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The activation of modality in virtual objects assembly

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Abstract. In the specific case of the assembly of virtual 3D objects, using tangible bimanual interaction, we discuss the choice of modality in order to activate another modality.

Keywords: CHI, TUI, Multimodality, Virtual Assembly.

1 Context and related works

We place our analyse in the specific case of the assembly of virtual 3D objects using tangible bimanual interaction. In that situation, both hands are requisitioned and the user can not drop the props to activate a new modality without changing his action or the expected results. Various solutions exist. It is this point that we wish to discuss at the workshop: the design and development of multimodal interaction, for virtual objects assembly, by the activation of a modality by another modality.

Given *m* the modality such that *m=<prop, (x,y,z)>*, where to move the *prop* leads to move the corresponding virtual object in the *(x,y,z)* 3D coordinates. The problem is to determine a modality in order to activate/inactivate the *m* modality. When the modality *m* is inactivated, moving props has not consequences on the 3D position of virtual objects. We focus on three potential modalities: the vocal modality, the modality embedded physically in the principal devices (the props) and the modality embedded physically in a foot pedal device.

The vocal modality is a solution commonly suggested by the users. The voice can actually be used to confirm, cancel or trigger an operation. In 1980, Bolt [1] first combined voice and gesture to interact with data projected onto a large screen. In [2], the manipulation of Passive Props is combined with the voice modality in a situation similar to our case study. Authors explain that the latency due to the voice recognition system is a source of embarrassment and they highlight the interference that may exist between the speech and the short-term memory. Despite the wishes of users, the voice modality is not a suitable solution in this case. This is mainly due to the fact that a discrete operation must be triggered by a brief and discrete action. The modality embedded physically in the principal devices (the props) is illustrated in I/O Brush [3]. The change of modalities exists in order to modify the use of the brush: acquire an image, acquire a colour and acquire a sequence of images. The change of

modalities is performed by turning a knob attached to the handle of the brush. Quoting the example of the declutching mechanism [2] a button was also embedded to a rectangular sheet. This button, activated by the thumb of the hand, allows user to start controlling the position of cutting plane represented by the rectangular sheet. These apparent equipments affect the conventional use of props. Thus, even if embedded physically actuators on the props are a solution that may seem "self-evident", this is not a good solution in an ubiquitous oriented design. Furthermore, from the handling point of view, these equipment buttons leads to problems of discomfort, loss of freedom and loss of accessibility and may also be activated unintentionally. It is therefore difficult to integrate this kind of modality efficiently in the interaction.
The modality embedded physically in a secondary device, a foot pedal, appears both in the previous example [2] and in [4]. The process of declutching has been delegated to a foot pedal. The users controlled the movement of the virtual objects by keeping the foot pedal pressed. Thereby, the user keeps a total freedom of movement with his/her hands.

2. Exploration of solutions

Our aim is the design and the development of a new tangible user interface, based on multimodal interaction, for the efficient assembly of 3D virtual objects. The key idea of the system is to use two props as physical representation and control for the virtual objects. In each hand, the user manipulates an electromagnetically tracked prop, and the translations and rotations are directly mapped to the corresponding virtual objects on the display. During the process of assembly, the user needs to reposition his/her hands or to switch props. Hence, the system has to provide a modality to clutch hand movements.
By relying on the state of the art, illustrated above, we have eliminated the voice modality due to the fact that it is not necessarily the technology that limits the use of the voice modality, but the user's capacities. We then conducted a user study to confirm the superiority, in our case study, of the modality <*foot pedal, activate/desactivate*> and <*button on props, activate/desactivate*>. The subjects had to accomplish a series of 6 assemblies of various shapes. The conditions were between-subject, and the preference between pedals and buttons was evenly distributed with a slight preference for the foot pedals. The user study revealed that the movement of the hands is more similar to real-world assembly scenarios when using the two foot pedals and that the users can keep on concentrating on the actual assembly task.

In conclusion, we have displayed the fact that to achieve some tasks, a modality has to be activated to realise the principal modality. Thus, it is often necessary to add equipment in the system. In the specific case of the assembly of virtual 3D objects, using tangible bimanual interaction, we shown that to activate the modality <*prop, (x,y,z)*> the best modality is <*foot pedal, on/off*>.

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References

1. Bolt, R. "Put-that-there": Voice and gesture at the graphics interface. In Proceedings of SIGGRAPH'80, pp 262–270. ACM, Jan. (2004).
2. Hinckley, K., Pausch, R., Goble, J. and Kassell, N. Passive Real-World Interface Props for Neurosurgical Visualization. In Proceedings of CHI'94, pp 452–458. ACM, Apr. (1994).
3. Ryokai, K., Marti, S. and Ishii, H. I/O Brush: drawing with everyday objects as ink. In Proceedings of CHI'04, pp 303–310. ACM, Apr.(2004).
4. Qi, W., Martens, J., van Liere, R. and Kok, A. Reach the virtual environment: 3D tangible interaction with scientific data. In Proceedings of OZCHI'05, pp 1–10, nov. (2005)