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Extended Excentric Labeling

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Abstract

The paper presents an extension to the Excentric Labeling, a labeling technique to dynamically show labels around a movable lens. Each labels refers to one object within the lens and is connected to it through a line. The original implementation has several known limitations and potential improvements that we address in this work, like: high density areas, uneven density distributions, and summary statistics. We describe the implemented extensions and present a think-aloud user study. The study shows that users can naturally understand and easily operate the majority of the implemented function but label scrolling, which requires additional research. From the study we also gained unanticipated requirements and interesting directions for further research.

Categories and Subject Descriptors (according to ACM CCS): Design Tools and Techniques [D.2.2]: User interfaces—User Interfaces [H.5.2]: Interaction styles—

1. Introduction

Labeling in visualization consists in attaching text labels to graphical marks to convey semantic information associated to the objects observed on the screen. Typically, visual items correspond to data items that, along with parameters used for layout and visual features (e.g., color, size, shape, etc.), contain some textual description or name that characterizes the object. Examples are: names of persons, product codes, book titles, geographical regions, id numbers, etc.

The problem of labeling has been studied since the first days of information visualization. As described in [FP99] the techniques can be broadly segmented into two main categories: *static* and *dynamic*. Static labeling aims at finding one single labeling configuration to be applied to the whole visualization once for all. Dynamic labeling instead treats the labels as dynamic object that can appear and disappear or change their location according to some specific user interactions or system states.

Fekete and Plaisant in [FP99] also present Excentric Labeling which consists in arranging the labels of the objects under a movable lens in its neighborhood. As the cursor is moved across the visualization the elements within the lens are dynamically labeled. The major benefit of this technique is that it represents a form of *transient visualization* [JH07] that reveals details of interest where and when they are needed without requiring extra screen space. It is intuitive, generic, and computationally non demanding. Together with these benefits the technique presents some major limitations and opportunities for improvements. The same authors suggest the following possible improvements (reworded here for brevity): allow size and shape change of the focus area; summary glyphs to show the distribution of the objects; inheritance of graphic attributes from data points to labels; use of labels as selection menus.

In this paper we present a first design and implementation of these requirements together with some additional features. Their implementation and study stem from a real need we encountered while developing a corporate intelligence exploratory visual tool. The following section briefly describes the context of this project in order to provide some background and motivation.

1.1. Background and Motivation

The idea of extending Excentric Labeling is born in the context of our project "The Risk Manager Dashboard" in which we study novel interactive visualization techniques to understand how people use corporate assets within large or-

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ganizations. More specifically, we developed a graph-based visualization "inspired" to the well known *RadViz* visualization [HGP99] in which points and anchors connect through springs and represents respectively software products and company departments. The visualization helps security managers and administrators segment their application inventory and eventually come up with novel administration strategies.

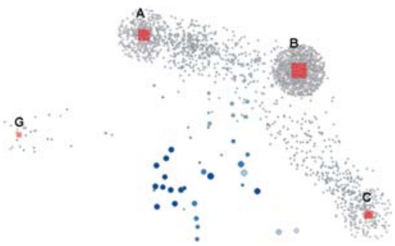

Figure 1: *RadViz inspired visualization from our project (top-half view). Data is unevenly distributed.*

Describing in more details the system and its functions is beyond the scope of this paper. We deem important however to describe how the extensions we propose stem from the problems we have encountered using Excentric Labeling in this environment. The first major issue is the need to cope with very dense areas, where the number of labels is too large. In our case study we have a total number of around 5000 data points (applications) of which more than 2000 are clamped together around anchors A and B, as shown in Figure 1 [†]. Moreover, very dense and very sparse areas coexist in the same visualization. In order to cope with these issues, our extensions allows label scrolling and automatic area adjustment. Another issue is related to the interpretation of the elements that fall within the area and their relationship with the labels. In the proposed design we let the labels inherit visual features from their data items and provide local filtering and ordering to focus on subsets of elements within the lens. Overall, we noticed that the real value of the Extended Excentric Labeling is that it offers to the user a sort of "semantic hook" between visual items and the domain objects they represent. In our context application names have a strong semantic value that helps a domain expert easily interpret the nature of the trends inspected with the lens.

It's important to stress that even if our proposal has been tested only on one visual technique, it can be directly generalized to any other visualization where data items are represented by dot-based visual primitives; which is a wide proportion of the existing visualizations: scatter plots, node-link diagrams, point maps, etc. Further, the tasks used in our evaluation presented below are generic enough to be considered domain-independent.

† the real department names have been substituted with generic letters for privacy reasons

1.2. Contribution

The first contribution of this paper is the description of technical and design solutions to some well-known limitations of Excentric Labeling. Visualization practitioners would be able, by reading the paper, to easily implement these extensions. Since the technical limitations and challenges of our implementation are described, it can also serve as a starting point for infovis researchers to further advance the technique. A second contribution is our usability study, which, along with the additional features we have designed, evaluates the basic functions of Excentric Labeling. The problems highlighted in the study and the lessons learned can help future implementers avoid important mistakes. Our indications for further research can inspire infovis researchers to explore new designs and pursue novel interesting studies.

1.3. Organization of the paper

In the following sections we first provide some related work to put our work in the whole context of data labeling. In Section 3 we describe in details the extended features we have implemented in the Excentric Labeling. Section 4 and 5 describe the usability study we conducted, its results, and recommendations for further developments. Finally, Section 6 traces our future work and Section 7 presents our conclusion.

2. Related Work

As already mentioned in the introduction the existing labeling techniques can be classified in two broad classes: static and dynamic. Static labeling is a very active area of research that goes well beyond labeling in visualization environments. It is traditionally related to the problem of labeling in geographic maps, where there is a need to carefully choose what objects to label, where to place the labels, and how to lay out them around the object of interest (e.g, a street label usually follows the path of the street). As demonstrated by the "Map Labeling Bibliography" [Wol] the area is still very active and very much concerned with global optimization algorithms that are typically NP-hard. Christensen in [CMS95] frames the problem of point-feature label placement and provides an empirical comparison of several algorithms. More recently, Ali et al. discuss in [AHS05] requirements for labeling and classify a series of layout styles in the context of 3D illustrations.

The problems addressed in this area are however not necessarily relevant when considering dynamic labeling. In dynamic labeling the problem is shifted from label placement optimization at all costs, to the problem of using as efficiently as possible the time resource. In dynamic labeling the designer is free to choose which subset of labels is relevant "now", given a specific system configuration and user action. As clearly described by Fekete and Plaisant in their taxonomy [FP99], dynamic labeling can be categorized in the following classes: *one label at a time*, *global display change*, *focus + context*, *sampling*, *dynamic labeling*.

To the best of our knowledge this categorization is still valid and very few additional dynamic techniques have been developed since then. Tatemura in [Tat00] describes a technique that combines *focus + context* and *sampling* to deal with numerous labels within the focus area. The visualization reacts to pan and zoom interactions and to dynamic filtering. In relation to this last feature, the technique is slightly related to our solution in that our extension comprises the possibility to filter out the labels within an area according to some filtering parameters.

Another recent related contribution is the "3D Explosion Probe" [SCS04] which permits to show annotations to related parts in 3D models as the user explores it with a 3D probe. The solution integrates advanced algorithms to let the parts "explode" apart and reveal annotated scrollable text. While the field of application of this techniques is rather different from ours, we share the idea of using some kind of scrolling to dynamically reveal text. In our solution we adopt scrolling to cope with dense areas that would reveal too many labels at once if not handled properly.

Google Earth [Goo] also presents a novel dynamic labeling technique. Small dots are used to represent one or more photographs associated to a particular map location. When the user clicks on a dot representing more than one picture, the dots are displaced from their original position and their labels are shown on the fly.

Dynamic Map Labeling is concerned with the specific problems of generating labels as users pan and zoom in interactive maps. Been et al. discuss the problem in general terms and provide a framework for desired quality parameters and potential algorithms [BDY06]. Recently, Mote proposed an optimization algorithm that permits to avoid the intensive preprocessing stage that is usually needed to achieve smooth interaction in such maps [Mot07]. The work posed in [LSC08] also permits fast computation of labels. The solution uses a particle-based technique that permits to avoid not only label overlap but also the obscuration of visualization objects.

Our solution also shares ideas with Magic Lenses [SFB94], a tool developed in the larger context of User Interfaces and Computer Graphics that permits to apply specific functions and reveal additional information on circumscribed movable areas. Some extensions to the specific infovis domain exist, like for instance the Enhanced Dynamic Queries [FS95] and the Sampling Lens [EBD05]. Our Extended Excentric Labeling can be considerer a sort of magic lens in that it permits to apply filtering functions in a specified area and provides summary data pertaining to the object under the lens.

3. Extended Excentric Labeling

The Extended Excentric Labeling, as described in the introduction, introduces a series of innovations over its standard implementation. *Label scrolling* and *focus area adjustment* deal with high density areas and uneven distributions. The user can scroll the list of labels when there are too many items to display. The lens size can be manually changed or adapts automatically to the local density to cope with uneven distributions. With these techniques the user can easily get rid of data density and devote more cognitive resources to exploration, while maintaining a certain degree of flexibility and precision. *Summary statistics*, *inheritance of visual features*, *filtering*, *layout and sorting* provide additional functionalities that facilitate inspection. A small glyph is positioned under or above the lens to provide summary statistics on the area's content. The labels inherit their visual features (color and size) from the data points they refer to. This permits to speed up interpretation and linking between labels and visual items. With filtering the user can filter out items within the lens by specifying, through check boxes, the desired combination of values. Different layouts and label sorting strategies can be selected to find a trade off between link crossing and a meaningful arrangement of the labels.

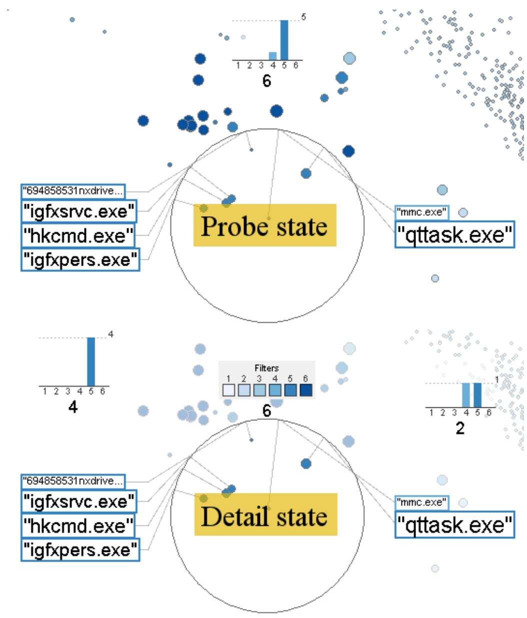

Figure 2: *The "probe state" above shows only labels and summary statistics. The "detail state" below provides additional details and interactive filtering.*

The main challenge in implementing these features is to preserve the original desirable properties of Extended Labeling, i.e., smooth interaction, ease of use, ease of implementation, and intuitiveness. We conceived the Extended Excentric Labeling trying to preserve them as much as possible.

The actual implementation does not require any complex algorithms and can be used smoothly on visualizations with thousand of data items.

The inclusion of new features however makes interaction a bit more complex. In particular, the focus area has two possible levels of detail: a *probe state* (see Figure 2 above) during which the tool updates the labels and the summary statistics on the fly, as the focus area is moved, and a *detail state* (see Figure 2 (below)), activated by a mouse click, which sticks the lens in the current position, provides additional details and activates the filtering function. Our own experience and the results of our usability test (see the details in Section 4) confirm that increasing the number of functions and providing two levels of detail is not harmful to the overall usability.

3.1. Label scrolling

In the original Excentric Labeling when the number of items under the focus area is higher than a given threshold the labels are sampled and the total number of elements is shown with a number on the top. To deal with this limitation we permit the user to scroll through the whole list of labels. Since the labels are split into two series, one on the right and one on the left side we allow independent scrolling on the two sides.

Figure 3 illustrates how we designed the scrolling function. When the user sets the area in a position where the number of labels is higher than the threshold, the tool is provided with interactive pie segments and indicators that show how many labels are left below/above the list. The pie segment's size is proportional to the list size and it serves the function of indicating the current position in the list; similarly to what happens with traditional scroll bars.

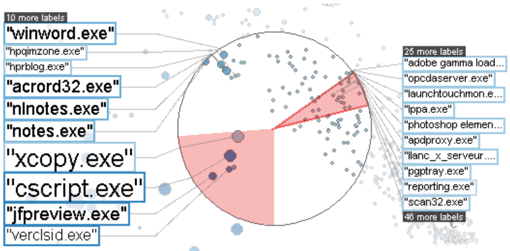

Figure 3: *The pie segments over the lens allow users to scroll the list of labels.*

By dragging the mouse up or down, to the left or to the right, the lists can be scrolled. The speed with which the list is scrolled depends from the distance of the pointer to the center, by going farther the scrolling slows down.

This design is motivated by the following main factors: 1) the need to minimize mouse displacement as the user initiate the scrolling tasks, 2) the fact that it lends itself to the scrolling speed function illustrated above, 3) and our desire to provide interaction functionalities in the center of the lens close to the focus point. It is also worth to mention that at any moment only the links of the currently visible lists are shown. Moreover, the user can stop scrolling at any time and hover through the labels to highlight the link that connects the label to its point.

We originally designed this solution in place of standard scroll bars to keep scrolling functions and visual feedback close to the focus area and the mouse pointer. This solution, however, proved somewhat unnatural and presented major interaction problems that are discussed in the section on the usability study below.

3.2. Focus area adjustment

Uneven distribution of plotted items in real world visualizations is extremely common: packed areas with hundreds of items coexist with sparse areas with few items [WLS98]. As noted above, this problem is partially addressed by the scroll function we have presented. Scrolling is not enough however, the area of the movable lens should adapt to the underlying density so that a small size is used when passing over packed areas and a larger size when passing over sparse areas. This, not only has the benefit of reducing the number of labels to be scrolled, but it also permits the focus area to "wrap around" any clusters of data points one may find in the visualization. Potential issues with the technique are: the distracting effect of automatic adjustment and interference on the judgment of the amount of overlap within the lens. In our usability study (see Section 4), however, users did not experience any major problems and could easily understand the mechanism. In addition, we provided as well a manual sizing option which turns off automatic adjustment and permits to change the area size manually. Both options have advantages and disadvantages which are discussed below in the study.

Automatic size adjustment is achieved by using an underlying density map as in [WLS98]. The screen space is split in a *NxM* matrix of cells and each cell counts how many data points fall inside. When the user moves the lens, the algorithm calculates the average of the density values contained in a *sampling window* of fixed size around the cursor. The average value is used to linearly map the size of the focus area in a given range between a predefined maximum and minimum (these parameters can be adjusted in a settings panel).

Since the purpose of the density map is to deal with very skewed distributions, we assume the values will always span a range of some orders of magnitude. For this reason, by default they are scaled through a logarithmic function and then normalized in a range between 0 and 1. Without such a scaling the final result would be a focus area that is either set to its maximum or minimum value, thus making the

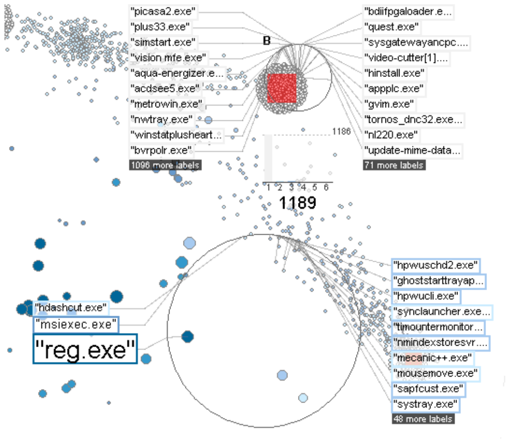

Figure 4: *The size of the lens automatically changes according to data density.*

functionality useless. The sampling window is necessary to obtain smooth adjustments. If only the single density value under the cursor would be used, the lens size might change abruptly provoking annoying effects.

The mechanism just described contains a number of discretionary parameters: 1) the matrix cell's size, 2) the sampling window size, and 3) the max/min value of the focus area. We are not able to suggest one common setting to be used once for all, nonetheless we can provide some hints. Cell size must be set in relation to granularity and time performance, taking into account that the density map must be re-calculated only when the position of the points changes. This is particularly relevant in that its re-computation does not directly affect the excentric labeling per se but rather the computation of a new configuration of the whole visualization. For all those visualizations where the position of the points does not change with interaction this is not in fact a problem. In our case, where re-computation is necessary, we found that a size of 5x5 pixels produces smooth adjustments and good performance. As for the sampling window size, we noticed that a size that permits to include in the computation 3 cells per side, that is a square made of 3x3 cells, is enough to avoid abrupt adjustments. Finally, the max/min lens size is a parameter that strongly depends on the application. For this reason we believe the best solution is to provide a reasonable default and then let the user adjust it if needed in a separate settings panel.

3.3. Summary statistics and filtering

Excentric Labeling is useful in visualization environments because it permits to quickly make sense of the patterns the user observes on the screen and because it helps drawing initial explanations and hints about their nature. Following this line of thought we added a summary statistics functionality that permits to see how the points under the focus area are distributed according to one of the data dimensions. The summary is implemented through a small bar chart (see Figure 2) positioned under (or above) the lens, according to the mouse position, and permits to better orient the user while probing the visualization. In our case study, it shows the distribution of the data points (software applications) according to the number of anchors (enterprise departments) they are connected to. An ordinal scale of blue shades, as found in Color Brewer [Bre], is used to represent these values.

The same approach can be used without any modifications in all the other domains where the data dimension is categorical or ordinal and the number of unique values is small enough. In other cases, the same intuition holds: use a sort of glyph to provide useful hints during data exploration.

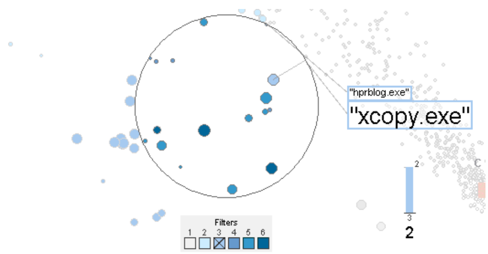

Figure 5: *Label filtering: only the labels of applications used in 3 departments are shown.*

When the user switches to the *detail state*, the bar chart is split in order to represent summary data for each list on the two sides of the focus area (see Figure 2). This *detail state* comes together with the filtering function that permits to isolate the labels that pertain to one or more categories represented in the bar chart. Figure 5 illustrates the filtering function in action: the applications used only in three departments are shown. The advantage of local over global filtering is that it permits to preserve and spot interesting patterns on the unfiltered view first and then offload the pattern only locally where detailed information is needed.

3.4. Inheritance of visual features

In many visualizations not only the position of the data points is related to one or more dimensions of the original data but also some other visual features like size, color, orientation, texture, etc. In our example, size is mapped to the number of users who use the application and color to the number of departments. In Excentric Labeling it is useful to let these visual features be inherited by the labels. The original implementation already takes in consideration this idea by coloring the labels according to the color of the object they refer to. Here we draw upon this idea and let the label inherit also the size feature. Figure 6 shows an example of how font size changes according to items size. Besides its limited resolution, since a small number of font sizes can be effectively used, we found this mapping can be useful to isolate interesting labels without visually link them to the objects they refer to.

Size and color are among the most common and effective visual features used in visualization, therefore this same implementation can be easily transferred to other domains. Among the other common visual features used in visualization *texture* might also be used quite straightforwardly, *shape* can generate some problems since it is difficult to let a label inherit a shape from its data point, and *orientation* is definitely problematic due to the constraint that labels should be aligned and horizontal to allow easy reading.

3.5. Layout and sorting

The original Excentric Labeling proposes three variants to lay out the labels around the focus area: *radial labeling*, *vertically coherent*, and *horizontally coherent*. Radial labeling avoids line crossing whereas the others use the vertical or horizontal topological order of data points to sort the labels and admit line crossing.

In our implementation we kept radial ordering as the basic algorithm to avoid line crossing. The ordering is obtained by projecting a line from the center, to the data item's position, to the lens' border. The labels are then sorted according to their projection on the circle. In addition we provide a sorting strategy that takes into account one of the data dimensions mapped to the labels. In the examples we use the ordinal colors but the same can be done with labels' size. In this way the labels are always ordered according to their color scale but generate crossing lines. Figure 6 shows the result of the two strategies on a specific instance: radial ordering on the top and data dimension ordering below.

Instability of labels and lines is one major problem of both the original and the extended Excentric Labeling, and layout and sorting clearly have an effect on them. Labels can easily swap from the right to the left side as the user moves the lens. Similarly, in an ordered list the position of the element can change abruptly. Animation is one potential solution to alleviate this problem, in this work however we did not investigate the issue in more details.

4. Usability Test

The main subject matter of the evaluation we performed was the usability and usefulness of the Extended Excentric Labeling. We conducted a subjective evaluation on 6 users, which we considered a decent number to capture most of the usability problems, feedbacks and tips. Tested users were mainly computer scientists or highly experienced with computers. The evaluation took the form of think-aloud walkthrough on four well-defined tasks. We also used a post-test questionnaire to capture satisfaction and perceived usability. We did not fix on purpose any independent variables or

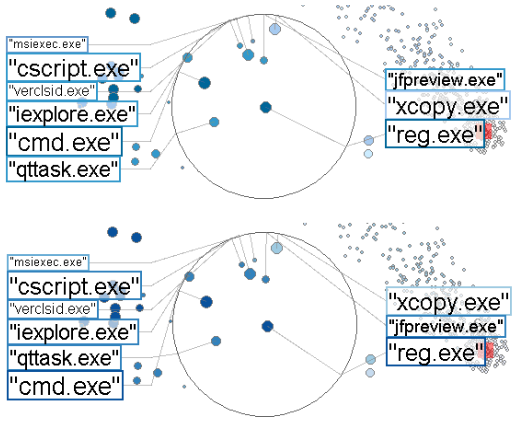

Figure 6: *Comparison of layout and sorting strategies: radial ordering on the top and data dimension ordering below.*

conditions to be compared, but rather asked users to freely change the available parameters and offered functionalities. Before running the test, presented below, we performed a trial test with one user which helped us to spot inconsistencies and ambiguities in the wording of the tasks and questions. The test followed the subsequent steps detailed below: an introduction to the test, a quick training, a task-based experiment, and a questionnaire.

Introduction. We first described the Excentric Labeling as being a lens that enable to investigate the content of a visualization by showing the labels of the objects under the lens. We also described the main features of the lens, its color features, its manually or automatically adaptive size, the filtering and scrolling mechanisms, the visual summary, the various layout strategies of the labels, etc. We also explained the visualization used during the test, making clear that the object of interest in this evaluation is not the visualization but the lens.

Training. Prior to the test, we did an initial training of less than five minutes in which users could explore the visualization and use the lens freely. We also instructed users to try all the alternative designs available. All along this training, users were free to ask questions and we provided help when necessary.

Task-based evaluation. The test in itself consisted in four tasks. Users were asked to read carefully the task list before starting so that they could ask questions if necessary. They were then asked to perform four tasks and to "think-aloud" to let us understand what they are doing. We did not give any time limit to perform the four tasks and encouraged users to freely explore different options, in the way the lens changes its size and in the way the labels are arranged. The four tasks were designed to particularly test the main new features of the extended Excentric Labeling that we propose: respectively (task 1) label reading and scrolling, (task 2) label filtering and label color feature, (task 3) label size feature, and (task 4) summary data reading. In order to encourage users to scroll and read labels, we asked them in the first task to inspect the applications used by department B (figure 1) and to estimate the number of applications they know. In the second task, we asked users to inspect a specific region and determine which applications are used by exactly 3 departments. For this purpose, users had to use the filtering function to prune the space or alternatively to observe the color feature of labels. Task 3 was aiming, for a specific region, at spotting the applications used by the least number of users, thus making use of label font size. Finally, in the fourth task, users had to explore the visualization with the lens to spot the region that contained a majority of applications used by two departments, thus making use of the summary.

Questionnaire. After the test we asked users to fill a short questionnaire, which they had to comment orally afterward. The questionnaire was meant to capture both the perceive usability and usefulness of the extended Excentric Labeling and of some of its major features: adaptive change of the lens' size (automatic or manual), labels layout technique (ordered topologically or by the color feature), the visual summary, the filtering and scrolling functions, etc.

4.1. Results

First of all, at a general level, it is important noticing that all users completed the tasks successfully in a minimum amount of time and with less than 5 minutes of training. The extra functionalities and levels of details brought by the Extended Excentric Labeling did not seem to prejudice the overall usability of the lens.

At the end of the overall test, users rated both the usefulness and usability, on a scale from 1 (bad) to 4 (good), of each major functionality of the Extended Excentric Labeling. Perceived usability and usefulness seems to carry complementary information; for instance users agreed that the scrolling function is useful, but that our current implementation can be improved. On the other hand, some users bounded the usefulness of the filtering to certain cases while observing that the current implementation is usable. Figure 7 indicates the average rating made by the 6 users tested.

	General	Filtering	Summary	Scrolling
usefulness	3.67	3.5	3.67	3.67
usability	3.33	4	3.67	2.17

Figure 7: *Average rating of the perceived usefulness and usability.*

We summarize below the major findings of this test, derived from the observations made by users during the think-aloud walk-through and their answers to the questionnaire.

Lens size. Users combined systematically automatic and manual resize for two distinct purposes. While they preferred the automatic mode to move along the visualization and overview the data, they were choosing manually the lens size when wanting to examine details. Automatic resize was particularly appreciated because it reduces the amount of labels without requiring additional interaction. Most users (5 out of 6) suggested that these two modes should be combined, making possible to switch quickly from one mode to another. In our experiment, the switch between the two modes was assigned to a radio button.

Labels layout. Users could not really tell which layout is best; instead most of them suggested that the layout algorithm for sorting labels depends on the task. Users also suggested to integrate other sorting algorithms, for instance to reorganize the labels alphabetically. When the amount of data is very large, users generally ignored the links and were not disturbed by their intersections.

Filtering. Users found this feature reasonably useful and usable. Notably, one user found this feature only useful for precise inspections, and otherwise redundant with the color feature in the list and its corresponding points in the RadViz.

Summary Statistics. Again, users found this feature useful and usable. However, most users suggested improving the overall summary while keeping as is the current partial summaries on each side of the lens. Some users also suggested to add interaction with the summary so that to highlight the labels corresponding to a category.

Scrolling. The scrolling mechanism was the most discussed feature. Although its usefulness was not in doubt, its integration and usability has been pointed out by users. In particular, the scroll widget represented as a pie generated some questioning, and most users expected that the area covered by the pie contain the data item corresponding to the labels, which is not the case in our implementation. When the area in focus is too crowded (in task 1, about 1400 items were in focus), some users found scrolling painful and wished to be able zoom in and out the zone in order to manipulate the number of visible labels. Instead of scrolling a large list, one user fixed the lens size at its minimum to reduce the number of labels and inspected the region by moving the lens around.

5. Lessons Learned and Further Research

Based on the evaluation above, we can make the following recommendations for future developments and improvements of the Excentric Labeling. First of all, automatic and manual adaptive lens size should be combined in a smooth way so that to switch easily from one to the other, for instance using a right mouse click. Both have proved to be useful and usable for different purposes as described in the previous section. Second, users should be provided with various sorting functions to lay the labels around the lens (e.g. alphabetically, feature-wise, topologically based, etc.). Third, the feature used as filtering function should provide extra information that the visualization on which the Excentric Labeling will be used do not carry. Finally, rather than using a pie widget to scroll the labels, we recommend using standard scrolling lists on each side of the lens.

The scrolling mechanism actually requires deeper research. Although we should make clear that in our experiment (task 1), users had to inspect a region containing about 1400 applications, which makes complex an exhaustive inspection of labels. However, still, we think our use case is realistic and improving scrolling is a reasonable research axis to pursue. From our experience with users, we have spotted four possible alternatives. First, using a zoom option within the lens. This seems a pretty complex option, and we do not have a proper solution to propose at the time of writing. The second approach uses standard scrolling lists. This solution is probably the most usable and it has the advantage to ease the integration of standard sorting functions for ordering the list. Sampling, as proposed in the original Excentric Labeling, remains a good solution to gain a quick overview; user however need more control to refresh and interpret different sample sets. Finally, label aggregation strategies can be devised to provide meaningful groups of labels. Each solution has pros and cons. At the time of writing, we think scrolling is the most reliable and natural one.

6. Future Work

In the next future we plan to investigate in mode details the label scrolling issue through the implementation of different strategies and a controlled study to test the alternatives. We also want to implement different label sorting strategies, notably alphabetical sorting which was requested by a good number of users during the test. Finally, we want to investigate how to best combine automatic and manual lens resizing. Finally, we plan to run a quantitative user study, comparing the original Excentric Labeling with various other prototypes with selected extensions. On a broader perspective we also want to investigate the added value of the Extended Excentric Labeling when used in real world environments.

7. Conclusion

In this paper we presented an extension of Excentric Labeling a dynamic labeling technique that permits to dynamically explore the labels around the objects close to the mouse cursor. Our extension deals with high density and uneven distributions and provides some new additional features like: label scrolling, ordering, and filtering. We have described their implementation in details and the result of a usability study. The study provided very useful hints on what works and what does not. Furthermore it helped to suggest new trails of research. In the paper we have discussed the implications of these results and suggest some potential solutions for the problems found. In conclusion, we believe the paper can help practitioners implement an extended version of the Excentric Labeling and researchers be challenged with new open issues to investigate.

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