Exchangeability of 3D Interaction Techniques

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Abstract

Supporting different 3D interaction techniques (ITs) plays an important role for the run-time flexibility of a Virtual Environment (VE) application. While many VE systems provide means for exchanging interaction devices that provide rather similar input data, exchanging fairly different interaction devices and thus exchanging rather different ITs has previously received little attention. This position paper deals with the term exchangeability of 3D ITs. A brief definition for exchangeability is given. A case study highlights the requirements and challenges for a flexible exchange of 3D ITs.

1. Introduction

There exists a large variety of user interfaces for VEs [1], each built upon a specific and rather limited set of interaction devices and ITs. A flexible exchange of ITs for a given VE application would allow users for adapting a user interface according to their needs and preferences. A locomotion interface might offer lots of fun for an occasional user of a VE, but could be rather disturbing for an application developer and not suitable for a disabled person.

This position paper points out the necessity of a more flexible approach to the exchangeability of 3D ITs. The following section describes the term exchangeability in more detail. Section 3 presents alternative ITs for a specific task and points out the requirements for exchanging them. Section 4 lists related work and identifies challenges for a flexible exchange of 3D ITs.

2. Exchangeability

Exchanging an IT means to substitute one IT by another. Two ITs are called to be exchangeable (or partially exchangeable) if they can be used to complete the same task (or parts of it) and if the usability is not or only slightly affected.

In theory, any input device could be exchanged with any other input device, but in practice this could result in rather impractical ITs. It is for example possible to replace a microphone that allows for speech input with a simple button. The user could enter text by using the morse code alphabet. However, this is a rather unviable user interface for users not acquainted with the morse code.

An IT is typically based on a specific interaction device or at least on a class of interaction devices. Exchanging an IT does not necessarily involve exchanging the interaction device, though, since a single interaction device may offer one or several alternative ITs.

3. Case study: Exchanging 3D interaction techniques

Figure 1 shows different ITs that can alternatively be used for the selection of a 3D object. (a) shows the selection of a virtual object by a hand tracker. The position and orientation data is used to project a ray. The virtual object picked by this ray is selected. Quite similar is the IT illustrated in (b). A cross hair in the user’s view is controlled by an eye tracker. The object that gets picked by a ray through the crosshair is selected. (c) illustrates the selection of a virtual object using a tracker and proximity. The object within a certain range of the tracker is selected. (d) shows the selection of virtual objects via speech commands. Objects are selected by pronouncing their unique identifier or by pronouncing characteristic features (e.g. “red”).

(a) and (b) are built upon similar input data and the utilized tracking devices could provide the same abstract interface as it is realized in several VE frameworks [3]. This way both ITs could be exchanged transparently for the application. Abstraction layers for interaction devices are limited,
though, since they do not allow for exchanging rather different ITs. Although devices used for (a) and (c) provide similar input data, exchanging both ITs would require the application to know whether pick-ray or proximity-based selection should be applied.

Figure 1. Alternative ITs for the selection of a 3D object.

When it comes to exchanging the first three ITs with (d) it becomes clear that this cannot be done using device abstraction. A common denominator of all four ITs is the identifier of the virtual object that is selected. To exchange the four ITs transparent for the application, an extra software layer that encapsulates the ITs would be required. The VE application could be built upon an interface that provides an object identifier of the selected object rather than device specific data (e.g. tracking data) as it is currently common practice for many VE systems.

4. Challenges for a flexible exchange of 3D interaction techniques

However, there are some approaches for a flexible exchange of 3D ITs that go beyond device abstraction. SlivVR for example fits semantic events, such as navigation tasks, to available interaction devices [4]. STARS allows for device independent formulation of interaction requests [2]. Both approaches are promising, but have either not been applied to different interaction tasks or they have not been used for a wide range of ITs.

For the realization of a viable support of run-time exchangeable ITs further issues need to be addressed. This includes basic parameters of interaction tasks and appropriate device and IT independent application interfaces. Another open question is the synchronization of alternative ITs. If alternative ITs are offered at the same time, this might result in inconsistencies that would need to be resolved by the VE system. Also, if a VE application supports a large variety of exchangeable ITs, how could the currently available ITs be communicated towards to user? Is it feasible to automatically generate or adjust help files?

ITs should be exchanged if an intended IT is either not possible because certain devices are not available or because another IT is more suitable. But how can suitability be measured? Suitability is rather user-dependent and with an increasing variety of interaction devices this might become a rather unfeasible task. Also, does the user prefer an automated switching between different ITs? Or does a user favor to explicitly select the interaction device he or she wants to use? A detailed evaluation would need to address whether an explicit or implicit exchange of ITs is preferred.

5. Conclusion

This position paper has presented some thoughts and considerations regarding the exchangeability of 3D ITs. At the 3D UI workshop we would like to present and discuss our ideas towards flexibly exchangeable ITs within VE applications.

6. References


Irma Lindt is working as a research associate at Fraunhofer FIT in St. Augustin, Germany, in the department Collaborative Virtual and Augmented Environments. Her research interests include adaptive user interfaces, interaction authoring and mobile Augmented Reality. Irma Lindt received her masters’ degree in Computer Science from the Eastern Michigan University, USA.