Hands Reaching Out of Dreamland: A Haptic Peripheral Alarm Clock

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Abstract. Checking your pocket for your mobile phone is still there, tying your shoelaces, moving a cup to your mouth to drink, are examples of peripheral activities, which can be performed without focused attention – something humans are perfectly capable of. However during the rapid development of technology these human skills are often not addressed in the designs that surround us. Products are simply designed for full attention without taking peripheral attention into account as an equally important mode of interaction. This paper explores the notion of peripheral interactivity using touch as a new mode of expression and experience by means of making time tangible. The haptic, peripheral alarm clock as presented in this paper turns the activity of checking the time while sleeping into a truly peripheral activity.

Keywords: Calm Technology, Design for the Periphery, Tangible Interaction, Time Awareness.

1 Introduction

Peripheral interactivity relates well to sleep as a daily activity of full and preferably undivided "attention" – humans need to be well rested to cope with the upcoming day. Still, timing sleep is important in our busy lives, e.g. not to miss a flight or an important meeting. In traditional alarm clock designs, full attention was required to perceive a visual representation of (remaining sleep) time – often only as absolute wakeup time, which requires another step of cognitive processing to come to a sense of relative remaining time. The more advanced alarm clocks experiment with a range of wakeup signals, however our focus is on the actual sleep time and the little moments you are awake during that time instead.

As a starting point the following hypothesis is used for this design challenge: the use of haptic interaction enables the user to shift the activity of checking time during sleep into the periphery of attention and decreases the use of centered attention only. Figure 1 visualizes how the design for periphery approach fits the users need for accuracy, in the sleeping with alarm clock scenario, in comparison with the old centered attention interaction style.

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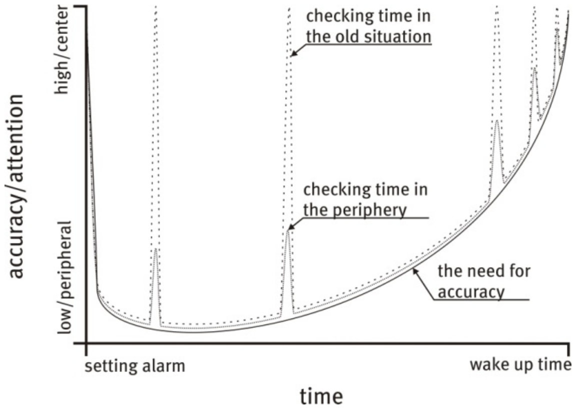

Fig. 1. The need for accuracy of time and attention to time in relation to sleep time

2 Related Work

The peripheral approach originates from the Calm Technology theory of Weiser and Brown[1]. They argue that computers in our environment should be designed to stay out of the way, this to keep users serene and in control. Their theory describes how humans are skilled to execute a variety of activities without consciously paying attention to them. This because the human brain dedicates the most to peripheral (sensory) processing, therefore by placing objects or activities in the periphery we are able to attune to many more things than we could if everything had to be at the center[1]. In short, calm technology engages both the center and the periphery of our attention and in fact moves back and forth between the two. Peripherally we may become aware and by re-centering we take control of it[1].

However, as Bakker et al.[2] describe, the world around us is constantly full of stimuli that we can potentially attend to. As we cannot completely value all that takes place at the same time, a process of selective allocation of attention is needed to understand and judge the world[2]. They furthermore explain how humans are able to selectively focus our attention on one stimulus or to divide our attentional resources over multiple attentional tasks at once and how peripheral designs are interactive systems that leverage these human attentional processing skills so that information can be perceived and manipulated without explicitly centering our attention on it[2].

Examples of peripheral designs are the Dangling String[1], which spins based on the information sent through an Ethernet cable; Motion Monitor[3], a ball that lights up in different colours resembling the amount of activity at a remote location, providing users with a sense of connectedness to friends and family; Data Fountain[4], the height of the different currencies is connected to real-time money currency rates on the Internet; Ambient Umbrella[4], the handle of the Ambient Umbrella glows if rain is forecast, reminding its owner.

Bakker et al. furthermore postulate exploring the tactile modality in the context of design for the periphery because humans are very capable to manipulate objects with their hands and for this purpose tangible interaction seems to be an appropriate method[2]. A tangible user interface is a denoting system that relies on physical representation of data and embodied interaction, tangible manipulation and embeddedness in real space[5]. So it is expected that when information becomes haptic it can inform and be manipulated in the periphery of our attention.

3 Haptic Design for the Periphery

Most design artifacts are stuck in the visual and auditory paradigm – the use of touch and shapes as an interaction style is very uncommon. Which is remarkable given that the density of receptors (nerve endings) on fingertips is 2,500 per cm^2[6]. Moreover most notable during the first user interviews was the fact that every user had an experience with the phenomenon of unintentionally checking pockets if you still have your belongings and how this shifts into the center of your attention when something is missing, i.e. those expectations are not met.

Alarm clocks essentially are objects in the very periphery of human attention – until they suddenly shift into the center of attention and wake us up. Most commercial products focus on the waking up, however the calmer features of the alarm clock are: reading and setting time, and sporadically observing the passing of time. Therefore the main functionality of the new alarm clock design, during the exploration phase and as presented in this paper, is communicating the amount of time left to sleep.

Before the final design was developed an iterative process explored the design space in search for guidelines. In line with the Rich Interaction theory of Frens[7] the properties of, and the relations between, the newly defined main function, form and interaction were investigated. This because through the unity of function, form, and interaction aesthetic and embodied interaction is created which respects and directly relates to all human skills instead of abstractly cognitive skills alone[8].

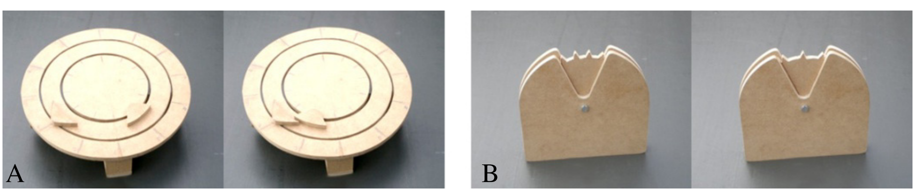

Fig. 2. Examples of prototypes 2a. Arrow in the inner circle represents current time, arrow in the outer circle represents the set alarm time. 2b. The spikes on the turning wheel represent hours left to sleep located in such a way that hours and the number of spikes decrease at once.

Following this method a variety of prototypes were created and tested. Early tests revealed that users are skilled in recognizing different shapes with the use of touch until a certain level of complexity beyond which shapes cannot be distinguished reliably anymore. Users can feel a state which a device is in – this can be a shape or for example the speed of a rotating object. However the device needs to transform from one state to another on a known scale to embed tangible information. Still, in a subsequent iteration, a lot of prototypes were dismissed for several reasons: mostly because they lack a point of reference and without that the scale upon which transformations occur cannot be determined; because users had orientation issues when relying on touch only, this was the case for the prototype in figure 2a; or the form was too complex for its purpose, in terms of needed level of attention, as for the prototype in figure 2b. These shapes are less suitable for peripheral design as complex orientation tasks commonly happen in the center of attention.

Fig. 3. The haptic peripheral alarm clock in context. Bedside lighting just for illumination of the evaluation setting.

The final haptic peripheral alarm clock design presented in this paper incorporates the solution for all challenges mentioned above. This final design can be seen in figure 3 and generally consists of a base and a shaft which contains a moving bar. This bar can fully disappear in the shaft but when in an upward position it is visible that this bar is divided into segments separated by grooves – each segment represents an hour. The device works as follows: The alarm time can be set by pressing the button on top of the bar to bring it up from the shaft – by doing so one programs the alarm clock with time-left-to-sleep. When this time-left-to-sleep is set the device will automatically start the countdown: the bar with its hour segments will, equal to the procession of real hours, lower into the shaft. This means that the time until alarm can be felt by touching what is left of the bar. This can be done at two attentional levels: either by feeling the total amount of the bar, and thus sleeping time left, or by feeling the density of the grooves on the bar right above the shaft for a more relative time perception: are hours left or less? Because the second last hour-segment is also divided into half hours and the last hour is divided into segments of ten minutes as seen in figure 4. This to express of the relativity of time; the difference between four or five hours until alarm is relatively less important than the difference between one hour or twenty minutes until alarm. In addition this relates to the linear relation between the complexity of shape (accuracy) and level of needed attention (see the illustrated hypothesis in figure 1).

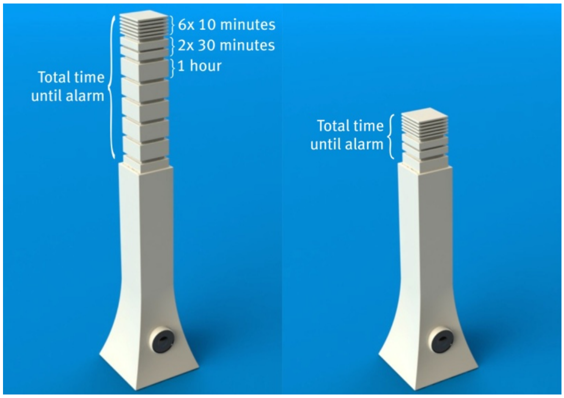

Fig. 4. Rendering of the haptic peripheral alarm clock with explanation. In two steps, first with more than 7 hours left until wake-up, second with 2,5 hours left until wake-up.

The final shape was also chosen because it relates to the famous "alarm clock interaction": a downward hitting motion. At the same time, it visualizes elapsing time by means of the downward motion of the bar which incorporates the feeling of the flow of time – it suggests the inextensibility of time, you cannot stop the time passing by. When the time is up the device will buzz, similar to traditional alarm clocks. However when snoozing one is manipulating or extending time-left-to-sleep, so by touching the top button on the bar, bringing it up again, the user is able to "bend" the time by extending the time until alarm. Moreover this action can be combined with feeling how many segments that are rising; also a manipulation in the periphery of attention.

When waking up during sleep time (before the alarm) one is still focused on sleep (the center task). So without shifting attention from the sleeping task to the time perception task, one can peripherally feel the time left for sleeping. This way, the user does not need to shift his full attention from the main task which, as predicted, suits the need for accuracy during sleep better (see the illustrated hypothesis in figure 1).

4 Evaluation

During the iterative development of the haptic peripheral alarm clock, a working prototype has been designed, developed, and subsequently evaluated with a number of users at their homes (see figure 3 for the final user test setting). The aim of evaluating during development was to test principles and to acquire guidelines for a next iteration. For the final evaluation the aim was to get initial feedback and a first impression of the usability of the final design. Nonetheless quantitative research is still needed.

The final evaluation consisted of five user tests and a focus group: during one test User X had felt he had around 4,5 hours left. He said: "I first felt that I had a lot left of the bar, which was good enough, but I wanted to feel the time that was left more exact. The great idea was that I did not need to lift my head or open my eyes". The flow of time, the downwards motion of the bar, cannot be seen. Yet this is a positive aspect of calm design, visually static, but when interacting the user can perceive change. The integration of the relativity of time was appreciated and instantly understood. User Y said: “when I woke up in the morning I felt I had 20 minutes left and it became clear why you made this division, very intuitive”. All five participants appreciated the overall experience and they indicated that they would like to have one for themselves.

Additionally, looking at the shape one could argue about instability. However while developing the final prototype (see figure 3) this issue was already reduced by increasing the width and weight of the base. Also it was not reported after user tests. Nevertheless future work will continue experimenting with size, weight and material.

5 Conclusion

In this paper we have described how tangible interaction, or more specific, a haptic interface is an appropriate method in the context of design for the periphery. How humans are able to unconsciously obtain information using touch, and how humans are capable of sensing and manipulating artifacts with our hands just by using their sense of touch. How haptic peripheral systems embed information in the transition between states of shape and/or motion, and how such systems require a scale with a point of reference for orientation. And how there is a linear relation between the complexity of shape, the level of needed accuracy, and the level of needed attention.

In addition we see more opportunities for haptic design for the periphery, since there are more products, systems and services which have a similar curve for the need for accuracy or attention over time (see the illustrated hypothesis in figure 1), which are currently not existing or available. Besides, such an approach directly relates to all human abilities instead of abstractly cognitive abilities alone and it will lead to a more controllable, engaging and a calmer future.

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