HS2012 Workshop on Haptic Interaction Design

Talk: Haptic interaction design based on users experience

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Extended Abstract

The aim of the research activity presented in this talk is to propose a new method for designing consumer products starting from and exploiting the users experience early in the concept design phase via the haptic interaction.

The method is based on the haptic interaction with the product concept, supported by the simulation, and on the testing of the users' experience and emotional response. The great advantage of this method is that it can be used early in the development process of a new product. Therefore, this methodology can be used for capturing the voice of the customers in terms of quantitative and engineering terms, and the testing results can be used for the definition of the product specification. Taking care of these aspects since the concept phase makes more likely that at the moment of purchase a customer will be attracted by this specific product instead of another one that exposes the same technological content and has a similar prize, but which is less appealing.

In our research the physical prototype traditionally used for users tests is replaced by an **interactive Virtual Prototype (iVP)**, which simulates the whole interactive part of the product that we are interested to evaluate in a valid contextual way.

We know that the use of Virtual Prototypes make the testing activity cheaper and more flexible with respect to the physical one.

The interaction with the Virtual Prototype (iVP) is based on three sensorial channels: vision, touch and hearing. The aim of the research hereafter presented is focused on the haptic interaction, even if we can not separate the haptic sense from the other senses since the overall perception of the product is a combination of all the senses, where haptic plays a fundamental role, but it is not the only sense involved. In literature various examples where haptic perception is influenced by visual and auditory cues, and vice-versa exist and that can provide an extra value to this approach.

The method is based on the following steps.

Step 1. We have analyzed the product to be and identified the interactive components that we are interested to study. Then we have analyzed the possible interaction processes with a selected existing consumer product in order to identify what can be simulated by using commercially-available hardware and software technologies and understand how to use "traditional" Virtual Prototypes (which are usually Visual Prototypes) instead of physical ones to design and simulate haptic interaction. As a first case study we have selected a commercial washing machine provided by the Whirlpool company (www.whirlpool.com).

Step 2. We have implemented the interactive Virtual Prototype (Figure 1) of the washing machine that gives the user the possibility to interact with the selected/relevant interface components (knob, doors, drawer). The haptic effects are not computed through physics-based algorithms but are based on simplified and parameterized force-based functional models, as derived by the real washing machine. The haptic feedback can be considered as independent from visual and auditory feedbacks, so for example we can experiment different sounds associated with the same force or we can easily reproduce, for evaluation, force-feedback profiles different from the real ones. During previous experiments we have detected that sound cues can influence the haptic feedback.

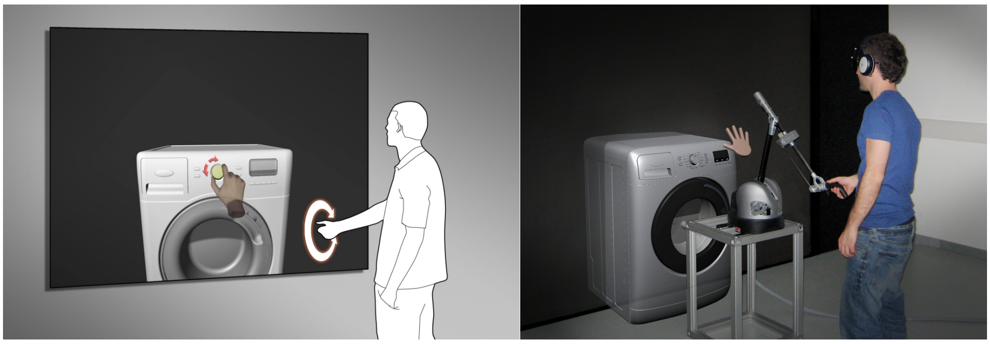

Figure 1. Step 2 of the research activity has focused on the virtual reproduction of the interaction with the interface components of a washing machine.

Step 3. We have performed a series of tests involving a group of users in a situation where a 3D immersive stereo wall is coupled with a commercial general purpose haptic device. The aim of the test was twofold: evaluating the fidelity of the simulated interaction with respect to the known and experienced real one, and easily proposing and changing a new set of possible interactions capturing the preferences and emotional response of the users. During the tests we have detected some limits of the Virtual Prototype, and in particular: the general-purpose end effector of the haptic device influences the haptic feedback, and the haptic device is not able to reproduce high forces and the interaction is not intuitive for a large number of users.

In the following phase of the research activity we have implemented an interactive Virtual Prototype of a commercial fridge provided by Indesit Company (www.indesitcompany.com) as represented in Figure 3, by following the same approach but taking into account the lessons learned.

This time, in order to overcome the problem that we previously detected with the end effector, we have milled a small physical prototype having exactly the same shape of the handle and we have used it for substituting the end effector of the haptic device. We have also used a more convenient haptic device and we have focused only on those interaction aspects of interest for the test in order to reduce the users' distraction. The results demonstrated, a much better perception similar to reality from the testers point of view.

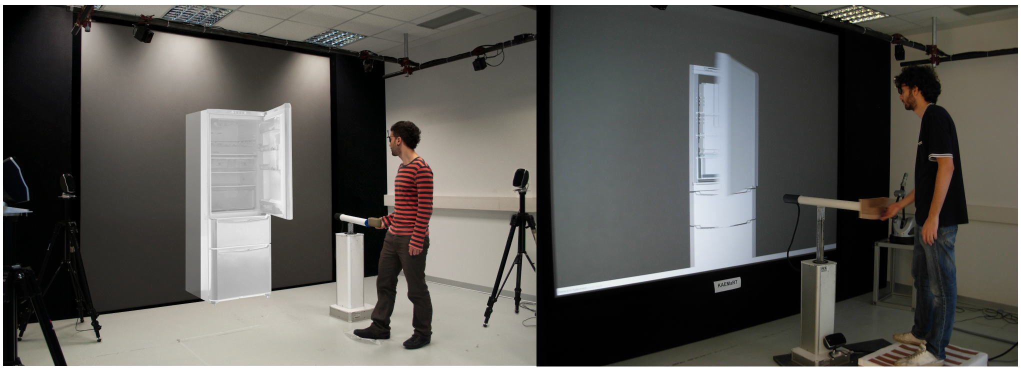

Figure 2. During the second phase of the research activity we have simulated the interaction with a commercial refrigerator. The haptic interaction is improved thanks to the use of a milled prototype of the handling attached to the end effector of the haptic device.

At the conclusion of our research, there are still some open issues.
From the point of view of the prototype implementation, we plan to change the visualization setup in order to superimpose perfectly the visual and the haptic representations, e.g. by using the Vuzix AR HMD www.vuzix.com.

From what concerns the method, we have proposed a map to represent the process of capturing the users' preferences in order to convert them into design specifications (as shown in Figure 3), which requires further validation.

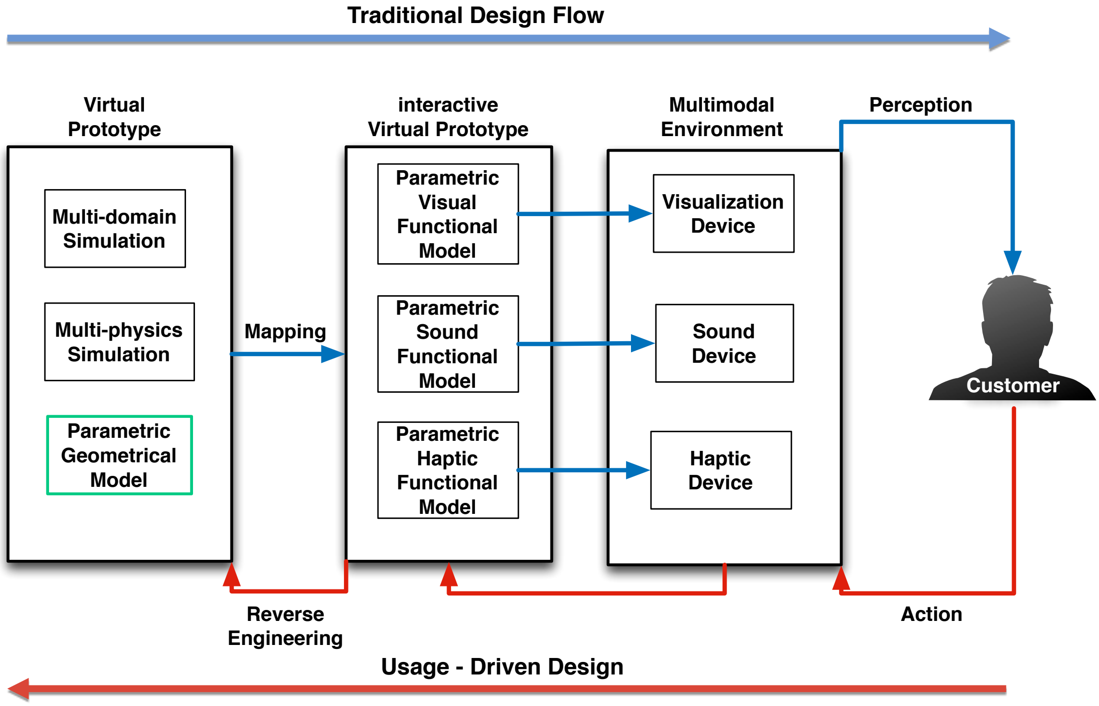

Figure 3. Method for mapping users' preferences into product specifications.

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