Do we need further multi-touch touch affordances?

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Abstract. People have developed sophisticated skills for sensing and manipulating their physical environments [1] with their fingers and hands. And more and more user interfaces taken advantage of that and allowing touch input to support these skills. Especially multi-touch interaction has received considerable attention in the last few years and the media interest in multi-touch interaction with large and small displays surfaces has seen a recent explosion. Multi-touch surfaces can be realized by using different technologies, ranging from capacitive sensing to video analysis of infrared or full colour video images [2–5]. In this paper we try to summarize some key values of multi-touch interaction. We think that is a first important step when thinking of methods to communicate touch-based interaction in an intuitive, implicit way or to evaluate the impact of a touch-related interface on user experience of success system. Because we think, it is important what values touch affordances afford.

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In 2005 Han [3] presented his low cost camera-based multi-touch sensing technique. His YouTube demonstration captured the imagination of researchers and users alike. Technologies that allow the low-cost implementation of robust multi-touch interaction, such as Frustrated Total Internal Reflection (FTIR) and Diffused Illumination (DI), have allowed for the low cost development of such surfaces, have led to a number of technological and application innovations. Hans rediscovery and dissemination of the FTIR principle [3] has greatly accelerated the development of new multi-touch applications and attention in the news media. In particular, his demonstration of a range of creatively applied multi-touch interaction techniques. With today's technology it is now possible to apply the basic advantages of bi-manual interaction [6–11] to any suitable domain. Bill Buxton gives a comprehensive overview of the history of development of multi-touch surface[1]. While the technology allows to use a rich set of gestures to explore complex data (e.g. geodata, any sort of media or medical data) often these gestures are hard to learn for users and often users are not sure what gestures will lead to which action.

To understand how people interaction with such new multi-touch systems we installed a geoapplication on a large-scale multi-touch screen during a technology exhibit called "Germany 'Land of ideas' " in a pedestrian underway in the city of Münster for one week. The focus of our study lies on the observation of spontaneous and group interaction patterns. The video[2] presents the short impression

[1] http://www.billbuxton.com/multitouchOverview.html

[2] Hightech-Underground on youtube: http://www.youtube.com/watch?v=27oSoDdU2fk

of the installation. To our knowledge this is the second attempt to analyze the interaction at a large multi-touch display in (or in our case under) a city centre. Peltonen et al. [12] presented detailed observations from their own large multi-touch display, called CityWall, in the city of Helsinki, Finland.

The ambient nature of our wall setup does not attract users by itself. Users watching other people interacting with the application before they interact seem to be less shy and more experimental [13]. Users had fun performing various gestures: rotating, flipping, scaling the digital globe (this "fun-factor" played an important role), but nearly 40% of the user stick to simple single touch interaction. They were often not aware of the possibilities of multi-touch interaction and often first discovered gestures (like *zooming*) when watching users. Most users were not so interested in the presented information that was intended for this exhibition but rather interacting with the globe in order to look for their house, vacation houses and tennis court [14]. In addition people still stick to single touch gestures. So it is obvious to ask what is really the benefit of multi-touch interaction and how can we build interfaces that allow users to intuitively understand the interaction possibilities? We think that it is important to understand what are the real values of "multi-touch" interaction for users before thinking of methods to communicate touch-based interaction in an intuitive, implicit way or to evaluate the impact of a touch-related interface on user experience of success system.

What is the value of "multi-touch" with regard to user perception?

As said before, the fun factor played a really important role in our first study. But of course that is not the only value of multi-touch interaction. But, that is maybe the big plus for the user experience when people interacting with a multi-touch system. From our point of view, the good user experience is a factor for the "hyped multi-touch interfaces in the last 4 years. Often just a couple of "values" of multi-touch interaction were presented in the demonstrations. We think that people often tend to forget the good work on bimanual interfaces of the early 80s and ignore the lessons learned 20 years ago. When thinking of touch affordance, we think it is very important to understand the value of "(multi-) touch" Therefore we start our summarization of the value of "multi-touch" interaction with some dogmas and framing of Bill Buxton.

Can multi-touch do more than scaling a picture?

The whole framing and the dogmas of Bill Buxton can be found online (see link above) and these should be required reading for developers of multi-touch technology. Firstly, be aware that "size matters", that there is a different between "Single-finger vs. multi-finger", "Multi-point vs. multi-touch" and "Multi-hand vs. multi-finger Multi-person vs. multi-touch" interaction. Furthermore, there is a difference between "Point and Gesture", and combining multi-touch hand and foot interaction has a couple of advantages and helps us to rethink the use of the dominant and non-dominant hand. In pure multi-touch hand interaction systems, the non-dominant hand often sets the reference frame that determines the navigation mode, while the dominant hand carries out the precise task. Since in this case one touch is only used to define a certain mode, the advantages of multi-touch are not fully exploited.

How can we communicate these values to the users?

First approaches already exist that try to assist users while interaction with a multi-touch system such as the TouchGhost widgets [15] (that are visual guides that are embedded in the multi-touch user interface and that demonstrate the available interactions to the user) or some new features available in the Microsoft Surface first service pack.

So do wee need multi-touch affordance? We do not want to give answers on that. We just wanted to underline the value of multi-touch for next generation user interfaces.

Again, people have developed sophisticated skills for sensing and manipulating their physical environments. However, most of these skills are more and more not employed in interaction with the digital world today. Surprisingly many applications using a multi-touch enabled surface fall well short of utilizing the full potential that multi-touch interaction has to offer as has we seen in our study. Many open questions for researchers interested in multi-touch interaction still remain: What are the benefits of multi-touch systems over single-touch systems? What are suitable applications? What kinds of applications are adequate for multi-touch systems? Are there more interaction possibilities than "just"' rotating and scaling photos or zooming into maps? We claim that researcher should:

- Let non-experts explore your systems (like in the City wall project or our study, which got a lot of interesting results).
- Design interfaces that help users forget WIMP.
- Design systems that can only used by performing multi-touch gestures to investigate the advantages against single-touch systems.
- Do less lab studies and give the technology to users and test it in the wild.

To design good multi-touch applications, affordances can be the right way to support the first steps with a multi-touch system. But still remember as Buxton says: "Remember that it took 30 years between when the mouse was invented by Engelbart and English in 1965 to when it became ubiquitous"- we want to underline this and let multi-touch become a genuine useful technology that successfully passes through the inevitable hype and help people to explore the full value of multi-touch interaction. The right affordances can support that.

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