

# Visualizing Search Results

## Knowledge Visualization Final Project Report

By: Hasti Seifi , Minoo Erfani

[hsa43@sfu.ca](mailto:hsa43@sfu.ca), [mea18@sfu.ca](mailto:mea18@sfu.ca)

Supervised by: Lyn Bartram

School of Interactive Arts and Technology  
Simon Fraser University  
Spring 2009

## ABSTRACT

In this paper, three different techniques for displaying and sorting search results were studied; namely Text, Circular Iconic Visualization and XY Iconic Visualization. The goal was to find out which technique of representing the search results would be the most efficient way for the buyer. Pilot and user studies were conducted to compare the usability of these two techniques. As the result of Circular Iconic Visualization in the pilot study was not considerable due to a misleading feature, we omit this technique in the user study. Collected data were in the form of satisfaction questionnaire, qualitative observations and participants' comments, and participants' answers to provided tasks. According to the results, while iconic visualization is better for overview (it gives a good overview in a short amount of time) and search with more than two criteria. While text-based performs better for displaying details.

### General Terms

Design, Experimentation, Verification.

### Keywords

Multi Criteria; Iconic Visualization; Knowledge Visualization; Search Results; Text; Icon;

## 1. INTRODUCTION

Searching for an item in commercial websites is a common task that people do very often these days. While looking into long lists of text results for an item is an exhaustive task, it becomes even harder when one wants to consider multiple criteria with different priorities. In such situation, people mostly consider two or three criteria and choose among items in the first page of results. While it is a good strategy, one may not find the best available option. We believe this problem is a matter of displaying information and the selection process can be enhanced by changing the current way of displaying search results.

To address this problem, some companies incorporate sorting by multiple criteria in their websites. Some other websites allow hierarchical sorting of results. In such websites, users can sort by one parameter and then use another parameter to sort items with the same value for the previous parameter. Although these strategies ease decision process, they do not exploit users' perceptual potential to the full extent. We believe incorporating elements aligned with humans' perceptual strengths could further enhance the selection process. As visual sense is the strongest sense in human being, visualizing search results may ease comparison, therefore, help in the task of selecting an item.

Each item has several attributes such as Relevance to search query, Price+Shipping, Price, Distance, Age and Sellers' Reputation. Users compare items according to these attribute in order to choose one. As a result, displaying search results can be mapped to visualizing multidimensional data.

As mentioned in [1] a number of techniques exist for visualizing multidimensional data such as icon-based techniques, Geometric Techniques, Pixel Oriented Techniques, Circle Segments Techniques, Dynamic/ interaction Techniques. Among these techniques, the proposed design is a modified version of [1]'s design and falls in the category of icon-based techniques. The basic Idea of icon based techniques is visualizing data values as features of icons. In these techniques, an icon, or symbol, represents a point in a p-dimensional space. Therefore, icon should have p features. Each feature varies in size or shape according to value of associate parameter in the p-dimensional space. One of drawbacks of this

technique is that it does not perform very well for large number of objects or high dimensionality of the variable space. Some example iconic designs are Castles, Chernoff faces and Stick figures. Castle is a squared-off tree, whose branches resemble the parapets of a castle [11]. The height of each parapet is a function of the associated dimension in the multidimensional space. In Chernoff faces, features of a cartoon face change relative to associated coordinates of the point [12].

Stick figures are icons in which two attributes of the data are mapped to the display axes and the remaining attributes are mapped to the angle and/or length of the limbs of stick figures.

There is a lot of work on visualizing document search results (e.g.: [3], [4], [5], [6], [7], [8]). Some of these works have been evaluated as well. One of those works has been done by Nowell, France, Hix, Heath, and Fox [9] on the Envision system. Envision is a multimedia digital library which includes publications of ACM and some other sources in computer science. In Envision, document attributes, such as author, date, or relevance score are mapped into graphical attributes, such as size, shape, and color of representing icon and users can control this mapping. For evaluating the system, Nowell et al. used a satisfaction survey and measured users' performance against performance of the designer of the system. Although, results were in favor of the Envision system, there was a lack in evaluating the system against another one (graphical or text-based system).

Veerasamy and Belkin [10] conducted another comparison between text and a simple 2D-grid system. In their system, search keywords were shown along the y-axis, and document IDs along the x-axis, with each cell of the grid showing the frequency of the corresponding keyword within that document. Although the conducted user study showed only a slight improvement in visualization over text-based system, the follow up user study using a constrained relevance judgment task demonstrated increase in speed and accuracy in visualization mode [comparative study] implemented a 3D, 2D and text version of NIRVE which is a tool for visualizing search results. [2] conducted a user study to evaluate users' performance using these three techniques for finding documents. In their results, the text condition showed the fastest response times. [2] discussed that these results may be due to prior familiarity with the alternative approaches to information access, interface constraints, and task characteristics. According to gathered qualitative data, users used the color-coding.

While all of these comparative studies are on visualizing document search results, less work has been done on visualizing results of a query on a commercial website.

## 1.1 Purpose

The purpose of this study was to provide a comparison of a text-based and a visualization-based system. Users' performance and satisfaction were considered for this purpose. The visualization-based system uses an iconic visualization (a modified version of the proposed design by [1]) to display the results. In this study, performance was measured based on number of wrong/right answers to a set of tasks. In addition, a post-questionnaire was used for determining users' satisfaction of the two systems. The independent variable in the study is the provided interface (text, iconic) while the dependent variables are users' satisfaction and performance.

### 1.1.1 Research Questions

1. Which technique do the participants prefer more?

2. Which technique is the most efficient one in terms of reducing the number of wrong answers?

The remainder of the paper is organized as follows. In the next section we discussed the elements of the design, such as the icon, three implemented layouts (XY visualization, Circular visualization and Text), their interfaces and sample data. Section 3 is dedicated to description of the experiment, and conducted pilot and user studies. In section 4, results of the experiment are presented. Last section concludes the paper and presents some directions for future work along with discussion.

## 2. SYSTEM DESIGN

As mentioned before, this tool helps in visualizing search results using multiple criteria for sorting items. In this system, user can sort search results using one or multiple parameters depending on the interface (mode) that he/she chooses. We implemented three different interfaces to visualize the search results: Text, XY Design and Circular Design. Moreover, in every three interfaces, top 20 results will be displayed to the users. It is also similar to what is common in commercial websites which show top results in the first page. This system has been implemented in Flex Builder 3.0 environment with ActionScript 3.0 language.

In Text design, results can be sorted by only one parameter at a time. In the other two designs, results can be sorted by multiple parameters. Therefore, these interfaces do not have exactly the same functionalities. The rationale behind this is that a large number of commercial websites allow users to sort items by only one parameter. In XY and Circular designs where sorting by multiple criteria is possible, results include items with better total scores. This score is calculated based on user's specified priorities (importance/weight) for sorting items. Therefore, system receives user's priorities as input, calculates total rank of each item in the result list, and then only displays the top 20 items with better total ranks on the screen. The available range of priority for all attributes is the same.

At the beginning as a default, top 20 items are displayed on the screen by their relevance to the search query. In both iconic visualizations (XY and Circular layout) if the icons have same position, they would cover each other and this sign (+) would appear on the top icon. To see the other covered icons, user can right click on the icon and another screen will open. This screen displays all the items in that position separately. But if the icons have close position (not same), they would overlap each other and some information would be hidden.

### 2.1 Sorting Panel

This panel is a part of XY and Circular layout and is positioned on the left side of the screen (see Figure1). The panel includes three parts. The first part is composed of five combo box (each for one sorting parameter such as Relevance, Price+Shipping, Price, Distance, and Seller's Reputation) and a "Sort" button. Users can use the provided combo boxes to assign importance values (weights) to these parameters. According to these weights, system displays top 20 items after clicking the "Sort" button. The second part of panel is composed of a box which shows detailed information (e.g. exact amount of Price, Distance, Seller's Reputation, etc.) of an item if user rolls the mouse over that item. Finally the third part of the panel includes some control options such as "Allow Multiple Selection" check box, "Finalize Selection" and "Exit" buttons.

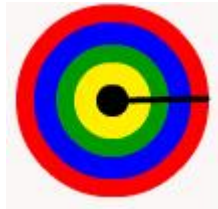
**Figure1.** The sorting panel. In this figure the user sort items and for him/her the most important factor was Price+Shipping (so assigned the highest weight to it), then Price and then Distance (more importance is determined by higher weight).

## 2.2 Icon Design

For displaying items with icons, we inspired with an iconic design which was proposed by [1]. In this design, each item is displayed by an icon. The icon is a circle; consists of several rings (see Figure 2). Each ring represents an attribute of the item. Thickness of each ring specifies how much the item is good in that attribute. Therefore bigger icons (having thicker rings) display that icons are better in some attributes. It is assumed that the range of possible values for a specific item (e.g. electrical guitar) is previously determined by statistical techniques. Therefore, thickness of each ring is a function of that item's value in that attribute and range of possible values for that attribute. Each attribute is determined by a specific color which is a pre-attentive visual cue.

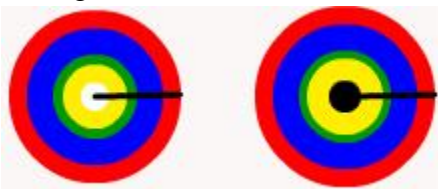
In our system the attributes are Price+Shipping, Price, Distance, Seller's Reputation. The other item's information that user can get, are the item's condition (new or used), it's bidding rate, it's relevance to

the search query and its age (number of days that item is posted on the website). These information are similar to the information that eBay displays for an item.



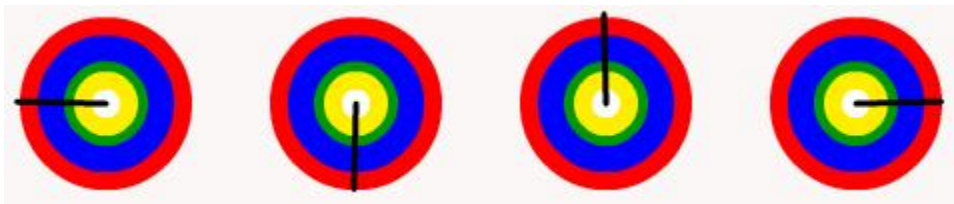
**Figure2.** Icon design. In this design the red ring displays the item's Price+Shipping, the blue ring displays the item's Price, the green ring displays the item's distance and the yellow ring displays the Seller's Reputation.

The most interior ring determines whether the item is used or new. White color displays new items while black is an indicator of used ones (see Figure 3).



**Figure3.** New (left) and used (right) icon.

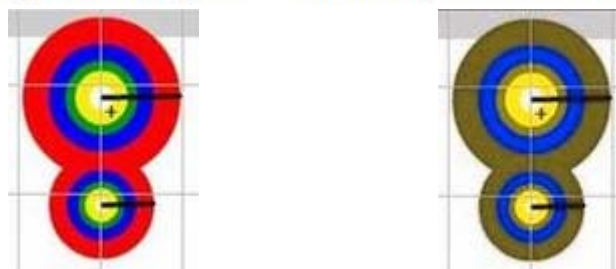
In terms of what we modified in the icon design; in the previous design [1], speed of each icon was an indicator of its bidding rate. The problem with this assignment is that icons carry lots of information, adding motion to them, could make them more confusing. In addition, motion distracts user and makes comparison of two items very difficult. In the modified design, bidding rate of each item is shown by a line inside the icon which could have 4 separate positions at 0, 90, 180 and 270 degree (see Figure 4). More degree shows higher bidding rate.

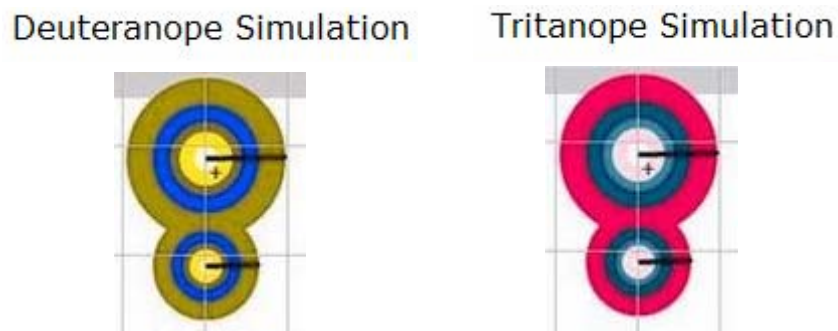


**Figure4.** Icon's bidding rate. More degree from the horizon line shows higher bidding rate.

We also changed the color and checked those with Visccheck website (see Figure 5).

Original Image      Protanope Simulation

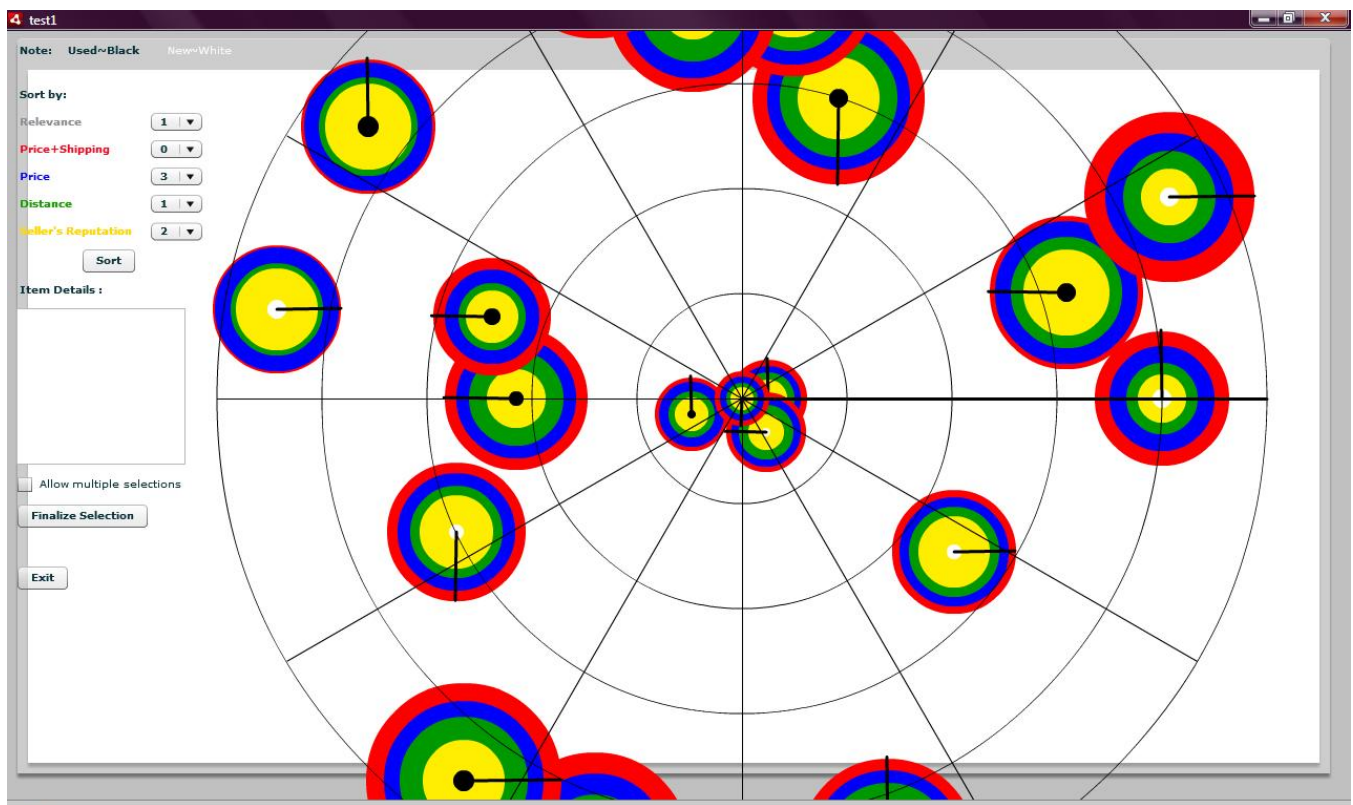




**Figure5.** Results of color checking with Vischeck website.

### 2.3 Circular Iconic Layout

Figure 6 shows this layout which is a Bull-eye layout which was proposed by [1]. In this layout positions of icons are calculated using polar coordinates. For each icon radius value (the distance from center of the screen) is represents items' age (the number of days that icon is posted on the website) and the angle represents to item's relevance to the search query. In this design older items has bigger size and they are closer to the periphery for expressing the importance of that item.



**Figure6.** Circular iconic layout.



## 2.4 XY Iconic Layout

Figure 7 shows this layout. In this layout icons are positioned in a scatter plot. The reason for choosing the scatter plot is that in the circular visualization the most relevant items with angle around 0 degree will be close to the least relevant items with angle around 360 degrees, which can be confusing for the user. For each icon X value shows its age (number of days that item is posted on the website) while the Y value represents item's relevance to the search query. Unlike the Circular layout, the age of an item doesn't have any effect on its size. Because it may affect the correct answer (after conducting the pilot study we found out that it is confusing in choosing the right answers therefore we omit this visualization from the user study – see section 4 for more details). As the rings of each icon have different thickness, icons are different in the total size of the circle.

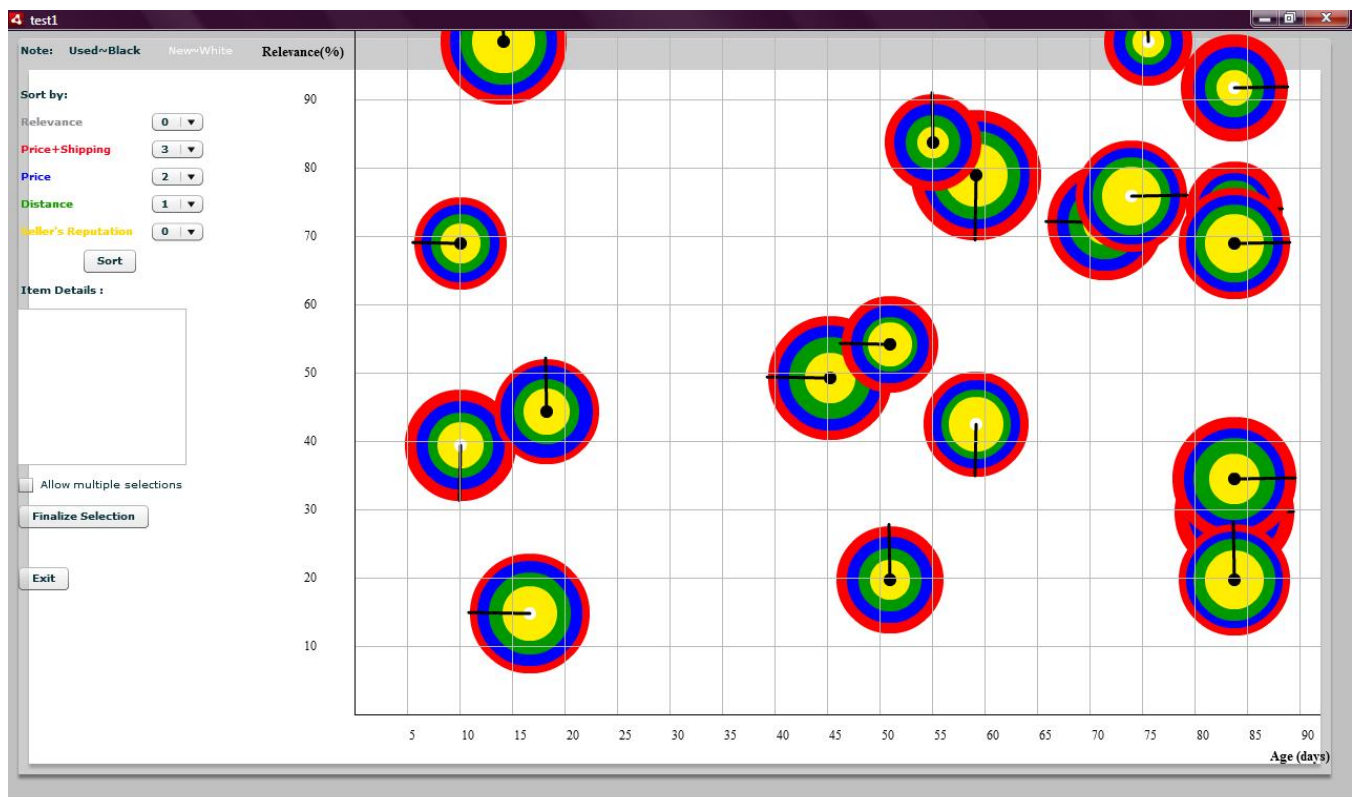


Figure7. XY iconic layout

## 2.5 Text Layout

Figure 8 shows this layout. This is a simple text layout. Each row, in this layout, displays detailed information of one item. In this technique user can sort icon based on only one criterion. Similar to the sorting panel in XY and Circular Iconic visualizations there are some control options such as “Allow Multiple Selection” check box, “Finalize Selection” and “Exit” buttons on the top of the screen.



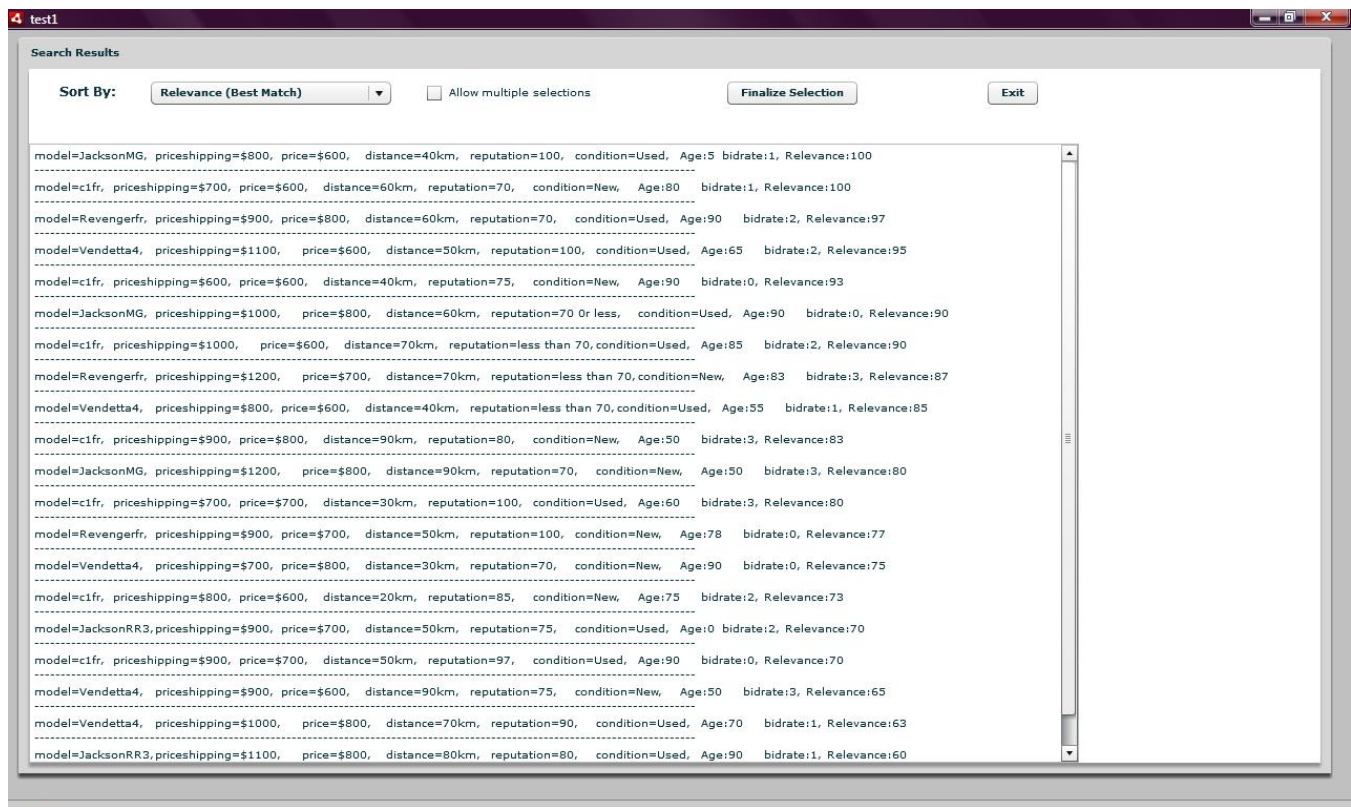


Figure8. Text layout

### 3. EXPERIMENT

We conduct a pilot study (to test the system and find the possible problems with the tasks, questionnaire, etc.) and a user study (to test the new visualization mode) in which participants should accomplish a number of task-sets with each mode. The task and questionnaires are attached at the end of this document.

#### 3.1 Pilot Study

##### 3.1.1 Participants

The pilot study testing sessions for Visualizing Search Result with Iconic Visualization took place on March 28<sup>th</sup> and 29<sup>th</sup>, 2009 with three subjects (one female and two male, n=3). Participants were two SIAT and one CS graduate students from SFU.

##### 3.1.2 Procedure

Each participant had an hour testing session. At the first of the session the subject was asked to fill a pre questionnaire which was about her/his demography, possible color deficient, computer skill, online shopping skill, etc. After that, there was a short description of how the tool, the visualizations and the icon work (see Figures 9, 10, 11, 12 and 13).

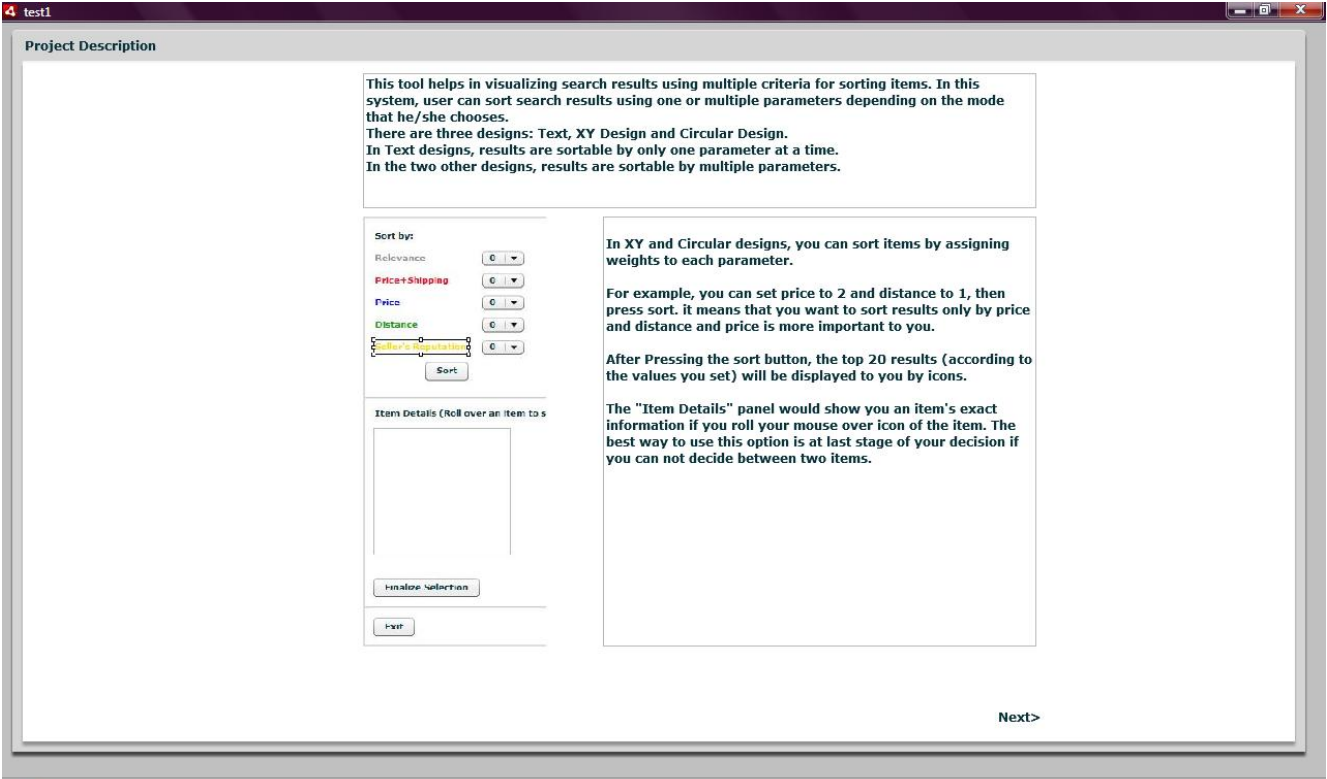


Figure9. Screenshot of the project description

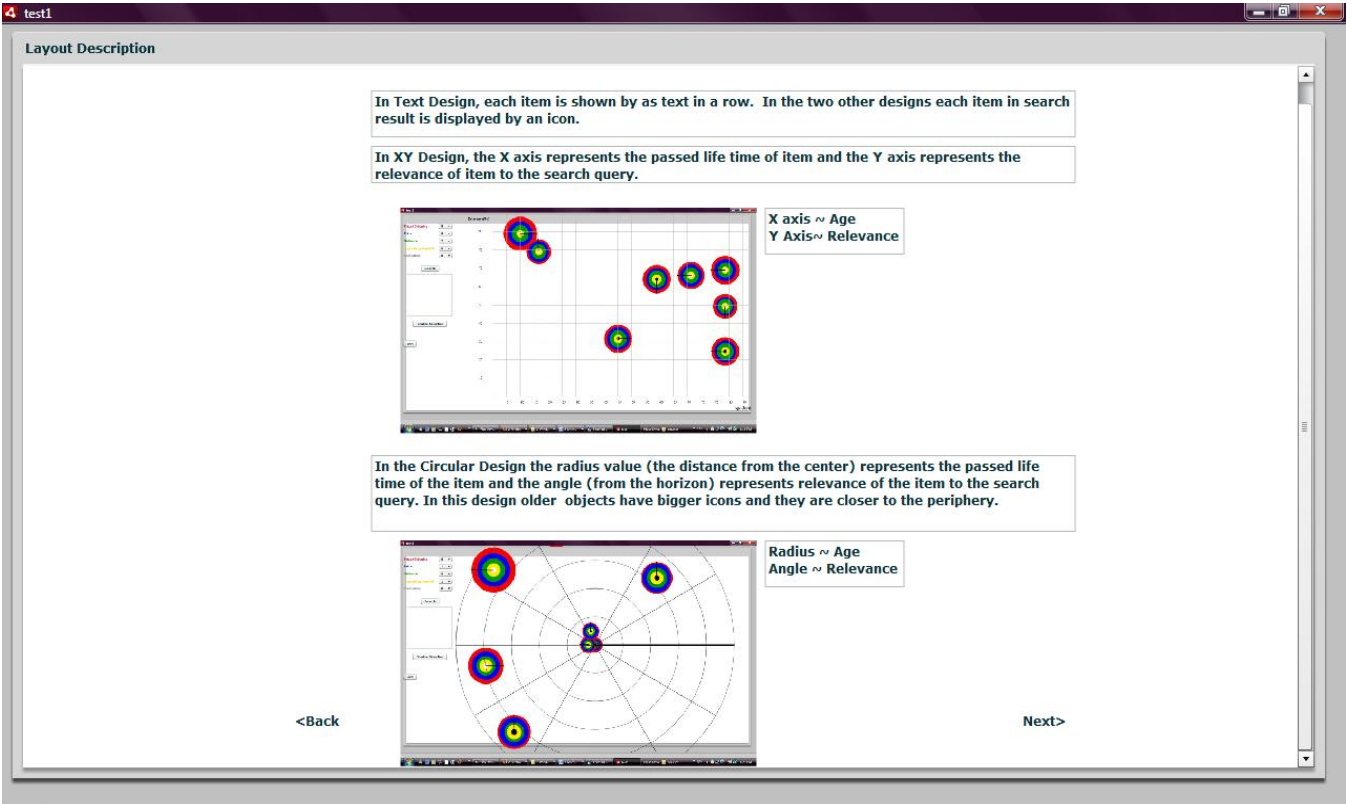


Figure10. Screenshot of the layout description

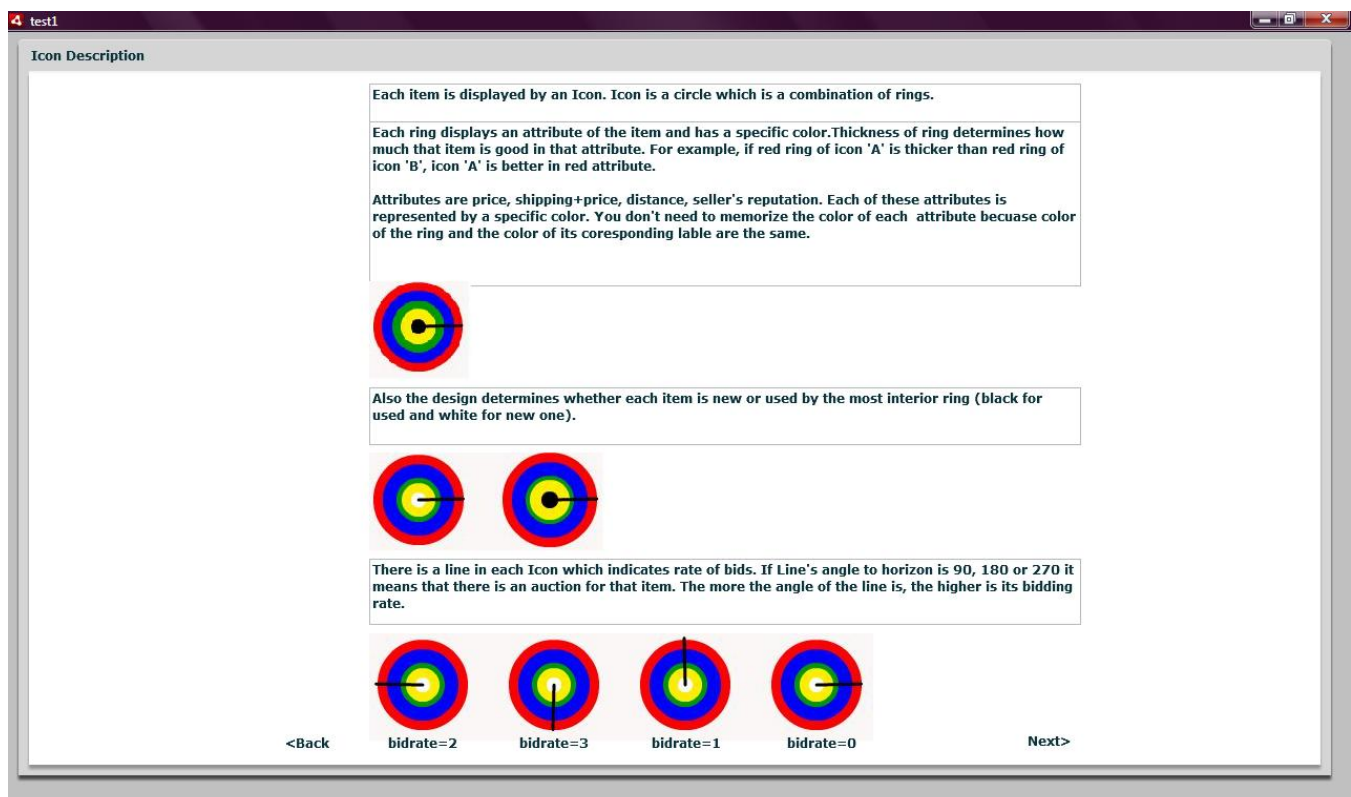


Figure11. Screenshot of the icon description

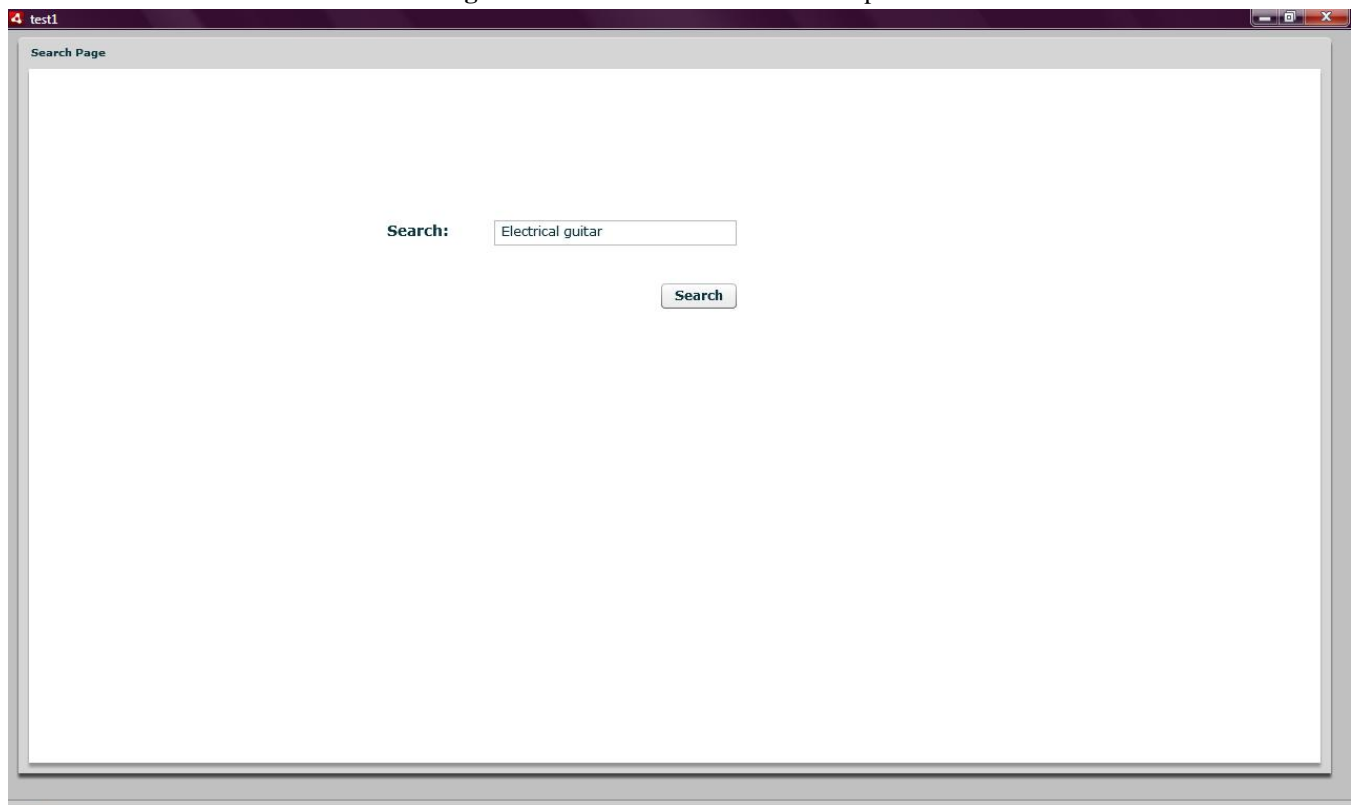
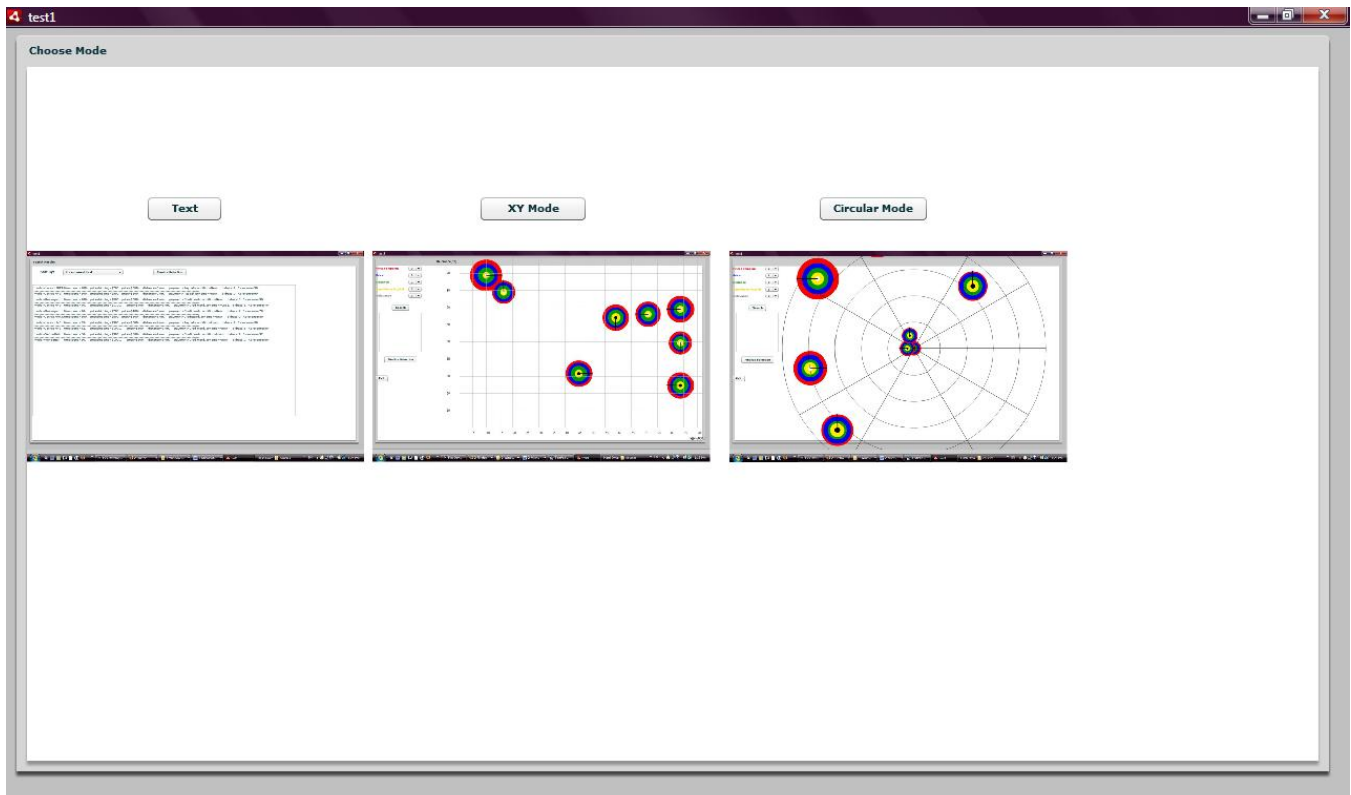


Figure12. Screenshot of the system



**Figure13.** Screenshot of the system

Next he/she performed several tasks which were consisted of three different phases. The tasks were finding an item according to its search query. The first and the third phases were performed in every mode (Text mode, XY mode and Circular mode) but the second phase was performed in the two visualization modes (XY mode and Circular mode). Tasks in the first phase were designed to make the participants become familiar with the icons' and text's properties. Tasks in the second phase were designed to make the participants become familiar with using the parameters at the left side of the screen and tasks in the third phase were the combination of both. Questions were answered during the first and second phases, but participants were on their own in the third phase. Once they completed the tasks, we gave them a post questionnaire to fill out which is mostly about their experience with the modes and what they like/dislike about the modes.

Purpose of conducting the pilot study was to find possible problems with the tool, visualizations, tasks, questionnaire and the dependent variables of the study (such as the number of icon selections before finalizing the selection, time to finalizing a selection, number of wrong answers) by both observing participants' behavior and analyzing their answers and comments. The conducted pilot study resulted in several changes. Main changes are listed below:

- Removing the Circular visualization from the study because it was misleading the users in selecting the correct answer. As we explained above, in the circular mode older items has bigger size to express the importance of that item. On the other hand bigger icons (thicker rings) display that icon is better in some attributes. These two were confused with each other.

- Rewriting some tasks to be clearer as they were confusing for the participants (not clear). Moreover some other tasks were added to the first and third phase.
- Finding some implementation problems. Also as explained above, there is an introduction part at the beginning of the experiment, we add some screenshots and image for better understanding.
- Removing the questions related to the Circular mode in the post questionnaire, as it was removed from the study.
- Removing two variables we intended to measure. The first was the number of icon selection before finalizing the selection because some participants select the icon while they were viewing it. The second one was time to finalizing a selection because each participant behaved differently so time can not be considered as a reliable parameter so we measure the number of wrong answers in the user study.

## 3.2 User Study

### 3.2.1 Participants

The user study testing sessions took place on April 7<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup>, 2009 with thirteen subjects (5 female and 8 male, n=13). Participants were ten SIAT, two CS and one mechatronic graduate students from SFU. Subjects' demographics (including pre and post questionnaires) were attached to the paper.

### 3.2.2 Procedure

Similar to the pilot study, each participant had an hour testing session. At first they were filling a pre questionnaire, and then having a short description of the system, after that performing the tasks and finally answering the post questionnaire. To balance the experiment we divided thirteen participants into two groups of six and seven people. Group1 started the experiment with XY mode and then Text mode. Group2 started the experiment with Text mode and then XY mode.

Group1: XY, Text

Group2: Text, XY

In terms of the pre questionnaire summary, the participants were between 20 and 40 years old. None of them were color-deficient. As all of them were graduate students they used computers once a day or more. Most of them use commercial websites for searching and buying an item once a month or once a week.

In terms of the post questionnaire summary, we used chi square test for questions 1, 2, 3, 4, 5, 6, 11, 12, 13 and 14 and calculated the mean for questions 7, 8, 9 and 10. But we analyzed each question qualitatively and paid attention to the comments especially for questions 12, 13 and 14.

In terms of the comments, we summarize the main points below:

- Text is good for details and XY mode is good for overview. XY mode gives a really good over view in a short amount of time.
- XY mode is better if there are more than two criteria to search.

- Some of the attributes are recognized really faster in XY mode than in Text mode such as new/used and bidding rate.
- Amount of the attributes are necessary as the thickness of the rings are not exactly distinguishable for buying an item.
- Need to learn some issues in the XY mode and it may be too information for the users.
- Overlaps in XY mode are frustrating as they hide the information (if the positions of the icons are same the user can view them in a separate screen without overlap but if the position of the icons are close they overlap each other).
- Colors of the rings are sharp (milder color may be better). Moreover try to find a relationship between the color and the attribute which is assigned to that color.
- Text mode is not tabular which made it difficult to find the answers on that (it would be better that the same attribute of different items be in same column). Moreover its font was small.
- Switching between the questionnaire form and the visualization was frustrating so add the task to the system.

Testing sessions of user study were useful for getting qualitative data in form of observations and users' comments about their preferences. Subjects' demographics (including pre and post-questionnaires) were attached to the paper.

### 3.3 Results

The following section describes analysis of the results.

#### 3.3.1 Research Question1: Which technique do the participants prefer more?

In this question, the independent variable is type of interface (XY visualization, Text) while the dependent variable is users' preference. Users' answers to post-questionnaire have been used for measuring users' preference from questions 1, 2, 3, 4, 5, 11, 12, 13 and 14 and questions 7, 8, 9 and 10 separately.

Results have been analyzed using chi-square for each question to see the results are statistically significant or not (see Table 1). During the experiment and after analyzing the results we realized that type of task was an important factor in determining users' preference and performance in finding the answer. According to the results, users preferred iconic technique (XY interface) for answering tasks of first phase and first task of the third phase which needs comparing more than two attributes of items or choosing an item with a specific attribute.

However, for questions 4, 5, and 6 they either preferred Text interface or had no preference. These questions mostly asked to choose one item based on two criteria. For those questions, almost all users first sorted all result based on the most important parameter in the Text mode (according to the task) and then chose the best item among top items in the list based on the second criterion.

**Table1: Results of Chi Square test**

Comparison	Question	X2(1)	XY%	Text%	Significant
	1	6.23	84.61	15.39	Significant (p)

<b>XY vs. Text</b>	2	6.23	84.61	15.39	Significant (p)
	3	0.33	58.33	41.66	Non-Significant (p)
	4	1.28	63.63	36.37	Non-Significant (0.1<p<0.2)
	5	0	50	50	Non-Significant (p)
	6	1.92	30.76	69.24	Non-Significant (0.1<p<0.2)
	11	2.27	72.72	27.28	Non-Significant (0.1<p<0.2)
	12	4.5	12.5	87.5	Significant (p)
	13	2.77	22.22	77.78	Significant (p=0.05)
	14	4.45	81.81	18.19	Significant (p)

For questions 7, 8, 9 and 10 the answers were a five point scale which we binned those into three categories: not true (-%), somewhat true(0%), true(+) (see Table 2). Each cell specifies the number of participants in percentage.

**Table2: Number of participants (percentage) in answering Q7, 8, 9 and 10**

<b>Question</b>	<b>-%</b>	<b>0%</b>	<b>+%</b>
<b>7 (feel competent)</b>	7.69	46.15	46.15
<b>8 (easy to use)</b>	15.38	38.46	46.15
<b>9 (intuitive to learn)</b>	7.69	53.84	38.46
<b>10 (need to concentrate)</b>	46.15	15.38	38.46

### 3.3.2 Research Question2: Which technique is the most efficient one in terms of reducing the number of wrong answers?

In this research question, type of interface is the independent variable and number of wrong answers to each task is the dependent variable. Results are provided in Table 3.

During the experiment sessions and after analyzing the results, we remove some tasks as they were misleading (e.g. task 1, 4 in first phase because the numbers of wrong answers were high for text as participants could not find the good overall rank in text. And task 2, 5 in third phase as they were not clear). For most of the tasks, there was no significant difference in number of wrong answers between these two interfaces. However, it is possible that the provided tasks did not take into account different strengths of both interfaces. As for some of the tasks, number of wrong answers in both interfaces are almost similar (for some tasks, this number is high and for some it is low), we can conclude that there was an issue with logic or wording of those tasks.



However, as provided in Table 3, there is a considerable difference in number of wrong answers to task 4 of third phase (10 in text vs. 5 in XY mode). We could not figure out the reason behind it.

**Table3: Number of wrong answers**

Task	Text	XY
First phase. 1	(Omitted)	(Omitted)
First phase. 2	3	0
First phase. 3	1	0
First phase. 4	6 (Omitted)	2 (Omitted)
First phase. 5	2	4
First phase. 6	0	0
First phase. 7	3	0
First phase. 8	9	2
Third phase. 1.a	2	1
Third phase. 1.b	8	5
Third phase. 1.c	1	1
Third phase. 1.d	4	3
Third phase. 2	7 (Omitted)	9 (Omitted)
Third phase. 3	3	4
Third phase. 4	10	5
Third phase. 5	9 (Omitted)	10 (Omitted)

## 4. DISCUSSION

According to the results and based on qualitative observations during testing sessions, we conclude that in general users liked using icons for items. However, as the XY layout did not preserve order of items (based on their total score using entered priorities), users felt more comfortable with the ordered list for finding answers. Therefore, we hypothesize that a combination of text-based and iconic interfaces will increase both satisfaction and performance. The proposed interface for future analysis is to include the sorting panel in the text interface and provide icon of each item along with the text in a text-based result list. This also removes the overlapping issue in the XY (and circular) interface.

In addition, the slight difference between text and iconic visualization performance could be, in part, a function of experience. A follow up study with the same participants could be conducted to investigate effect of experience and familiarity with the design on users' performance.

## 5. REFERENCES

- [1] Arefe Dalvandi in knowledge Visualization course in spring 2008.
- [2] SEBRECHTS, M., VASILAKIS, J., MILLER, M., CUGINI, J. AND LASKOWSKI, S. 1999. Visualization of Search Results: A Comparative Evaluation of Text, 2D, and 3D Interfaces. In *Proceedings of the 22<sup>nd</sup> Annual International ACM SIGIR*.

- [3] ALLEN, R.B., OBRY, P. AND LITTMAN, M. 1993. An Interface for Navigating Clustered Document Sets Returned by Queries. In *Proceedings of SIGOIS 203-208*.
- [4] BENFORD, S., SNOWDON, D., GREENHALGH, C., INGRAM, R., KNOX, I. AND BROWN, C. 1995. VR-VIBE: A Virtual Environment for Co-operative Information Retrieval. In *Eurographics '95, Maastricht, 349-36'*.
- [5] FOWLER, R., WILSON, B. AND FOWLER, W. Information Navigator: An Information System Using Associative Networks for Display and Retrieval. *Report NAG9-551, No. 92-1*, Univ. of Texas – Pan American, Edinburg, TX. See [http://bahia.cs.panam.edu/info\\_vis/inf\\_nav/info\\_nav\\_tr\\_92.html](http://bahia.cs.panam.edu/info_vis/inf_nav/info_nav_tr_92.html).
- [6] HEARST, M. AND KARADI, C. 1997. Cat-a-Cone: An Interactive Interface for Specifying Searches and Viewing Retrieval Results sing a Large Category Hierarchy. In *Proceedings 20th Annual International ACM/SIGIR Conference*. See: <http://www.parc.xerox.com/istl/projects/ia/papers/cac-sigir97/sigir97.html>.
- [7] RENNISON, E. Galaxy of News: An Approach to Visualizing and Understanding Expansive News Landscapes. In *Proceedings of UIST'94*.
- [8] WISE, J. 1998. The Ecological Approach to Text Visualization. In *JASIS*.
- [9] NOWELL, L.T., FRANCE, R.K., HIX, D., HEATH, L.S. AND FOX, E.A. 1996. Visualizing Search Results: Some Alternatives to Query Document Similarity. In *Proceedings of SIGIR'96*.
- [10] VEERASAMY, A. AND BELKIN, N. 1996. Evaluation of a Tool for Visualization of Information Retrieval Results. In *Proceedings of SIGIR '96*.
- [11] KLEINER, B. AND HARTIGAN, J.A. Representing Points in many Dimensions by Trees and Castles. *Journal of the American Statistical Association*, 19 I~, 76, 260-269.
- [12] CHERNOFF, H. 1973. Using Faces to Represent Points in K-Dimensional Space Graphically. *Journal of the American Statistical Association*, 6\_\_8, 361- 368.

## Tasks

Imagine you want to buy a guitar. The icons (guitars) on the screen are the results of your search. Now you want to **choose** among those, based on the criteria in each task.

### *First Phase*

These tasks are designed to make you become familiar with the icons' properties and text. **Do not sort** guitars in this part. **Just select the answer** among the displayed ones:

1. Choose top three guitars (guitars that you think have the better overall rank than the other guitars). For this task first tick "allow multiple selections" check box.
2. Choose the oldest guitar.
3. Choose the most relevant guitar.
4. Choose one of guitars with the best overall rank.
5. Choose the one that have the better price+shipping.
6. Choose one of the "new" guitars (not used).
7. Choose one of the guitars with the highest bidding rate.
8. Choose a new guitar that has a better overall rank among the other new guitars.

### *Second Phase*

These tasks are designed to make you become familiar with working with the parameters at the left side of the screen and the **chosen item is not important** in these tasks. For each task you need to **sort the parameters**:

1. Senario1: Imagine you want to find a guitar. The most important factor for you is its relevance, then its price and finally its reputation. Sort results based on these order of importance. Then select one of the guitars and finalize it.
2. Senario2: Imagine you want to find a guitar. The most important factor for you is its relevance, then its distance and finally its price+shipping. Sort results based on these order of importance. Then select one of the guitars and finalize it.

### *Third Phase*

1. Imagine you want to find a guitar. The most important factor for you is its relevance, then its price and finally its reputation in selecting a guitar. Now answer the following four tasks.
  - Choose the best overall option (guitar).
  - Choose one of the guitars with the best price.
  - Choose a guitar with the best distance among guitars with relevance more than 90%.
  - Find an item with the most bidding rate and at least 70 days old.
2. Imagine you want to find the oldest guitar among the most relevant ones. Sort the results base on these preferences and select the guitar and finalize it.
3. Imagine you want to find a guitar with the best (least) distance and then the best price

- (distance is more important than price). Sort the results base on these preferences and select the guitar and finalize it.
- 4. Imagine you want to find a guitar with the best reputation and then the best price+shipping (reputation is more important than the price+shipping). Sort the results base on these preferences and select the guitar and finalize it.
  - 5. Imagine you want to find a used guitar with the most bidding rate and the best price+shipping. Sort the results base on these preferences and select the guitar and finalize it.

Pre Questionnaire Form

Complete Name: -----

Age:	20-24	25-29	30-34	35-40
Gender:	Female	Male		

Are you color-deficient?

If yes, please explain -----

How often do you work with the computer?

More than once a day   Once a day   Once a week   Once a month   Almost Never

How often do you use commercial websites for searching and buying an item?

Once a day   Once a week   Once a month   Once a year   Almost Never

Signature-----

### Post Questionnaire Form

1. Which design did you find out was easier to answer the questions of the first phase?

Text Mode                      XY Mode

2. Which design did you find out was easier to answer the question 1 (third phase)?

Text Mode                      XY Mode

3. Which design did you find out was easier to answer the question 2 (third phase)?

Text Mode                      XY Mode

4. Which design did you find out was easier to answer the question 3 (third phase)?

Text Mode                      XY Mode

5. Which design did you find out was easier to answer the question 4 (third phase)?

Text Mode

XY Mode

6. Which design did you find out was easier to answer the question 5 (third phase)?

Text Mode

XY Mode

7. After working with XY Visualization for awhile, I felt pretty competent.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
not at all		somewhat		very
true		true		true

8. I found the XY Visualization environment easy to learn to use.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
not at all		somewhat		very
true		true		true

9. I found the XY Visualization environment intuitive to learn.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
not at all		somewhat		very
true		true		true

10. I found that I had to really concentrate to learn how to use XY Visualization.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
not at all		somewhat		very
true		true		true

11. Which interface was easier for you to learn?

Text Mode

XY Mode

12. Which interface was more convenient for you to find the answer?

Text Mode

XY Mode

Why? -----

13. If you want to find an item on a website (e.g. eBay), which option you are more likely to use?

Text Mode

XY Mode

Why? -----

14. Were used colors distinguishable (Did you like the assignment of colors)? Yes No

If No please explain -----

15. Any more comments?

-----

Signature -----