The user wants to be in control? - Balancing the consistency of actuated tabletop controls with user control

Thesis proposal

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1. INTRODUCTION

Tabletops with tangible user interfaces (TUI) allow users to change digital values by using physical control elements [7, 15, 16]. The system's inability to update the states of tangibles after changing corresponding digital states leads to inconsistencies. The actuation concept added to TUIs solves that problem by forcing physical objects to movements on tabletops [1, 12, 13, 14]. Thus, the consistency between digital objects and their physical counterparts can be maintained. The disadvantage is, that users have to give up their control to a certain extent.

Important keys to successful user interface design are simplicity, consistency, predictability, feedback, and task performance [5]. Nevertheless, perceived user control is also a fundamental point, whereas user control can be conceptualized as the level of user intervention, that is required to operate a system [9]. The degree of control strongly determines emotions and behavior humans have over their environments and therefore defines user's perceptions of the aforementioned keys to successful design. People who perceive a loss of control maybe avoid to use the systems, show reactance [4], feel helpless or even angry.

The combination of actuation technology and TUI is a concept, that does not satisfy the user's desire for control. The problem is, that the actuation not always behaves in the way desired by the user. For example, a TUI suddenly gets actuated and changes the position without the user's influence. The consequence is probably a perceived loss of control and solutions are necessary to avoid or at least to minimize such a feeling. In this context the question arises, to what extent users are willing to give up their control over the environment.

So far, few studies regarding the user's emotional response to actuation of tangible objects on tabletops exists. In my thesis, I will investigate the user's perception of control, and present knowledge for balancing actuated tabletop controls and user control.

2. RELATED WORK

In 1966, Brehm [4] defines the term psychological reactance as a person's impulse to resist rules, that restrict behavioral freedom and hence threat the person's autonomy. Although this is an ancient work, it contributes to the question, how users probably perceive system autonomy.

Maes and Shneiderman [11] discuss interfaces, in which users have complete control and those, in which agents act on behalf of the user. Shneiderman believes, that using the agent metaphor leads to anxious feelings, whereas Maes argues, that using agents will simplify the user's life.

Due to the fact of missing empirical studies about what contributes to the user's control in an interface, Hinds [10] presents several empirical studies and suggests a tradeoff between perceived control and ease of use.

User control in context-aware systems has been investigated by Barkuus and Dey [2]. They examined three levels of interactivity between a mobile computing device and its users and conclude, that people are willing to accept reduced control, as long as a certain usefulness is guaranteed.

Hardian, et al. [8] present a design space for providing user control in context-aware systems and confront user control with system autonomy. They suggest, that revealing the system state, e.g. context information, is necessary to make users aware of reasons for application autonomy.

In [9], Heijden investigates the role of user control in ubiquitous computing and argues, that increasing the application autonomy leads to an personal discomfort, the user associate with the use of the system. Additionally he suggests, that the lower the level of user control, the easier to operate the system.

All aforementioned approaches investigate the perception of control or discuss the reaction to system involvement. Specific studies about the user's sensation of control concerning actuated TUIs on tabletops are missing.

3. RESEARCH QUESTIONS

The actuation of tangible objects on horizontal surfaces, as described in [1, 12], happens as if by an invisible hand, what leads to the following questions:

1. Do users have a feeling of being out of control, resulting from sudden and unannounced actuations?

2. How does the actuation of tangible objects affect the ease of use of the system?

3. Do users feel anxious, confused, or helpless?

In several situations the actuation of tangible objects is useful or even necessary, e.g. for increasing the sensation of social presence with remote communication partners or keeping digital and physical objects consistent. Therefore it is important to find answers to the following questions:

1. Are users willing to accept decreased control, as long it preserves a certain purpose?

2. Do users want to have the possibility to interrupt actuations and what do they expect, in case of interrupting an actuation process?

4. CHALLENGE

The usage of actuation is necessary for several situations, e.g., for increasing the awareness of remote communication partners in CSCW groupware. But what, if participants categorically refuse the actuation concept, due to fact of missing control or understanding? One challenge will be to support users with sufficient and appropriate feedback and feedforward [3, 6] without distracting them but additionally increasing their perceived control over the environment.

Assume an actuation process is executed and a user is trying to interrupt the action by moving or lifting the corresponding physical object. A challenge will be to define appropriate system reactions in form of a control hierarchy depending on security or consistency issues.

There is a need to define some kind of guidelines for application designers, who want to develop software for tabletops with actuated TUIs. Therefore one challenge is to define user scenarios and provide results, which have a certain generality.

5. APPROACH AND TIME SCHEDULE

After getting a detailed overview about existing literature (2 weeks), I am going to conduct user interviews (3 weeks) to gain information about the user's general sensation, if something moves "as if by magic". In the case, that a user feels uncomfortable, I want to gain knowledge, how to avoid negative perceptions.

Afterwards, I am going to define (3 weeks) and implement (6 weeks) basic user tasks, in which users have to deal with actuations. For instance, we consider a task scenario, in which remote users watching a digital map and planning a roadtrip. Flag tokens represent several intermediate stops, that can be used to set the route.

Then, I will examine different variables (e.g., perceived ease of use, failure anxiety, task performance, perceived system control) known to contribute to a sense of control via testing the scenarios (3 weeks).

Finally, I will conduct a qualitative and quantitative evaluation (3 weeks) of the results gained from user testing and write down the notes and results collected in the previous weeks (4 weeks).

6. REFERENCES

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