# DRAFT OF A MULTIMODAL REALITY-ORIENTED USER INTERFACE FOR FREEFORM MODELLING

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In my contribution I introduce a broadening of the Real Reality interaction concept into a multimodal human-computer interface for 3D modeling. Real Reality is a direct and intuitive graspable user interface that focuses on the grasping and manipulating human hand as bridge between concrete material objects and virtual models. To employ this concept for the construction process in computer aided design is a step towards a conceptual design system. It leaves the user in her habitual not restricted space of the sensual real world without losing the benefit of using computers.

## Motivation

During the last years considerable amount of research has been spent developing new kinds of human computer interfaces for the interaction between human and machine in production areas. Users in this areas have and need other capabilities and skills than their colleagues working in office environments and therefore they need other input/output devices for their interaction with computers. In the field of developing new interfaces a trend is to notice towards the integration of humans various perceptive faculties and abilities to express into multimodal interface design. For instance the coupling of speech and pointing gestures as input possibility (Oviatt et al 1997) or the developing of miscellaneous haptic displays as output devices for use in virtual environments (Dionisio et al 1998). Other approaches are Computer Augmented Reality (Barfield and Caudell 1999) and Ubiquitous Computing (Buxton 1997). Those both research directions leave the user in her habitual environment and enrich it with computer generated information. Thus her faculties and abilities don't get restricted, the exact opposite is fact: her capacity to act in the real world can be enlarged. Some research projects of the Tangible Media Group of MIT Media Lab and the underlying concept of graspable user interfaces (Fitzmaurice et al 1995) are further examples. These approaches indicate that graspable real objects used as handles in dealing with complex virtual structures are beneficial for understanding them.

## The Real Reality Concept

Our concept – we call it Real Reality – aims at a similar direction. In 1993 Bruns et al laid the foundation for a new class of user interfaces in shop floor and handicraft working. They developed a concept of a *Graspable Real Reality User Interface* (Bruns and Brauer 1996) which bridges two previous separated modeling worlds: the real world of physical objects and the virtual world of signs and images. Their basic idea was to record and process the manipulation of real concrete objects and use the real world as a user interface. Several projects with industrial partners as well as their own practice in designing simulation models indicated that physical models play an important role for cognition and communication. To achieve this goal our research group linked physical objects to appropriate virtual representations by using Virtual Reality technologies like data gloves and tracking systems or image processing to capture the user's hand. The raw data of hand movements and finger flexions are analyzed by recognition algorithms. Gestures, grasps, and user commands are recognized by the computer in real time. The user can work with physical objects, she can grasp them, move them, and place them at another location and the computer internal model of the workplace is immediately updated. The used objects are complex objects. They have two parts which belong together: a concrete material artifact as real object and its virtual counterpart as geometric model with additional features. During the modeling process both parts are coupled by means of the sensorized hand.

By giving the user acoustic feedback in accordance with grasping and releasing a synchronous visual output becomes superfluous. In this situation the computer serves as a passive observer and is ideally not noticed by the user. But during the modeling process and in later stages the user can take advantage of the capabilities of computers for instance to provide context sensitive help, to vary, to validate or to simulate machine calculable problems. In order to demonstrate the feasibility of the proposed concept, prototype applications have already been implemented (see e.g. http://www.artec.uni-bremen.de/field1/RUGAMS or http://www.brevie.uni-bremen.de). At the moment they are in a phase of evaluation and validation.

## A Reality-Oriented User Interface for Geometric Modelling

As external objects we use things like wooden bricks, pneumatic elements from Festo didactic®, Fischertechnik® or LEGO® blocks, the choice depends on the particular application. Up to now the geometric shape of the basic internal objects are constructed with a conventional geometrical modeler beyond and before modeling within the new system. A logical continuation is to use the Real Reality concept for this construction process itself: With sensorized hands and additional input modalities (like speech) the user can create a virtual geometric model of a real object by "touching" and "describing" it in a multimodal multisensory environment, concentrating on the task (and not on the tool) and bringing into play the bright human sensual experience with real objects and the unequalled human ability to conceptualize. The data of hand movements and finger flexions are completed by data from touch sensors and discriminating spoken characterizations. The computer recognizes gestures, locations, orientations, and keywords and uses this information to generate and modify the geometric model.

Efforts have been undertaken elsewhere to improve the concreteness of modeling. In 1994 Murakami et al proposed DO-IT, a new interface for direct and intuitive 3D shape deformation. Their interface consists of a real elastic object that can be deformed with bare hands, thus deforming a 3D shape model displayed on a computer screen. In contrast to our approach their real object is sensorized and serves as device to deform virtual objects and the users attention lies on the screen and the virtual representation. There are other ways conceivable to extract a virtual geometric model out of a real object, e.g. by combining 3D scanning systems with reverse engineering methods (Várady et al 1997). But no fully automatic procedures exist yet, because the non-limited human experience and intelligence and therefore human-computer interaction is inevitable for a reliable and effective translation between real and virtual worlds.

## Conclusion

We still hold the opinion that there is a connection between grasping (greifen) and understanding (begreifen) that can be used to make the transition between reality and virtuality much easier (Robben and Rügge 1998). With the implementation and evaluation of the Real Reality concept in various applications, and its broadening to a multimodal human-computer interface for computer aided design, we expect to consolidate this thesis.

## References


Barfield, W.; Caudell, T. (eds.): *Augmented Reality and Wearable Computers*. Lawrence Erlbaum Press, in preparation.

Bruns, F.W.; Brauer V. (1996): *Bridging the Gap between Real and Virtual Modeling – A new Approach for Human-Computer-Interaction*. artec-paper 46, Universität Bremen.

Bruns, F.W.; Heimbucher, A.; Müller D. (1993): *Ansätze einer erfahrungsorientierten Gestaltung von Rechnersystemen für die Produktion*. artec-paper 21, Universität Bremen.

Buxton, W. (1997): Living in Augmented Reality: Ubiquitous Media and Reactive Environments. In: Finn, K.; Sellner, A.; Wilbur, S. (eds.): *Video Mediated Communication*. Erlbaum: Hilsdale, N.J., pp. 363-384.

Dionisio, J.; Jakob, U.; Ziegler, R. (1998): Haptische Rückkopplung als Interaktionsverbesserung mit Virtuellen Umgebungen. In: Rügge I. et al. (eds.): *Arbeiten und begreifen: Neue Mensch-Maschine-Schnittstellen*. Lit Verlag: Münster, pp. 51-61.

Fitzmaurice, G.W.; Ishii, H.; Buxton, W. (1995): Bricks: Laying the Foundations for Graspable User Interfaces. In: *Proc. of CHI'95*, pp. 442-449.

Murakami, T.; Hayashi, K.; Oikawa, K.; Nakajima, N. (1995): DO-IT: Deformable Objects as Input Tools. In: *Proc. of CHI'95*, pp. 87-88.

Oviatt, S.; DeAngeli, A.; Kuhn, K. (1997): Integration and Synchronization of Input Modes during Multimodal Human-Computer Interaction. In: *Proc. of CHI'97*, pp. 415-422.

Robben, B.; Rügge I. (1998): Mit den Händen be-Greifen: Real Reality. In: Rügge et al. (eds.): *Arbeiten und begreifen: Neue Mensch-Maschine-Schnittstellen*. Lit Verlag: Münster, pp. 133-146.

Várady, T.; Martin, R.R.; Cox, J. (eds.) (1997): Special Issue: Reverse engineering of geometric models. *Computer-Aided Design* 29(4).