not immediately afford the user a next step. As we focus on the use case of students moving from an empty hallway space to a communal lounge area, our users have a clear, physical goal: open the door and enter the lounge. However, ROCKITUI subverts their ability to open the door until a set of other physical actions (reflecting their emotional state and energy level) have been taken. Applying the appropriate metaphors that direct the user to these physical actions is paramount to the success of the interaction between the system and the user.

ROCKITUI AND EXISTING TAXONOMIES

As HCI research has become increasingly diverse, there have been multiple taxonomies defined in different parts of the field. We will identify where ROCKITUI fits within these taxonomies and how it reflects opportunities for greater research in these areas.

Pousman and Stasko proposed "a definition of ambient information systems and a taxonomy across four design dimensions: Information Capacity, Notification Level, Representational Fidelity, and Aesthetic Emphasis." [2]

Information Capacity: ROCKITUI has a somewhat low information capacity. It captures information on number of individuals, movement, and noise levels, but does not aim for total capture of all information available in the lounge or for perfect accuracy of the input that it does capture. As ROCKITUI's emphasis is on emotional levels and energy states, increasing information or fidelity provides little value beyond a certain threshold. This suggests that, despite the rapidly decreasing costs of data collection, it may be possible to design many tangible information systems that do not require complex inputs.

Notification Level: As a system that elicits and requires a specific response from the visitor, ROCKITUI potentially "interrupts" or "demands attention" from its users. Since this is part of an entryway that becomes a habitual part of its users' lives, the notification level (and resulting disruption to the users) may decrease over time. Initially, this disruption is expected but it serves the purpose of making the users conscious about the activity level they have to recreate to enter the lounge otherwise, they adjustment to their energy level would be of temporary nature. There may also be ways to design the system to work at a more subconscious and intuitive level (discussed below).

Representational Fidelity: This system does not seek to directly or explicitly represent the activity within the lounge, but does so at a more abstract level. In the current system, the speed and color of the lights are signs of the activity within the lounge. At the same time, ROCKITUI invokes metaphors from other spheres of life; the arrangement and pattern of the lights is reminiscent of an airport runway guiding the visitor on the proper path.

Aesthetic Emphasis: Aesthetics are not an emphasis of ROCKITUI's goals and the level of aesthetic emphasis is thus far rather low.

FUTURE WORK

Our current implementation does not actually sense the activity level within our lounge space -- the type of activity is manually selected within the Arduino serial input.

The current system only has two modes of operation -- an "active" and a "quiet" state. Ideally, the system should have more nuance than a binary choice in understanding and presenting the mood within the room, and in aiding a visitor's transition. There might be, for example, different types of "active" states, as a holiday party embodies different emotional energy than an active group work session.

It is also worth exploring how the actions required to enter the door can be communicated more transparently and intuitively.One can imagine that visitors need not be consciously thinking of the atmosphere they are entering, but simply follow the guided actions suggested by the system almost subconsciously. As a result, the visitor may seamlessly transition from one mood and energy level to another without being distracted by the process.

One way to improve the current prototype in this regard would be to experiment more with the way the lights are shown -- different patterns and speeds of the lights may be more successful than the current system, which simply displays the lights on the next step with no dynamic patterns shown.

CONCLUSION

In this paper we present ROCKITUI (Rock It, To Unlock It!), a system that only permits entry from a hallway to a student lounge when the visitor matches the energy level and emotional state of the lounge, as directed by embedded devices in the hall. We demonstrate through this case study that tangible interfaces in the built environment can not only inform users but also drive changes in users' emotional states, and construct a doorway and entrance that serves an active transitional role in a visitor's approach. Additionally, ROCKITUI, not only produces a change in the user's emotional state but also plays a role in maintaining and perpetuating the atmosphere and environment inside the room.

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