Benefits of Tablet Interfaces for Immersive Visualization in Information Visualization

L. Wurm[1], R. J. García-Hernández[2], C. Anthes[2,1], D. Kranzlmüller[1,2], W. Höhl[1]

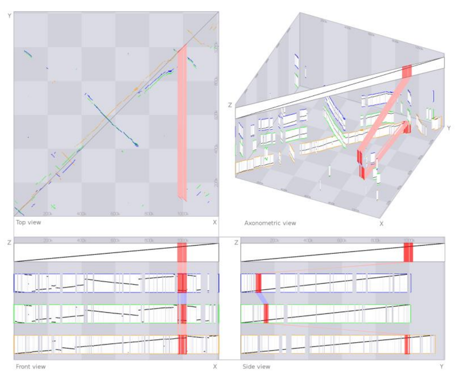
Email: l.wurm@campus.lmu.de; garcia@lrz.de; anthes@lrz.de; kranzlmueller@lrz.de; hoehl@cip.ifi.lmu.de

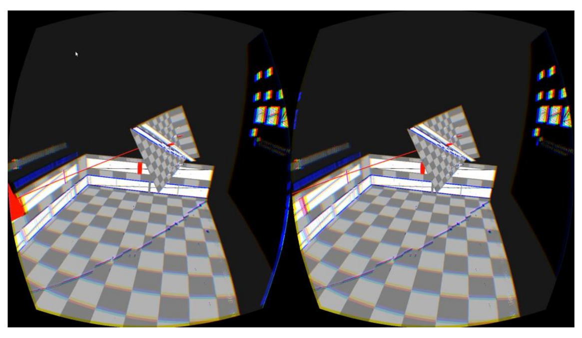
1 Ludwig-Maximilians-Universität,
Geschwister-Scholl-Platz 1
D-80539, Munich, Germany

2 Leibniz Supercomputing Centre, Bavarian Academy of Sciences
Boltzmannstraße 1
D-85748, Garching, Germany

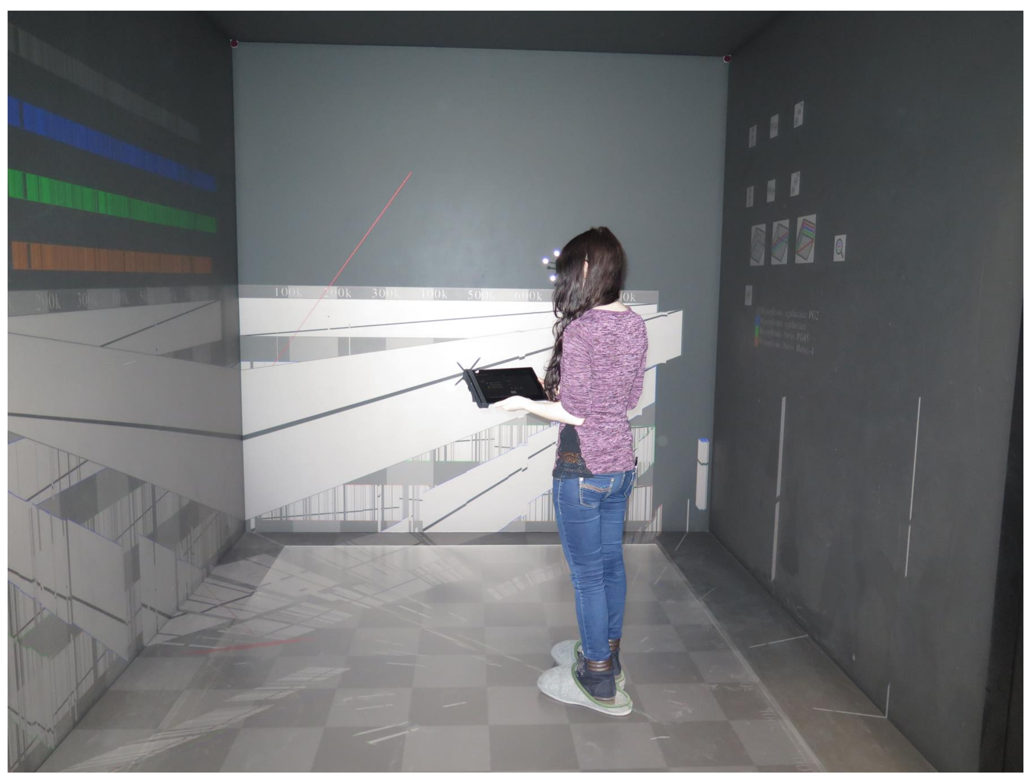
Introduction

3DScover is a genome comparison tool available for Desktop. Prototypes running on CAVE[1] and Oculus Rift have been developed.





In this research, we have studied the use of tablets within the CAVE to enhance usability and satisfaction of users.



Motivation

Complex system control and text input are difficult to provide in CAVEs with standard I/O devices such as wands. Tablets are ideally suited to help in these situations, as they are portable and easy to integrate to CAVEs.

Materials and methods

We have used a 5-sided CAVE-like display with 2.7m side as our display device. For interaction we tested an ART Flystick 3 wand versus a Samsung Galaxy 9 tablet.

We performed three user studies.

The first one was an interface design questionnaire, web-based, whose goal was to maximize ease of understanding of the icons used in our application.

The second study was a mock-up analysis, in order to verify usability.

Finally, we performed a more complete user study to verify the speed and accuracy of the different I/O devices. A post-questionnaire studied the satisfaction of users with different aspects of the system.

1 CAVE™ is a registered trademark of the University of Illinois' Board of Trustee. The term is used here to generically refer to CAVEs™ and CAVE-like displays.

Evaluation

The interface design questionnaire (taken by 35 participants, 22 male, 13 female) provided valuable feedback from users. A request was made to add textual descriptions to icons. A tab-based interface was preferred to a slide-in interface.

The mock-up analysis (taken by 10 participants, 4 male, 6 female) resulted in the search button, sliders and data input fields being modified to add more information, again at the request of users.

The final user study (taken by 20 participants, 17 male, 3 female) included four tasks designed to measure accuracy and speed:

T1 First the user has to scale the visualization to the side and select a defined huge area on the front wall. After the selection he has to activate the default view.

T2 Next the user has to move the visualization on the front wall and select a small area on the side wall. The default view has to be activated afterwards.

T3 In the last selection task the user has to deactivate the 3D view and select a square area on the floor. After the selection return to the default view.

T4 In the final task the user has to scale the visualization. The small cube has to be scaled to it's maximum size. Then, the cube has to be grabbed and placed on the top right corner of the front wall.

We created and evaluated four hypothesis to test the difference in speed, accuracy and user satisfaction for the wand versus the tablet interface.

- ✓H1: Selection faster with wand than with tablet
- ✗H2: Selection by tablet more precise than by wand
- ✓H3: User satisfied with both devices
- ✓H4: User satisfied with additional features of tablet

No statistical difference in precision between tablet with new selection mode and traditional wand selection was found.

The weight of the tablet is sometimes considered too high with respect to the wand (using a smartphone instead of a tablet would help resolve this). This affects the evaluation of the difficulty to move the small object.

Conclusions

The tablet can be used as an alternative to traditional wand interfaces, allowing new tasks to be performed easily and to the user's satisfaction.

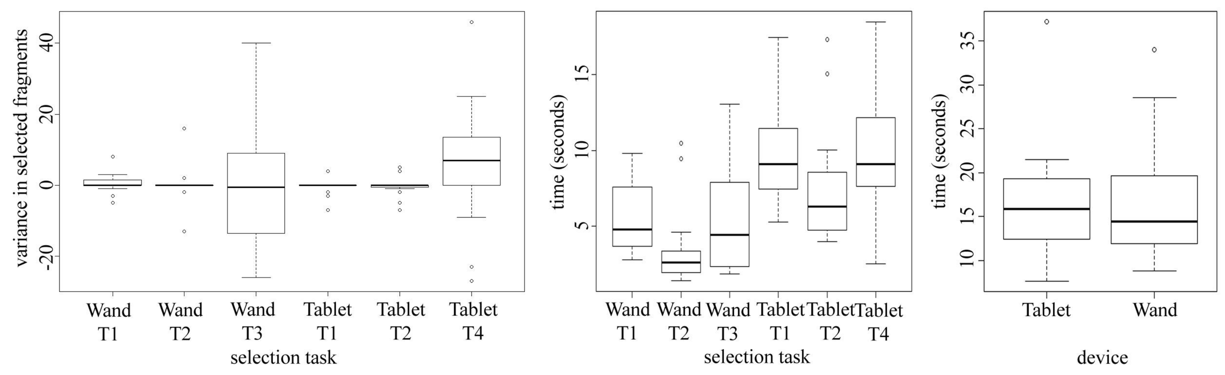
Future Work

In the future, we plan to perform a user study to compare the performance of different versions of our genomic comparison tool: 2D on desktop (classical workflow), 3D on desktop (better data understanding) and CAVE (better immersion).

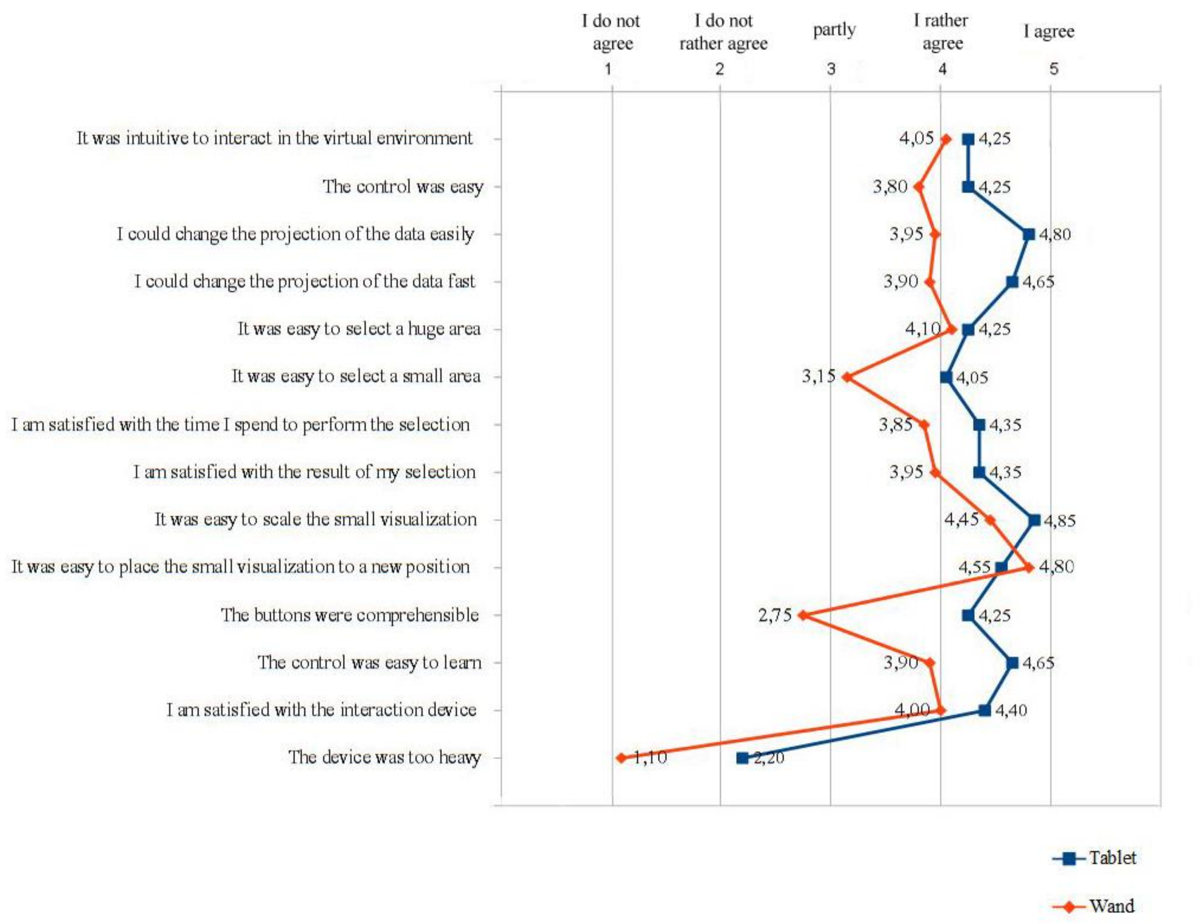
We also plan to test the use of small factor mobile phones for control, and to study other applications where VR information visualization may be beneficial.

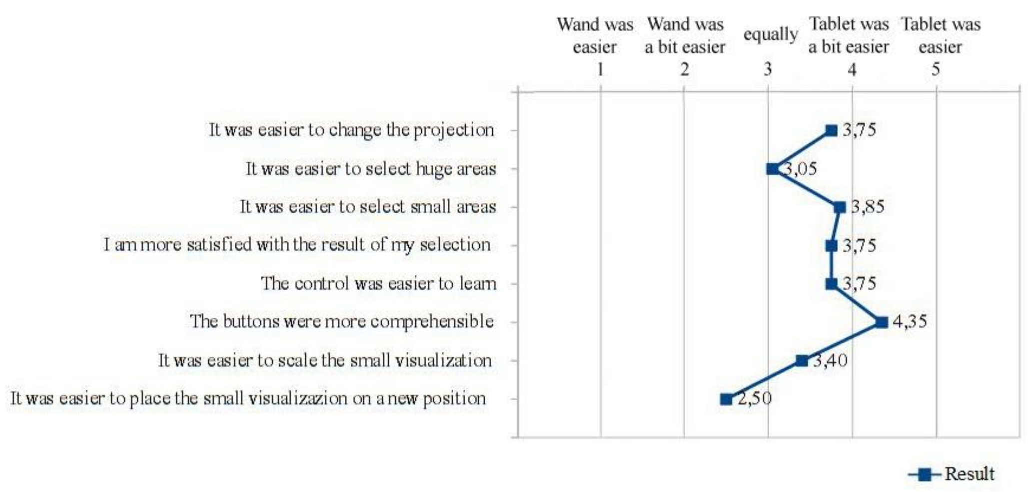
Results

Evaluation of time and accuracy for tasks 1-3, and for time for task 4.
The Wilcoxon-MannWhitney-Test was used to measure significance.
Time for tasks 1-3: statistical difference (value 6e-4, 6e-6, 6e-4 resp.)
Accuracy for tasks 1-3: no statistical difference (12%, 39%, 12%)
Time for task 4: no statistical difference (70%)

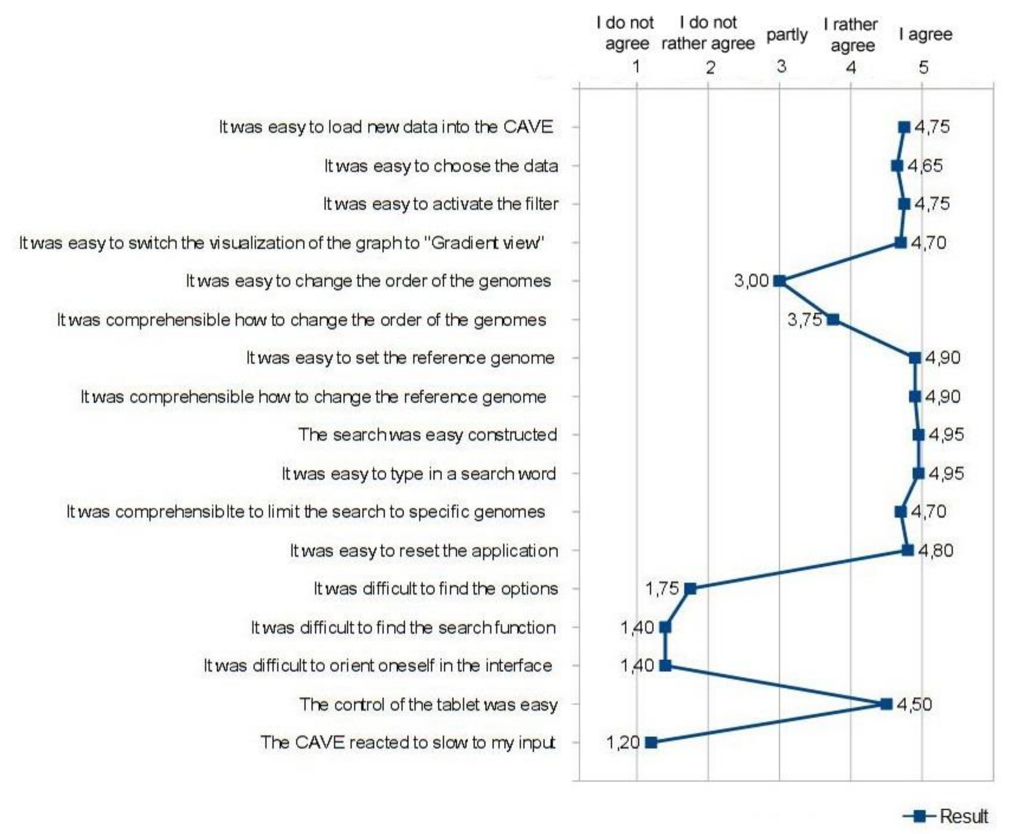


The post-questionnaire shows a general preference for using the tablet, except for moving the small visualization to a new position and some complaints of excessive weight; the wand was preferred in those cases





The post-questionnaire also queried users about the new functionality not available when using only the wand. Changing the order of the genomes gave more difficulties to users than expected, but the rest of the new functionality was well received; users found it easy to perform



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VR and Visualisation Centre