Comparing Visualizations for Tracking Off-Screen Moving Targets

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Motivation

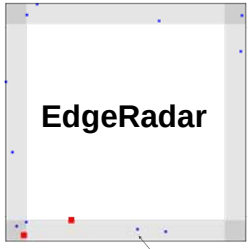
- In games, aircraft navigation systems and in control systems, users track moving targets around workspaces that may extend beyond the users' viewport.
- We compared two different off-screen visualization techniques for accurately tracking off-screen moving targets: Halo [1], the most common off-screen representation and EdgeRadar, a new fisheye-based visualization technique.

- Tracking objects with Halo is difficult because the arcs overlap and become cluttered.
- Halos can bunch up on the edge of the screen and it can be very hard to distinguish between different targets.
- The goal was to develop a new technique to avoid problems with clutter and experiment with new ways of representing off-screen objects.

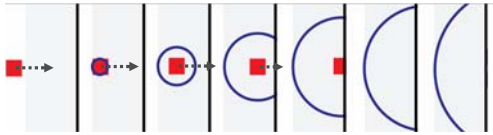
EdgeRadar

New visualization technique for representing off-screen objects, an alternative to Halo that alleviates some of Halo's drawbacks, specifically clutter.

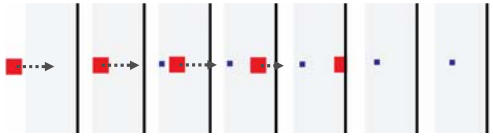
- EdgeRadar is based on the idea of splitting up the overview window (i.e. radar view) found in overview+detail displays.
- The radar view is split up into elongated sections that are shown at the edge of the screen.
- EdgeRadar blips are positioned in the band along the edge such that those closer to the edge of the display are farthest away. This creates a simple fisheye view that provides context in a minimally intrusive way.
- Specifically designed for a moving object tracking task and it will not perform well in tasks that require explicit positioning information.



An object and its EdgeRadar *blip*.



The Halo grows as the object move away from the screen.



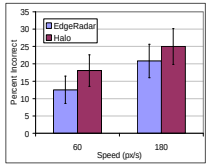
As the object leaves the screen an EdgeRadar *blip* is left behind to show the object's relative position off-screen.

Experiment and Results

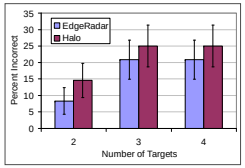
We compared the performance of EdgeRadar to Halo by replicating Pylyshyn's [2] Multiple Object Tracking task but allowing targets to leave the on-screen area. The task was performed like this:

- User is shown a set of target and distractor objects.
- Target objects are highlighted.
- All objects start moving and the user tracks the target objects as they leave the screen.
- After 10 seconds the objects stop moving and one object is highlighted.
- The user is asked if the highlighted object was one of the targets.

EdgeRadar consistently outperformed Halo in this task. However, the results were not statistically significant. A more extensive study is required.



Error rate by target speed.



Error rate by number of targets.

Future Work

This work presents a preliminary but promising step toward the design of visualization techniques for tracking off-screen moving targets. Future work will involve:

- Designing a new technique to address problems with EdgeRadar and Halo. We are in the process of an extensive iterative design process towards this goal.
- Evaluation with a more realistic platform, such as a PDA.
- Comparison with overview+detail and fisheye views.
- Evaluation with tasks other than target tracking. Attempting to mimic real PDA map usage.

Acknowledgments

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References

[1] Baudisch, P. and Rosenholtz, R. 2003. Halo: a technique for visualizing off-screen objects. *CHI '03*, 481-488.

[2] Pylyshyn, Z.W. and Storm, R.W. 1988. Tracking multiple independent targets: Evidence for a parallel tracking mechanism. *Spatial Vision*, v3(3), 179-197.