Augmenting digital jewelry with advanced display capacities

Simon T. Perrault
TELECOM ParisTech - CNRS LTCI UMR 5141
46 rue Barrault
Paris, France
simon.perrault@telecom-paristech.fr

Hind Gacem
TELECOM ParisTech - CNRS LTCI UMR 5141
46 rue Barrault
Paris, France
hind.gacem@telecom-paristech.fr

Eric Lecolinet
TELECOM ParisTech - CNRS LTCI UMR 5141
46 rue Barrault
Paris, France
eric.lecolinet@telecom-paristech.fr

Yves Guiard
TELECOM ParisTech - CNRS LTCI UMR 5141
46 rue Barrault
Paris, France
yves.guiard@telecom-paristech.fr

CHI 2013 Workshop on Displays Take New Shape: An Agenda for Interactive Surfaces, April 28, 2013, Paris, France.

Abstract
In this paper, we present ways to enhance digital jewelry with new generation displays. We first present ways to improve display capabilities on existing pieces of jewelry by using curved deformable displays and projectors. In a second part, we focus on the particular case of wristwatches, presenting new results about interaction on wristband and propose new usages unlocked by the use of such displays on digital jewelry.

Author Keywords
Display; interaction; separated; everyday life object; input; wristwatch; digital jewelry

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces – Input Devices and Strategies

General Terms
Human Factors.

Introduction
After decades of miniaturization race, mobile computing is taking a new path lately. Instead of users carrying computers around, they tend to wear them directly on their body. It started with augmented garments and digital jewelry [4]. This kind of devices remains usually accessible [1] and visible [2] for the user, thus

Figure 1. The I'm Watch wristwatch

providing faster and smoother interaction than smartphone. However, objects and prototypes presented in the current literature usually offer limited interaction capabilities, compared to a computer or even a phone. This can be explained by their lack of display, or, when there is one, its limited size. With a whole new generation of displays, that can now be flexible, bendable and offers high resolution, this problem could be corrected soon. But using these new technologies also raises new challenges. In this paper, we will present example of specific digital jewelry and how they could benefit from enhanced display capabilities.

Digital jewelry

Necklaces, Pendants

Necklaces are not well suited for displays (like screens), but their location (close to the head of the user, on the least mobile body part) makes them the most suitable location for projection. Wristwatches or smartphones could be other candidates for embedded projectors, but they have a major drawback over pendants: the position of the watch/phone has to be maintained by the user in order to project properly, inducing fatigue. A projecting necklace would also stay something discreet, and socially acceptable.

Compared to larger, curved display on a wristwatch, a projector cannot be used in the same context: projection is harder if the user is mobile (walking, running), but still could be used in addition to a wristwatch, in order to share information with others, watch high definition picture, movie, or read complex documents.

Rings

Rings are the most visible pieces of jewelry for their porter, but their display potential is limited by their very small size. By taking advantage of their toric design (like a bracelet), it could be possible to display simple, single line piece of information (e.g. caller ID, reminder for a meeting). Using e-ink display on a ring would make it a cheap, low power, visible device perfectly fitted for displaying notifications alerts.

Bracelet, Wristwatches

A lot of new interactive wristwatches became available for sale in the last few years (Pebble, I'm watch -Figure 1-, Sony android wristwatch), and the common point they share is their small screen (usually less than 2" diagonal).

The next generation should take advantage of the form factor of wristwatches, and offer a larger display surface (ideally the whole surface), *e.g.* by using foldable displays. In Facet [3], displays are all other the watch, but are seen as independent segments, making it possible to display a lot of different information. Using a flexible display to cover the entire bracelet would provide better interaction and also better flexibility for displaying information. In that case, the surface can be divided in areas (Figure 2):

- Area clearly visible by the user (Figure 2-a, green). This part should be used to display complex information.

- Area partly visible for the user (Figure 2-b, orange). This part would be best suited for simple information (notifications), and could still be used for interaction. The WatchIt prototype [5] is designed to use this part for interaction, with good results.

- Area invisible to the user, which usually corresponds to the clasp area (Figure 2-c, red). The factor makes this part diametrically opposite to the visible area, which can provide occlusion-free interaction.

The system should know in real time the location of this area, depending on the movements of the arm of the user.

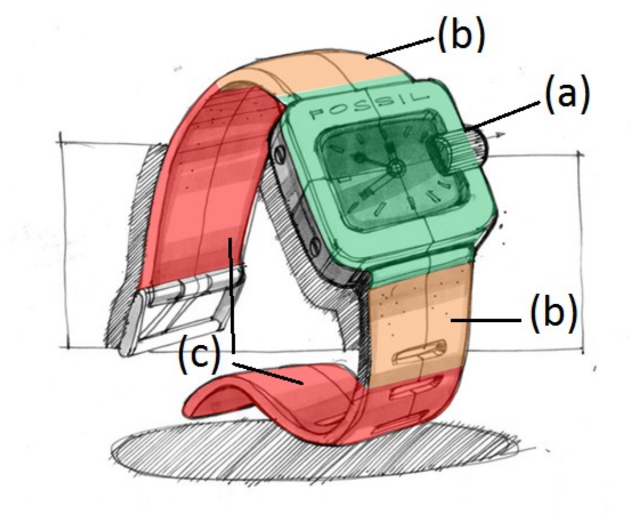

Figure 2. Areas of visibility of a wristwatch (a) green: clearly visible, b) orange: partly visible, c) red: invisible), providing the user is looking at the screen.

Interacting around the wrist: guidelines

Let us now imagine a wristband composed of a flexible display wrapped around the wrist (as in [6]). While fixed on the user, a great part of its surface is hardly visible for the user. However, it is still possible, and interesting to interact on the whole device.

In WatchIt [5], we especially focus on the interaction in the "partly visible" and "invisible area". We designed a gesture vocabulary for simple interaction and proved that users were able to easily interact, even in an eyes-free context.

But most importantly, we showed that users were also capable of being precise on the whole surface of the wristband. We designed an experiment that involved list scrolling, and suggested an absolute pointing technique: in this technique, users had to browse through a list (sizes of 15, 60 and 240 items), that was mapped on the lower part of the wristband.

Our results suggest that browsing with this technique on the wristband was significantly faster than simply browsing on the screen (cf Figure 3).

New usages

The results presented in Figure 3 are a strong argument to change the actual wristwatch paradigm: instead of offering a tiny screen, it seems more desirable to use a flexible display covering the whole surface of the wristband.

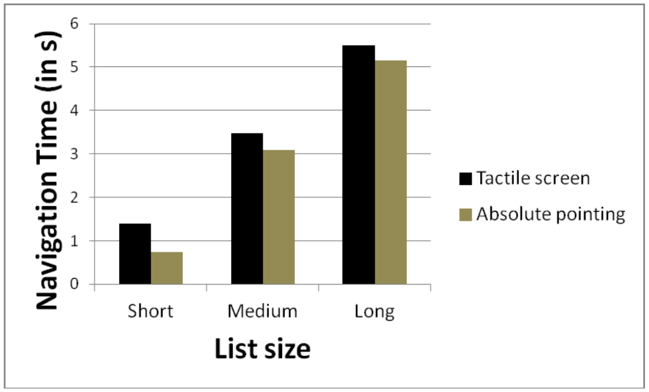

Figure 3: Navigation time depending on list size

While we only addressed input problems, the next step would be to evaluate the capability of users to distinguish information on different part of the bracelet.

An interactive wristband could have the same surface as a smartphone, and would be more easily accessible. A good association for this kind of wristband would be a ring that could display alerts and minimal information, making the interaction easier and deporting alerts on an even more visible location.

If we consider a situation where the user is in mobility, the wristband can fulfill basic yet indispensable features (like phone, navigation), even though its whole surface is not usable for display. But when the wristband is detached from the wrist [6], it becomes a fully functional "smartphone".

Conclusion

In this paper, we presented ideas to design and evaluate interaction techniques on digital jewelry. First, we showed how curved display and projectors could enhance the display potential of such small devices. We then presented results from a wristband prototype and suggested new usage that could be done of enhanced digital jewelry.

Acknowledgements

This research has been funded by the Futur et Ruptures PhD program from Institut Telecom.

References

[1] Ashbrook, D.L., Clawson, J.R., Lyons, K., Starner, T.E., and Patel, N. Quickdraw: the impact of mobility and on-body placement on device access time. In *Proc. CHI'08*, 219–222.

[2] Harrison, C., Lim, B.Y., Shick, A., and Hudson, S.E. Where to Locate Wearable Displays? Reaction Time Performance of Visual Alerts from Tip to Toe. In Proc. CHI'09, 941–944.

[3] Lyons, K., Nguyen, D.H., Ashbrook, D., and White, S. Facet : A Multi-Segment Wrist Worn System. In *Proc. UIST'12*, 123–129.

[4] Miner, C., Chan, D., and Campbell, C. Digital jewelry: wearable technology for everyday life. In *CHI EA'01*, 45–46.

[5] Perrault, S. T., Lecolinet, E., Eagan, J., Guiard, Y. WatchIt: WatchIt: Simple Gestures and Eyes-free Interaction for Wristwatches and Bracelets. In *CHI'13*, 10 pages, to appear.

[6] Tarun, A., Lahey, B., and Girouard, A. Snaplet: using body shape to inform function in mobile flexible display devices. In *CHI EA'11*, (2011), 329–334.