Differences in Perspective and Software Scaling

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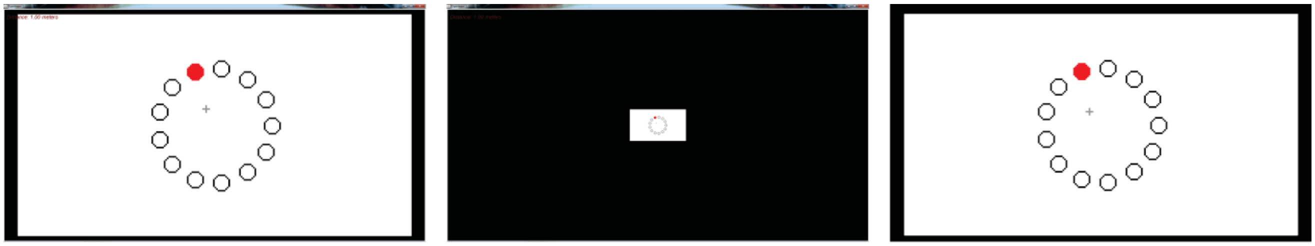

(a) (b) (c)

Figure 1. (a) 70" display. (b) 10" display (c) 10" display subject to 700% magnification, yielding same image as 70" display, same quantization, and relative resolution.

1. INTRODUCTION

With a greater range in display sizes available than ever before, it is important to understand the effects of scaling content across different-sized displays. We are interested in the effects of viewing distance, which implicitly scales content in isolation from other scale factors (e.g., CD gain or motor scale) due to perspective. This is especially important in spatial applications, since unlike desktop systems, the viewing distance of the user can be highly variable (e.g., standing, or moving) while motor scale is often constant (e.g., absolute 1:1 position, with remote pointing).

The effects of control-display gain have been studied extensively [1, 2]. The effects of visual scale in isolation from CD gain have not been explored in depth [3, 4]. Previous work on visual scale has confounded this with motor scale, for example, changing CD gain with visual scale, hence changing the effective motor task the user performs. We thus present a study comparing distance-based (perspective) scaling with artificial (software-based) scaling. The objective is to assess if visual scale due to viewing distance influences task performance differently than artificially re-sizing content. We isolate this factor by maintaining a constant sized motor space and display resolution.

2. USER STUDY

We conducted a study with 12 participants to investigate these issues. The study used a Fitts' pointing task, see Figure 1. We used a 75" TV. In software scale conditions, the task was re-sized in software - Figure 1b depicts a simulated 10" display, while Figure 1a depicts a 70" display. Effective display resolution and motor scale were constant – the same mouse movement would move the cursor the same relative distance on the display. Figure 1c depicts the 10" display magnified to yield the same image as the 70" display. For perspective scale conditions, participants were moved to different distances corresponding to the same scale factors as those used with the software scale methods.

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The experiment used a 2x3x3 within-subjects design with the independent variables *scale method* (software, perspective), *visual angle* (24.5º, 21º, 14º, 10.5º, 7º, 3.5º), *block* (1, 2, 3). We report throughput (in bits per second) as the dependent variable.

3. RESULTS & CONCLUSIONS

There was a significant interaction between scale method and visual angle ($F_{5,55} = 22.7$, $p < .0001$). See Figure 2. Notably, software scaling at 24.5º was significantly worse ($p < .05$) than all other conditions. The "curvature" of the software scaling line was also significant: both 3.5º and 21º were significantly worse than 14º, 10.5º, and 7º. In contrast, none of the visual angles were significantly different from one another with perspective scaling. Overall, these results suggest a stronger impact of scale with artificial software-based scaling than with perspective scaling.

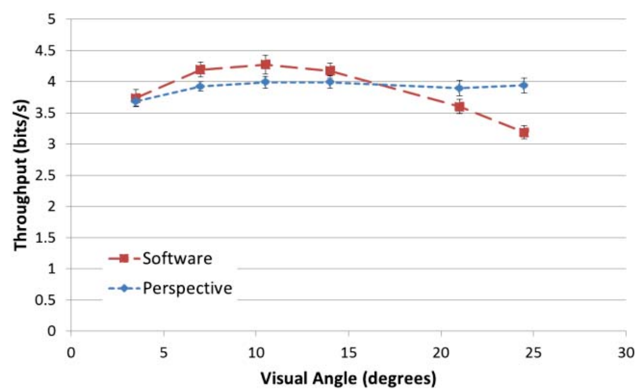

Figure 2. Throughput by scale method and visual angle, averaged over all blocks. Error bars show ±1SD.

4. REFERENCES

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