Mobile Liquid 2D Scatter Space (ML2DSS)

A visual interactive information space (ispace) for displaying large amounts of information and allowing simple vision-based knowledge discovery on small screen sizes

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Abstract

This (video-) paper describes a user interface concept, which facilitates browsing of comparably large amounts of information on small screens.

The viewing concept is based on a visually optimized star field display ([1] Ahlberg & Shneiderman 1994) and is introducing new concepts like ***liquid browsing*** *(an expansion lens with pressure controlled magnetic force simulation),* ***selection based filtering and representation manipulation****,* ***multimotion behavior tagging****,* ***(inter-action-) transparent spaces*** *and* ***continuous state animation****. All this creates a very versatile information space with a liquid-like look and feel, which can be used in a very intuitive way, providing all the advantages of a mature interactive scatter plot and can easily be scaled to different screen sizes without any adjustment efforts.*

This paper focuses on visual design and interaction details and emphasizes the importance of the visual interactive quality for mobile information visualization.

Keywords: liquid browsing, visual interactive information spaces, mobile computing, user interface design, dynamic interactive visualization

1. Introduction and Problem Description

In Mobile Information Visualization, one of the big issues is the problem of small and a multitude of different screen sizes.

In spite of diverse screen concepts like roll up displays, or digital paper, it is most likely that we will continue to battle with the limited screen spaces of handheld computers for quite some time. Further, the related issue of constantly having to adapt the view to different screen sizes presents a complex problem.

Figure 1: many different mobile devices on the market today

A common table view on a Pocket PC or PDA allows us to only look at 10-20 objects at a time without scrolling, allowing to sort and compare according to one single criterion. An interactive 2D scatter plot approach would allow much larger amounts of information to be visualized and is simultaneously sortable based on two criteria. In addition, comparisons based on a multitude of criteria are possible at the same time (according to mapping and expressivity of the visual parameters: size, opacity, color value, shape, orientation, ...or time animation of all these parameters, which results in visual representations like motion, growing/shrinking, pulsing, rotation, shape morphing,...).

One disadvantage of a 2D scatter plot approach however, is the possibility of the information objects to overlap to some extent hindering readability and perceptibility of the information or, worst case, even making it impossible. To solve this problem, zoom and lens functions have been implemented ([10] Sarkar & Brown 1992), which allow the (partial) enlargement of the information to counter this problem. Still, browsing high information densities this way proved to be a very challenging task, because a simple enlargement based fisheye lens does not reduce the overlapping and very often has to deal with heavy distortion issues.

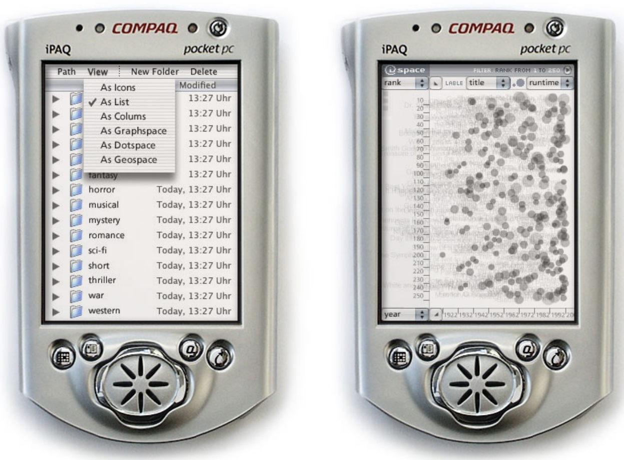
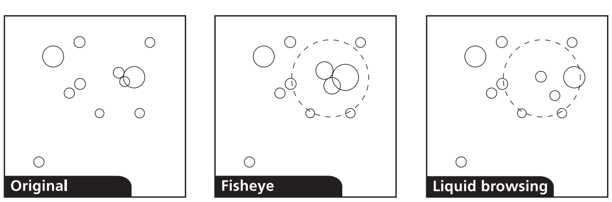


Figure 2: Comparison: Table view (left) vs. star field display (right); 15 vs. 250 information objects on an iPaq (240x320 pixel)

2. Solutions

2.1. Liquid browsing: To address the above-mentioned problems, we are proposing a **distance manipulation based expansion lens** (in contrast to the common size manipulation based magnification lens). By not enlarging the information objects themselves, but rather the spaces between them, we are solving our real problem - the overlapping - much more effectively.



By using this kind of "lens" model, we are achieving much greater clarity with less space consumption and minimal context distortion.

Figure 4: Comparison on screen: enlargement based lens (fisheye) with distortion on left vs. distance based lens (liquid browsing) on right

In addition, we are using rollover opacity raising for the typography to separate the related text tag from the background. Supplementary, the offset motion of the lens increases this intention.

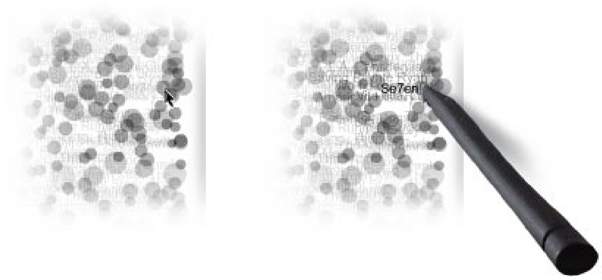
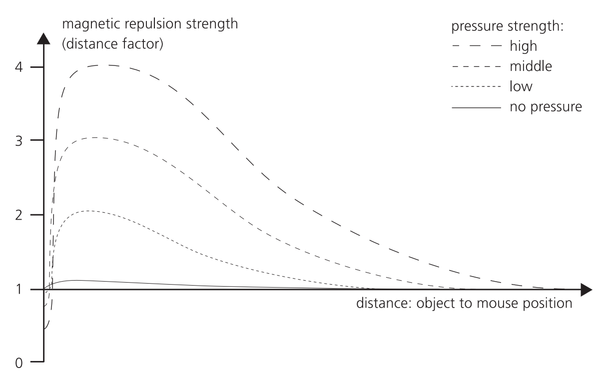


Figure 5: Comparison: Original view on left vs. opacity raised typo-detail (to better understand this effect please refer to video).

By using the pressure the user puts on the screen with the input device (naturally a pen) to control strength and radius of the expansion lens (also "push lens") and adding oil- or liquid-like friction and acceleration forces, we achieved a very direct 1:1 “impression”, which makes it intuitively controllable and creates a nicely flowing browsing experience. This is why people liked to refer to it as “liquid browsing”.



2.2. Selection based manipulation

To reduce input effort (big issue on mobile devices without a proper keyboard) and to increase the effective display space, we propose selection based filtering and selection based representation adjustment in addition to (or instead of) sliders or text input for adjusting the filters and directly manipulating the views:

Simply draw a selection and choose an action from the context menu to set the axis filters, highlight relations or undertake other representation manipulations.

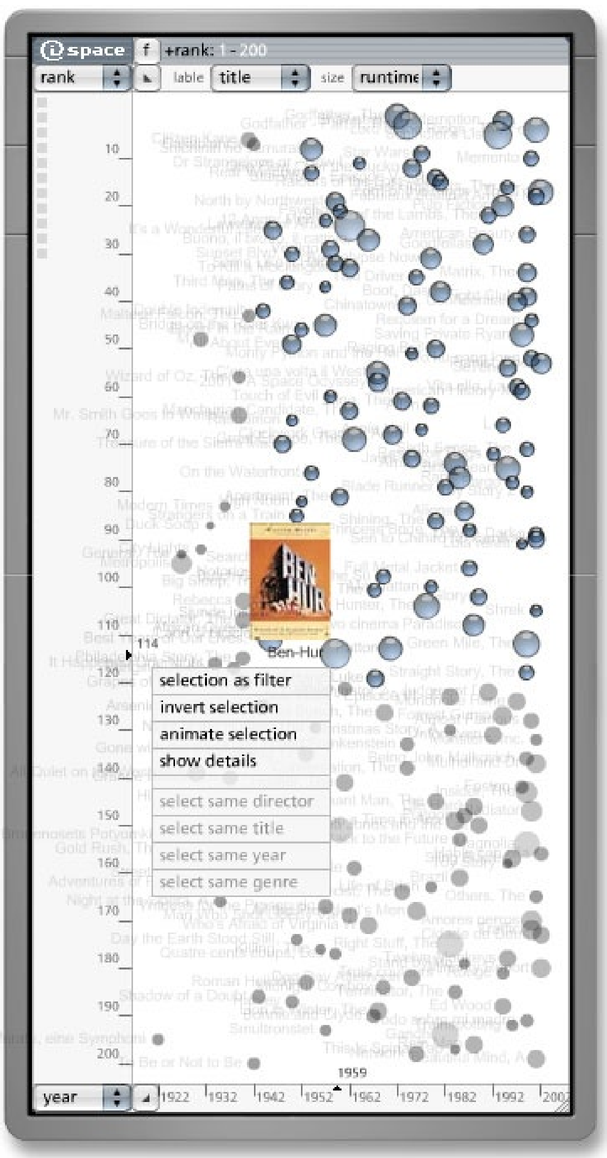


Figure 7: Screenshot of a selection with context menu

2.3. Multimotion behavior tagging

Motion or animation like blinking or flashing have often been used for visualization purposes. Many of our studies have revealed that it is not only possible to easily perceive macro- and micro-movements at the same time, but also multiple synchronized micro-movements if they are used in succession.

There are many ways of using this effect. When implementing our prototype, it was our goal to keep it very easy to use: so we used it to transform the position of the information object on the scatter plot into motion, which allowed us to use the two free position dimensions for different purposes (see movie):

Just draw a selection and choose “animate selection”. The information objects will be animated according to their position on the scatter plot. E.g. better movies jump up and down, newer movies move sideways.

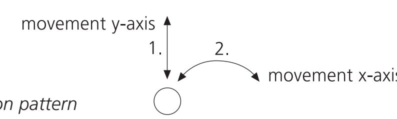


Figure 8: Animation pattern

Another very good way of adding more simultaneously visualizable dimensions is the synchronization of additional views. However, this possibility is limited due to little available screen space on mobile devices.

2.4. (Interaction-) transparent spaces

Windows which are only displaying information and do not offer own interaction possibilities, can be transparent: Thus the screen space behind the window can still be seen as well as interacted with. This method is only adequate, if applied in the right way (opacity level, contrast of information objects, etc,...) and to the right viewing technique ([8+9] Harrison, B.L, et al. 1995). This concept can greatly contribute to the solution of the small screen problem.

Figure 9: Screenshot of interaction-transparent detail window

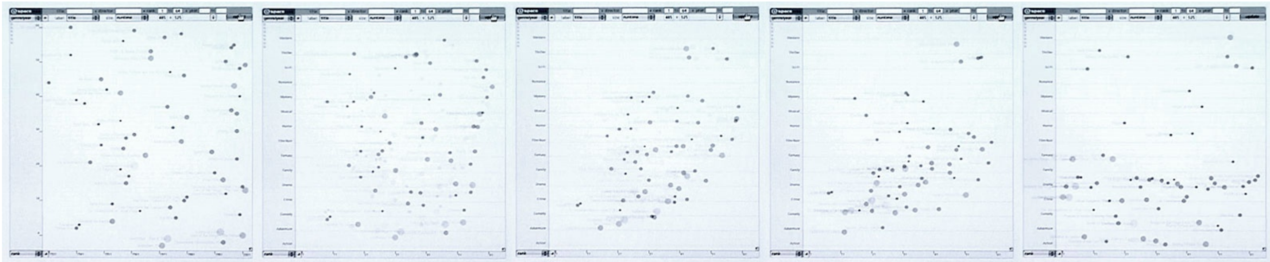


Figure 10: Screenshots of a state animation in 5 phases
(images can not really communicate this effect)

2.5. Continuous state animation

All position changes of information objects are continuously animated, which explains complex processes in a very straightforward way and makes it possible to detect clusters of object masses and very detailed object movements simultaneously, as well as following information objects to a new position in a different context. To better understand (or better: experience!) this effect it is very important to have a look at the video.

2.6. Contrary coding

One very important issue is finding the right values for the visual variables (like size, opacity, color value, shape, orientation,...) to achieve the maximal coherence and expressiveness of the visual representation ([4] Bertin, 1983). To examine this subject, we built a prototype which allowed us to freely set every single one of those correlations and compare the expressivity and the perceptibility of a combination of several visual parameters used simultaneously.

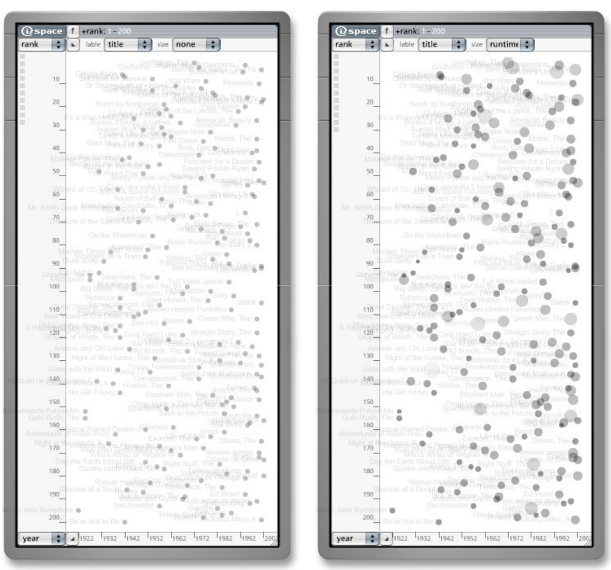


Figure 11: no size and opacity coding (left) vs.
size and opacity contra-coding (right);

Naturally, it is advantageous to avoid contrary correlations of visual parameters to achieve the maximal expressiveness. But for our prototype, we used this effect on purpose to further increase the information density: by using a contrary coding of size and opacity, it was possible to reduce the overlapping problem even more and increase visual clarity (bigger objects are less opaque).

3. Prototype

The first Mobile Liquid Scatter Space prototypes were implemented in Macromedia Flash, Java and ObjectiveC (macOSX). Most of what you can see in the movie is based on a Flash application that reads an XML database of the 250 most popular movies of the world [12].

You can find this movie at:
http://www.infoverse.org/ispace/ispace_movie.htm

A flash prototype can also be experienced at:
http://www.infoverse.org/ispace/ispace_flash.htm

The Mobile Liquid 2D Scatter Space version you see in the movie is optimized for fast devices with pressure sensitive screens (something like a tablet PC today). We also have a version for HP ipaq (Flash), but it is very slow and pressure sensitivity and rollover functionality are missing. We believe there will be small, fast and pressure-sensitive handhelds in the future and want to focus on those kinds of devices. Most of the prototypes are tested and presented on a fast computer with a Wacom Cintiq (Interactive Pen Display).

4. Conclusion and Future Work

This paper has introduced liquid browsing as an interaction method to solve the overlapping problem of interactive 2D scatter plots. Optimizing visual interactive details is crucial, especially for the mobile domain. Though empirical studies still have to be done, we believe that ML2DSS can be very useful as a versatile and very flexible ispace in a wide range of applications (file systems, media libraries, map browsing, email,...). It's ability to effortlessly adapt to different screen sizes and allowing very high information densities makes it especially interesting for mobile applications.

ML2DSS is a part of the "iworld" project, which is about a versatile multiple view information browser with a special focus on semantic web browsing.

4. Acknowledgments

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5. References

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[11] Macromedia Flash: http://www.macromedia.com/software/flash/

[12] Internet Movie Database: http://www.imdb.com

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