

## ***Information Visualization for Peer Patent Examination***

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Initial draft: 12/07/06

This document is prepared in response to questions from Beth Noveck about Information Visualization for the Peer2Patent project.

### **When is it Appropriate to Use Information Visualization?**

Beth Noveck posed the question: how can visualization be used to encourage participation and attract expertise in the peer2patent system?

I am assuming here that we are intended to address visualization in particular as opposed to user interface design more generally, although of course the latter subsumes the former. I would like to note that, in my opinion, the proposed user interface mock-ups are very well done; visually they are professional yet appealing, they transmit a great deal of information with a minimum of clutter, and they appear to have a clean interaction flow. So I am assuming that we intend to start with an interface that is roughly like those already mocked up, and consider how they may fruitfully be augmented with visualization.

My initial reaction is to proceed with caution. Many innovative visualization ideas have been proposed. Unfortunately, many suffer from usability problems; they initially are interesting, or even stimulating, but in practice do not match to the task well enough to be used on a regular basis. In addition, in commercial systems the graphic design is often gratuitous and overdone, thus obscuring the intended meaning. (See [Few 2006a] for excellent examples of constructive critiques.)

On the other hand, some visualizations turn out to usefully enhance understanding, but take some time for users to get accustomed to; the usability of these improve with experience. We may wish to include a number of such visualizations and see which succeed and which do not, with the intention of removing those that do not work.

To make a successful visualization, the details the design often needs to be carefully tailored to the domain being explicated. There also is empirical evidence that the aesthetics of the design affect users' desire to use a system as well as the perceived usability of the system. [Norman 2004, Ben-Basset et al. 2006]. Thus it is important that the design be visually and interactively appealing to the user population.

The web design community has been becoming progressively more accomplished at presenting complex information in an appealing, easy-to-read manner. For example, interfaces for showing user comments have advanced nicely over the years. The forum format seen at DIGG is very nicely done (<http://digg.com/users/forumreader/dugg>) while older forum readers are often unattractive and difficult to navigate and assimilate.

## “Dashboard” Visualizations

One aspect of the project in which I think visualization can have the most impact is in the expression of time-critical information, especially for showing participants which pieces of work most need to be done in the time remaining before the patent review process ends. “Dashboard”-type visualizations may be useful for this purpose.

Dashboards are visualizations whose intent is to show all relevant information for an analysis task within a single screen [Few 2006a]. One nice example of a highly interactive interface that simultaneously shows interactions among different kinds of information is found in the PaperLens work [Lee et al. 2005] (See Figure 1). PaperLens allows the user to gain insight about a decade's worth of conference publications, simultaneously showing how many papers were published in each of five main topics, when they were published, the names of authors of the papers, most cited authors, and the publishing relationships among a set of selected authors.

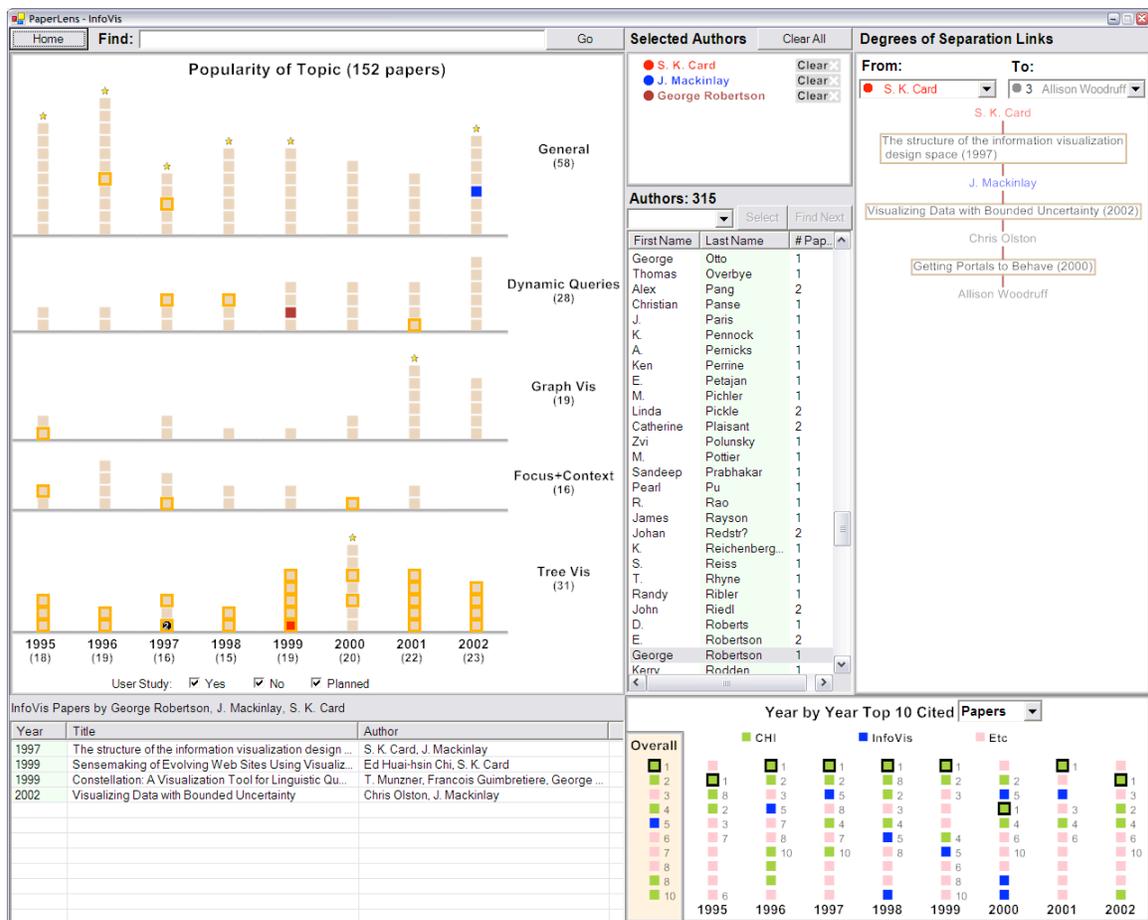


Figure 1: Screenshot from the PaperLens project, Lee et al. 2005.

Another nice example of dashboard design uses “Micrographs” include Tufte’s sparklines idea and Few’s bullet charts [Few 2006b] (See Figure 2). Careful consideration is given to the highlighting of the important information, fitting in a great deal of information in a small space while avoiding clutter. This sample interface is not interactive, and so may be easier to understand than the PaperLens-style interface.

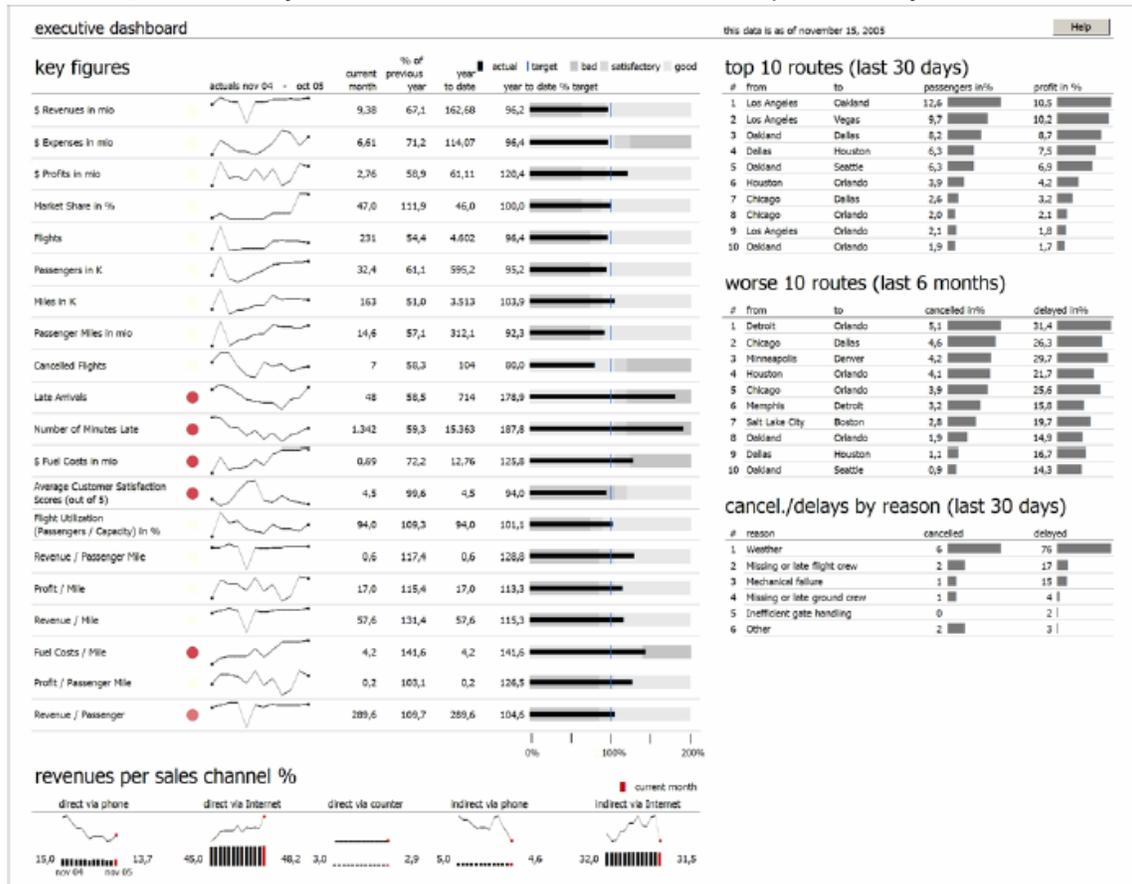


Figure 6: Andreas Flockermann of BonaVista Systems’ winning solution.

Figure 2: An example of good dashboard design, by Andreas Flockermann, from Few 2006b.

I think a set of well-designed dashboards may be effective for encouraging participation. They may be especially useful for emphasizing time-critical information, providing summary information at the patent, patent claim, and patent category levels. In addition, dashboards may be effective for showing participant-centered summary screens indicating what kind of information a given participant has contributed, and which subsets of contributors have worked on the same patents.

Dashboard displays could include a facility for participants to contact others to address specific claims in a time-critical window. I am envisioning a kind of “to-do” list, one created by the participants themselves, and another created by suggestions generated

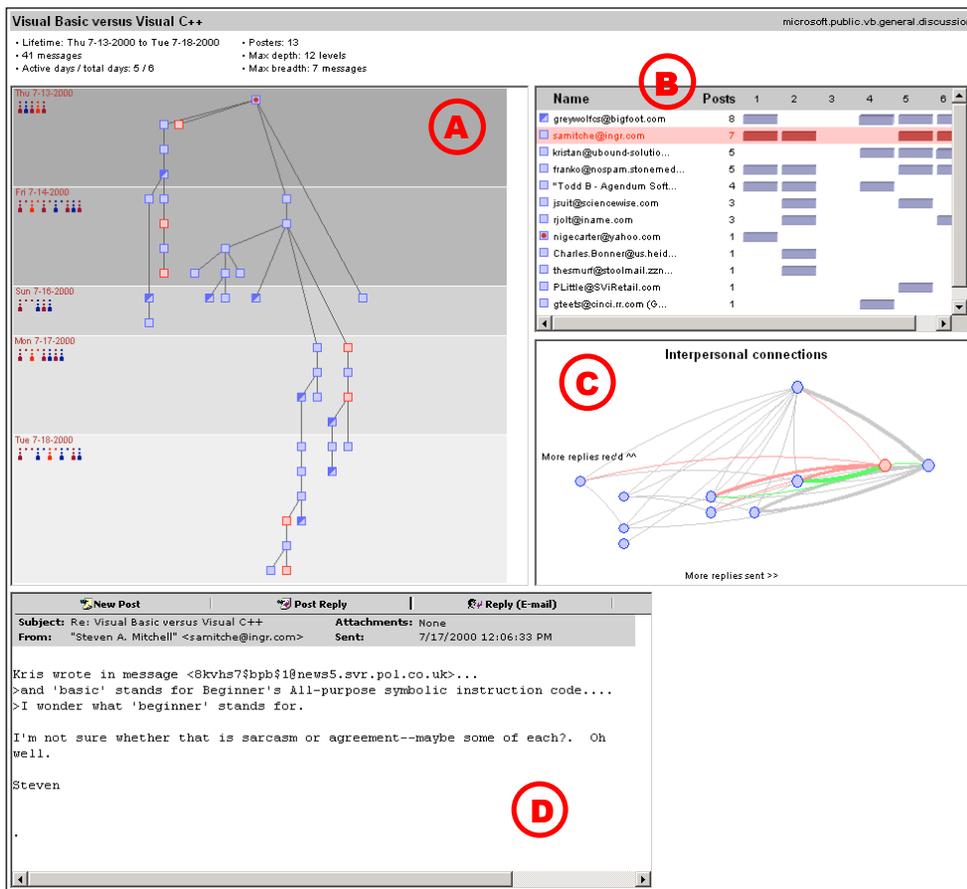
by other participants who know the individual's areas of expertise and are suggesting that this person take a look at a particular claim that needs more attention.

It may be the case that self-appointed "minders" arise who track the progress of specific patents and try to recruit knowledgeable people to tackle parts of their monitored patents. I think the system would be well-served by supporting such roles and allowing minders to see how much work participants have taken on, so as to avoid overloading them. These minders might even be allowed to try to bump up tasks in a given expert's to-do queue. In one scenario, an expert gives some number of tokens to various minders allowing them to manipulate their to-do list according to the minder's notion of priority.

### **Visualizing Comments: Lessons from the NetScan Project**

There is a great deal of interest in visualizing social relationships and interactions. The most common visualization is a nodes-and-links social network diagram, but there is little if any support in the literature for the usability of such displays. (The more directed and focused linkage between pairs of people as shown in the PaperLens interface may however be useful.) One relatively recent project, NetScan, attempted to communicate newsgroup information visually [Smith & Fiore 2001]. The authors developed a dashboard interface containing a tree-like visualization of thread structure, a "piano-roll" visualization of people indicating which thread they had posted on, and on which date, and a social network diagram indicating who had replied to whom (see Figure 3). The interface was assessed informally by asking 9 people who often read netnews to answer some specific questions using the tool. The mean usefulness ratings for both the tree and the network was 3.3 on a 5 point Likert scale, indicating that users did not find them particularly helpful. Aggregate results were not reported for the piano roll visualization, although the authors suggest that most people did not understand it.

It may be the case that this kind of visualization is more useful for people who are trying to accomplish a cooperative task. The NetScan evaluation was done with casual users who did not have a particular goal in mind. Nevertheless, I think the interface design should proceed with caution in attempts to visualize social networks and thread structure.



**Figure 3.** The Netscan dashboard combines the thread tree, piano roll, reply-based sociogram views, message display, and header information. **(A)** The thread tree visualization presents information about the structural and temporal history of the selected thread. Selecting a message displays its contents in the message pane (D) below. **(B)** The piano roll component displays a list of all posters who are present in the selected thread ordered by the number of posts they contributed. Columns for each day the thread was active contain bars if the poster posted on that day. When the user mouses over each poster, the related posts are highlighted in the thread tree and the interpersonal connection component. **(C)** The interpersonal connection component displays a sociogram that relates users with those they reply to and who reply to them. Posters are located based on the number of responses they send (the x axis) and the number they receive (the y axis). **(D)** The message display pane presents the contents of a selected message and controls for replying via Usenet or email.

Figure 3 The NetScan visualization, from Smith & Fiore 2001.

## Document Collections

Document collections are very difficult to visualize successfully [Hearst '99]. I would recommend against attempting to display document collections using information visualization as it is usually construed. Instead, I recommend using a faceted metadata navigation interface for organizing and navigating patents and prior art. The approach has a visual component but is more accurately considered an interaction paradigm. It allows for flexible, dynamic navigation of information collections, and will dovetail nicely with tagging, provided that some organization feature is provided for the tags.<sup>1</sup>

In faceted navigation systems, every item in the collection is assigned labels from multiple categories, or facets. The user can choose which dimensions to navigate along, and can navigate according to different dimensions simultaneously. Modern e-commerce sites use a version of this interaction method, often allowing the user to select

<sup>1</sup> (NB: Collection display and navigation via hierarchical faceted metadata is a research area I am known for. However, I am also known for a number of document visualization ideas which I am not promoting here. I am suggesting this because it is proven to work well not just in my research but in that of others', and the approach is becoming increasingly adopted by people in industry and research alike.)

a price range, a brand, and perhaps a size or color. For information-rich collections, subject categories should also be navigable. In a fully faceted interface, a participant would be able to, say, first choose all patents that contain the tag “input devices” and then select a subcategory, say “pointing devices” and then select from another facet such as “RFID”, thus viewing all patents that discuss both topics. The patents could also be organized by submitting organization and submission date, and so on. Figure 4 shows the general idea with an art history image collection using the Flamenco system [Hearst et al. 2002]. The user has selected all items from Europe (from the Location facet), then selected Musical Instruments from the Object facet, and lute from within Musical Instruments. The user then organized the 116 items that meet this criterion according to their Media type. A key component of faceted navigation displays is that they show how many items in the collections satisfy the constraints selected so far. They also seamlessly integrate keyword search.

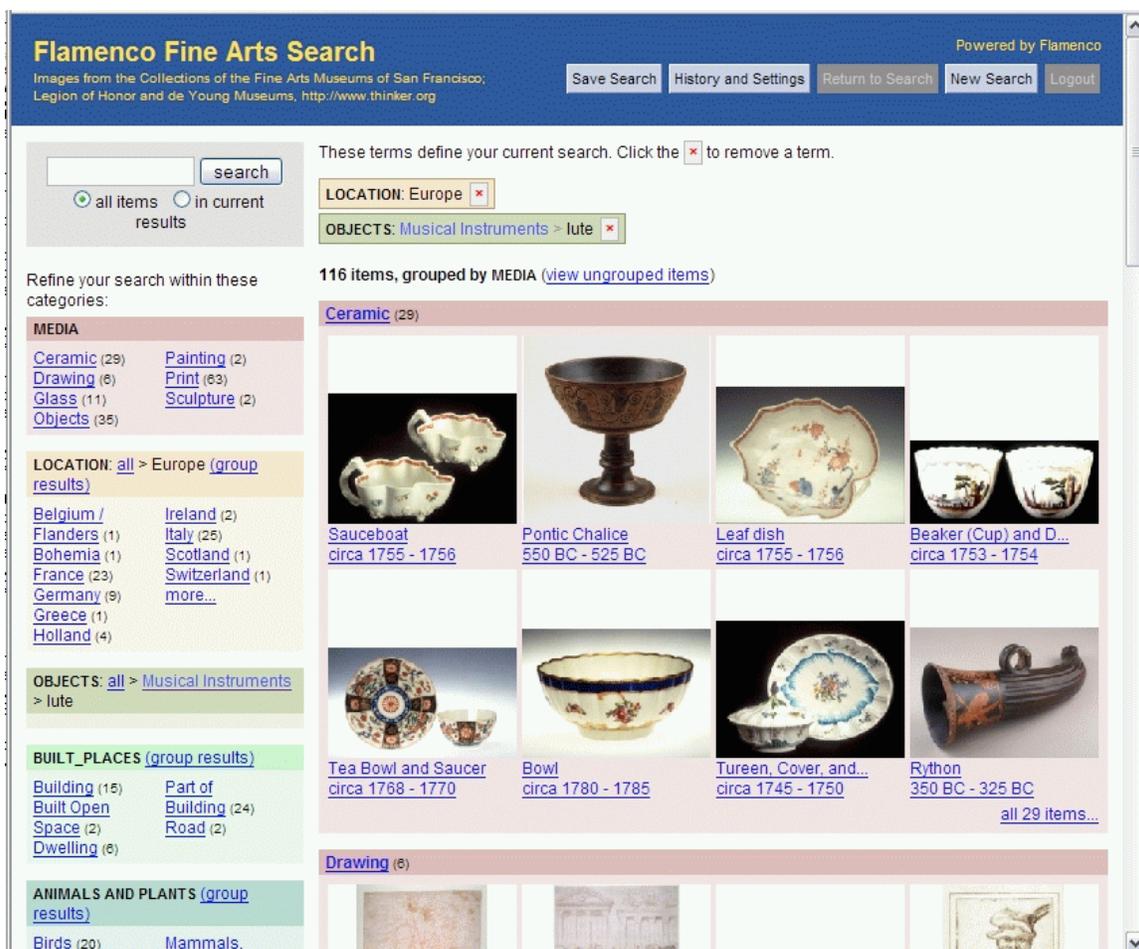


Figure 4: Example of a Faceted Navigation Interface (using the Flamenco system).

The visual display within the faceted navigation approach can vary. Figure 5 shows an alternative way of presenting the information, from eBay Express, and Figure 6 shows an even more visual version from [wefeelfine.org](http://wefeelfine.org).

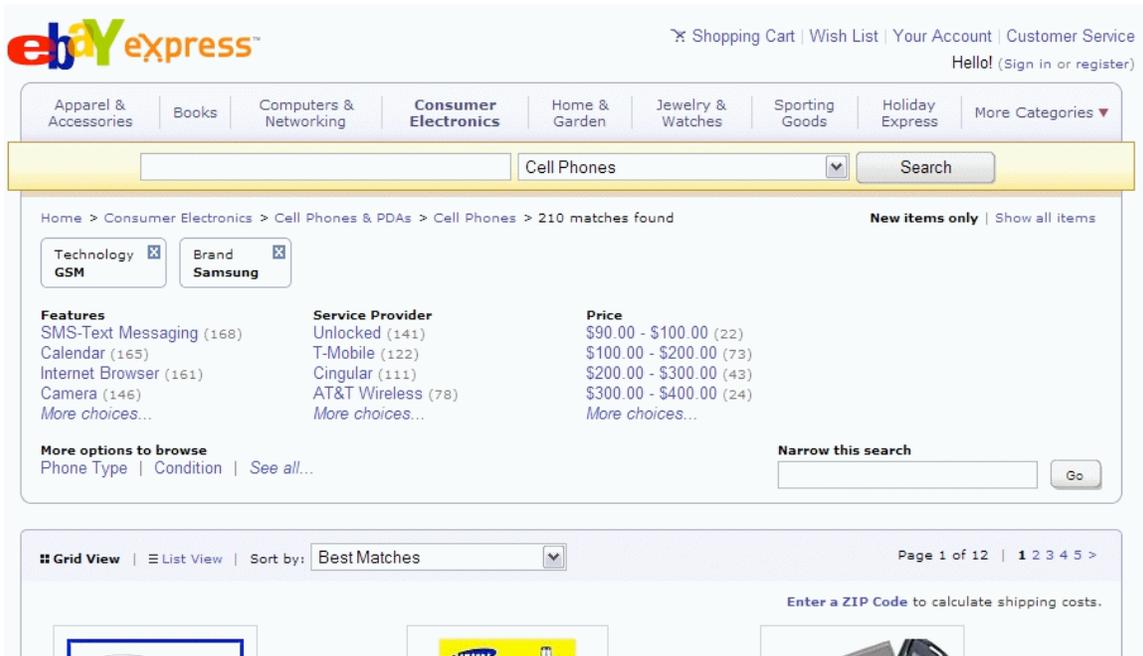


Figure 5: Faceted interface from eBay Express.

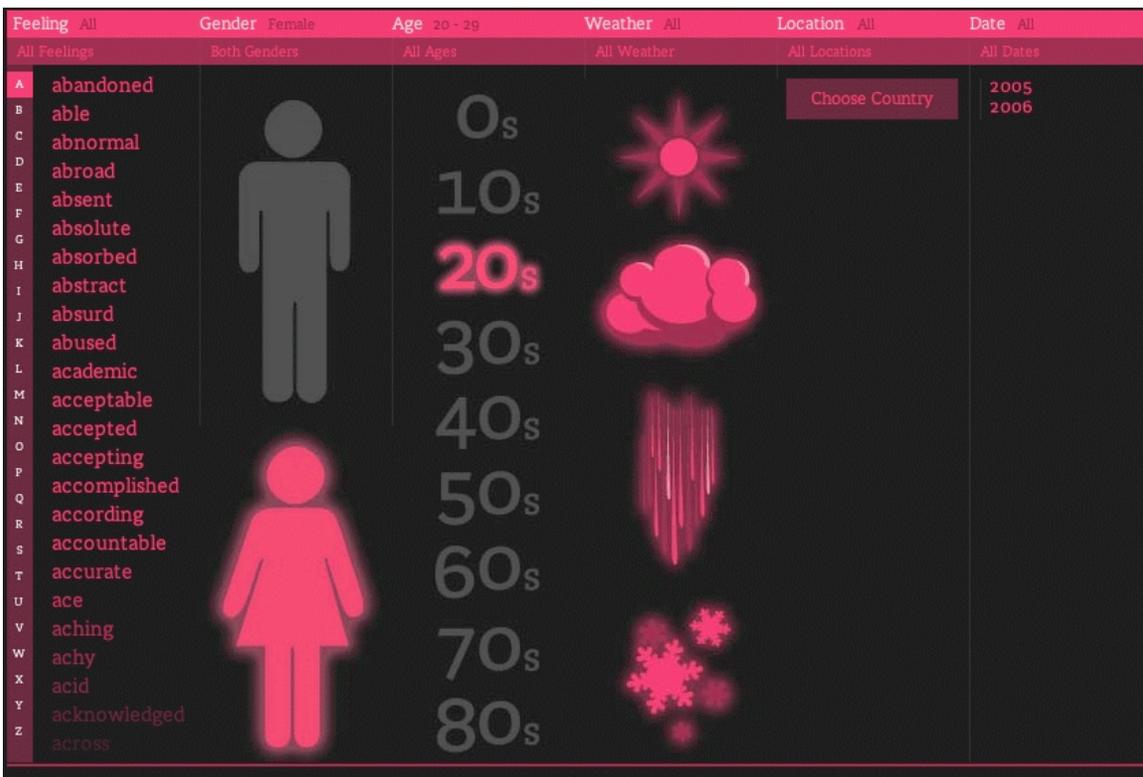


Figure 6: A radically visual method for facet selection, from wefeelfine.org

## Displaying Individual Documents

In addition to allowing annotation of comment meaning, I think it will be important to allow authors to visually indicate which part(s) of the prior art are of most interest to the claim being discussed. There are interesting dynamic visualization techniques for this sort of thing, most notably the fluid documents work [Zellweger et al. 2000] (see Figure 7). This kind of interaction has recently become visible in AJAX / javascript interfaces on the web, and to some degree in the annotation mechanisms seen in the more recent versions of Microsoft Word. However, it requires access to a copy of the original document, which is probably not going to be possible in most cases due to copyright issues surrounding the descriptions of the prior art.

When in the Course of human Events, it becomes necessary for one People to dissolve the Political Bands which have connected them with another, and to assume among the Powers of the Earth, the separate and equal Station to which the Laws of Nature and of Nature's God entitle them, a decent Respect to the Opinions of Mankind requires that they should declare the causes which impel them to the Separation.

We hold these Truths to be self-evident, that all Men are created

**As unequal in many ways as humans may be, no one human or class of humans is superior to another human or class of humans.**

equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the Pursuit of Happiness -- That to secure these Rights, Governments are instituted among Men, deriving their just Powers from the Consent of the Governed, that whenever any Form of Government

Figure 7: An example of fluid documents, from the project described in Zellweger et al. 2000.

If we do eventually have a mechanism to comment on or annotate particular units within a document, then a SeeSoft [Eick et al. 1992- and Read Wear [Hill et al. 1992]-style visualization may be useful to allow participants to see which parts of the patent application and/or which parts of the prior art have been commented upon, perhaps with links to that prior art. An example of this type of visualization, applied to showing where

search hits fall, is shown in Figure 8 by Jonathan Corum of style.org

## State of the Union Parsing Tool



Figure 8: Highlighting search results in documents; a similar visualization could show which parts of a patent or prior art have been commented on. From [style.org](http://style.org)

## Representing Argument Structure

It may be the case that participants will want to apply some structure to their comments, to reflect the role the comments play in the larger discussion. Certain discussion lists allow participants to mark the subject of their comment with an indicator signifying level of agreement. For example, the Apache developers email lists allowed participants to vote on design ideas by prefacing their comments with a +1 (in favor) +/-0 (neutral) or -1 (against).<sup>2</sup> Annotations can become more explicit. In the Zest system [Yee 2002], message writers were encouraged to preface their comments with four types of characters: [?] marks a question, [#] marks a statement, [+] marks a supporting argument, and [-] marks an opposing argument. The peer2patent comment system could be designed to provide a drop-down menu of such argument marking types (as is currently done for indicating mood for some blog posting software). If these markings became commonly used, they could be automatically processed to make argument-structure visual layouts. Toulmin structures are well-known argument structure layouts, and other graphical approaches have been experimented with, as the example from Austhink in Figure 9 shows.

<sup>2</sup> <http://httpd.apache.org/dev/guidelines.htm>

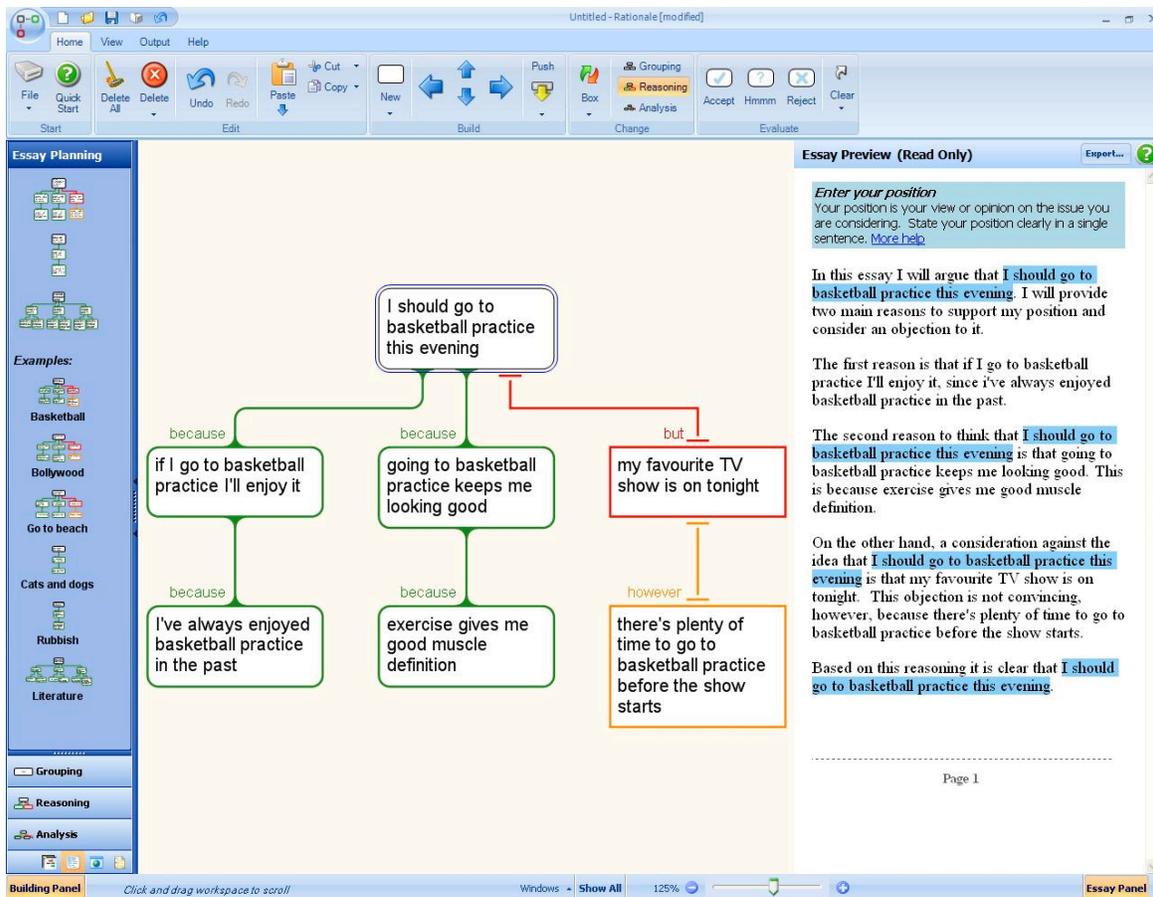


Figure 9: an example of graphical display of argument structure. This image is ©2006 Austhink Software Pty Ltd. Obtained from <http://www.austhink.org/rationale/largescreenshotgallery/>

## Recommendations

In summary, I think that the current screen mock-ups are a good starting point for the peer2patent system design. I suggest they be augmented with dashboard-style screen summarizing the patents within a category, the activity on a particular patent and on a particular claim within a patent. I also suggest that contributing participants have customized screens which displays a “to-do” list consisting of items that the participant is currently working on as well as actions suggested by other knowledgeable participants, with time critical information gaps highlighted. I further suggest that a faceted navigation approach be used for organizing patents and prior art, making use of user-supplied tags and other forms of metadata. I also suggest considering some lightweight form of argument structure indication for commenting on claims and prior art. I recommend avoiding graphical text collection visualizations and general social network visualizations, although more targeted ones like those seen in PaperLens may be feasible.

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