Interaction strategies on three-dimensional user interfaces with pointer devices

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Motivation

Autostereoscopic 3D displays allow the perception of 3D interfaces without additional tools and can therefore easily be used in office environments. Such 3D-UIs allow a better user performance in recognizing and classifying screen objects.

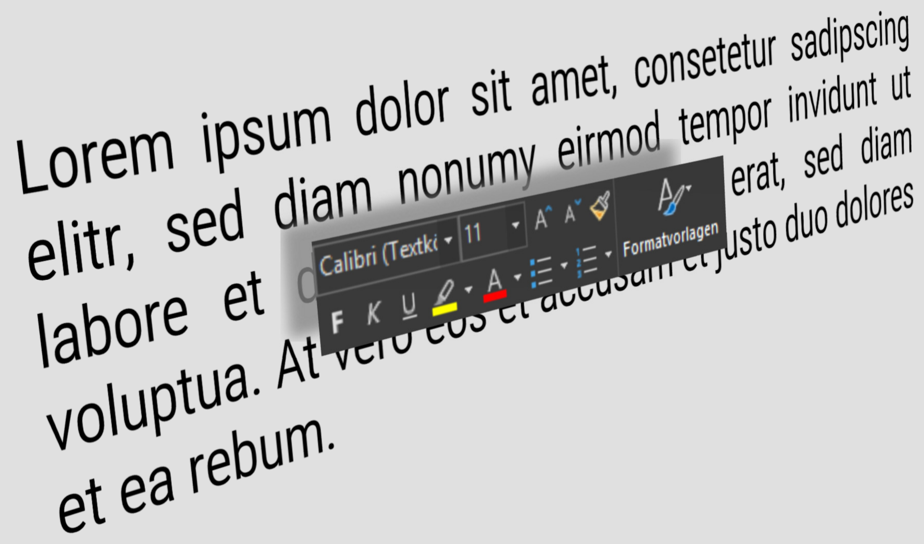
A common challenge when using 3D-UIs is the direct interaction with two-dimensional pointer devices, e.g. a computer mouse. When structuring information on several depth layers, the mouse interaction layer needs to be at least on the top level. In this situation, parallax effects will degrade the speed and the precision, i.e. the effectiveness, of pointer devices.

This study examines two alternative interaction strategies on 3D-UIs with pointer devices to counteract the negative effects on precision and speed.

Conclusion

The study investigated a 3D-UI with different interaction strategies. The gliding mouse movement is the most accepted and leads to a better hedonistic assessment than other pointer movements.

Outlook: Ongoing usability related studies will examine the gaze-behaviour as well as depth as a salient attribute to further determine if autostereoscopic displays are suitable for office applications



Method

- Laboratory study with 20 participants (M_{age} = 25.0 years; *SD* = 3.0)
  - all capable of perceiving 3D content (Random dot stereo blindness test)
- Within-design
- Independent variables:
  - Interaction strategies (see Fig.1)
  - Virtual target height (see Fig.1)
  - Target distance from centre (see Fig.2)
- Task was to click the centre of a randomized pop-up-target (diameter 105 px)

- Measures:
  - Performance (Distance to target centre and time)
  - Visual function questionnaire (NEI-VFQ 25)
  - Visual fatigue questionnaire (Bangor, 2000)
  - UX (UEQ) & Acceptance (van der Laan)
  - socio-demographic questionnaires

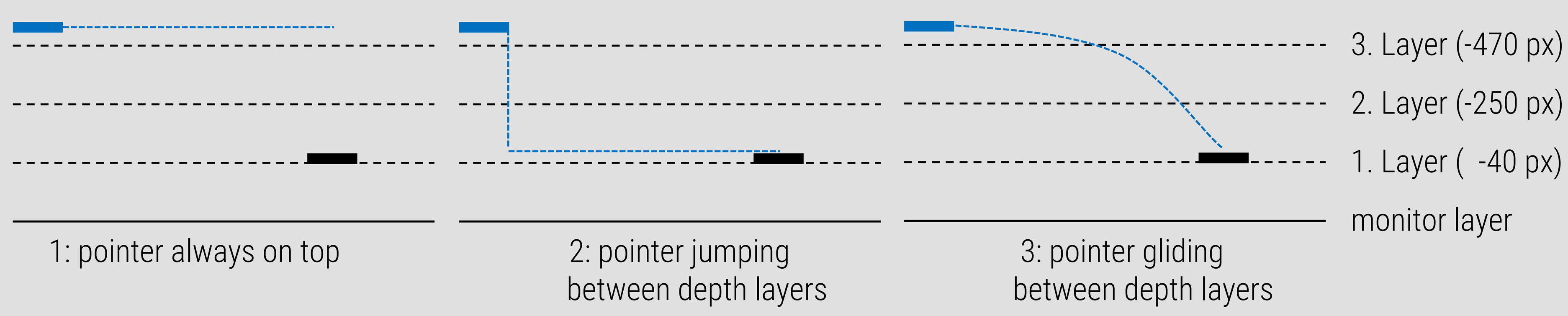


Fig.1 Interaction strategies (pointer: blue; target: black)

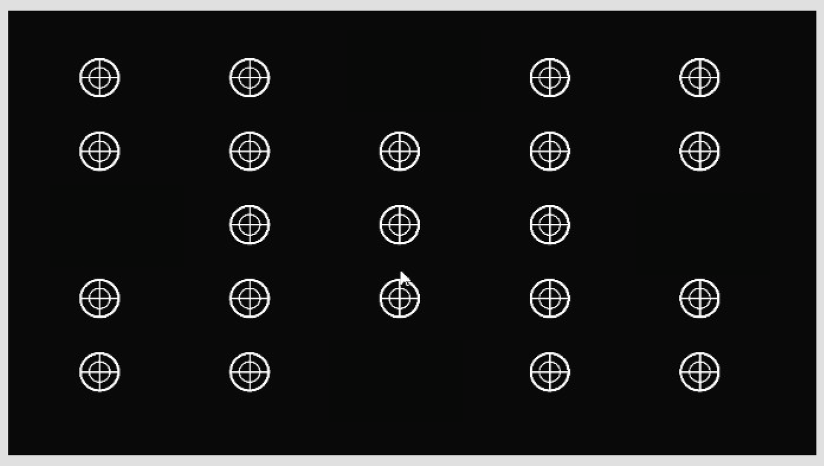


Fig.2 Schematic of the target placement

Results

- Effects on **Precision**: Interaction strategy F(2, 40) = 107.14, $p < .001$, $\eta^2 = .84$) and depth F(2, 40) = 80.53, $p < .001$, $\eta^2 = .84$)
  - Post-Hoc (Bonferroni) found significant differences between all interaction strategies and depth parameters
- Effects on **Speed**: Interaction strategy F(2, 40) = 3.99, $p = .026$, $\eta^2 = .16$) and distance F(2, 40) = 38.561, $p < .001$, $\eta^2 = .66$)
  - Post-Hoc (Bonferroni) found a significant difference between interaction strategy 1 & 3 ($p = .003$)
  - Post-Hoc (Bonferroni) found significant differences between all distances from monitor centre

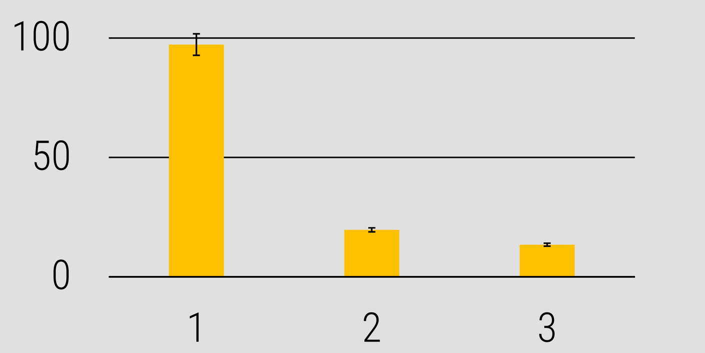


Fig.3 Mean distance form target centre in [px] depending on interaction strategy

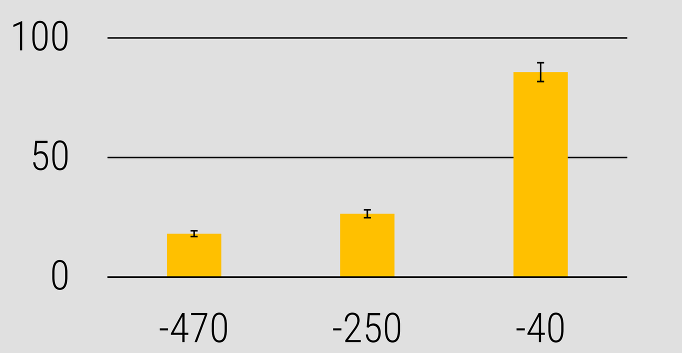


Fig.4 Mean distance form target centre in [px] depending on depth effect

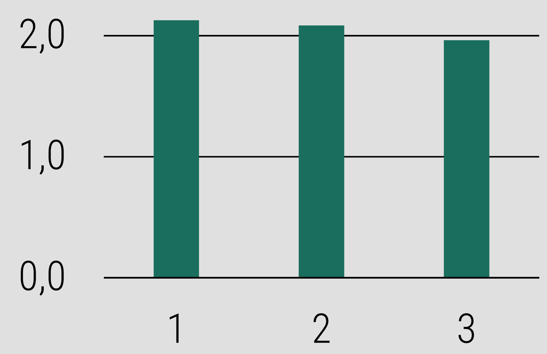


Fig.5 Mean time needed in [sec] depending on interaction strategy

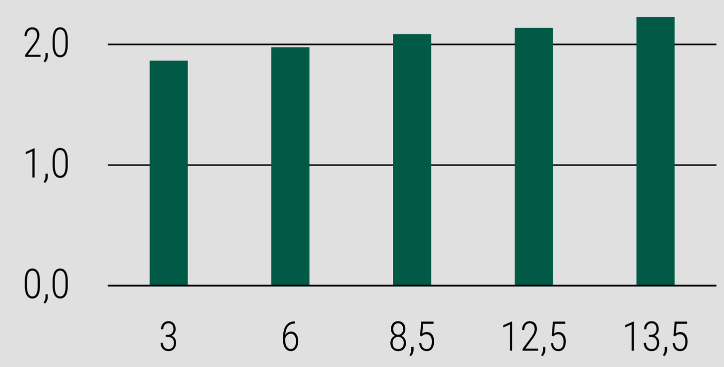


Fig.6 Mean time needed in [sec] depending on distance from monitor centre [cm]

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