Off-Screen Objects Targeting using Contextual Cues

Faizan Ahmad
Institute of Geoinformatics
University of Muenster
Muenster, Germany
f_ahma02@uni-muenster.de

ABSTRACT

Everybody needs information, now a day on mobile phones user have enormous data. However, the problem is it is not possible to visualize this whole data at once on the small screen of mobile phones. The paper will provide information about some techniques of targeting off-screen objects of user's interest. Users are facing some issues related to these techniques. In addition, some methods to overcome the limitations while using these techniques.

Author Keywords

Off-screen object, Techniques, Data, Information, Limitations.

INTRODUCTION

Everybody needs information, whether it is about food, sports, entertainment, tourism, etc. One can have this information using technology like computer or mobiles. As the technology evolved and we have very compact design of visual devices like Mobile phone and Tablets, the main problem with the devices is the compact screen size. It is very difficult to display large amount of information on these small screens. To explore the large maps on these small screens zooming and panning can be used. With the help of zooming and panning user can see the points of interest around. But Zooming and panning is often difficult for the user to remember. So multiple different techniques are under research to provide users with better results on small screens. [3]

It is due to huge data available online and it is very difficult to extract meaningful information through this data without implementing some useful methods. Very common examples of large dataset are Geo-spatial data, huge scattered plots, etc. The main goal for this research is to extract the information of common interest with proper relationship. [5]

Devices like mobile phones have some applications which have larger information but the platform to display that information is substantially small. So, to view that information the user has to put some effort and spend some time. Researchers are continuously working on the methods to reduce this effort and time and display sufficient amount of information on smaller screens. [8]

Tourism is one of the most important aspect of county's economy, and providing easy and meaningful information about the tourist points is big challenge for the service providers. This is not important that how the system is technically advanced, but most important thing for the system is the friendly environment while using it. Researchers have studied that for tourist really want every information about the points of interests. The main questions in the mind of every tourist is what is nearest place to visit and what place is this? [9]

To answer these questions technology is getting advance day by day to help users in daily life.

The main problem or hurdle with small screen displays is to develop some techniques to provide the most wanted and usable information to the user and to minimize the cluttering. The focus of research in developing these techniques is that the mobile should not only capture the location of anything but also the temporal data and properties of the object as well. [10]

The paper will discuss the different techniques used for the off-screen objects, their advantages and their limitations in a summarized way. Paper comprises of different sections. Next Section will discuss Different Techniques. After that, the section will put some light on the issues and limitations of these techniques and the last section will be a conclusion of all the discussion.

TECHNIQUES

Lot of work has been done to overcome the visualization of the objects, which cannot be visualize due to the smaller size of screens. Researchers have proposed few techniques to get information about the objects which are directly not on screen but can be of user's interests. It includes the large maps which are very difficult to show on smaller screens with appropriate or needful information. [11]

Halo

"Halo is a Contextual Cues Technique that surrounds every off-screen q y object with a circle large enough to enter the

display area, exploiting the human ability to visually complete a circle by looking at only a portion of it, to derive position and distance of off-screen objects." [2]

Halo is the technique to visualize off screen objects by providing the information about the objects which are not on the screen but for the interests of the users. Halo provides the distance information which is encoded in the arcs pointing towards off screen objects and at the same time provides the scale of the scene. [11]

It is very easy for the user to search through higher curvatures or arc than from the lesser curvatures. This shows that the arcs on screen which are smaller part of the whole ring are useful in searching the objects closer to the screen. This reduce the time completion time of many tasks, like finding distance of Italian restaurant closer to user's location on the map [11]

Figure 1: "a" providing the information about five off screens objects with five arcs on different place of the screen giving the information about the direction of the object. Figure "b" showing that position of object, and at the same time that an object [11]

Wedge

User always wanted to have detail information and clear overview of the objects on their screens. This thing gives user a clear view about the objects to explore around. Beside user wanted this detail and overview of the objects, this is a big issue to display on small screen. Because it covers large part of the screen and make it difficult for the user to switch between two views. [2]

Wedge is also among one of the techniques to visualize off-screen objects. It uses triangle shape at the border of the screen which gives more accurate direction of the object as compared to Halo. This works better in the situation when number of off-screen objects are larger. It is only duw to halo take more space on screen and wedge takes less space. [2]

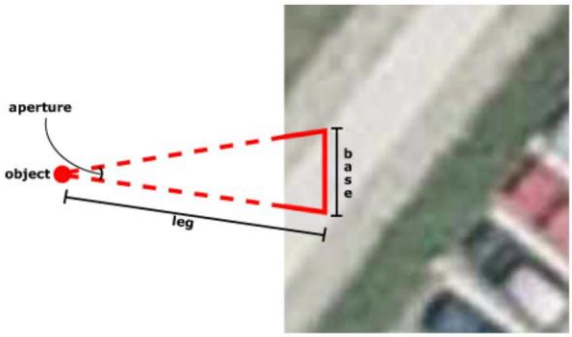

Figure 2: Wedge have two legs and base visible on screen while the tip of the legs touches the off-screen object [2]

HaloDot

Halo Dot is a Technique to enhance the Halo interaction method to overcome the cluttering problem in the presence of large number of off-screen objects. In HaloDot technique Halo's arc is used and small dot or point is inserted at the arc visible on the screen to give the information about the objects. Furthermore color relevance used in this technique to give user's more information about their interests. [3]

A problem with Halo technique is where a large number of off-screen objects are present and it makes very difficult for the user to segregate the relevant object. HaloDot covers this issue by using a number clue and reduce the number of the arcs to make it easy for the user to navigate. As it is clear from the following Figure 3.

Figure 3: On left It represents Halo, On right Side It is HaloDot with aggregation and number clues [3]

.

EdgeSplit

A technique which supports both visualization and selection of off-screen object is EdgeSpilt. It creates a space at the border of the screen in a rectangular shape with the proxy dots representing the off-screen objects. One rectangle at the border never overlaps the next rectangle having

information about other off-screen object. As shown in Figure 4 This reduce the problem of selection of wrong objects which is the main issue in other techniques. [1]

Figure 4: Borders representing the rectangular shape with proxy dots. Every shape contains different off-screen object with its information. [1]

"EdgeSplit has two components. The first component is inspired by EdgeRadar and provides a mechanism to visually represent off-screen objects. An off-screen object is represented by a 'dot' on a radar resulting in less clutter and overlap of such cues in comparison to other techniques e.g. Halo or Wedge." [1]

Hopping

There is no any method which fulfills the goals like proper awareness of the targets which are not on screen for the user, lesser navigational effort to approach the off-screen target, environmental use to select the target and Substantial amount of detail about off-screen objects in the selection of off-screen objects. [4]

Hop is a technique which is a faster way to access or locate the off-screen objects. It uses following methods:

- Halo: Details of Off-screen objects
- Laser Beam: Invoking Proxies
- Teleporting: Getting close to the target [4]

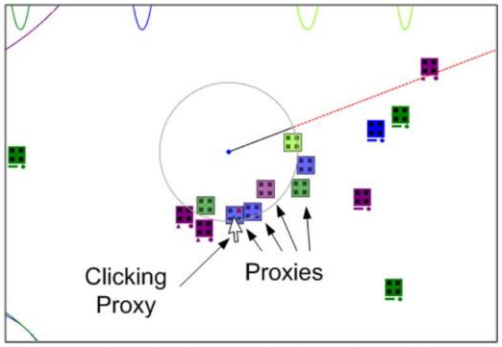

Figure 5: Proxies with laser beam [4]

Figure 5 shows the user's screen with off-screen objects and laser beam, which create proxies, among them, the user can choose one of them and the teleporting mechanism takes user towards that target.

AroundPlot

In Augmented Reality some techniques were used to highlight the off-screen objects like Rubber band visualization, 3D arrows etc. But these techniques doesn't perform well in the situation with large number of off-screen objects. [6]

AroundPlot is a way of visualizing the off-screen object in the augmented reality environment. It provides directional cues in such a way that will not cause disturbance in selection of multiple objects. As shown in Figure 6. One important feature which is used which is derived from orthogonal fisheye is dynamic magnification, provides high density in the target area and also helps in accurate movement towards the object. [6]

Figure 6: AroundPlot in 3D arrow cluster and top down 2D Radar. [6]

WinHop

This is a method to visualize off-screen objects with time and space multiplexing. to find the off-screen object it uses halos and proxies. With the space-multiplexing it mean using inset window to show the off-screen area, and zooming and panning in the portal refers to time-multiplexing. Winhop provides a thick line from the dot on the screen to the actual object to show the direction. [8]

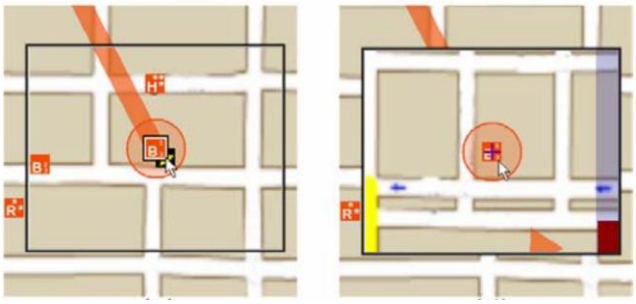

Figure 7: Selection of Proxy, shifts the proxy in the center of the screen and creates a portal around the object. [8]

MultiScale Zoom

This technique works in such a way that when user's zoom out the map to see the off-screen objects, the scale of the map reduced but scale of objects remain the same. This

helps user in readability of the objects while zooming out the map. [8]

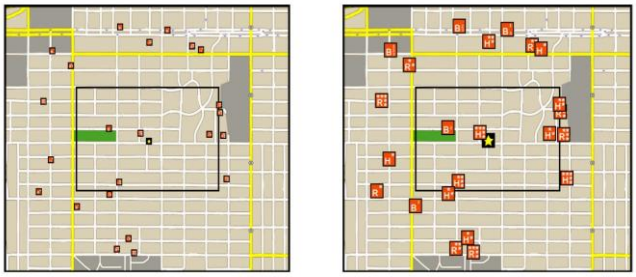

Figure 8: On left it's the conventional zoom, on right with Multiscale Zoom where objects maintain their actual size on every scale. [8]

Figure 7 shows the two scales of map in Multiscale Zoom. On Left Scale of Map zoomed out and on right scale is zoomed in but the objects always maintain their size.

In Multiscale zoom the main challenge is when objects covers more space on the screen and cause cluttering and block the view of map. To deal with this problem a technique of stack is useful. Whenever user brings the cursor over the objects they show the desired details. [8]

LIMITATIONS

Mobile screens are always make it difficult for the user to navigate through large workspaces, and the user have to use zooming or panning to locate the target location. Few techniques discussed earlier in the report, helping the user to find desired object currently not present on the screen due smaller size. Some methods are very useful in navigation but also have limitations as well.

Cluttering

The main issue while using these techniques is cluttering. Almost every method is facing difficulty in the representation of large number of off-screen objects and cause occlusion. In this situation, the user is unable to navigate or select the desire object. While using Wedge technique when number of object increase up to 20 it cause cluttering and make it difficult for the user to visualize. [2]

Halo has also problem in dealing with cluttering issue. But it can be reduce by using different colors and transparency for the arcs to facilitate the user in selection of relevant objects. [3]. Some other techniques can also be used to reduce cluttering while using Halo. As researcher discussed, Halo has also problem of cluttering but it overcomes this problem by merging the arcs into multiple arc using a technique names bottom-up clustering. [11] User can still perform in cluttered situation in Hopping Technique but control over off-screen objects reduced. In Hopping cluttering issue can be minimized by using glyphs instead of halos. [4] In Multiscale zoom as objects does not lose their scale, so cause cluttering and take most of the space on the screen as user zoom out the map. [8]

Tasks Efficiency

Tasks completion time is also very important while using off-screen visualization technique. Some methods are more efficient than others are. Edgesplit is much faster that Wedge in tasks completion and visualization+Selection. One could be the reason that as compared to Wedge, Edgesplit has larger selection area which enables the user to select accurately and faster. [1] Efficiency can be achieve by updating the information in timely manner. If it takes long then the user may get annoyed. It is a big challenge to update the information about the off-screen objects when the user is performing interaction with the system. [7] Users performed faster while using HaloDot than Halo due to usage of colors. Most of the users are attracted towards red color of the dots which help them in task completion [3] Hopping is much faster than the typical zooming and panning techniques. [4] Researcher also claim about Multiscale zoom is much faster as it gives proper view and selection ease to user. Among all Techniques the faster technique is the Multiscale Zoom and it is consistent as well. [8]

CONCLUSION

The focus of the whole report is, How new techniques are providing ease to users in targeting the off-screen object? Number of different techniques were discussed earlier, and it is obvious that almost all of them are using different methods to facilitate the users. One focus of all the techniques was to provide as much information on screen about the objects potentially not visible to users. Every user wants to navigate in the workspace quickly. Few techniques are more accurate in this scenario like Multiscale Zoom as its efficiency is higher than that of others. HaloDot also provide information in time with accurate directions towards the target. This thing helps user in location the target. A Cluttering issue effects almost every method. However, some of them used effective techniques to overcome this issue and facilitate user in this situation. As in Wedge, transparency is use to overcome cluttering problem while in Halo bottom-up cluster method is used to deal with this issue. In the end, it is clear that every technique has unique ways to locate off screen targets with some limitations depending upon the interests of the user. Because every technique cannot perform all tasks perfectly.

As a Programmer, It is not possible to make a single technique, which can perform all tasks. On the same, time it not possible for the user to change the techniques to perform different tasks. However, what is possible is to develop some application, which can perform activities that are more common.

REFERENCES

[1] Churchill, E. 2012. *MobileHCI '12. Companion proceedings of the 14th International Conference on Human Computer Interaction with Mobile Devices and Services ; September 21 - 24, 2012, San Francisco, CA, USA*. ACM international conference proceedings series. ACM, New York, NY.

[2] Churchill, E. 2012. *MobileHCI '12. Companion proceedings of the 14th International Conference on Human Computer Interaction with Mobile Devices and Services ; September 21 - 24, 2012, San Francisco, CA, USA*. ACM international conference proceedings series. ACM, New York, NY.

[3] Gonçalves, T., Afonso, A. P., Carmo, M. B., and Pombinho, P. 2011. Evaluation of HaloDot: Visualization of Relevance of Off-Screen Objects with over Cluttering Prevention on Mobile Devices. In *Human-Computer Interaction – INTERACT 2011*, D. Hutchison, T. Kanade, J. Kittler, J. M. Kleinberg, F. Mattern, J. C. Mitchell, M. Naor, O. Nierstrasz, C. Pandu Rangan, B. Steffen, M. Sudan, D. Terzopoulos, D. Tygar, M. Y. Vardi, G. Weikum, P. Campos, N. Graham, J. Jorge, N. Nunes, P. Palanque and M. Winckler, Eds. Lecture Notes in Computer Science. Springer Berlin Heidelberg, Berlin, Heidelberg, 300–308. DOI=10.1007/978-3-642-23768-3_25.

[4] Grinter, R. 2006. *CHI 2006. Interact, inform, inspire conference proceedings Conference on Human Factors in Computing Systems Montreal, Quebec, Canada, April 22-27*. Association for Computing Machinery, New York N.Y.

[5] Jäckle, D., Fuchs, J., and Reiterer, H. 2017. *Topology-Preserving Off-screen Visualization: Effects of Projection Strategy and Intrusion Adaption*.

[6] Jo, H., Hwang, S., Park, H., and Ryu, J.-h. 2011. Aroundplot: Focus+context interface for off-screen objects in 3D environments. *Computers & Graphics* 35, 4, 841–853.

[7] offscreen_perspectives_jaeckle_vds15.

[8] Pourang Irani, Carl Gutwin, Grant Partridge, and Mahtab Nezhadasl. 2007. LNCS 4663 - Techniques for Interacting with Off-Screen Content.

[9] Schinke, T., Henze, N., and Boll, S. 2010. Visualization of off-screen objects in mobile augmented reality. In *Proceedings of the 12th international conference on Human computer interaction with mobile devices and services - MobileHCI '10*. ACM Press, New York, New York, USA, 313. DOI=10.1145/1851600.1851655.

[10] Tiago Gonçalves, Ana Paula Afonso, Maria Beatriz Carmo, and Paulo Pombinho. 2011. LNCS 6949 - Evaluation of HaloDot: Visualization of Relevance of Off-Screen Objects with over Cluttering Prevention on Mobile Devices.

[11] Wixon, D. 2002. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, New York, NY.