

Can People Collaborate in Networked Virtual Environments?

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Immersive projection technology (IPT) installations are proliferating around the world and increasingly these are being used in networked situations, where participants collaborate using a heterogeneous collection of IPTs and non-immersive systems. In our experiments we show that the ability of the users to collaborate within these systems is affected by the participant's level of immersion. In particular we show that collaboration can be problematic between participants using very different systems such as an IPT and a desktop. To the best of our knowledge, these experiments on collaboration between IPTs are the first of their kind and the results have important implications for the design of networked virtual environments.

Situation

We compare performance and experience in solving a 3D cube puzzle between three conditions: two participants in real space (R condition), both participants in different IPTs (C2C condition) and one participant in an IPT and one on a desktop system (C2D condition). The participants in the R trial performed the task with real blocks. In the C2C condition we used a Tan VR-CUBE at Chalmers University and a Trimension ReaCToR at UCL. In the C2D condition we used the Chalmers' VR-CUBE and an sgi O2 workstation. The desktop participant used a mouse and keyboard to interact with the cube puzzle. The C2D condition was implemented in dVISE (now renamed DIVISION, www.ptc.com/products/division). For the C2C condition the environment was precisely replicated on the DIVE platform (www.sics.se/dive). Figure 1 shows a pair of immersed participants in the C2C condition at various stages in the completion of the task.

Performance

The R condition is a standard that we do not expect to be bettered in a networked virtual environment. Figure 2



Figure 1: Two participants completing the 3D cube puzzle

shows the percentage of pairs that complete the task for each condition. 22 pairs did each condition. Note that users were stopped after 20 minutes if they had not completed the task. The mean completion times were: R condition 8 minutes, C2C 8.8 minutes and C2D 15 minutes.

Experience

In the C2C condition interaction between the two participants is very fluid, and in our opinion collaboration was much more successful than any of our prior experiences with other collaborative virtual environment systems.

In the C2D condition confusion seemed to arise between the participants because they do not comprehend how the other participant interacts with the world and the limitations that the other's interface might impose. Consequently we have observed IPT users being frustrated with the slow performance of the other user and in post-trial questionnaires and interviews, they rate the desktop user disparagingly as contributing little to the task or even being uncooperative.

Impact

The answer to the question posed in the title is thus a qualified yes. IPT users can be re-assured that performance in the C2C condition was similar to that on the real task and that collaboration can be very natural. However collaboration between IPT and desktop is significantly worse than in the real task. We therefore hypothesize, based on our observation and participant feedback, that this is not simply due to the desktop participant's poorer interface, but due to confusion between the users about what the other is capable of. Broader study is obviously required into precisely why collaboration is hindered in the C2D condition and how collaboration might be better supported.

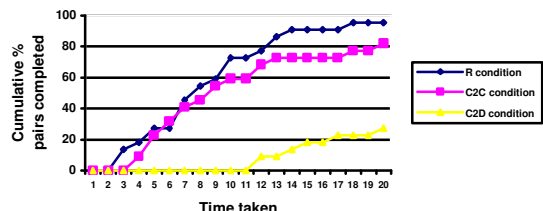


Figure 2: Cumulative percentage of pairs of participants that had completed the task by the given time for each of the three conditions. Note that not all pairs complete the task within 20 minutes.