Complete feel of user interfaces with vibrotactile feedback

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Touchscreen mobile devices, phones and tablet computers, have gained prominence in our everyday life in the past years. Their user interfaces, however, make quite crude use of touch and the somatosensory system. Teemu Ahmaniemi has studied in his dissertation for the Department of Biomedical Engineering and Computational Science in Aalto University, how the tactile feedback in these devices could be improved.

Continuous tactile feedback has a lot to give to user interfaces controlled with touch and gestures, thinks Ahmaniemi. In his research he has looked into the tactile feedback that is produced to the user with vibrotactile actuators.

"Touch can convey a significant amount of information to the user. I aimed to find out if the interaction between user and device could be enhanced so that the user would know better how the user interface functions, explains Ahmaniemi."

"Even a doorknob provides a whole lot of information of its functions by touch alone, he reminds."

Gut feeling for the fingertips with vibration

Ahmaniemi has created, with tactile vibration feedback, illusion of textures, made use of the feedback to search and locate targets in the environment, and also studied the subtlety of the users use of force on

surfaces such as touchscreens.

The modelling of the virtual texture as tactile vibration feedback was particularly successful: by adjusting the density and frequency of the [vibration](), Ahmaniemi created realistic surface contours – roughness, bumpiness, [stickiness]() and so on.

"My colleagues and I modelled different elements of textures and the ways people perceive them. It is actually quite simple to provide the user with versatile [sensations]() as if she were touching real textures."

Vibrotactile feedback can also assist to search for and locate targets in the environment. However, in these kinds of tasks, touch only compliments the other senses. Still, the manner in which the direction of the target is presented to the user makes little difference: sight, hearing and touch are all equally effective. Touch is not enough though to convey detailed information: other senses and methods are needed as well.

"Applications for virtual reality are nowadays predominantly visual. I wanted to find out what the role of tactility could be in them."

The first clue a device gives while localising targets could very well be haptic, that is, based on touch, and conveyed by vibrofeedback. The device would also be more inconspicuous and more tactful to use socially than for instance a mobile phone camera. In addition, vibrotactile feedback would lighten the user's cognitive load: the device would not restrain sight and it could be used to surviving in traffic for example.

"Questions like 'Is there something over there?' or 'Is this the right direction?' are easy and sensible to answer with haptic [feedback](). The exact location of, say, a parking area is simpler to explain visually or by

sound. "

Which to model, the real or the virtual?

Modelling augmented reality – the real world extended with technology – requires combining computer science, cognitive sciences and humanistic understanding of human action in the same vein as Ahmaniemi.

"The quality of a user interface always comes down to the user, not to its realism, remarks Ahmaniemi."

"User interfaces are not to be designed on a clean slate: devices like that would be unfeasible for the human perception system and ergonomics. User interfaces have their own evolution, which needs to be accounted for in the development. For instance, planting the computer keyboard directly into mobile devices may very well not be the most effective or sensible solution, believes Ahmaniemi."

Especially in tablet computers the possibilities of touch are only now being investigated. Ahmaniemi is certain that the user interfaces of tablets could be constructed in ways yet to be seen and felt. They would combine the texture illusions, the haptically assisted navigation in augmented reality and the nuanced use of force, all of which Ahmaniemi has now studied.

"The feel of quality in every product is always multisensory. In my research I have intended to provide basics for the design of these kinds of devices."

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