Body Mnemonics
Portable device interaction design concept

Jussi Ängeslevä, Ian Oakley, Stephen Hughes, Sile O'Modhrain
Media Lab Europe
Sugar House Lane
Bellevue
Dublin 8, Ireland
Tel: +353 (0)1 474 2890
E-mail: {jussi,ian,steveh,sile}@medialabeurope.org

ABSTRACT
Body Mnemonics is an interface design concept for portable devices that uses the body space of the user as an interface. In this system, information can be stored and subsequently accessed by moving a device to different locations around one's body. The system is designed to ease cognitive load by relying on our proprioceptive sense and the use of the body image of the user as a mnemonic frame of reference. The hardware approach is to use motion sensing in the device itself. Two user studies were conducted to evaluate the feasibility of the system.

KEYWORDS: Mnemonics, Proprioception, Portable Device Interaction, Embodied Interfaces

INTRODUCTION
Mobile telephones, personal digital assistants (PDAs) and other handheld computers are currently one of the fastest growth areas of computing. Existing devices have limited input and output capabilities, making them cumbersome and hard to use when mobile[1]. Consequently, a current requirement in this field is the development of new interaction techniques specifically designed for mobile scenarios.

The data in these devices is commonly managed with a traditional desktop or laptop computer, and they are mainly used to retrieve information while mobile[2]. Therefore, making the retrieval as easy and quick as possible is essential in the interface design.

Gestural interfaces have been demonstrated as a successful alternative to physical and on-screen buttons on handheld devices. Typical interfaces involve shaking and tilting the device to trigger different commands[1, 3-5]. We adopt a related approach by using inertial sensing embedded within the portable device.

DESIGN CONCEPT
Instead of looking at command gestures, we propose a system where the information is stored in the body space. Moving one's hand to the shoulder for example, can be seen as a gesture. However, we ask the user to think of the shoulder itself as the location of the information. With this different way of thinking, a historically established memory technique called the Method of Loci can be harnessed[6]. This technique was originally used by orators as a means to recite long narratives. They used architectural space as a mental model, associating story fragments to different rooms. In medieval Europe the method was adapted to include body space. Different body positions were used as markers to remember chants, lists or even as a computational system[7].

To facilitate the study of this interaction paradigm, we are currently developing an inertial sensing board that fits in the expansion slot of a PDA and tracks the motions of the device. By beginning the gesture from a common starting location, the system can compare motions to previously stored movement patterns, triggering the desired functionality.

USER STUDY
In order to assess the technological feasibility of the concept and gain some insight into its potential, two user studies were conducted.

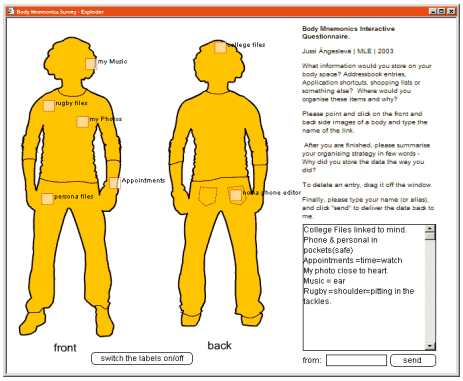

Figure 1: Online Survey application screenshot.

An online survey was designed (Figure 1), which allowed participants from around the world to create their own hypothetical body maps describing arrangements of their chosen items on a front and back image of a person.

We received a total of 45 responses, of which 14 were incomplete and thus omitted. The total number of individual entries among all the participants was 199, where an individual's average was 6.8 entries (SD=3.18, Min=3, Max=14).

To estimate the required accuracy of the system we looked at the distances between the entries. We first defined an average height for the figure as 170.5 cm[1] to compute the distance between the closest two entries in one body space, considering the front and back as different spaces. The total number of distances measured was 145, as the front and back side had to be analysed separately. On average the shortest distance between 2 adjacent entries was 54.7 cm (SD=32) with the median at 47 cm, the shortest distance being 5.4 cm and the longest 167.5 cm. From these we estimated that the system should be able to differentiate at least 7 items, the minimum distance between them being 15 cm.

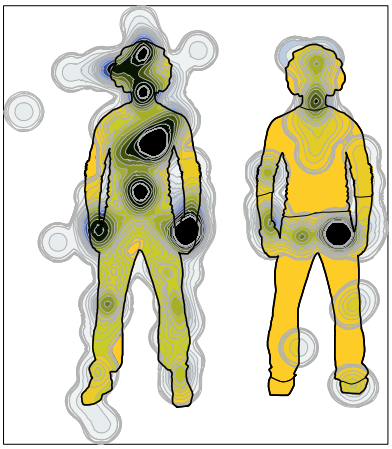

Figure 2: A collective body map comprising the entries from all the participants of the online survey and illustrating areas of significance in the body space.

To evaluate the usability of the system, we first looked at the versatility of the placements of different common items, such as different lists, personal files, finance and music. We then looked at the rationales people had for the storage. Some items, such as music players and address books were frequently placed by the ears and by the pockets respectively.

[1] The average American male is 177 cm, and 90% of males are between 167cm and 185 cm. The average female is 164cm, and 90% of females are between 156cm and 171cm. Source: US National Center for Health Statistic Percentile, 1979.

For more personal data, such as photo albums and hobby related information the arrangement was much more varied, but still meaningful to the individual.

Finally, we collated all the replies into a single body map. This visualisation allowed us to see locations with higher general associational value. (Figure 2.) Higher densities can be seen on the pockets, stomach, heart and head. We suggest that their significance as a *container* (pockets), *emotional reference* (stomach, heart) or *function* (mouth, eyes, ears) was leveraged as a memory cue.

To evaluate the memorability of the system, a Wizard of Oz experiment was conducted, where the participants (N=9) were asked to store a predefined list of 12 applications to their body space with a PDA. 3-5 days later they were asked to recall the list.

Omitting one participant, who felt she did not want to associate anything to her body space, the recall rate was 10.2/12 on average. All the errors resulted from mixing left and right pockets.

CONCLUSIONS AND FUTURE WORK

The user studies were conducted to gain insight to inform our design and as rigorous usability studies, their validity can be questioned. We feel, however, that they provide a good starting point for the prototype development and confirm that the design concept is meaningful and usable. We are currently building the hardware system which will facilitate the conduction of real life user studies and usability testing.

REFERENCES

1. Hinkley, K., et al., *Sensing techniques for mobile interaction.* Symposium on User Interface Software and Technology, 2000: p. 91-100.

2. Cliff, *Do People Really Use Their PDAs?* 2002. http://ask.slashdot.org/askslashdot/02/11/24/0224251.shtml?tid=99 (4th of June 2003).

3. Fitzmaurice, G.W., *Situated information spaces and spatially aware palmtop computers.* Communications of the ACM, 1993. **36**(7): p. 39-49.

4. Rekimoto, J., *Tilting Operations for Small Screen Interfaces.* UIST, 1996.

5. Bartlett, J.F., *Rock 'n' Scroll is Here to Stay*. 2000.

6. Yates, F.A., *The art of memory*. 1966, London,: Routledge and K. Paul. xv, 400.

7. Sherman, C.R., *Writing on Hands: Memory and Knowledge in Early Modern Europe*. 2000, Pennsylvania: University of Washington Press. 277.