

The Reminder Bracelet: Subtle Notification Cues for Mobile Devices

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ABSTRACT

We are investigating new ways of conveying event notifications from mobile devices to their users. Our ambition has been to explore non-intrusive, or subtle ways of notifying users, to hide the technology and make room for aesthetic considerations. We argue that there is need for new ways of attracting a user's attention, while at the same time not disturbing other people. We have built a notification tool, the *Reminder Bracelet*, that is worn on the wrist and connected to a PDA. It notifies its user of scheduled events in a subtle and silent manner using light, color and patterns. Initial evaluations have shown that in a number of situations, the bracelet was preferred to the alert sound of a PDA or a mobile phone.

Keywords

Notifications, Mobile devices, Aesthetics

INTRODUCTION

The proliferation of personal devices such as mobile phones, pagers and personal digital assistants (PDAs) risk to create an "attention overload" problem related to information overload, since notifications from them tend to be intrusive and uncorrelated. Presently, users are notified mainly by attention-demanding sounds and beeps, and to a lesser extent by tactile vibrating devices such as those found in some mobile phones. Having a multitude of devices that are unaware of each other's states can result in situations that are very hard to interpret, for instance when different notifications coincide. Furthermore, even though notifications generally are intended for the owner of the device, other people nearby can be disturbed, making notifications a social issue as well. People typically address this by disabling alerts sounds in social environments, e.g. business meetings or cinemas [4]. However, this is not a satisfactory solution, as the users actually *want* to be notified in most cases.

Another related problem is that the devices often have similar, if not identical sounds, and it is hard to pinpoint from which device the sound originated. Several co-located people often react to an incoming phone signal by simultaneously picking up their respective mobile phones, though only one phone was ringing. Coordinating the devices and their notifications is a hard task. Emerging technologies like Bluetooth could allow for low-level communication between the devices. However, the complexity increases as higher level layers are needed to successfully utilize information about the state of these devices in a way that makes sense to the users.



Figure 1. A user wearing the Reminder Bracelet.

We strive for a technology that is not only functional, but also aesthetically pleasing and easy to integrate with the normal outfit in order to be well accepted among potential users. Consider a wristwatch - looking at the watch, the user does not see a piece of machinery, she rather sees an everyday item that tells the current time. Because function and technology are mature, the buyer of a watch need not be concerned about these aspects and thus aesthetics are granted higher value [cf. 3]. Hence, watches are fashion, and since watches are ubiquitous and their function is well-known, other people nearby instantly understand your action if you take a glance at the watch. We wanted to draw on such properties when exploring new ways of conveying notification cues from mobile or wearable devices.

THE REMINDER BRACELET

The *Reminder Bracelet* (Figure 1, left) is our first experiment in the search for complementary ways of displaying notification cues. It is a bracelet, worn on the wrist and connected to a user's PDA. The light emitting diodes (LEDs) embedded in the Reminder Bracelet act as a display for conveying notifications. The reason for using light was to allow for more subtle, less attention-demanding cues, and also to make the notifications public to a certain degree.

We decided to place the Reminder Bracelet on the wrist, a location that generally rests in the periphery of the user's attention [1], and also a familiar place for an informational device (cf. the wristwatch above). When a notification occurs, it is first perceived in the periphery of the user's vision and then it might move into the center of attention. In an effort to reduce the user interaction and to convey notifications in a consequent and easily interpreted manner, the Reminder Bracelet always notifies its user 15 minutes ahead of scheduled events in the PDA.

Implementation Details

The current prototype uses a 3Com Palm III PDA. The bracelet is connected to the PDA's serial port with a thin cable hidden in the user's clothing, via a Basic Stamp 2 microcontroller that controls the LEDs. The bracelet is made of black textile material with Velcro on the inside, much like a sports watch wristband, and has three embedded red LEDs (**Figure 1, right**). On the PDA, a program is regularly checking the user's calendar for upcoming events. The LEDs on the bracelet start to pulsate 15 minutes before each event. First one LED starts to twinkle, having a duty cycle of about one second. After one minute, the second LED starts to twinkle, with the third LED following after yet another minute. All three LEDs continue to pulsate for two more minutes before automatically stopping. The frequency, duty cycle and light intensity of the twinkling does not currently change during the twinkling sequence.

USER EXPERIENCE

We let four university students, all familiar with PDAs, use the system for two days and then we conducted semistructured interviews with each of them. In general, they had had difficulty perceiving the light transmitted from the LEDs and therefore had, at several occasions, failed to be notified. Thus, they had felt it hard to *trust* the system and due to that they had often caught themselves looking at the bracelet just to make sure the LEDs were not twinkling. However, all agreed that it would be a useful tool if the issues of trust could be resolved. We addressed this problem by replacing the original LEDs with higher intensity LEDs and then we let two people from the first group use the new system for one day. Now they were notified of each scheduled event and the trust for the system increased. Despite the change from low to high intensity LEDs, the Reminder Bracelet conveyed the notifications in a manner which they perceived to be subtle and non-intrusive and they were both of the opinion that they would prefer to be notified by the prototype rather than by a typical alert sound. Concerning further development of the system, they expressed that there had been a problem keeping the prototype visible when having to wear it on the wrist. They suggested making it wireless and thus more mobile, and also adding a button to it. This would make it easy to disable the twinkling after being notified, in effect a tradeoff between subtlety and functionality.

DISCUSSION

Imagine the following scenario:

John is at a business meeting, and it is taking longer time than he expected. There is a presentation going on and suddenly John's PDA starts beeping. John changes focus and remembers that he had promised to pick his daughter up at school. The presenter is interrupted, John makes excuses since the beeping had made everyone change focus from the presenter to him. Then John leaves.

If John had used a Reminder Bracelet, the notification would not have caused such an interruption, and he could have left without distracting the others that much. A tactile display, such as a vibrating device could also have worked well in the scenario above. Such tactile displays are private, non-intrusive and silent. However, there are some major differences to a Reminder Bracelet. Since a vibrating device

needs to be carried rather close to the body it is usually not visible to the people nearby the user and it is therefore hard for others to understand why, for instance, the user suddenly leaves from a meeting. It provides the user with completely private information and therefore it has a low degree of *publicity*. An audible signal has a high degree of publicity, whereas a device such as the Reminder Bracelet falls somewhere in between these two extreme cases. Using notification cues with a higher degree of publicity allows other people present to interpret the situation at hand, e.g. in terms of causality (cf. the wristwatch above). Handsfree headsets for mobile phones have introduced a similar issue, where people can appear to be talking to themselves, because the headset is hardly noticeable to others [2]. Thus, personal devices with low publicity increases the risk for misinterpretations of the user's actions in social environments.

Another important property regards mobility, wearability, and how tightly the device integrates with its user. The Reminder Bracelet has the potential to evolve into a device which, as long as it stays visible, can be placed wherever the user wants to, whereas a tactile device always needs to be carried close to the user's body in order function properly.

Finally, the work on Nomadic Radio [4] shares our interest in providing mobile users with timely notification cues, and highlights the problem of differentiating between various cues from a device. This is especially important when considering displaying cues with different media types. However, Nomadic Radio uses a private, audio only environment that needs to be worn at all times, and as the system uses earphones, it has a low degree of publicity.

CONCLUSION AND FUTURE WORK

Placing a device which conveys notifications using light and color in the periphery of the user's attention proved to be a useful complement to existing notification technologies. Our initial user experiences indicated that the Reminder Bracelet can notify its user in a subtle and non-intrusive way and the test users were all positive to a further development of such a device. More evaluations of the Reminder Bracelet should be performed to clearly determine which areas need improvement and to conclude in what ways, if any, the Reminder Bracelet offers advantages over existing manners of notification. Adding new functionality might increase the need of user interaction and make the device less subtle, therefore the tradeoff between subtlety and functionality needs to be investigated and studies need to be performed in order to gain an understanding on how to achieve a balance between the two concepts. The current plans for the Reminder Bracelet is to make it have a wireless connection to the PDA, instead of using a thin cable, and also make it able to deal with several types of notifications.

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