---------- Paper 795, Review 5 ----------

Title: Wedges: Accurate Visualization of Off-Screen Locations

Reviewer: Primary AC

Overall Rating

5 (Possibly accept: Possibly above the line, but I wouldn't want it to edge out stronger submissions.)

Expertise

3 (Knowledgeable)

Contribution to HCI

The paper presents a new technique for visualizing the location of off-screen objects on small-screen devices. The presented technique (Wedges) has been developed to overcome the limitations of existing techniques (Halos in particular) while providing the same advantages in terms of information conveyed to the user. In contrast to Halos, Wedges can be arranged in a way that they do not overlap and thus provide more accurate estimates of direction. Wedges clearly outperform Halos in the corners of the screen, where offscreen locations are difficult to visualize. The design was guided by perceptual theories and the paper concludes with a set of recommendations for designers based on the results; both of these add value to the paper, even though they remain on a rather general level. The visualization technique is potentially useful in navigation and games, for instance.

The Meta-Review

The paper presents Wedges as a technique aimed at visualizing the location of off-screen objects on small-screen devices, especially to provide visual cues for estimating the accurate location of the targets. The technical details of the design are sound, the paper is well written and the experiments for evaluating the benefits of Wedges are competently carried out. There are, however, three main concerns that the reviewers have concerning the paper.

(1) Since Wedges are a further development of Halos, the idea of trying to convey accurate location information is not new, and the approaches have some similarity. Thus, although the devil may be in the details, which are arguably a clear improvement over Halos, the novelty of the basic approach is not high.

(2) The practical motivation of trying to convey ***accurate*** location information does not convince Reviewer 1. A couple of different categories could be simpler and sufficient for many tasks. Reviewer 4 has similar concerns, suggesting the use of zoom-out for comparison.

(3) The evaluation is carried out with a small number of off-screen objects (five), which does not prove the benefits in real-life situations that can have a much higher number of objects. This is pointed out by Reviewers 1 and 3. Reviewers 2 and 4 would have liked to see a real-world task in addition to the tasks in the controlled experiment.

Reviewer 1 points out a published comparison of previous techniques for the same task; this should be referenced in the paper. The paper is very well written and makes for enjoyable reading. The use of illustrations is, in general, excellent. However, reviewer 3 points out an apparent inconsistency, in that the way of drawing Wedges (curved vs. straight lines) appears to be different in Figure 10 compared to the rest of the paper. Reviewer 4 notes a possible problem with the verbalisation of one of the statistical results.

In summary, the paper presents a new visualization technique that has merits compared to previous techniques. However, the results of the user study do not fully substantiate the claims made in the paper: Wedges were markedly better only in one task configuration, as pointed out by Reviewers 3 and 4. Even with the good theoretical discussion guiding the design and with an attempt to generalize the findings, the paper is somewhat incremental and would have been more appropriate as a tech note at this stage. A more large scale user study, which the authors are planning to carry out, would have made this a strong paper.

Associate Chairs Additional Comments

The authors' rebuttal is clear, and addresses especially the (non)incrementality of the work. I have not upgraded my score, but this is a strong paper in the "Possibly accept" category.

---------- Paper 795, Review 1 ----------

Title: Wedges: Accurate Visualization of Off-Screen Locations

Overall Rating

4 (Borderline: Overall I would not argue for accepting or rejecting this paper.)

Expertise

4 (Expert)

Contribution to HCI

The paper addresses a problem related to the visualization of large information spaces on small-screen devices, namely how to provide awareness of objects of interest that move off-screen while users navigate an information space. The presented technique (Wedges) tries to overcome the limitations of a previous technique to visualize off-screen locations of objects (Halo) while providing the same advantages in terms of information conveyed to the user.

Main strengths of the contribution:
- discussion of the theoretical background that guided the design
- sound technical design of the proposed technique
- detailed description of the proposed technique

Main weaknesses of the contribution:
- limited novelty with respect to previous work

- weak motivation for the usefulness of the proposed technique with respect to more simple solutions
- lack of evidence of the effectiveness of the proposed technique in practical scenarios

The Review

The paper presents a technique, Wedges, aimed at visualizing the location of off-screen objects on small-screen devices. Since the main idea of conveying accurate location information about off-screen objects and the first proposal for its implementation were predated by Halo, the novelty of Wedges lies mainly in the technical details, which are nonetheless sound. The authors clearly state the goal of their work but do not provide a strong case for the usefulness of the proposed technique, especially for practitioners. In general, I'm dubious about the usefulness of conveying accurate location information about off-screen objects, as done by Wedges. More simple solutions (e.g., discriminating between far and near objects, maybe with one or two intermediate levels) would suffice in most mobile scenarios and would probably be easier to understand for the user (reducing the time needed to get an overview of the situation). Moreover, actual object distance (in meters) depends on the scale of the information space and cannot be directly obtained from the visualization. If distance is critical for a given task, showing it explicitly (e.g., with labels) would be a better solution.

The evaluation would have been much more informative and useful if it had provided indication of how Wedges scales with respect to higher numbers of off-screen objects. This information would have been very valuable because configurations with several objects are quite common in mobile applications (e.g., map-based applications typically involve tens of objects). Thus, even if the authors plan to investigate these configurations in the future, the current evaluation with 5 objects is of limited practical interest. In particular, I'm concerned that the availability of three degrees of freedom for each wedge, which is useful to decrease the amount of overlap on the display (with respect to Halo) in sparse configurations, might put a strain on the cognitive resources of users in cluttered configurations where wedges start to overlap. The results of the evaluation do not decrease such concern since they show that Wedges outperforms Halo only in one task (out of three) and only with respect to user accuracy when wedges are positioned at the corners. Moreover, the study involves only a limited number of participants (as is unfortunately common in most HCI studies) which may negatively affect the significance of the obtained results (unless one is aiming at a very specific and well-defined population).

Probably due to a typo, the function for computing leg length in the discussion of the algorithm for wedge layout is uncorrect since it makes intrusion depth grow in an unbounded fashion.

A relevant reference about off-screen objects visualization is missing: Burigat S., Chittaro L., Gabrielli S. "Visualizing Locations of Off-Screen Objects on Mobile Devices: A Comparative Evaluation of Three Approaches", Mobile HCI 2006

In the end, the paper presents a solution for off-screen objects visualization that is technically sound and an evaluation that provides some evidence of the advantages of Wedges over Halo. On the other hand,

the originality of the work with respect to previous work is limited, and there is no evidence of the usefulness and effectiveness of the proposed technique in practical scenarios, which typically involve a high number of off-screen objects.

Areas for Improvement

The paper is well written and easy to understand, with only some occasional glitches (especially in the related work section) that a thorough proof-reading can easily solve.

In the upper images in figure 10, the base of wedges seems to be an arc instead of a straight line as in the other figures.

---------- Paper 795, Review 2 ----------

Title: Wedges: Accurate Visualization of Off-Screen Locations

Overall Rating

5 (Possibly accept: Possibly above the line, but I wouldn't want it to edge out stronger submissions.)

Expertise

2 (Passing Knowledge)

Contribution to HCI

Describes a novel solution to visualize the positions of off-screen objects. This is necessary, for instance, in navigation and games. Their solution "Wedges" improved upon earlier designs in terms of user satisfaction and performance with map-based tasks in a limited study. More studies are needed for reveal the real significance, though.

The Review

PREVIOUS WORK: Seems to be sufficiently covered.

SIGNIFIGANCE: Greater than average. This simple method is a modest improvement but may have major applications, for instance in virtual worlds that the authors mention.

VALIDITY: A quick read of the study revealed no major flaws in the work.

ORIGINALITY: Improves upon earlier work, which is properly acknowledged. In my view provides sufficient advances to merit publishing, even though the research is not a breakthrough but an increment.

Areas for Improvement

Nicely formatted paper that flows well. No problems that jumped out.

---------- Paper 795, Review 3 ----------

Title: Wedges: Accurate Visualization of Off-Screen Locations

Overall Rating

6 (Accept: I would argue for accepting this paper.)

Expertise

3 (Knowledgeable)

Contribution to HCI

This paper reports a novel visualization technique for objects with off-screen locations, which relies on a similar perceptual principle as the Halo technique. In contrast to Halos the presented Wegdes, can be arranged in a way that they do not overlap and thus provide more accurate estimates of direction. The technique has been carefully evaluated in a similar trial that has been presented in the original Halo CHI paper, which makes the two techniques comparable. Wedges clearly outperform Halos in the corners of the screen, where offscreen-locations are difficult to visualize.

The Review

The contribution is clearly relevant to CHI. The contribution is novel, however in certain aspects incremental given the similar perceptual concepts it shares with Halo (basing on amodal completion). The difference of performance in terms of error rate and interaction time in the corners of the screen are significant and the examples in the paper convincing. Still it is not very surprising to see that in most of the other conditions there is no significant difference between Halos and Wedges, given their similarity.
So overall one could argue that his paper is an incremental contribution with a small delta over existing work. However, the authors did an excellent job by explaining the theoretical motivation for their work and by explaining the degrees of freedom of the wedges and how a layout algorithm should control those. In this respect the first part of the paper has convinced me, while the second part with the evaluation was slightly disappointing, given the small performance advantage of Wedges. The authors note that more off-screen objects would yield to more visual clutter with Halos than with wedges. This seems reasonable and it is surprising to see that the experimental design contained only 5 to 10 objects. Overall, I think the good performance in the corners of the screen together with the nice conceptualization justifies publication.

Areas for Improvement

The paper is well written, so I have only little further comments to

make:

a) From the paper it was not clear if the proposed algorithm has been tested. I.e. it would be interesting to see if the algorithm has been used to automatically design the layout of the wedges in the experiment, or if those have been drawn by hand.
b) The authors say that the algorithm does stop after a couple of passes.
How does this affect performance? How does occlusion of wedges (which might be a result of the algorithm) affect performance compared to Halo occlusions?
c) From the paper it was difficult to understand how the dense and sparse
condition differed and why folding was necessary. I would suggest to extend the argument to make it more understandable. Also, please indicate how many objects have been used in the spare (5?) and dense (10-20?) condition.
d) In the first part of the paper Wedges had a straight base, while in the evaluation (cf figure 10) they seem to be curved. I would assume that this has an effect on the perception of angles. A curved base should make it more difficult (i.e. when rotated) to judge the angle of the legs. Please comment.
e) In the references please check the appearance of the year. Sometimes it appears directly after the author's names, sometimes only implicitly in the conference name.

---------- Paper 795, Review 4 ----------

Title: Wedges: Accurate Visualization of Off-Screen Locations

Overall Rating

5 (Possibly accept: Possibly above the line, but I wouldn't want it to edge out stronger submissions.)

Expertise

3 (Knowledgeable)

Contribution to HCI

The paper presents a new technique for visualizing the location of off-screen objects. The technique provides benefits over existing techniques, especially by avoiding overlap in display corners. The proposed approach is compared to the state-of-the-art technique and the authors present a set of recommendations for designers based on the results. However, the recommendations are somewhat general in nature.

The Review

In general the paper does a good job of summarizing previous work in the area of contextual visualization, however the discussion about perceptual theories and their application to the design of the proposed visualization is lacking in detail. Is the selection of an isosceles triangle as the visual paradigm the only or best application of the local models, or are there other shapes that could be considered in that

context?

The description proposed visualization is meticulously documented and easy to follow, much thanks to informative illustrations. The design provides a more elegant solution to conveying relative proximity of the off-screen items than previous approaches, although the authors do not take into account e.g. color value. As one of the aims of wedges is to provide proximal distance cues, redundant coding of distance by change in value might have been beneficial (now the results show that the design offers little benefit over the Halo technique in terms of judging relative distance).

The user study is generally well reported. The evaluation was conducted with a simulator, which somewhat diminishes the ecological validity of the results. Using the technique in real life tasks (e.g. orienteering) in a realistic context of use might have provided additional information about the applicability of the technique in practice.

The main shortcoming in the evaluation is the assessment of subjective preference. Using a more rigorous method than simply asking for preference would undoubtedly have yielded more insight into the strengths and weaknesses of the proposed technique. Overall, the authors are perhaps a little bit too optimistic in their statement in the abstract that "Participants were significantly more accurate when using wedges than when using halos", given that this was only the case for corners.

Areas for Improvement

The statistics reported for completion time for the "Closest task" are a little confusing. Judging by the overlap error bars, it does not seem likely that wedges was faster than Halo in the corner trials, although the opposite might certainly be the case for side trials. Also, this result does not probably follow from the observed interaction between Visualization and Density -- shouldn't that mean that the difference between visualizations was larger between dense and sparse displays, not side or corner trials?

Additionally, while applicable for measuring the use contextual displays, some of the tasks seem contrived when considering the larger context. If the task is to figure out which restaurant is closest to the car, wouldn't a simple zoom out action in most cases provide this information more easily than trying to judge the distance based on proxy cues?

The guidelines provided in the discussion are quite general and some of them are not directly the results of this study per se (e.g. avoiding overlap and problems with corners). While good pointers in terms of issues to keep in mind when designing contextual displays, their practical value for solving the problems is questionable. The main benefit of this research is the introduction of a new visualization technique that provides benefits over the existing techniques in situations when the off-screen targets are clustered towards the corners. More research is needed, as the authors note, to realize the additional benefits the proposed technique might offer in other situations. As it is, the work shows promise but not enough improvements overall over existing techniques to be considered a significant contribution.