

# Water Lamp and Pinwheels: Ambient Projection of Digital Information into Architectural Space

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## ABSTRACT

We envision that the architectural spaces we inhabit will be an interface between humans and online digital information. This paper introduces ambient fixtures called *Water Lamp* and *Pinwheels*: a new approach to interfacing people with online digital information. The *Water Lamp* projects water ripple shadow created by a "rain of bits." The *Pinwheels* spin in a "bit wind." These ambient fixtures present information within an architectural space through subtle changes in light, sound, and movement, which can be processed in the background of awareness. We describe the design and implementation of the *Water Lamp* and the *Pinwheels*, and discuss their potential applications as well as design issues.

## Keywords

ambient media, Tangible Bits, Tangible User Interface, ambientROOM, ambient fixtures, architectural space, lights

## INTRODUCTION

Nature is filled with subtle, beautiful and expressive ambient displays that engage each of our senses. The sounds of rain and the feeling of warm wind on our cheeks help us understand and enjoy the weather even as we engage in other activities. Similarly, we are aware of the activity of neighbors through passing sounds and shadows at the periphery of our attention. Cues like an open door or lights in an office help us subconsciously understand the activities of other people and communicate our own activity and availability.

Current personal computing interfaces, however, largely ignore these rich ambient spaces, and squeeze vast amounts of digital information into small rectangular screens. Information is presented as "painted bits" on flat screens that must be in the center (foreground) of a user's focus to be processed. The interactions between people and digital information are currently almost entirely confined to a conventional GUI (Graphical User Interface) comprised of a keyboard, screen, and mouse.

We are trying to broaden the concept of "display" to make use of the entire physical environment as an interface [1]. We are moving information off the screen into the physical environment, where it is manifested as subtle changes in form, movement, sound, color, smell, temperature, or light. We call such displays "ambient displays." We expect ambient displays are well suited as a means to keep users aware of people, weather, or general states of large systems [3].

This paper will introduce two specific ambient display designs: the *Water Lamp* and the *Pinwheels*. We call these standalone displays "ambient fixtures" to separate them from their precursor "ambientROOM" [2]. We will introduce motivation, implementation, and application of ambient fixtures, and discuss some preliminary lessons we have learned through their experimental use.

## ambientROOM

In the ambientROOM project, we explored how an architectural space could be used to convey information to a user and have that information smoothly transition from the user's center of attention (foreground) when needed and fade into the periphery (background) when not in use [2]. We constructed a special room equipped with embedded ambient displays and sensors. This work was a preliminary investigation into background/peripheral interfaces, and led us to the design of standalone ambient fixtures which we will introduce in detail in this paper.

## AMBIENT FIXTURES

Ambient fixtures are standalone ambient media displays. We have taken concepts developed within the ambientROOM, and have moved them out of a small room into an open space. In the ambientROOM, the user is "inside the computer," while ambient fixtures allow us to externalize the displays and distribute them throughout an open architectural space. Ambient fixtures thus allow ambient displays to be used by several people at once.

We have implemented two ambient fixtures: the *Water Lamp* and *Pinwheels*. The *Water Lamp* is an extension of the ceiling water ripples of the ambientROOM [2] and the *Pinwheels* explore the ideas of physical movement caused by invisible information flow. Both are designed based on the metaphor of natural physical phenomena.

### The Water Lamp

The first ambient fixture we developed is the *Water Lamp*. Water ripples created by raindrops on the surface of still water was the starting point of this *Water Lamp* design. Instead of physical raindrops, we envisioned that "bits" (digital information) falling from cyberspace could create physical water ripples. The raindrops of "bits" have been realized with a computer-controlled solenoids tapping the water. Fig. 1 illustrates the prototype of the *Water Lamp*.

The *Water Lamp* is composed of a wooden base, 3 aluminum support tubes and an acrylic water pan. There are 3 small solenoids mounted above the water tray. These solenoids are controlled through a single circuit board.

reflection of water ripple on a ceiling



water pan with 3 computer-controlled solenoids

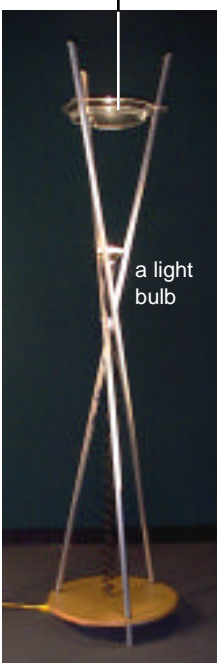


Fig. 1 The Water Lamp

pinwheels” could be legible and poetic. The Pinwheels spin in the “bit wind” at different speeds based upon their input information source.

The Pinwheels are made from folded fiberglass mounted on the shaft of a small DC motor. Four Pinwheels are connected to each iRX control board. Pulse width modulation controls the speed at which the motors spin.

#### APPLICATIONS

Ambient fixtures are envisioned as being all around and suited to the display of a) people’s presence (awareness of remote people’s status / activities), b) atmospheric and astronomical phenomena, or c) general states of large and complex systems (e.g. atomic power plant).

For instance, an atmospheric scientist might map patterns of solar wind into patterns of Pinwheel spins in a room. Other users might want to be aware of tension in the Earth’s fault-lines, giving an indication of earthquake activity through an array of Water Lamps.

People have a strong desire to feel connected to others, especially loved ones. The Water Lamp may aid in this

When actuated, the solenoids tap on the surface of the water in the tray, causing ripples in the water surface. Various digital information sources can drive this circuit board to actuate these three solenoids. A light shines upward through a pan of water, and produces changing patterns of light and shadow projected onto a ceiling (Fig. 1).

The Ambient fixtures, both Water Lamp and Pinwheels are based upon a common control platform- the iRX 2.0 PIC Micro-controller Board designed at the MIT Media Lab by Robert Poor. The iRX board accepts commands over a serial line from a computer to control each fixture. This allows us to distribute fixtures throughout our research space. TCL-based software sends commands to the fixtures. Information can be relayed from the internet or other networked information source and be routed to the appropriate fixture.

#### Pinwheels

The Pinwheels evolved from the idea of using airflow in the ambientROOM. We found that the flow of air itself was difficult to control and to convey information. As an alternative, we envisioned that a visual/physical representation of airflow based on the “spinning

sense of connection by displaying the heart beat of a significant other picked up by a special wristwatch.

We have been using the Water Lamp and Pinwheels mainly as displays of activities in cyberspace. We have mapped the wireless LAN traffic onto the Pinwheels and the web hits to the Water Lamp.



Fig. 2 Array of Pinwheels

#### DISCUSSION

Our explorations have given us insight into many research issues that arise in designing and testing ambient fixtures.

##### 1) Mapping of information to the physical motion

A designer of ambient displays must transform the digital data into a meaningful pattern of physical motion that successfully communicates the information.

##### 2) Persistence in the space

Due to the physical persistence of the fixtures in a space, we learn where to “look” for the information within the environment. Selection of location for those fixtures in an architectural space becomes an important design decision.

##### 3) Thresholds between background to foreground

Ambient displays are expected to go largely unnoticed until some change in the display or user’s state of attention makes it come into the foreground of attention. How to keep the level of display at the threshold of a user’s attention is an open design issue which we are now working on from a cognitive science point of view.

#### CONCLUSION

Ambient fixtures like the Pinwheels and the Water Lamp have the potential to create subtle and yet informative reactive environments through the application of displays integrated within our architectural spaces. We expect that ambient fixtures will shift the use of ambient media from a private context to more communal environment.

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