Touch-Based Organization of Patent Collections

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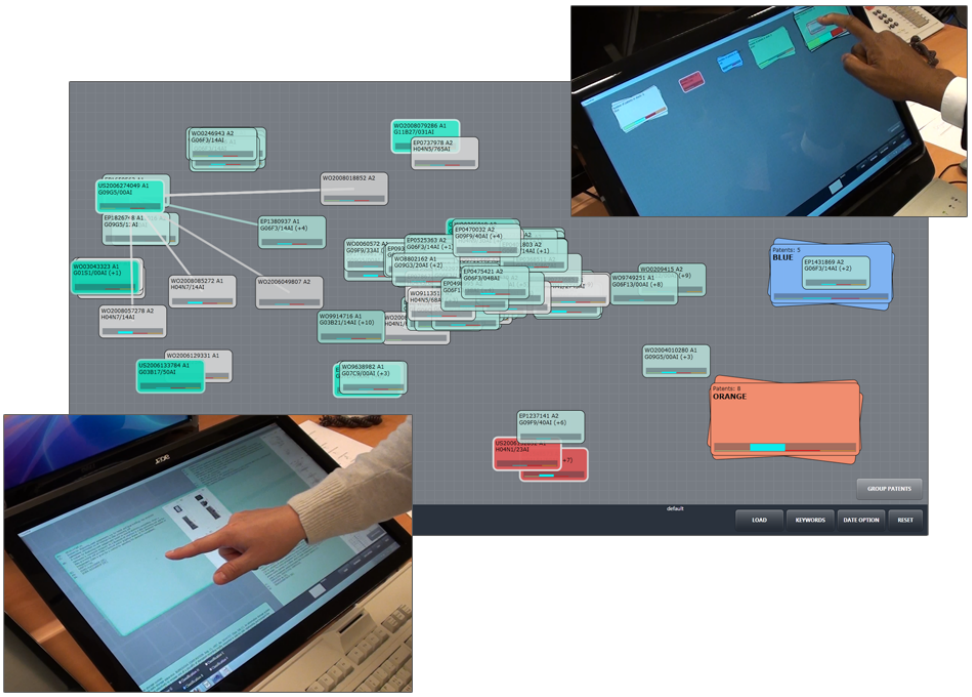

Anne Marijn van Ee

Touch-Based Organization of Patent Collections

THESIS

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in

COMPUTER SCIENCE

by

Anne Marijn van Ee
born in 's-Gravenhage, the Netherlands

Computer Graphics and Visualization Group
Department of Intelligent Systems
Faculty EEMCS, Delft University of Technology
Delft, the Netherlands
www.ewi.tudelft.nl

Research & Development
European Patent Office
The Hague, the Netherlands
www.epo.org

Cover picture: An organization of patents based on their classification and two stills from the end-user evaluations.

Touch-Based Organization of Patent Collections

Author: Anne Marijn van Ee
Student id: 1308033
Email: a.m.vanee@student.tudelft.nl

Abstract

The number of patent applications has been growing rapidly: in 2010 the patent application requests increased with 11% at the European Patent Office. It is important that patent examiners can efficiently compare new applications with published patents. Patent examiners review the list of relevant patents, returned by a search query, one at a time using the current tools. There is no overview of the patents and time is wasted when the best document is the last in the list. An overview of the patent collection can provide insights into which patents can be skipped and which should be read in detail.

This work proposes an *Organization Viewer* for reviewing a collection of patents. It is based on the research prototype *TouchPat* which uses multi-touch interaction and displays the patents in a static 2D grid. In the Organizational Viewer, the patents can be organized manually in a spatial layout using a new multi-touch gesture set and *Stacks*. In addition, this work examines how automatic organization using the *Local Affine Multidimensional Projection* (LAMP) technique can also support the user. These new organization techniques are evaluated with twelve patent examiners at the European Patent Office using the think-aloud protocol. The results of these evaluation show that an overview is a valuable addition to the work of patent examiners and that the value of an overview for patent examiners depends on personal preferences as well as their domain of expertise. The TouchPat prototype and the evaluation transcripts give insight into the features that can improve the process of reviewing relevant patents.

Thesis Committee:

Chair:	Prof. Dr. Ir. F. W. Jansen, Faculty EEMCS, TU Delft
University supervisor:	Dr. Ir. G. de Haan, Faculty EEMCS, TU Delft
Company supervisor:	Dr. B. Diallo, European Patent Office
Committee Member:	Dr. Ir. W. P. Brinkman, Faculty EEMCS, TU Delft

Preface

The research conducted in this Master's thesis is in fulfillment of the Master of Science degree in Computer Science at the Delft University of Technology in the Netherlands. This project was done as an internship at the Research and Development department at the European Patent Office in The Hague and at the Computer Graphics and Visualization Group, Department of Intelligent Systems at the university. I already had a preference for projects about information visualization and liked this project in particular because the problem of examining a collection of documents, files or websites is something everyone encounters.

First of all, I would like to thank my supervisors, Gerwin de Haan and Barrou Diallo, for guiding me through this project. Without their help I would not have had a clue about what I was doing during this project.

Michel de Ridder helped me get started on the project and I want to thank him for explaining how he implemented TouchPat. My thanks also go out to Anton Heijs who helped me gain insight into how Natural Language Processing works.

I give my thanks to the patent examiners who participated in the evaluations and attended my demonstrations. Hearing their opinions directly was very valuable for me and helped me understand the process of examining patent applications.

Finally, I thank my family and Ivy for being there for me during the past months. A special thanks goes out to Erik who helped me get the DllImport working for LAMP and who is always there for me.

Anne Marijn van Ee
Delft, the Netherlands
August 21, 2012

Contents

Chapter 1

Introduction

The future of organizations will be one without paper. A paperless organization is not a new idea but has been in the pipeline since the introduction of digital word-processing equipment in 1975[1]. Moving towards a paperless office has a number of advantages such as saving space and easier information tracking and sharing. In the case of the European Patent Office, patents no longer have to be stored in huge filing cabinets and patent examiners are able to access documents through databases and keep track of their queries to map their search process. One advantage paper documents have, however, is that they are physical entities. When organizing a collection of paper documents, their locations on a desk or in a file cabinet have a meaning and a single document can easily be retrieved because its location is saved in people's spatial memory. The focus of this project is to allow patent examiners to use their spatial memory during the search for relevant documents with respect to a patent application by organizing a collection of patents digitally.

The introduction consists of four parts: the context of this project in 1.1, the problem definition containing the motivation and background of this project in section 1.2, the proposed solution in section 1.3, and finally the structure of this thesis is presented in section 1.4.

1.1 Context

Before a patent application is granted, the document has to be compared to prior art to determine if the invention described in the patent is novel. Patent examiners are experts in their fields and one of their tasks is examining patent applications. This section describes the process of examining a patent application to help the reader understand the context of this project. The process is summarized in fig. 1.1. First, an example of a patent is given and then the search process is explained in detail. For a more detailed description of the patent examination process, the reader is referred to the thesis of Michel de Ridder [Ridder 11].

[1] http://www.businessweek.com/stories/1975-06-30/the-office-of-the-futurebusinessweek-business-news-stock-market-and-financial-advice

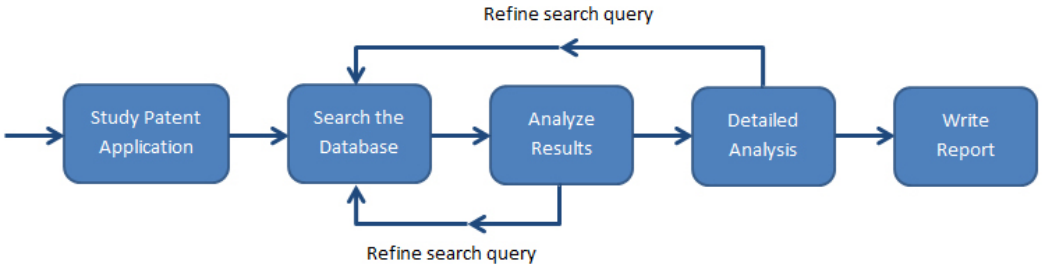

Figure 1.1: The process of examining a patent application can be divided into five phases. [Ridder 11]

A patent is similar to scientific publications since both have a standard setup with, for example, a title and an abstract. A patent contains the following sections: bibliography, description, claims and drawings. The bibliography contains information about the ownership of the patent, such as inventor and applicant, and the filling details, such as country and date of filling—see fig. 1.2. An important aspect of the bibliography is the classification of a patent. A patent can be placed into a number of classes to indicate the scientific area of the invention. The description of the patent contains the full text explaining the invention and the claims section lists what the patent claims to be novel. The drawings are the images in the patent which are referred from the description.

When a patent examiner receives a new patent application, it needs to be compared to existing patents to determine if the application does not infringe any existing inventions. First, the patent application must be read in detail to determine what to search for. Then, patents relevant to the patent application are found by writing queries using keywords and classes to retrieve patents from the databases. A query can return thousands of documents which require inspection. Looking at that many documents is not possible is the time an examiner has to look at a patent application, therefore the search query is refined until at most 500 patents are returned.

A search query returns a list of patents—an example of a patent represented in a list is given in fig. 1.3. Patent examiners can run statistics on this list to help them refine the search query. The statistics show how many patents are contained in each class.

Once the patent examiner is satisfied with the result of the query, the result is loaded into the *Viewer* application—see fig. 1.4. The patent examiner is now able to view the full patent document and can determine whether the patent is relevant to the patent application. The patent examiners must go through the whole search result if they are not satisfied with what they find. It is possible that the document the examiner is looking for is the last document in the list or not in the list at all. In the latter case, the search query must be refined to get a new collection of patents to review.

The final step in the examination of a patent application is going through the claims to check if each claim is exclusive to this application. A report is then written with the findings of the patent examiner and the relevant patents are cited to support these findings.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

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(71) Applicant: **SHARP KABUSHIKI KAISHA**
22-22 Nagaike-cho Abeno-ku
Osaka 545(JP)

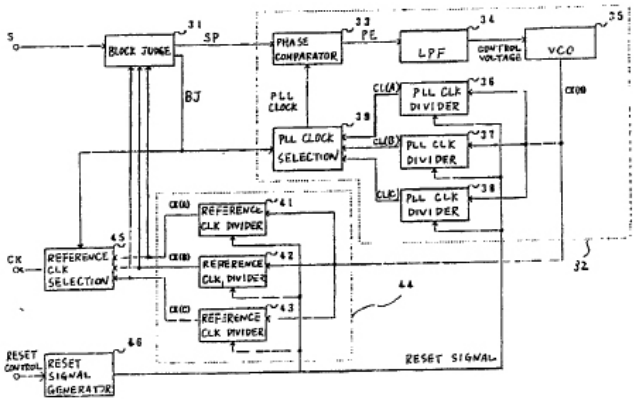
(72) Inventor: **Deguchi, Toshihisa**
C-722 Daiya Heights, 2-200-5,
Gakuendaiwa-cho
Nara-shi, Nara-ken(JP)
Inventor: **Fuji, Hiroshi**
3-1-30-206 Kataokadai, Kanmaki-cho
Kitakatsuragi-gun, Nara-ken(JP)
Inventor: **Terashima, Shigeo**
95-86 Kaminosho-cho, Nikaido
Tenri-shi, Nara-ken(JP)

(74) Representative: **Huntingford, David Ian et al**
W.P. THOMPSON & CO. Coopers Building
Church Street
Liverpool L1 3AB(GB)

(54) An apparatus for recording and reproducing information on and from an optical disk.

(57) An apparatus for recording and reproducing information on and from an optical disk in which at least one optical beam and a reference clock signal are used. The optical disk comprises recording tracks which are divided into a plurality of blocks and concentrically arranged along the radial direction. The apparatus comprises: a block judging unit for judging which one of the blocks is the one which is currently impinged by the optical beam; a clock signal generator for generating a plurality of clock signals which are different in frequency from each other; and a clock signal selecting unit for selecting one of the clock signals as the reference clock signal, on the basis of the judgment of the block judging unit.

Fig 1



EP 0 392 853 A2

Figure 1.2: An example of a first page of a patent containing the bibliographic details such as the title and abstract of the patent EP 0392853 A2, published 17 October 1990.

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Search statement  2

?  ..li /pn /ti /ct
1/1 - (C) EPODOC / EPO
PN  - EP2015576 A1 20090114
TI  - Information distribution system, information distribution method, and
      information display device
CT  - WO2005125198 A2 [Y];      WO0191415 A2 [Y];
      WO0072596 A1 [Y];         US2002133393 A1 [Y];
      US2003046162 A1 [Y];      WO9840816 A1 [Y];
      US2007169047 A1 [YP];     EP1343324 A2 [A];
      WO0065576 A2 [A]

Search statement  2
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Figure 1.3: The result of a search query is a list of patents. This figure shows how one patent is displayed in a list.

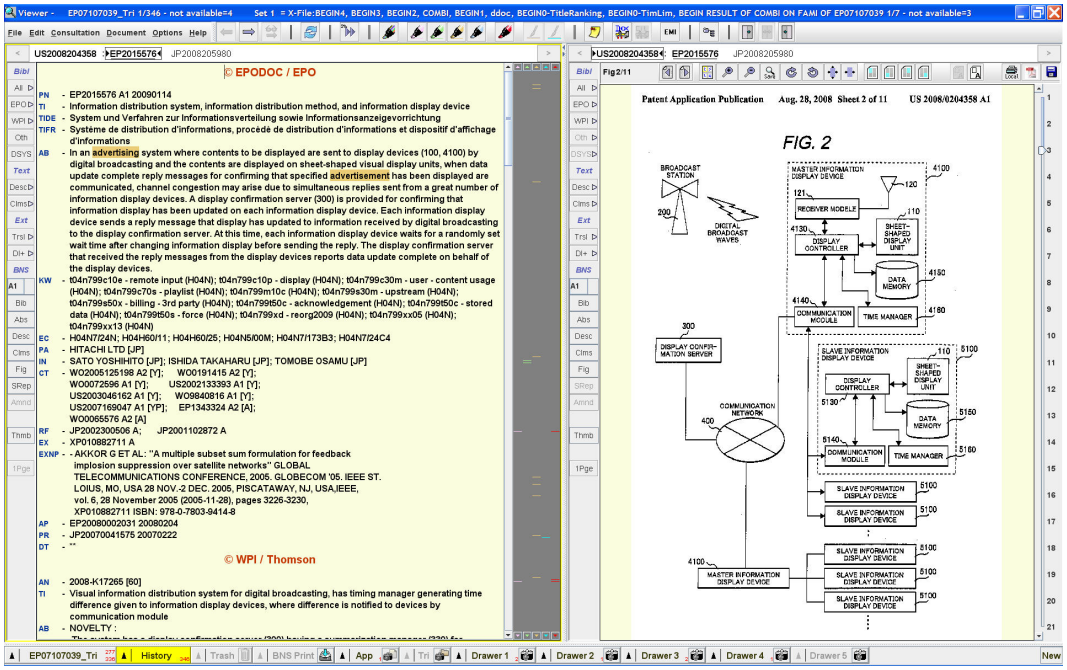


Figure 1.4: The Viewer application shows the full text of the patent contain the bibliography, description and claims (left) and the drawings (right). The middel bar shows where the annotations are located within the document.

1.2 Problem Definition

The background of this project is described in this section. First, the motivation for this project from the perspective of searching for relevant patents is shown in section 1.2.1. This project extends the work done by a previous student at the Delft University of Technology for the European Patent Office. Michel de Ridder created the *TouchPat* application which displays a collection of patents [Ridder 11]. Section 1.2.2 shows the feedback on TouchPat given by patent examiners that is addressed in this project.

1.2.1 Motivation

The number of patent applications has been growing rapidly: in 2010 the patent application requests increased with 11% at the European Patent Office[2]. The worldwide patent offices cannot keep up with the large amount of patent applications, which causes an increasing backlog of patents that have yet to be processed[3]. It is, therefore, of importance that patent examiners can efficiently compare new applications with the published patents.

Currently, patent examiners review the relevant patents to a patent application, returned by a search query, one at a time. None of the current tools the patent examiners use are able to provide an overview of a patent collection. A global overview of the patent collection provides insights with respect to which patents can be skipped and which should be read in detail. At the moment, this overview does not exist and time is wasted when, for example, the best document is the last document in the list of the query.

Another process were an overview of a collection of patents can contribute is during the re-classification of patents. All documents that need to be reclassified are printed and for 3000 documents, this means using a lot of paper. To move towards a paperless office, automatic reclassification tools have been created. Even with this automation, patent examiners must provide the examples to the system by manually classifying an average of at least the half of the documents. To reduce the use of paper, the reorganization of these patents could be done virtually.

Spatial memory was important at the European Patent Office when they worked with paper documents in file cabinets. Patent examiners would know exactly where to find documents based on their locations in the cabinets. Now that all documents are saved digitally, this spatial memory is no longer used.

1.2.2 TouchPat

An overview of a patent collection has already been created during a previous Master's thesis project by Michel de Ridder [Ridder 11]. He created a system called *TouchPat* to display a collection of up to 1000 patents in a grid view—see fig. 1.6. It is possible to

[2] http://www.epo.org/news-issues/news/2011/20110413.html

[3] http://www.ipo.gov.uk/p-backlog-report.pdf

browse and navigate through this collection using a multi-touch input device and the patent examiners can use this application to narrow down the number of relevant patents to 2 to 5 patents. The relevance of the patents is based on the patent application that has to be examined. Within the search process, his work focuses on helping the patent examiners during their detailed analysis of the search results—see fig. 1.5.

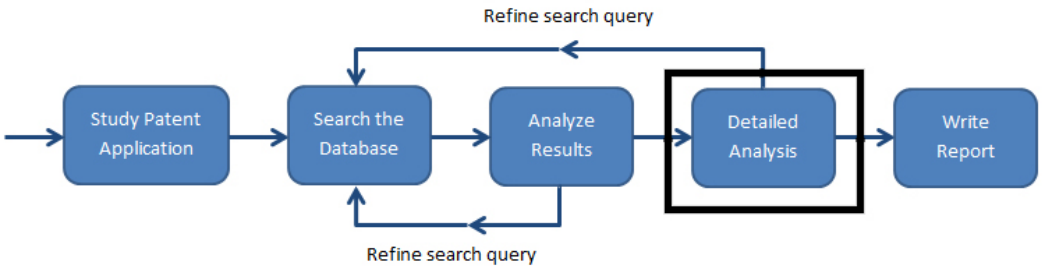


Figure 1.5: The process of examining a patent application can be divided into five phases. The focus of TouchPat was to enhance the Detailed Analysis phase by providing patent examiners with a visual overview of a collection of patents. [Ridder 11]

TouchPat uses thumbnails to display patents. Based on the size of the thumbnail, the content of the thumbnail is updated. When a thumbnail is large, it has more space to display the data of a patent in. Images and the abstract can then be added to the thumbnail, for example. Smaller thumbnails can only show a limited amount of data and might be restricted to only showing the patent number and classification.

TouchPat was evaluated with end users after de Ridder gave them a demonstration of the system. Their comments in the discussion following the demo are listed in his thesis [Ridder 11]. The most promising topics were selected as the topic of this thesis: clustering patents and the spatial relations between the patents. Below are the excerpts from the discussion describing these two topics:

Clustering "TouchPat gives an overview of 1000 patents, each patent is visualized by a rectangle object that contains information about the patent. Clustering algorithms could directly provide subcollections of similar patents and need less space to visualize the whole collection. Why did we not make use of clusters?" [Ridder 11]

Spatial Relations "The patent collection can be ordered in different ways. What is the relation between two horizontal and two vertical patents in the ordered list?" [Ridder 11]

TouchPat does not use clusters to display groups of patents because 1000 can still be shown using the grid. However, the information in the thumbnail of the patent is reduced to only a color that represents the classification. Clusters can be used to make groups of similar patents and give them a thumbnail representing the group. This reduces the amount of space needed to display multiple documents.

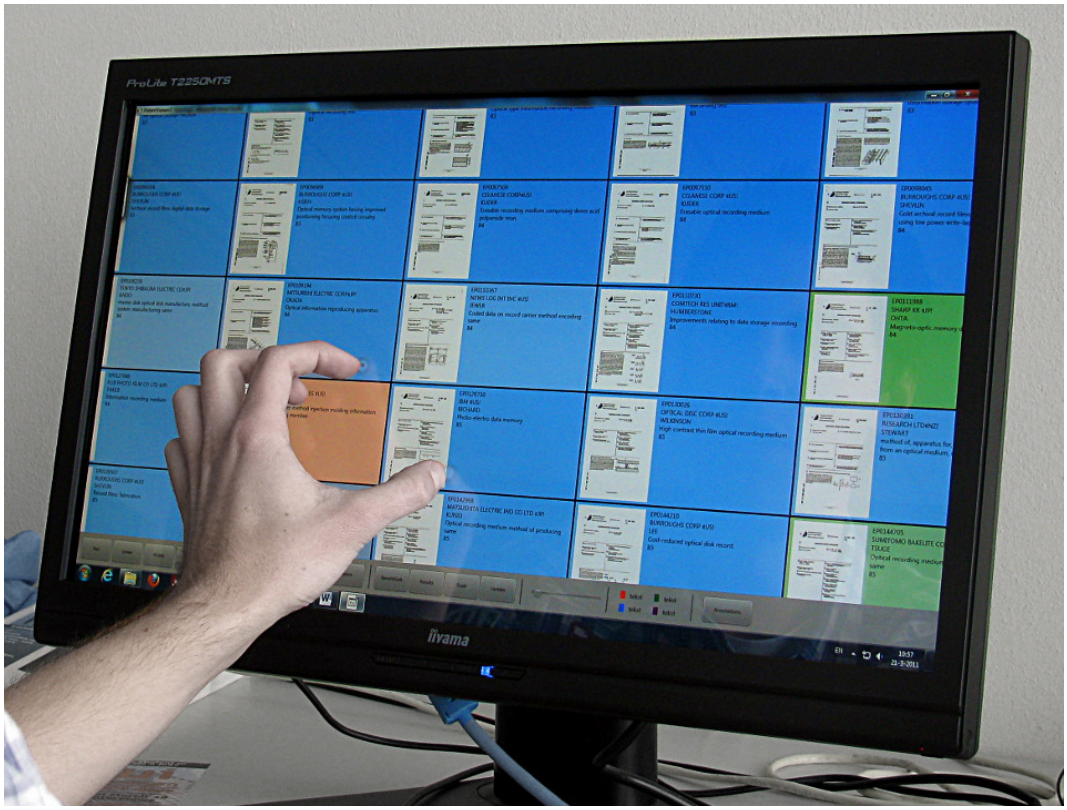


Figure 1.6: The multi-touch interaction with TouchPat. The patents are placed in a grid and each document is represented by a thumbnail containing data from the patent. [Ridder 11]

In TouchPat patents can be sorted using data such as the classification. The sorting of the patents is based on the sorting of a list: only one dimension is used. TouchPat displays the patents in a grid, however. Thus, this method of sorting does not take advantage of the two dimensions of the grid. When trying to determine if a patent is similar to another patent after sorting the collection, only the patents on the horizontal line can be used. The patents placed above and below the patent do not have to be related to this patent in any way. The spatial relations between the patents can thus be improved.

1.3 Research Goal

To give an overview of a collection of patents, the patents need to be displayed in a way that they are identifiable. An overview is meaningless if examiners are not able see the information they need to determine if a patent is relevant or not. The system should, therefore, provide the examiner with an overview but also make more detailed information about a patent easily accessible. This will help the examiner to quickly decide which patents need to be reviewed in more detail and which patents are not relevant to the application.

Placing patents in an overview display requires that patents are positioned with respect to each other: patents can be ordered using a measure such as date or the patents can be positioned by the users. When the examiners determine where to place a patent, they create a mind map of the collection just as when they organize their desks. Using their spatial memory helps examiners keep their overview of the collection, even after returning to the collection after a period of time. The grid display in TouchPat is too rigid for organization because it does not allow the user to manually place patents in the visual space. This project, therefore, aims to be the first step in the Detailed Analysis phase and the grid display can be used at a later stage within this phase.

Due to the increasing amount of work the patent examiners face, tools can help them perform certain aspects of their search for relevant patents automatically. A clustering algorithm is able to support the user during the organization of the patents by automatically placing patents in the visual space.

Three issues are addressed in this project: the overview of a patent collection, using organization to give patents meaningful positions in the visual space, and providing automatic tools to support the users during their organization of the collection. This had lead to the formulation of the following research goal:

Research Goal: "Investigate and develop a prototype that provides the user an overview to explore and organize a patent collection by clustering the documents based on a similarity measure. The user is able to organize and navigate the collection using a multi-touch input device."

This research goal can be divided into two sub-goals: clustering versus organizing manually and navigating the collection. This division is used through this thesis to explore if one of the two goals is enough or if indeed a combination of the two is needed for this solution to be a successful addition to the work of a patent examiner.

- **Organize & Navigate**: Provide the user with the tools needed to explore a patent collection and to organize the patents within this collection using touch-based interaction.
- **Automatic Clustering**: Provide an automatic clustering technique to allow the users to organize the patents based on a similarity measure.

1.4 Overview of Remaining Chapters

The chapters in this thesis are structured in the following manner. First, chapter 2 deals with the related work in the field of patent visualization, the display of large document collections and multi-touch gesture set designs. It also contains a section about TouchPat. This is used as the basis for the requirements and design of the new visualization within TouchPat, the Organization Viewer, which is described in chapter 3. The organization of

a collection can be done manually, but this project also looks at the possibility of using (semi) automatic clustering methods. Chapter 4 shows what methods were considered for the clustering algorithm and explains the algorithm behind the chosen method, Local Affine Multidimensional Projection. How the design and clustering algorithm have been realized in the Organization Viewer within TouchPat is the focus of chapter 5. This system is evaluated at several stages with patent examiners. How these evaluations were conducted and the results are discussed in chapter 6. The final chapter, chapter 7, contains the conclusions about this project and provides possible future work.

Chapter 2

Background & Related Work

This project is preceded by the work of Michel de Ridder [Ridder 11] but is also based on patent visualizations and the visualizations of collections of research publications. The system uses touchscreens to allow users to directly interact with the patents, therefore, research on gesture sets is also a topic of related work that is explored here. These topics of related work are presented in this chapter.

The first section of this chapter describes *TouchPat*, the system created by de Ridder, to understand the background of this project. Section 2.2 shows a number of visualizations of patent data and section 2.3 gives examples of methods to display a collection of documents. Users interact with a touchscreen to perform actions. This requires other interactions that are normally performed with a mouse and keyboard. Section 2.4 describes navigation techniques and gives two examples of existing gesture sets. This chapter ends with the conclusions reached from the related work. The clustering algorithms considered during this project are compared in chapter 4.

2.1 TouchPat

The research project for organizing patents stems from the previous work done by de Ridder at the Delft University of Technology and the European Patent Office [Ridder 11]. During his project, he created *TouchPat* to browse a collection of patents using multi-touch interaction. The new system for patent organization, the Organization Viewer, is an extension of TouchPat. To understand why certain solutions for the Organization Viewer are chosen, this section describes TouchPat. First, the goal of the system is explained and in section 2.1.2 the result of de Ridder's project is shown.

2.1.1 Goal

Patent examiners work with several systems during their examination process. First, a search engine is used to find a collection of patents relevant to keywords and/or classifi-

cations and once a result of 500 patents is reached, each patent is viewed one by one in the *Viewer* system. There is no overview of the collection of patents other than information such as the number of patents in the collection. The goal of de Ridder's project was to create a system which allows a patent examiner to have a visual overview of a patent collection and interact with it using a touchscreen. The formal goal stated in de Ridder's thesis is shown below [Ridder 11].

Research goal Investigate and construct a prototype that gives the user a visual overview of a patent collection of up to 1000 documents; allow the user to browse and navigate through this collection by using a multi-touch input device; and be able to create a subcollection of two to five patents that are most relevant based on the patent application.

2.1.2 Result

The result of de Ridder's project is the TouchPat prototype. As stated in his research goal, the system visualizes a collection of patents which users can browse through using a touchscreen. The users are also able to create groups of patents. Specific implementation details are provided in this section that also highlights a number of features of the system.

TouchPat was created using the *Microsoft Surface Beta API*. This API makes it possible to create touch-based applications using C# and the *Windows Presentation Foundation*[1] (WPF). It runs on Windows 7 and can be programmed in Visual Studio with the .NET framework 4. The *Surface Toolkit Runtime* application must also be installed. With this setup, standard gestures such as a pinch for zooming can be easily implemented. The gestures used in TouchPat are shown in section 3.4.1.

A collection of 1000 patents is visualized in TouchPat by displaying a grid which utilizes the whole screen area to display the patents. Patents are given a color based on their classification and when 1000 patents need to be displayed, other information can hardly be shown in the limited space of one patent—see fig. 2.1. When users zoom in, the grid displays a subset of the collection so each patent shows more information. The patents are represented by a thumbnail containing a certain amount of data based on the space available to the patent, see fig. 2.2 for an example. This type of display is called a Zoomable User Interface and this is explained in more detail in section 2.4.

TouchPat gives the user the option to open a patent in the *DetailViewer*. The interface is based on the Viewer application, the program the patent examiners currently use to look at individual patents—see fig. 2.3. Multi-touch interactions are used to scroll through the text of the document and to swipe through the drawings. The drawings can be opened and manipulated to look at the details of the image by zooming in.

The *context menu* is used to select actions that can be performed on individual patents, on a selection of patents or on the whole set of patents. For example, a patent can be viewed in

[1] http://msdn.microsoft.com/en-us/library/aa970268.aspx

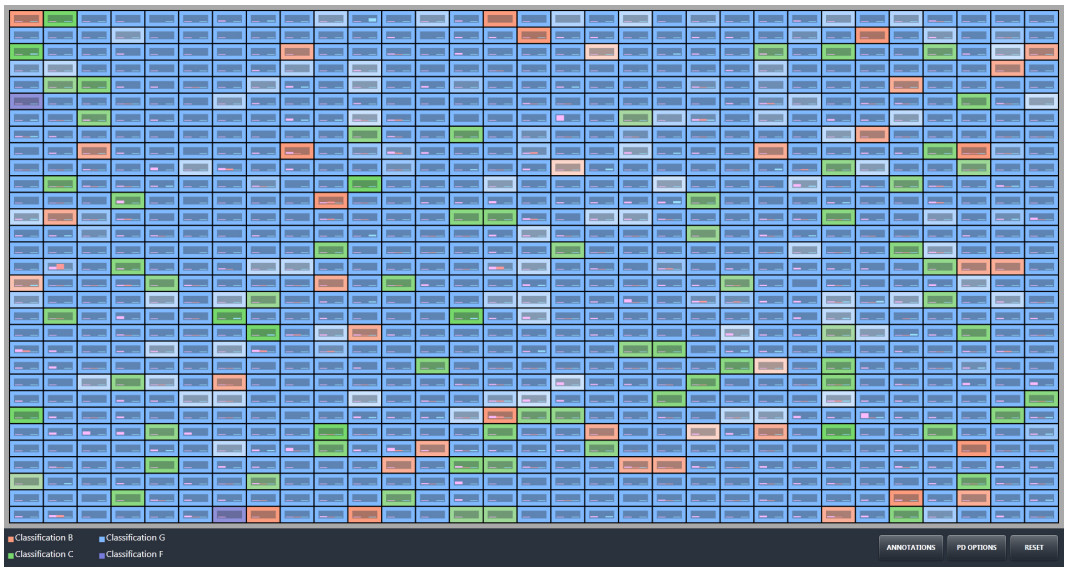


Figure 2.1: The display of 1000 patents in TouchPat. Each patent is represented by a rectangle where the color is determined by its classification and the histogram shows the frequency of the keywords in the document. [Ridder 11]

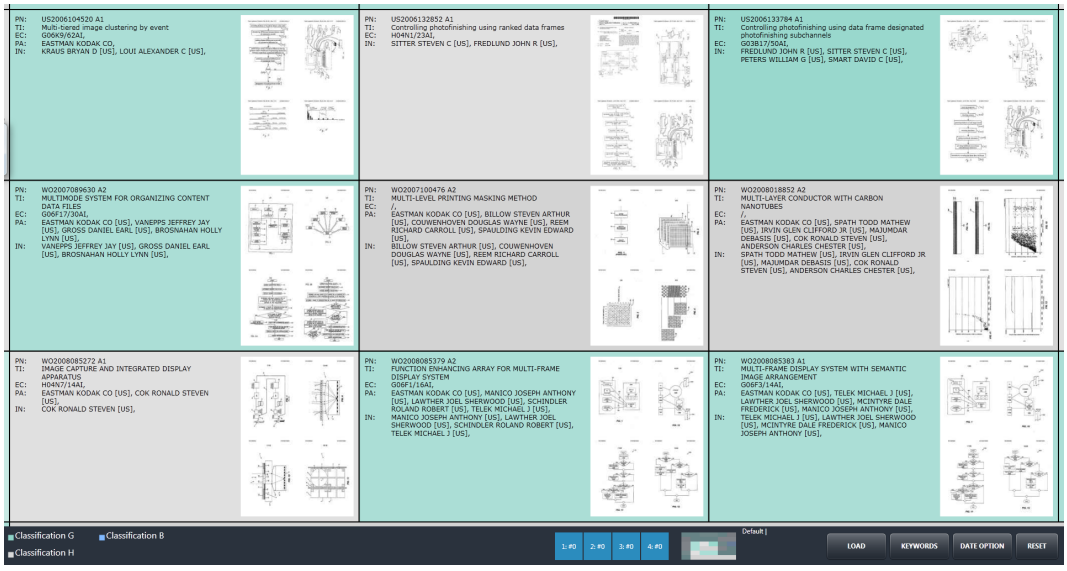


Figure 2.2: The zoomed in display of TouchPat. The 9 patents fill the whole screen to be able to display as much information as possible. When the space available is large enough, images are added to the display. [Ridder 11]

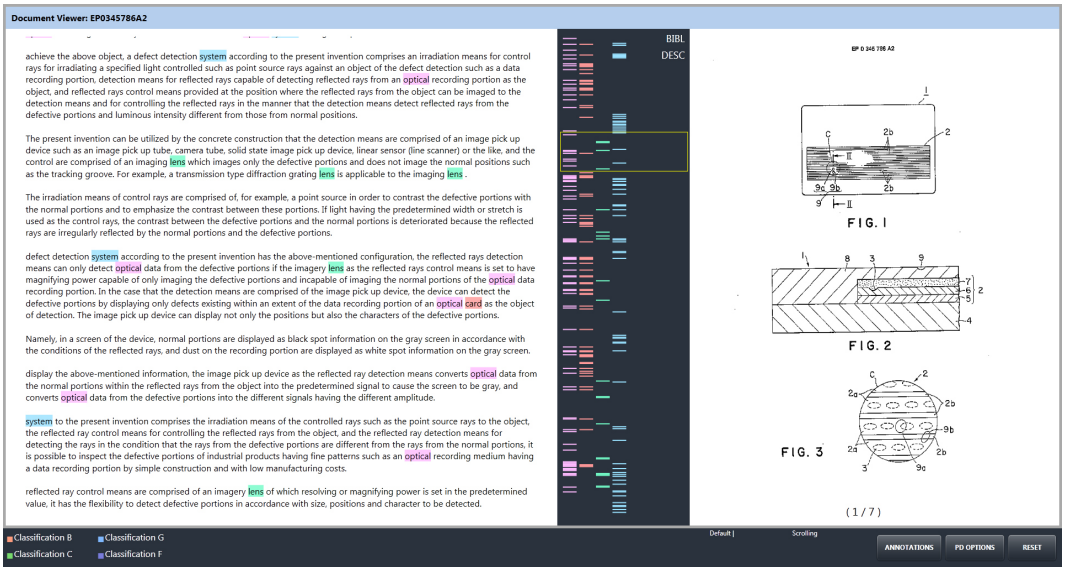


Figure 2.3: The detailed view of a patent. The left part of the screen shows the text of the document and the right side contains the drawings in the document. The middle part consists of the annotation bar which shows where keywords are located and can be used for directly moving to a part of the text. The interface is based on Viewer, the tool patent examiners currently use to view patents. [Ridder 11]

the DetailViewer by selecting the 'open' action through the menu. Menus created for multi-touch require different interactions than the menus used with a mouse because a finger is less accurate than the mouse pointer is. Rather than clicking on menu items, the users drag their fingers through the menu as can be seen in fig. 2.4. The shape of the menu is a hexagonal and this makes some gesture easier to perform than others. Actions that are frequently performed using the menu are placed on the straight lines from the center since this is a quick and easy gesture to perform.

The last sub-goal of de Ridder's project was to allow an examiner to create subcollections of patents. Patent examiners currently use a concept of 'drawers' to place the documents in groups. The term drawer is used in TouchPat as well. Users can select multiple patents and place these in drawers using the context menu. Patents can also be removed from the display when, for instance, the patent is clearly not relevant to what the examiner is looking for. These options help the users organize the patent collection and to narrow down the number of patents they need to examine in greater detail.

2.2 Patent Visualization

Various researchers have spent time on providing visual tools to gain a better understanding of the content of patents. The focus can be from finding the trends of patent applications

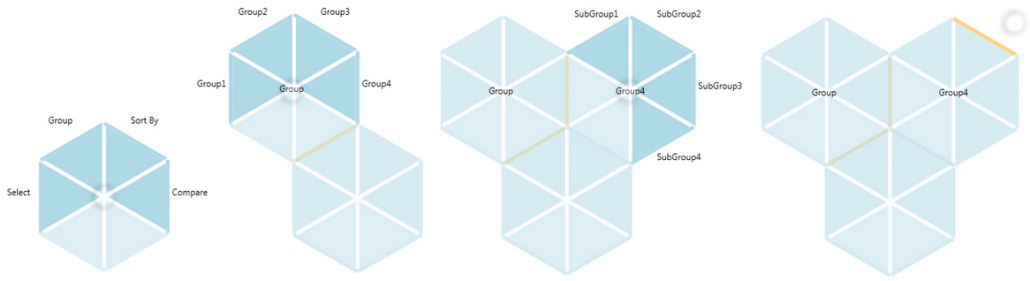


Figure 2.4: The context menu needs the user to cross the outer border of a menu item to either open a sub-menu (middle images) or select the action to perform (right image). [Ridder 11]

through the years [Gress 10] to systems that help search and analyze patents such as PatViz [Koch 10]. In this section, an overview of a number of existing patent visualization tools is given.

A recent project dealing with patent data is *PATExpert* [Wanner 08]. The goal was to provide an application which allows semantic processing rather than only using the current textual representation[2]. One of the applications created as part of this project was *PatViz*, which provides "a new interface for advanced patent navigation and visualization" [Koch 10]. PatViz uses a desktop with several visualizations such as a *World Map*, a 2D and 3D treemap to show the classifications, and a *Term Cloud* showing the most frequent terms. In total there are 11 views available to the user, see fig. 2.5. The 3D Treemap is discussed in more detail below.

The *3D Treemap* view visualizes the distribution of the classifications in a patent collection [Giereth 08]. Instead of coloring a 2D treemap, the third dimension shows the amount of patents in a classification, as can be seen in fig. 2.6. This makes it possible to compare the distributions of several patent collections in one view by stacking the amounts in each collection on top of each other using different colors. Another feature of this 3D treemap is the use of edges to indicate co-classifications. A patent can have multiple classifications and the co-classification is the relationship between classifications that contain the same patent(s). This is used to look for similar patents in other classifications that are related through the co-classification.

The *patent family graph*, which is explained in detail in [Giereth 07], is another view in the PATExpert project [Wanner 08]. A patent family contains all patents, which have been filled in different countries, that have the same priorities and claims. When searching for patents, the amount of patents returned by a query can be reduced by grouping the patents that belong to the same family. The patent family graph shows when each patent in a patent family is filled in which country. The larger the node of a patent in the graph, the

[2] http://www.patexpert.org/

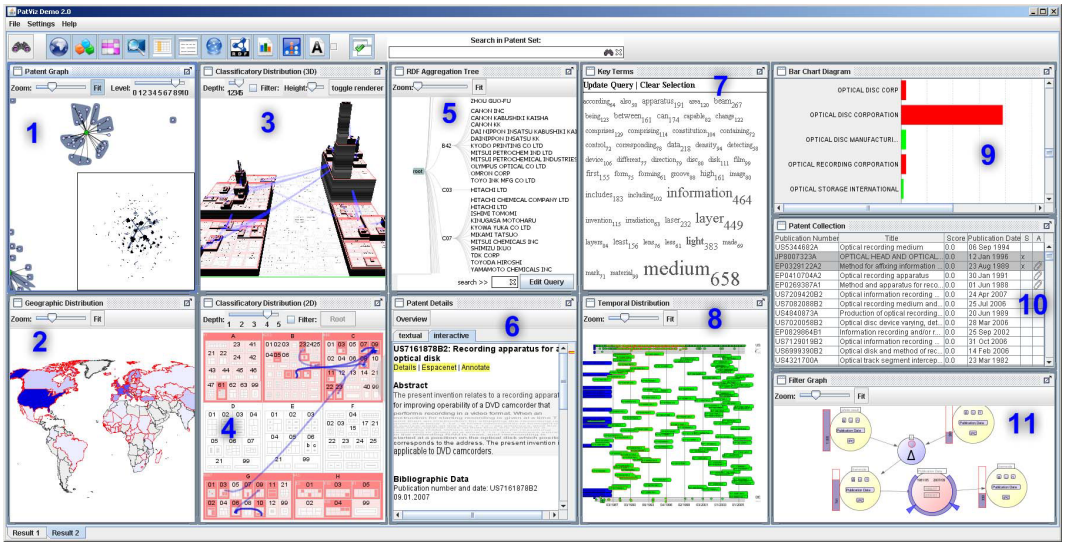


Figure 2.5: The PatViz desktop shows 11 visualizations. "These are from top to bottom and from left to right: 1. *Patent Graph* - a configurable graph view that can show various connections between entities of the result set; 2. *World Map* - a distribution of the patent documents over the filing countries; 3. *3D IPC Treemap* - a distribution of the patent documents over a classification schema shown in a 3D Treemap; 4. the same Treemap in 2D; 5. *Aggregation Tree* - a tree view that can aggregate the result set by an adjustable hierarchy; 6. *Text View* - a viewer for patent document texts that can overlay results of the linguistic analysis and allow for intra-document navigation; 7. *Term Cloud* - a cloud of words that refers to the most frequent terms; 8. *Geo-Timeline* - a scatterplot of the filing date and filing country of patent documents; 9. *Bar Charts* - a simple bar chart aggregation of the set by one choosable metadata field; 10. *Table* - a table containing the most important data of the patent documents like number, title, and applicant; 11. *Selection Management* - a graph based tool to store, combine and adjust selections." [Koch 10]

more often it is referred to by other patents. This is also used in the other visualization shown in [Giereth 07]: the *patent family clusters*. The clusters within a patent family are created using force-directed graph drawing algorithm. This visualization also gives insight into which priority documents are an important basis for the patents within the family—see fig. 2.7.

Another graph representation, relating to patents, is the visualization of the USPTO patent citation network [Gress 10]. The data sets used contains 4 million US patents with 22 million citations from the year 1963 to 2002. One of the visualizations consists of 6 patents and their distance-2 or distance-3 citation neighborhood which is shown in fig. 2.8. The visualizations were used to evaluate the trends within technology categories.

The last type of patent visualization mentioned here is the use of *Self-Organizing Maps* (SOM). Kohonen et al. mapped 6,840,568 patent abstracts onto a 1,002,240 node SOM to demonstrate that the SOM algorithm could handle large amount of high dimensional data [Kohonen 00]. Patent abstracts that are similar are placed near each other on 2 dimensions.

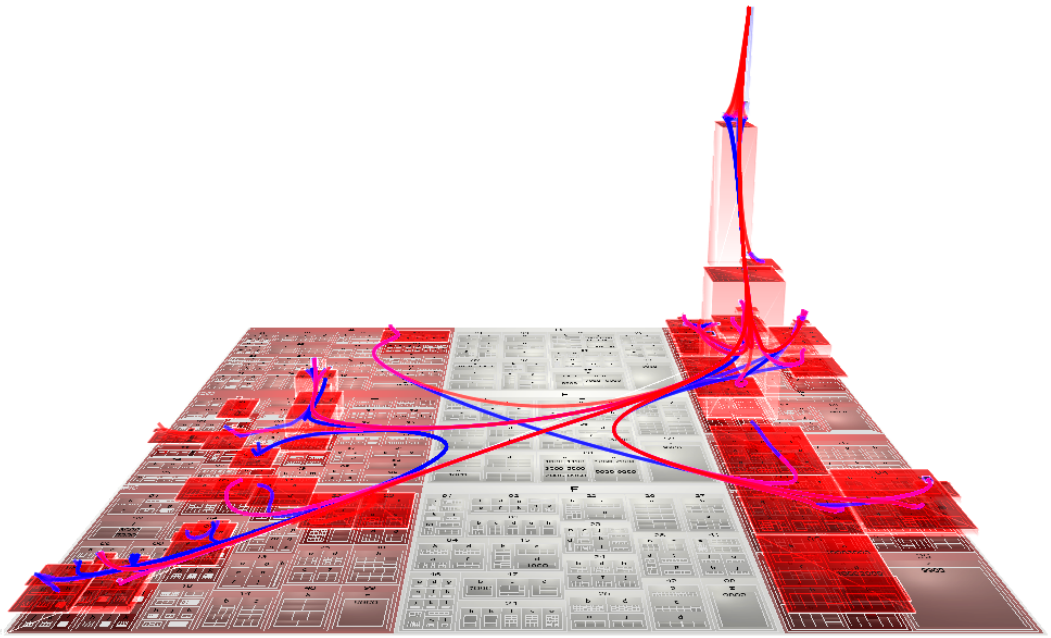


Figure 2.6: The 3D treemap visualization of classifications where the height indicates the amount of patents per classification and edges represent co-classifications.[Giereth 08]

The result allows users to query the map by providing a short document or keywords. The matching points are marked on the map with circles where the size of the circle shows how well it matches the query. The points can be used as a starting point to begin browsing and exploring the collection of patents by looking at patents that are placed near the circles—see fig. 2.9.

Yoon et al. 2002 [Yoon 02] also use a self-organizing feature map (SOFM) to show the relationships between patents. Several maps are created by using certain parts of the patent data. For example, the technology vacuum map, which can be used to find the up and coming technologies, uses all the patent data. On the other hand, the claim point map only uses the keywords of the claims of the patents to show possible claim infringements.

Most of these studies have not conducted any evaluation with users. Only in the project of Koch et al. was a user study conducted [Koch 10]. One part of the study was a questionnaire about the visual query builder. Two patent specialists participated in the study and the 13 other users were post graduates in the field of computer science. The second part of the study was a think-aloud evaluation with patent specialists who were involved in the PATExpert consortium. The number of participants is this second study is not mentioned, only that a relatively small sample was used in this evaluation. The results are presented informally and include that at first the simpler views, such as the world map and tag cloud, were used more by the patent experts. The reason might be that most of the patent experts have never worked with an interlinked and interactive visual interface. After an introduction, however,

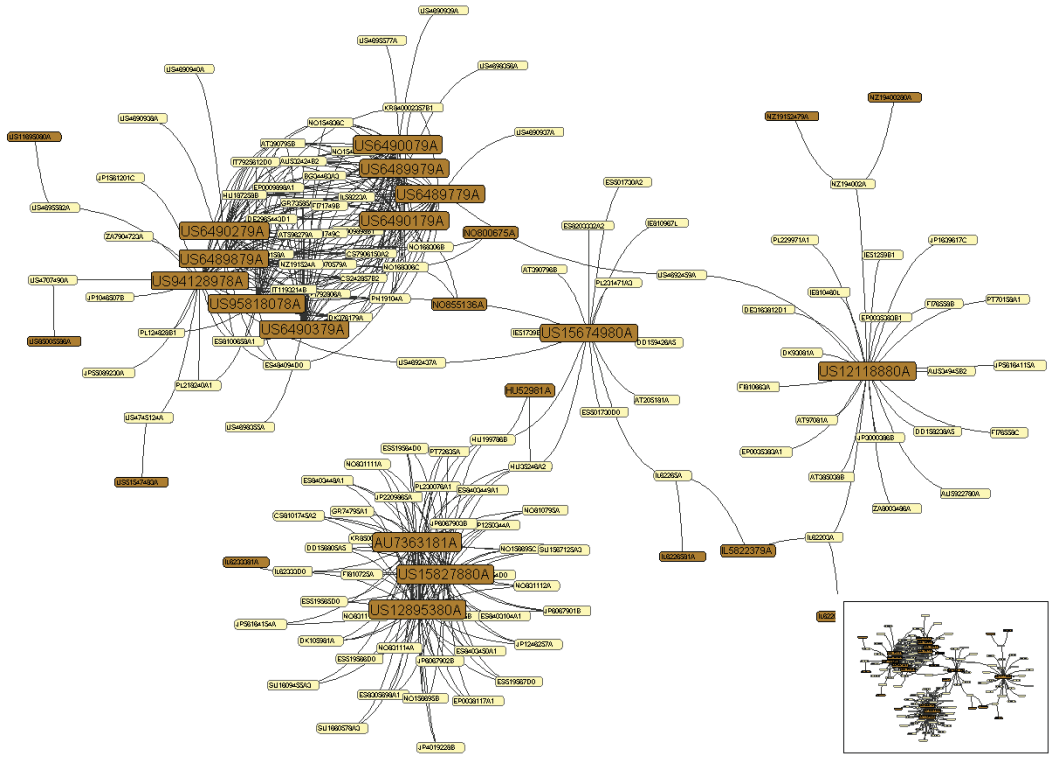


Figure 2.7: Clusters within a patent family shows which documents are priority documents. [Giereth 07]

the other views were also used during their analysis. This suggests that after some training, patent experts can use the more sophisticated views without any issues.

2.3 Document Collection Visualization

As seen in the previous section, graphs are used to display relations between patents such as citations or patent families. Scientific publications also have large citation networks that can be visualized using graphs. This section provides some examples of applications which display citations using different types of graphs. For instance, radial graphs are used by *PaperScope*—see section 2.3.1—and by *PaperCube* which also uses bubble graphs as is explained in section 2.3.2. Section 2.3.3 describes the *Action Science Explorer* system which is an example of a clustered graph.

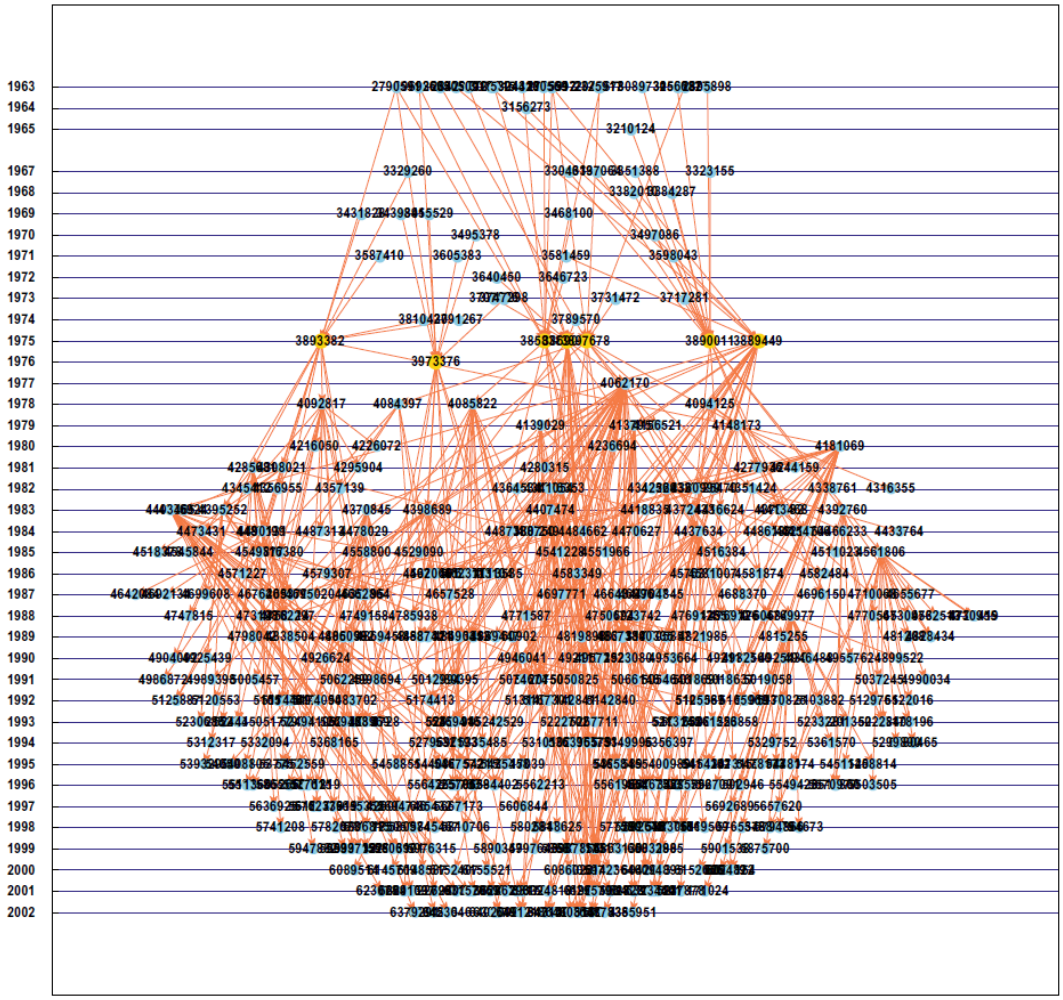


Figure 2.8: A graph showing the distance-2 citation neighborhood around six patents from 1975 (pictures in yellow) [Gress 10]. The patent numbers are positioned based on the year they were published and the edges represent the citations between patents.

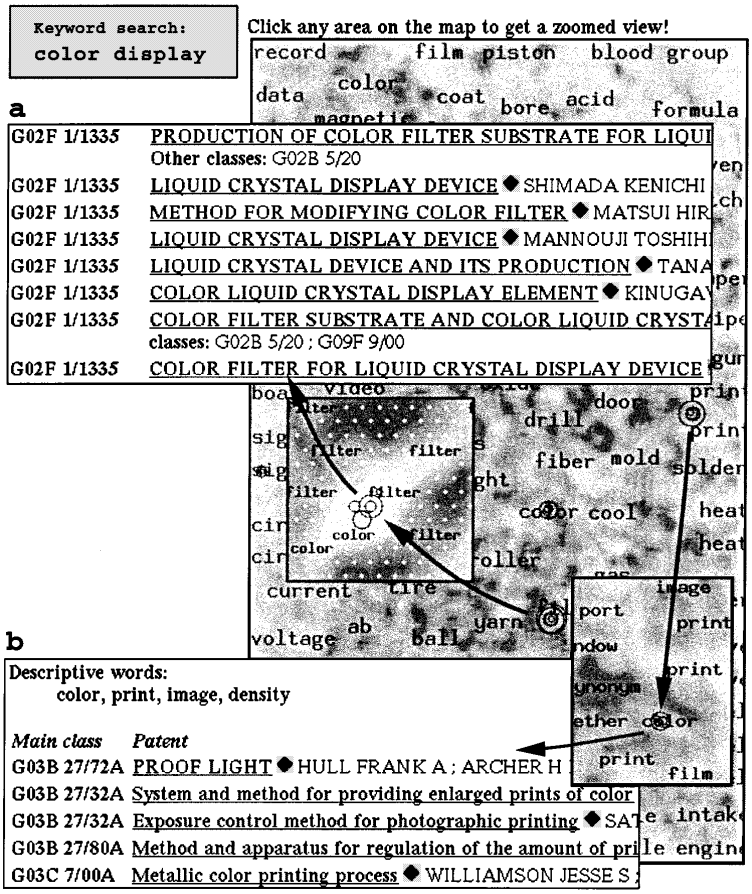


Figure 2.9: Keyword search visualized using a SOM. [Kohonen 00]

2.3.1 PaperScope

PaperScope[3] is an example of a radial graph to display citations from scientific publications. PaperScope shows a paper in the center and places the papers it cites (the references) around it as shown in figure 2.10. The papers that cite this paper are also displayed but are given a different color. The edges are represented by arrows indicating the relationship; this makes it a directed graph. Users are able to display this same information for any document already on the screen. By doing this for several papers, the screen will become cluttered. A provided option is to remove papers that are not highly connected to give a clear overview of the interconnected papers.

[3]http://paperscope.sourceforge.net/

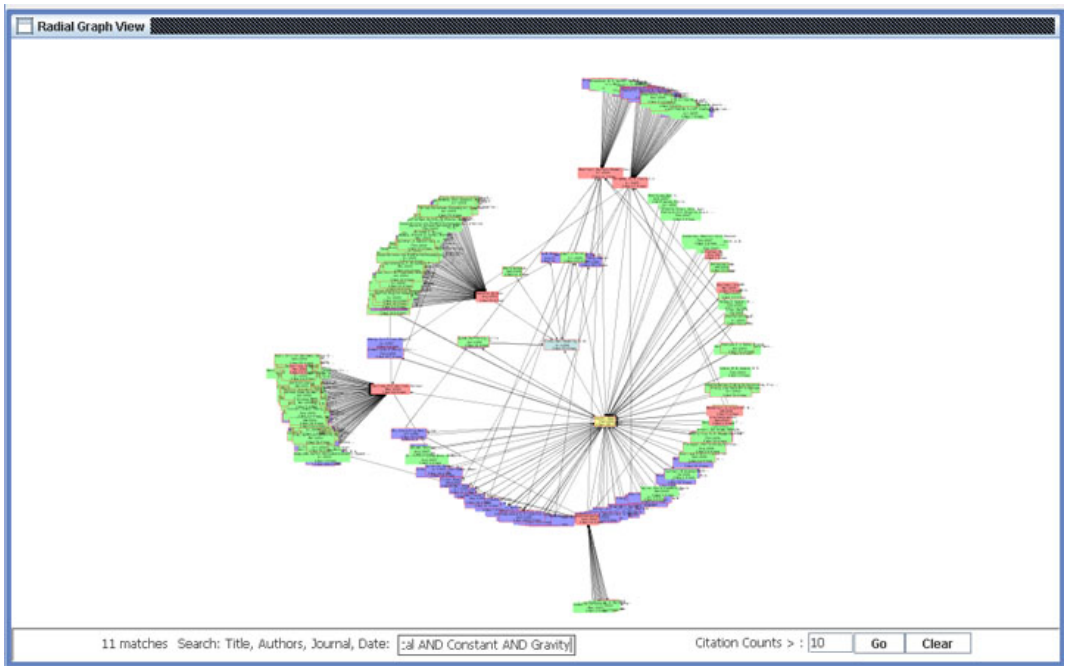


Figure 2.10: The radial layout in PaperScope where the citations are displayed up to a few levels removed from the root publication (the yellow node).

2.3.2 PaperCube

PaperCube[4] is another example of a visualization of citations using a radial graph [Bergstrom 09]. In this case, the user has to choose what is displayed: the references or citations. The other papers can also be interconnected and the layout is a radial tree where the hierarchy is determined by the number of steps each paper is removed from the root node. PaperCube also provides another type of graph layout: the bubble graph (see figure 2.11). In the bubble graph (or circle view as it is called in the system), some papers can be displayed more than once if they are references of or cite multiple papers. This reduces the amount of clutter generated by too many edges between nodes. In this system the views can also be changed to show only highly connected nodes and the user can zoom in and pan.

2.3.3 Action Science Explorer

The third system that supports visualizations of citations and relationships between papers is the Action Science Explorer [Dunne 11]. The goals of this system are to identify key papers, topics and research groups within a collection of papers. The Action Science Explorer is an example of a clustered graph: highly connected nodes are placed near each other using a force-directed layout to create groups of documents. This visualization is enhanced by

[4]http://papercube.peterbergstrom.com/

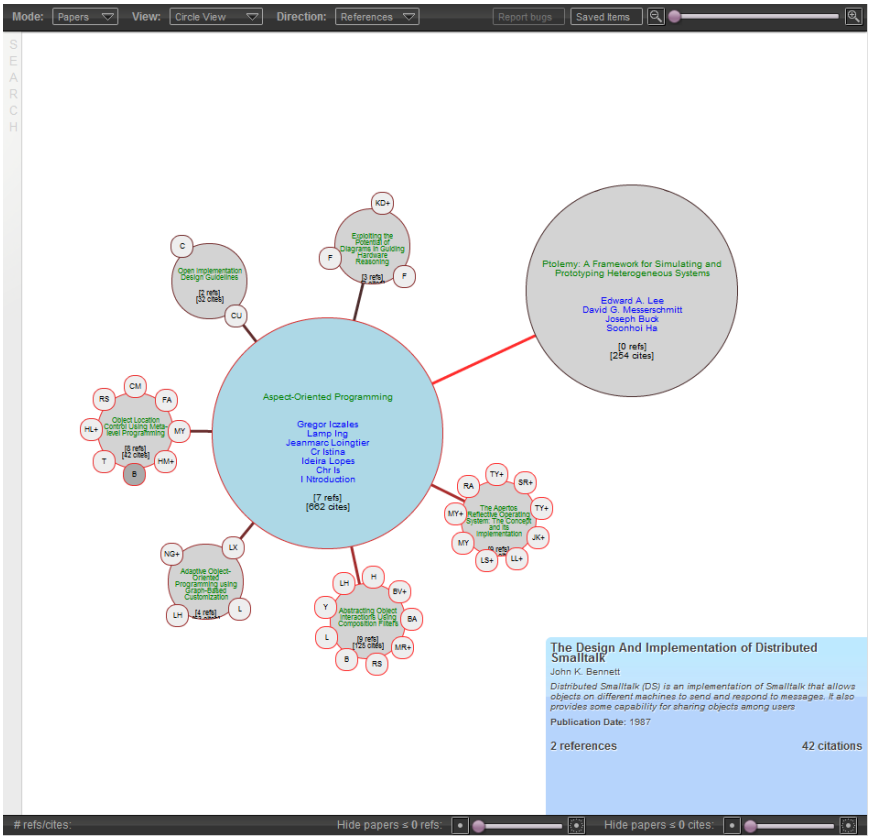


Figure 2.11: The bubble layout in PaperCube. The root publication is shown in blue.

coloring the convex hulls of the groups—see figure 2.12. These groups can be created manually or by Newman's fast community-finding algorithm [Newman 04].

2.4 Interaction Techniques

To interact and navigate through a large document collection on a touchscreen, a set of gestures has to be defined. Currently, most people have experience using a touch interface to control an electronic device. These are usually phones since most smartphones use a touchscreen. A well known and intuitive gesture on a touchscreen is the pinch: moving the thumb and a finger towards each other to zoom out—a reverse pinch zooms in. Other gestures are needed to perform the organizational tasks in the new Organization Viewer in TouchPat.

This section provides an overview of current research on multi-touch interaction techniques that can be used for the patent collection. The most important interaction is navigating through the collection since it is impossible to display a large amount of documents within

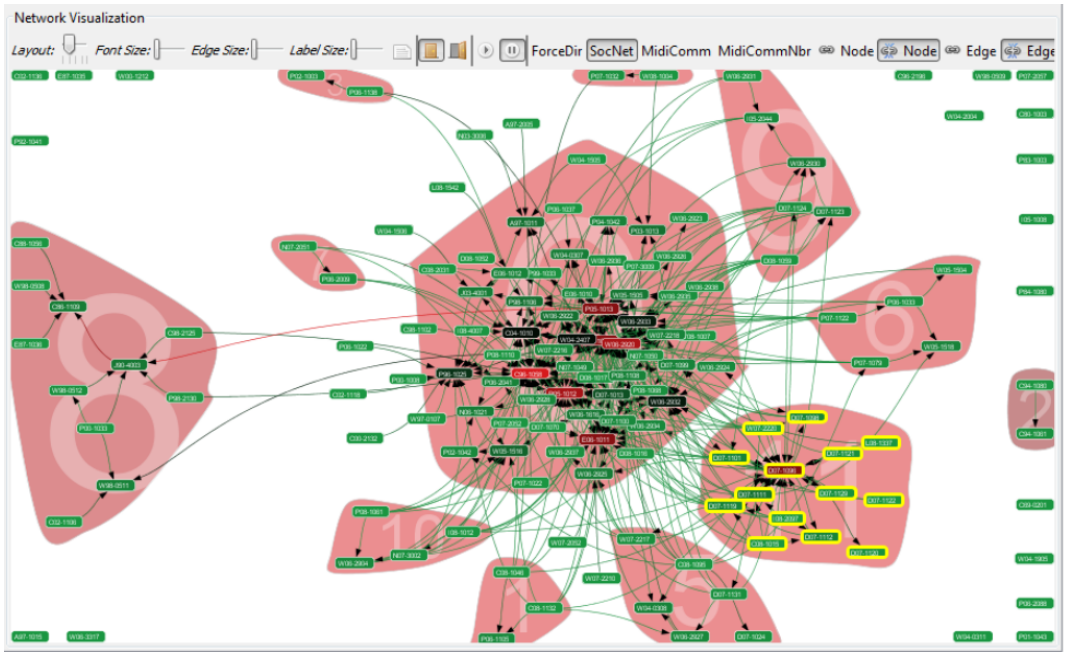


Figure 2.12: In one of the views in Action Science Explorer, the communities within a graph are highlighted by drawing a red convex hull. [Dunne 11]

one view in an understandable way. The navigation and exploration techniques will be dealt with first. The second part focuses on multi-touch interaction.

2.4.1 Navigation

When working with large collections of documents, one global overview is not enough. Each point representing a patent cannot display all information needed to evaluate the importance of the patent because adding more information fills the screen up quickly. This causes the points to overlap, resulting in a very cluttered view. Using different levels of detail provides a solution to display more patent information. Interaction techniques for navigation are needed to go from one view to another in a natural way, e.g. navigating from the global overview with few details to a more detailed representation of the patents.

Cockburn et al. give an extensive overview of different navigation techniques [Cockburn 08]. Several ways to navigate through a visualization are: *zooming*, *focus+context*, *detail+overview* and *cue techniques*. The first method allows users to zoom into parts of the data and move around (pan) in the document collection by viewing different parts of the visualization. The overview of the collection is provided by zooming out. The second method, focus+context, is to focus on a part of the collection while still displaying the remaining documents in a less detailed way. Detail+overview shows a part of the data in detail but also provides an overview of the global structure in a separate view. The cue-based methods use semantic

information to highlight or de-emphasize certain items in the data and this can be used in combination with the other three methods.

Semantic zooming is used to move from one level of detail to another [Bederson 10]. When zooming in, more information of each patent is displayed. Of course, one cannot keep zooming in and adding information because this will clutter the screen. Each time more details are displayed, less patents can be shown on the screen. Geometric zooming, therefore, also has to be used to zoom in on specific areas which contain the patents. By using these techniques, a *Zoomable User Interface* (ZUI) can be implemented. Bederson describes ZUIs as "those systems that support the spatial organization of and navigation among multiple documents or visual objects" [Bederson 10]. One of the problems of a ZUI is that users may not be able to keep track of the spatial arrangement of the data items because zooming and panning keeps changing the positions [Cockburn 08].

Focus+context techniques make it possible to display all data by showing the focused area in detail while still keeping the rest of the data in view. An example of this is a fish-eye lens which distorts the layout of the spatial arrangement but does show the focus area in more detail than the surrounding area. An example of this is the dock in Mac OS X, see figure 2.13. Research has shown that these types of techniques are suited for tasks such as getting a quick overview of the data and navigating through graphs which have clear categories [Cockburn 08]. These techniques do cause problems when trying to make relative spatial judgements [Cockburn 08].

Figure 2.13: Using a fisheye lens to navigate through the Mac OS X dock.

To keep an overview of the layout of the data, overview+detail techniques can be a good option. Often a small space in the screen is reserved for an overview display such as in Google Maps where the *mini-map* shows a zoomed out view and highlights the part displayed in the main screen, see figure 2.14. Another example is Microsoft PowerPoint where one slide is shown in detail and the other slides are represented by thumbnails to help the user remember where the slide is within the presentation. A disadvantage can be that space on the screen has to be given up for this purpose rather than displaying more details [Cockburn 08].

2.4.2 Multi-Touch Interaction

One of the features of TouchPat is the multi-touch interaction with the patents. Zoomable User Interfaces lend themselves well for multi-touch interaction since the pinch gestures

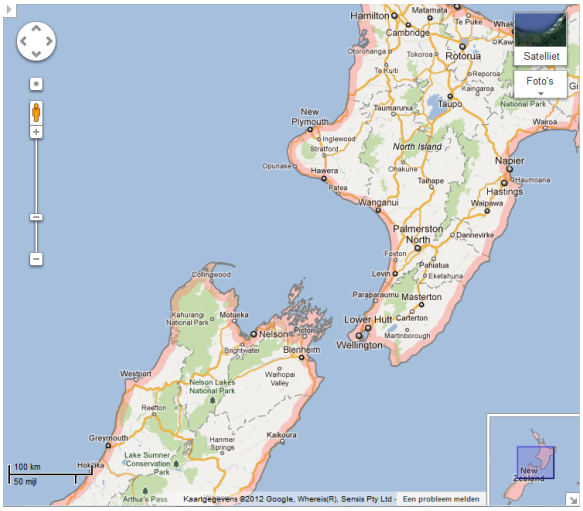


Figure 2.14: Google Maps shows a detailed view but also has an overview display in the bottom right corner.

provide an intuitive way to zoom in and out [Bederson 10]. North et al. show how multi-touch interaction improves performance times over mouse input when sorting nodes [North 09]. These are the reasons that multi-touch is interesting for organizing a collection of patents. In this subsection, guidelines for creating a multi-touch gesture set are given and current multi-touch techniques are explained.

Schmidt et al. propose a set of gestures focused on interacting with graphs to analyze them, rather than create graphs [Schmidt 10]. When there are many edges and nodes, it is necessary to have interactions that help obtain clarity. An example of a task the gesture set supports is finding out which nodes are connected. This gesture set requires two fingers for all techniques except one: creating the *PushLens*—see fig. 2.15), which pushes edges away that do not relate to the nodes within, requires three fingers.

Natural and Effective Layout Techniques (NEAT) is a gesture set that uses multiple fingers but also uses other objects such as a pen and even a ruler [Frisch 11]. The goal of this set is to support the arrangement and creation of graphical objects. Using guides, objects can be aligned on geometric objects such as circles or straight lines, see figure 2.16 for an example. Another possibility is to distribute objects evenly within a certain space.

There is no complete set of gestures that can be used for the patent system. The gestures used in TouchPat were also not created to provide the interaction with nodes, edges or clusters. Choosing the gestures to use in the new visualization, the following guidelines need to be taken into account [Yee 09]:

1. Provide a high degree of interaction context;

2. Allow users to gesture with minimal effort;

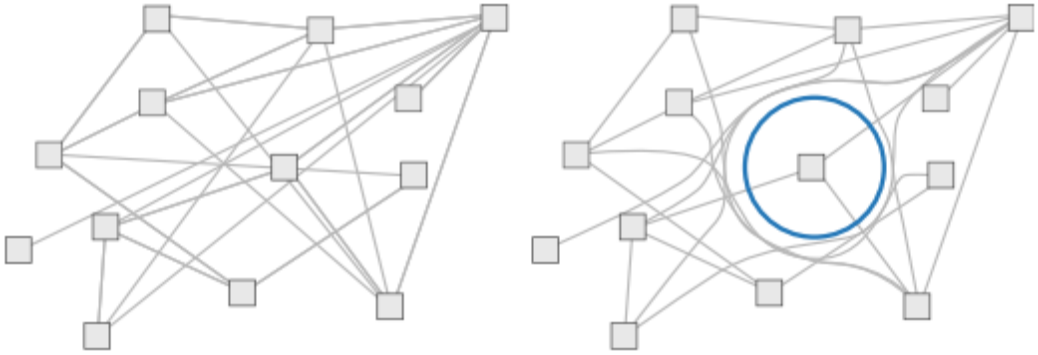


Figure 2.15: Using the PushLens to identify the edges attached to a node. [Schmidt 10]

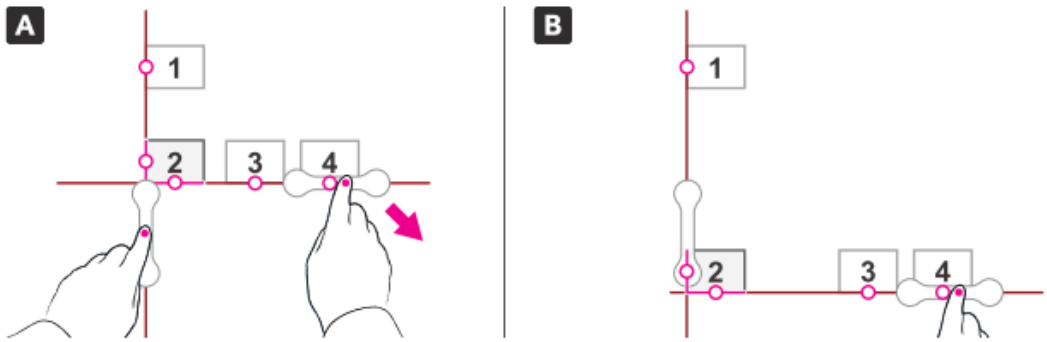


Figure 2.16: Using guides to align and distribute objects on a surface. [Frisch 11]

3. Use appropriate metaphors;
4. Be designed for repetitive use and minimal muscle stress;
5. Facilitate accurate recognition by the application;
6. Minimize the learning curve among users/ increase differentiation among gestures;
7. Cue efficient gestures;
8. Focus abstract gestures on finger movements.

The system should make it obvious which gestures can be used (1) and these gestures should not be difficult to perform (2). These gestures should not tire users quickly so using only the fingers and not moving the whole hand is better for repetitive actions (4 and 8). By using appropriate metaphors, it should be easier for users to remember them (3). For indirect actions, abstract gestures are needed and this means there is a learning curve. To reduce

the learning curve, the gestures should be tested thoroughly to determine if they are not too difficult (6). By providing cues in the user interface, shortcuts can also be learned faster (7). Finally, the gestures have to be recognized by the system even when they are not performed perfectly by the user (5). The strength of the gestures is dependent on the whole set. The set should be consistent so the user knows what to expect.

2.5 Conclusions

This project continues the work done by de Ridder and extends his prototype TouchPat with a new view for organizing patents, the Organization Viewer. This chapter gives background information about TouchPat to help the reader understand concepts such as the context menu. The thumbnail representation for patents and the Zoomable User Interface are two things that are also used during this project.

Besides TouchPat, there are other patent visualizations available. They do not relate to the task of organizing a patent collection but they do show how patent data can be used to create meaningful displays. The visualizations are hardly tested by users, however. Only PatViz has been evaluated by patent experts.

Looking outside of the field of patents, other documents that resemble patents are scientific publications. These documents also have an abstract and citations to other papers. Creating graphs from citations between documents is a topic researched by a number of people. Three systems are described in this chapter. They show how explicit relationships between documents can be visualized and this can be incorporated into the Organization Viewer.

There is currently no standard set of multi-touch gestures for interaction but there are gesture sets created for specific tasks such as interacting with graphs or creating and arranging graphical objects. These gestures can serve as an inspiration for the gesture set of the Organization Viewer. Guidelines for creating a gesture set can be used to help make the gestures as natural and obvious to the user as possible.

Chapter 3

System Requirements and Design

In the previous chapter the work of de Ridder [Ridder 11], the TouchPat application, is shown. The feedback from the end-users served as the input for the requirements of a new visual representation for patents, the *Organization Viewer*. The goal of new visualization is to support the spatial memory of the user by helping the user with the organization of a collection of patents. Many aspects of TouchPat are reused to display and interact with patents, but because the visualization has a different goal, some changes to the patent representations and multi-touch gestures have to be made.

This chapter starts off with a section about the requirements for the new system. Then the process of the design of the Organization Viewer is described in section 3.2. Section 3.3 describes the display of the three types of objects used in the system: patents, groups of patents and relationships between patents. After this section, the design of the multi-touch gesture set is given in section 3.4. The chapter ends with several concluding remarks.

3.1 Requirements

The requirements for the new *Organization Viewer* stem from the feedback on the TouchPat application given by end-users. The discussions after the demonstration of the system dealt with several topics of which two addressed here. The first is using clustering to display more than 1000 documents and the second deals with the ordering of the patents in the grid. This part of the feedback was the starting point for the design of the user interface.

3.1.1 Clustering

One topic of the discussions after the demonstration of TouchPat was the use of clustering techniques to display more than 1000 documents. The amount of patents that can be displayed at the same time in the grid view of TouchPat is limited to the screen size because eventually the patents are too small to be useful. The idea from the discussion was that by clustering multiple documents, a smaller space on the screen can be used to represent

more patents. This allows the visualization to display more patents, which is needed when queries return more than 1000 patents.

To use clustering in the new system, there are two things that need to be given attention during the design of the Organization Viewer.

1. How should clustering be performed: automatically, manually or a bit of both?
2. How should clusters be represented: keeping the individual display of patents or using a new cluster item?

The topic of automatic versus manual clustering is discussed in chapter 4. The representation of clusters is dealt with in section 3.3.2.

3.1.2 Spatial Relations

The discussion with the end-users about the TouchPat application also addressed how the patents are ordered in the system. The patents are displayed in a grid and can be ordered according to various measures such as classification or date. The ordering is performed by ordering a one-dimensional list of patents. This means that when looking at a patent, the patents to the left and right are similar based on the ordering but of the patents above and below the relationship is not determined—see fig. 3.1 for an example.

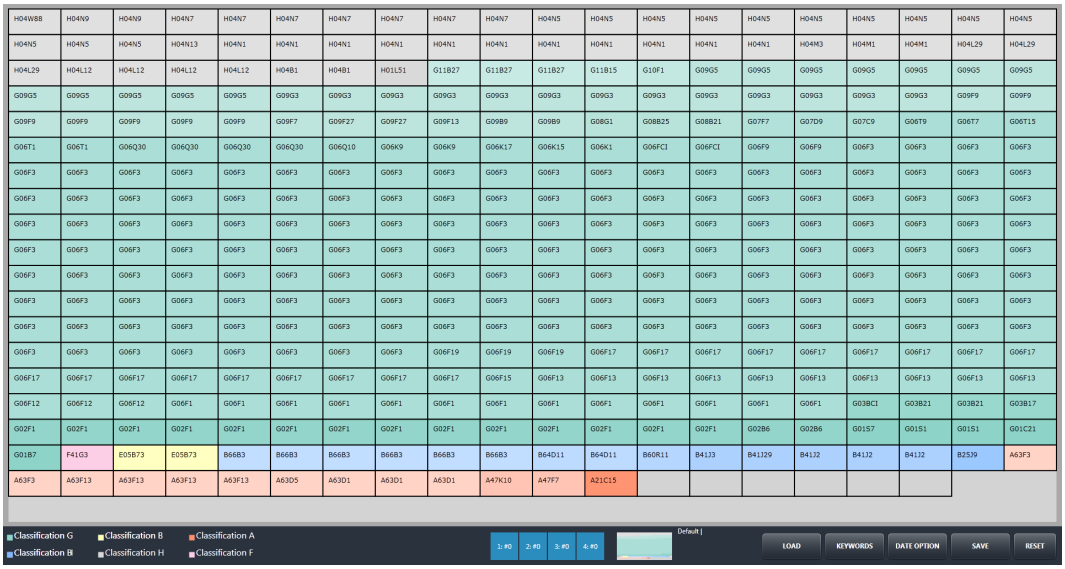


Figure 3.1: The ordered view in TouchPat where the ordering is based on classification. The colors of the patent represent their classification. Patents are not always near similar patents using this type of ordering; for example, the right most orange patent is not next to any other orange patent.

The Organization Viewer should make use of the two-dimensional space for arranging patents on the screen. This can also be achieved by using a clustering algorithm with a

certain similarity measure, which is another topic in chapter 4. The next section provides the requirements determined from this section and the previous section.

3.1.3 Requirements of the Organization Viewer

The previous two sections provide the input for creating a set of requirements for the new system. The Organization Viewer has to address two challenges: using clustering and the two-dimensional space to create the spatial arrangement of a collection of patents.

The idea of the new Organization Viewer is to let patent examiners organize a collection of patents as if the patents are paper documents on their desks. When people place items on their desks, they can often remember where they left them, even when the items are not directly visible. This referred to as spatial memory, remembering the spatial arrangement of objects. The desk metaphor also applies to arranging documents by their similarity; similar documents are placed near each other and are not restricted in the arrangement in the sense that both horizontal and vertical locations indicate similarity. The Organization Viewer should help the patent examiners use their spatial memory when going through a collection of patents. The requirements of this system are, therefore, focused on supporting the organization of patents.

The requirements for the Organization Viewer were determined to be:

R.1. Visualize a collection of patents;

R.2. Allow users to arrange patents in a two-dimensional space;

R.3. Display patents, but also patents that function as examples for the clustering algorithm—see chapter 4;

R.4. Display groups of patents;

R.5. Display implicit and explicit relationships between patents;

R.6. Keep the displayed items in line with the user interface of TouchPat.

Most of these requirements are discussed in this chapter, but the choice of clustering algorithm can be found in chapter 4. The next sections describe the design of the patent visualization and the touch interactions for the Organization Viewer. First, however, the process of the design is described in the next section.

3.2 Design Process

The design of the Organization Viewer is based on the related work described in the previous chapter and often paper prototypes were used to experiment with different options for the displays of the patent items. The design was not established at the start but has resulted

from creating spikes and gradually tweaking the interface and the touch gestures. The requirements for the Organization Viewer also evolved by evaluating the system halfway through the project. This section shows what spikes were created and in what steps the design of the system was formed.

Before implementing new items in the Organization Viewer, paper prototypes are created to test the different options of a design. An example of this is the design for the stacks as is described in the next section. This was a quick and easy method to compare different ideas.

The first aspect of the system that explored is moving patents around using touch-based interaction. After this, different types of patents were added to the display to make a difference between normal patents and the control point patents for the Local Affine Multidimensional Projection method—see fig. 3.2. Showing the differences between the types of patents was tweaked during the whole project; a few weeks after the introduction of different patents the display is already very different as can be seen in fig. 3.3. Then, to allow a faster selection of patents, the lasso gesture was added.

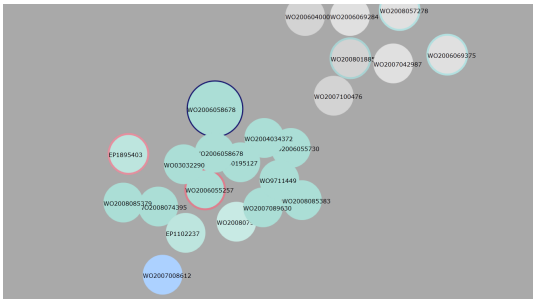


Figure 3.2: One of the first views of the Organization Viewer were only different types of patents are implemented.

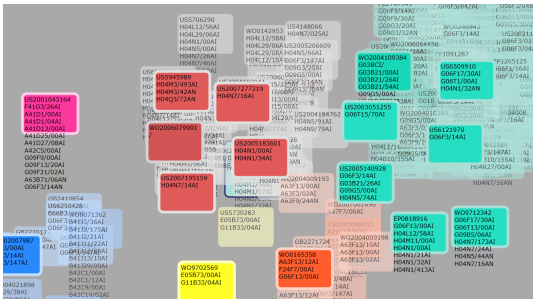


Figure 3.3: A few weeks later the differences between the patent types is based on the saturation of the background color.

To give a demo to patent examiners, the system had to seem complete because otherwise the users would focus on unimportant details. Therefore, functionality provided in TouchPat such as the annotations bar and the date display had to be added. The demo gave interesting feedback and prompted the creation of links and further tweaking of the patent thumbnails.

After the demo, the Zoomable User Interface was added and parts of the patent examiners' feedback implemented. At this point Stacks were also introduced to the Organization Viewer. The interface and touch gestures were finalized and the result of the design is described in the next sections.

3.3 Patent Visualization

Several requirements determined in section 3.1 are specific about what needs to be displayed, such as displaying groups of patents. How to display these items is the topic of this section. First the design for the representation of single patents is described in section 3.3.1.

Then how to display a group of patents is discussed. Section 3.3.3 explains how explicit relationships between patents—such as citations—are represented. TouchPat gives users the option to show a subset of patents that fall within the chosen date range. This date option can be visualized in several ways which are shown in section 3.3.4. The last visual aspect of the Organization Viewer is the zoomable user interface. This is also used in TouchPat to display more patent information when zoomed in, while zooming out gives an overview of the whole collection.

3.3.1 Single Patents

In TouchPat patents are displayed by rectangles which are placed in a grid. The rectangles fill the space of the screen to display as much information as possible and are used as thumbnails for the actual patents. They display patent information in a smaller space and depending on how far the user has zoomed in, the thumbnail information is updated to make use of the new space. In the new Organization Viewer the patent displays also make use of the thumbnail representation. This section focuses on the representation of the patent, not on the textual information displayed within the patent since this is already available in TouchPat. The difference between the original version of TouchPat and the Organization Viewer is that not all patents are equal: some patents will be used as examples for the clustering algorithm—see chapter 4 for more information about the algorithm. This section explains how the representation of these examples is designed.

The new representation of the patents has to allow the information about a patent to be displayed inside it. The rectangle is a geometry that is structured: it is neat and makes outlining information inside it easy—a circle is more challenging to display as much information as possible in it but does give the idea of a node which the user can move around. The ideas for the system where based on the work discussed in section 2.3. Those documents are displayed by circles or rounded rectangles. Rounded rectangles have the same advantage of normal rectangles because they can fill the display with more information than circles can, but still seem to give an indication that the object can be placed at other positions.

There are different types of patents in the Organization Viewer: normal patents and patents that function as examples for the clustering algorithm. The example patents contain the same information as they would as a normal patent, but only have to be visually different to show the user what the input of the clustering algorithm is. Before the design of the examples is determined, the use of the visual channels is explained.

Figure 3.4 shows the different visual channels that can be used to indicate a difference between items. The normal and example patents are categorical items. In TouchPat the *hue* channel is already used to show the classification of a patent. *Texture* does not seem suited to use for a patent because this can make it hard to read the textual information. The next three channels, *connection*, *containment* and *lightness*, are used for the representations described in the following sections. This leaves *saturation* as the best option to show the difference between normal and example patents.

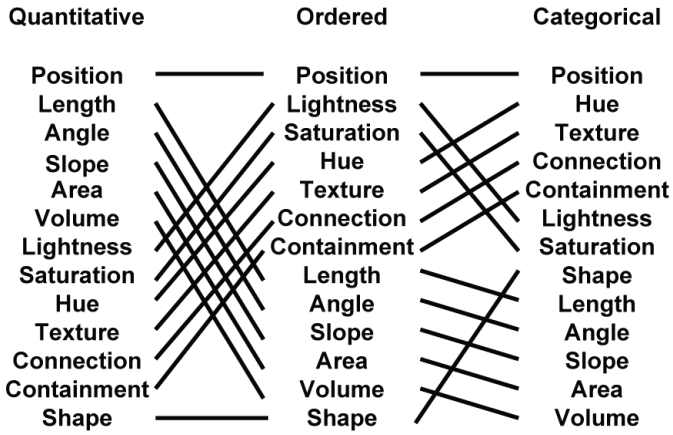


Figure 3.4: The visual channel overview by Tamara Munzner. For each type of data, some visual channels are more effective than others. The channels are sorted per data type and the higher the visual channel is in the list, the more accurate it displays information. [Munzner 09]

Increasing the saturation of the patent makes it difficult to compare the classifications of the patents. To overcome this, the border of a patent example is given the original classification color. Normal patents are displayed with a black border. The saturation and the border are the only differences with respect to a normal patent to make it obvious that there are different types of patents. However, the patent examples look just like a normal patent and do not display other information than they would when they are normal patents—see fig. 3.5.

In TouchPat the user is able to select and deselect patents. To make it clear to the user that patents have been selected in TouchPat, the patent's opacity is decreased and the color is inverted. To keep the Organization Viewer in line with TouchPat, the color inversion was implemented in the early stages of the project. User feedback showed, however, that this did not make it clear that patents were selected: it seemed as if the patents were part of a different classification. The design is changed to let the hue only represent classification, selection is indicated by emphasizing the border as is shown in fig. 3.6.

3.3.2 Patent Group Visualization

Requirement R.4. states that groups of patents need to be displayed. People like to order items because it gives them a better overview of the whole collection. During the patent examination process, examples of groups can be 'relevant to the application', 'certainly not relevant', 'needs further inspection' and so on. Other groups are also possible; this has to be open for the patent examiner to decide. The current systems used by patent examiners allow them to place patents in drawers. This type of grouping patents was used in TouchPat as well—see fig. 3.7. In the Organization Viewer the grouping should allow more flexibility than defining only four drawers. To keep the spatial memory of the arrangement of the patents in the collection, the groups should also be visible in the patent space. First, the

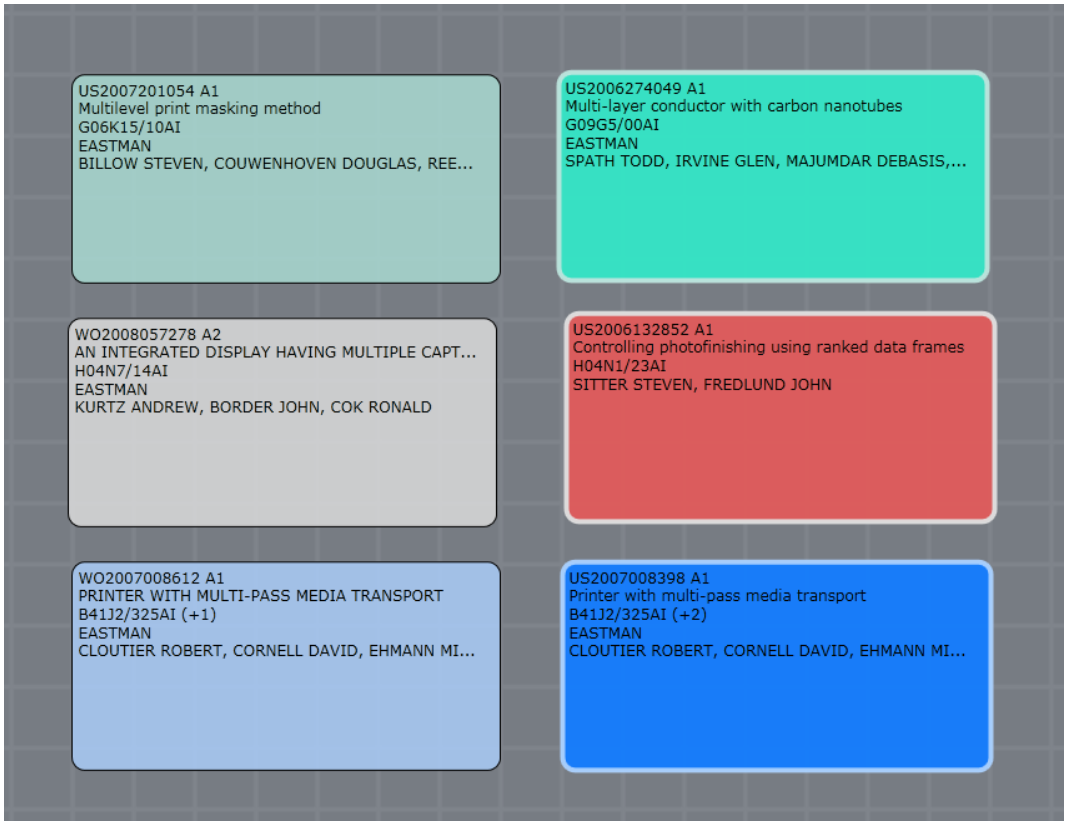


Figure 3.5: Saturation is used to show the difference between a normal (left) and example (right) patents. Note that the border of an example patent shows the original color of the classification.

different options for visualizing a group are discussed in this section and then the designs for the chosen representation are explored.

To visualize a group of patents, the first idea is to use the convex hull around the patents placed in a group as is done by the Action Science Explorer application described in section 2.3. This keeps the information of the individual patents but does show that the patents are related to each other as can be seen in fig. 3.8. A disadvantage of this grouping method is that it does not reduce the clutter when displaying a large amount of patents.

Using one item to display multiple patents reduces the amount of space needed to represent a group of patents. This reduces the clutter experienced when displaying a large collection of patents. The disadvantage here is that the information from the individual patents is lost. The combined display can provide information about the set of patents it contains, such as the most common classification among the patents. Reducing the clutter outweighs the loss of individual patent information so the convex hull visualization is replaced by a single item display.

The idea to use one representation for a set of patents comes from the organization of paper documents on a desk metaphor: groups are represented by stacks of paper. In the Organi-

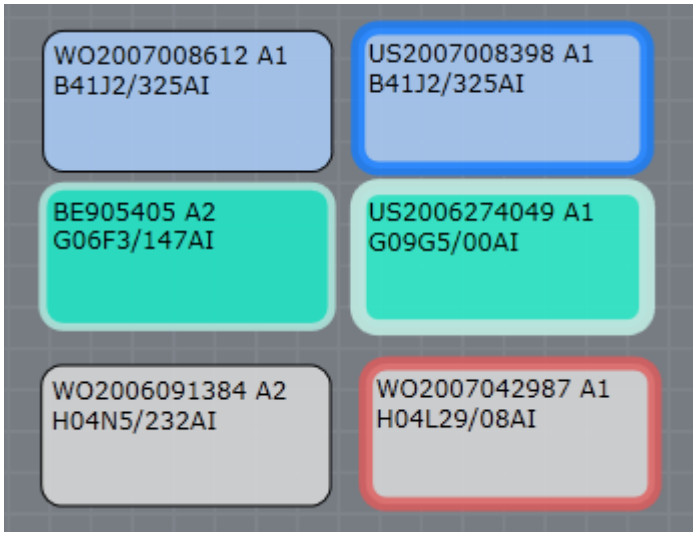


Figure 3.6: The border of the patents is emphasized to show that a patent has been selected. The border width is increased and the color is changed in the case of normal patents (blue and grey patents). In the case of examples, such as the green patent, only the thickness of the border is increased.

zation Viewer this can be visualized as stacks of the patents. The designs for the stacks of patents are shown in fig. 3.9.

Adding a 3D representation to the Organization Viewer is not in line with the other objects displayed, therefore this option is discarded. Choosing between the neat and messy version of the stack is based on preference. The messy version is chosen because the idea is that the messy representation is more similar to paper stacks.

A stack is displayed with three patent shapes. The two background shapes can provide the user with a small bit of information. The colors of the classifications in the stack are shown in these three patent shapes and are based on the frequency of the classifications within the group.

Since the number of patents displayed in the background of the stack is limited to three, size is used to indicate how many patents are contained in the stack. When a patent is added to the stack, the size should increase. However, stacks can become very large, containing over 100 patents, when using a linear formula to set the size. After a while it is no longer interesting to see a difference between 80 and 100 patents and the space the stack uses can be used more effectively. A logarithmic formula can be, therefore, used to calculate the size of the stack based on the number of patents within the group—see fig. 3.10. This way differences between stacks containing 5 or 25 patents will be more obvious than stacks representing 80 or 100 patents.

The content of the stack is difficult to determine because to provide content automatically, a summary of the documents within the group has to be given. Since the user creates the groups manually, the stack displays a label to help the user remember what the stack

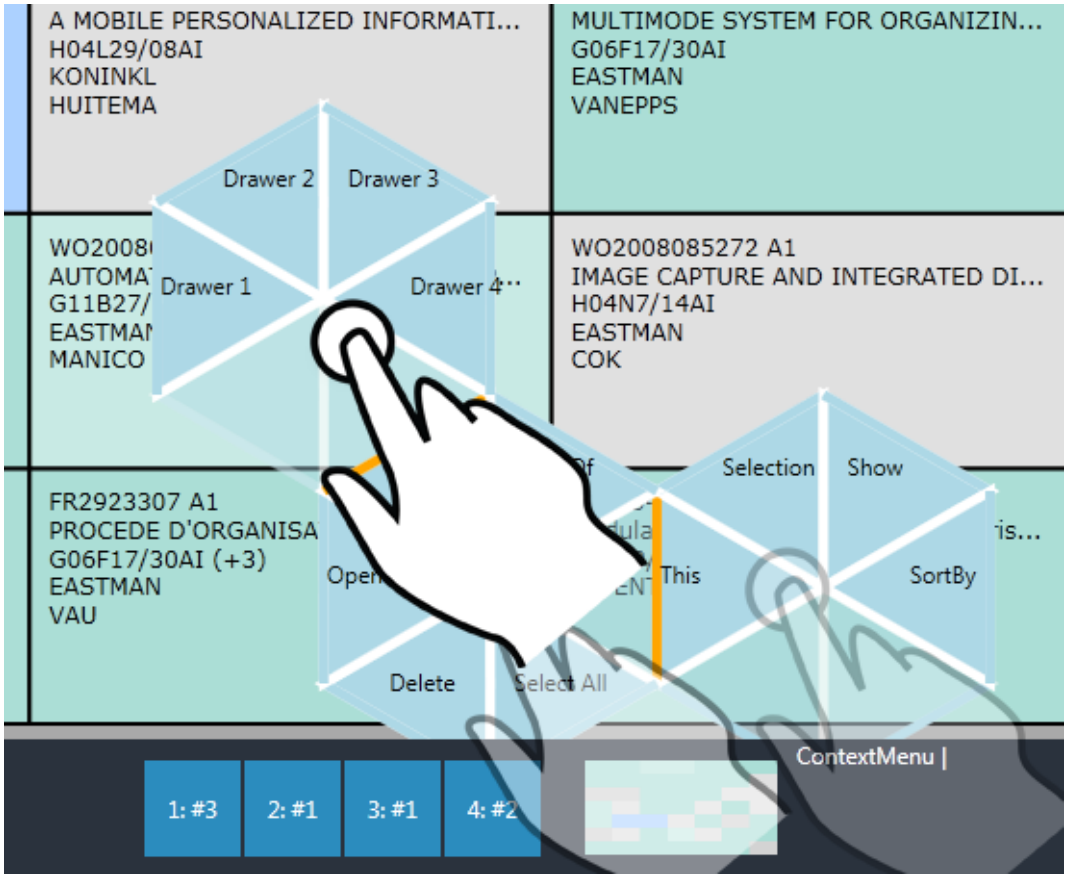


Figure 3.7: TouchPat allows users to add patents to 4 drawers using the context menu. The bottom bar shows how many patents are contained in each drawer. A drawer can be opened through the context menu. The gesture image is taken from GestureWorks (www.gestureworks.com).

contains. The only other piece of information displayed is the number of patents in the group.

3.3.3 Connections between Patents

Patents are documents which are very rich in the amount of data they contain. Most of this data gives insight into the invention that is patented, but some data fields do not provide any indication of the invention described by the patent. Some examples are the country in which the patent has been filed, the applicants which can be individuals or companies, and the date of the patent application. This information may not help when determining the similarity of patents, but is used by patent examiners to guide their search strategy. Requirement R.5. states that implicit and explicit information about patents needs to be displayed. This section describes how the explicit relationships between patents are visualized and what data can be used to indicate such connections.

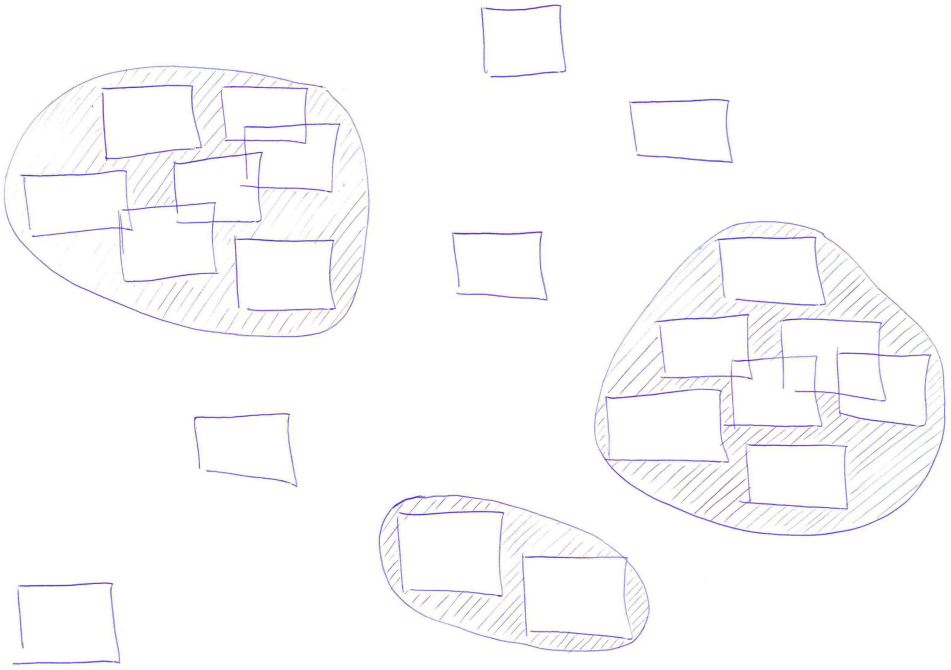


Figure 3.8: A sketch of using convex hulls to indicate when documents are part of the same group.

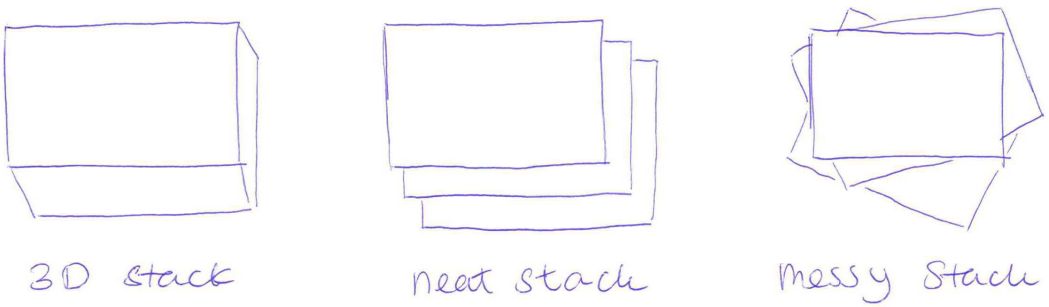


Figure 3.9: Sketches of different designs for stacks of patents (from left to right): 3D, neat and messy.

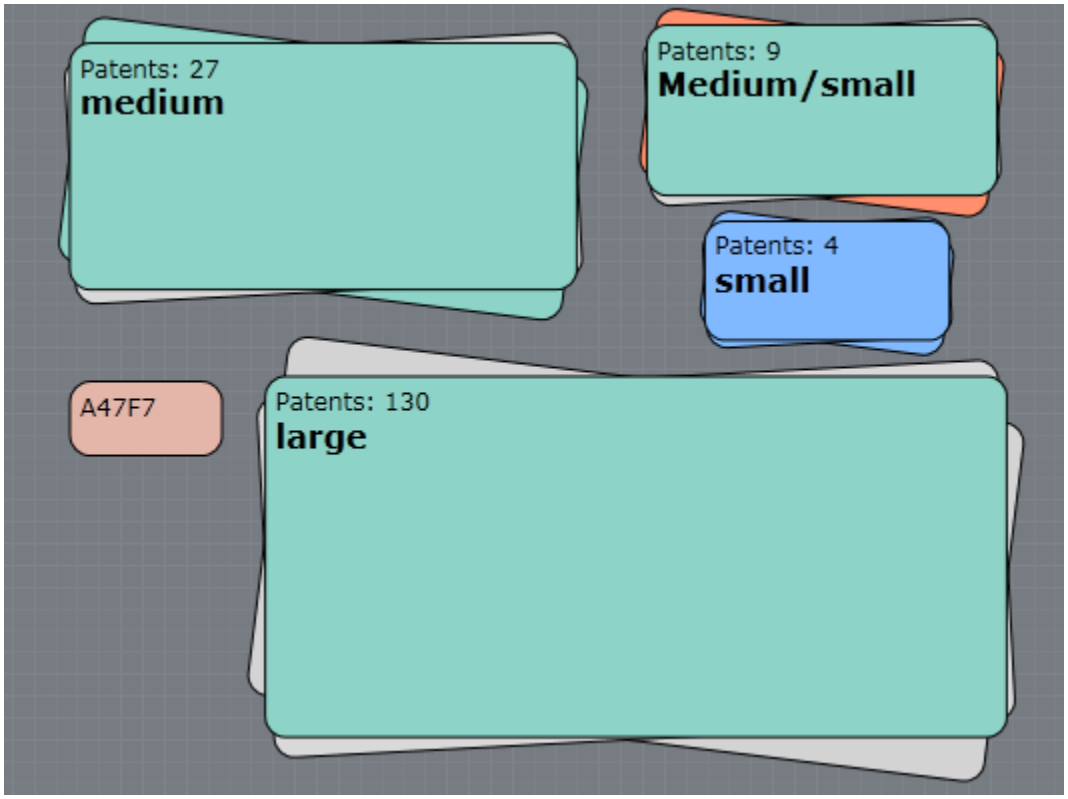


Figure 3.10: The size of the stack depends on the number of documents it contains. The bottom stack contains 130 patents, the top left 27 patents, the top right 9 patents and the middle right 4 patents. The formula used is the base size of a stack times the log of the number of patents (plus one).

The information about a patent that can be used to visualize connections between patents are listed below. While the dates of filing and publication can also represent an explicit relationship, it is preferred to display patents that have been filed between two dates. The design for this is shown in the next section—section 3.3.4.

Applicant This can be one or more inventors, companies and/or institutions.

Inventor The people who invented the idea in the patent.

Classification A classification code in a certain format such as the European Classification (ECLA).

Citations These can be patents or other documents.

Country Where the patent has been filed.

Patent Family If a patent is filed in several countries, it will be part of a patent family to keep track of the different application numbers of the patent at each patent office.

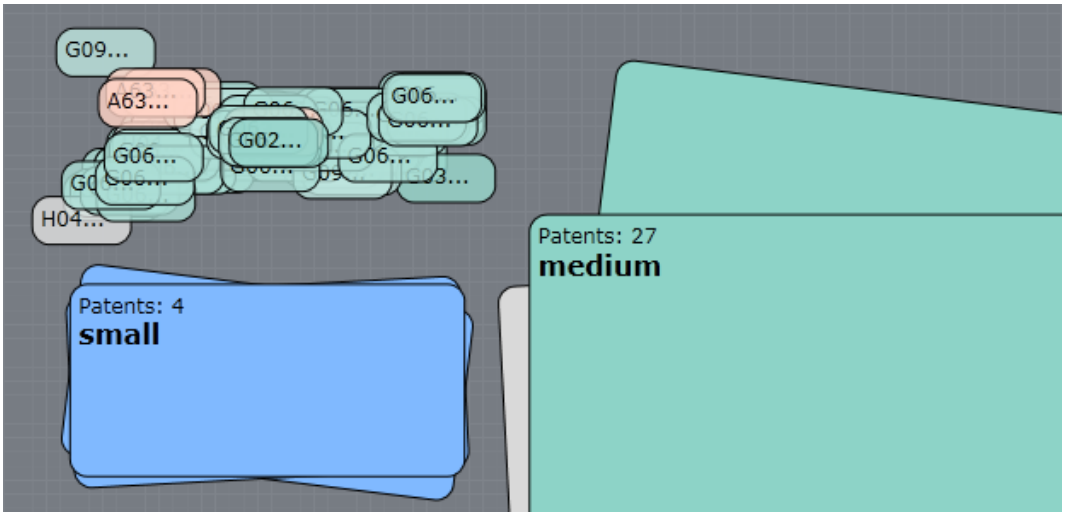


Figure 3.11: When the size of a stack is determined linearly, large groups can become very large with respect to the single patents. The medium stack contains 27 patents and the small stack 4. A bunch of single patents are also shown. The formula used is the base size of a stack times the number of patents it contains.

Citations between documents have been visualized using edges between nodes—the nodes being the documents—by other researchers as is shown in section 2.3. These visualizations for scientific papers are the inspiration for displaying explicit relationships between patents using edges.

At first the idea was to allow a patent examiner to choose which information should be displayed, e.g. choosing to display the citations between patents or to display common applicants between patents. The system then displayed all the edges for all patents—see fig. 3.12. This was found to be too overwhelming and the idea of showing edges was abandoned.

A demonstration was given to a patent examiner halfway through this project. He noted that he would like to see the links between the patents starting from a single patent. Rather than displaying all possible connections between all patents, only connections with the selected patent are displayed. This gives a new impulse to determine which patent to examine next. The connections are visualized using edges, as was the original idea.

With the introduction of stacks, the display of the connections between a patent and a stack has to be redesigned. A patent can have connections to multiple patents within the stack and this should be clear to the patent examiner. The width of the edge is increased to indicate the connections to more than one patent within the stack.

3.3.4 Visualization of Patents within a Date Range

When patent examiners need to review a patent collection containing 1000 patents, they have to decide which patents they will examine first. One strategy to for this is starting with

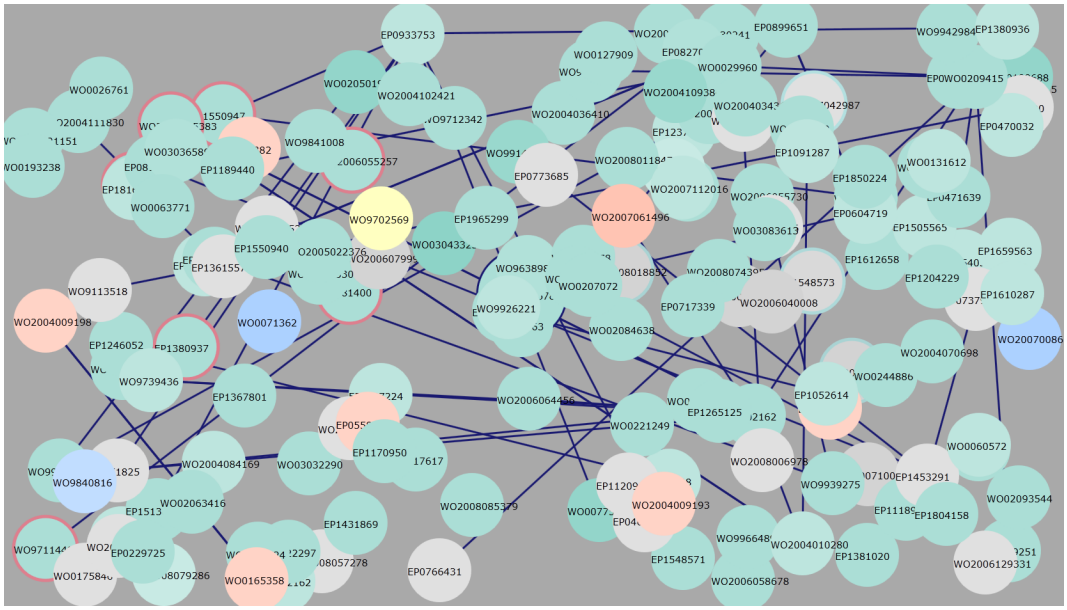


Figure 3.12: The display of all the citations between patents in a collection using edges.

a smaller set of patents from that collection which fall in a certain date range—for example, only look at patents from before 1990. TouchPat supports this strategy by allowing users to select a lower and upper bound for the dates of the patents, see fig. 3.13. Only patents that fall within this range are then displayed.

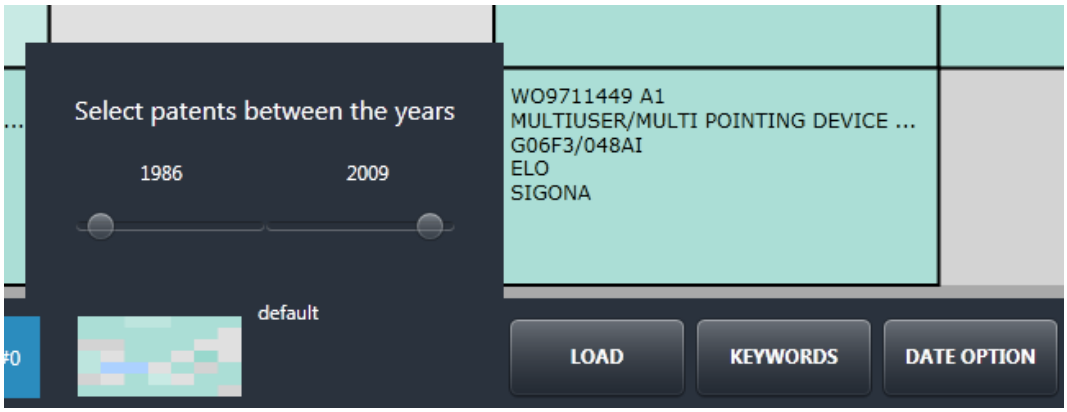


Figure 3.13: TouchPat allows users to select a date range and updates the patent displayed by removing any patents that fall outside of this range. The popup containing the range can be opened/closed by pressing the 'Date Option' button.

In the Organization Viewer, the positions of the patents are important for the user to retain the spatial memory they have of the collection. When patents are no longer displayed, because they fall outside the range of the chosen dates, the user may lose their orientation

points and will certainly lose their perception of the relation between the sub-collection and the total collection. The Organization Viewer should, therefore, always display all patents but does not have to display all the patents in the same manner.

There are two ways to make clear which patents fall within the date range and which fall outside of the range. The first method is to emphasize the patents that are in the range. The second method is to de-emphasize the patents that fall outside of the date range. Patents are already emphasized when they are examples. To use the first method, the patents would have to be emphasized differently. Another reason why the emphasizing patents might not be the best option is that there are already many patents displayed, and placing the emphasis on a few patents does not reduce the visual overload of seeing the whole patent collection. De-emphasizing patents outside of the date range makes the amount of patent information to process less and focuses the attention of the examiner on the patents that are within the range. This method gives an idea of removing patents from the view, without losing the spatial arrangement of the patents.

When the date range option is used, the patents within the range will not be altered. Only the patents that fall outside of the range are displayed differently because they need to be de-emphasized. The visual channels that can be used to separate categorical data are already used to indicate the different classifications of the patents (hue), the difference between a normal and an example patent (saturation), if an item is a single patent or patent group (shape) and the amount of patents in a group (size). One visual channel that has not been used yet, however, is lightness. To de-emphasize patents, their opacity can be changed. Their lightness is then reduced when a dark background is used—see fig. 3.14.

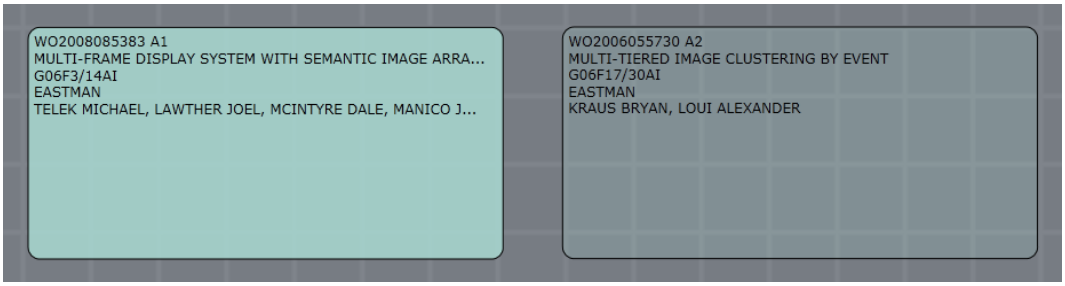


Figure 3.14: By reducing the opacity of a patent, the lightness of the display is affected. It makes it more difficult to see the patent, but the user can still be aware of the patent's existence in the collection.

Groups can be de-emphasized by using their opacity as well. A group contains multiple patents and some may fall within the date range while others do not. Groups are represented by one item—rather than showing all patents separately. The opacity of a group should be changed according to the proportion of patents that fall within the date range.

3.3.5 Zoomable User Interface

Requirement R.1. states that a collection of patents must be visualized. The goal is to provide the user with an overview of the whole collection, but also allow the user to inspect patents on a detailed level. This was the goal of TouchPat as well and the chosen solution to this problem was to use a Zoomable User Interface (ZUI) as described in section 2.4.1. The ZUI is used in the Organization Viewer as well and this section describes its design.

When patents are organized into groups, there has to be space between them to show the separation. This space does not contain any patents and when zooming in or out, no feedback is given to show the effect of the user's action because there are no patents to display the effect of the action. This problem is solved by adding a grid to the background which shows the users when they zoom in or out because this increases or decreases the space between the grid lines.

When zooming in or out in an area where there are patents, the display of the patents has to change. A ZUI changes the amount of information displayed in a patent (*semantic zooming*) but also zooms into an area by making a smaller viewport (*geometric zooming*). The patents use a thumbnail representation to display information which was created for TouchPat. The same information is displayed in the Organization Viewer.

As in TouchPat, zooming out is limited to a certain level. TouchPat allows users to zoom out until all patents are displayed on the screen. In the Organization Viewer the locations of the patents are allowed to change, so zooming out has to be limited based on another heuristic. Zooming out reduces the size of the patents which means that the area where a finger can interact with a patent becomes smaller. The requirement for limiting the zooming out is, therefore, that patents need to be large enough to be touched by a finger.

3.4 Touch-based Interaction

Touch screens are becoming more and more prevalent in our everyday life: from using them on your smart phone to buying a train ticket at the self-service ticket machine. North et al. have already shown that some tasks can be completed faster with multi-touch gestures than with a mouse [North 09]. These tasks were based on organizing circles on a touch display, which is similar to organizing patents on a touch display. De Ridder's work also incorporated multi-touch gestures to browse and navigate through a collection of patents using a ZUI [Ridder 11]. First, things that need to be taking into account, such as hardware constraints and the gestures created by de Ridder, are described in section 3.4.1. After that, section 3.4.2 shows the design of the gesture set for this project.

3.4.1 Constraints

Before designing the touch gestures, it is necessary to take the constraints into account. Since the system is implemented on existing hardware, the number of touch input points that

can be recognized is already fixed. Details about this are given in the first subsection 3.4.1. Section 3.4.1 gives a small summary of the touch gestures implemented in the previous version of the system. Both systems can be used by the user during one patent application examination so the gestures should be similar to reduce any confusion.

System Capabilities

TouchPat is implemented to run on a large touch screen. Therefore, the European Patent Office and the Delft University of Technology purchased touchscreens to test TouchPat on. Touchscreens are able to register one finger or even 11, as is the case for an iPad [1]. The touch screens available at the European Patent Office and the Delft University of Technology can recognize up to two touch inputs. This limits the possible gestures because only gestures with one or two fingers can be used. Figure 3.15 shows the setup used at the European Patent Office.

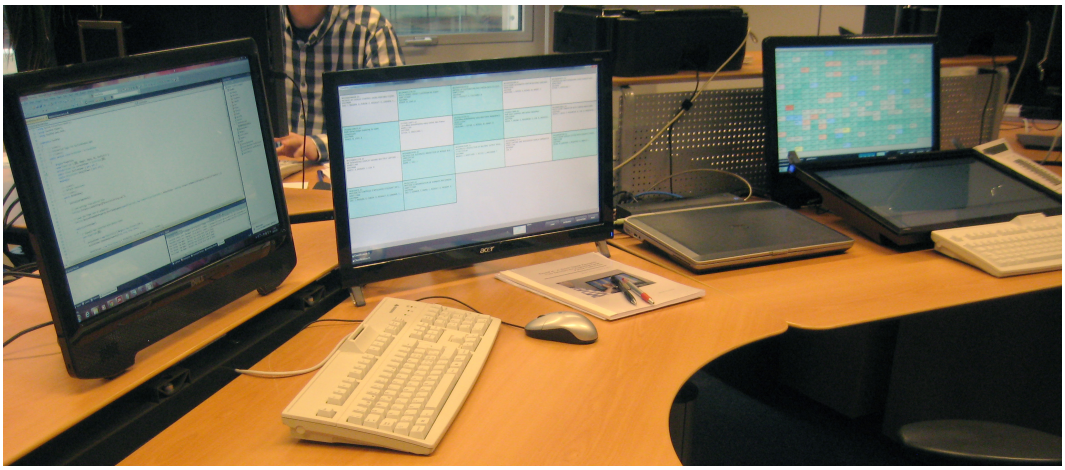


Figure 3.15: The setup at the European Patent Office: the Dell ST2220T and Acer T231H.

The software that is used to handle the touch events is the Microsoft Surface Touch Beta API. There are no constraints to the number of touch points this API can use. The API receives the touch inputs from the hardware and, therefore, it is limited to the hardware capabilities.

Multi-touch Gestures in TouchPat

The touch gestures in TouchPat use either one or two finger due to the limits of the hardware. This system has two views: the patent overview with the ZUI and the detailed view of a patent. Each view has a collection of gestures to perform actions. This section contains the overview of these gestures and actions in tables 3.1 and 3.2. The detail viewer, for example, is also used in the Organization Viewer and the touch gestures are not changed.

[1] http://mattgemmell.com/2010/05/09/ipad-multi-touch/

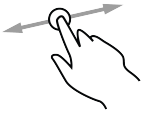
Action	Gesture
(De)Select a patent	 *One finger tap on patent*
Pan (also possible with two fingers while zooming)	 *One finger drag*
Zoom	 *Two finger scale*
Zoom in on patent	 *One finger double tap*
Open Context Menu	 *One finger hold*

Table 3.1: The zoomable user interface actions and corresponding gestures. All images are from GestureWorks (www.gestureworks.com).

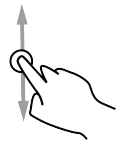
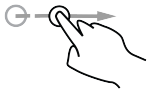
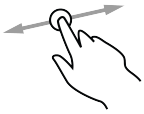
Action	Gesture
Scroll through text	 *One finger scroll in text*
Scroll through figures	 *One finger flick over figures*
Open/close figure manipulation	 *One finger tap on image*
Zoom figure	 *Two finger scale*
Rotate figure	 *Two finger rotate*
Pan figure or select text for annotations	 *One finger drag*
Close the detailed view of a patent	 *Two finger move down*

Table 3.2: The detailed viewer actions and corresponding gestures. All images are from GestureWorks (www.gestureworks.com).

3.4.2 Actions and Gestures

Actions that are performed often need gestures that require minimal effort to perform. For example, selecting multiple patents can be achieved by selecting each patent separately or by selecting a group with one gesture. Both options are desirable in different situations. If one situation is more common, it is obvious which gesture to choose; one can also use both gestures, however. These types of things must be considered during the creation of the gesture set. The gestures for the organizational actions are described first. After that, there is a subsection about the gestures for the navigational actions such as zooming in and out. This section ends with a brief explanation of the Context Menu gesture.

Organization

The main task that has to be performed in the Organization Viewer is the organization of documents. The gestures for the organizational actions were, therefore, kept as simple as possible. This section will first define the actions that can be used to organize a collection of documents and then explain the reasoning behind the chosen gestures for each action. The final gesture set can be found in table 3.3.

The action performed most often when organizing documents is moving them around. The easiest way to do this is by dragging the documents across the screen. The user might also want to move multiple documents at the same time. At first the idea was to move all selected patents at once by also using the one finger drag gesture. This leads to some problems, however, such as what to do when only one of the selected patents should be moved or how should the documents move, keeping the original spacing between documents or grouping them automatically and moving the group? It made more sense to group the documents before being able to move them simultaneously. A group can also be touched and moved in the same manner a single document is moved.

Creating a group of documents also needs to be easy. When organizing documents on a desk, it makes sense to create stacks of documents. When you want to place 100 documents on one stack, you need to place each document on this stack separately. This is where a virtual world has an advantage: several documents can be selected at the same time with one gesture. With the mouse this is often done by drawing a rectangle over the items that need to be selected. With touch it is more natural to contour the documents, as if encircling them on a piece of paper as shown in fig. 3.16.

The idea of tracing a line around the objects one wants to select was used for the ‘lasso’ gesture. Using a one finger drag, a line can be drawn on the screen. This can only be initiated when the gesture starts on a empty space, otherwise a patent is touched and thus moved. The user can draw a line around the items that need to be selected. The line can create any shape as long as the start and finish points are the same so that it becomes a polygon. This makes it possible to check which items are inside the polygon and which should, therefore, be selected. The creation of the polygon can be done automatically by connecting the first and last points which making the user trace back to the origin of the gesture—see fig. 3.17.

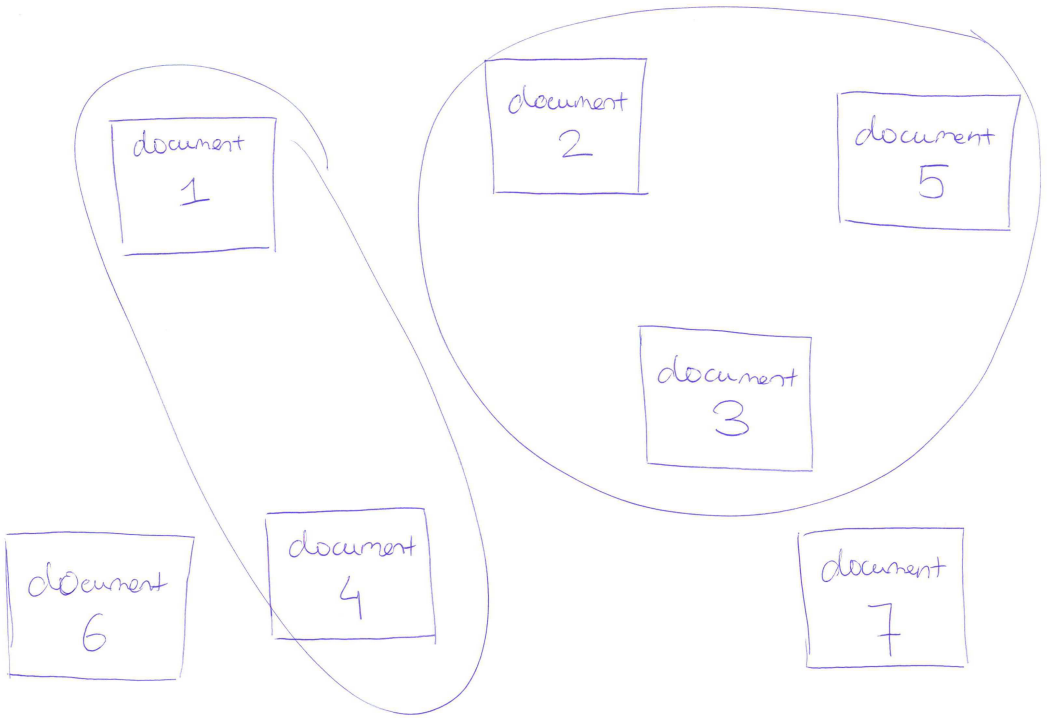


Figure 3.16: The selection of items on a piece of paper by drawing a shape around them.

When the user only wants to select one document, circling around it can be a hassle. It must also be possible to select multiple items that are not necessarily located next to each other. This is simply done by tapping on a document once. If the document was not selected yet, it will become selected and if it was already selected, it will be deselected.

To organize the documents automatically, the algorithm needs example patents. Users are allowed to quickly mark documents as viewed, and therefore as examples, by tapping on the patent twice. This is different from TouchPat where the double click zooms in on the clicked patent until it fills the whole screen. Since the algorithm needs examples, it seems more important to allow users to do this action in a simple manner.

The stacks of paper metaphor was also the inspiration for the ‘drag and drop into group’ gesture. This gesture makes it easy to add a document to a group. The user has to move the document to the area of the group and the let the document go, as if dropping it there. Feedback has to be given to the user to indicate when a document will be added to the group when letting it go. This is a lot like placing a paper on a stack which papers because it is the same action of moving an item to the group location.

Once documents are selected, other actions can be performed on them such as creating a group containing those documents or adding them to an existing group. Since most one finger gestures have already been used, a menu can be opened to choose these other actions from. This is done in exactly the same way as in the previous system by holding down

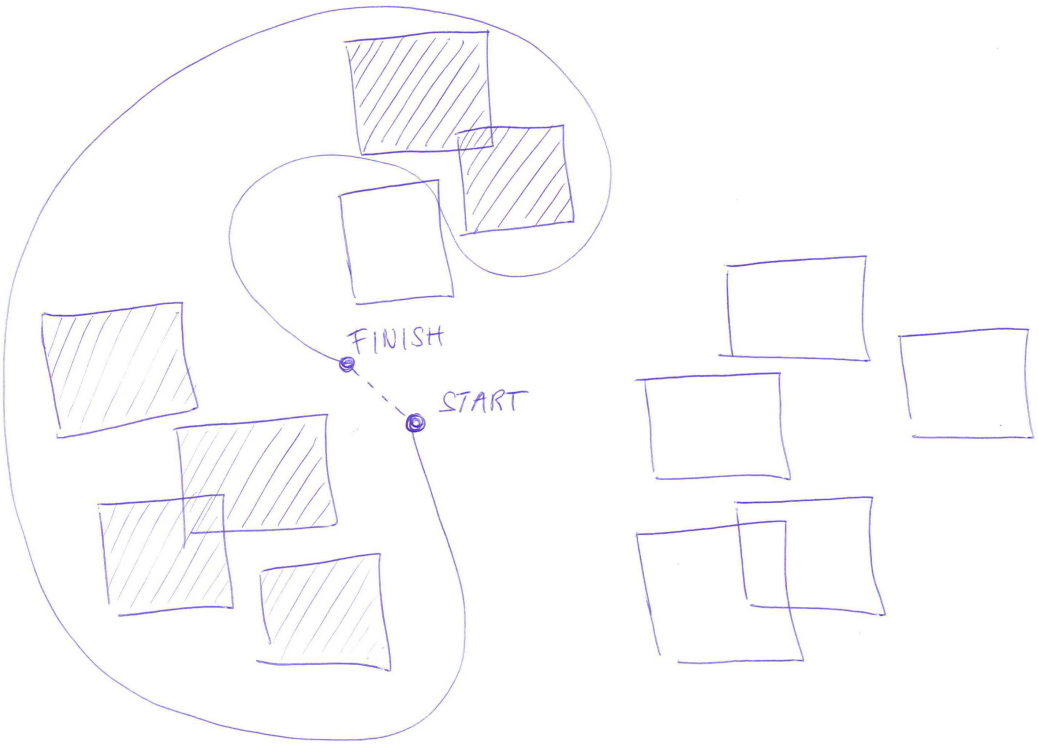


Figure 3.17: The selection of items using the lasso gesture. The start point is the first place a touch point is recognized by the system and the finish point shows where the finger has left the screen. The dotted line shows that the contour is automatically completed.

one finger for a longer period of time. The actions of the context menu are described in section 3.4.2 but first the navigational gestures are explained in the next section.

Navigation

Some gestures are very common for certain actions and it is best to use these in new systems as well because users are familiar with them. This is the case for navigational gestures because they are used on smartphones. Since the screens on smartphones are quite small, zooming in gestures are needed to display details on a web page, for example. Panning is then used to move around in the zoomed in view. This section explains the chosen gestures for this system and the overview can be found in table 3.4.

To zoom in and out, the pinch and spread gestures are used. This is in line with the normal implementation of zooming gestures and was also used in TouchPat. When the user wants to zoom in, two fingers need to be moved away from each other, as if spreading the background. When zooming out, the two fingers are moved closer together which is like pinching the background.

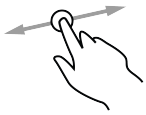
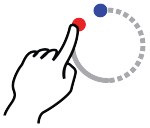
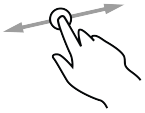
Action	Gesture
Move a patent	 *One finger drag on a patent*
Select a patent	 *One finger tap on a patent*
Deselect a patent	 *One finger tap on a patent*
Select multiple patents	 *One finger shape*
Add patent to group	 *Drag patent into group area*
Mark patent as example	 *One finger double tap*
Open Context Menu	 *One finger hold*

Table 3.3: The actions and corresponding gestures for organization in the Organization Viewer. All images are from GestureWorks (www.gestureworks.com).

The panning action is usually represented by a single finger drag. This was, however, already used for moving a document and using the lasso gesture. Since the organizational gestures use one finger, the choice is made to let navigation gestures use two fingers. These gestures are a bit more difficult to use but might not be used as often as the organization actions. The panning action is, therefore, represented by a two finger drag. A disadvantage is that this is not how panning is usually implemented and there is, therefore, a chance that the users will be confused.

The last navigation action can be used to go back to the original view. Groups can be opened in the grid view used in TouchPat from the Organization Viewer. This is similar to opening the detailed view of a document because it is like opening the detailed view of the group. To close this view, it made the most sense to do this using the same gesture used in the detailed view: the two finger drag down.

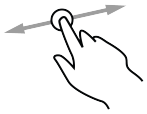
Action	Gesture
Pan	 *Two finger drag*
Zoom	 *Two finger scale*
Close other view	 *Two finger move down*

Table 3.4: The actions and corresponding gestures for navigation in the Organization Viewer. All images are from GestureWorks (www.gestureworks.com).

Context Menu

The context menu was created by de Ridder [Ridder 11] to allow the user to perform actions that are not easy to represent using touch gestures. It is different from menus that are currently used because an action is not selected by clicking on the menu item, but by performing a gesture as is described in 2.1.2. This type of menu is used again in this project. This section shows the actions can be chosen by using the context menu.

The actions a user can perform using the menu are split into 4 groups: actions on a single selected patent, actions corresponding to interaction with stacks, general actions on the whole collection of patents, and link actions to show relationships between patents.

- Patent Actions
  - Open the the patent in the detailed view;
  - Delete the patent from the view;
  - Make the patent an example;
  - Remove the example status of the patent.
- Stack Actions
  - Create a stack;
  - Edit the label of the stack;
  - Open the stack;
  - Remove the stack but keep the patents;
  - Delete the stack and all patents inside.
- General Actions
  - Select all patents;
  - Deselect all patents;
  - Show the patents in the grid view.
- Link Actions
  - Show the citations links;
  - Show the inventor links;
  - Show the applicant links;
  - Show the classification links;
  - Remove the links.

3.5 Conclusions

The requirements for the system are based on feedback given by patent examiners during de Ridder's project. Two points they mentioned during a discussion were being able to position patents themselves in the visual space and clustering documents to save screen space. The first point is addressed by creating the new Organization Viewer in which patents can be freely placed in the overview to allow users to organize a collection of patents. The creation of stacks enable the users to group multiple patents into one object.

The design of the Organization Viewer in TouchPat is based on the existing grid view in TouchPat. Patents are represented by thumbnails and semantic zooming allows the users to view more information about a patent by zooming in. The Zoomable User Interface is implemented in the same manner. Changes that have been made to the design with respect to the original TouchPat version are how a selected patent is visualized and the date display. Three new items have been added to the overview: groups of patents represented by stacks, links between patents to show relationships between them and patent examples which are used for the automatic arrangement of the patents as described in the next chapter.

As the name indicates, TouchPat works with multi-touch interaction. This chapter has shown the gesture sets designed for the grid and detailed views in TouchPat. While most gestures remain the same in the Organization Viewer, some changes are necessary to allow more interactions with the patents. The context menu is used again in this project because it is an interesting menu for multi-touch interaction.

Chapter 4

Automatic Arrangement of Patents

The requirements for the new visualization for organizing patents using a touch screen are defined in the previous chapter. One requirement is that the patents can be clustered. This can be done manually and the actions necessary for this are also described in the previous chapter. Clustering can also be performed automatically when enough data is available to determine the similarity between documents. Patents have a rich amount of data which can be used by a clustering algorithm. The focus of this chapter is, therefore, which clustering algorithm is suitable for organizing patents in the Organization Viewer and how that algorithm can use the information of the patents.

This chapter begins with a description of the requirements for an automatic organization algorithm. Section 4.2 shows what types of data a patent contains to determine the similarity between patents. A number of solutions are given in detail in section 4.4. The conclusions of this chapter are discussed in section 4.5.

4.1 Requirements

Patents can be organized manually, automatically or by a combination of both. The feedback on TouchPat from the end-users did not specify in which manner patents should be clustered. This section explores the advantages and disadvantages of automatic versus manual clustering of patents with respect to the requirements.

There are two things that are important when examining a patent application: *quality* and *efficiency*—both described below. The requirements for using clustering algorithms in the Organization Viewer are that the quality and efficiency of the patent application examination stays the same or improves.

Quality The patent examiners need to decide whether the correct documents have been found. After this, they can compare these relevant documents to the patent application to determine if the invention is indeed novel. When a relevant document is overlooked, the decision of the patent examiner to grant the patent can be incorrect.

Efficiency The patent examiners only have a short period of time to go through the prior art. The system must not slow them down and it would be better if the system can help them examine patents quicker.

Patent examiners do most of their work manually: they have their own search strategies and methods for grouping patents. These strategies help patent examiners search through the document corpus to find the relevant patents with respect to the application. This provides them with an assurance that the quality of their work is up to par. A new computer program may help the patent examiners perform their duties more efficiently by supporting the manual work effectively. An idea for this is the clustering of the search results as if organizing documents on a desk. This is described in the previous chapter—chapter 3.

When the prior art is automatically clustered, this can increases the efficiency of going through all the documents to determine which are relevant and which are not. The accuracy of the algorithm, when determining which document is relevant or not, must be very high and this is currently not feasible.

Using a combination of automatic and manual clustering can benefit the efficiency of the patent examination while allowing the users to gain insight into what the algorithm does based on their input. When the users can define the input for the algorithm and when it is clear what has changed by the algorithm, the quality of the examination can be better ensured than when only using automatic clustering. The user can then verify the clustering of the algorithm and make changes to the result when necessary. The quality may not be as high as when going through everything manually: users might overlook a document more easily when documents are clustered using an algorithm.

Clustering	**Quality**	**Efficiency**
Manual	High	Low
Automatic	Low	High
Combination	Medium / High	Medium

Table 4.1: Comparison of the different ways to organize a collection of documents.

The choice for the Organization Viewer is to use the combination of automatic and manual clustering. Manual clustering should also be possible because this is the only method that will certainly keep the quality high enough. With automatic clustering, the only way to ensure the quality is upheld is by checking all documents manually and this reduces the efficiency. The combination of the two might help improve the efficiency of the examination without comprising the quality.

4.2 Patent Data

Patents contain various types of information which can be used to determine the similarity between two patents. Before choosing an algorithm to cluster patents, it is good to know

what information is available. The data types of a patent are shown below and given a short description.

Title Each patent has a descriptive title.

Date of filing The date the patent has been delivered at a patent office.

Date of publication The date the patent has been granted. This can be several years after the filing date.

Applicant One or more inventors, companies and/or institutions who have applied for the patent.

Inventor The people who invented the technology in the patent.

Classification A classification code in a certain format such as the European Classification (ECLA).

Citations Patents cite other patents but can cite documents such as scientific publications as well.

Country Where the patent has been filed.

Patent Family If a patent is filed in several countries, it will be part of a patent family to keep track of the different application numbers of the patent at the different patent offices.

Abstract This contains a brief description of the invention.

Description The main body of patent describing the invention in detail.

Claims A list of statements that embody the extent of protection for the invention described by the patent.

Images Figures and drawings are added to the patent to visualize the invention.

Information, such as the citations, define explicit relationships between patents. Other data, for instance the title and abstract, define an implicit relationship: the patents cannot be exactly linked to each other because, for example, two patents will not have the exact same abstract. Finally, the information about the country and dates do not provide any usable information for comparing the similarity of patents but are useful to patent examiners when deciding if a document is relevant prior art.

4.3 Possible Solutions

The requirements for the clustering algorithm conclude that the Organization Viewer can use the combination of manual input and automatic clustering. There are multiple algorithms that can be used as a solution to the clustering of documents. One option to create a graph from the patent information and position the patents using a force-directed algorithm—see section 4.3.1. The second option is to use a projection method to place the patents on a 2-dimensional plane. Two multi-dimensional projection methods are described in section 4.3.2.

4.3.1 Force-Directed Algorithms

To visualize relationships between documents, such as which documents cite one another, a graph representation can be used. Herman et al. state that if the question "Is there an inherent relation among the data elements to be visualized?" can be answered with a "yes", then the data items can be displayed using nodes while the edges represent the relation [Herman 00]. Citations link patents explicitly, as does other information associated with patents such as applicant, inventor, classification and country as noted in the previous section. These pieces of information form the relationship between patents and a graph visualizes this relationship.

Related work, such as the Action Science Explorer described in section 2.3, has shown that force-directed algorithms can be used to position the nodes in a graph. The problem with this type of solution is that patents have richer data that help determine their similarity which cannot be formed into edges: the title, abstract, description and claims. Projection methods allow any type of similarity measure and are discussed below.

4.3.2 Projection Methods

The projection methods described in this section are Local Affine Multidimensional Projection and Hierarchical Point Placement. Both methods use a feature vector representation to compare the similarities between documents. The similarity is based on any part of the patent data and it not limited to the use of explicit links between the patents as is the case for force-directed algorithms.

The first algorithm described here is *Local Affine Multidimensional Projection* (LAMP), which is a recent technique to determine the positioning of data items based on examples [Joia 11]. LAMP can project each patent onto a plane based on a multidimensional similarity measure which can be created by taking the frequency of relevant terms in, for example, the abstract, title, and citations of a patent. The algorithm uses *control points*, which are data items from the set, to function as examples for the algorithm. The user places these control points in the 2-dimensional space and LAMP uses this as the input to calculate the locations of the remaining data items.

What makes LAMP useful for organizing patents is that the positions of the control points are not changed. This allows the user to keep the spatial memory of the positions of these example patents. If the result of the projection is not what the user wanted, control points can be moved, removed or added to create a new layout. Figure 4.1 shows the LAMP process where control points are used to create a layout containing all points. Compared to 9 other multidimensional projection techniques, LAMP is one of the most accurate and fastest (all computations were under 2 seconds) [Joia 11].

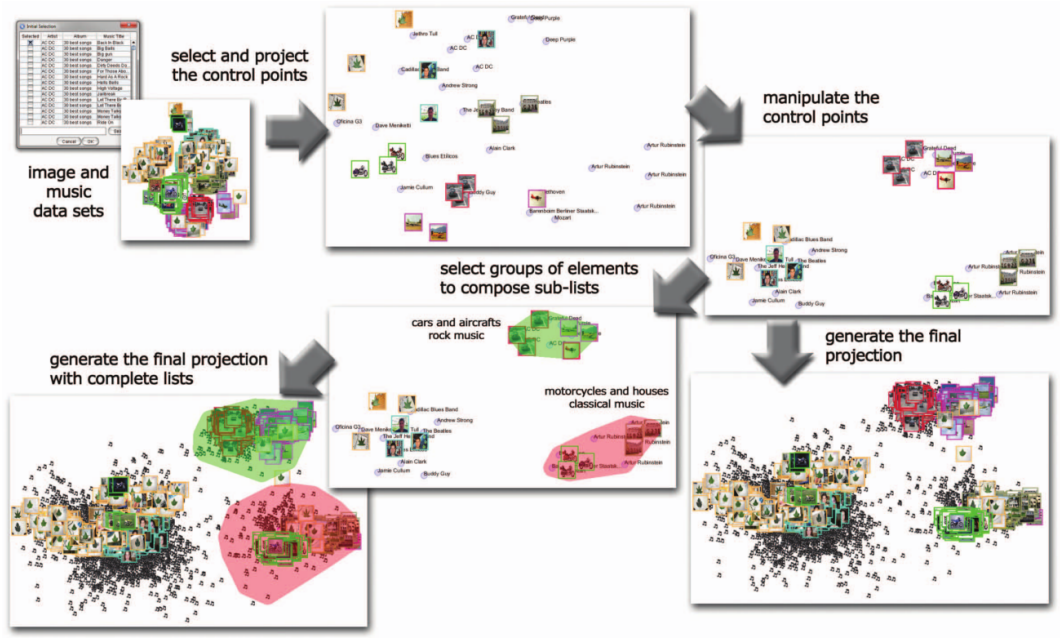


Figure 4.1: The LAMP process of moving control points as the basis of the clustering layout. [Joia 11]

LAMP does not provide a way to reduce the number of objects of a collection that need to be displayed. *Hierarchical Point Placement* (HiPP) [Paulovich 08] uses a hierarchical cluster tree to visualize groups of similar data items but can also show the individual items as can be seen in figure 4.2. The *Least-Square Projection* (LSP) technique is used to position the nodes representing each cluster. Child elements are placed in the same area as the parent to preserve the spatial layout of the clusters. Another interesting feature is that clusters can be re-arranged by the users meaning that the users can organize the clustering based on their knowledge. This method also reduces the document to a vector containing the frequency of relevant terms to create the similarity measure.

There are other methods to cluster documents, such as *Scatter / Gather* [Karger 92]. These methods place the focus on creating categories to place documents in. This is different from the idea to keep the spatial arrangement to show the similarity between the clusters. Both LAMP and HiPP show the similarity between the documents in the whole collection.

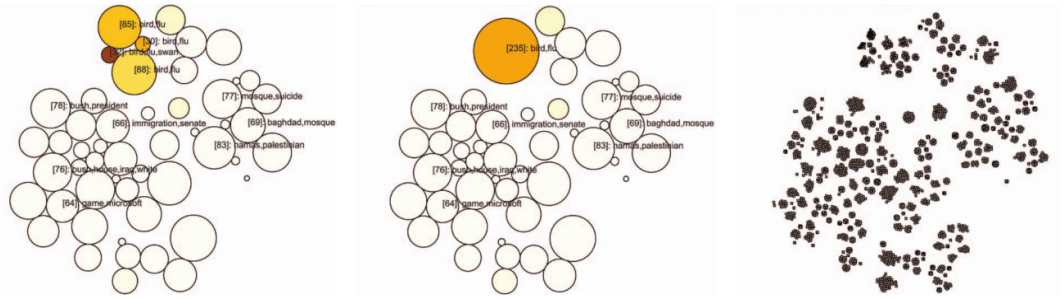


Figure 4.2: HiPP: The top level abstract view (left), joining four clusters (middle) and the lowest level view showing the individual documents (right). [Paulovich 08]

For the Organization Viewer, LAMP is chosen to organize the patents automatically. The HiPP method is good for creating a hierarchy of groups of patents, but does not help organize the collection of patents. The positions of the patents have to be determined before the grouping can begin. LAMP helps the organization process because it shows the similarity between patents based on their positions and allows the user to change the projection by updating the control points. It is a combination of automatic and manual clustering of the patent collection. The next section describes the LAMP algorithm and how it can be used in combination with patents.

4.4 Local Affine Multidimensional Projection

The technique chosen to automatically arrange the documents in a collection is Local Affine Multidimensional Project, LAMP. The previous sections explain how this choice is made. This section shows the algorithm of the projection method and gives an example from the original paper to illustrate how this method can be used.

4.4.1 The LAMP Algorithm

The LAMP method uses a subset of data items X_S from a collection X as control points, or samples, to position the data. The positions of the control points Y_S are used as an input for the projection. The positions of the remaining data items are determined by a family of orthogonal affine mappings. These mappings are found using the algorithm shown in algorithm 1. For the mathematical reasoning behind this algorithm, the reader is referred to the original paper which describes LAMP [Joia 11].

Each data item is represented by a vector x and the algorithm maps this vector to the visual space. To do this, first the scalar weights α_i are computed using eq. (4.1) where x_i is the i^{th} element of the control points set.

Algorithm 1 The LAMP algorithm

Require: Data set X, control points X_S, and the mappings Y_S of X_S.
  for each $x \in X$ **do**
    compute weights a_i
    compute $\tilde{x}$ and $\tilde{y}$
    build matrices A and B
    compute the singular value decomposition UDV from $A^T B$
    make $M = UV$
    compute the mapping $y = (x - \tilde{x})M + \tilde{y}$
  end for

$$\alpha_i = \frac{1}{\| x_i - x \|^2} \tag{4.1}$$

The weights are then used to calculate $\tilde{x}$ and $\tilde{y}$ by

$$\tilde{x} = \frac{\sum_i \alpha_i x_i}{\alpha}, \quad \tilde{y} = \frac{\sum_i \alpha_i y_i}{\alpha} \tag{4.2}$$

where $\alpha = \sum_i \alpha_i$.

The next step is to create the matrices A and B using the weights a_i, $\tilde{x}$ and $\tilde{y}$ by

$$A = \begin{bmatrix} \sqrt{\alpha_1}\hat{x}_1 \\ \sqrt{\alpha_2}\hat{x}_2 \\ \vdots \\ \sqrt{\alpha_k}\hat{x}_k \end{bmatrix}, \quad B = \begin{bmatrix} \sqrt{\alpha_1}\hat{y}_1 \\ \sqrt{\alpha_2}\hat{y}_2 \\ \vdots \\ \sqrt{\alpha_k}\hat{y}_k \end{bmatrix} \tag{4.3}$$

where $\hat{x}_i = x_i - \tilde{x}$ and $\hat{y}_i = y_i - \tilde{y}$.

The singular value decomposition (SVD) of these matrices is then used to find $UDV = A^T B$. Using this, the matrix M can be found by $M = UV$. The final step is calculating the new position y of the data item x with

$$y = (x - \tilde{x})M + \tilde{y}. \tag{4.4}$$

Taking these steps for each data item in the collection results in the projection of the collection based on the similarity measures and the location of the control points.

4.4.2 An Example Of Using LAMP

One example the authors give in [Joia 11] is the grouping of 675 scientific papers. The users were given 12 papers to arrange as can be seen in fig. 4.3. All documents were reduced to a vector of 390 dimensions containing the frequency of relevant terms from the authors, title,

abstract and references. This determines the similarity of the documents and projects them to 2-dimensions using the algorithm described in the previous section. When necessary, users can rearrange the control points to produce a different layout. As the image shows, the layout of the control points drastically effects the result of the projection.

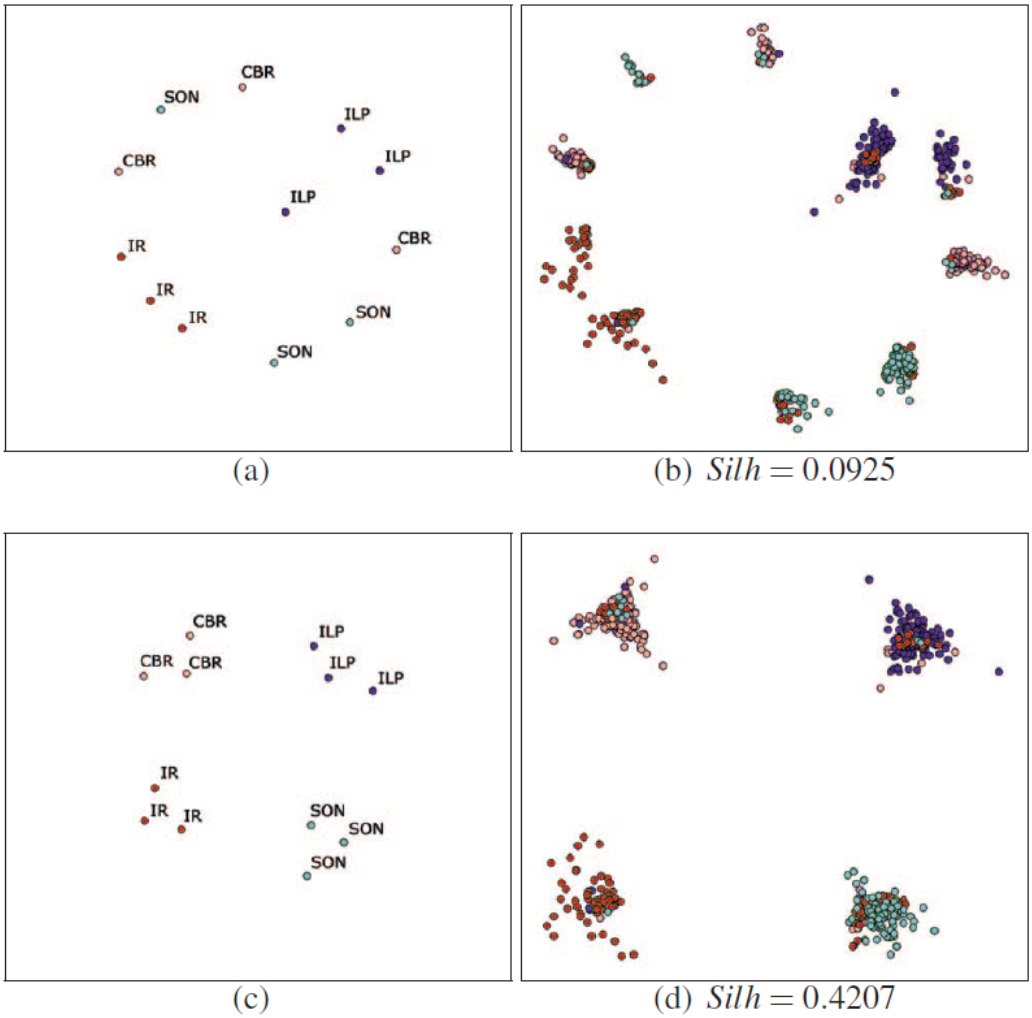


Figure 4.3: "Due to the high dimensional nature of textual document data, the force-based scheme can not properly group similar instances in the visual space (a), resulting in a tangled mapping (b). Since LAMP supports few control points, the user can easily identify and group similar textual instances (c), resulting in a better projection (d). Colors are used to highlight documents belonging to the same class, but the class information is not used by the system." [Joia 11] The *Silh* value indicates how well the items have been grouped: the larger the value of Silh (between -1 and 1) is, the better the cohesion and separation of the data items.

4.5 Conclusions

Automatically arranging patents in the visual overview can help patent examiners perform their work faster. The algorithm, however, must give high quality results. By using an algorithm where it is clear what the user has organized and what the system has done, the quality can remain the same and efficiency can be improved.

A number of algorithms are shown in this chapter and the best suited for this project is the Local Affine Multidimensional Projection (LAMP) method. Using control points—or examples—positioned by the user and a similarity measure, the data is projected onto the two-dimensional space of the overview. The positions of the control points do not change, therefore the work a patent examiner has already done is not lost.

Chapter 5

Visual Organization of Patent Collections using Touch

The results of the user interface design and exploration of the automatic arrangement possibilities are combined in a new view in TouchPat, the Organization Viewer. In the Organization Viewer, the user is able to position patents manually. Since organizing a large collection by hand is a tiresome process, the users have the option to let the system automatically place a remaining set of patents based on the locations of the previously organized patents.

The manual and automatic organization techniques are described in this section. First, the manual possibilities are shown in section 5.1. The automatic organization using LAMP is the focus of section 5.2. Details about the implementation can be found in appendix A.

5.1 Manual Organization

The design of the touch and user interface has been the topic of chapter 3. This section shows how the designs have been incorporated into the system. The manual organization touch gestures are shown here and the feedback given to the users by the system.

The three main actions that a user has to perform to organize the collection are moving patents to new locations (fig. 5.1), selecting patents for actions such as grouping them (fig. 5.3 and fig. 5.4), and adding patents to a group (fig. 5.5).

To move a patent, the users must touch the area of the patent and move their finger before the system recognizes the touch to be a long press, as this triggers the context menu. To show the user that the touch has been recognized on the patent, the patent is given the selected state: the border color has a highly saturated color and the thickness is increased. To move multiple patents simultaneously, the patents have to be grouped first. Then the group can be moved in the same manner as patents—see fig. 5.2.

To perform actions such as grouping a number of patents, the user needs to have the possibility to select patents. Single patents can be selected by tapping them once but this becomes a hassle when multiple patents have to be selected. To select multiple patents, the user can

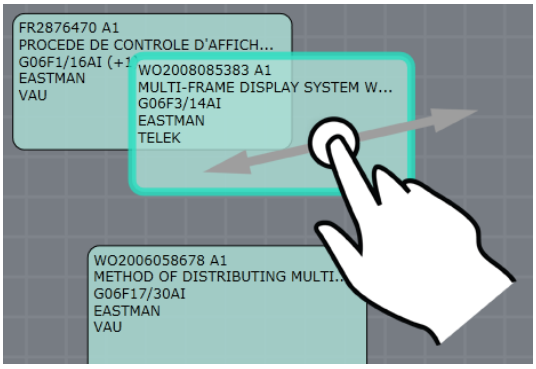


Figure 5.1: A patent is moved by touching it and moving the finger before the context menu is triggered. The patent border changes color and becomes thicker to indicate that the patent is selected.

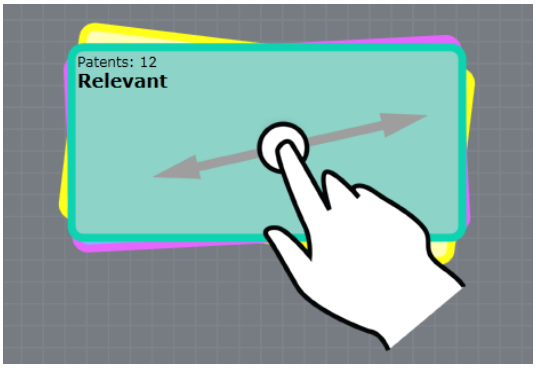


Figure 5.2: A group of patents (a stack) can be moved just like patents and also shows it has been selected by the change in the border: the thickness is increased and the color becomes highly saturated.

draw a lasso around them. To trigger this gesture, the touch has to start on an area that does not contain a patent and the finger must move before the context menu is opened. A circle is drawn at the initial touch point position and a line is drawn to show where the finger has touched the screen. The user does not have to trace back to the initial start point because the lasso gesture is automatically completed by the system and this is shown by a light line. Once the finger leaves the screen, the patents are selected.

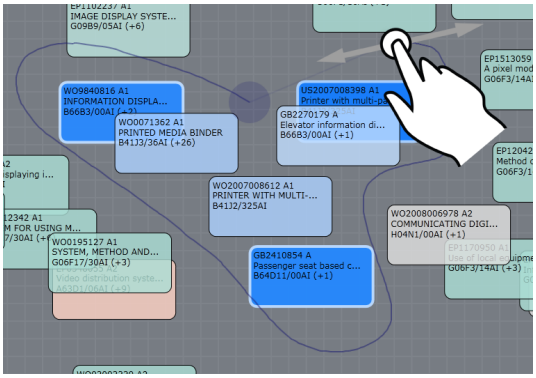


Figure 5.3: Multiple patents can be selected simultaneously by using the lasso gesture. The lasso is automatically closed so the user is not required to go back to the initial starting point.

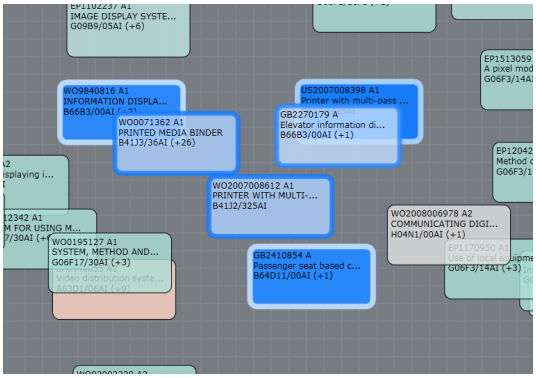


Figure 5.4: The result of the lasso gesture is that all patents within the area of the gesture are selected. The patent borders change to indicate the success of the action.

After a group is created, the user can add patents to it. Selected patents can be added using the context menu but individual patents can also be dragged and dropped into the group. When the patent is moved to the area of the group, the border of the stack become thicker. The saturation does not change because the group is not selected. When the user lets go of the patent in this state, the patent will be added to the group.

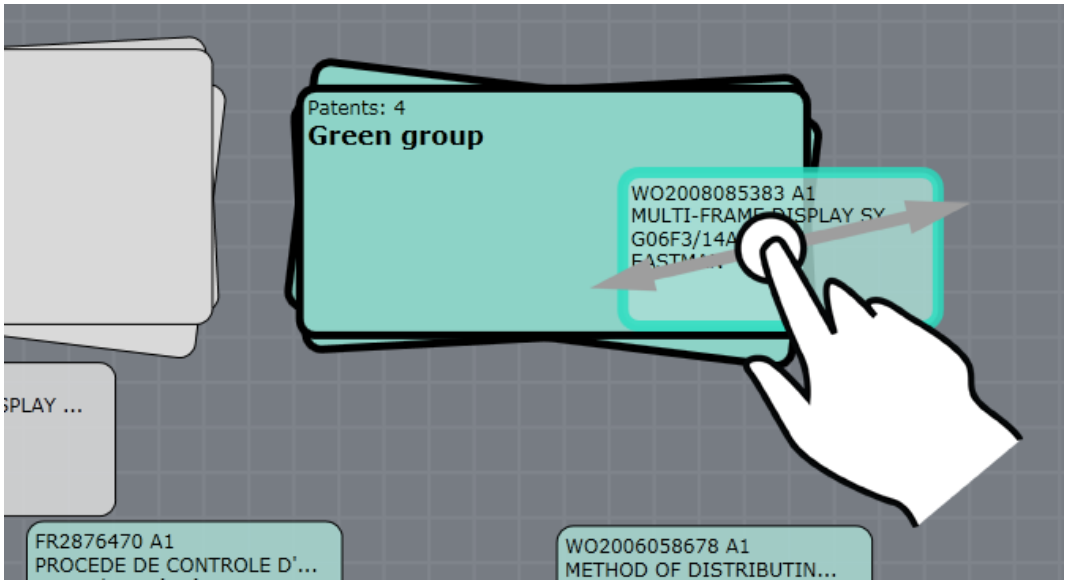


Figure 5.5: A patent can be added to a group by a drag and drop action. As soon as the patent enters the area of the group, the border of the group becomes thicker to show the user that the patent will be added to the group if the patent is placed here.

After the user has organized the patents into different groups, it is time to review the groups. A group is opened using the context menu and the result of this action is that the patents in the group are shown in the original grid view of TouchPat. Only one action is added to this view: the grid view can be closed by using the two finger drag downwards gesture—the same gesture used to close the detailed view of a patent.

One type of display that can be used to help organize the patents is the date display. When a date range is chosen, the patents that fall outside of the range are de-emphasized to make it clear which patents do fall within the range. Figure 5.6 shows the effect of de-emphasizing a part of the collection of the patents. This makes it easy to find the relevant patents for this date range.

5.2 Organization using LAMP

The second feature of the Organization Viewer in TouchPat is the automatic placement of patents based on the locations of the example patents. The projection method used is Local Affine Multidimensional Projection (LAMP) which is explained in the detail in section 4.4. This section shows how LAMP was incorporated into TouchPat by first presenting how the user interacts with LAMP and then how the information of a patent is processed to fit a feature vector. The LAMP algorithm is implemented by calling DLL files created by Paulo Joia Filho, one of the authors of the LAMP paper. More information about this is presented in the appendix about the implementation, appendix A.

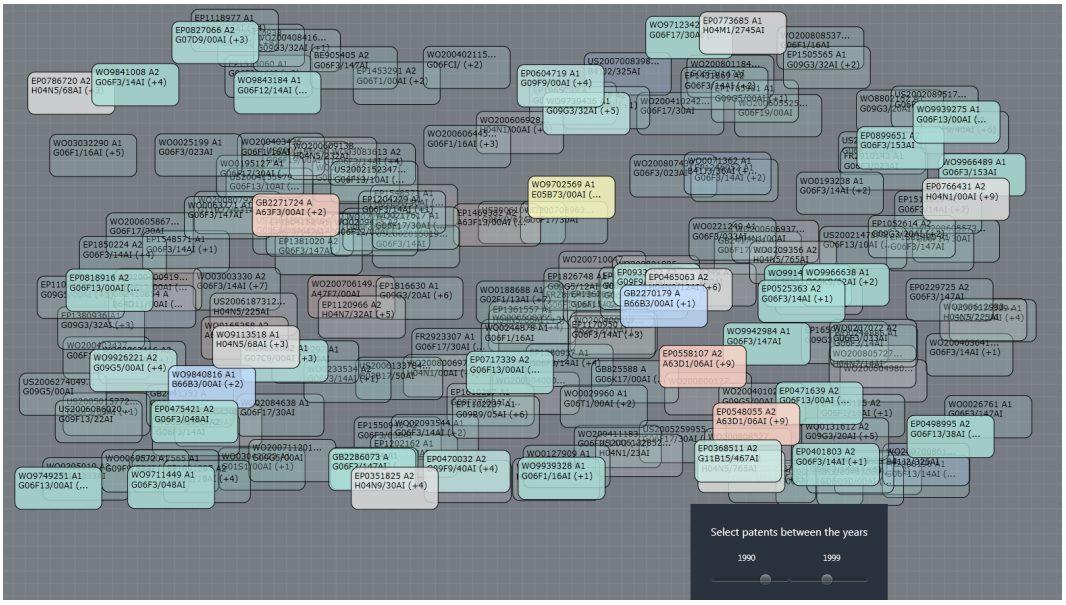


Figure 5.6: A range of dates is chosen to only display patents from 1990 to 1999. All the patents are displayed, but only the patents that are still clearly visible fall within this range. The other patents are de-emphasized by lowering their opacity.

To use LAMP, the user must provide several patents to serve as examples—sometimes denoted as control points—for the algorithm. Based on the positions of the examples and the similarity measure, the positions of the remaining patents can be calculated. A user can make a patent an example by double clicking it. The saturation of the background color of the patent is then increased to show that the action was successful. A patent can also be made an example using the context menu. Marking patents as examples for LAMP is a way to indicate which patents have been reviewed by the patent examiner. Stacks are by definition examples because a patent would not be in a stack if the user has not looked at it yet. In the algorithm, a stack is implemented by giving all the individual patents in the stack the same position.

LAMP requires a high dimensional vector as input. In this project two similarity measures have been created: one based on the text of the title and abstract and another based on the classifications. The methods used to retrieve information from the title and abstract are explained in section 5.2.1 and after that the classification retrieval is shown in section 5.2.2.

5.2.1 Term-based Feature Vectors

Text can give an indication of the similarity of documents: if both documents contain many of the same words, they are probably alike. However, words such as ‘the’ and ‘a’ do not provide any insight into the similarity between documents. Removing these words is part of the preprocessing phase to generate a meaningful vector space model of the text within the document. The next paragraphs show the actions that need to be taken to use text within a

document as the similarity measure for LAMP: *text retrieval*, *stopword removal*, *stemming* and calculating the *term frequency-inverse document frequency*.

The first step in the text mining process is retrieving the text from documents. This can be several documents but in this case is limited to retrieving the text from within the individual patents. A patent has various sections such as the title, abstract, description and claims. All these sections can be used but one can also make the choice to only look at the title and abstract or only the claims. Once it has been decided which part(s) of the patent to use, a vector of all the terms in the patent collection is created. In this project, the words in the title and the abstract are saved.

Some words do not indicate similarity between documents because they are so common. An example of this is the word 'the' which is used very often but does not provide any information with respect to the topic of the patent. The European Patent Office has a list of stopwords that are found in patents and that can be removed from the vector space—see fig. 5.7.

Once the terms have been retrieved from the patent, they have to be stemmed to be able to compare them correctly. For example, the words 'display', 'displays' and 'displaying' all have a similar meaning but are totally different words to a computer. Stemming them, therefore, brings words down to their root by removing endings such as '-ing' and '-ed'. This increases the accuracy of comparing words with each other and allows for a better similarity measure. The stemming algorithm used in TouchPat is the Porter Stemmer[1].

The final step in the processing of a patent is calculating the term frequency-inverse document frequency (tf-idf) [Salton 88]. This is done once all patents have been preprocessed because it depends on the amount of documents in which the term is found.

$$idf(t, D) = \log \frac{|D|}{|\{d \in D : t \in d\}|}$$

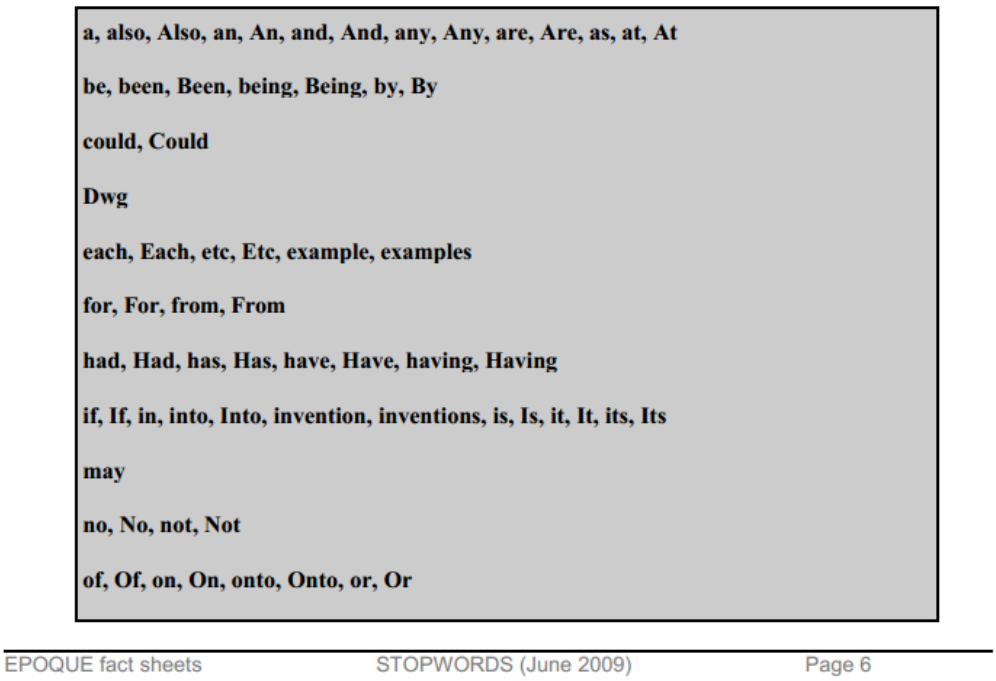
$$weight = tf * idf = tf(t, d) \times idf(t, D)$$

where $idf(t, D)$ is the inverse document frequency of a term t in the collection of documents D and $tf(t, d)$ is the term frequency of the term t in the document d. The inverse document frequency calculates in how many documents contain a term with respect to the whole collection. If a term is common in the collection, the weight given to it in the feature vector will be lower than when a term is rare among the collection. Since the vector of the terms per patent is available, it is straightforward to calculate this for each term in the collection to create a feature vector for each patent.

5.2.2 Classification-based Feature Vectors

The results of LAMP when using the textual similarity measure were not satisfactory—see fig. 5.8, therefore, a similarity measure based on the classifications is also implemented.

[1] http://tartarus.org/ martin/PorterStemmer/



a, also, Also, an, An, and, And, any, Any, are, Are, as, at, At

be, been, Been, being, Being, by, By

could, Could

Dwg

each, Each, etc, Etc, example, examples

for, For, from, From

had, Had, has, Has, have, Have, having, Having

if, If, in, into, Into, invention, inventions, is, Is, it, It, its, Its

may

no, No, not, Not

of, Of, on, On, onto, Onto, or, Or

EPOQUE fact sheets STOPWORDS (June 2009) Page 6

EPOQUE

SEP
should, Should, so, So, some, Some, such, Such

tb
that, That, the, The, THE, their, Their, then, Then, there, There, thereby, Thereby, therefore, Therefore, therein, Therein, thereof, Thereof, these, These,this, This, those, Those, thus, Thus, to, To

was, Was, were, Were, when, When, where, Where, wherein, Wherein, which, Which, while, While, with, With, would, Would

Figure 5.7: The English stopword list used by the EPOQUE databases. These terms are not indexed and, therefore, cannot be searched. This list is retrieved from the EPOQUE Fact Sheet.

This implementation was used during the evaluations because it gives a better idea of how LAMP works since the patents are spread out more in the visual space than when using text. Another reason is that the colors represent the classifications and this makes the results of LAMP clearer for the users when organizing based on color.

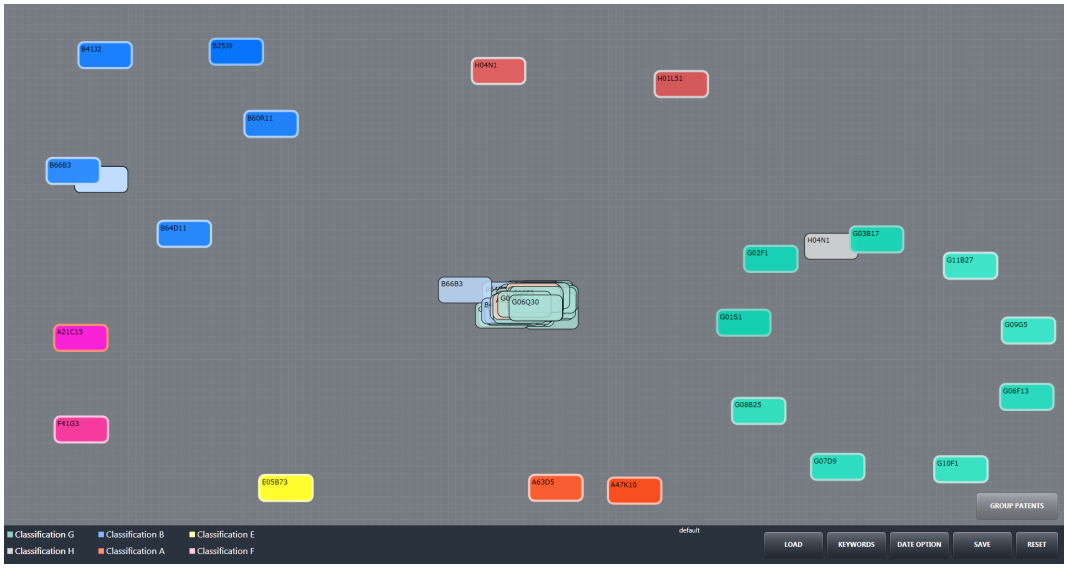


Figure 5.8: The result of using LAMP and a similarity measure based on the terms in the title and abstract. Note that most documents are placed in the middle of the screen between the groups of examples.

The similarity based on classification is determined by looking at the classifications of each patent. A patent is not limited to one classification but can have multiple classes assigned to it. For example, one patent in the collection used for testing has 18 classes. Since the classes are very specific, only the first two identifiers of the classes are used in the similarity measure: section and subsection—see an example of a classification below, section G and subsection 06 are used for the similarity. The similarity measure is created by weighing the amount of classifications with the same section and subsection c with respect to how often the section and subsection appear in the collection C.

$$weight = \frac{c}{C}$$

To represent patents in this manner is not correct, but it does give a better visual indication of how LAMP can be used when organizing patents—see fig. 5.9. LAMP uses the same information to project the patents as the user does to organize the patents, which is based on color and, therefore, on classification.

```
Classification: G06F17/30M9
Section:    G  = PHYSICS
Subsection: 06 = COMPUTING; CALCULATING; COUNTING
```

```
Class:       F   = ELECTRICAL DIGITAL DATA PROCESSING
Subclass:    17  = Digital computing or data processing
                   equipment or methods, specially adapted for
                   specific functions
Group:       30  = Information retrieval; Database structure
                   therefor
Subgroup:    M9  = in image database; data organization and
                   access thereof
```

Source: Espacenet[2]

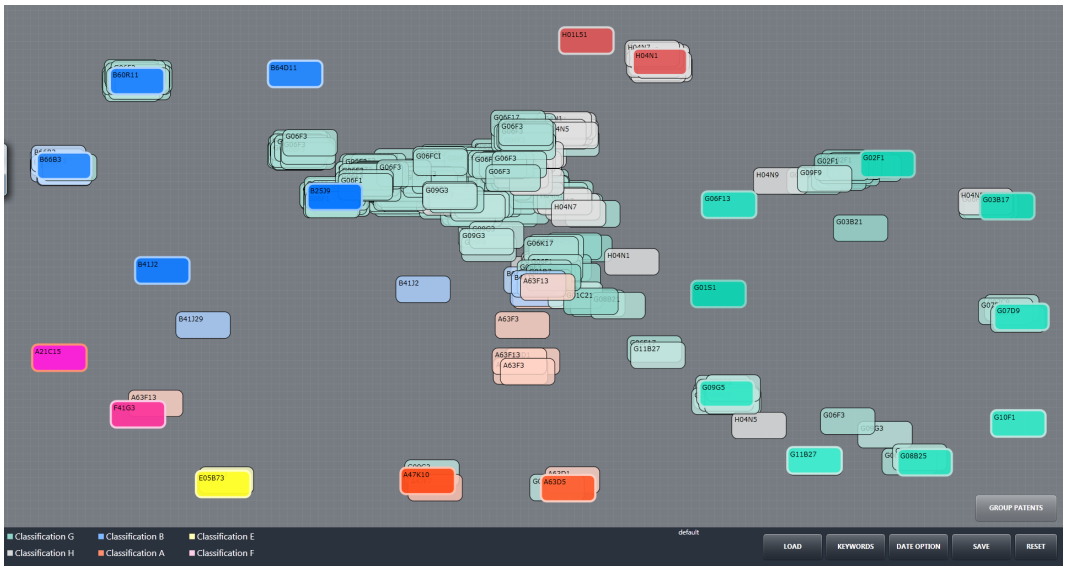


Figure 5.9: The result of using LAMP and a similarity measure based on the classifications of the patents. In this case, the patents are spread more evenly than when using the similarity measure based on text.

5.3 Conclusions

The Organization Viewer in TouchPat allows users to organize patents manually and automatically using LAMP. This chapter shows how the interface and multi-touch gestures have been combined to give the users feedback on their actions. For example, a patent can be added to a stack by dragging it into the area of a stack and dropping it there. The stack displays a thicker border to indicate the patent will be added to it if let go.

For the automatic arrangement of patents, LAMP is used. It requires a feature vector for the documents to project the data onto the visual space. In this project, there are two versions

[2]http://worldwide.espacenet.com/eclasrch?classification=ecla&locale=en_EP&ECLA=g06f17/30m9

of the similarity measure. The first version uses the text from the abstract and title to create a feature vector. The text-based version did not provide useful results, therefore another version based on the classifications of the patents is added.

Chapter 6

Evaluation and Results

TouchPat is created for a specific group of users: patent examiners. As noted in chapter 2 about the related work, visualizations created on patent information were not evaluated with a group of users. Only the PatViz project [Koch 10] conducted a user study with two patent experts and a group of students. This chapter presents a user study with twelve examiners who used TouchPat and gave feedback.

The first section, section 6.1, shows how the evaluations are setup. The results of the evaluations are presented in section 6.2. The discussion of the results takes place in section 6.3 and this chapter ends with a number of conclusions.

6.1 Evaluations

Chapter 3, about the design of the visualization of patents, describes how some design decisions are based on feedback from patent examiners. For example, creating links between a selected patents and other patents in the collection—rather than showing the connections between all patents—was an idea described during the first evaluation session with an examiner. The first evaluations were informal sessions and are described in section 6.1.1. After the implementation of the system, a second round of evaluations is used to understand the benefits and drawbacks of the system. This second type of evaluation is the think-aloud protocol which allows patent examiners to use the system and give feedback. The setup of these evaluations is described in section 6.1.2.

6.1.1 Unstructured Interviews

During the implementation phase of the project, two feedback sessions with patent examiners were arranged at the European Patent Office. These sessions helped refine the design of the system and provided new ideas on how the system can be used. First, the setup of these sessions is explained in this section. After this, the backgrounds of the participants is given—this is needed to understand the results in section 6.2.1.

Both sessions started with a demonstration of TouchPat. De Ridder's grid display of patents was shown first to help the examiners understand the context of this project. The Organization Viewer was shown after this and the use of LAMP was explained and executed: first a messy layout of patents was shown, then the examples are organized according to classification and finally LAMP is used to organize the patents based on their classifications. After this demonstration, the system was discussed to see what the examiners did or did not like and to see if they had any other thoughts about the system. These discussions are unstructured interviews of which notes have been taken.

The first evaluation session was with a patent examiner in the field of Computer Graphics. The second evaluation was with a group of people consisting of an ergonomics specialist and two patent examiners from the Mechanical Engineering field. When evaluating the similarity between patents in the Mechanical or Civil Engineering fields, comparing images is the main task of the examiners. The group of examiners was, therefore, also shown a version of the grid display that only displays the images of a patent.

6.1.2 Think-Aloud Evaluations

The think-aloud technique gives insight into the thoughts of a participant during the use of a system. The participants of the study are asked to voice what they expect to happen when performing actions [Sharp 07]. This direct observation technique is chosen to understand how the patent examiners perceive the new patent display and to see what they expect to happen when using the multi-touch gestures. This section describes the setup of the evaluations and the equipment used to observe the patent examiners. The background of the participants concludes this section.

The think-aloud technique was chosen because at first it was not clear how many patent examiners would be able to participate in the evaluations and this technique provides a wealth of information even if only a couple people participate. Since system has to be used with a touch screen, the examiners are not able to take a look at the system from their own computer and give feedback using a questionnaire. The results of a questionnaire would also vary depending on the field of the examiner as the previous evaluations had already shown that how the system is used is dependent on the background of the patent examiners. Observations with the think-aloud technique, therefore, were chosen to evaluate this system.

These evaluations were performed after the system had been implemented as described in the previous chapter. Examiners were invited to participate in a 30 minute evaluation session. First, the context of the project was explained and what would happen during the evaluation session. Then, a few basic questions about the participant were asked such as what field they work in. A demonstration of the system was given after this to show the different types of actions that could be performed using gestures and the menu. The gestures were also printed out on a sheet of paper allowing the participants to get a reminder about the gestures while using the system. The participants were then asked to use the system themselves and to voice their expectations and opinions about the system. After a while this progressed into a discussion about the system where the participant could show examples of what they meant by using the system.

The basic questions asked at the beginning of the evaluation session are:

1. What is your age?
2. In what field do you examine patents?
3. Have you used a touch screen before (e.g. on a smart phone or tablet)?

The demonstration explains the following features of the system:

Patents The colors represent the classification of a patent. An example patent has a brighter color.

Zooming To show more/less information about the patents, the pinch gesture is used.

Menu The menu can be opened using a long press and a swipe past the border of the menu triggers an action.

Links To show relations between patents, links can be shown through the menu.

Open/close patents Patents can be opened through the menu to see the full document. Two fingers moved downwards closes the detailed view.

LAMP To automatically arrange patents, a button can be pressed after the examples have been organized.

Stacks A group of patents can be selected and a stack can then be created with a label.

Grid view The stack can be shown in the grid view.

The evaluation sessions were held at the European Patent Office, see the setup in fig. 6.1. The two touch screens available were both used during evaluations to see if there was any difference in hardware. During an evaluation one of the two screens was used and the screens were switched between participants. A camera on a tripod recorded the hand movements of the participants to see how the gestures were performed. This also recorded what the participants said while using the system. The transcripts of the audio recordings are described in section 6.2.2.

Participants were invited to be part of this evaluation through email. Two participants had already given feedback on the system during the earlier demonstrations. Other participants had either never seen the system before or had seen a short demonstration of the system beforehand but did not provide feedback at those sessions. In total 22 people were asked to participate. 17 responded positively to the invitation and in the end 12 examiners participated. The evaluations were held over a period of 3 weeks. An overview of the participants is given in the table below, table 6.1. The tables contains their answers to the three questions asked before the start of the evaluation of the system. All participants indicated that they had experience using a touch screen so this question was not included in the table.

Figure 6.1: The setup used for the evaluations consisted of one touch screen, a laptop and a camera on a tripod to record the hand movements and comments of the participants. The papers to the right of the screen show the gestures and their corresponding actions.

6.2 Results

Feedback given during the first two evaluation sessions, described in section 6.2.1, has already been used during the design and implementation of the system. Not all results from this feedback has been implemented, however. The results from these evaluation sessions is given in more detail in section 6.2.2. The results of the think-aloud evaluation sessions are discussed in section 6.2.2. The complete collection of notes and transcripts from the evaluations is found in appendix B. This section gives an overview of the results gathered from the data.

6.2.1 Informal Feedback

The notes taken during the informal feedback evaluation sessions can be found in appendix B.1. This section gives a summary of both evaluation sessions and shows the comments that have been implemented already. Other comments fall outside of the scope of this project but are important requirements for a future system.

Participant Number	Field	Age
1	Electronics & Computer Science	40-49
2	Mechanical	30-39
3	Mechanical	40-49
4	Computer Science	50-59
5	Computer Graphics - Audio, video, media	30-39
6	Electrical & Mechanical	40-49
7	Biotechnology - Medical diagnostics	30-39
8	Aerospace	30-39
9	Mechanical - Ergonomics	30-39
10	Chemistry - Polymers	30-39
11	Electronics	30-39
12	Mechanical - Woodworking	50-59

Table 6.1: The results of the initial questions of the evaluations: the background and ages of the 12 participants. All participants had used a touch screen before, therefore the answers to this question are not shown in the table.

The first examiner to provide feedback on the system noted that it is necessary to show others why the patents have been organized in a certain way. The use of the text is mentioned and this was the basis for creating the labels of the stacks. Another comment was that the stacks must indicate the amount of patents they contain. This comment was the inspiration to make the size of the stacks relate to the amount of patents they contain. Opening the stack in the grid view was also an result of this evaluation.

Another wish the first patent examiner had was to see links between the patents. Showing the links between all patents had been omitted in the system, but his idea was to show the links starting from one patent. The links go from one patent to the other patents that have, for example, the same inventor, applicants, date or citations. A menu part is added to let the user select the type of links to draw.

During the evaluation the color of a patent was inverted when the patent is selected. This was confusing for the examiners. The ergonomics specialist in the second evaluation session specifically commented on this. Based on his feedback, the design of a selected patent was changed to keep the same color of the classification while the border thickness and color was changed. Based on his other feedback, a patent is no longer centered around the finger but the patent moves with respect to the finger.

The other comments the examiners gave have not been implemented yet. In both sessions the wish for an ‘undo’ function was voiced. Going back through the decision tree of the search is important for patent examiners because it allows them to go back and make other search decisions to find all relevant patents to the application.

Another interesting idea is selecting a subset of patents and to have the computer determine what their similarities are. This can be useful when a patent examiner has placed a number

of patents near each other but cannot put his/her finger on why the patents are similar. A computer can compare information to see what the documents have in common, such as applicants, dates, citations, words in the abstract or text, for example. The similarities can then be shown to the user.

The first evaluation with the examiner also provided some new ideas on information to add to the thumbnail representation of the patents. For example, it can be interesting to see the number of pages a patent has when determining where to start the search for relevant patents. A large patent with multiple classifications can be tiring to read, but a short patent of 20 pages with a number of classifications is interesting because it is unusual and it will not take very long to assess its relevance with respect to the application. The list below shows the statistics the patent examiner can find interesting:

- The number of pages of the patent;
- The number of figures;
- The amount of keywords in the abstract;
- The amount of keywords in the text.

In the second evaluation, the two examiners with a mechanical background noted they prefer to work with images. This led to the idea of creating the thumbnails based on a set of preferences. In mechanical fields the images can be shown at an earlier zoom stage and text is added once the patent is zoomed in more. Other fields, such as computer sciences, do not rely on images as heavily and use text as well. For examiners in those fields, having text and images as is currently implemented might be satisfactory.

6.2.2 Think-Aloud Results

The results are divided into four main themes: interface, touch, hardware and organization. These themes are the result of examining the transcripts. The comments given during the evaluation were divided into five topics: display (blue), touch (pink), new functionality (green), field specific (orange) and hardware (yellow). The colors represented the highlighted color used in the transcripts—see fig. 6.2 for an example. This division is not used in the report because the topics sometimes overlap, for example field specific comments are mostly related to the interface so it is best to discuss these with the design comments in a section about the user interface. Three examples of transcripts of the think-aloud evaluations with the patent examiners are provided in appendix B.2.

This section is divided into the four topics. First, the results dealing with the interface are discussed. Then, comments and observations about the touch gestures are provided. This is followed by a subsection about the hardware because the touch screens impacted the evaluations. This section ends with the results about the organization of patents.

The detail view is closed and now the keywords are also shown in the patent thumbnails.
He drags a patent to a new position and taps it once.
P: "This one for instance, I want to see… Oh you have to hold."
He opens the menu and remembers how to open the patent without any problems.

He manipulates the image, but swipes it out of the screen. Now there is no way to get it back. The patent is closed and a new one is opened.
P: "Quite often you have to turn the image so it would help if you have a 'turn left 90 degrees' and 'turn right' (button). Otherwise it takes too long to (do this)."
He scrolls in the annotations bar. He does a thumbs up after scrolling down. Then he scrolls upwards.
P: "The only thing is to move upwards it is… (difficult)"
P: "Ah, you can use the nail even. How does it (the screen) work?"
He is shown that a pen can also be used to interact with the touch screen. He scrolls with his finger nails.

Figure 6.2: An example of a transcript from the evaluation with participant 2. The transcripts are highlighted according to five types of comments: display (blue), touch (pink), new functionality (green), field specific (orange) and hardware (yellow).

Interface

The comments about the interface are presented in this section. First, the thumbnail displays of the patents and stacks are discussed. The links are the other aspect of the interface described here. The context menu is a topic in the next section about the touch gestures. Comments about the arrangement of the patents are discussed in the section about organization.

Patent Thumbnails

The thumbnails of the patents show more or less information based on their size. None of the participants reacted negatively to the thumbnails and zoomable user interface. Two participants made positive remarks about the ZUI as for example the reaction of participant 4 below.

> "When you zoom in and see more information, that is a wonderful thing."
>
> *Participant 4 - Computer Science*

The content displayed in the thumbnails was unsatisfactory for a number of users, however. The comments given on the content depended on the field of the examiner and sometimes on personal preferences. For example, to see images the user must zoom in. All 5 examiners from the mechanical fields commented that images are more important to them than the text is—see comments by participant 8 and 12 below. They would, therefore, prefer to see images at an earlier stage or as participant 12 indicates, images are shown first and once zoomed in, text is added to the thumbnail.

> "A lot of search is based on images, some of it is based on text. Because it is a mechanical field, the far bigger part is looking for a certain mechanical thing and then you look at the drawings."
>
> *Participant 8 - Aerospace*

> "Can you make the drawing bigger within this box?"
> He tries to zoom and rotate the drawing in the thumbnail.
> "The amount of [text versus image], to me it would be the other way around."
>
> *Participant 12 - Mechanical*

Another frequent comment the participants made was to see more images without having to zoom in completely. The first participant suggested the possibility of swiping through the images in the thumbnail—see comment below. A total of 6 participants said that swiping would be useful.

> "Is it possible to flip this (the image in the thumbnail)?"
> He is told this is currently not implemented.
> "Would be nice to flip it."
>
> *Participant 1 - Computer Science*

The other 6 participants had no negative comments on the images in the thumbnails. Of these 6 participants, 2 examiners gave positive remarks about seeing all the images of the patent in the bottom bar—see fig. 6.3. Participant 12 suggested to click on the small image preview in the bottom bar and to place it in the larger image area on the right side of the thumbnail.

> "I think this is quite a good idea actually, where you sort of just... where you are looking at these but you sort of say, well actually this is the interesting drawing [in the bottom images bar] and then it appears here [on the side where the larger images are displayed], you know, blown up."
>
> *Participant 12 - Mechanical*

How a patent is displayed to be selected is different in the Organization Viewer and grid view. Feedback given during the first round of evaluations prompted the change to indicating a patent is selected by changing the border, rather than inverting the color of a patent. During these evaluations 2 participants were confused about the selection in the grid view, see a quote by participant 11 below for an example. Changing the border was clear to the participants, however it can be improved for people who are colorblind such as participant 3.

> "Why are some darkened?"
> He is told those patents are selected.

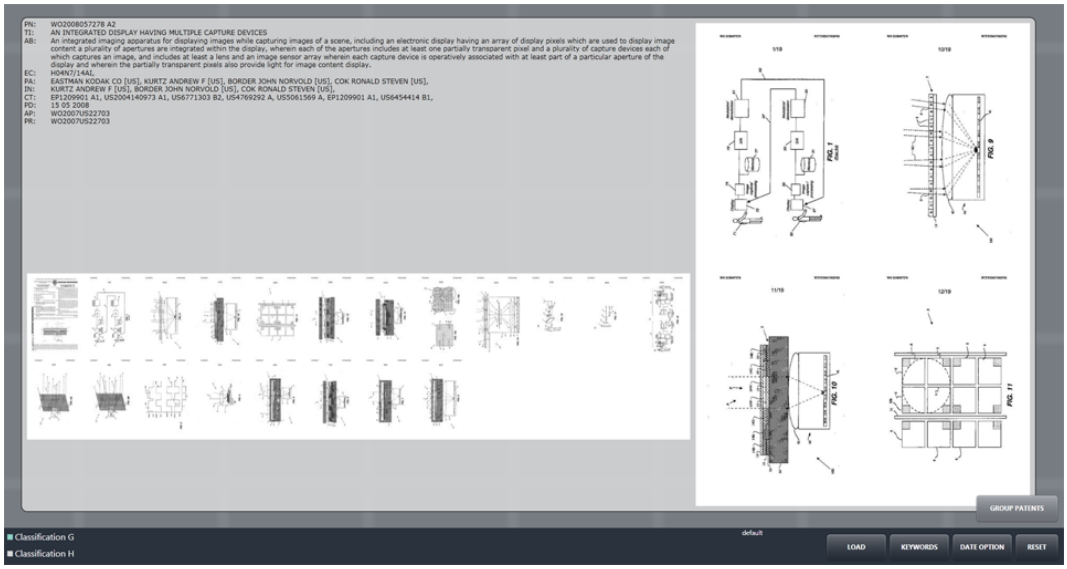


Figure 6.3: When a patent fills the screen, a row of all the images in the patent is placed at the bottom of the thumbnail.

> "Ah. They are the ones that I have selected."
> He closes the grid view.
> He is asked if it was obvious that those patents were selected.
> "No."
> He is then asked if it is obvious in the organization view when the patents are selected.
> "Yeah... I think so."
>
> *Participant 11 - Electronics*

> The participant selects a patent and is asked if it obvious to him that it is selected.
> "Yeah, I would say so. Probably, of course the background color is already green, that makes it a little bit difficult, therefore I assume that you make a selection color a different color than the patent itself because I am a little bit colorblind. Therefore it makes it already more difficult these kind of only small changes of color."
> He is asked if the border was black it would be better.
> "For example, or maybe a big white border."
>
> *Participant 3 - Mechanics*

Stacks

The stack thumbnails do not contain as much information as the patents do and, therefore, feedback was focused on understanding what to display in a stack to help the examiners.

Currently the number of patents, a label and the keywords count is displayed. The label is often enough to convey the concept represented in the stack, but for examiners with a mechanical background, a key image is better than a label. Of the 5 mechanical participants, 2 participants gave this feedback. The comment from participant 3 is shown below.

> "You know, a label [for the stack] is fine but if I would have the option between the label and an additional drawing, I would like to have a drawing. Because I am very much in my field drawing orientated therefore I easily see the drawing in one eye glance, for the text I am 'which label was it now...'."
>
> *Participant 3 - Mechanics*

Seeing a summary of the patents inside was received well by 1 examiner, the others did not comment about it or indicated they did not care for it. No negative comments were given about the annotation bar for the stacks, and participant 1 thought it was interesting—see comment below. Of the other participants, 2 examiners indicated they would like to see the class frequency in the stack, because the colors were not clear enough, and they would keep the frequency of the keywords as well.

> "For me to understand, this [the annotation bar at the bottom of the stack] is the total number of occurrences [of keywords] in the stack?"
> He is told that is correct.
> "Ah, that is interesting, that is a statistic that we don't have right now. This is giving you the feedback so it should show that it is very relevant for a certain concept. Then it is an interesting statistics on a group. Because currently somehow we can see, when we flip documents in Viewer, we see the occurrences of the search terms but it is for one document."
>
> *Participant 1 - Computer Science*

Rather than displaying stacks, the patents can also be placed in an area with a custom label to indicate they are related. This was preferred by 3 participants, often because they did not like having to make a stack to move multiple patents.

> The participant selects the four patents using the lasso gesture. He moves one patent. He is asked what he expected would happen.
> "Pack them all or move them all."
> He is told he can make a stack to move them all at once.
> "Yes, but that is the menu. Then I have to use the menu."
>
> *Participant 11 - Electronics*

Links

Examiners, in fields where text plays a larger role, responded well to the use of the links between the patents in the collection, which is similar to *Combi*—a system used to show

the relationships from one specific patent to any other documents. The examiners from mechanical fields did not care much for this feature. 5 participants gave positive comments about the links and 3 of them wanted more sophisticated links to make combinations of applicants and inventors, for example. The comments of participant 5 give an example of such ideas. The colors of the links could then be determined by the type of links they represent, for example red for applicants and blue for inventors.

> "In an ideal case, a logical combination is the best [for the links]. Not [showing] everything [i.e. all possible links: applicant and inventor and citations, etc.], or just one [type of link], but 'applicant AND/OR classification'. Because normally the classes, you combine not a little bit complex but a little bit more than just and/or. But you say 'this one and this one' or 'inside this one too' and maybe and/or an applicant or inventor. I can imagine that this is the best but maybe it is a bit too much. But I think the ideal would be to combine with a certain freedom, at least 'and' and 'or' of them [the possibilities for links]."
>
> *Participant 5 - Computer Science*

Creating links starting from stacks was also proposed by participant 5, see his feedback below.

> "Certainly stack links [are] interesting because imagine if this was a group I am interested in, to know there is an inventor somewhere and you didn't realize that they were close and now you can say this one, I think I will put it in the stack even if I was not interested in it. Of course, imagine with links between the stacks is interesting because maybe you think they are two stacks but maybe they are strong enough [to be combined into one stack]."
>
> *Participant 5 - Computer Science*

Date Display

The final aspect of the interface discussed here is the date display. In the Organization Viewer the patents are de-emphasized when they fall outside of the date range. No participants said anything negative about this way of displaying the patents, and 3 participants gave positive comments. One example of participant 7 is shown below.

> The participant presses on the 'date' button in the bottom menu.
> "I think that would be really useful. Especially when you are looking for a date in the future. I mean, not in the future but you already made your whole search and you want to be sure that at a certain date nothing came up in addition."
> She is asked if she likes being able to see all patents, with some de-emphasized.
> "Yeah. Maybe some people would like them to disappear but I don't know, depending also on how precise you can be because for us it is by the day sometimes you look."

> The participant plays around with the date sliders.
> "I think it is quite nice to see them because you can quickly have an idea: okay, in the last, I don't know, in 2005 there were very few applications and then if you go up here, there is a boom."
>
> *Participant 7 - Biotechnology*

Touch Gestures

TouchPat uses three views that all have their own specific gesture set. Feedback given on the detailed view and the grid view is not discussed because it is not focus of this project. The gestures of the Organization Viewer are discussed here. The design of the gesture set is described in section 3.4.2.

The gestures for selecting, moving and adding patents to a stack received no negative comments. The 5 participants who dragged a patent into a stack during the evaluation, for example, all did this without any issues as can be seen in fig. 6.4.

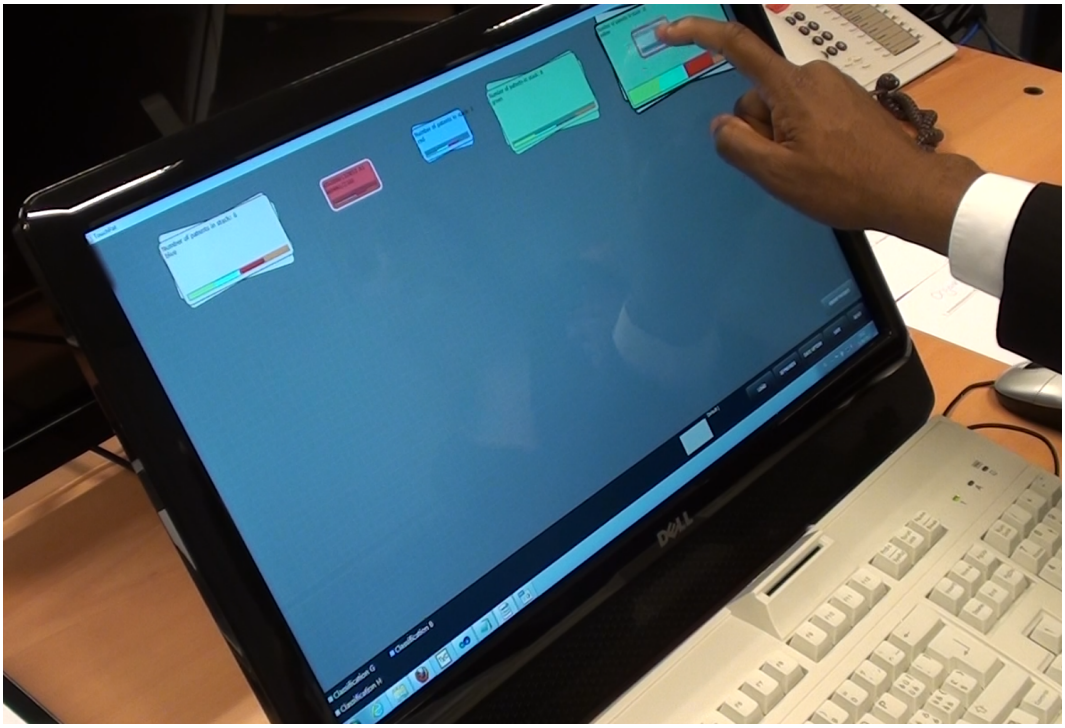


Figure 6.4: Multi-touch gesture that were given visual feedback cues were less difficult to use for the examiners. An example is dragging a patent into a stack: the border of the stack becomes bold and the user understands that the patent will be added to the stack (top right of the screen).

Using two fingers to pan did prove to be difficult for the participants to remember. Of the 12 participants, 8 tried to pan using one finger rather than two. Of these 8 participants, 2 participants indicated that they could get used to using two fingers. The other participants

gave no comment expect for 2 participants who stated that they would prefer to select patents in a control-click type of way, see the feedback of participant 7.

> The participant pans using her index and middle finger placed horizontally. She then switches to using her thumb and index finger, as is used when zooming in and out.
> "Moving sideways or up and down is a bit difficult."
> She moves around some patents.
> "Because moving things, it is quite easy, but moving like that (horizontally) is a bit more..."
> She is asked if she would prefer to pan with one finger rather than select patents.
> "Yeah, maybe. Because I try to have more space but still it sometimes zooms as well. And then maybe to [select] we can press [with one finger] to circle [with the other finger], like a control + something. We still have this stuck in our mind: alt, shift, control. It takes a bit of time to get used to this logic."
>
> *Participant 7 - Biotechnology*

Another multi-touch action that was expected by 7 of the participants was that double tapping on a patent would open the patent in the detailed view or zoom into the patent. Below the comments from participant 4 are shown on his expectations of double clicking on a patent.

> The participant double clicks and the patent becomes an example. He double clicks again and nothing happens.
> "What is it now?"
> He is told that the patent has become an example.
> "I wanted to open it."
> He is told to use the context menu to open it.
> "Okay, that is maybe something, double click would be for me to open it."
>
> *Participant 4 - Computer Science*

Hardware

The evaluation was performed with two touchscreens: the first 4 examiners used the Acer screen and the other 8 used the Dell screen. The screen plays a significant role in the experience of the system because most participants gave comments relating to the hardware. The experiences fall under three categories: the feel, the sensitivity and the display of the screen—in this case, the reflection and finger grease on the screen.

The 4 participants using the Acer screen all commented on the feel of the screen while none of the participants using the Dell screen noted any opinions about how the touch screen feels. The participants, using the Acer screen, found the screen to have too much friction on their fingers making the experience of using it for a longer period of time unpleasant. Participant 4 goes as far to say that it feels like he is losing his fingers.

> "The screen... I feel the touch is... I feel like, it's not like sand paper but you feel arghhhh (sound as if there is too much friction). The resistance really... It feels like you are losing your fingers a little. When I am using iPhone and iPad I don't have that feeling. And I know because I was also using the tablet pc from HP and I also had this feeling. So, it's not that... I am not an Apple fan but I found that it is natural, you don't feel it, and here you feel like a resistance. It is not really a pleasant feeling. So I think it is important that the screen is really inviting you to do this. What is nice it that is does not leave too much dirt (finger grease marks on the screen). On longer term I would prefer to use mouse. I think the experience of the screen is really important."
>
> *Participant 4 - Acer*

The Dell screen does not suffer from these problems but due to the sensitivity of the screen, touch gestures are more difficult to perform: other parts of a user's hand are often also recognized, which triggers actions the user did not expect. Sometimes a touch point would be recognized by the hardware at a totally different area, as can be seen in fig. 6.5.

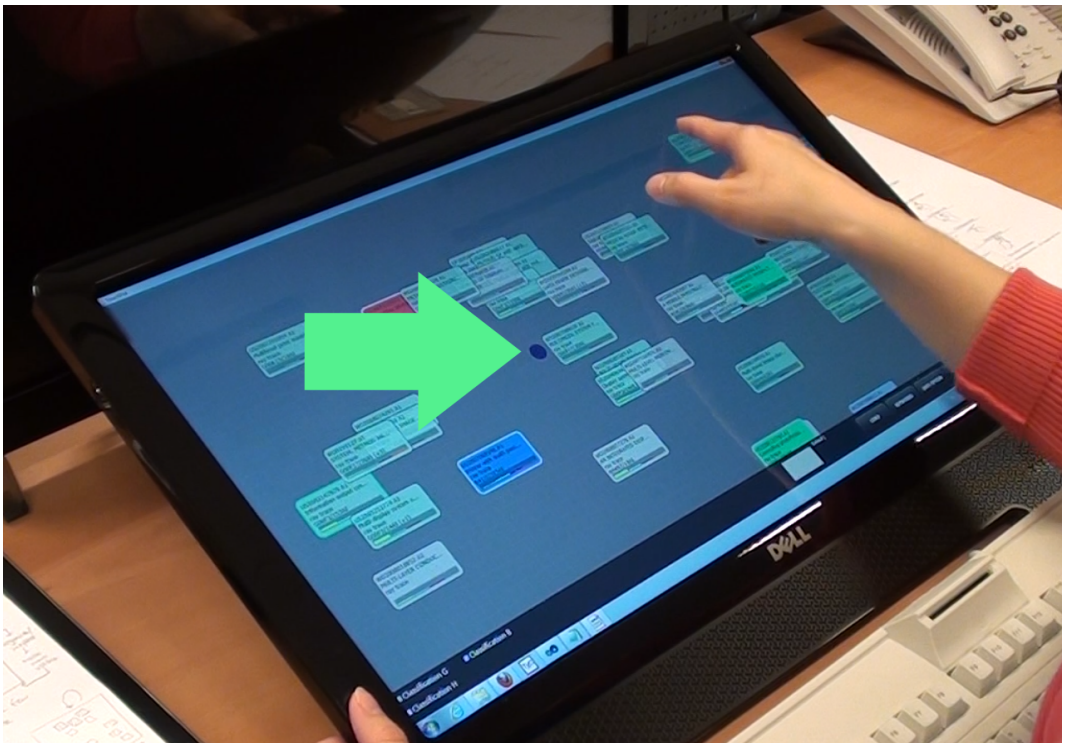


Figure 6.5: While the user is moving a patent, the Dell screen recognizes a touch point which is not even close to the user's hands. This triggers the zooming action and confused the participant 7 in the evaluation.

Another difference between the screens is their reflections of the surroundings and the display of greasy finger marks left on the screen. The Dell screen reflects light more than the

Acer screen does, as participant 6 notes. The Dell screen shows the effect of greasy fingers on the screen more than the Acer screen does—see the comments by participant 4 at the beginning of this section and participant 6.

> "Other things what is a little disadvantage here is that [the Dell screen] is reflecting, very much. The lights and so on. And the other thing is if you use your finger, after a certain point you really see [the grease]. That could be annoying but I don't know how to deal with that so that's, I think, the intrinsic problem of the whole touch screen."
>
> *Participant 6 - Dell*

Organization

Feedback on the organization of patents is presented in this section. First, the comments on having an overview are shown. Then the feedback on organizing a patent collection is given, ending with some notes on how the participants experienced using LAMP. This section concludes with the user preferences for an initial layout.

An overview of the collection of patents was received positively by 7 participants—see the comment by participant 10 for an example of their feedback. One participant stated that he preferred to go through the patents one-by-one, as is the current way of working. He liked using the grid to go through the patents, but would have preferred it to have one dimension. The other 4 participants did not comment on having an overview of the collection.

> "I think at least getting the option of getting an overview is always useful. I think it is nice. It is like actually having several patents/documents printed in front of you and just maybe quickly comparing the abstracts which is possible with this one."
>
> *Participant 10 - Chemistry*

Participants were asked if they could see themselves organizing a patent collection. Four indicated they would organize a patent collection, 4 said they would not use this type of organization because they would prefer to just go through the collection one by one or in the grid view, and the final 4 did not provide any comments on this topic. A reason for not wishing to organize is that some fields are already specific so the number of patents returned by a search can be between 10 and 30, see the comments by participant 2 below.

> The participant is asked if he would use the organization of the patents or sees himself using this in any way.
> "As I said, it is usually already organized. You search in a certain class and have a set of 10 or 20 documents."
> He is asked how many patents are returned by a search.
> "Between 10 and 30."

> He is asked if that is already specific enough.
> "Yes, you do the search and some out with a number of 10 to 20 I would say. I group them according the classification scheme. I have several drawers and then I usually sort it according to relevance and/or classification. So it is nice to have/to do a kind of drawers or stacks as you call it. You need that, but it is already there, you don't need to create this stack. Out of this search already comes a stack. So there are too many documents and as I say I usually have 10 to 20 out of a search and not like 100."
> "It is different if this is your search [the 100 patents displayed on the screen], if you make your search like this. But if you say you already finished your search, to examine the thing, then you don't need this [organization] first. It is different if you have 1000 documents then you cannot display it like this. You have to order them before, stack them."
>
> *Participant 2 - Mechanical*

Organizing a collection can be done manually, but 7 participants gave feedback on types of automatic organizations they would like to have. They would like to organize patents on classification automatically, either by creating stacks per classification or by modifying the positions of the patents in the visual space according to classification. Another possibility of grouping patents automatically is by creating a stack from the links that are displayed, as suggested by participant 11.

LAMP was difficult to understand for the participants. Only 3 participants used it during the evaluation. They did not understand what had happened after pressing the 'Group Patent' button. As participant 5 says about this kind of automatic clustering: "Easy to say, difficult to do." The similarity measure is difficult to define and he found it "difficult to judge" such automatic clustering. His ideal case would be to work on 20 documents and then let the computer do the rest.

The current display of patents in the Organization Viewer is overwhelming for the participants because it was too messy. The participant were, therefore, asked how they would like to have the collection displayed after loading the patents. A grid layout was preferred by 4 participants, but all had a different grid in mind. The basis of the grid is the classification with sometimes the date. A description of an initial display of a grid is given by participant 10.

> "For example what I would prefer, for example, because there is already an indication of the classes by the color, I would put that in three different colors here [indicating columns] next to each other. And if possible, for example, maybe it is too structured... Here [on the right] the view like this [columns of classes], and here [left], but not really split frames, the grid view also based on which column of classes is active, or which stack. But I don't know, maybe it is too restrictive, structure wise."
>
> *Participant 10 - Chemistry*

Another option is to keep the space empty and allow the user to drag patents into the visual space. This lets them organize the collection starting from scratch. Participant 1 and 7 preferred this initial display. The other participants did not provide any feedback on the initial display for organizing the patents.

> "The first time I will have the documents... For us what is important first is the date to see if it is on time or not. And then I think it is quite nice if your desk is clean, so the patents are stuck there [to the side] and then you start moving [the patents onto the desk] and making your own groups, little by little. I am a quite picky person, so I like maybe to have a stack [of patents to the side, not like the group stack] and then to make my own groups and not have to fish like now."
>
> *Participant 7 - Biotechnology*

6.3 Discussion

The results of the evaluations show that the users are able to use a graphical visualization tool to process patents. They agree on a high level with each other on how to use the system, but once the details of the display are discussed, they each have their own preferences. This section is divided into three parts: the user interface, the touch interaction and the organization methods.

6.3.1 User Interface

Each participant had different expectations of how to work with patents in a new system. These expectations are rooted in their current way of working. For example, all examiners in the mechanical fields need to see images to determine if a patent is relevant but not all of them want to see multiple patents at the same time: some examiners will go through each patent separately, while others would like to look at 12 patent drawings simultaneously. These different preferences make it difficult to find one view that suits everyone. Personalizing what is shown in the patent thumbnails can be a solution to this problem.

These different user preferences are also present when looking at how the participants wish to have the initial layout of the patents. Four examiners requested a grid in which the patents are placed in the visual space based on classification and/or date. Other examiners prefer to start with an empty space and place patents in the view themselves.

The feedback on links was also dependent on the background of the participant. Examiners from the mechanical fields did not need the links and prefer to use the grid view. Moving single patents in the grid view would be an enhancement of the view, however. The participants, who did respond positively to the links, recognized that the Organization Viewer was better suited for displaying links due to the empty area between the patents which makes it possible to draw links. The links can be improved by allowing more sophisticated links through combining options such as 'inventor OR applicant'.

Opening the stacks in the grid view was received well by the participants. Some participants requested to also have a quick view of the contents of the stack. Suggestions are to swipe through the patents in the stack or to get a pop-up of the patents in the stack. To quickly visualize patents in the stack, without opening the stack in the grid view, inspiration can be found in *BumpTop* such as fanning out the patents around the stack or creating a small grid of the contents of the stack [Agarawala 06]. For the display of a stack, the participants from fields were images play an important role would like to see an image in the stack while a computer science and a chemistry participant were happy with the annotation bar and text.

Two things that are implemented differently in the Organization Viewer with respect to the grid view in TouchPat are the date display and how patents are displayed to be selected. The date displayed was used by only a few participants but those who used it were positive about the option of seeing the whole collection. Showing the patents as selected by changing the border was also received well, but can be made clearer by only changing the border thickness while the color of the borders stay black or white. This selection display is clearer than the display used in the grid view.

6.3.2 Multi-Touch Interaction

Working with patents on a touchscreen was a new experience for the participants. It showed the possibilities of a multi-touch system, but also indicated what negative effects arise when working with touchscreens. This section discusses the hardware aspect of a multi-touch system first. Then, the difference between natural and abstract gestures are described.

What has become clear during the evaluation sessions is that hardware plays a large role in the experience of the system. Screens that are too sensitive result in unwanted touch points which trigger unexpected actions. Less sensitive screens, however, result in physical discomfort.

Users experienced difficulties with multi-touch gestures for actions that do not directly manipulate the display, such as closing a view or opening a menu, due to a lack of visual feedback. Actions that do provide direct feedback, such as dragging a patent into a stack, were natural to the users and did not result in any issues. Adding more feedback on the multi-touch gestures will improve the user experience.

Another enhancement of the system is to add shortcuts for actions. The participants indicated that shortcuts for actions such as zooming into a patent will reduce the amount of effort it takes them to perform such a task. Another example is when links are shown from a patent, rather than moving all the links manually to this patent and then grouping them, a group can automatically be created through a menu, button or multi-touch gesture.

It is a challenge for users to get used to new implementations of standard actions. Panning with two fingers was not a success because users would sometimes like to pan without zooming. This is nearly impossible when using two fingers to pan and to zoom because the zooming is also triggered. Creating a type of control click for touch is a solution to use the selection gesture with two fingers. Another example of a gesture that should result in a

different action is the double tap with one finger. The participants expected this to open the patent or to zoom into it as is the case in the grid view.

In the related work, section 2.4.2 lists the guidelines created by [Yee 09] for creating a gesture set. One guideline is to "use appropriate metaphors". Multi-touch gestures that directly manipulated the patents and the stacks are easy to use and to remember and this can be attributed to this guideline. Another guideline is to "cue efficient gestures" which is done by changing the stack display when a patent was dragged over it. It is obvious to the users that letting the patent go will trigger an action. Providing cues for shortcuts is, therefore, also implemented successfully. One guideline that is not followed well enough is "facilitate accurate recognition by the application". In the case of the 'close view' gesture, the implementation should be changed to recognize this gesture in more cases.

North et al. studied how touch-based interaction can outperform mouse actions when organizing circles based on color on a touchscreen [North 09]. In the Organization Viewer it is also obvious that the actions a user can perform are easier to do using touch than with a mouse. This is not a totally fair comparison, however, because this system is designed for touch-based interaction. On the other hand, it is interesting to see how natural and easy gestures such as swiping through a document are in comparison to using a mouse to do the same action.

6.3.3 Manual versus Automatic Organization

During the evaluation, LAMP was used by 3 participants but 7 participants gave feedback on automatic clustering. The results of their feedback show that clustering patents automatically is a feature that they want. This section discusses the role of automatic organization in TouchPat.

Organizing a patent collection manually is not something all patent examiners need. In some fields, the number of patents returned during the search are small, 10 to 30 patents, that going through them one by one is good enough. The participants who responded positively to organizing a patent collection worked in fields were the classifications are more abstract, as is the case for patents in the field of computer science for example. This makes it necessary for examiners to go through more patents to find the relevant documents.

A comment given by two participants during the study was that using the system for a longer period of time can be tiresome. They, and other participants, expected more shortcuts in the system to perform their tasks. One of the shortcuts is to automatically group patents. The suggestions on how the patents could be grouped were options such as grouping patents on classification and grouping all the links from a patent into one stack. What happens when this type of grouping is performed is clear to the user because they understand on what basis the patents are grouped.

While LAMP is a method to automatically organize the patents, it was not clear to the participants what features of the patent were used to create the new layout of patents. Even when told that LAMP uses the classes of the patent and the example, they remained confused by the outcome.

Another issue with LAMP is the positioning of documents that are similar to all examples and documents that are not comparable to any example: both types of documents are placed in the center between all the examples—see fig. 6.6.

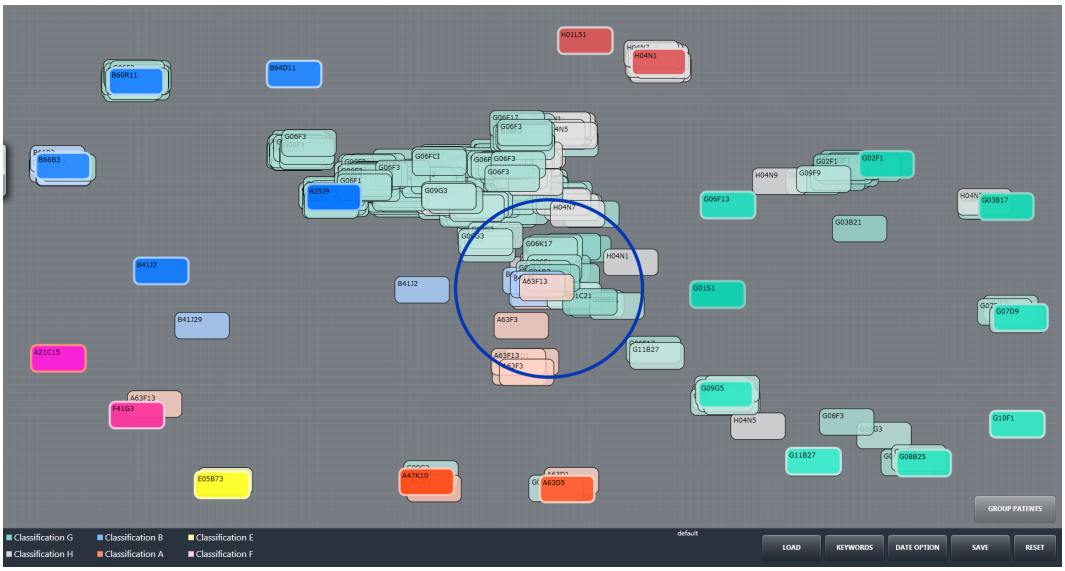


Figure 6.6: The result of organizing patents using LAMP based on classification. Many patents are placed in the center of the screen. This is either because they are equally similar to the surrounding example or because they are not similar to any example.

It is a challenge to find the correct examples to create a good layout in LAMP because the examples should cover every type of document. In patents this can be difficult because the documents all represent each other, otherwise they would not be returned by the search. The example given of LAMP, section 4.4.2, the papers were from different research fields. This makes it easier to select the examples and text in the publications do not deal with the same topics so a similarity measure based on text is also more appropriate than in the case of using LAMP on patents from the same research field.

6.4 Conclusions

TouchPat was evaluated twice during this project to discover the user needs with respect to a visual overview of a collection of patents. An early prototype of the system was shown to three patent examiners and their feedback was used to improve the system. Think-aloud evaluation sessions were conducted with twelve patent examiners.

The results of the evaluations show the differences between the needs and expectations of patent examiners in different fields. People also have personal preferences dealing with the visual overview. Some examiners like to have a structured setup like a grid while others prefer to create their own layout from scratch. The results do show that patent examiners are positive about having a visual overview of a patent collection.

Organizing patents is not a solution for all the patent examiners, but can be a addition to the work of examiners in fast-moving fields were the classifications are not as precise as classifications in mechanical fields, for example. The display and multi-touch features show promise but do need improvements. Patent examiners requirement more shortcuts to reduce the amount of actions they need to perform. Some suggested automatic grouping on simple features such as creating groups of the different classifications. LAMP, however, was used by only a few participants of the study. How the patents were placed was confusing for them because it was difficult to grasp what information the algorithm used.

Chapter 7

Conclusions and Future Work

This chapter presents the conclusions of this project. First, the contributions of the project are listed in section 7.1. The conclusions then follow in section 7.2. Finally, the recommendations for future work are discussed in section 7.3.

7.1 Contributions

The main contribution of this project is the creation of a the Organization Viewer within the TouchPat prototype. In this viewer, patent examiners get a visual overview of a collection of patents and are able to organize the patents as they see fit. Aspects such as a zoomable user interface and patent thumbnails are reused to allow the users to have an overview of the collection but also to zoom into a patent to see more detailed information. New functionality has been added to let the user create groups of patents and to see the relationships between patents.

The Local Affine Multidimensional Projection method is used to automatically position patents in the visual space. While the projection method is suited for this project, because it does not change the positions of patents that have already been organized, it is difficult to find the correct examples and the right similarity measure to use. Patents returned from a search are already similar so a similarity measure based on text proved to be difficult to use.

A user evaluation was performed during this project with 12 patent examiners. The think-aloud evaluations give insight into how users use a multi-touch system and what their expectations are. The video recordings and annotated transcripts of the recordings are available of all the 12 sessions with the patent examiners. A user study with this many patent examiners is unique for patent visualization studies. It shows how the patent examiners from different fields have different needs with respect to how a patent should be displayed. It also shows in what fields organizing a collection of patents can make a contribution. Finally, it shows how people have different preferences with respect to the display of the overview.

7.2 Conclusions

The research goal of this project was to create an overview of a collection of patents and to allow the user to organize the patents manually and automatically in this Organization Viewer. The TouchPat prototype was extended with a new view and the LAMP algorithm was added to the system for the automatic organization of patents.

First, the main conclusions are presented below. The sections that follow give a number of conclusions about the specific aspects of the system, such as the user interface and the touch-based interaction.

The original research goal is shown below with the two sub-goals:

Research Goal: "Investigate and develop a prototype that provides the user an overview to explore and organize a patent collection by clustering the documents based on a similarity measure. The user is able to organize and navigate the collection using a multi-touch input device."

- **Organize & Navigate**: Provide the user with the tools needed to explore a patent collection and to organize the patents within this collection using touch-based interaction.
- **Automatic Clustering**: Provide an automatic clustering technique to allow the users to organize the patents based on a similarity measure.

User evaluations show that organizing a collection of patents is a valuable addition to the work of patent examiners whose fields of expertise do not provide precise enough classifications of the patents. The evaluations also show that a combination of manual and automatic organization is necessary because organizing the whole collection manually using touch-based interaction will be too tiring. The automatic clustering technique used in this project, LAMP, is not suited however, because it was not clear enough on what basis the patents were organized.

User Interface

Patents are represented by thumbnails and semantic zooming is used to update the amount of information that is displayed: a small thumbnail displays less information than a larger thumbnail. This Zoomable User Interface was implemented by de Ridder in TouchPat and is reused in the Organization Viewer for organization. In this Organization Viewer users can move, select and group patents. Groups of patents are displayed as stacks of paper. Links can also be added to the view to show the relationships between patents in the collection.

An overview of a patent collection was received positively by the patent examiners during the evaluations. It is a welcome addition because it lets them go through multiple patents at once as if they are looking at multiple patents on paper.

Manual Organization

The type of overview preferred by the examiners depends on their field of work and on personal preferences. In fast moving fields, such as computer science and biotechnology, the classifications are not as precise and organizing a patent collection in the Organization Viewer can be an addition to the workflow of an examiner.

Classifications in mechanics are well defined; therefore, examiners prefer to go through the patents without organizing them. The classifications and keywords are already specific enough in their case.

Automatic Organization

Organizing a patent collection of hundreds of patents can become very tiresome for the examiners. The Local Affine Multidimensional Projection (LAMP) was therefore added to the system. LAMP determines the positions of patents in the visual space based on a similarity measure and on a set of examples. These examples are positioned by the user and are not changed by LAMP. This method was difficult to understand for the patent examiners because it was not clear how the similarity measure is determined. Another issue is selecting a good set of examples as input for the algorithm.

Automatic grouping can play a role in TouchPat, however. The basis on what the patents are grouped must be simple concepts such as classifications or links so the patent examiners understand what has happened.

Touch-Based Interaction

TouchPat lets users interact with patents using a touchscreen. Multi-touch gestures interacting directly with objects such as patents and stacks are natural to use for the users. Abstract gestures, such as closing a view with a two finger drag down gesture, prove to be difficult to perform when no direct visual feedback is given.

In the design of the gesture set, changes were made to the implementation of the standard gestures to pan and to open patents. These changes were confusing for the users during the evaluations of the system. Standard gestures should be adhered when designing a gesture set.

The experience of using a multi-touch system also depends on the hardware of the screen. A screen that is not sensitive enough is uncomfortable for users because they have to press harder to perform the gestures. A screen that is too sensitive, on the other hand, triggers unexpected actions which confuse the user. Other issues are how reflective the touchscreen is—the screen can reflect light from lamps hanging above the screen when it is placed flat on a desk—and the amount of grease left on the screen after using it.

7.3 Future work

The evaluation of TouchPat identified the aspects of the system that can be improved. The work is divided into short term, medium term and long term goals. Short term goals can be implemented within a few months while medium term future work can be seen as a project to take on for a year. A long term project spans a number of years, for example a PhD project. This section concludes with a vision of the future.

7.3.1 Short Term

Since the feedback from the evaluations has not been implemented yet, the main focus on the short term will be to address a number of issues that can be quickly implemented. The first aspect is the initial display of the system. Another point of interest is creating shortcuts in the interface such as a double tap on a patent will zoom in fully rather than make it an example. Finally, grouping patents based on simple similarities, such as links between patents can be added to the system.

Overview Displays

Having an overview of a collection of patents is well received by the patent examiners. However, the layout of the overview is up for discussion and depends on personal preferences. The different possibilities of overviews needs to be examined to see which types are preferred by the users. To do this, the different overviews must be implemented first. The initial overviews that should be created are listed below.

Empty Overview The patents are placed in a side bar and can be dragged into the view to organize them starting from scratch.

Grid Overview The patents are ordered based on date or classification.

Interaction Shortcuts

Touch gestures such as panning with two fingers and double tapping to make a patent an example were not natural gestures to the users. The double tapping gesture should zoom into the patent, as is the case in the grid view created by de Ridder [Ridder 11], because this is what users expect. Panning should return to one finger. Since selecting patents with the lasso gesture is difficult with two fingers, a solution such as a long press and second finger movement could be a solution—this is similar to holding the CTRL button while performing an action in Windows. This might interfere with the context menu and zooming, and therefore needs further research.

Grouping Patents

Currently, patents can be grouped using LAMP. During the evaluations this method was difficult to grasp for users and they proposed simpler solutions such as grouping all patents that are currently linked. This type of grouping is straightforward to the user because it is clear on what basis the patents are grouped. The options for grouping on these simple parameters needs to be determined and implemented.

7.3.2 Medium Term

Work for the medium term is focused on feedback from the examiners that cannot be implemented directly. The first topic of interest is the creation of user profiles. Another area to explore is creating sophisticated links between patents. An idea that surfaced during this project is the possibility to compare the effects of queries. This is also described in this section. The final topic is the impact of the screen size on the display of patents and the usability of touch.

Patent Thumbnails and User Profiles

Users like having a thumbnail with a summary of the content of a patent or of the content of a group of patents. What the users want to have displayed in the patent thumbnail is not the same for everyone: some examiners only need images while others would like a tag cloud of frequent words in the document, for example. What is shown in the thumbnail for the different user profiles requires more research.

First, the different user profiles must be identified. While their field of work gives a good indication of the user's needs, personal preferences also play a role in how users will want to interact with the system. Finding the different user profiles will make it possible to create various thumbnails. Users can then select their preferred thumbnail display. User preferences are already part of a number of systems at the European Patent Office. By keeping the location of where to change these preferences the same as in other programs, users should not have difficulty working with the thumbnail preferences.

Links

The links are currently given the color of the patent it links to. A suggestion the examiners gave was to create link queries, e.g. 'applicant OR inventor', and to give a color to each link type: applicant links are represented by red and inventors by blue, for example.

At the moment, links cannot be initiated from stacks. Adding this to the system can help the examiners discover any patents that are related to the group but have not been added to it yet.

Query Comparison

One of the reasons LAMP was chosen was because it could also be useful to compare the effects of changing a query on the collection of patents: since the locations of the example patents are unaltered and the organized patents from the first query can be used as the examples. The patents that are added to the collection can be placed in the view, based on the locations of the examples—see fig. 7.1. A user is then able to select the display of the differences between the queries: which patents are returned by both queries, which patents are only returned by the first, and which are returned by the second query.

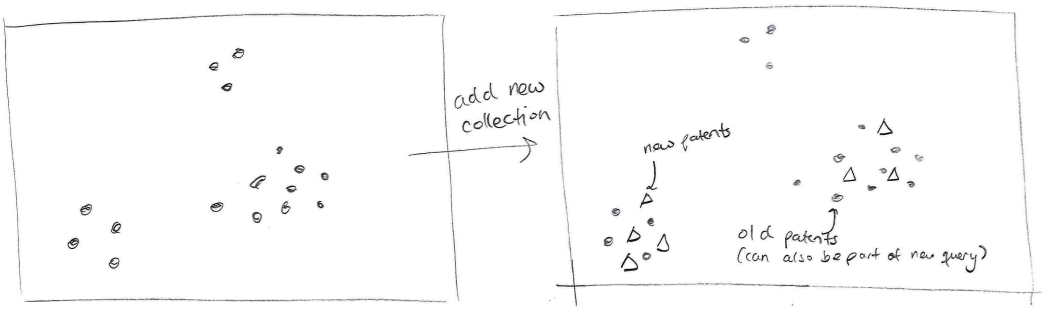


Figure 7.1: The organization of the original patent collection remains unaltered while new patents (the triangles) are added to the view based on their similarity to the patents already shown.

Screen Size

The size of the screens used during this project is 21.5 inches. This requires the user to make multi-touch gestures over a large area, which makes it difficult to keep other parts of the body from touching the screen. Working on a tablet has the disadvantage of the screen being smaller—thus less information can be displayed—but it is easier to interact with using multi-touch because the user is less likely to accidentally touch the smaller screen. A better understanding of the impact of the size of the screen is necessary to improve the user experience of touchscreens.

7.3.3 Long Term

In the long term, research on what to display in the thumbnails can be continued but there are other areas that can also be explored. New visualizations can obviously be created but an interesting approach is to link views in the system. The PatExpert project already demonstrated that using brushing between linked visualizations was appreciated by the users, though difficult to use for the first time [Koch 10]. Another topic in this section is the ergonomics of using a touchscreen.

Integration With Various Views

Creating new visualizations of a collection of patents in an obvious area that can be researched. What is interesting, however, is to research how a number of visualizations can be used to reach the goal of finding the relevant documents. Currently, the views in TouchPat focus on different tasks within the search: organization, browsing and going through a patent in detail. Visualizations can be complementary and for the same task, various views can be created. PaperCube [Bergstrom 09] is an example of a system where multiple visualizations display the same set of documents.

Ergonomics of Multi-Touch

It is unknown what the effects are of using a touch screen for a longer period of time and it is, therefore, important to get recommendations from ergonomists on how multi-touch systems should be incorporated in the work space. It will also be beneficial to work closer with the ergonomists while designing new multi-touch systems. The use of touchscreens is currently not the solution to replace the mouse and keyboard. Discovering the advantages and disadvantages of using multi-touch systems for a longer period of time is, therefore, another topic to be researched. Identifying the disadvantages makes it possible to start finding the solutions to these problems.

7.3.4 Vision

Adding an overview of documents in a collection in the search for relevant patents is an enhancement of the current situation. The exact representation of patents in the overview remains up for discussion, however. By creating user profiles it should be clearer what the needs of the users are and which displays support them.

Multi-touch displays are becoming a bigger part of our lives and will make their way into organizations as well. One aspect that should be kept in mind is the reason for using multi-touch. In the case of directly interacting with data the benefit of touch is its natural feel. Other actions are more suited for a mouse and keyboard, for example creating textual documents. A mouse is much more accurate than a finger and is, therefore, better at precise actions such as selecting text. Multi-touch will not be a replacement of the mouse and keyboard in the near future but rather an addition to the user experience and a new way of interacting with data.

Organizing a patent collection using a touchscreen does show promise. It is especially useful for patent examiners who work in fast-moving fields. Their classifications are not as well defined as in other fields, such as the mechanical classifications, and they can, therefore, benefit more from creating a mind-map of the search result. Organizing everything manually is too strenuous, however. Simple automatic options need to be incorporated into the system before it becomes useful for the patent examiners.

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Appendix A

Implementation Details

TouchPat was created using the *Microsoft Surface Beta API*. This API makes it possible to create touch-based applications using C# and the *Windows Presentation Foundation*[1] (WPF). It runs on Windows 7 and can be programmed in Visual Studio with the .NET framework 4. The *Surface Toolkit Runtime* application must also be installed. With this setup, standard gestures such as a pinch for zooming can be easily implemented.

This appendix describes the implementation of TouchPat and especially the Organization Viewer. It shows how the touch events work and how LAMP is added to the system.

A.1 WPF

WPF is used to create the user interface of an application. One important aspect is that any screen created in WPF will have two files: the *XAML* and C# file. Extensible Application Markup Language (XAML) is used to display items in the view such as textboxes and buttons. These items can be manipulated in the C# file but also created there.

In TouchPat, standard items in the interface, such as the bottom buttons, are coded in the XAML file. The loaded patents are added in the C# file. Patents are displayed using a *DrawingVisual*[2] object for performance reasons. These lightweight objects render shapes, images and text. No layout or event handling is provided for the DrawingVisuals which increases their performance. However, this means that event handling must be manually coded. To do this, a *Visual Host* is used to keep track of the DrawingVisual objects.

In the Organization Viewer, the *LAMPVisualHost* is used to display the patents and perform event handling for moving patents and drawings the lasso gesture objects. In the grid view, *MyVisualHost* draws the patents based on the size of the grid.

The Organization Viewer has different types of patents, normal and examples, but also stacks which can be moved. To handle these objects, a class structure was created—see

[1] http://msdn.microsoft.com/en-us/library/aa970268.aspx
[2] http://msdn.microsoft.com/en-us/library/ms742254.aspx

fig. A.1. An abstract class was created for DrawingVisual objects that can be moved, the *MovingDrawingVisual*. Then, the children are split up into patents and stacks. Patents are represented by another abstract class, the *NodeDrawingVisual*, to make sure the children keep the same information such as the patent is references. The difference between the two patents classes, *PatentNode* and *ControlPointNode*, is how a patent is displayed. A stack is rendered in the *Stack* class and displayed a *PatentGroup*.

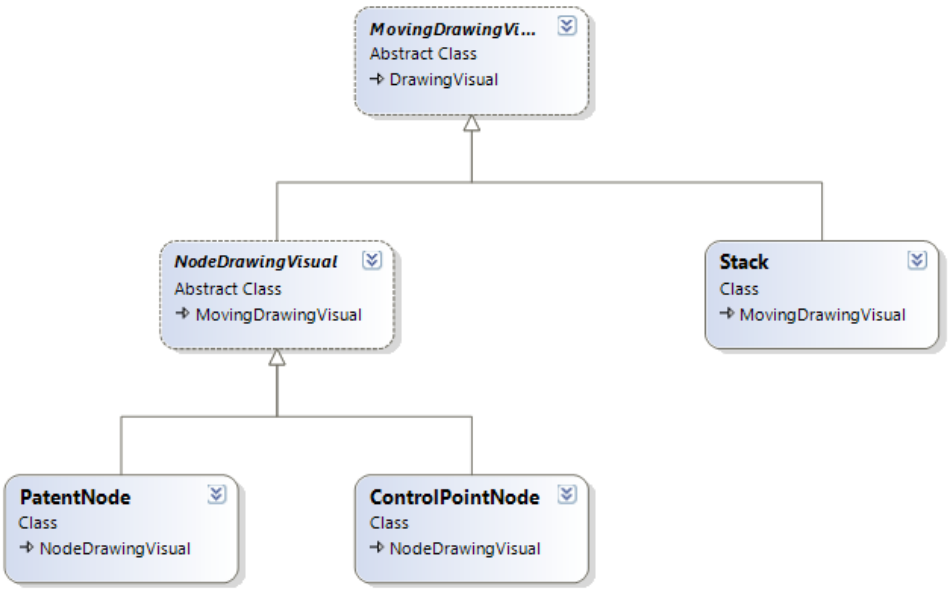

Figure A.1: The classes for the DrawingVisuals of patents (PatentNode), example patents (ControlPointNode) and stacks (Stack).

The actual class that displays the user interface is the *LAMPViewer*. This class recognizes the touch events and calls the VisualHost class to deal with the display of the patents. The touch events are described in the next section. TouchPat is designed that new views can easily be added by inheriting the abstract *Viewer* class. This defined which methods must be implemented to let the new view run within TouchPat.

A.2 Touch Implementation

With the Microsoft Surface Beta API it is possible to detect and handle multi-touch input on any object displayed on the screen. This section briefly explains how touch is recognized in WPF and how it is used in TouchPat. For a full explanation of the touch events, the reader is referred to the Input Overview[3].

[3]http://msdn.microsoft.com/en-us/library/ms754010.aspx

Touch events are handled in the Viewer classes. In this case, the LAMPViewer is the class that is created for the Organization Viewer. This class loads the patents, recognizes and handles touch events and displays the context menu. Touch events are divided into two groups: touch event and manipulation events. Touch events handle when a finger touches the screen (TouchEnter and TouchDown), when the finger moves TouchMove) and when the finger leaves the screen (TouchUp and TouchLeave)—see fig. A.2 for an overview of the touch events. Multiple touch points can be recognized because each touch is given an ID.

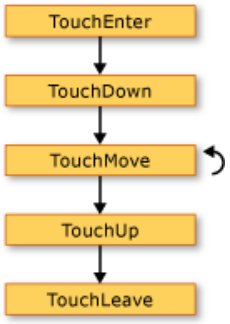

Figure A.2: The five events during a touch. TouchPat uses the middle three: TouchDown, TouchMove and TouchUp.

If a touch events manipulates a user interface item (the item must have the manipulation enabled), then manipulation events are triggered. This can be used to zoom and pan but also to 'throw' objects to another part of the screen because manipulation events can use inertia to simulate physical effects on objects. An overview of the manipulation events is shown in fig. A.3. These events are triggered by the touch events as can be seen in fig. A.4. This shows that the ManipulationStarting can be triggered after a TouchDown event is left to be unhandled. The ManipulationDelta events trigger after the TouchMove events. The inertia events are triggered once a TouchUp event is recognized because these events apply forces on objects after the touch as finished.

In the LAMPViewer, manipulation events are only triggered when two touch points are recognized because the zooming and panning was designed to work with two fingers. No inertia events are implemented.

To recognize a long press of a finger on the screen or a double versus single tap, a timer is used. After a certain amount of time, the LAMPViewer checks what has happened. This is explained in de Ridder's thesis [Ridder 11].

In this project a new gesture is the lasso selection method. This gesture triggers when a touch point moves and this touch point started on an empty area. If the touch started on a patent, the VisualHost is called to handle the events of moving a patent. The VisualHost is also called during the lasso gesture to draw the circle and path of the finger, but no touch events are handled in this case.

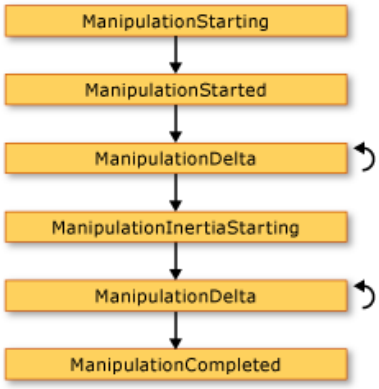

Figure A.3: The six events during the manipulation of an object. After the user had lifted his/her finger off of the screen during movement, the object can still be manipulated.

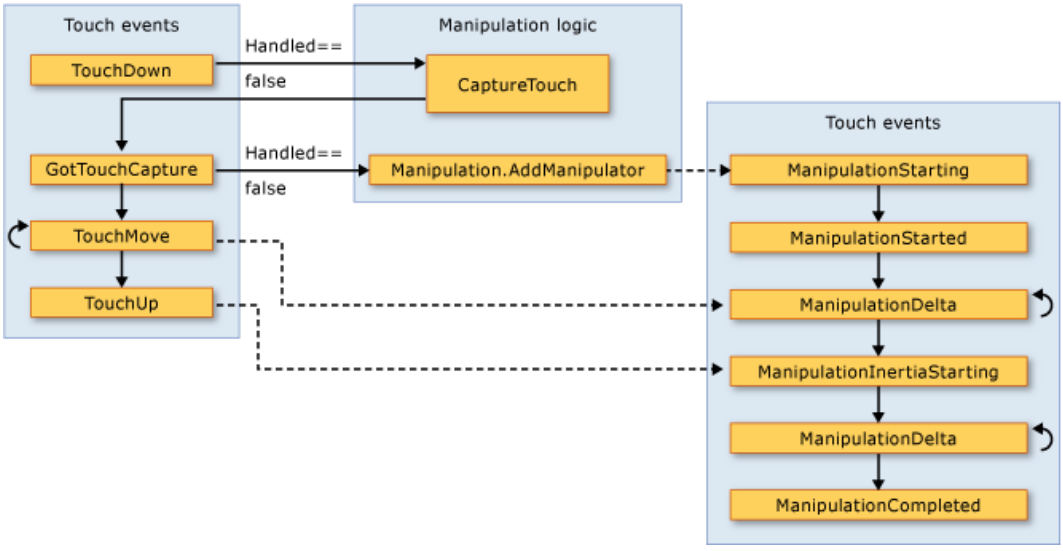

Figure A.4: This figure shows how the Touch Events and Manipulation Events relate to each other.

A.3 Adding LAMP to TouchPat

The Local Affine Multidimensional Projection method is used in this project to automatically project patents in the two-dimensional space. The algorithm of this method was not implemented from scratch, but a library was found online which contained the algorithm. This section describes how this library was incorporated into the TouchPat project.

A.3.1 Panlib

The online library containing LAMP is called Panlib[4]. This project contains two projection methods and the author of the LAMP paper, Paulo Joia Filho, is one of the contributors. For Windows, the C DLLs are available. The original code can also be used and this was useful when importing the DLL files in the C# project. The reason this implementation was chosen was because this means the algorithm is implemented correctly and the C code in the DLLs is fast.

A.3.2 DllImport

To use the Panlib libraries, the DLL files had to be imported. C# has a class that supports the DLL imports[5] and this was used for the C DLLs.

Importing simple data such as integers and strings is very simple using the DllImport method. The trouble was that the libraries had more sophisticated data types such as string arrays within a struct and a self-defined decimal. Most data items are, therefore, redefined in the C# project and passed to the DllImport using *IntPtr*[6]. The data was passed in IntPtr form to the DLLs. Nobody wants to do this, so a wrapper class was created around it and all the code dealing with the DLLs is placed in a separate project called *panlibrary*.

A.3.3 Panlib in TouchPat

The panlibrary project is part of the TouchPat solution. The methods to call the DLLs can be accessed through the Panlib class. Through this class the internal decimal can be accessed. Once all the data has been added to the Panlib class, the DLLs can be executed by calling the *executeLAMP* method. This returns an array of decimals which have to be handled to retrieve the new projection.

A.4 Performance

A number of measures have been taken to keep the performance of TouchPat acceptable. The first was introduced by de Ridder [Ridder 11] and is the use of DrawingVisual objects.

[4] http://code.google.com/p/projection-analyzer/

[5] http://msdn.microsoft.com/en-us/library/system.runtime.interopservices.dllimportattribute(v=vs.100).aspx

[6] http://msdn.microsoft.com/en-us/library/system.intptr(v=vs.100).aspx

This helps the performance when dealing with hundreds of patents. However, once the patents have been zoomed in and images are displayed, the system becomes slow. To reduce the effect of the images, only images are displayed of patents on the screen. Any patents that fall outside of the screen are ignored.

The grid background of the ZUI is an image of a grid. This made it easy to show the difference when zooming in and out because the size of the image changes. This is a huge image, however, and when many patents have to be displayed as well, the system will sometimes run slowly. One thing that improved the performance slightly was how the opacity was implemented. Rather than changing the opacity of the DrawingVisual, the opacity of the *Brush* used to color the DrawingVisual was changed.

Appendix B

Evaluation Notes and Transcripts

B.1 Notes from the Unstructured Interviews

B.1.1 First Evaluation

The system was shown to a patent examiner at EPO specialized in Computer Graphics. He was shown de Ridder's version first to explain the reasoning behind the system. Then a messy view of the TouchPat application was shown. A projection based on the classification was used to place patents on the screen. The rest of the evaluation was spent discussing what types of interaction, functions and displays could be used. The notes from the discussion are shown here.

- It is necessary to show others why you have grouped certain things so make it possible to add text to a group display.
- Memorize movements: go back and forth through your actions as you would with *CTRL* + *z* because sometimes you realize that an action taken before produces the noise you see now.
- Another seed that could be used to project the patents are the keywords from the search.
- Maybe update the projection can be in real time?
- Using stacks: indicate how many documents are in a stack, e.g. 'number in stack / total number of documents'.
- Sometimes different colors are placed close together. This could have been done by an examiner, for example, who knows the patents are similar but just cannot put his/her finger on it. A computer can quickly compare information to see what the documents have in common, such as applicants, dates, citations, words in the abstract or text, etc. Perhaps choose to display these similarities.

- Interesting information to display is:
  - # of pages of the patent (start with a patent of 20 pages rather than one with hundreds of pages);
  - # of classifications (a long document with many classifications makes sense, but a short document with many classifications can mean it might be interesting);
  - # of figures;
  - # of keywords in the abstract;
  - # of keywords in the text.
- Sometimes date is important so either use color or position to indicate the date. For example: patents at the beginning of 1990s versus patents later in the 90s.
- ZUI would be good to zoom in and organize things within the viewport.
- Add links from a certain patent to other patents that have the same inventor, applicants, date, citations, etc. This can be done by adding a part to the context menu: show links'.
- Link to the grid view. For example: when you have a stack and you know these patents are related, use TouchPat to go through them in a more detailed manner.

B.1.2 Second Evaluation

The system was shown to an ergonomic specialist and two staff representatives/patent examiners from the Mechanical fields. First, the original version of TouchPat was shown to explain the idea of visually displaying a collection of patents and to provide an idea of the possibilities. A comment given during this phase of the evaluation session was:

- The DetailViewer would be useful if you could see two patents in detail to compare them.

After that the ImagesViewer was shown as well. There was a discussion about images and comparing them:

- It would be useful to compare different images of different patents for the mechanical examiner. Custom thumbnails might be a possibly: choosing what is more important to display, text or images.

The demo finished with the organizational view in TouchPat. The comment given here was:

- An undo function is necessary.

Finally, the ergonomic specialist had some detailed remarks about the system.

- Location of patent should not change when touching the border instead of centering around the user's finger.
- When touching the patent, the color currently changes but it is not a good way to indicate the patent is selected because color is already used for classification. Adding a border or shadow might be a better indication for the state of the patent.

B.2 Transcripts from the Think-Aloud Sessions

This section shows the transcripts from three evaluations with patent examiners from different backgrounds. The transcripts are color coded to show the types of comments made.

Pink represents comments about the multi-touch interaction.

Blue shows which comments refer to the interface design.

Yellow deals with the hardware comments.

Orange shows comments relating to the background of the examiner.

Green comments show how things could be changed and improved.

B.2.1 Participant 2

Mechanics - Acer touchscreen

P: "It depends on how it is grouped now, I mean, a pre-selection to the groups according to the classification. It would be nice to group them. So how did that work if you want to group them according to a certain classification?"
A: "You cannot select all of them by classification, but you can select a group of green ones (patents)."
A circle gesture is shown to select a group of patents.
P: "Then you could, you made your own group and then called it green. How did you go that?"
The participant is instructed to open the context menu by making a long press with his finger anywhere. It takes some tries to understand the crossing of the border of the context menu to trigger an action. The zooming while using the menu is also enabled, this is a bug because the context menu is still shown but you can no longer interact with it once it start zooming. This zooming is caused by another part of the hand touching the screen.

P: " You see, it is uncomfortable to move like this (moving your finger away from yourself). Usually on a smart phone you always pull and now you have to push. Here you cannot pull (your finger through the menu). I think, for me it would be better to..."
The stack is created surprisingly. He enters a label for it.
P: "See, if it is not sliding very good, then you have to (push hard with your finger)."

P: "Okay, then I would try to classify, or to sort them by classification for instance. So I move them (a patent). Let's see, we have..."
He sorts the highly saturated patents.
P: "What I would prefer is if you would press long and then you leave, it (the context menu) stays. For me that would work better."
A: "And then if you click somewhere else (on the screen), it would disappear for example."
P: "Exactly. To make a certain... it could even be a field there (pointing to the side of the screen), then is disappears."

P: "It would help to sort them geographically all according to whatever criteria (such as date or classification)."

He uses the context menu to interact with a patent and opens the sub-menu but lifts his hand before selecting an action. He is asked what he wanted to do and says he wanted to see the patent so he is instructed to select open from the patent sub menu. This time he crosses the border without any problem. The patent is opened in the detailed view.
P: "Okay, yeah that is nice. How can I close it?"
He is told to use two fingers in a downwards motion and succeeds in doing so at the first try.
P: "That is quite okay."
P: "It's already a new way of displaying it. Usually when you do a search it is already sorted. It is unusual to work like this because it is already sorted according to a..."
A: "So would you like as an initial start (screen) to have it sorted and then organize it from there?"
P: "Hm hm. According to keywords or... Search a lot according to classification schemes so you have already sorted according to a scheme and I would need to sort this according to classification again, to see what is more relevant."
A: "Or you can sort it to whatever you would like. I mean, you don't have to make a stack with a certain classification, it could be a relevant stack and a stack of 'things I need to look at later' or defiantly (not relevant stack)."
P: "So what I asked before, would it be possible to sort them according to classification?"
He is told about the grid view and the previous work done by de Ridder. A stack is opened in this view to show the participant how this can be sorted on classification or applicant for example.

He is asked how he would prefer to see the initial display/arrangement of the patents in the organizational view. He doesn't respond to this.

P: "Another thing that would be nice for us is if you could see the drawings because we usually look for drawings."
Zooming in, the drawings are displayed.
P: "Ah yeah, that is good."
A: "You have to zoom in quite a bit before you can see them (the drawings)."
P: "Usually you have about 7 to 10 documents and you can, let's say these are the relevant documents..."
The participant moves some patents to the side.
P: "Yeah, it's really a bit, you have to..." while making the 'push movements'.

He is told standing might help reduce the strain on his fingers so the participant stands up to try it.

He zooms in one his 'relevant' documents which he has arrange in a grid like manner. He tries to pan with one finger, but the selection gesture is triggered.
P: "How do you push it around?"
He is told to use two fingers.
P: "Okay. Yeah, that's nice.That is really... okay in this case it is not really helpful with these kinds of documents but okay."
He is told he can also move the patents using one finger.
P: "Yeah, that is working great."
He positions the patents next to each other.
P: "There is nothing to add to this."
P: "If you just want to increase one, it is also possible?"
A: "Yes, you can zoom into this (patent) as well."
He zooms in and the patent fills the whole screen. He moves the patent and at a certain point the image disappears because the center of the patent is no longer displayed on the screen. The participant does not seem to be bothered by it. He plays around with zooming in and out and moving the patents. He tries to pan again with one finger but immediately realizes it doesn't work. He told again to use two finger "to move the whole thing".
P: "I understand, but that is not the way you are used to using the other things."
He now pans a bit with two fingers.
He zooms in on one patent and the bottom row of images is displayed which seems to surprise him. He then tries to use a rotate gesture on the images in the bottom row. He is told this is not possible in this view, but can open the detail viewer to manipulate images.
He uses the menu without issues and is shown how to manipulate the images.
P: "Yeah that is nice."
He forgets to click the patent to start manipulating it after scrolling through some images. He is instructed to click it first. He now goes through several images and opens en closes them without any issues.
The participant selects some text.
P: "How can you scroll this then?"
As he says that, he manages to scroll through the text rather than selecting it.

P: "And then of course you need how to search for keywords."
The keywords are entered through the pop-up and automatically display in the detailed view.
He tries to scroll again but makes a selection instead. He then tries to zoom out the text.
P: "Can I make it smaller?"
A: "No, why would you like to do make it smaller?"
P: "Because I see there are more relevant things so I need to keep scrolling (through the text)."
He is shown he can also scroll in the annotation bar.
P: "Okay, you solved the problem already!"
Credit is given to de Ridder and it is explained that he worked on incorporating different views into one system.

The detail view is closed and now the keywords are also shown in the patent thumbnails.
He drags a patent to a new position and taps it once.
P: "This one for instance, I want to see... Oh you have to hold."
He opens the menu and remembers how to open the patent without any problems.

He manipulates the image, but swipes it out of the screen. Now there is no way to get it back. The patent is closed and a new one is opened.
P: "Quite often you have to turn the image so it would help if you have a 'turn left 90 degrees' and 'turn right' (button). Otherwise it takes too long to (do this)."
He scrolls in the annotations bar. He does a thumbs up after scrolling down. Then he scrolls upwards.
P: "The only thing is to move upwards it is...(difficult)"
P: "Ah, you can use the nail even. How does it (the screen) work?"
He is shown that a pen can also be used to interact with the touch screen. He scrolls with his finger nails.
P: "Yeah, that is really easy. The system is quick enough (for scrolling quickly)."
P: "More you actually do not need, it is a limited task we have to do. We have to sort it and what would be nice is probably when you have the paperless office in mind that you show the current application, just to compare. If you see, for example, usually we have the application next to you but when you open this (a patent) and you think, yeah this looks good, then you compare it to the paper or on another screen. You need the application somewhere."

He is asked if he would use the organization of the patents or sees himself using this in any way.
P: "As I said, it is usually already organized. You search in a certain class and have a set of 10 or 20 documents."
A: "Because usually how many patents would you get out of a search?" P: "Between 10 and 30."
A: "So that is already pretty specific right?"
P: "Yes, you do the search and some out with a number of 10 to 20 I would say. I group them according the classification scheme. I have several drawers and then I usually sort it according to relevance and/or classification. So it is nice to have/to do a kind of drawers or stacks as you call it. You need that, but it is already there, you don't need to create this stack. Out of this search already comes a stack. So there are too many documents and as I say I usually have 10 to 20 out of a search and not like 100."
P: "It is different if this is your search, if you make your search like this. But if you say you already finished your search, to examine the thing, then you don't need this (organization) first. It is different if you have 1000 documents then you cannot display it like this. You have to order them before, stack them"
He tries to pan again with one finger, realizes he should use two and pans successfully.
P: "You have to get used to it. Is it not possible if you click with your finger on an empty thing?"
The choice between the selection versus pan gesture is explained.
P: "If you get used to it, it is no problem."

He zooms in more and looks at the drawings of the patent.
P: "Our search is really to drawings. We are usually not that interested in the text. The keywords and just the drawing. Then you come up with 3 or 5 documents and then you need to read them."

B.2.2 Participant 4

Computer Science - Dell touchscreen

The participant plays around with the system first. He tries to make links using the menu, he zooms out, moves a couple of patents and opens the keywords and adds some more words.
P: "They (the keywords) are predefined?"
A: "Yes, but you can change them if you want to."
P: "Ah okay."
He changes what keyword is displayed. He moves the patents with many keywords to the same area. He zooms in to view the patent in more detail and moves the patents around to get a better look. He double clicks and the patent becomes an example. He double clicks again and nothing happens.
P: "What is it now?"
A: "You made it an example. What were you trying to do?"
P: "I wanted to open it."
He is told to open the context menu to open it.
P: "Okay, that is maybe something, double click would be for me to open it."

The detailed view opens and he scrolls though the text and also scrolls using the annotation bar. He double clicks on a word but it isn't selected. P: "I would have selected this, highlighted. Because it works now..."
He selects the word using his finger.
P: "Because this is what normally happens and for example, you know, I say 'yes, I want to highlight it'. Do I see the highlight? I see the highlight. Very nice. Then this works like this (highlighting a whole paragraph), yes."
He highlight the whole paragraph using the pop-up menu options.
P: "Normally indeed I look for..."
He clicks on a part in the annotation bar where there is a keyword. The keyword is not highlighted in the text.
P: "It doesn't highlight it this one. Normally when we are looking for a keyword... it disappeared, the highlighting (of keywords) was there. But this is normally in detail how I would work. I would look at the passages where it is relevant and if I would say find that relevant passage. The problem indeed is that normally what I would do to select with my finger keep (the first part to select) and then select like that (move finger to the end). Which it does, with some delay. Okay. That is more or less what I would do."
He highlights the selected text.
P: "Now I close it. I close it like that (with two fingers down)?"
A: "Yes, with two fingers down but for me it doesn't always work like that so you want use your whole hand as well."

He tries to close the view a few times. It is closed for him.
He opens the patent again and after a few more tries he manages to close the view.
P: "Okay, I see it."

P: "So that would be the comment, what I would say. I like it indeed very much like that (zooming in)."
P: "Now, you see what would be nice as well, I highlighted some text and I would like to see that highlight here on the top screen (when zoomed out to the furthest level). So now I see that the keywords of my search, but also my highlights. I see this is a relevant document. Now I... this is what I would do, double click."
He double clicks on a patent but it doesn't open. He zooms in. He tries to pan with one finger. He is triggered to use two fingers.
P: "I move it. So that is pretty cool.So here I cannot scroll here (in the text in the thumbnail). So can I? No. So this is sometimes, you know, I have already seen the abstract because this is the first source of information I use to see if anything is close. And then I would like as well to have a quick look without opening (the patent). So that would be as well useful. And normally as well what you do when indeed you need to select which ones are relevant, which ones you will have a look or not, normally I would say depends on the technology field, but I look at the pictures and okay, this is pretty nice (zoomed in fully) but now I would like immediately to go to the next one that is there. And for example, select this one or not for having a later look. So for me it would be a little bit cumbersome because right now you have to zoom but I would like, let's say, I would select those few ones that are having the keywords. Let's say those ones, is what I would do."

He moves a few patents to another part of the screen.
P: "Those ones having the relevant keyword that I want. Now I select that one, and now I would like to view them one by one."
He is shown how to select the patents with the circle gesture, how to create a stack using the menu and it is labeled relevant. The stack is opened in the grid view for him.
P: ' 'Okay, this (double clicking) is not (how to open a patent). I need to do again use the menu."
He is shown that a double click will zoom in to the patent and the patent fills the whole screen. He is shown how to browse through the patents one by one.
P: "Okay that's... good. Yeah. And now what I would like to have an option, let's say you have a tick, whatever, I select it or not."
A: "For example, add it to a drawer or?"
P: "Yes, something like that. Selected: yes I need to have a closer look or not. So this is what I would do normally. Let's say now I have a set and now I want to just only have a quick scan, it something relevant or not so then I say yes/no so in principle the choice will be yes/no, yes/no (for the patents) and this really takes me 1 or 2 seconds and the figures or even from the abstract I can immediately see 'is it something close or not'."
A: "You could also, for example, delete it."
P: "No, I wouldn't like to delete it. Because it comes sometimes like this that you don't find the perfect document that you want, then you have reached the limits and now you have to go to the worse ones, so then you want to go back to those that were not perfect, but

might be some information. What is pretty nice here, what I like, is indeed, let's say, how you see how high is the color. For example I see here..."
He clicks a patent but realizes he must use the menu to open the patent. The detailed view is opened.
P: "So now I see that there is quite a lot of those (keywords)..."
He closes the view again and points at another patent in the grid view.
P: "But now I see here that in this one..."
He opens the patent with a lower bar for keywords.
P: "There are only a few. So that is pretty nice. That I like very much because..."
He tries to close the detailed view but is only able to after a few tries. P: "Okay, because then I can immediately see, okay here there is quite a lot (of keywords) so probably this would be more relevant and those are let's say less relevant so that is pretty nice. But as I said, now I would like to select this one, this one and this one."
He taps on the patents and they are selected.
P: "Oh okay, I can select. And now put them aside. Can I do that?"
A: "No, but you can in the original version of the system."
P: "Okay, that's... I would say putting them aside, having a closer look and those ones (the not selected patents), I would just keep it."
He closed the view with the two fingers down gesture.

The organization view is shown again.
P: "So that's pretty nice. Now as well what is quite annoying, I think, is the menu, but I don't know how to do it better, but you have to keep and then keeping moving one. I think, at least for me, I wouldn't know how to make a different menu, but I would try to make a different gesture but for me the touch should, because you have to keep your finger, because if you release then you lose it."
A: "So would you prefer buttons at the bottom or...?"
P: "Yes, indeed that I would have a toolbar that changes context depending on the selection of that (a stack or patent) , because that (context menu), that's nice but for me I have seen it in the past that it was, especially when you need to do this, you quite often lose the context and then you already went through, let's say, here because it is quite nice, it is okay because you only have two submenus, you only have one submenu. But then if you go further, when you lose it, you have to do it again. It's quite annoying."

He selects multiple patents using the selection gesture.
P: "The grouping... I cannot move the whole group?"
A: "No."
P: "Okay, this is as well something that I would say, but okay."
A: "Do you want to deselect them?"
P: "Deselect was... through the menu yeah."
He selects a few patents by tapping them once. He doesn't always succeed so he tries a few times. He is zoomed out quite a bit so he is asked to zoom in a bit because this makes the selection of patents easier.
P: "So this is as well something... Let's say this is what I would like... I could select these few (by pressing them separately), and now when those are selected I would like to move

them all."
A: "Rather than making a stack and moving them?"
P: "Yes. I think rather than making a stack. Because how I would work, indeed you can do that, I select and ah, here now I can make a stack from those selections... No. I think, maybe I biased, but it's like when you do things in Photoshop. When I work with layers and I add those with the mouse and I select, you have to use the control select and then I have all the selections and then I want to move it aside. So this is my way I would do this. So indeed, when I select a few and create a stack..."
He opens the context menu and creates a stack. He adds a label to the stack.
P: "And now I move it. It's okay; I mean it's doable. I mean it's an alternative way. I would not have a preference."
He is told that he can now drag other patents into the stack.
P: "That is pretty nice yes."
He drags a few patents into the stack.
P: "This is like a foldering thing that is quite nice. Now if I... I cannot see..."
He double taps the stack. Then he starts zooming in.
P: "I want to see quickly..."
A: "Yes, so that is my question, what would you put in a stack, rather than just a label."
P: "Well if possible, then what I would do, but that I might be biased by Apple, but I find it pretty useful indeed that I have some things and I put some things in the folder or stack and then I can swipe through the things that are there (swipe through the patents in the stack in the thumbnail of the stack). I think that would be pretty nice. Because that (menu) requires me to open the stack..."
He double taps it again.
P: "Eh... that was menu. Open."
He has selected the patent submenu and slides over open. He is told to select the stack menu and to open from there.
P: "Yes you see why it would potentially be, I wouldn't say annoying because once you know, you know how the menu is and it is fine. But at the beginning, you don't know the menu and this is my way of working: I see there or maybe it is there, and if you have to do like that (move your finger around), it's..."

He has opened the grid view, looks at it and closes it again after a few tries.
P: "Indeed it would be nice that I could now swipe through that quickly and see what it is."
A: "Rather than have like a thumbnail giving a summary about..."
P: "No, I would say because the more documents you... because if you have 100 documents then you cannot use a thumbnail. So I think, this (swiping) short seeing would be beneficially for me. Because I could immediately see what I put there. And then for example now if I open it, you see I open the stack and I look and I don't see anything else. And now if I want to see for example, can I see the selection, the link...? No. I cannot see the link anymore."
A: "No, not in this one. That is the difference between seeing thing in the grid and the..."
P: "Okay. So now the document is only in the stack, not in the grid. So what I would like to have still..."

He tries to close the grid view still has trouble doing so.
P: "I see how it works now."
He creates a link from a patent in the view to other patents and the stack.
P: "Yes, so I see there is something there..."
He double taps on the stack. He then opens it using the menu. A: "And then here you would see which one it is."
P: "Yes."

He zooms in and out in the grid view.
P: "When you zoom in and see more information, that is a wonderful thing so."
He tries to close the view again and still has trouble doing so.

P: "So yes, defiantly in this case I would like to see where it is (the patent that is linked to in the stack)."
He moves the stack to another part of the screen and starts to move the linked patents as well.
P: "And the colors what do they mean?"
A: "They are the classification, just to kind of define..."
P: "Now what would be useful as well for me... I could do it manually but I would like now if I add different classification, then I would like to group them by different classifications. For example, all links like that (with the classifications together). You cannot automatically put..."
A: "No."
He moves some patents together. He tries to pan with one finger, but then remembers he needs to use two. He is asked what he thinks about the two-finger pan.
P: "The screen... I feel the touch is.. I feel like, it's not like sand paper but you feel arghhhh (sound as if there is too much friction). The resistance really... It feels like you are losing your fingers a little. When I am using iPhone and iPad I don't have that feeling. And I know because I was also using the tablet pc from HP and I also had this feeling. So, it's not that... I am not an Apple fan but I found that it is natural, you don't feel it, and here you feel like a resistance. It is not really a pleasant feeling. So I think it is important that the screen is really inviting you to do this. What is nice it that is does not leave too much dirt (finger grease marks on the screen). On longer term I would prefer to use mouse. I think the experience of the screen is really important."

He places one patent on top of another.
P: "What I would say, but maybe I am biased by Apple, that indeed when I put two patents on top of each other, that they group. But if I am thinking in the Windows, you have a folder. I would say it would be me, that it is not really necessary because I can very well as well use the stack. It is fine for me."

He is asked a couple of questions. First about using the examples to group patents automatically.
P: "Let's say I go to the first match, so if I find something that is very good for me, then I don't look any further. So then I don't care about the rest. So I would say I would go for reverse entropy and then you try to organize until you get something and eventually you

might organize everything and then if you didn't find what you wanted, then I would go back to indeed all those stuffs (organized stacks and patents). The purpose of the organization is in fact that I can go back..."
He tries to pan the view, but has trouble doing so. He is shown how to use your thumb and index finger to pan when you keep those parallel. He understands now.
P: "So I organize information like that in order to be able to go back if I need it. So I see that 'okay, those are probably irrelevant' and now if I find something here that is perfect, I would not even go back to that. I would like to keep that information because then when it comes to patent examination and the aspects change, I still want to have it available. You know, in the patent world it is like this, you have an initial set of claims that have some scope but then during the examination normally it changes because they try to make it narrow so they add features or they shift the scope. In computers it is very... they start with very abstract software and you try to make it a little bit narrow and then suddenly you need something that you didn't have in your initial documents so you need to go back. That is why there are different flavors (different groups to create) and some people, for me sometimes I do it as well, those different flavors I leave it there. I don't use them in the beginning but I know that they are there if I need it. It is like a weapon, if I need it, it is still there. That is the purpose of organizing information. In principle, once I have finished and I have found the document that I want, then I don't really care anymore about the rest."
A: "During your organization you still haven't found your document."
P: "Then in principle I go back, I look at all those documents and then indeed, normally what I do, I have some drawers, and it depends on the feeling as well as on the patent: very good, good, less good or completely irrelevant, I delete even completely irrelevant. What I do, I quickly go through the documents and I take those who are having the most relevant keywords, that I see there is a lot of keywords and that they have a lot of the right class for example. The class is in software, for me, less important because as I said they are very abstract and the classification is not always reliable. So normally I use keywords. In software I use keywords (in mechanics it is different)."
He opens a stack in the grid view.
P: "I have some set of the documents and then I put this is relevant, not relevant, etc. And then in principle then I see that this is a very good document but for example something is wrong, it is too late with the date. Then normally what I try to do as well is I try to backtrack it. Is there any link by application, is there any family, are there any citations that cite this document. This is where I go and I have a specific document that is very very close. Either it is very very close but there are some things that are missing then I would click and now I would like to see all relevant information. Who cited it or all the document that were cited (so the documents that cite it, and the documents it cites). All those things because maybe then I can go again around. It is not always one step but on those documents that cited, if I can see another citations that is useful. But this is more or less feeling and knowing a little bit (about) the technology. So this is how I would work. So I see this is very good but not 100 percent, then I would even skip all the other information (the other patents in the set) that are there and I would try to start from this document to see where it can get me."
The idea of a graph is given where the edges have different colors for each type of connection.

B.2.3 Participant 7

Biotechnology (Medical Diagnostics) - Dell touchscreen

P: "I think I would more with keywords because our classifications... biotech is really a moving field so we are not that as precise as mechanics for example. So usually we start with some classes and then you add keywords or also this kind of profiles (histograms of the keyword frequency in a document) are very helpful because you enter your highlight and perhaps you focus on them."

Zooming in. P: "Oh yes, it is very sensitive!"
She tries to pan.
A: "So if you want to move, that is also two fingers."
P: "Ah, it's two."

The participant opens the context menu but it disappears.
P: "I am trying to see what was the options (in the context menu)."
The context menu kept disappearing because her ring on a different finger would also touch the screen which triggered a two finger input, but also other fingers, like her thumb would touch the screen.
She tries to use the menu but does not cross the end of the action in the menu.
A: "The thing with the menu is that you have to cross it (the action)."
P: "Ah and cross it out."

She then tries to create links by selecting similar applicants. Nothing happens.
P: "Oh but it doesn't so or does it?"
A: "I don't think there are similar applicants."
P: "Okay."
Creates links for classifications which is then displayed.

P: "If I want to remove it (the links), I just click on it (the patent)?"
A: "No, you can go through the menu to remove them as well: 'Show Links'."
She uses the menu but again does not finish the gesture for the action.
A: "You have cross it."
P: "Ah yeah! It takes some time to remember (how to use the menu)."

She opens the menu again.
P: "So what is a stack?"
A: "A stack is the group of patents. So first you can make a stack by selecting multiple patents. You can try it."
P: "So I make one..."
She opens the menu and is instructed to use add to stack. Again the zooming is enabled and the menu disappears twice.
P: "I am actually too slow I think."
She then succeeds and enters a label for the stack.
P: "So I have one here."
A: "If you want to add that one (patent), you can drag it in there (in the stack)."
The participant adds multiple patents to the stack without any issues. P: "To open the stack,

I think..."
She opens the stack through the menu.
P: "Okay and then I see (what is inside)."
P: "Okay, right now we only see that, but we don't see more (information)?"
She zooms in after being prompted to do so which shows more images of the patent. At this point the patents fill the screen in the grid display. The participant tries to click on the smaller images. Nothing happens.
P: "So you can maybe go move (through the images)?"
A: "So yes, maybe you could swipe through (the images) but that is not possible here."
P: "Yeah. Okay. I think sometimes you are looking for (images). Not us but especially mechanics where they have some specific instrument you want to scroll through the things."
Then she wants to close the grid view, and is shown the two finger down gesture.

She uses the context menu to open all the patents in the grid view.

P: "Can I highlight some things in the title for example?"
A: "No."
P: "Oh, I was just wondering because I think you know how the Viewer works? We have highlights everywhere so."
A: "Would that be useful here?"
P: "Not the title honestly, maybe the abstract. Not the title, usually they are not that informative."
She tries to click the minimap and nothing happens.
Then she wants to close the grid view and attempts to do so by zooming out.
P: "To go back?"
A: "To go back you can use two fingers down."
She closes the view.

She pans with 1 finger but realizes it does not work.
P: "Oh yes it is with two fingers."

She then pans and zooms.
P: "Yes that is quite sensitive."
"But yeah, you have to get used to that. It is the same with the..."

She is asked to keep her fingers further apart to see if that reduces the sensitiveness of the zooming in and out. This helps when she pans because the movement is much smoother.

She points at a stack.
P: "Why do I have one (stack) that is bigger than the others?"
A: "That is the stack you made."
P: "Ah so that you can see the stack."

A: "So do you think that it is useful that the stack is bigger when it has more patents? The size will increase if it contains more patents."
P: "Ah that could be useful. When you look in a general way you know where you have tons of documents, where the priorities are. I think that could be quite useful because you have a visual. What is nice with this kind of thing is that you have visual information. You

don't need to think too much: the pile is bigger so you have more documents, I think that is a good idea."

P: "Also when we discuss touch screens, we are also discussing opening many programs side by side. Typing the communication in one while having the document also in front. I think that is kind of different program I guess. You are more for the patent organization as a search phase."
A: "Yes, so other ideas for this would be to use it for reclassification , for example. So your classification becomes too big, then you..."
P: "Yeah, then usually what you do when a classification group is too big, you make sub groups and someone is reclassifying all the big groups into the subgroups."
A: "So this might also be an application where organizing documents becomes very important."
P: "Exactly because then you can actually have a huge group of patents, like I don't know, 3000 patents and flag them with these keywords and make stacks of keywords and do a kind of automatic splitting and then go through them one by one."

P: "Okay so keywords is something..."
She clicks on the keywords button in the bottom menu bar.
P: "We can add..."
She clicks on the 'add keyword' button.
A: "These are predefined, but maybe when you load the patents in, it would take the keywords from your search right away."
P: "Okay, so they are already predefined but you can add more."
She clicks on the apply changes button and nothing happens. She told she can close the pop-up by clicking on the 'keywords' button again.

She now presses on the 'date' button in the bottom menu.
P: "I think that would be really useful. Especially when you are looking for a date in the future. I mean, not in the future but you already made your whole search and you want to be sure that at a certain date nothing came up in addition."
A: "Do you like it that the patents are still shown but very de-emphasized?"
P: "Yeah. Maybe some people would like them to disappear but I don't know, depending also on how precise you can be because for us it is by the day sometimes you look."
The participant plays around with the date sliders.
P: "I think it is quite nice to see them because you can quickly have an idea: okay, in the last, I don't know, in 2005 there were very few applications and then if you go up here, there is a boom."
The participant closes the date pop-up by pressing on the date button without having to be reminded.

A: "So what do you think of the links between patents?"
P: "So the links are the lines so that you can group by class, or keywords, by applicants. No, I think that is really good. That is extremely good because we need to combine patents a lot of time, and sometimes it is nice to just compare a few documents and in the Viewer you don't remember when you have 50 documents what is the link between them and here

you have it graphically and you can customize the link, that is also very important."
She looks for a 'family member' link which is not included in the current system.She then chooses inventor and one link between two patents is displayed. She then moves the patents which are links.
P: "That is really useful honestly."

A: "Would it also be useful to see the links between the patents in the same patent family?"
P: "Yeah like, for example, you have the EP, the Japanese, the US. Yes. Sometimes it is important from a legal point of view because the US is, let's say, a little bit earlier than the EP so you can use the US for the EP. No, that is very useful."
Without looking at the menu, the participant starts to list what links can be used.
P: "What other links can we have? Keywords, class, applicant, inventors, citations... Because also what we do sometimes when we have a document that is quite nice but not the one, then we try to see everything that is linked around this document: citing, cited."
A: "So would you like to see multiple types of links in, perhaps, different colors to show, for example, red would be applicant and blue would be cited by and green cited to?"
P: "And then you can activate the link so you can see it or not. That would be very nice."

The participant removes the link using the context menu. She then opens the patent and the detail viewer is shown. She starts swiping through the images right away.

P: "Oh yeah, that is better than clicking, I can tell you!"
A: "So you like the swiping when going through the document like this?"
P: "That is good, really good. Because we do a lot of clicking."

She then goes on to explain that when citing a document, the examiners have to provide the page and paragraph of what they are citing. In this case the paragraphs have numbers but this is not always the case. It is a Viewer problem she says.

She then goes back to scrolling through the text.
P: "Scrolling like that, this is fantastic. This is nice because you don't have to use...(clicking)"
Starts scrolling with her other hand. P: "Ah when you are used to it, you can also use you other hand as well!"
P: "It is true that with a mouse you are... yeah..."
She gestures the swiping and then scrolls again.
P: "These kinds of things and scrolling is a very mild movement."

She then wants to close the window by pressing on the Windows 'x' button. She is instructed to use the two fingers down gesture.

She pans again using her index and middle finger placed horizontally. She then switches to using her thumb and index finger, as is used when zooming in and out.
P: "Moving sideways or up and down is a bit difficult."
She moves around some patents.
P: "Because moving things, it is quite easy, but moving like that (horizontally) is a bit more..."
A: "Would you rather have that you move the background rather than use the selection gesture with one finger?"

P: “Yeah, maybe. Because I try to have more space but still it sometimes zooms as well. And then maybe to (select) we can press (with one finger) to circle (with the other finger), like a control + something. We still have this stuck in our mind: alt, shift, control. It takes a bit of time to get used to this logic.”
P: “It is really nice actually, a very different way to see things but it is a good overview of what you get if you have a pile of patents you can already sort them...”

A: “As a final thing, how would you start your pile. Now, everything has been placed randomly but there are different options that you could use to start your evaluations. For example, you could have all your patents in a list on the side or they could be kind of randomly placed or placed in a grid-like manner based on their date or classification so that is more structured.”
P: “The first time I will have the documents... For us what is important first is the date to see if it is on time or not. And then I think it is quite nice if your desk is clean, so the patents are stuck there (to the side) and then you start moving (the patents onto the desk) and making your own groups, little by little. I am a quite picky person, so I like maybe to have a stack (of patents to the side, not like the group stack) and then to make my own groups and not have to fish like now. Maybe other people are different.”