# Touch Me, Hit Me and I Know How You Feel. A Design Approach to Emotionally Rich Interaction.


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## ABSTRACT

In this paper we propose a 3-step method for designing emotionally rich interactions, illustrated by the design of an alarm clock. By emotionally rich interaction we understand interaction that heavily relies on emotion expressed through action. The method addresses three questions: What are the relevant emotional aspects for a context for experience? How can a product recognise and express these aspects? How should the product adapt its behaviour to the user on the basis of this information? The essence of our approach is that a product not only elicits emotionally expressive actions, but that the feedback is inextricably linked to these actions. The feedback should be inherent to the design, and not gratuitously added.



## Keywords

Product design, tangibility, rich interaction, emotion


## 1. INTRODUCTION

When I got up this morning, I was rather moody because I went to bed too late. My dog noticed, but my alarm clock didn't. He showed it by hiding under the bed, the alarm was imperturbable. We do get mad at products and push all their buttons aggressively, but they just do not care. One can express his frustration *at* a product but not communicate this frustration *to* a product. Why does my alarm clock not know that it should wake me up with different sounds depending on my emotional state? In this paper we address this question and take a product design approach to answer it.

In what way is this relevant for designing interactive systems? As electronics become embedded in more products, product design becomes designing human-product interaction, or designing interfaces. In products these interfaces are physical objects, not screens. Physical objects are about actions, about human perceptual-motor skills [7]. HCI design also moves away from screens towards physical interfacing [5].




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In both disciplines the talk is about tangible interfaces, and many issues are thus the same. But there is more. The emphasis on emotional skills in both product and human-computer design is growing as well. Product design changes into designing contexts for experience [7]. The Media Lab at MIT is researching "affective computing" [8]. Damasio's book [2] has shown that pure logic alone, without emotional value, leaves a person, or a machine for that matter, indecisive.

In this paper we argue that emotions and actions are closely intertwined. We use actions as the source of information to get to emotions. Indeed, people should be able to communicate their emotions *to* the product, not at it.

How do we tackle the alarm clock problem? Obviously there is no established methodology yet for designing emotionally intelligent products. New methods have to be devised and borrowed as we go along. The aim of this paper is to propose methods for (and to warn against pitfalls when) designing emotionally rich interaction. By emotionally rich interaction we understand interaction that heavily relies on emotion expressed through action.

## 2. THREE STEPS

Translating Picard's three issues for affective computing [8] to (product) design, the proposed method consists of three steps:

1. What are the relevant emotional aspects for a context for experience?
2. A. What sources of information on these aspects does the product have at its disposal?

   B. How can the product get hold of this information?

   C. How can the product communicate to a person that it received this information?
3. How should the product adapt its behaviour to the person on the basis of this information?

In this paper we concentrate on the second step. The answer to the first step was published elsewhere [10] and is summarised here. The third question is still largely unanswered. It is part of our ongoing research. We sketch the outline of this research and report preliminary results.

## 3. STEP 1: THE RELEVANT EMOTIONAL ASPECTS

To learn more about the relevant emotional aspects of a context for experience we need insight into the experience. In the case of the emotionally intelligent alarm clock we need to know how people experience waking up. We have to access and capture this experience. This poses some interesting challenges [10].

Capturing experiences has to be done in the right context, by a person himself in his own environment. You cannot invite yourself in somebody's bedroom and videotape his emotions when he wakes up. Just as it's not useful to invite someone with his alarm clock into a lab situation. New methods should facilitate exchange between the people who experience products, interfaces, systems and spaces and the people who design for experiencing [9]. Verbal questions alone cannot stimulate people to explore their emotions and experiences nor can words describe them fully. We need images to feed their imaginations. We use images of facial expressions to make it easier for people to describe their feelings. Images are also essential in giving a visual impression of the different contexts in which people wake up. With sound being one of the strongest means for waking up, we need auditory information about the experience as well.

Inspired by Gaver's 'probes' [6], we use an explorative research method where people capture their emotional experience of waking up in words, images and sounds.

**Figure 1: The probe.**

Our probe is a package (Figure 1) containing different tasks, coloured pens, question cards, a diary, an audio recorder and a disposable camera. The central task in the probe is a small diary in which the participants are asked to monitor their day during a week. The questions relate to what time they got up, what their plans are for the rest of the day and how their day has been. They have to mark images of facial expressions with different coloured pens to indicate how they feel about it. Another task involves the making of a family tree (Figure 2) in order to investigate the desirable personality of future intelligent alarm clocks. We ask the participants to imagine that their current and ideal alarm clock can have parents and inherit their characters. Who would they be? For this purpose they are provided with portraits which they can stick on a family tree postcard. Figure 2 depicts the personality of the current alarm as being a mix of Stalin ("my alarm is a dictator") and a tv-news anchorman ("...a bit boring, but reliable"). The desired personality is a mix of the Dalai Lama ("waking up in a peaceful, tranquil way") and the sun ("...a natural, gradual way of waking up").

The probe also contains a disposable photographic camera and an audio recorder. The participants are asked to explore and capture their experience of waking up by making pictures and recording sounds: sounds and images of themselves, their alarm clock, their bedroom, something pleasant, something irritating, something relaxing or beautiful. They are also asked to record sounds and images with which they want to wake up in different situations.

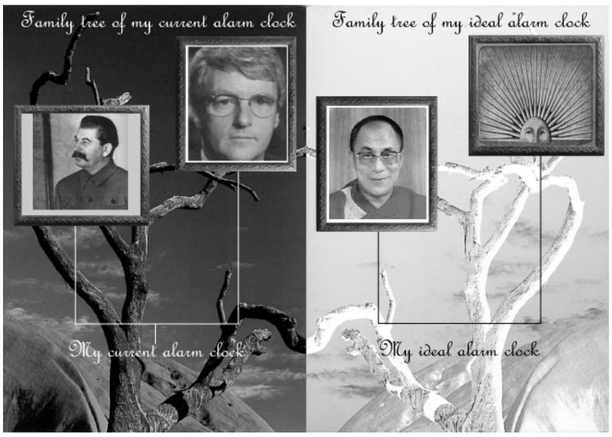


**Figure 2: The family tree.**

In another task we asked people to imagine that they had an extremely smart alarm clock. The given pictures showed different possibilities of information, but they could add their own ideas as well. They had to give their preferences by sticking coloured dots on the different pictures. Figure 3 shows how the dots were distributed.

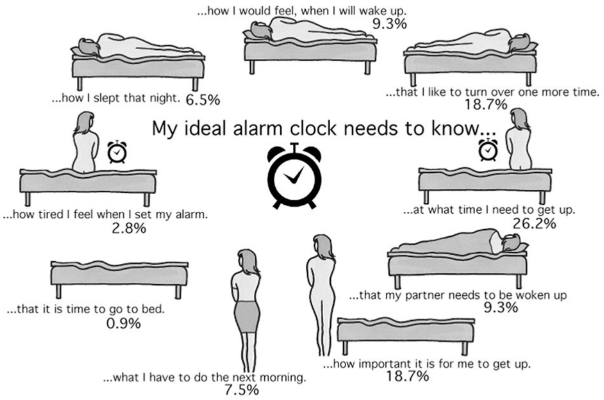


**Figure 3: My ideal alarm clock needs to know...**

The probes return rich feedback from each individual, which helps to empathise with each person and give a good feeling for the context in which they wake up.

Some generalisations about relevant emotional aspects can be made. For instance, the time that people wake up and the amount of sleep both influence their emotion when they wake up. Both aspects have an even bigger influence on how they feel at the end of the day. Other relevant aspects that people indicated were the degree of importance of getting up and the need for turning over one more time (Figure 3). The family tree task showed the difference between the perceived and the desired personality of an alarm clock. It also showed differences between people in the desired personalities. Other differences between people came up in the diaries. They showed, for example, that people differ in their deviations from their daily patterns and in how this influences their emotions. For some staying up late is the exception, for others it's getting up early. Others lead a very regular life.

It is these individual aspects and differences that an emotionally intelligent alarm clock should adapt to.

# 4. STEP 2: INFORMATION ABOUT EMOTIONS?

In Step 1 the probe showed that the time-related aspects of sleeping and waking up, the degree of urgency of getting up and a person's current mood are important parameters for the expected emotional experience in the morning. In step 2 we ask how the alarm clock becomes aware of this information? In this part we make an analysis of the types of information available to the alarm, of how it gets hold of this information, and how it lets a person know that it understood him.

## 4.1 Types of information

We distinguish four sources of information (see Table 1): Information found through the direct interaction with a person (proximal information); and information found in the environment of the person (distal information). Both proximal and distal sources can give factual or sensed information. We explain the different sources by examples.

**Table 1 Examples of the four types of information.**

| | proximal | distal |
|---|---|---|
| factual | time of waking up<br>amount of sleep | traffic information<br>flight information |
| sensed | behaviour<br>blood pressure | light intensity<br>noise levels |

### *4.1.1 Factual proximal information*

Time of waking up: People set the time through direct interaction with the alarm clock. Our probes research shows that when you wake up at a later than usual time it positively influences your emotion in the morning and even stronger in the evening [10].

Amount of sleep: The alarm clock can roughly calculate the amount of sleep by subtracting the time in the evening at which the alarm was set from the wake up time a person has set. We found that the amount of sleep has an even bigger influence on how you feel in the morning and in the evening than the time of waking.

### *4.1.2 Factual distal information*

Traffic or flight information: If an intelligent alarm clock gets information from a distal source about flight delays or accidents on the motorway, it can adapt its actions, e.g., let you sleep. This will have an effect on people's emotions.

### *4.1.3 Sensed distal information*

Light intensity or noise levels: Noise or changes in lighting during the night resulting in tossing and turning can affect a person's emotions. If an alarm clock can perceive the changes in light and sound in the environment, it can anticipate the emotions and try to, e.g., soothe a person by waking her up with his favourite music.

### *4.1.4 Sensed proximal information*

Whereas the other three types of information are important for a product to anticipate emotions, sensed proximal information carries direct information about a person's emotion. People express and communicate their emotions through behaviour and therefor behaviour is a source of direct information about the emotions.

On the other hand, a lot of research in affective computing focuses on physiological information, e.g., blood pressure, skin conductivity and heart rate. This information can be very useful to recognise emotions. However, we do not use this kind of information, as it does not allow a person to express his emotion *to* the product. After all, you do not express your emotions through physiology. An example clarifies our stance. The emotion-mouse [1] registers your heart rate, body temperature, general somatic activity and galvanic skin response. By doing this it can discriminate between six emotions. And these emotions can be fed to a computer and then the computer increases your productivity. This, of course, is very useful. But you cannot express to the computer that you are angry by means of this mouse. Your behaviour simply is not taken into account. So while the mouse does detect your emotions through your physiology, it denies your urge to express them.

The mouse shows that it is not always possible to take an existing design and modify it to detect behaviour. A mouse requires precision control and for it to function properly you have to control the behavioural expression of your emotions, because it cannot cope with the behaviour that comes with high arousal. Both the design and the function of the mouse are in conflict with your expressive behaviour.

## 4.2 Alternative approach

Keeping this in mind, industrial designers can offer an alternative approach to detect and recognise emotions. In this approach a product is designed in such a way that it elicits bodily actions which are rich in emotional content. Through his perceptual skills a person perceives the possibility of acting in an emotionally expressive way (the product's affordance) and uses his motor skills to express how he feels. To communicate understanding the product must also express that it received the information about the emotional aspects. The same approach is used to tackle this problem. By giving feedback a well-designed product can communicate that it received the emotional content of the action.

The goal of this approach is to design solutions that elicit expressive actions and that can communicate understanding of these actions to the person through inextricably linked feedback. These solutions are solid bases for further designing to which additional feedback can be added. The additional feedback should take the third step into consideration: how should the product adapt its behaviour to the person on the basis of this information?

The following matrix (Figure 4) illustrates this approach. It compares existing controls and alternative solutions on the expressivity of the person's action and the expressivity of the product's reaction. From left to right the examples elicit more expressive actions and from top to bottom the products' physical appearance gives more expressive feedback.

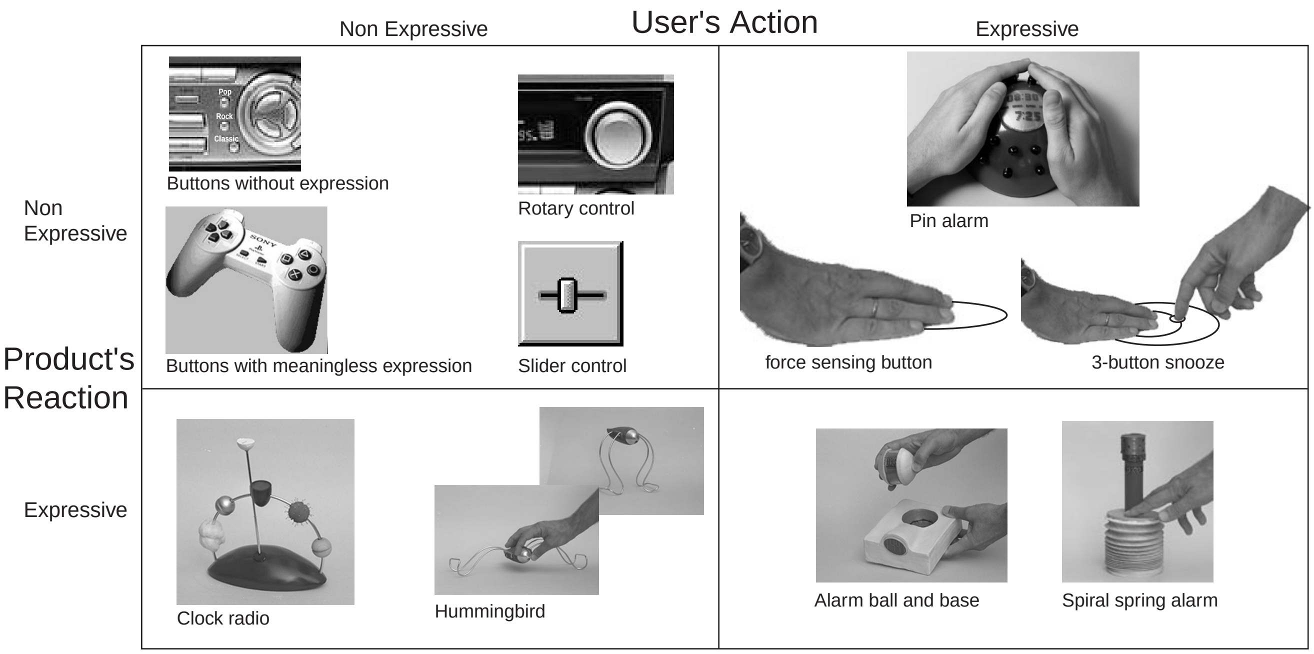


**Figure 4: A comparison of existing controls and alternative solutions on the expressivity of the person's action and the expressivity of the product's reaction. From left to right the examples elicit more expressive actions and from top to bottom the products' physical appearance gives more expressive feedback.**

### *4.2.1 Non-expressive action resulting in non-expressive feedback*

Buttons without expression: the buttons 'pop', 'rock' and 'classic' on an audio set look the same and require the same action to achieve different expressions in sound. The non-expressive action of pushing does not result in a change of appearance and therefor needs added feedback.

Buttons with meaningless expression: the buttons on a game console look different, with e.g., a red circle and a green triangle, yet their expression or the acquired action has nothing to do with or does not differentiate between their functions of shooting, kicking or punching.

Rotary and slider control: Buttons all require a discrete action of 'on' or 'off'. If the variable is continuous (sound volume, time, temperature) you want a control that fits to that continuous nature, e.g., a rotary or slider control. Yet, both controls require non-expressive actions and do not result in an expressive change of appearance and therefor need additional feedback, just like the buttons.

### *4.2.2 Non-expressive action resulting in an expressive feedback.*

In the Formtheory course we teach second-year students to design products with a rich expression. This clock radio by Van Es and Hillen features four settings for radio stations. Instead of meaningless controls, the designers have opted for four objects which differ in their expression. Varying from a very soft and fluffy texture to a spiky, aggressive texture these spheres try to express the associated sound. However, the action to set the station is the same for all objects.

Another example is the hummingbird, designed by Den Boer and Leneman where the tempo of the sound can be set. The upright position expresses an urgent sound with a high tempo, whereas the spread out position expresses a more relaxed flowing sound. The way in which the person handles the hummingbird is in no way related to the expressivity of the output (form and sound).

### *4.2.3 Expressive action resulting in a non-expressive feedback.*

This 'pin alarm' by Hellman and Ypma allows for setting the waking up time with meaningful expressive actions. By pushing as many pins as possible you indicate that you want a lot of sleep and by pushing them one by one you indicate a more urgent situation. Yet the design needs additional feedback to communicate understanding.

Other designs have snooze buttons with pressure sensors that elicit pushing, stroking or slamming. Yet these expressive actions offer no feedback to a person.

### *4.2.4 Expressive action resulting in expressive feedback.*

To teach the students to design solutions which allow for more expressive actions and feedback about these actions, we had them experiment with a new method, called 'Interaction relabelling' [3]. We asked them to pretend that the given product e.g. a stapler, a foot pump, an espresso maker, was their alarm clock. They then had to act out different scenarios, e.g. How do you convince this 'alarm' that you really need a lot of sleep? How will it know it made a wrong decision? How can you let the 'alarm' know that you have to get up?

To set the alarm time in the design by Van Delft and Godschalk you have to push the spiral spring. The more sleep you want the more effort you have to put into your action. You get visual and tactile feedback from the compression of the spring. This is an obvious result from relabelling a foot pump.

Consider the alarm clock by De Groot and Van de Velden that consists of two parts, a home base and an alarm ball. Turning the two halves of the alarm ball sets the alarm time. The right half is for the minutes, the left half for the hours. Depending on how he feels, a person can then place or throw the alarm ball away from the home base. The distance between the two is a measure for the urgency of waking up. The further the ball is away from the home base, the more urgent the sound and the volume will be the next morning. To silence the alarm the person has to get out of bed, get the ball and replace it in the home base. By doing this he seals off the loudspeaker and muffles the sound.

## 4.3 Inextricably linked feedback

The essence of our approach is that a product not only elicits emotionally expressive actions, but that the feedback is inextricably linked to these actions. The feedback should be inherent to the design. It is not trivial to 'move' solutions with non-expressive feedback to the expressive side by just adding feedback. This requires serious design interventions. For example, it may be tempting to add auditive feedback to the force-sensing buttons in Figure 4. Imagine that the button squeaks when you push it. This addition does not make the product more understandable because the button does not express in its design that it squeaks when you touch it. To attain this expression the product will have to be thoroughly redesigned.

Adding feedback to improve a solution that essentially lacks inextricably linked feedback has to be done with serious consideration. Too many mistakes have already been made and representations on displays and icons will not do [4].

# 5. STEP 3: ADAPTIVE BEHAVIOUR / FUTURE RESEARCH

In the first step the emotional relevant aspects of the context for experience were determined. Given that the alarm clock gets information about these aspects from the person's actions and other sources, how will it then adapt its behaviour to these aspects?

The whole person-system interaction has to be investigated in experiments. In the next experiment we need to find how the different behavioural parameters, e.g., the time one takes to complete a task, the kind and the intensity of the needed actions and the distribution of these actions over time result in a categorisation of the relevant emotional aspects.

Other relevant questions for future research are:

- What are possible decisions for the product to take?
- What are the criteria for these decisions?
- How should the personality of the product develop?
- On the basis of what criteria will it learn?

Essential to this research is to alternate between experiments and design. Findings of experiments have to be embodied in the product's appearance and its interaction with the person. Designing products thus becomes designing interactions in a context for experience.

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