Building Flexible Displays for Awareness and Interaction

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ABSTRACT
This video illustrates a set of flexible ambient devices that can be connected to any available information source and that provide a simple means for people to move from awareness into interaction.

Keywords
Ambient displays, information appliances.

1. INTRODUCTION
Ambient information displays are now a well-known concept in ubiquitous computing [3]. Yet most (but not all) of the example ambient devices seen so far are fairly limited. First, while all display some kind of information, many do not provide a way for a person to smoothly move from awareness of the information into interaction with it. Instead, people typically go to another source (e.g., a computer) for more detail or to work with the information. Second, most devices are rigidly tied to a single information source. This lack of adaptability limits how devices are used in particular contexts (e.g., various places in the home or the office), and how they can meet the shifting desires of people over time. As an appliance, these devices could be much more opportunistic, where they are tuned to different people, or to their location.

We designed these *flexible ambient devices* to address these issues by meeting two design goals.

1. The display should allow a person to smoothly move from awareness into interaction. Through a simple act on the device, such as a gesture or touch, the person should be able to gather more detail about that information as well as the means to take action on it. That is, devices should become a doorway into information access and interaction.
2. The display should be flexible, where it allows people to attach different information and interaction sources to it. This will allow a device to be customized to the needs or desires of a specific person or location, which is especially useful in a home setting, where the device may be handed down to different home members over time, or where it may be placed in different locations and contexts.

Cite as:
Elliot, K. and Greenberg, S. (2004) **Building Flexible Displays for Awareness and Interaction.** Technical Report 2004-753-18, Department of Computer Science, University of Calgary, Calgary, Alberta CANADA. Video (duration 6:11) and 2-page summary, May.

2. DESCRIPTION
The current set of flexible ambient devices consists of three prototype physical displays, all constructed using Phidgets [1]. These are:

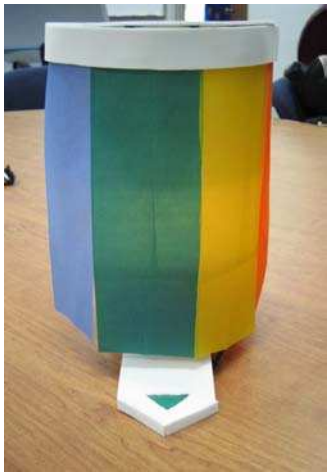
1. The lamp shade (shown in fig. 1a) which rotates to display five different colored panels, with a range of warmer to cooler colors.
2. A group of eight flowers "growing" out of a small felt base (shown in fig. 1b) which each contain either a red or a green LED. The lights can be lit individually or as part of a group.
3. A set of two beads that hang off the edge of a computer monitor (shown in fig. 1c). The beads can be moved up and down the monitor independently.

Each device incorporates one or more touch and light sensors. These sensors allow the user to request more information through the simple gesture of touching the display, rather than having to go to another source (e.g., a computer). This is intended to provide a more direct and natural means of interacting with the information.

In addition, the ability to interact directly with the display device can lead to devices that are somewhat aware. For example, the ambient beads could represent two of my instant messaging contacts. The height of the beads could represent that the contacts are online, and touching the sensor for one of the beads (hence, one of the contacts) could open an instant messaging window. When the height shows they are offline, the same gesture could open a new email message instead.

All three devices are visually and interactively designed to allow for a fairly generic information display. Varying colors, lights and levels are used to display both discrete ordered and unordered states, as well as continuous values. For example, the rotating lamp shade can display five discrete states (ie. IM contact availability) through its five different colors. It can also display a value within a continuous range (ie. a temperature forecast) through how far around the shade rotates. Since most ambient displays show abstractions of data [3], it is a logical step to design for a more generic abstraction while maintaining the inherent qualities of ambient displays.

3. IMPLEMENTATION
From the developer's point of view, each device is wrapped up as a programming component, so that no knowledge of the motor, sensor or light setup is needed. All the programmer does is set the desired properties on the device and it will react appropriately.



1a: the Glow Lamp

1b: the Ambient Garden

1c: the Ambient Beads

Figure 1. Three prototype flexible ambient devices

Events are also provided by the devices to notify the programmer of sensor touches. These events can easily be handled exactly as a typical widget event would be (for example, a button click).

Each device also has a corresponding graphical "skin" or user control. These user controls can be connected to the physical device through the component. The skins will then reflect the state of the device without any code. This provides for an optional graphical view, in case the physical device is broken, located at a distance, or not present.

Connecting an information source is as simple as obtaining values from the source and passing them along to the device. Information sources are readily available, for example through web services and programming APIs.

4. FUTURE WORK

These devices are intended as a first step towards creating ambient displays that are truly flexible. While we feel that these prototypes are successful, we recognize that several major improvements need to be made before the devices can be used to fully capitalize on the opportunities made possible by flexible, interactive information display:

Non-programmers. The most obvious and most challenging improvement is that these devices need to be able to be connected to information sources by non-programmers. This is a very difficult problem, as it necessarily assumes the availability of an information source as well as access to the set-up of the device. Were these devices to be used in homes, where they potentially could be of the greatest value, users would need to be able to have *easy* control over the connections.

Wireless. Creating wireless flexible devices would be extremely useful. They would not be tethered directly to a computer, so they could be moved and repositioned easily. This would also allow devices to be placed in non-traditional computing environments, such as a kitchen, living room or even a conference or meeting room in a busy office. More flexibility in the positioning of a device also provides new opportunities for exciting information sources that could benefit from this type of display.

Device design. Improved device construction and design would allow for richer information display possibilities and more ways to request information.

Context-Aware. If the devices were aware of who was around and what they were doing, their flexibility could be easily extended to provide different information depending the current user or situation.

Distributed device architecture. We would like to make the devices distributed, such that information is drawn from and sent to a common 'repository' and shared among all the devices in a single home or office. This would extend the possibilities provided by context aware devices, as devices could communicate so as to provide the best possible display and interaction.

5. CONCLUSION

Our flexible ambient devices are visually and programmatically designed to be easy to connect to a wide variety of information sources. We do this by capitalizing on component-based design to interface between the physical devices and their graphical skins and events.

6. ACKNOWLEDGMENTS

We thank the National Science and Engineering Research Council (NSERC) for supporting this work.

7. REFERENCES

[1] Greenberg, S. and Fitchett, C. Phidgets: Easy Development of Physical Interfaces through Physical Widgets. In *Proceedings of UIST 2001,* pp. 209-218. ACM Press, 2001.

[2] Miller, T. and Stasko, J. The InfoCanvas: Information Conveyance through Personalized, Expressive Art. In *Proceedings of CHI 2001,* pp. 305-306. ACM Press, 2001.

[3] Wisneski C. et al. Ambient Displays: Turning Architectural Space into an Interface Between People, Bits and Atoms. In *Proceedings of CoBuild '98,* pp. 305-306. Springer-Verlag, 1998.