LaughingLily: Using a Flower as a Real World Information Display

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ABSTRACT
Ambient displays and calm technology as termed by Weiser and Brown [5] are key techniques to help ubiquitous computing applications enter our everyday life. Here we present an ambient display in the form of a physical object that can be moved around in physical space, thus being highly adaptive to the users needs. LaughingLily is an artificial Lily enhanced with an electromechanical system that enables the flower to let its petals hang or open them up to full bloom. Using the flower as a meeting mediator we show how well it can be integrated into the real world and how easily it is accepted by potential users.

Keywords
Calm Technology, Ambient Display, Real World Display

INTRODUCTION
Many ubiquitous computing applications exist, which use elaborate sensing of their environment to adapt to local context. But they mostly still rely on classic output methods such as computer displays or projection screens. Many researchers have worked on integrating output into the physical world by using classic displays in different ways [1,2,3]. Experience however shows that classic displays often become the main focus of attention, which can distract the user from his activity. Oppositely displays hanging on the wall as in [1] can seemingly vanish into the periphery if someone is looking the opposite way.

Weiser and Brown [5] proposed the concept of *Calm Technology*. Their goal is to design technology so it is equally *encalming* and informative. To do so they propose presenting information in the user's periphery. This makes it possible for the information to move out of the user's focus when it is not important, and to move to the center as soon as an important event occurs. Calm Technology aims to manage this transition easily. In the AmbientROOM project [6] the presence of distant people is represented with different peripheral displays. As soon as someone enters the distant but connected space light reflections appear on the wall and water ripples start moving. By presenting information in the periphery and only moving to the user's center of attention at specific events these Ambient Displays represent a form of Calm Technology.

Besides having the ability of moving between the periphery and the center of attention Calm Technology also can enhance the user's *peripheral reach* by bringing more details into the periphery. Informative Art as presented by Holmquist et al. [1] refers to a set of paintings, which display different kind of information in a subtle way. The information displayed ranges from weather forecasts of distant cities, to recent earthquake activity around the globe. By slowly adapting to information changes the art pieces don't attract the user's attention. However, the user can bring the art piece to the center of his attention if he or she wants to extract some information.

Let's regard the example of a meeting, where information needs to be displayed unobtrusively. In order to be visible for all participants the ambient display should be close if not in the center of the physical space of the people and their activity. We propose to integrate the display into the physical world by actually using a real physical object as the display itself. This enables a display to be omni-directional in order to be visible for all meeting participants. It should display peripheral information without distracting from the actual task. Finally the aim should be for a visually appealing object since it is more likely to be accepted and even enjoyed by people.

This paper proposes such a display, named LaughingLily, where a physical object - here an artificial flower - becomes the ambient display itself. Depending on the information to be displayed the flower can let its petals hang, or open them up to full bloom (see Figure 1). By nature a flower is omni-directional and can be perceived by all participants. By careful design of the movements and blooming behavior of the flower LaughingLily can display information without distracting.

MEDIATING BETWEEN MEETING PARTICIPANTS `
Team meetings with a handful of participants can sometimes be very cumbersome. Do you remember your last meeting that got out of hand? When your colleagues kept arguing about the same thing over and over again? Oppositely there can be brainstorming sessions where nobody has any ideas and a laming silence fills the room.

To mediate between meeting participants we built a flower

Figure 1: LaughingLily opening her petals to full bloom.

that can droop its petals or show its bud in full bloom; thus representing a sad or a happy state. The flower stands on the middle of the meeting table and changes its stature depending on the surrounding sound. If nobody is talking the flower lets its petals droop. If a conversation at an intermediate volume is going on the flower moves towards full bloom. If an argument breaks out the flower starts drooping again.

To be able to react on the audio activity of the participants the flower is connected to a microphone. Using multiple directed microphones each connected to an individual flower the display can show which participants in the meeting are dominating the discussions and which have not spoken for some time. A similar effect can be achieved by placing two or three flowers on the table at different positions. This way, the meeting participants are not directly exposed as too loud or too silent, but the one side of the table is accused as a whole.

LaughingLily - Implementation

LaughingLily is an artificial Lily extended with a electro-mechanical system. The microphone on a Smart-Its [4] sensor board was used to capture an audio signal. The onboard processor (PIC microcontroller) calculates the energy level of the signal, representing the loudness of the people speaking. To make the flower move a servo motor was controlled directly from the sensor board. A shaft connecting the servo motor with a cup-shaped plastic part actuates the flowers petals. The whole system can either be powered by batteries (working for several days using 4xAA batteries) or directly from the mains.

First Impressions and Discussion

The first afternoon LaughingLily was standing on the coffee table in our hall many comments from office colleagues were made about how sad or how pretty the flower looked. They soon learnt that when someone is talking in the environment the flower starts lifting up her petals. After the novelty wore off everybody continued with their everyday business. LaughingLily had become integrated into the physical space and became a peripheral display.

We believe the quick integration of LaughingLily resulted mainly from having a physical object as a display itself. An object can be moved around in space and be placed amidst people. In this way the display is adapted to the situation instead of having the people adapt to the display.

As expected due to the natural association between LaughingLily and a real flower, first experiments showed how people's emotions can be invoked. A drooping flower is naturally associated with sadness, whereas a flower in full bloom can trigger happiness to a certain extent. Exploiting these associations people have with physical objects could be a powerful tool in interface design.

OTHER APPLICATIONS

Beyond the meeting application presented in the previous section many more applications are imaginable. In office environments LaughingLily could be used to warn computer users from repetitive strain injuries by letting the petals droop if someone hasn't had a break for a long time. Further LaughingLily could display to co-workers how interruptible one is depending on approaching deadlines, calendar information or e-mail load.

In the domestic environment LaughingLily could act as a progress bar for simple procedures. For example, the flower could show how far the washing machine is by slowly elevating its petals. It could show how long the cake has been in the oven. The petals would then simply start to droop again if the cake was is in for too long.

Finally, LaughingLily can display the interaction level between conference participators and the poster presenter at a conference such as UbiComp 2003.

CONCLUSIONS AND FUTURE WORK

In this paper we have presented LaughingLily – an ambient display embodied by a flower. Although we have yet to conduct a comprehensive user study, we have shown how well such an ambient display - in the form of a flower - can integrate into the environment. We believe that displaying feedback to the user in a physical object is the key to making ubiquitous computing applications calmer and more suitable to human needs.

Besides exploring LaughingLily's effects on meeting participants in a larger user study we want to continue developing further physical feedback devices.

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