Rich Interaction: Issues

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Abstract. The topic of this paper is rich interaction. Rich interaction borrows from tangible interaction and the concept of affordances. This is achieved through integral design of form, interaction and function of products. It is applied to interactive consumer products. A digital camera with a rich user interface (RUI) was designed and compared in a user study to a digital camera with a more conventional user interface. Several issues concerning rich interfaces are discussed.

1. Introduction

Tangible interaction is a hot issue today. Coined in 1997 by Ishii & Ullmer [1] their term comprises user system interaction by means of physical representations of digital data. Ullmer argues that by means of tangible interfacing user-system interaction can be made more natural in that it fits human skills [2]. The examples commonly given of tangible interaction include computer supported cooperative work (CSCW) and computer supported tools [3][4]. Although the first well-known example of tangible interaction, the marble answering machine of Bishop [5], explored an alternative interaction style with a consumer product, the relevance of tangible interaction seems to be somewhat forgotten.

At our department of Industrial Design in Eindhoven research is conducted to intelligent products, in particular interactive consumer products. Inspired by examples of tangible user interfaces we envision those products to have what we call rich user interfaces (RUIs). Rich user interfaces borrow from tangible user interfacing techniques and from the concept of affordances [6]. Key to rich interfacing is the notion that form, interaction and function are strongly related to each other, see figure 1. Form invites to interact and in this interaction

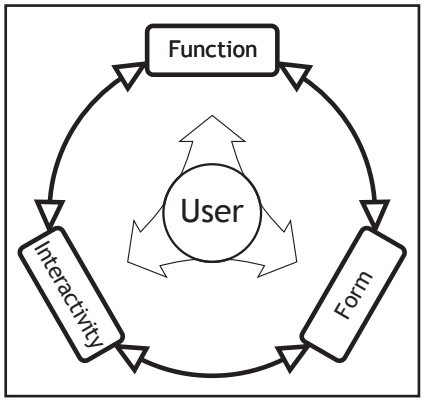


Figure 1. Circle model of properties

functionality is opened, preferably in a beautiful way. In order to design a product with a rich user interface those three properties should be designed simultaneously. We see the tight integration of form, interaction and function as a challenge particularly suited for industrial designers. Increasing complexity of interactive products might be made easier to grasp using rich interfacing techniques. For rich interfaces appeal to the perceptual-motor skills of people [7][8] and they allow for more sense modalities to express information on use. This new interfacing approach will lead to new products. Which, as a consequence, will lead to more variety in interactive products.

The digital camera was deemed a good example of an interface that degenerated in the process of going from analog to digital. To demonstrate the power of integrating form, interaction and function, a design for a digital camera with a rich interface was made. In this paper we first show and discuss the rich interface of this digital camera. Then we present a user study in which this digital camera was compared to a digital camera with a more conventional interface on terms of aesthetics of appearance, aesthetics of interaction and ease of use. And finally we discuss our results.

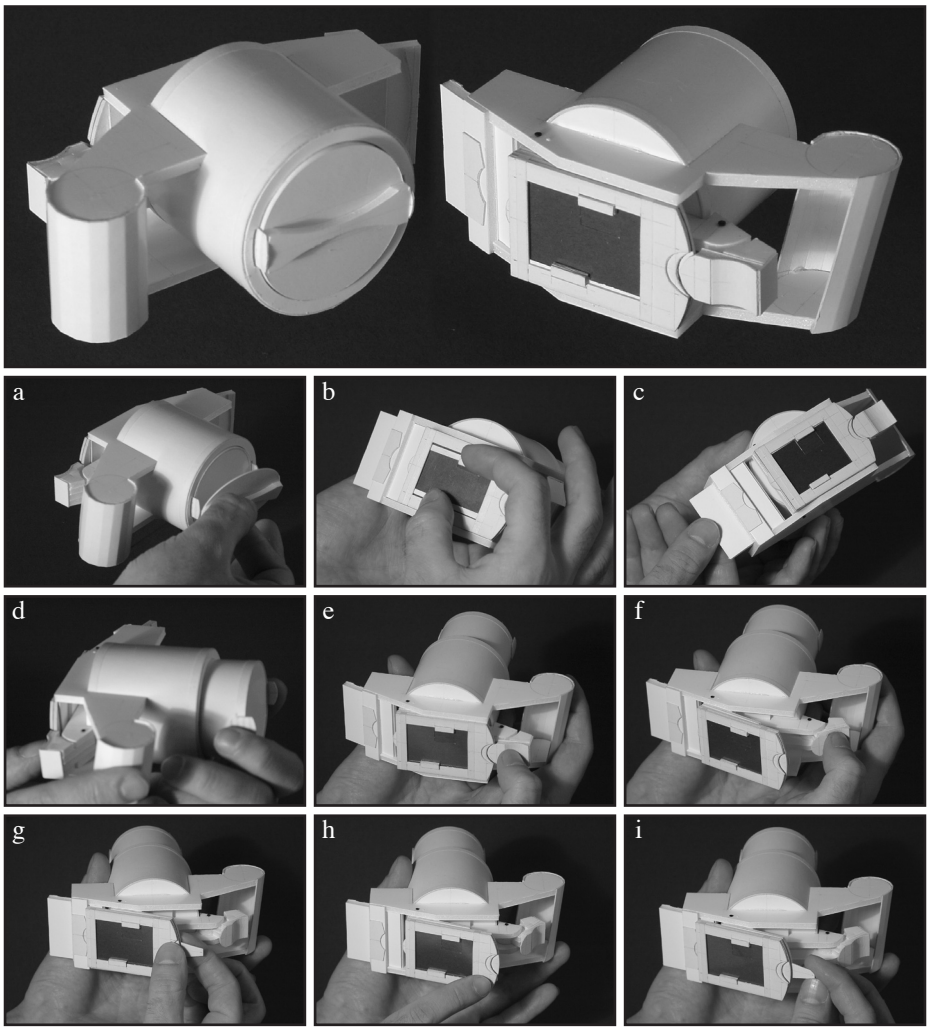
2. Example: Digital Camera With Rich Interface

A design was made for a digital camera with a rich interface. The starting point for the design was a technical description of the functionality. It was decided to focus on the core functionality of a digital camera. It has the following feature-list.

1. switch on/off
2. shoot a photo
3. reject a photo
4. store a photo
5. review/play photos
6. control size (pixels) of photo
7. zoom in/zoom out

The user-actions drove the design. Several pre-models were made to explore form, interaction and function. Step by step combinations of function and interaction were researched, put into form and tested out. The design process was an iterative process. In testing and changing pre-models the opening of functionality through form and interactivity was assessed. The result of this process was a cardboard mock-up of the camera that offers action possibilities, see figure 2.

Functionality is expressed solely in the form and in the interaction with the form of the camera, and not in screen based user interface. Although the camera does have a screen this screen is only used to display pictures, it is not used to navigate through menu's. The controls of the camera not only express what you can do with them, they also express what will happen when you use them [9]. For example, the trigger expresses that it can be pushed. It also shows that it restrains the screen in the closed position. The screen has two possible positions, it can align with the lens and it can align with a trajectory towards the memory card. In this way we try to convey the message that when the trigger is pushed the screen will flip in the other position, thus capturing an image.



When the lenscap (**a**) is taken off, the camera switches on and displays the image on the screen at the backside of the camera. The pixelsize of the photos can be set (e.g. 2560x1920 or 1600x1200) by changing the size of the screen with physical 'scalers' (**b**). The removable memorycard is always visible (**c**).
At the sides of the lens two small handles are placed. When the handles are pulled (**d**) the lens comes out of the body and one can zoom in on the object of interest. When the composition seems good, the trigger can be pushed (**e**) to capture the image. The screen will flip away from the lens by means of a spring (screen open position (**f**)) and one is given the opportunity to review the photo. It now can either be saved or deleted.
When the photo is satisfactory it is saved by moving the screen towards the memory card (**g**). The photo will 'flow' from the screen into the card, the screen blanks. The screen is spring loaded and will return to the screen open position when released, it can then be clicked back against the lens and a new picture can be made. If however the photo is not satisfactory the screen is just clicked back (**h**) against the lens, the image is not saved and disappears, a new picture can be taken.
If the screen is held against the memory card, it clicks into place and it will start to display the images that were stored in the memory card. Those images can be browsed using a small lever (**i**) that is exposed when the screen is moved towards the memory card.

Figure 2. Camera with a RUI

3. User Study

We conducted a user study to investigate how the camera's rich user interface compared to a camera with a conventional user interface in terms of usability and beauty. These latter notions are central to human experience and thus to industrial design.

3.1 stimuli

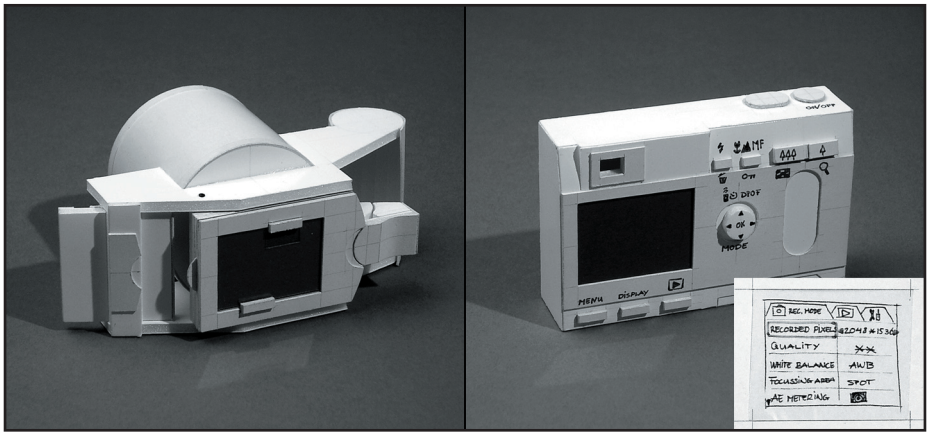


Figure 3. Stimuli, camera with a rich interface and camera with a conventional interface (simulated screen content shown right bottom)

In the study, two mock-ups of digital cameras were compared. One was the camera with the RUI described earlier, the other was a mock-up of a camera with a more conventional interface. It was decided to use an existing camera (Pentax Optio S) as an example of a conventionally interfaced camera, however, it was scaled 125 percent in size so that it was comparable in size to the RUI-camera. To ensure consistence in outlook and feel the two mock-ups were both made out of cardboard. Both models had limited action possibilities. The RUI-camera allowed for moving its control and feedback elements, but lacked the spring loaded reactions. The conventional camera had glued on 'buttons' and a simulated screen content and though the buttons could be touched they did not respond to pressing, see figure 3. The cameras did not autonomously provide feedback since they were built out of cardboard.

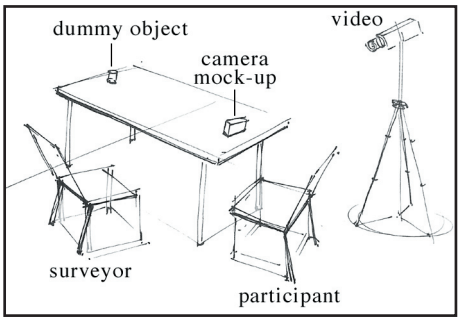


Figure 4. Setup of the user study

3.2 procedure

The study took place in a room where the surveyor and participant were sitting at a table. At the end of the table a dummy object was present as a point of interest

for the camera to be pointed at. The whole study was recorded on videotape. See figure 4.

Ten subjects of different backgrounds, age (13-59 years old) and gender (2 female, 8 male) participated. The study existed of three parts. The first camera was evaluated, then the second camera was evaluated and finally the subjects were asked which camera they liked best. Alternatingly, the RUI-camera or the conventional camera was shown first. Only in the third part of the study both cameras were present on the table.

The first and the second part of the study were of similar setup. The participant was first asked to spontaneously speculate on the operation of the cameras. Then a series of small assignments was given in which the participant was walked through the functionality of the cameras (switch on, zoom in, take a picture, save picture, do not save picture, play saved pictures, set the resolution of the camera to small). During those assignments the surveyor provided feedback on actions of the participants by manually moving parts of the mock-ups when necessary. After this he was asked if he liked the camera and the way it could be used to make photos. If the participant had a different way of using the camera than we had in mind, the intended workings were explained. In that case he was again asked what he thought of the camera. Part one and part two of the study were concluded by asking the participant if he missed functions and if he had any remarks on the cameras.

The third part of the study consisted of a comparison of the two cameras on three aspects: the aesthetics of form, the aesthetics of use and the ease of use.

Finally the subject was asked to fill in a short questionnaire (gender, age and occupation).

3.3 Findings

The first author analyzed the almost five hours of video-tape that resulted from the experiment.

Part 1&2: In part 1 and 2 of the user study the two cameras were assessed separately. When asked to speculate on the workings of the cameras the participants were better in explaining how the conventional camera was operated, see figure 5. They were not sure what to do with the RUI-camera, they kept trying to find buttons, especially a menu-button, and were frustrated that no labels were present. When asked to complete a series of small assignments the conventional camera again did better, the results were more nuanced however, see figure 6.

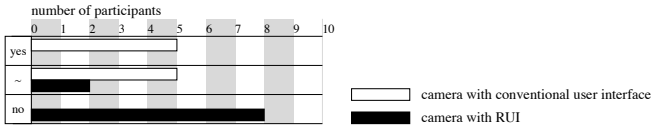


Figure 5. speculation on the workings of the two cameras - did the participant succeed in fulfilling the assignment: yes, more or less (~), no

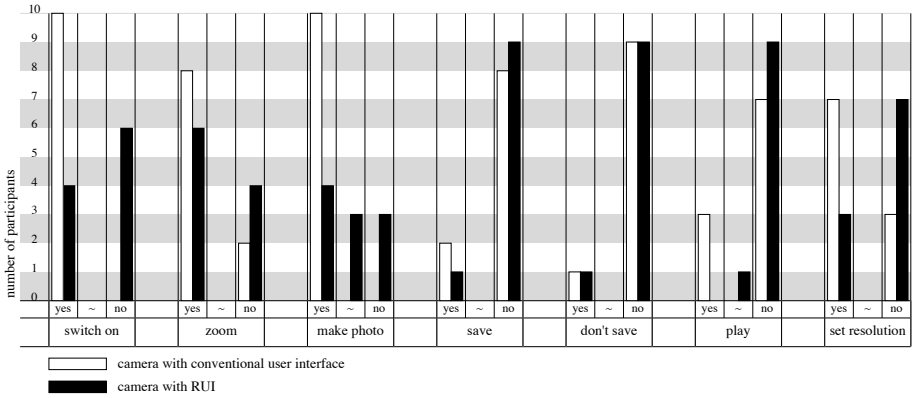


Figure 6. walkthrough of limited set of functionality - did the participant succeed in fulfilling the assignment: yes, more or less (~), no

Part 3. In part 3 of the user study the participants were asked to give preference for aesthetics of form, aesthetics of use and ease of use for the cameras, see figure 7. At this time the workings of both cameras were thoroughly explained. When asked for a preference for form, most participants preferred the RUI-camera over the conventional camera, figure 7, row 1. The reason that was given most was that they liked it better because the form was more outspoken (6 times). When asked to make a choice for a camera on aesthetics of use and ease of use there was less consensus. Several participants were unable to make a choice, figure 7, row 2&3. Four participants claimed that they would use the RUI-camera in different situations as the conventional camera; the conventional camera for holiday pictures, the RUI-camera for more professional use. One person found it difficult to differentiate between aesthetics of use and ease of use.

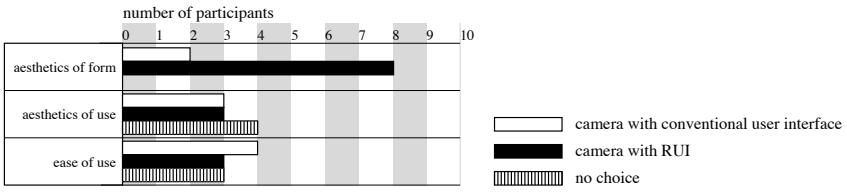


Figure 7. preferences of the participants

4. Discussion

Of course when comparing just two cameras no general conclusions can be made on interfacing techniques. Still a lot was learned from the study: on the study itself and on interfacing techniques in general.

4.1 On the study:

Bias caused by lack of interactivity: The proper operation of the RUI-camera depends on the interplay between feedforward (expression of form and movement) and feedback (camera reactions). In contrast, the proper operation of the conventional camera depends on labels on its controls and to a lesser degree on feedback. The mock-ups, however, did not provide autonomous feedback while the subject of investigation was interaction techniques. This resulted in an advantage for the conventional camera in the user study.

The conventional camera is designed with labels on its buttons that literally tell a user what will happen if those buttons are pressed. The RUI-camera is designed to expresses in its form and in its movements what can be done with it (action possibilities/ affordances), what the camera will do (functionality) and how the form of the camera will change as a result of that action to express new action possibilities. Therefore it is much more important for the RUI-camera that it actually reacts on users actions then it is for the conventional camera.

No naive users: There seem to be no naive users around anymore when it comes to cameras (analog or digital) or to on-screen graphical user interfaces. The participants are used to the fact that electronics can only be operated with buttons. They were quite unwilling to directly manipulate the parts of the RUI-camera.

4.2 On Interfacing Techniques In General

On rich interaction: The workings of the RUI-camera are action driven. Form and action possibilities were designed simultaneously. We intended the camera to be a physical reflection of the story of the action possibilities it offers. However, in the study we found that it was not always clear to the participants how to operate the camera. We suspect this is because the story that is told by the camera occasionally is a very technical one. To give an example, the screen, and thus the picture, should be moved towards the memory card to save the picture on that memory card. This is a reflection of the process that is at work in the insides of the camera. This is not necessarily the same as the mental model of the user on the workings of the camera. This is a problem, it is relatively easy to point out where a design fails, but it is very hard to get it right.

Opening up functionality is crucial for interactive products. All too often the technical functionality drives the interaction with a product. The argument being that since functionality is what defines a product, functionality should be delivered to the user in its purest form. Rich interaction, however, goes deeper than interaction alone.

Rich interfaces are designed to exploit the expressiveness of form to invite the user to explore what can be done with a product. Functionality is an intangible thing, only through physical form the user is able to reach functionality, and only by designing this form for interaction the functionality is opened up for use.

Does rich interfacing make sense? During the user study the participants kept trying to find buttons to apply functions to when exploring the camera with the rich interface. The camera with the rich interface had few extremities that could be perceived as buttons, and still functionality was assigned to diverse spots on the camera, seemingly at random. Why was this? Earlier we already speculated that naive users do not exist anymore. People expect buttons, they know conventional interfaces and they seem to expect those kind of interfaces. Presumably because there are a lot of those interfaces on the market today.

The important question of course is if we should leave it at that. For people seem to cope and rich interfaces are hard to design. Do they want the linearity and the sequentiality of conventional interfaces or do they want the expressive and dynamic interaction of rich interfaces? We do not want to make this choice for people. But what we do recognize is that people increasingly have problems with the featurism of conventional interfaces.

5. Concluding

- To assess its value, a RUI-prototype has to be a working prototype. That is, it has to react to users actions in the way intended by its designer.
- A follow-up experiment with the same participants is considered to investigate if RUIs are remembered better than conventional interfaces.
- It is hard to design rich interfaces for in the early stages of the design process feedback and feedforward [9] are missing because of the lack of interactive mock-ups.
- In retrospect we find that our RUI-camera is designed with too much emphasis on technical functionality. We think this can be remedied by exploring not only form and interaction but also functionality when designing future RUIs.
- On aesthetics of appearance. The participants liked the RUI-camera - design makes a difference.
- On aesthetics of use, the jury is still out...

6. References

1. Ishii, H., Ullmer, B.: Tangible Bits: Towards Seamless Interfaces between People, Bits, and Atoms. In Proceedings of CHI'97 (1997) 234-241
2. Ullmer, B.A.: Tangible Interfaces for Manipulating Aggregates of Digital Information. Ph.D. thesis, Massachusetts Institute of Technology (2002)
3. Dourish P. Where the Action Is, The Foundations of Embodied Interaction. MIT Press Cambridge, MA (2001)
4. Underkoffler, J., Ishii, H.: Urp: A Luminous-Tangible Workbench for Urban Planning and Design, Proceedings of CHI'99 (1999) 386–393.
5. Crampton-Smith, G.: The Hand That Rocks the Cradle, I.D., May/June (1995) 60–65
6. Norman DA. The design of everyday things. Currency/Doubleday, New York (1990)
7. Overbeeke, C.J., Djajadiningrat, J.P., Wensveen, S.A.G. and Hummels, C.C.M.: Experiential and respectful. Proceedings of the international conference Useful and Critical: the position of research and design, Sptember 9-11 (1999)
8. Djajadiningrat, J.P., Wensveen, S.A.G., Frens, J.W., & Overbeeke, C.J.: Tangible products: Redressing the balance between appearance and action. Accepted for the Special Issue on Tangible Interaction of the Journal for Personal and Ubiquitous Computing (2004)
9. Wensveen, S. A. G., Djajadiningrat, J. P., and Overbeeke, C. J.: Interaction Frogger: a Design Framework to Couple Action and Function. In Proceedings of the DIS'04, August 1-4, Cambridge, MA, USA (2004) [Accepted]