

daDA interface

Cooperative online interface for the compArt database of
digital art.

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Independence Statement

Herewith I declare that I have completed this work solely and with only the help of the mentioned references. Bremen, 8th June, 2010

Walter Jenner

Contents

Independence Statement	iii
Acknowledgements	vi
Kurzfassung	vii
Abstract	viii
1 Introduction	1
1.1 Can visualisations help?	2
1.2 Research questions	2
1.3 Structure of this thesis	2
2 Analysis	3
2.1 Let's start with a manifesto	3
2.2 Interaction design	4
2.3 Understanding the design situation	7
2.3.1 Building an interface for a database	7
2.3.2 The world wide web	9
2.3.3 Online collaboration	17
2.3.4 Information retrieval	24
2.3.5 Information visualisation	29
2.4 Conclusion and guidelines	36
2.4.1 Make a reference work	36
2.4.2 Make an online medium	37
3 Synthesis	38
3.1 The daDA Interface	38
3.1.1 Navigation in knowledge space	38
3.1.2 Exploratory information retrieval	41
3.1.3 The database is not an island	42
3.1.4 Inviting the world	43
3.2 Prototype of a visual interface	44

4	User study	47
4.1	Evaluating IR systems	47
4.2	Open user study	48
4.2.1	Participants	48
4.2.2	Questionnaire	48
4.2.3	Results	48
5	Conclusion	54
5.1	About participation	54
5.2	Content	55
5.3	How can visualisations help in this context?	55
5.4	How can a reference work profit from being online?	55
5.5	Open features	56
A	Survey results	57
A.1	Detailed results of the survey	57
	Bibliography	61

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/goa_is

Kurzfassung

Welche Chancen bieten Web Applikationen im Vergleich zu Desktop Applikationen? Durch die Entwicklung einer Oberfläche für die compArt Datenbank der digitalen Kunst wird diese Frage im Rahmen dieser Master Arbeit betrachtet. Die Arbeit umfasst die Konzeption und Umsetzung der Oberfläche und ist somit im Gebiet des Interaktionsdesigns angesiedelt.

Die spezielle Designsituation ist also beeinflusst von den Charakteristiken des World Wide Web, im Speziellen spielt die Frage eine Rolle inwiefern dort kooperative und kollaborative Szenarien umgesetzt werden können. Des Weiteren wird der explorative Suchprozess untersucht, mit Fokus auf facettrierte Suchoberflächen. Ein Exkurs in das Gebiet der Informationsvisualisierung wird unternommen, um festzustellen inwiefern diese Ideen in dem speziellen Fall helfen können.

Zum Schluss wird die entwickelte Oberfläche präsentiert und bezüglich Einfachheit und Nützlichkeit getestet. Es stellt sich heraus, dass die meisten implementierten Funktionen als nützliche Hilfen eines kooperativen Informationsfindungsszenarios angesehen werden können.

Abstract

What are the chances that arise for online applications in contrast to offline applications? As an interface for the compArt database of digital art is being developed, I examine this question within this thesis. The work focuses on the overall conception and realisation of the interface, hence it resides in the domain of interaction design.

The specific design situation is influenced by the characteristics of the world wide web and in particular how collaborative and cooperative scenarios can be developed within. Furthermore, the process of exploratory searching is examined, with a focus on faceted browsing interfaces. A short excursus is made into the world of information visualisation, to see if these ideas can help.

Finally, the developed interface is presented in detail and tested regarding its *ease of use* and *usefulness*. The implemented features are evaluated with the result that most features are seen to support cooperative information retrieval.

Chapter 1

Introduction

There are fascinating things happening, at this moment, in and around the world wide web. Some years ago, someone¹ started to use the term *Web 2.0* to describe that the world wide has reached a new level. This trend has not stopped so far and new buzzwords are spread. With the new success of social networking sites the arrival of the *social web* is claimed. Others await the *semantic web* around the corner, and consequently some others also see a *social semantic web* arriving. In 2006, *Time Magazine* reacted to the rise of user-generated content and declared that the most important person of the year was *You* [21]—meaning everyone who actively participates on the web. The *Ars Electronica Center* in 2005 introduced *Digital Communities* as a new category for their *Prix Ars Electronica* as a reaction of and a support for the appearance of new online applications and artworks.

These events indicate that the medium internet currently is expected to provide new possibilities for digital applications in contrast to other media. Print media (books, newspapers) are static—once they are printed they possibility to change is null. A digital medium, in comparison, is dynamic as its content as well as its appearance can change momentarily, depending on the human in front of it. The term *digital* refers to the way data is saved and transmitted within these media. One could also call them *algorithmic media* as they are computer programs made of algorithms, that access and manipulate the (digital) data. To satisfy this new quality in the process of shaping or designing such digital media applications the term *Interaction Design* is used at times [39]. The digital online medium allows people to access the same instance of a program which is saved and executed on a central server. The application can react and change itself according to the behaviour of the sum of all users. The digital online medium is algorithmic and centralised.

This substantial difference between online and offline applications is examined by developing a web interface for the database of digital art (in short

¹It was first used by Tim O'Reilly in 2005. See <http://oreilly.com/web2/archive/what-is-web-20.html>, retrieved on 22/04/2010

called daDA). This database is developed and filled by the *compArt* project² at the University of Bremen. Under the guidance of Frieder Nake information about artworks, artists, publications and more objects related to digital art are collected and saved in this digital collection. Around the database various interfaces³ are implemented to access the data. A web interface to browse and search the data was missing so far, and therefore the practical part of this work fulfills a real need. The resulting application implements just a subset of all features defined during the analysis phase due to time constraints. However, the first version is online already and can be accessed at <http://dada.compart-bremen.de>.

1.1 Can visualisations help?

As another special focus the potential of visualisations in this context is examined. Databases typically are represented by a set of tables which store the data. As the amount of data increases more visual representations may help to keep the overview and find relevant information easier.

1.2 Research questions

The application to be developed within this thesis, is an interface for a *reference work*. In print media, a typical example are lexicons, and in the digital domain often databases can be categorised as reference works. I have examined two research questions as a focus within this thesis.

1. How can a reference work profit from being online?
2. How can visualisations help in this context?

1.3 Structure of this thesis

In the next chapter I provide the theoretical framework of the topic as an analysis of the current research and related work. It can roughly be divided as *the world wide web*, *information retrieval*, and *visualisation*. At the end of this chapter, I present guidelines for the practical development. In the third chapter, I show the developed web interface for the compArt database. To see whether certain aspects of the developed interface were successful, a user study was conducted whose methods and results are presented in chapter four. Finally, the conclusion which gives an outlook about possible future steps to further improve the interface.

²<http://www.compart-bremen.de>

³see also <http://viola.informatik.uni-bremen.de/typo/index.php?id=10>

Chapter 2

Analysis

This thesis tries on a practical and a theoretical level to develop a computer program—the focus shall be on the overall appearance of the program and how it is experienced by the humans who use it. I am not a software engineer, neither am I an interface designer. I studied the programme "Mediatechnology and -design" and here the most prominent feature was the consequent mixture of formerly separated courses. Like learning how to design graphics in the morning and programming a jpeg compression algorithm in the afternoon.

This programme started in 1997. A few years earlier, in 1991, Mitchell Kapor had published a document called *A software design manifesto* [33]¹. In this manifesto he argues for the establishment of a new profession, that of the software designer, who—with a strong background in design as well as in computer sciences—should be involved in the creation process of software. With programmes like Mediatechnology and -design in Hagenberg, and also Digital Media in Bremen, it seems Kapor's call was heard.

Kapor's manifesto laid the ground for the programmes I was studying and it also describes the field this thesis is situated in.

2.1 Let's start with a manifesto

[Design is] where you stand with a foot in two worlds—the world of technology and the world of people and human purposes—and you try to bring the two together. [33, p. 4]

Mitchell Kapor², in *A software design manifesto* wanted to introduce a stronger influence of traditional design thinking in the creation process of software. He used *software design* to describe a new needed discipline which

¹I am referring to a reprint from 1996 here, as access to it was easier.

²He is one of the two founders of Lotus Development Corporation and designed the software Lotus 1-2-3.

should have the "overall responsibility for the conception and realization of the program" [33, p. 4].

The term *software design*, however, took on another meaning over time. It is nowadays connected to the process of sketching the structure of software programs. By making use of software design methods, software engineers plan their work before they actually write code³. Nevertheless, the concept Kapor meant with software design is still researched and vital today. Kapor saw an important role for traditional design when shaping digital artefacts. Currently, *interaction design* is the term for what Kapor meant. Both terms contain the word *design*—and in both cases this is intentional. At least when they are used by Kapor, in the case of software design, and for example by Löwgren [39, 40] in the case of interaction design.

Besides Kapor's misfortune that the term he described in his manifesto has quite a different meaning today, he stated a lot of very important thoughts which in retrospect seem to have inspired scholars in this area. He writes that (software) design is combining "two worlds" [33, p. 4]. Accordingly, when he argues for a professional training for this discipline to be developed, he includes technical knowledge and deep understanding of design as needed skills for software or interaction designers. Referring to the Roman architecture critic Vitruvius, Kapor adds *delightfulness* as a quality for software in addition to functionality [33, p. 5].

Furthermore, he states the need for sketching and prototyping tools as well as for iterative development cycles where the designs are refined over and over again.

Kapor's work *A software design manifesto* is an astonishing document which appears to have laid the ground for the field now known as *interaction design*.

2.2 Interaction design

The term *interaction design* seems to be introduced in the 1980s at the industrial design firm *ID2* (or *IDTwo*) [64, p. 165], by Bill Verplank⁴. He later on developed his own concept of how to understand interaction design (Fig. 2.1). For him three questions are essential⁵.

- *How do you do? What sort of ways do you affect the world: poke it, manipulate it, sit on it?*
- *How do you feel? What do you sense of the world and what are the sensory qualities that shape media?*

³Probably that is the reason, why this book resides next to books about software modeling techniques in the library of the University of Bremen.

⁴Cp. <http://www.billverplank.com/professional.html>, retrieved on 29/01/2010

⁵Cp. <http://www.billverplank.com/Lecture/>, retrieved 29/01/2010

INTERACTION DESIGN



Figure 2.1: Sketch by Bill Verplank of his understanding of interaction design. From <http://www.billverplank.com/Lecture/>.

- *How do you know? What are the ways that you learn and plan (or perhaps, how we want you to think)?*

This sketches how he sees interaction in general. Interesting is the use of the word *feel*, as it indicates an emotional reaction by the user, rather than just a rational reaction. When something is created to be used by humans, there always is an emotional, an aesthetic and also an ethical dimension in addition to the functional and structural dimension, which is central to any design work, especially in a design discipline which has such a strong influence from "clinical" sciences as interaction design⁶.

Interaction design extends product design. *Interaction* stresses the fluid appearance of digital artefacts. It is not a static material that can be shaped, rather it is a dynamic process between a human and a computer, which can be influenced by the way the artefact actually is designed.

Interaction design means the shaping of digital artefacts. Just as a carpenter needs to know the different types of wood and its special properties, the interaction designer needs to know the material she is working with. The

⁶As a footnote it should be mentioned that this process of interaction is also examined by various scholars by building on semiotics, the study of sign processes (In particular Anderson [2], Nake [44], De Souza [57], and Nadin [43]).

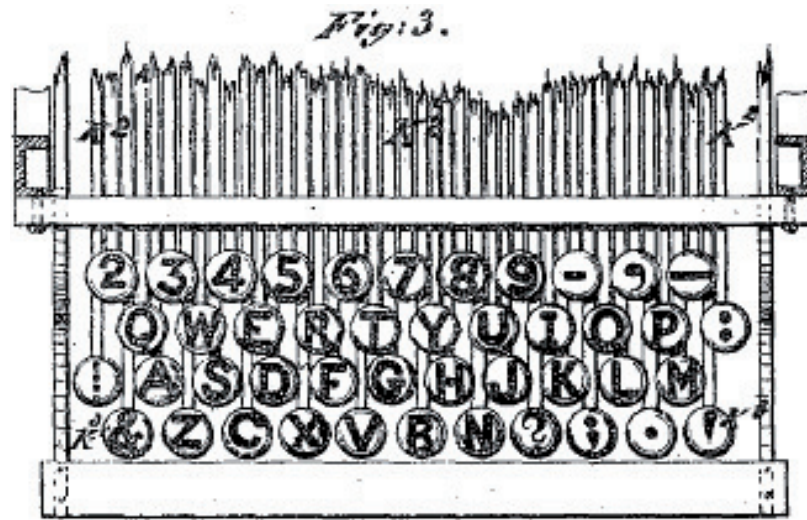


Figure 2.2: Keyboard Layout from Christopher Sholes, 1870s (C.L. Sholes, 1878).

complexity and fast pace of new developments in software and hardware makes the task of the interaction designer difficult. A thorough knowledge of the technology is needed to understand what are the possibilities and constraints that are given by the material. Interaction design insofar is interdisciplinary as it requires a solid knowledge of information technology, computer science, software engineering and the like.

However, it is first and foremost a design discipline and it resides in between tradition and transcendence as Pelle Ehn stated [18]. It needs to build on established mechanisms in order to create usable products for the people. As an example for building upon traditions the layout of keyboards can be taken. In the 1870s the QWERTY layout was created by Christopher Sholes to minimise type bar clashes (Fig. 2.2). Although this problem does not occur on digital computers anymore, the same layout of the keyboard is still used without major modifications, as people are used to having a certain keyboard layout. This very simple example shows how "user centered design" can be accomplished by building on traditions.

In relation to the traditional aspect of design, I would like to bring in the concept of design languages. Rheinfrank and Evenson [49] note that by the establishment of a design language, which is consistently designing elements and artefacts, it is easier for people to interpret these elements as they can build upon their previous knowledge and do not have to learn something new all the time. In web browsers, for example, hyperlinks are displayed in blue color and underlined if no further formatting is applied to by the designer. This tradition is so strong that changing it seems almost impossible. The

designer has to know these "rules" for two reasons. Firstly, to use them when they are appropriate and secondly, to not accidentally use a common visual element in a wrong context. For example, making a text [blue and underlined](#) on a web page when it is not a link would be a considerable design fault. However, Rheinfrank and Evenson also state that the strength of design languages can be dangerous [49, p. 73 and 74].

Design languages typically are most influential when they have become deeply embedded, when people can unconsciously assume that they are valid and can continue to act through them, rather than think about them and their appropriateness.

Here is where we meet the second principle of design again, transcendence. Design traditions have to evolve and change as the context and the design situation changes. In the domain of digital artefacts new technical developments impose new problems and new possibilities which need new solutions. Creating something new is also at the core of design, and indeed there are some methods which try to support this. Halskov mentions for example combination of unrelated elements as a strategy to facilitate innovation [22]. However, the basis for creating something new that actually changes something for the better is to develop an understanding of the design situation.

According to Donald Schön the "totality of an artifact, system or situation" [55, p. 175] needs to be considered, when designing a product. Any action that is taken by the designer has side effects, therefore she is in a process, that Schön calls "reflective conversation with materials" [55].

2.3 Understanding the design situation

The following section reflects important parts of the particular design situation this thesis is situated in. It acts as the theoretical basis for the practical work.

2.3.1 Building an interface for a database

The application to be built is an interface for a database of digital art. It consists of information about people (for example artists, authors, art collectors, and curators), artworks, events (for example exhibitions), institutions (for example museums and universities), publications, and more. Furthermore, it is interlinked and thus contains lists, for example a list of artworks done by a single artist.

Its most basic purpose is to make the data it contains available. As such it shares similarities with "old-fashioned" dictionary-like books. Just as a lexicon, it needs to provide mechanisms to find the item the reader is looking

for. In print media we can identify some structures which should help to find a single item quickly. The items are ordered alphabetically, which is a convenient solution in many cases. In an encyclopaedia an alphabetical index is provided, to find objects which do not have their entry. The ability of being searched must be at the core of dictionary-like media or reference works.

It is also important that the provided information is credible. For example, the biggest and most popular encyclopaedia nowadays, *Wikipedia*⁷, still lacks credibility at times, which definitely is a problem for its users [48].

Finally, completeness is another aspect that reference works are striving for. Of course, the focus of a particular work can be well-defined, but within this boundary every medium of this type is aiming for completeness.

In the digital realm these goals stay the same, but they can be reached by different means. Additionally new possibilities arise. At first I would like to focus on offline applications in contrast to web applications. Probably the most convenient enhancement for a digital reference work is the ability to search against keywords in the whole collection. An algorithm can match search terms against the content and return a list of results, which extends the index known from books by adding the possibility to search for any self chosen word. The digital medium makes the strive for completeness easier, as content updates can be installed easily. The benefits of hypertext can be leveraged in digital documents, as following hyperlinks to another piece of text can be accomplished by a simple click on a word or text fragment. The concept of linking to other parts of texts is not new, however, but in the digital world it can be implemented conveniently. With the break-through of hypertext a form of reading known as browsing gains more influence over the traditional linear form of reading. In particular in the world wide web (WWW) hypertext is an integral part—the programs used for accessing the WWW are called *browsers* and documents within the WWW are structured with HTML which stands for Hypertext Markup Language.

In the context of reference works, two more features seem interesting. Firstly, the set or list of entities visible to the reader can be changed dynamically. It can be sorted in particular ways, depending on what the reader prefers in the current context. It can also be filtered by constraints in order to reduce the number of entities shown. The dynamic, algorithmic nature also allows a personalised version of the collection. In a trivial example, the reader might choose the color of the font according to his preferences, but also the programme could remember the favourite items and suggest new items which might be interesting according to what the reader has viewed already.

The digital *online* medium again introduces a substantial difference, each reader is accessing the same instance of a program on a central server. Web applications are server-based and are accessed through the internet. This

⁷<http://www.wikipedia.org>

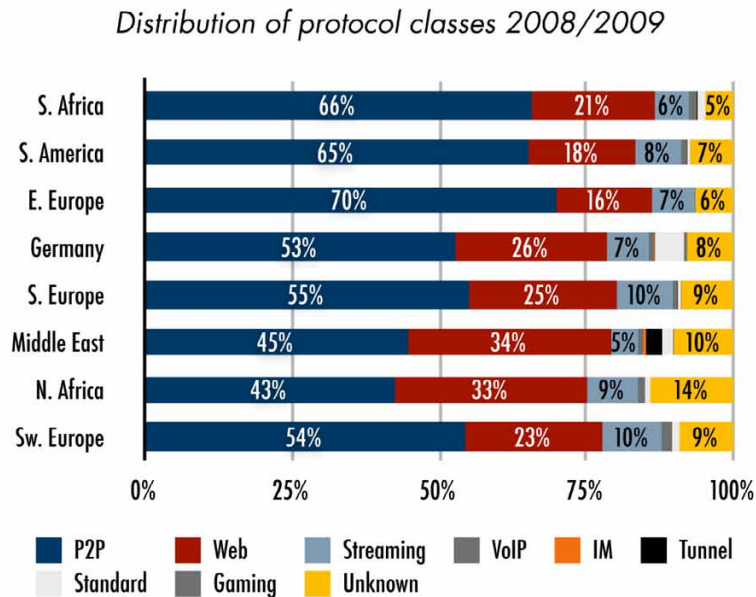


Figure 2.3: Share of different protocols on the overall internet traffic [56].

introduces a social component which can be used as a design material by a designer. To investigate the current status of this domain, the following sections deal with the most prominent web applications on the internet and how they are used.

2.3.2 The world wide web

To identify a few qualities of the WWW and the internet one can take a look on the current status and see what applications are successful and try to find out what basic properties they have.

According to statistics on Alexa⁸ the most popular websites worldwide are search engines (Google⁹, Yahoo¹⁰, Windows Live¹¹, Baidu¹²), then social networks (primarily Facebook¹³, but also Myspace¹⁴), YouTube¹⁵ is on 4th place, Wikipedia on 6th place followed by blogs (blogger.com, word-

⁸Cp. <http://www.alexa.com/topsites>, retrieved on 22/04/2010

⁹<http://www.google.com>

¹⁰<http://www.yahoo.com>

¹¹<http://www.live.com>, recently relaunched as <http://www.bing.com>

¹²<http://www.baidu.com>

¹³<http://www.facebook.com>

¹⁴<http://www.myspace.com>

¹⁵<http://www.youtube.com>

press.com). Amazon¹⁶ is on 20th place, and eBay¹⁷ on 24th.

The importance of search engines is striking, nevertheless, I consider them as meta-applications as they are just gateways to other sites. To summarise, I state that at the moment following types of sites are the most prominent: **social network sites, video streaming sites, information and news sites** and also **shopping sites**¹⁸.

In addition to the WWW other technologies which work on the internet are very popular at the moment. According to a study by the German hardware manufacturer ipoque¹⁹ [56] *Peer to Peer* (P2P) protocols cover between 42% (North Africa) and 70% (Eastern Europe) of the overall internet traffic (Fig. 2.3). The WWW based on HTTP, takes the second biggest share with 16% (Eastern Europe) to 32% (Middle East). The third biggest traffic source is streaming media including Flash-based streaming via websites like YouTube.

Even though traffic rates are usually higher when sharing files, these numbers indicate that file sharing also is a popular activity on the internet, which I would put on the same level regarding importance as the already mentioned types of websites.

Why are these activities so popular on the internet?

Social network sites

According to [11, p. 1] social network sites (SNS) allow individuals to

1. *construct a public or semi-public profile within a bounded system,*
2. *articulate a list of other users with whom they share a connection, and*
3. *view and traverse their list of connections and those made by others within the system.*

I would add the possibility to send messages to other users as another integral feature of such websites. If you take this set of features as given for most if not all social network sites, and if you at the same time accept that SNS are quite successful nowadays, one can claim that those features fulfill a valuable need for people. I state that users of social network sites like to

- express themselves by putting up a profile and by updating it regularly.
- want to externalise their social connections for means of expression again, but also to save them in a kind of address book for later use.

¹⁶<http://www.amazon.com>

¹⁷<http://www.ebay.com>

¹⁸Find an interactive tree map visualisation of another, similar, statistical analysis of how the web is used here <http://news.bbc.co.uk/2/hi/technology/8562801.stm>. Retrieved on 18/05/2010.

¹⁹www.ipoque.com

- want to socialise with their friends and stay updated about their activities.

Regarding the question of whether SNS are used to connect to strangers or people already known, Lampe et al. [36] suggest that on *Facebook* most people connect to someone they met at first offline. Similar results are provided by Schäfer [52] for the German SNS *Xing*²⁰. Other types of social network sites concentrate in particular on making new connections. Here members meet because they have "shared interests, political views, or activities" [11, p. 1]. An example is *Couchsurfing*²¹ where the members try to find sleeping accommodation while traveling. SNS are used to foster pre-existing offline connections, as well as to find formerly unknown people who share similarities in one or another way.

In general the success of SNS shows that the internet offers the quality as an expression and communication medium, which can be considered as a design material, when creating a web application.

Video streaming sites

Video streaming sites allow to access video content on demand. They provide the infrastructure for creating video channels on the internet and it is possible for basically everyone with internet access to spread video content. Though those platforms are one of the most prominent examples of user generated content [14], they to some extent are also filled with copyrighted material recorded from television. A study by *Visible Measures*²² says that the amount of copyrighted videos on *YouTube* amounted to approximately 10% in early 2007 [28]. They checked around 6000 of the most popular videos, and counted the number of videos which got removed by *YouTube* due to copyright infringements. Another survey suggests an even bigger share of copyrighted material. It is published in the book *YouTube: Online Video and Participatory Culture* [12] and says that the material originally produced by mainstream media gets the most views on *YouTube*.

In order to structure the mass of videos a bit, different means are implemented on different sites. On *YouTube*, viewers can rate videos on a scale from one to five stars and it is also possible to "favour" a video. It eventually appears on a personal list of favourite videos. As the number of favourites for each video is counted, videos can be sorted according the number of favourites. The most popular videos are detected as well, by saving the numbers of views.

The cultural influence of such video streaming sites can not be neglected, as those platforms are extremely popular and most likely continue to grow.

²⁰www.xing.com

²¹<http://www.couchsurfing.org>

²²<http://www.visiblemeasures.com>

The most popular video at the moment on *YouTube UK* was viewed 157 million times²³.

The internet as a means for distributing video is used by television stations also. On <http://mediathek.zdf.de> broadcasts from the German public-service television channel *ZDF* can be viewed on demand.

To summarise, video streaming on the internet can be seen as an interactive extension of television. On this interactive medium, viewers can watch videos on demand and also videos can be rated and discussed online. Video sites also implement features of social network sites, therefore they probably could also be seen as a sub-category of such sites, which would increase the importance of SNS even more.

Information and news sites

Online news sites leverage the quality that they can be updated at any time. They can report in real time and live, a central element for news. They can also be accessed globally and searched easily. In comparison to print media, the publishing costs are lower, as nothing needs to be printed. The possibility to integrate multimedia content as audio and video seamlessly, can be considered as an advantage to traditional print media. Consequently, the media landscape is changing; blogs which are not necessarily written by educated journalists are gaining the attention of the readers. The biggest news blogs reach masses of readers—*Huffington Post*²⁴, as an example, attracts around 8 million visitors a month²⁵.

Online news are more difficult to control, since everyone with an internet access can publish and distribute—and if done properly she can stay anonymous. In countries where news and information is still controlled by the people in power, the internet provides a significant information and communication medium. Its decentralised and non-hierarchical structure allows publishing by everybody and makes control much more difficult.

Wikipedia The online encyclopaedia *Wikipedia* tries to collect the knowledge of all users of the internet. It is technically very easy to contribute, as it is not even necessary to log in with a personal account. To avoid misuse, every change is tracked and can be reversed easily. To resolve disagreements between authors, a discussion page exists for each entry, where the people can debate about what to write.

All text on *Wikipedia* is licenced under the *Creative Commons Attribution / Share-Alike License 3.0 (Unported)*²⁶, which says that the text can be used

²³http://www.youtube.com/watch?v=_OBlgSz8sSM, retrieved on 8th of February. By the 6th of May it has already 186 million views

²⁴<http://www.huffingtonpost.com/>

²⁵Cp. <http://siteanalytics.compete.com/huffingtonpost.com/>, retrieved on 06/05/2010

²⁶<http://creativecommons.org/licenses/by-sa/3.0/>

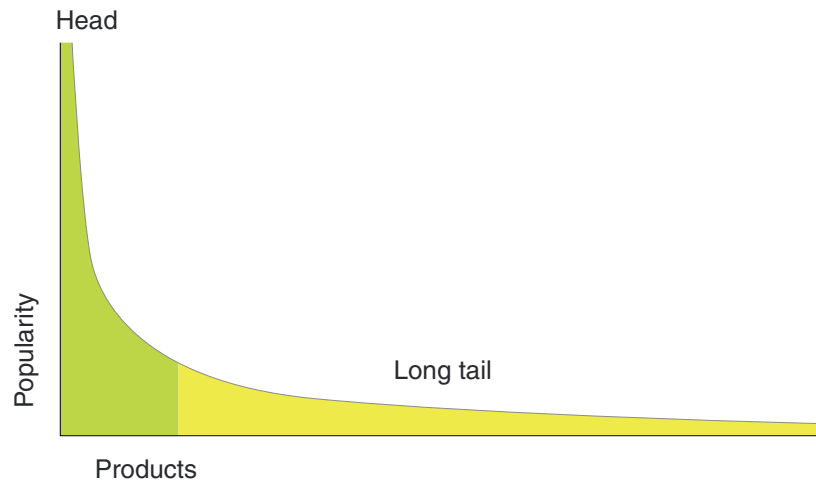


Figure 2.4: A power law graph illustrating a popularity distribution of products. Adopted from [3].

and altered freely by everyone, as long as the resulting text is shared under the same licence and the source is attributed to.

Wikipedia is probably the most prominent undertaking of online collaboration, which is covered in more detail in section 2.3.3.

Shopping sites

Similar as blogs allow to publish basically anything without the need of expensive structures, online shops make the selling of goods feasible for a lot of people. On platforms like *DaWanda*²⁷ an online shop can be opened with almost no technical knowledge needed. Due to easy searchability of web pages and the shipment of products almost worldwide, even a large audience for niche products can be reached online. Chris Anderson made the term *long tail* popular, which also describes these properties of online shops [3]. Anderson says that a big number of items which are sold just a few times each (the *long tail*), can generate as much profit as a small number items which are bestsellers (Fig. 2.4). An example where some new developments work together is the distribution of music. The traditional medium of music is a CD (or Vinyl, or MC), a tangible medium, which has to be manufactured. Extending the number of offered items for traditional shops means that more physical space is needed. For the producer, the music label, a bigger variety means also more investments and also a bigger risk of not selling some items. When non-physical music downloads are sold online, the increase of the offer is not as expensive. Together with the fact, that people from anywhere in the world provide a possible audience even for "exotic" music, this leads to the

²⁷<http://en.dawanda.com/>

different selling pattern, known as the long tail phenomena. Consequently, the characteristics of online shopping support a higher diversity of available products.

Under the term *social shopping* some typical Web 2.0 features reoccur in the domain of shopping. User-generated reviews, comments and ratings should help to compare items.

Websites which highly rely on trust, such as eBay, are highly dependent on mechanisms which make trustworthy actions visible. Nevertheless people have adopted to it, and security seems to not be a large hindering issue.

File sharing

In 1999 the first P2P file sharing platform, *Napster*, appeared. Since then the technology got better and the internet connections got faster and now P2P file sharing is as popular as ever. Besides music and video files, photos and graphics are also shared online on platforms like *Flickr*²⁸ for photos and *Vecteezy*²⁹ for graphics. Due to *Creative Commons*(CC)³⁰ licences, which were introduced in 2001, such distribution can happen on a legal basis. With the use of such licences the originator can allow certain usage of the work, while still retaining as much rights as wanted. While those licences can be used for any type of media, the most vital community seem to exist for photos and graphics. CC licenced photos can be easily found on *Flickr* and *Google images*, as the search function allows filtering of the results by licence type. It gained even more popularity since Virgin Mobile Australia used CC licenced photos found on *Flickr* for an advertising campaign in 2007³¹.

The fact that digital files can be copied losslessly and that they can be altered easily to make them fit to new contexts lay the basis for the relevance of file sharing. Hughes et al. [29] call digital files *transmutable* to describe this quality. The impact of digital file sharing on culture production in general is also examined by Lessig in [37] a book which itself is released under a CC licence, where he calls for a fundamental change in copyright law in order to fit the current situation.

Discussions about the legal situation as well as its possible cultural and commercial consequences are a vital and interesting topic at the moment, but exceed the scope this thesis.

The web as a whole

So far certain parts of the world wide web have been examined, but as a network the web is more than the sum of its parts. While browsing the web,

²⁸<http://www.flickr.com>

²⁹<http://www.vecteezy.com>

³⁰<http://creativecommons.org/>

³¹Cp. <http://www.flickr.com/photos/sesh00/515961023/>, retrieved on 22/04/2010

multiple services and websites are used. Therefore, one can see the web itself as an application, where all the websites in it fulfill sub-functions. For a user this perspective makes sense, as she mainly cares about the use-value of the whole web; she wants to know what she can do with it. While analysing the web in this manner, certain issues become apparent³².

Searchability The web is growing quickly and new websites are added daily. The main entry point to the web are search engines, they are so important that one could claim, that if a web site cannot be found with one of the major search engines, then it does not *exist*. This has the simple but important practical consequence that a web site, which aims to be used by visitors of the internet, has to be concerned about its visibility for search engines.

Redundancy and Integrability On the web the same information may exist a couple of times, maybe different in quality and also regarding correctness and timeliness. If someone searches for the biography of Manfred Mohr, as an example, one will find a few different sources ranging from mediaartnet.org, artfacts.net, the compArt database, *Wikipedia* and finally Manfred Mohr's own website. While diversity makes errors in a single entity less problematic, as by comparing different instances those errors might be found, it also makes the task of finding information more difficult for the user. Furthermore, it is cumbersome for the people who maintain the data, as each one has to update her own text as soon as something has changed. Hence, it would make sense to reduce redundancy in cases where the information can be considered as more or less objective, which requires the means for integrating content from different websites by reference. So far the answer to this problem are APIs of websites, which allow to use content and data in another context. RSS feeds and microformats are mechanisms supporting such integration and research in the area of the *semantic web* is dealing with such topics. In [4] Ankolekar et al. tries to combine ideas of Web 2.0 with semantic web approaches and sketches a scenario on how "mashup-like information sharing" could improve the web. The basic idea is that if information is structured in a standardised way and enhanced by semantic meta information, then it can be more useful. Data can be extracted automatically and reused in other contexts. The main vision is a transformation of the *web of documents*, as we have it now, to a *web of data*, where the global web could be queried just like a database [9].

Two exciting applications which demonstrate the potential of the web of

³²In the scientific community a discipline called *Web science* came up in 2006. It deals with the internet, its technologies and its impact on society. Its most prominent supporter is Tim Berners-Lee. More on <http://webscience.org>

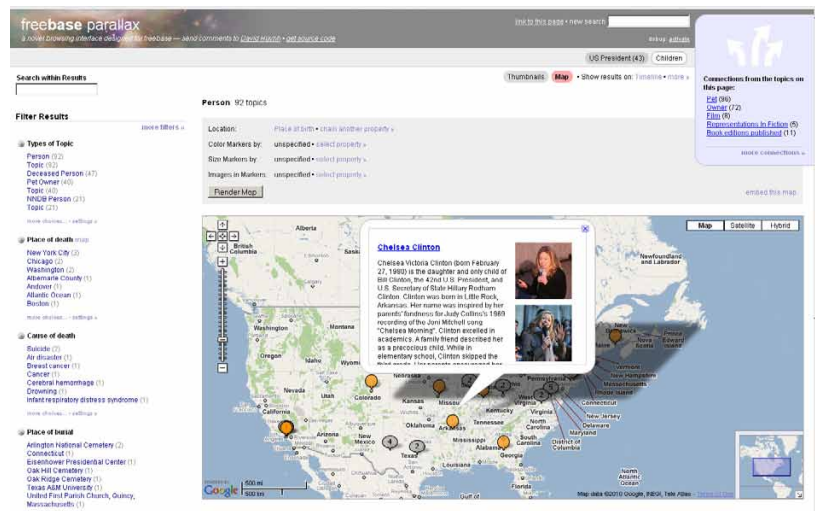


Figure 2.5: The birth places of all children of Democratic US presidents shown on a geographical map. Screenshot from <http://www.freebase.com/labs/parallax>.

data are *uberblic.org*³³ by Georgi Kobilarov and *Parallax*³⁴ by David Huynh. *Uberblic.org* is the attempt to integrate existing sources of RDF³⁵ formatted data to be accessed from a single website, <http://platform.uberblic.org>. The seamless combination of multiple data sources is only possible by usage of a common standard like RDF. *Parallax* is an interface for browsing the *Freebase* database. *Freebase* harvests data from various sources (including *Wikipedia*), displays them on their website and also provides it in RDF format. The *Parallax* interface demonstrates how browsing structured semantic data can be beneficial in contrast to browsing document based data as on *Wikipedia*. For example, the interface makes it possible to retrieve a list of all US American presidents, then to filter them to just the ones from the Democratic Party, and further to get a list of all children of all those presidents, and finally display all places of birth of those children on a geographical map (Fig. 2.5). Most of the information needed might be available on *Wikipedia* as well, but it is not possible to extract that information in a similar way. The way *Parallax* is working can arguably be described as performing complex visual queries on a database, while the document-based *Wikipedia* just allows the retrieval of single documents. This shortcoming of *Wikipedia* is also visible, when lists of items are generated. Any list on *Wikipedia* again is a document, meaning that it has to be created and maintained by hand. It is not possible, to query *Wikipedia* to retrieve dynamically built lists. Such

³³<http://uberblic.org/>

³⁴<http://www.freebase.com/labs/parallax/>

³⁵Resource Description Framework

detailed querying remains impossible within a document-based *Wikipedia*.

Such applications give an idea about the vision of the *web of data* and what benefits it promises.

Characteristics of the WWW

To conclude this section about the WWW, the most important characteristics of the internet are summarised.

- *Real-time*. The Web is a live medium, changes on the server are immediately visible to everyone.
- *Social*. As people can communicate, cooperate and collaborate online the web is a social medium.
- *World Wide Web*. The WWW is (quasi) world wide, people around the globe can access it. It has a huge reach.
- *Multimedia*. On the web multiple media, such as audio, video and textual content can be transferred.
- *Super-Application*. The web as a whole can be seen as a super-application consisting of all websites and available web services available.
- *Digital*. The web is a digital medium. The digital file is transmutable and can be copied and adapted easily.

2.3.3 Online collaboration

An early experiment about online collaboration was done in 1984, at a time when the world wide web did not even exist. For the exhibition *Les Immatériaux* in the Centre Pompidou in Paris, which was curated by the philosopher Jean François Lyotard, an experiment called *Epreuves d'écriture* (which means "proof-sheets") was initiated [66]. Twentysix French authors, artists and scientists were invited to collaboratively write definitions of fifty given words on computers connected to a network and save them on a central server. All words were connected to the topic of the exhibition like *interaction*, *sign* and *author* amongst more³⁶. The contributions of each person were made visible to all the others, therefore a single contribution could influence the others. One author could extend the text of another, disprove it, or refer to it. When the experiment ended two month later, more than 600 definitions were collected in total. In a later analysis, Lyotard tried to get an idea how the process of writing in a collaborative way differs from traditional process of writing. The time of when this experiment was conducted shows that

³⁶Find a full list of the words and also the name of the contributors here <http://www.medienkunstnetz.de/exhibitions/lesimateriaux/>, retrieved 20/04/2010

computer networks have been seen as a medium for collaboration for a long time. In particular with the rise of the world wide web, research on collaborative online scenarios gained momentum. Its intermediate highlight might be *Wikipedia*, a platform which interestingly could well have been inspired by the experiment done for the exhibition *Les Immatériaux*.

Collaboration or Cooperation?

Taking an article by Stephen Downes as a basis [17], the difference between collaboration and cooperation is explored³⁷. To find characteristics of *collaboration* Downes [17, p. 34] refers to the *National Network for Collaboration*³⁸:

1. *Accomplish shared vision and impact benchmarks*
2. *Build interdependent system to address issues and opportunities*
3. *Consensus used in shared decision making*
4. *Roles, time and evaluation formalized*
5. *Links are formal and written in work assignments*
6. *Leadership high, trust level high, productivity high*
7. *Ideas and decisions equally shared*
8. *Highly developed communication*

In a collaboration as described here, a group of people work together to reach a **common goal** and the workflow in general needs to be highly structured in various aspects (identification of issues and opportunities, decision making, clearly defined roles within the team, etc.).

One example, which fits this description of collaboration very well, is the creation process of open source software. Even though the individual developers are probably spread all over the world, the work is organised rigorously. The shared vision might be communicated by a roadmap, marking some important milestones of future development; The team is organised in different departments, where some care about the security issues of the code and another team just designs the user interface; Furthermore some leaders define a schedule, which has to be kept if a new part of the program should end up in the new release of the software.

³⁷In computer science these terms got some attention with a series of ACM conferences starting in 1986. Its title is CSCW, standing for *Computer Supported Cooperative Work*, and as the ACM description says, its focus is "the use of computer technologies to support collaborative activities, as well as the impact of digital collaboration technologies on users, groups, organizations and society". The terms **cooperative work** and **collaboration** are used synonymously here.

³⁸<http://crs.uvm.edu/ncco/collab/framework.html>, retrieved on 22/04/2010



Figure 2.6: The finished 100 dollar note with a detail view of one of the rectangles. On the left side of the rectangle is the original part of the dollar note and on the right side the re-drawn one.

Other examples of similar structured collaboration include *OpenStreetMap*³⁹, a collaborative map drawing platform, and *Fotopedia*⁴⁰, where a photographic encyclopaedia is built. Probably the most famous collaborative platform nowadays, the *Wikipedia*, also defines comprehensive guidelines for contributors in order to align the shared work towards a common goal⁴¹.

Commercially the *Mechanical Turk*⁴² platform by Amazon can also be mentioned. Here, people can post tasks, which can be accomplished in a short time, but need to be done very often by different people. Amazon calls them *HIT*, Human Intelligence Tasks, and examples include identifying objects in images and other tasks which cannot be accomplished by computers yet.

There are also art projects dealing with this topic, one prominent example are works by Aaron Koblin like *Ten Thousand Cents* [34]⁴³. Here, he divided a 100 dollar note into 10.000 rectangular parts and asked people online to re-draw each part with a custom built drawing tool embedded on his website. Each contribution was rewarded with one cent, summing up to 100 dollars in total.

Cooperation In contrast to such typical collaborative platforms, other community sites exist, which do have not such a strong orientation towards collaboration. Nevertheless people still influence each other and **act** together, while not necessarily **working** together. As Downes calls it, they share some kind of "sameness", while they do not need to share one common goal. He

³⁹<http://www.openstreetmap.org>

⁴⁰<http://www.fotopedia.com>

⁴¹See the rules that *Wikipedia* defines here http://en.wikipedia.org/wiki/Wikipedia:Community_portal, retrieved on 22/04/2010

⁴²<https://www.mturk.com/mturk/welcome>

⁴³<http://www.tenthousandcents.com/>

suggests to use the term *cooperation* to differentiate such forms of group effort [17, p. 34-35]:

When we are not concerned with sameness of entity, when we are not concerned with shared meaning, when we are not concerned with diffusion of content, then the mechanisms for community look very different. They do not resemble collaboration, as we have described it above, but rather, what we may style here as cooperation. For the purposes of the current discussion, 'cooperation' may be thought of as the sharing by entities of a common system of communication or infrastructure.

While collaboration requires a "sameness of entity" [17, p. 34] for all participants, cooperation is just a sharing of a "common system of communication or infrastructure", where the "diversity among entities is expected and accepted" [17, p. 34]. When cooperating, people remain independent from each other, as they work towards their own goals, while when collaborating people form a group, where the individuals have to align to a common goal.

Online platforms which provide a personal value for the user and a network value for the public can function as examples for such cooperative applications. In particular sites like *Flickr*, where the individual user finds a place where photos can be uploaded, and the public finds a database of pictures from all over the world. While there is no common goal that all users of this platform share, there still is a community whose basis is that they put photos online together. Similarly, social bookmarking services like *delicious*⁴⁴, fulfill the personal need to organise ones bookmarks and also by sharing these bookmarks with the public allowing for the generation of a cooperative value. People contribute to such platforms for their personal value at first, and the generated network value is a side-effect. Consequently, the motivation for contribution is more egoistic than in collaborative platforms.

Most cooperative tools can also be used to collaborate if additional effort is made. For example a group of people can use *delicious* to collect web pages for a specific topic. Still, to constitute a state of collaboration other means for structuring the workflow are needed, otherwise it would still be a vague cooperation.

Collaborative filtering Collaborative filtering⁴⁵ is a widespread technique to generate individual recommendations of items for single users. Based on algorithms, which compare individual habits to the habits of other users,

⁴⁴<http://delicious.com/>

⁴⁵Here the term *collaborative* does not go along with the differentiation made in the section before.

personal recommendations are generated. The basic assumption is that people, who have chosen the same items in the past, will also be interested in the same items in the future. When a "neighbour-in-taste" finds a new item to be interesting it might be relevant to the other user as well, and therefore it is put on the list of recommended items. In order to get personal recommendations, at first one's personal preferences need to be tracked—that can either happen passively by letting the system record one's actions, or actively by voting or rating certain items.

This personalisation technique is found across different domains, and it covers the major online media.

- Music: *Last.FM* can track the music listened to and generate an individual online radio stream which includes already listened to music and new recommended music.
- Video: *YouTube* can recommend new videos based on your viewing history.
- News: *Google Reader* can recommend new RSS feeds.

On participatory culture

The popularity of social websites has led scholars like Henry Jenkins [31] [32] and Schäfer [53] to write about an emerging "participatory culture" which eventually leads to a new "democratization" of information and media. These authors base their observations on the fact that through new applications on the web it is easier for individuals to publish. People can write blogs (*Blogger.com*), can create and publish videos and music (*YouTube*, *Jamendo*), can open an online shop (*DaWanda.com*) and can write and publish books (*Lulu.com*). People can also actively participate in cultural production and the mass of consumers can now produce as well.

Furthermore, online collaboration platforms are seen as possibilities to enable participation. Don Tapscott and Anthony D. Williams haven written a book entitled *Wikinomics: how mass collaboration changes everything* [62]. They focus on how businesses and companies could strengthen their position by opening their company and letting people participate in collaborative efforts for the benefit of the company.

According to Eggo Müller [42] this emerging culture is often polarised by two extremes: the utopians, who think that "the individual gains control over the production and distribution of media content" [42, p. 49] and the dystopians, whose discourse "focuses on corporate industry's ability to exploit the interactive potential of participatory cultures" [42, p. 50]. The dystopian view in particular thinks that "whenever users share their views or content online, they perform unpaid labor and submit to extensive monitoring. This generates a surplus value that only the producers can control and exploit" [42, p. 55].

Similarly, Scholz [54] argues that most participation on the web supports the companies which are the providers of the space:

Standing on their shoulders [of the providers, note], we are entering their rooms; we are banking on the hospitality of their server farms, we are trusting that all the data that we are sharing through our conversations and on our profiles are not abused in scenarios of total control, barely imaginable today.

However, Scholz also points to another side of the internet. "But deep in the forest there is a door to another land.", he writes [54]. This other side are non-profit projects that aim to change something for the better for all participants of the internet. Scholz names *Project Gutenberg* as an example for the "other Social Web" [54].

Every participation happens in a space, which in the case of *YouTube* and similar sites is shaped mainly by the provider of the space. Consequently, the control about this space, and the data collected within, stays in the hand of the provider. Nevertheless, collaborative efforts on and through the internet have also led to the creation of open software platforms, which also can be used to create such spaces. Open source software exists on all needed levels, starting from an operating system (OS) and ending with web application frameworks. In the case of an OS, a set of Linux distributions can be used and also the most popular server software, Apache⁴⁶, is open-source. To programme web applications a lot of programming languages are available, such as PHP and Ruby, both of which again are available under open source licences. Finally there exists masses of open-source applications built with such languages which are ready to install. With this stack of open source software as a basis, the creation of spaces for online participation which are not controlled by companies is possible.

One example in the domain of video is *Miro*, an initiative by a non-profit foundation called *Participatory Culture Foundation*⁴⁷. They have built an open-source video player, an online community platform⁴⁸, where videos can be uploaded and viewed, and a website which helps people on learning how to create videos⁴⁹. They provide a complete platform for creating, publishing and viewing video content on the web—without a company standing behind, whose final goal **must** be the increase of revenue. It is run as a non-profit, which is the only form of organisation that can plausibly support any collaborative effort and is ultimately not supposed to help a certain group of people, but the general public.

⁴⁶According to a survey conducted in 2010 Apache gets a share of over 50%. <http://news.netcraft.com/archives/2010/01/>, retrieved 20/04/2010

⁴⁷<http://www.participatoryculture.org/>

⁴⁸MiroGuide. <http://www.miroguide.com/>

⁴⁹<http://makeinternettv.org>

To sum up, open source initiatives which are based on non-profit foundations can be the meta-spaces for creating participatory spaces, while company led platforms carry the immanent risk that contributions will be exploited for the company's sake.

Why do people participate

As research has shown, the number of people participating actively is relatively small in most online communities. Adar and Huberman studied how many people actively contribute to the file sharing network *Gnutella* and how many are just *free riders* [1]. They showed that 66% of the users do not share any file, and that 50% of all downloads come from 1% of all hosts. Nielsen introduces a **90-9-1 rule** for participation in online communities, meaning that 90% of the users are passive *lurkers*, 9% contribute at times, and 1% participate a lot and account for most contributions [46].

Just a small percentage of all users of an online community is likely to contribute actively. As every online community is highly dependent on contributions, it is interesting to know what parameters influence the participation rates, or in other words, what motivates people to take part actively.

One fact that can hardly be doubted is that the smaller the technical barrier is, the more people will contribute to it. If a person is technically not able to participate, participation will not happen. Not only must the person be able to do it, it must also be perceived to be easy. Fred Davis et al. [15] showed that the *perceived ease of use* has a significant influence on the intention of people to use a certain computer system⁵⁰. The *perceived usefulness* [15] is also an important parameter for people to use a system. While the benefit a system introduces is clear for the people who created it, it must also be communicated to the people who use it. Besides these two factors, there is also a social dimension in community applications. Löwgren mentions four keywords which play a role for online communities [38, p. 7-8]:

- ***Belonging*** to a social constellation based on shared meaning and practices.
- ***Creative Expression*** is self-indulgent and at the same time social - performed for the eyes of others.
- ***Identity and Status***. Identity as expressed in fashion demonstrates community affinities and is closely related to belonging. (...) The participatory media also allow you to reach positions of power in your tribes without being typecast by physical and material status conditions.

⁵⁰The term *system* is used here, in order to emphasise that the whole stack of components included, like software, interface, input devices, hardware, determines the *perceived ease of use* and the *perceived usefulness*.

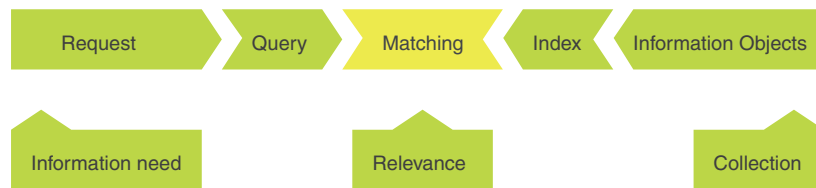


Figure 2.7: The general information retrieval process. Adapted from [19].

- **Influence.** *Identity and status are key preconditions for exerting influence within your tribe.*

To allow to let a community grow, it needs to support the mentioned mechanisms. For example, the possibility to upload a user-image can increase the possibility of expression of the community members in most cases.

Löwgren also states that as being a social process, online communities cannot be controlled completely, nevertheless the space where it happens can be designed [38, p. 9]:

It is a bit like producing an improvisation performance. You choose actors, give them some directions and starting points, create a set and fill it with props. But on the opening night, when the lights come on, you have to sit back with the audience and share their surprise at what comes out.

2.3.4 Information retrieval

Information retrieval (IR) is the scientific field concerned with the process of how people find information in data collections. The process starts with a person, who has an *information need*, which is transformed into a *query* and is input into the IR system. The system matches the *query* with a pre-built *index* and finds *relevant information objects* from the *collection* [19]. This process is also illustrated in Fig. 2.7.

Extending the traditional IR model, Marchionini [41] differentiates between three types of searching as shown in Fig. 2.8. Firstly, he mentions *lookup*, which as a result delivers simple facts. An example of a lookup-question would be *What is the date of birth of Picasso?* The second kind search is *searching to learn*, which typically involves multiple iterations of searches and cognitive processing of the results. Thirdly, Marchionini mentions *investigative searches*, which are long term efforts in building a personal and professional knowledge base. Often results are annotated by the searcher, in order to save evaluative information. As the two last approaches are both open-ended and involve multiple iterations, he describes them as *exploratory search*. Similar models of how people search for information online include *Berry picking* by Marcia J. Bates [6] and the *information foraging* theory

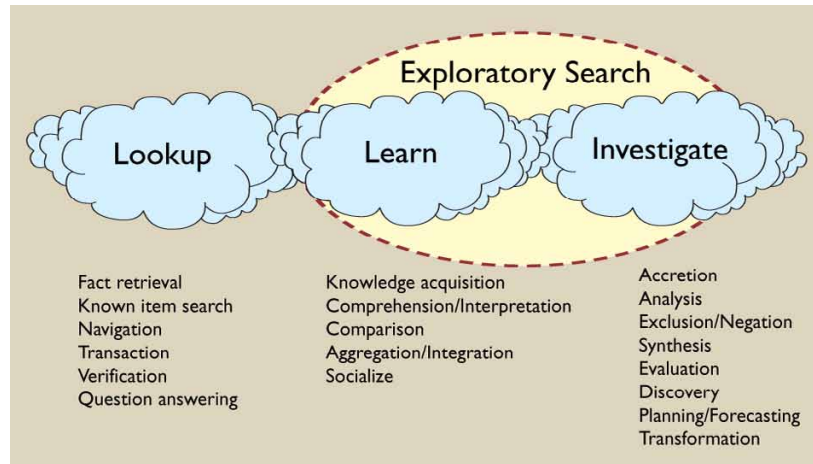


Figure 2.8: Marchionini's types of search. From [41].

of Peter Pirolli [47]. In general, the search for information in the world wide web is a vital research area, whose recent developments are described by Marchionini [41, p. 43] like that:

Rather than viewing the search problem as matching queries and documents for the purpose of ranking, interactive IR views the search problem from the vantage of an active human with information *needs*, information *skills*, powerful digital library resources situated in global and locally connected *communities*—all of which evolve over time.

The focus has shifted from the single query to the process as a whole—the activity of *browsing*, which is typical for the web as already stated in 2.3.1, is examined more closely. That also requires more attention on the **search interfaces**, which should support an exploration of the information as a whole and provide all needed features at hand.

Faceted browsing interfaces

One popular interface paradigm to support *exploratory search* is *faceted browsing* (See Fig. 2.9). It features iterative and visual query formulation to narrow down a result set. The interface shows a set of attributes (also called *facets*, for example *color*), which are attached to the results (for example *cars*). By selecting a particular value (for example *red*), the result set is filtered to just matching objects. One positive effect is that **an empty result set can be avoided** [23, p. 189] [51, p. 75], even if complex queries are constructed by the searcher.

AND or OR? Typically, selections from different facets are implemented as AND-queries, whereas multiple selections from the same facet are understood as OR-queries. For example, we can imagine two facets, *color* and *brand*. If one selects color *red* and brand *BMW*, this typically is combined with an AND operator, meaning that just cars, which are red **and** a BMW are returned. In contrast, if one would select red and green from the color facet, this typically is combined with an OR operator, meaning that cars which are red **or** green are returned.

Keyword search The importance of integrating a keyword search to complement faceted browsing is recognised widely [51, p. 78] [23, p. 192] [67]. However, there exist different ways how keyword searches can be used in conjunction with faceted browsing. Firstly, it can serve as a starting point, whose results then are filtered by a faceted browsing interface⁵¹. Secondly, it can work as a filter of the options within a facet, when the list of options is very long. Finally, it can also work simply as a keyword filter on the result set.

Examples

Exhibit Outstanding works in this area include *Exhibit*, which is an extremely easy to use toolkit to create full-featured faceted browsing interfaces [30]. It provides different views, such as a timeline view, which displays the results on an interactive timeline, and a map view, which places the results on a geographical map. At the same time, the result list can be filtered by facets via different user interface components, as attribute list, tag cloud, free text filter and numerical range sliders. Additionally, it supports the export of a result set in different formats such as RDF and BibTex. In total, it is an very useful and easy to use toolkit to enable full-featured faceted browsing for any database-like web page. Find example applications using *Exhibit* on this web page <http://simile.mit.edu/wiki/Exhibit/Examples>.

Elastic lists Aesthetically interesting work is done by Moritz Stefaner, whose *elastic lists* [60] concept makes faceted browsing even more usable and also aesthetically more pleasant to use (See Fig. 2.9). By visually encoding the number of items per value and by calculating and visualising the *un-usualness* of a certain value in a subset, the known faceted browsing interface is enhanced. Another significant improvement is the use of animations for transitions from one state to another. Find examples on this web page <http://moritz.stefaner.eu/projects/elastic-lists/>.

⁵¹The search options on *Google*, which can be used to filter a result set, work like that.

VisGets Also Dörk's *VisGets* [16] approach, which features *coordinated views* and *weighted brushing* is very promising. It combines different interface components, which he calls *VisGets*, like a tag cloud for topical facets, range sliders for numerical facets, and a geographical map to filter according to location data. Thereby, it is very similar to the already mentioned *Exhibit* toolkit. The innovative approach, however, is the usage of *weighted brushing*, which means that when the user moves the mouse above a value in any of those *VisGets*, the connected facets in the other views are highlighted accordingly. Find a demo on this web page <http://pages.cpsc.ucalgary.ca/~mdoerk/view/explore>.

Summary The focus of research in IR has shifted towards an *exploratory search* process, as this resembles the actual behaviour of the person who seeks for information. That leads to a need for optimisation of the search interfaces. One popular interface paradigm, aiming to support *exploratory search* in particular, is *faceted browsing*. In the following section another complementary IR approach called *social tagging* is examined.

Social tagging

Die Bedeutung eines Wortes ist sein Gebrauch in der Sprache.

I would like to take this quote by Wittgenstein from [65, p. 40], which says that the meaning of a word lies in its usage in language, as a starting point for analysing the nature of social tags. This quote suggests that by somehow externalising the usage of a word, one can understand its meaning. I propose that social tagging is such an externalisation of the usage of words. What happens while *tagging* is that people see something, an object like a photo, and assign words to it. As a result, there is a list of assigned words to each object, which is generated by a group of people, and if the tags are *weighted*, the amount of people who assigned the same word is visible. One could now ask, if the tags describe the object, or if the object gives a hint to the meaning of the tag and which meaning are we externalising? Of course, it works both ways.

Social tagging is a categorisation of objects, just like librarians categorise books with keywords. The novel approach, which was introduced on the internet a few years ago on sites like *delicious* is that this process of assigning keywords was opened to a community. On *delicious* everyone can save the address of a web page for later use and can assign arbitrary keywords to this address in order to organise the collection. Besides the individual keyword list, there also exists a collective keyword list for each resource, which is aggregating the keywords of the whole community. Tags, which are used more often for the same resource, gain importance, while "exotic" tags, which are just used by few people, remain less important. Furthermore, each keyword



Figure 2.9: A screenshot of a demonstration of the *elastic lists* concept by Stefaner [60] in a faceted browser. Here the data source are Nobel Prize winners—in the current state of the faceted browser, the set is filtered by Peace prize winner from the 1980s. The **height** of each item in the facet-list encodes the number of appearances. The **lightness** indicates the *unusualness* of this facet value in the current context compared to the unfiltered set of results.

functions as a navigational link, which can be used to view all resources that are labeled with this tag.

Bottom-up and dynamic In contrast to traditional keyword assignment in libraries, social tagging is open. It can be referred to as a bottom-up process, as a collective of people assigns the tags and not a single expert. Social tags are dynamic as they develop over time and hence new associations can be comprised. Usually, any arbitrary word can be used as a tag, which is referred to as *free-tagging*. Nevertheless *controlled vocabularies* are also used at times, which then resembles more a categorisation.

Externalised knowledge As Cress et al. [26] and Hesse [27] state, the cooperative assignment of tags to resources can be seen as externalising knowledge from a community. In an information retrieval situation people with more previous knowledge are likely to get better search results, because they know under which keywords the wanted information can be found. In a so-

cial tagging environment, the expert users have left behind knowledge from which new users can profit.

Navigational aid Tags can be navigational aids for exploratory searches, as they can work as an additional access-point to the knowledge space. Especially in combination with faceted browsing interfaces (See Fig. 2.9), filtering a set of resources by tags can be a very effective way to find information. In contrast to hierarchy based information architecture, tags allow that a single resource can be found under multiple keywords. In most domains, different hierarchical structures for its elements are possible, depending on the respective view or context on the domain. Therefore static hierarchies seem to be an inflexible information architecture. For example, one could structure a hierarchy of trees by family, which could be sufficient in most cases, but sometimes a hierarchy based on the geographic occurrence might be preferred. Tags allow a flexible annotation of resources, which can reflect multiple views. A tree tagged as "broadleaf" and "Europe" can be either on a global list of broadleaf trees or on a list of all trees in Europe. A similar problem exists on computer file systems, which are structured hierarchically. When organising the files, one hierarchy has to be decided in advance. This could be a hierarchy by file type, by date, by work task or similar. Depending on the situation, the preferred hierarchy of the files can differ, which unfortunately is not supported by static hierarchies.

Drawbacks Social tagging systems also have some shortcomings [20, 68]:

- **Ambiguity and polysemy:** The meaning of a word can depend on its context, for example by *Apple* one can either mean the fruit or the company.
- **Synonyms** lead to multiple tags, which actually mean the same. Similarly, the mixture of singular and plural words and typing errors lead to the same circumstances. In all those situations, it can help that the system suggests already given tags and also a manual clean-up process can help. Yet, as long as free-tagging is used (in opposition to predefined vocabularies), such difficulties remain.

2.3.5 Information visualisation

Information visualisation deals with visually encoding abstract information or data. The main benefit is seen to reduce cognitive load when "reading" the data⁵². According to Shneiderman, visual representations are in particular

⁵²See the keynote of the behavioural physiologist Gerhard Roth at the *see conference #4* for an interesting talk (in German) about how the human brain processes images in comparison to text. One main idea is that humans are much faster at understanding visual

<i>Gestalt Principles</i>	<i>Principles</i>
Figure-Ground	When perceiving a visual field, some objects (figures) seem prominent, and other aspects of the field recede into the background (ground)
Proximity	When we perceive an assortment of objects, we tend to see objects that are close to each other as forming a group.
Similarity	We tend to group objects on the basis of their similarity
Continuity	We tend to perceive smoothly flowing or continuous forms rather than disrupted or discontinuous ones.
Closure	We tend to perceptually close up, or complete, objects that are not, in fact, complete.
Symmetry	We tend to perceive objects as forming mirror images about their center.

Table 2.1: The principles of Gestalt. From [61, p. 94]

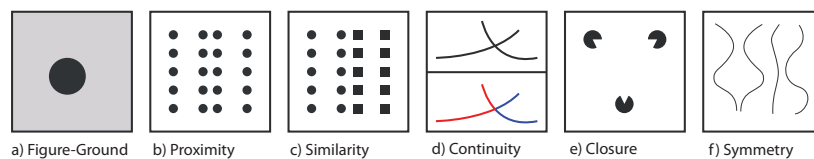


Figure 2.10: The principles of Gestalt.

useful to get an overview and to identify patterns in the data [13, p. 10]. To achieve this, information visualisations can make use of the *Gestalt theory*, which describes different phenomena of the human visual perception (See Table 2.1 and Fig. 2.10).

Types of Information visualisation

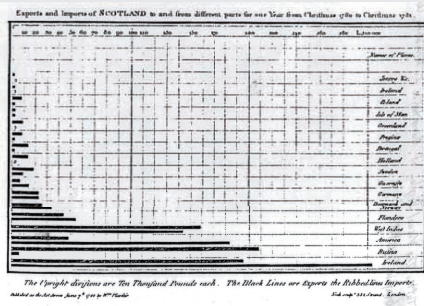
Info graphics and charts Known from Newspapers and from spreadsheet applications, charts are probably the most famous type of information visualisation. Further differentiated by type, such as bar-chart and pie-chart, those diagrams can be used in many different contexts.

Historically, those ideas root in the 18th century when William Playfair published the book *Commercial and Political Atlas* in 1786, where he first used line graphs and bar charts (See A on Fig. 2.11). Besides giving numbers a visible appearance, as in bar graphs, info graphics can also reveal otherwise hidden information. Dr. John Snow placed the locations of where people died from cholera on a map (See B on Fig. 2.11) which revealed that all victims

information than textual information. <http://see-conference.com/prof-roth/>, retrieved on 24/03/2010.

Milestones of Info Graphics

A



Bar chart showing the amount of exports and imports from different countries to Scotland in 1780.

1786
William Playfair

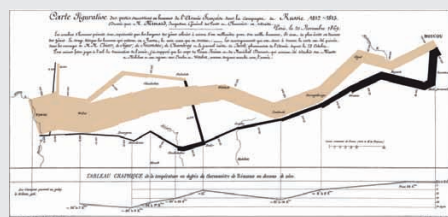
B



Placing the locations of cholera deaths on a map helped to find out that it spread via contaminated pump wells.

1854
Dr. John Snow

C



Visualising Napoleons campaign against Russia in 1912-1913. It encodes the army's location and direction, the declining size of the army, and the temperature.

1869
Charles Minard

Figure 2.11: Milestones of info graphic. (Sources: A from <http://en.wikipedia.org/wiki/File:Minard.png>, B from http://en.wikipedia.org/wiki/File:Playfair_Barchart.gif, C from <http://en.wikipedia.org/wiki/File:Snow-cholera-map-1.jpg>.)

Milestones of Info Graphics, 2

D

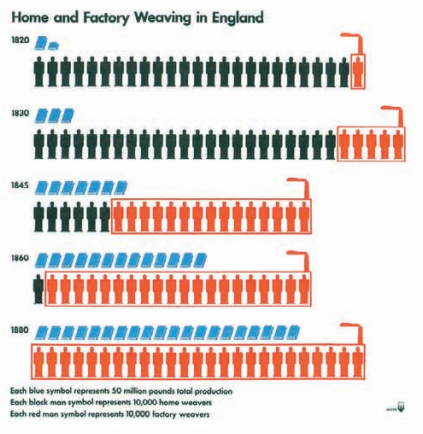


In 1933 Harry Beck designed the first "schematic" version of the London Underground map. While ignoring the real distances, it improves the overall appearance significantly. The principle is still in use nowadays.

1933
Harry Beck

1939
Otto Neurath

E



Showing the rise of factory production in England in the 19th century. It enhances the principle of bar charts with self-explanatory icons, based on the famous *Isotype*.

Figure 2.12: Milestones of info graphic, part 2. (Sources: D from http://britton.disted.camosun.bc.ca/beck_map.jpg, E from [45].)

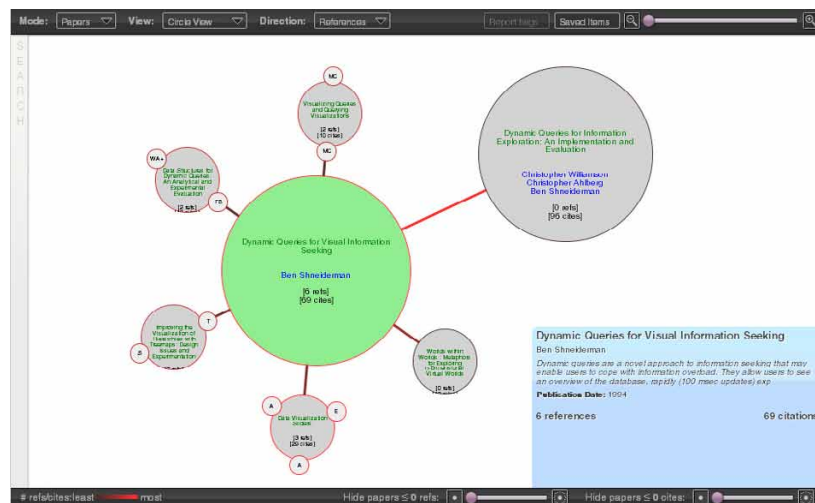


Figure 2.13: The *circle view* showing the references of scientific paper in a circle around it. Screenshot of the *PaperCube* application.

lived within the reach of the same pump well. The subsequent assumption that the well was the source of the disease later on was proven [58, p. 3]. Another highlight of early info graphics is the flow map of Charles Minard (See C on Fig. 2.11) which visually encodes multiple variables in the same graphic in a comprehensive form. According to Tufte [63, p. 40] it "may well be the best statistical graphic ever drawn". In the 20th century Harry Beck produced a remarkable work with his new design of the London tube map (See D on Fig. 2.12). The *schematic* map ignores the real geographical location of the stations, and thus also the real distances between them. However, its visual appearance is very clean and the most valuable information about how to travel from one place to another within London is achieved very effectively. In spite of the fact his work was rejected in the beginning, many underground maps build on Beck's idea nowadays [58, p. 4].

Interactive information visualisation On the computer a new substantial quality can be leveraged—the usage of interaction. As the visualisation can react on the viewer's input and change over time newer possibilities arise. Often such applications feature what Shneiderman summarises in the *Visual Information Seeking Mantra* [7, p. 376].

Overview first, zoom and filter, then details on demand.

This means, that while *exploring* a visual information space, one usually starts with gaining an overview, displaying all, or most objects from a distance, maybe to reveal patterns, or to identify interesting parts. If something interesting is found, a *zoom* closer to the region of interest might be the next

step. Additionally, *filtering* out of uninteresting items can reduce complexity and help to focus on certain aspects. This particular navigational help is also at the heart of faceted browsing. Finally, when an interesting object is identified, viewing the details should be possible easily, while retaining the possibility to return to the result set [7, p. 368].

Shneiderman gives interesting hints, about how the navigation in data spaces works. Additionally, Stefaner et al. define *navigational modes* to evaluate interfaces whether they support the full range of them [59, p. 79]. That are *zoom-in* (make a query more specific), *zoom-out* (make a query more general), *shift* (moving the focus within the result set; can be also seen as a *zoom-out* followed by a *zoom-in*), *pivot* (placing a new query, based on the results of a previous query), *slice-and-dice* (specific form of *shift* where two independent parameters are changed), and *range selection* (specifying a lower and upper bound for a query).

Whether this particular selection of navigational modes is appropriate or not, the freedom of navigation within an information space is an important parameter. It is a matter of interface design to make this freedom accessible and easy to use.

Use of animations Besides interaction, the digital medium also allows time-based animations, which can be a valuable extension to information visualisation. They can be used for transitions from one state of the interface to another. Heer et al. [24] examined this topic in detail and came up with a taxonomy of transitions and also with helpful design guidelines. One typical transition is *timestep*, which means the use of animations for temporal developments. Such transitions are heavily in use in the *Gapminder*.⁵³ presentations by Hans Rosling, where he uses animations to show the developments of countries over time⁵⁴. In [50], Robertson et al. differentiate between two uses of visualisation, that is *presentation* and *analysis* and compare the value of animations in both. In short, their result is that while animations work well to **present** temporal developments, they are the least effective tool for **analysis**, as compared to static graphics which allow faster and more accurate insights.

Visualisations as navigation tool On the web, visualisations often work as alternative interfaces for browsing and navigating the data. Those visualisations use another visual representation than plain textual lists to display data sets. Often network representations or graphs are used as this form shows how nodes are connected to each other. That one aspect can not be shown using "traditional" web interfaces, as mostly just an overview (list)

⁵³<http://gapminder.org>

⁵⁴See for example http://www.ted.com/talks/lang/eng/hans_rosling_shows_the_best_stats_you_ve_ever_seen.html

and a detail view (one single item) is provided. The relations to other objects might be visible in the detail view as a list of hyperlinks—but a view revealing the full relation network is mostly lacking.

One interesting project which tries to use visualisations for browsing an information space is *Papercube*⁵⁵ by Peter Bergstrom from Santa Clara University (See Fig. 2.13). The used data basis are scientific papers, which are well intertwined due to references and citations. It features different views on the data space, but as no general overview is provided, the starting point is a keyword search. So any paper from the result list can be chosen to begin with. Besides a tabular view, also a *circle view* can be chosen, which displays the current paper and its references in a concentric graph view, which can be navigated as well. Further available views are a hierarchical tree map view (showing a reference hierarchy up to 15 levels), a year view (giving an overview from what year the references are) and a *paper graph* (showing the network of references). The main hypothesis of Bergstrom is that the application enables researchers to "gain new insights and find relationships that were not previously apparent" [8, p. 2] and that they "find what they were looking for more quickly and intuitively" [8, p. 2]. A user study has shown that "it was very useful when it comes to augmenting digital library search by reducing the 'cognitive load' put on a scholar and aiding the 'discoverability' of new research material" [8, p. 1].

This application also offers the possibility to save papers on a list for later use. As already mentioned in section 2.3.4 exploratory searching involves multiple searches and thus such a feature can be a helpful tool.

Collaborative online visualisations

In practice, however, sensemaking is often also a social process. People may disagree on how to interpret the data and may contribute contextual knowledge that deepens understanding. As participants build consensus or make decisions they learn from their peers.

This quote from [25, p. 1] suggests that while viewing an information graphic, one can benefit from previous findings of others and that discussing it together can improve the understanding. There are quite some platforms available on the net which experiment with collaborative visualisations that allow such interaction. Examples include *ManyEyes*⁵⁶, *Swivel*⁵⁷, and *Sense.us* [25]. These systems allow the discussion of given or user-generated interactive information visualisations as well as sharing the visualisation by distributing its URL.

⁵⁵<http://www.peterbergstrom.com/2008/11/14/papercube/>

⁵⁶<http://manyeyes.alphaworks.ibm.com/manyeyes/>. Another instance at <http://vizlab.nytimes.com>

⁵⁷<http://www.swivel.com>

Accompanying the *Sense.us* project Heer et al. [25] provides a scientific investigation in this area. Their system focuses on how to support social sensemaking with interactive features. Their system makes it possible to attach a comment to the current state of the (interactive) info-graphic. It is also possible to make graphical annotations by directly drawing onto the info-graphics, to support the commenting possibilities. In the concluding user-test, it is examined how the commenting feature is used. It shows that approximately 80% of the comments were observations, 38% were questions and 35% were hypotheses. Other comments were about data integrity (16%) and included hyperlinks (14%) [25, p. 6]. Regarding the usefulness of the comments from other people, an average of approximately 4.5 out of 5 points⁵⁸ was reached.

These results give a hint, on how comments and other discussion-enabling features (such as allowing to share an info-graphic) can support sensemaking in a collaborative scenario.

2.4 Conclusion and guidelines

To conclude this chapter about understanding the design situation, guidelines are formulated in the following section. It also marks the transition from the theoretical part of the thesis to the practical part. The rather broad spectrum of topics will be summarised in this chapter in perspective to practical guidelines and concrete features for the implementation.

2.4.1 Make a reference work

The application to be built is of the type of a **reference work** and it has three main goals: **searchability**, **completeness**, and **correctness**.

Exploratory information retrieval

Besides simple lookup searches, exploratory searches to gain a deeper understanding of the topic should be supported. By placing multiple searches, knowledge is constructed over time, which requires tools for assisting this process.

Navigation in knowledge space

The full range of navigation modes such as **zoom**, **shift** and **pivot** should be supported. The navigation possibilities can be enhanced by leveraging cooperative features such as social tagging.

⁵⁸Where 1 is *not useful* and 5 is *very useful*

2.4.2 Make an online medium

The digital online medium is different to the digital offline medium. The new possibilities must be analysed and considered while building new applications. The central element is that applications reside on a server and all people access the same instance of the program. Therefore **cooperative**, **collaborative** and **communicative** features can be implemented on the WWW.

Your website is not an island

The WWW is an eco-system, where all available websites and services together form an own **super-application**. People use search engines to find a website, if it is not visible there, one could claim that this website does not exist. Embedding a website into the WWW means that instead of copying existing content it should integrate it and—consequently—also allow other applications to integrate its own content. The only way to achieve that is to make use of international standards.

The World Wide Web or the era of niches

The (quasi) world wide web connects people from around the globe and communities of shared interest can be established independent of geographical barriers. Critical masses can be reached even for niche topics. On Wikipedia the distributed knowledge is collected and presented to the public—the English version of Wikipedia features over 3 million entries, while the Encyclopaedia Britannica includes 65.000 entries only.

Chapter 3

Synthesis

3.1 The daDA Interface

In the following section the developed interface is presented. The structure is similar to section 2.4 to make a direct connection to the guidelines that resulted from the analysis of the design situation.

The interface has already been online since 10th of December 2009 and can be accessed at <http://dada.compart-bremen.de>.

3.1.1 Navigation in knowledge space

At the heart of the developed interface are its functions which support the navigation in the knowledge space.

Search and jump

As keyword-search is still the most prominent and popular entry point for searches, there is a search field provided on the interface accessible from every page (See Fig. 3.1). To simplify the keyword input, an auto-complete feature is implemented, which suggests items as soon as the first letters are typed in. As an item is selected from the drop-down list, the respective page is loaded directly. If no item is selected, a fulltext search is performed and a result list is shown which features a snippet view.

Faceted Browsing

Alternative to the keyword search the collection can be explored by object type via faceted browsing interfaces. For each major object type—such as person, artwork, event, publication, and institution—an own interface with a set of filtering widgets is available (See Fig. 3.1). All these interfaces feature a keyword filter widget, which can be used to reduce the result list

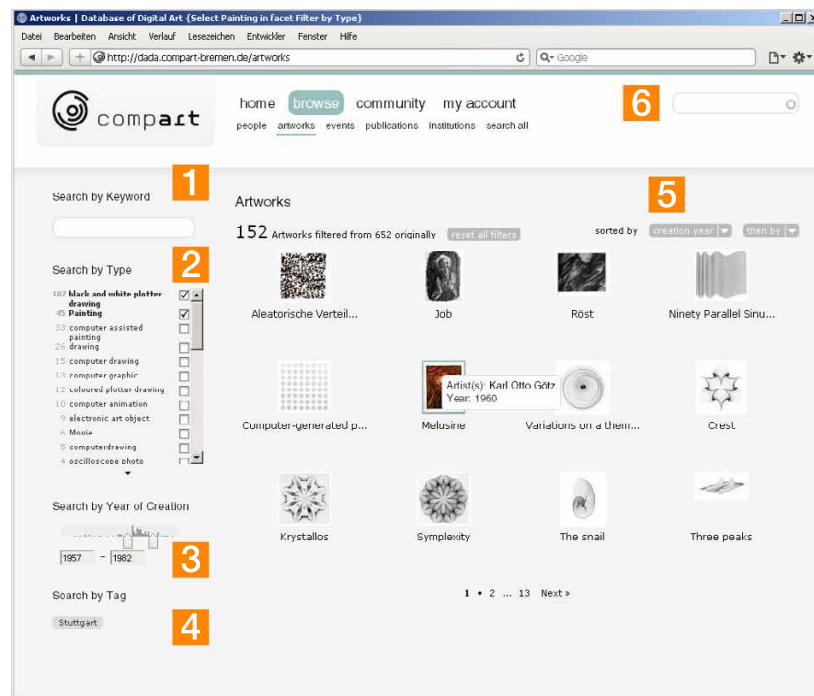


Figure 3.1: The faceted browsing interface for artworks. 1) The keyword filter widget. 2) Artwork category filter. Multiple selections are possible. 3) Temporal range-slider widget. Can be used to set an upper and lower limit of years. 4) Tag-cloud widget of community tags. 5) Controls to change the sorting of the results. 6) The global search text-field, with auto-complete feature.

to those items matching an entered keyword. The results can further be filtered by category (for example by artwork-category, such as plotter-drawing) and also by community tags. Additionally, publications and artworks can be temporally filtered, using a range slider widget. All available filters can be combined, more precisely, multiple selections within the same facet are connected with OR and multiple selections from different facets are connected with AND.

A sorting mechanism is provided which allows sorting against static attributes such as name, and dynamic properties such as the number of times an item was viewed.

The faceted browsing interface supports visual query formulation with instant display of the result list. It also supports serendipitous exploration of the collection, where each facet provides a cognitive entry point for the search. Statistical information about the collection is shown as the number of items is displayed which are in each category. Similarly, the temporal range slider reveals the temporal distribution of items via a histogram (See

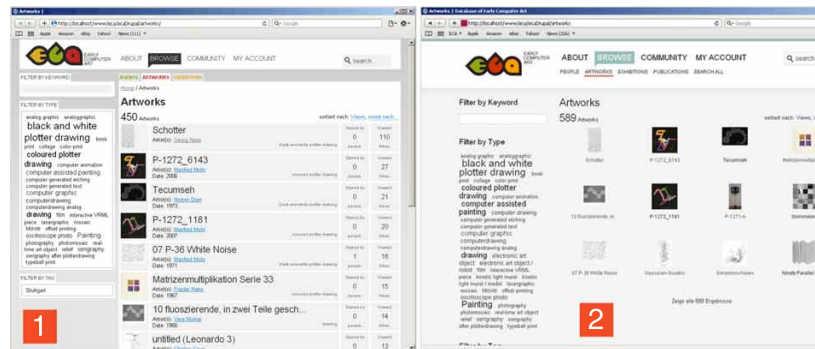


Figure 3.2: The first two versions of the faceted browsing interface. 1) Initial version, where the artworks are aligned in rows. At this stage, only three main object types were integrated (person, artwork, exhibition). For them a color coding, which also is integrated in the logo, was used. 2) Second version. The artworks are positioned in a grid. More main object types are added, color coding and also the logo, get slowly obsolete, and are not used anymore in the next version. In both versions, the categories are presented in a tag-cloud, which was changed in the current version.

Fig. 3.1).

Iterative interface development By the example of the faceted browsing interface it can be demonstrated, how the whole interface was developed iteratively. In between the different stages, discussions with focus groups helped to further improve the interface (See Fig. 3.2).

Browsing related items

When coming from an artist page, one can perform a pivot query and view all artworks created by this artist (See Fig. 3.5). The artworks then are presented in the standard faceted browsing interface and can be further processed as explained above.

Another rich navigational aid are inline links, which can appear in any descriptive text. They link directly to another entity in the database. Thus, the full capabilities of hypertext are leveraged. Besides the five already mentioned main objects, there are more types, such as award, algorithm, etc. They can be accessed either via inline links or via link lists. In contrast to the main items, such objects are displayed in AJAX powered overlay boxes (See Fig. 3.3). As those items are minor objects, which mostly just provide additional information (for example the underlying algorithm of an artwork), the current navigational context should not be lost. If JavaScript is disabled (like it is the case for search engine crawlers), a plain HTTP request is sent, and the object is shown on a new page. For each item an URL for such items

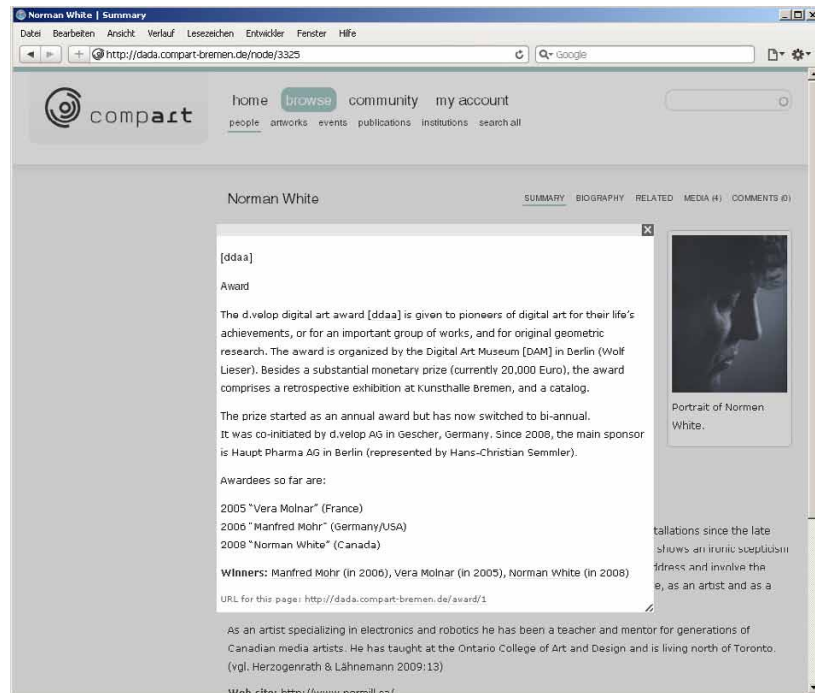


Figure 3.3: Non-main objects are shown in overlay-boxes, to retain the current navigational context. On the bottom, the URL is displayed under which this entry can be viewed directly, or when JavaScript is disabled on the client computer.

is provided, to make it possible to access them directly or to save them as a browser bookmark.

3.1.2 Exploratory information retrieval

The exploratory knowledge building process which includes multiple searches is supported by some tools. If an item of interest is found, it can then be saved on a list in order to be retrieved later. This works as a watchlist as it also indicates if one item was updated since the last visit.

Additionally, keywords can be assigned to all items, to structure the personal collection of items, and also to contribute to a public tag cloud for each entry (See Fig. 3.5). Hence it has two functions—primarily it is a personal tool, but the public can also benefit from it.

Besides tools for supporting long term exploration, also aids for serendipitous browsing are provided. On the community dashboard (See Fig. 3.4) the latest activity of the community is visible, and can be used as a starting point for browsing. A list of the most popular items is available, as well as a list of the latest registered users, which can also be used to access the user profiles.

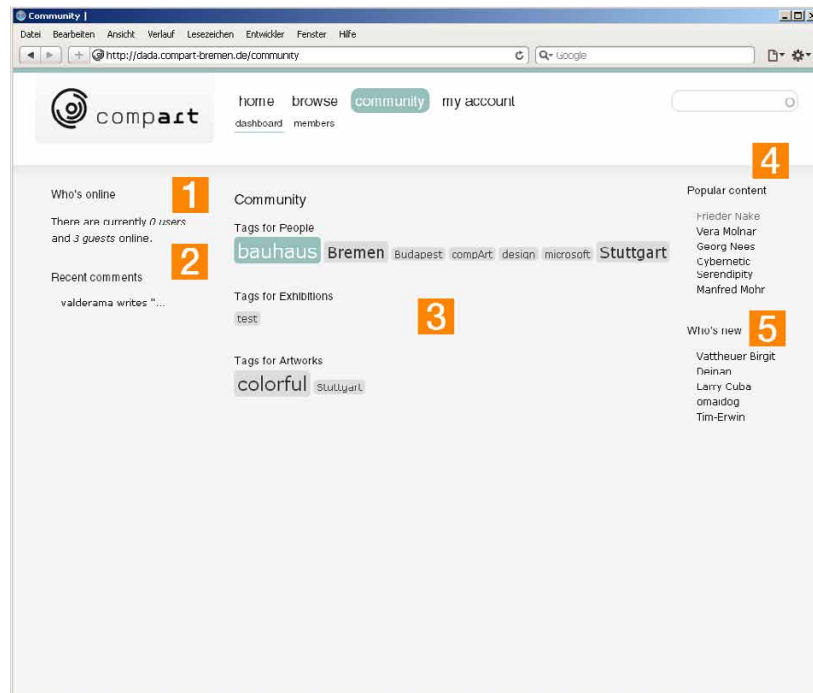


Figure 3.4: The community dashboard. 1) List of currently online members. 2) List of most recent comments. 3) Community tag-clouds 4) List of popular content. 5) List of newest members.

From there one can jump to the items this user has written or commented on. Another entry point for browsing is the tag cloud on the community dashboard, by which the items connected to each tag can be explored.

3.1.3 The database is not an island

Various features including some trivial help to embed the daDA interface into the eco-system of the web. Firstly, due to the usage of standard XHTML all entries are indexable by search-engines. To further support this process, a sitemap is provided for search-engines. All entities are accessible by a URL, which enables bookmarking and sharing of links for example via email.

The site features a community section, which requires a user account—to simplify the registration process *OpenID* support is provided. *OpenID* is an open and decentralised standard for user authentication which makes it possible to login to every site that supports *OpenID* with just one user-account.

Future steps

The linkage of the daDA interface with the WWW can be extended in various directions. One possible enhancement is the integration of already existing online content. In particular content from *Wikipedia* could be integrated, especially if a particular information does not exist yet in the compArt database. As *Wikipedia* provides an API¹ which allows the syndication of content, it could be seamlessly embedded into the daDA interface.

Consequently, the daDA interface could provide its content for the public via an API or using the semantic web standard format RDF. There already exist some tools that support that transformation such as Triplify [5]. Alternatively, the XHTML documents could be enriched with RDFa metadata, which also makes reusing and extracting structured data from the daDA database in semantic web scenarios possible.

3.1.4 Inviting the world

The daDA interface features a community section, which invites interested people to join and contribute to the website. So far, it is possible to discuss the objects in the database, via a threaded commenting feature. There are no guidelines about which comments are expected, but the intention is to allow the posting of observations, questions, hypotheses and links to further information. It should necessarily provide a feedback channel for the community to contribute actively.

A social tagging feature is implemented where registered users can leave free-form tags for any of the five main object types. The resulting tag cloud is provided as a filtering widget in the faceted browsing interface. The tags can work as additional navigational categories and a way to externalise knowledge from the community (See also section 2.3.4). Tags become a tool for structuring interesting items for the user itself.

Future steps

A major future step could be to allow visitors to contribute to the database directly, like it is possible in *Wikipedia*. As detailed in section 2.3.3, such a collaborative undertaking needs quite comprehensive structures, like guidelines, places for discussion, and more. A working licencing model is also needed, which makes clear under which terms the contributed work is licenced. In order to honestly provoke participation for the good of everyone, an open licence would have to be chosen as already mentioned in section 2.3.3.

The currently available feedback form could be extended in order to collect more detailed user feedback, to let people participate in planning the future development of the site.

¹Available at <http://en.wikipedia.org/w/api.php>

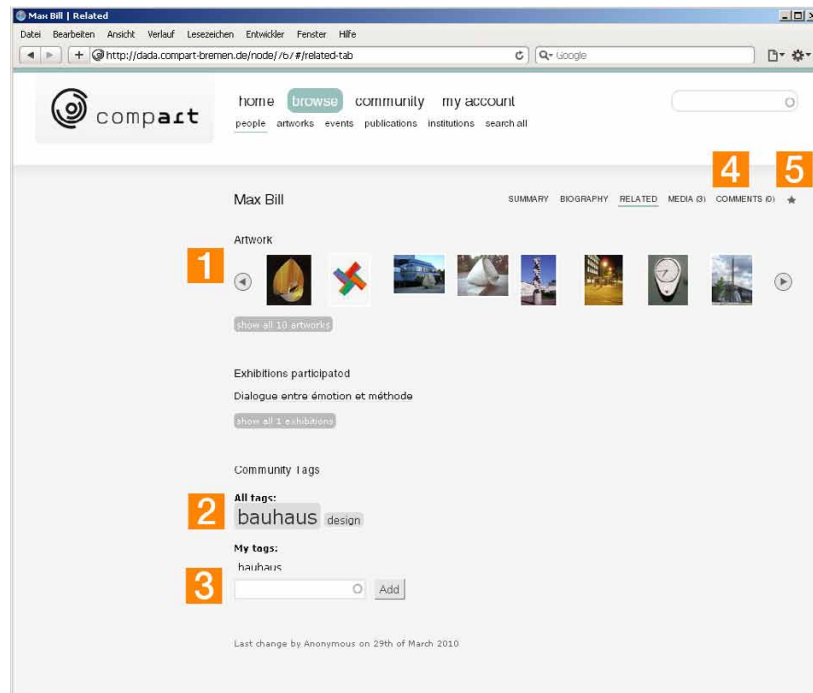


Figure 3.5: Showing related items. 1) Showing artwork created by the selected artist. By clicking on the button below, all created artworks are shown in the known faceted browsing interface, and can be worked on further. 2) Community tag cloud for this item. The bigger a tag is, the more people have assigned this keyword to this item. 3) Input form for a new tag. 4) Link to comment page for this item. 5) By clicking on the star, an item is "starred" and put the personal short list of starred items.

3.2 Prototype of a visual interface

Even though the final interface does not include visualisations, experiments with mock-ups and prototypes were done during the development phase of the application.

The basic approach was to create a visual browsing tool, which supports serendipitous exploration of the information space. As one of the key elements of the database are the relations between different objects, this aspect should be made explorable. Traditional document based webpages typically are not the perfect tools to accomplish that, because relations to other objects are just shown as hyperlinks. In contrast, a graph-based network visualisation promised to provide richer possibilities for browsing the relations, and also for providing an overview of the complete network of objects. By using visualisation techniques, objects and links could visually encode more parameters, which would eventually lead to an ambient and richer information

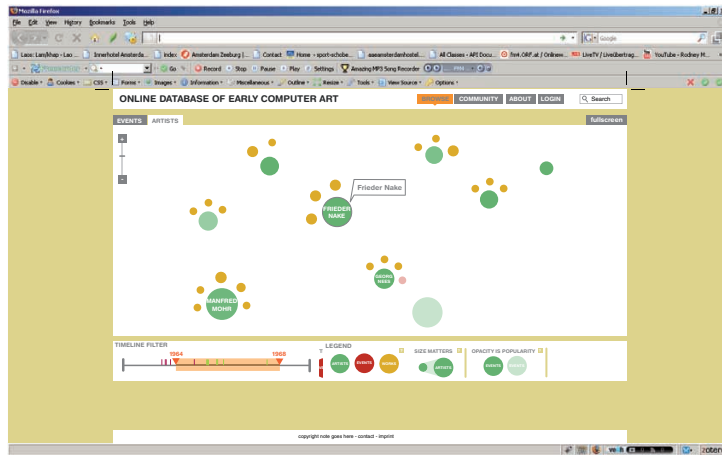


Figure 3.6: Artist map. Artists (green bubbles) are placed on a map, "similar" or highly connected artists are closer to each other. The size of the bubble encodes the amount of creations (artwork, publications, curated exhibitions, etc.) and the opacity encodes the popularity based on the amount of views, comments and stars left by users. Filtering by object type and zooming controls are also included.

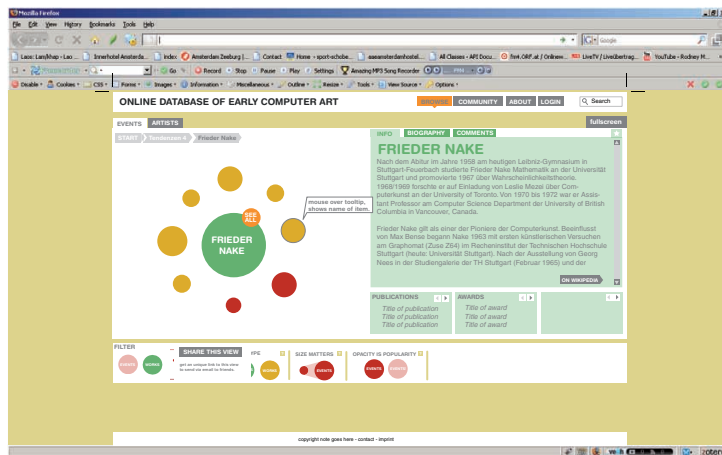


Figure 3.7: Detail view showing information related to a single object. On the left side, the related objects are displayed and can be explored further.

representation.

Two different views of the database were chosen to be most promising. At first a map of artists is provided which places them on a two dimensional map depending on multiple facets (See a mock-up in Fig. 3.6). Each artist can

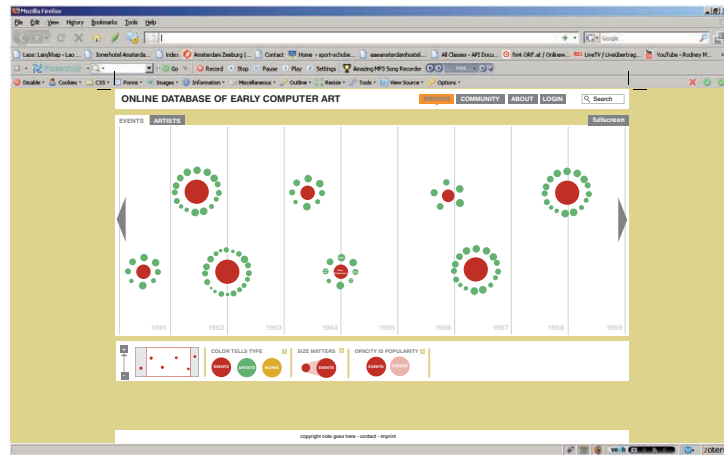


Figure 3.8: Event timeline. Red bubbles are events, and green bubbles are contributing artists. Again, size of the bubbles encodes the amount of creations attached to it, and the opacity the popularity.

then be further explored (See the mock-up in Fig. 3.7). The second overview and entry-point to the database was supposed to be an event timeline (See Fig. 3.8), for this view an interactive prototype was developed, which can be accessed at <http://valderama.net/ecaBrowser/ecaBrowser.html>.

By evaluating and discussing the mock-ups and also relating to the amount of data in the database, the largest problem of visual approaches become clearer. They do not scale well for big quantities of data, as there are two limiting factors, firstly the available space and secondly the "capacity" of visually recognising structures. If, for example, an artist has created 50 artworks and has participated actively at 50 exhibitions during his life, that would lead to 100 bubbles positioned around the artist bubble in the detail view, which would stress both limiting factors, the available space and cognitive abilities of the viewer.

It becomes clear that besides just showing the relations, it is also important to provide means for reducing the amount of relations to enable an enjoyable browsing experience. As faceted browsing interfaces appear to be a promising way to accomplish it, the further work on visualisation tools was given up in exchange for the integration of a faceted browsing interface.

And finally a practical reason played a role. During development time, the decision to deploy the interface for public use due to a close deadline, demanded to shift the focus from building a feature-rich prototype, to a robust and complete application.

Chapter 4

User study

4.1 Evaluating IR systems

A transition from system-centered testing of IR systems, where typically *precision* and *recall* function as the main parameters, to a user-oriented evaluation, where the process of an exploratory search is observed, can be seen [10]. While system-centric evaluation assesses the *performance* of a search algorithm, user-oriented tests try to examine the *adequacy* of the system as a whole [35]. Therefore, also the quality of the interface and the long and short-term interactions can be evaluated, which is obviously neglected in system-centred measures. On the other hand, the benefit of Precision-and-Recall based tests is that different systems can be easily compared by these metrics.

Borlund [10] suggests an interactive information retrieval (IIR) evaluation model, which aims to take the exploratory nature of searches into account. In short, the evaluation model consists of an observational user-study, where *simulated work task situations* are one central element. Those simulated work task situations should stay as close to real-life usage scenarios, what preferably should be verified by empirical measures. A set of pre-defined tasks is important, in order to have a working experimental setting for the test. Additionally, Borlund suggests "alternative performance measures capable of managing non-binary based relevance assessments" [10, p. 29], to cope with the difference of exploratory searches, where relevance can not be determined as easily as at lookup searches.

Some of the main features of the developed interface, however, can not be tested easily in a laboratory. In particular, the features which support the long-term investigations, such as the short list and the commenting feature, can be evaluated best if the interface is in use for a longer period. Therefore, another type of user study was prepared in favor of a laboratory test.

4.2 Open user study

As mentioned in section 2.3.3, the *perceived usefulness* and *ease of use* are two main parameters, which influence the success of a computer program.

In the lecture "Two Roots of Digital Media" by Frieder Nake the exhibitions of early computer art "Cybernetic Serendipity" and "Tendencies 4" are investigated. For this user study, the students of this lecture were asked to conduct specific research in particular by using the daDA interface. They were encouraged to try out all available features, and after a period of two weeks they should fill out a questionnaire.

Additionally, volunteers and users of the daDA interface were asked to participate via email and via an explanation on the website.

4.2.1 Participants

Finally eleven people completed the survey, aged between 25 and 39. Seven were male, three female, and one did not specify a gender.

4.2.2 Questionnaire

The questionnaire concentrated on two questions, first on the *perceived ease of use*, and second on the *perceived usefulness*, following the TAM model by Davis et al. [15]. With regard to contents, the questions were separated into questions about the faceted browsing interface, and about "social" features like commenting and tagging. Furthermore, there was the possibility to name the favourite feature and to suggest new ones.

4.2.3 Results

The general result is very positive—on a 5-point Likert scale, the average value of all questions related to the ease of use is 4.12 and regarding the usefulness 4. In the following the detailed results are shown.

Perceived ease of use

Faceted browsing interface As figure 4.1 shows, the faceted browsing interface was very easy to use. It was understood very well, how to filter the result-list, and also how to control the sorting of the items.

Social features Figure 4.2 shows, how the certain social features were perceived. The only feature, which was seen to be a bit difficult to use is tagging, which has an average value of 2.71. Most likely people did not find the input form for new tags easily, as it is not positioned on the front-page of each entry. This is also suggested by one comment in the questionnaire. As at the same time tagging was seen to be very useful (4.67, see detailed results

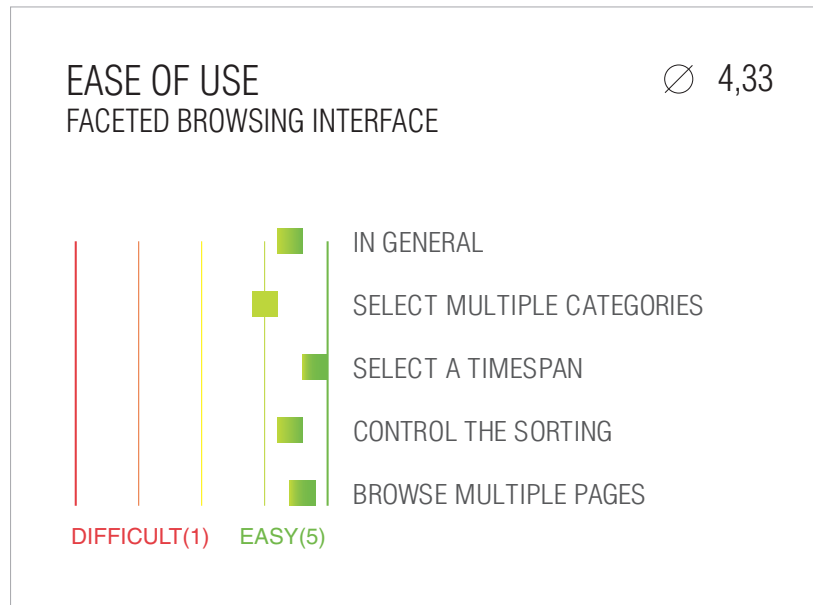


Figure 4.1: Results regarding the ease of use of the faceted browsing interface.

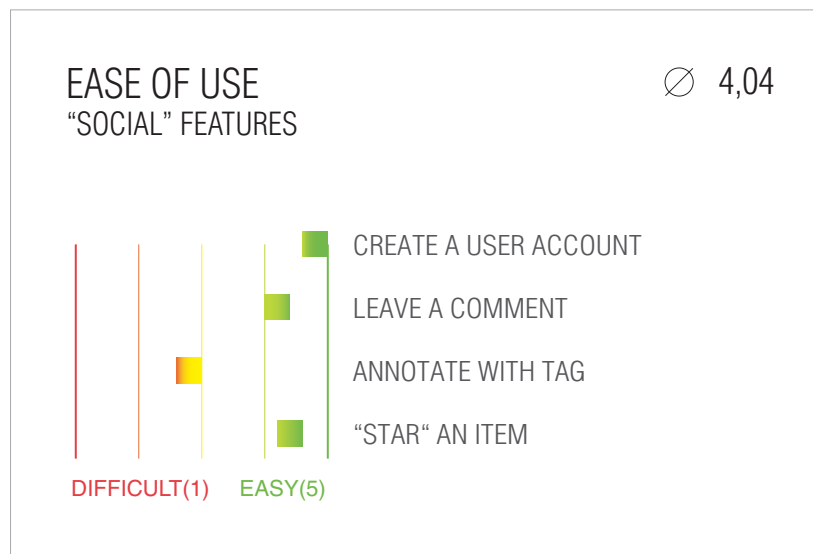


Figure 4.2: Results regarding the ease of use of the social features.

in the next subsection), it is very important to make tagging easier. Placing the input form on a more prominent place could be start.

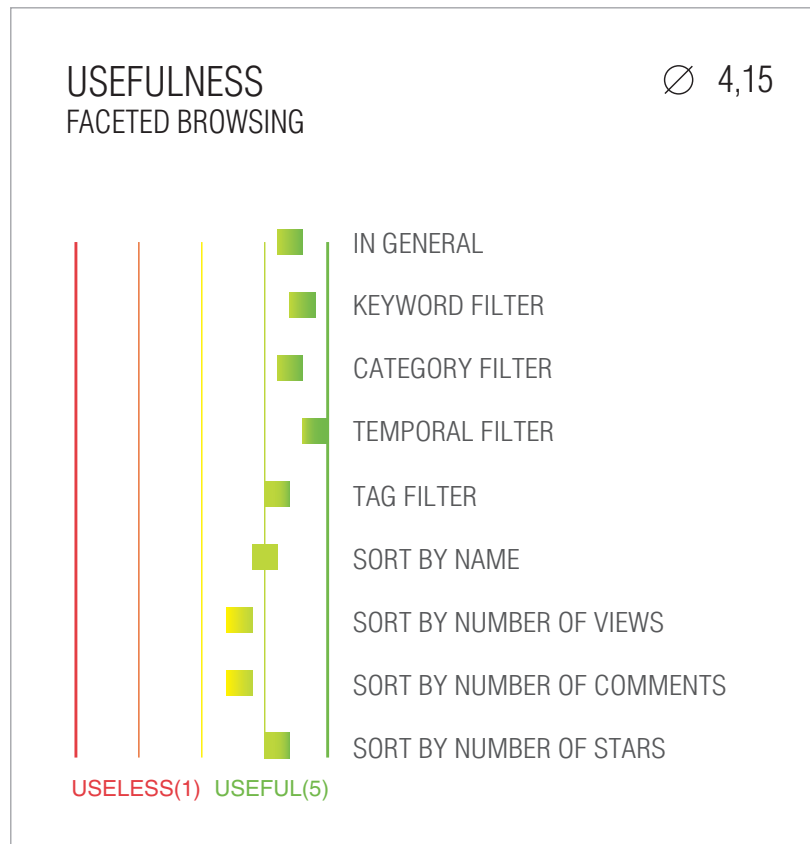


Figure 4.3: Results regarding the usefulness of the faceted browsing interface.

Perceived usefulness

Faceted browsing interface In general the usefulness of the faceted browsing interface was perceived to be high (See Fig. 4.3). The only doubts occurred regarding the options to sort against number of views and number of comments. While still considered useful, the value was not as high, as for the other sort orders.

The possibility to sort against the number of views is supposed to help people, that are new to the domain of digital art, to get a quick impression, which items are more important than others. It provides an entry point for the research by showing showing popular items of the database. However, the result of the user study shows, that this benefit is not rated very high. Therefore, it is worth some considerations if this sort-order should be kept as default order as it is currently for the artworks page, or if it should be optional in all places. Instead, the sorting against number of stars, which is perceived as being more useful, could probably work better to indicate

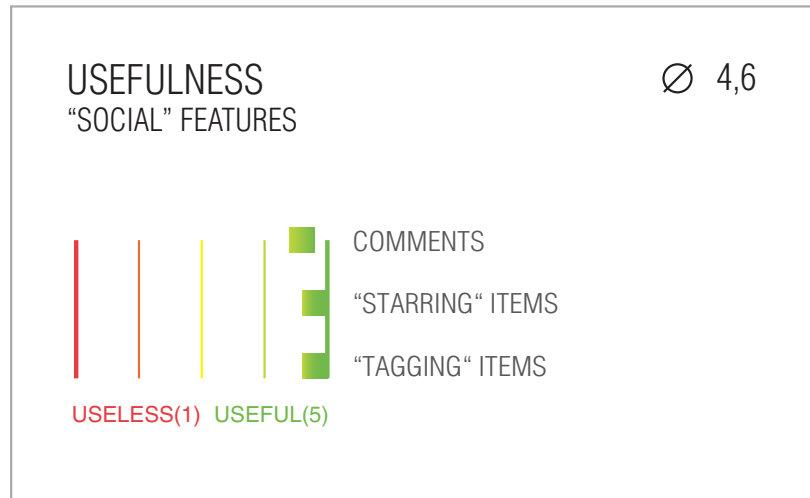


Figure 4.4: Results regarding the usefulness of the social features.

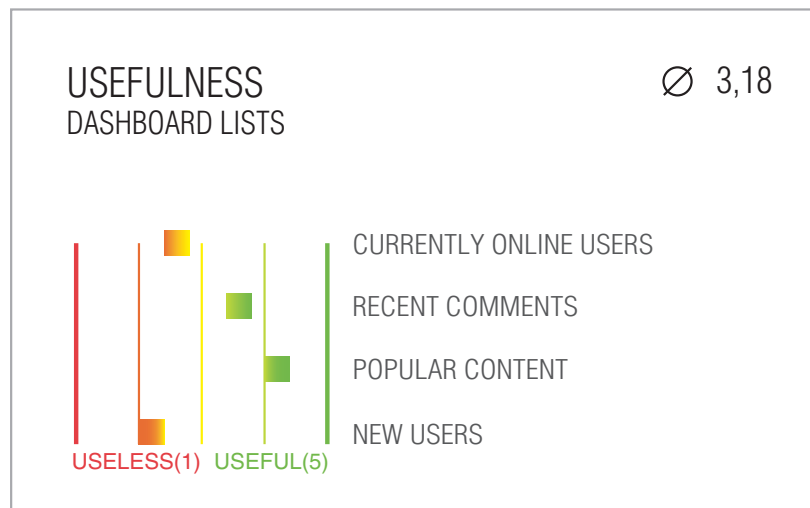


Figure 4.5: Results regarding the usefulness of the community dashboard.

popular items.

Social features The usefulness of the social features is rated very high, as it can be seen in figure 4.4.

Lists on community dashboard In an additional section of the questionnaire, the usefulness of the lists that show the recent actions of the community was tested. The lists that show the recent comments and the most

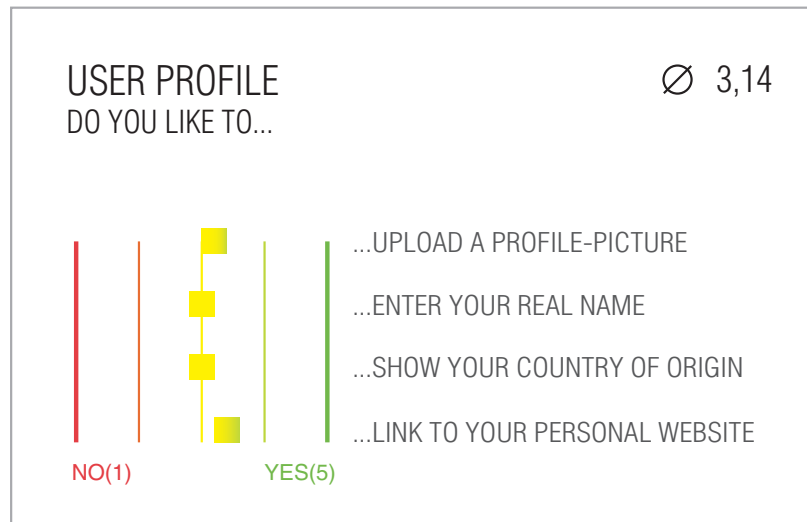


Figure 4.6: To what extent people like to give information about themselves in user profiles.

popular content were perceived to be rather useful, while the list of currently online users and newly registered users, was perceived to be less useful (See Fig. 4.5). That indicates that the user-related lists can be left out—they appear to be interesting only from the point of view of a developer, as they reveal parameters of participation, but as the user study has shown, they are less interesting for the public.

User profiles To find out a bit more about the habits and preferences of the tested people towards providing personal information in user profiles, some questions were asked (See Fig. 4.6). The result suggests that there is no clear preference in average. However, taking a look at the single responses, it gets clear that these questions show large differences between individuals. While some do not like to give information about themselves at all, others do especially like it.

General comments

Favourite feature The temporal range slider widget was the favourite feature—seven out of the eleven participants explicitly named this feature in a comment. Furthermore, the tagging feature was named twice.

Suggested features One feature that was requested multiple times (3) is related to browsing the detail views. It is wished that while viewing the detail information of an item, the navigational context of the faceted browsing

selection remains persistent. One suggests to open the detail view in a pop-up, while another one suggests to have "previous" and "next" buttons in the detail view, which allows to iterate over the selection of the faceted browsing interface. Another similar suggestion was that the faceted browsing interface should stay in the same state, when someone returns to it, for example after quickly viewing the details of an item, and then returning to the result list.

Summary

The user study shows that the developed interface is commonly perceived positively. It is seen as an useful and easy way to search and browse the database. The tested version of the interface, was already improved a few times, and seems to be in an already good state right now. As always, there is space for improvements. The user study revealed some starting points for further advancements. Besides issues that can be resolved relatively fast, like the positioning of the tagging input form, other issues require more attention, like how to better integrate the detail views into the faceted browsing interface.

In general, the user study was a valueable way to gather feedback about how the interface is perceived. The developer always has another view on the application than the average people using it. It is a constant challenge to see the application not from the perspective of the developer but through the eyes of the user.

Chapter 5

Conclusion

5.1 About participation

The contribution to the daDA community seems to approve Nielson's 90-9-1 observation. The building of an online community is a complicated task, where many factors play a role. Two main parameters are the perceived usefulness and the perceived ease of use¹.

In detail, the tagging feature was said to be difficult to use, which could explain why it was used rarely. On the other hand, the commenting feature was said to be easy to use and also to be useful, but still it was rarely used. There seem to be barriers which hinder people to comment. Maybe people did not have an urgent need to comment on something or they were unsure about which comments are expected within this community. Furthermore it also could be a question of deeply embedded individual values, which influences the personal willingness of public participation on the internet. While some see the possible advantages of new forms of public cooperation, others seem to fear leaving traces in the new public.

A study by Peter Kruse² suggests that "heavy users" of the internet can be divided in two groups. While both have basically the same factual knowledge about the internet, their judgement about it is different based on their personal values. Both groups know the subject matter well, but the one group (Kruse calls them *digital residents*) is feeling fine about it, while the other (*digital visitors*) is feeling uncomfortable. In particular there are different preferences regarding controlled stability versus self-organizing dynamics and reliability versus new possibilities.

One can conclude that some people simply do not accept the internet as a space for public communication (yet?).

¹Another parameter is the aesthetic quality, which must support the usefulness and the ease of use.

²Presented on the re:publica Conference in Berlin, April 2010. See <http://blog.whatsnext.de/2010/04/ist-die-nutzung-des-internets-eine-glaubensfrage/>, and <http://blog.whatsnext.de/2010/04/kulturraum-internet/>, both retrieved on 10/05/2010.

5.2 Content

One large aspect not covered by my research is the role of the content itself. The focus clearly was on the interface, while the content was seen as given. From a broad view, the content itself of course also defines the usefulness of an application. It is a matter to be designed; content needs to be composed, nicely structured and selected. Further work could examine how this can be accomplished appropriately for this specific context.

5.3 How can visualisations help in this context?

Regarding the use of visualisations to aid information retrieval some conclusions can be drawn. A graph-based layout of the network of objects alone is not an effective aid for browsing the data, simply because it visually does not work for a high number of nodes and edges. In contrast, the faceted browsing interface allows to reduce the amount of items by various filters and hence supports an exploration of the data. Each facet provides a handle to generate a specific view on the database. Furthermore, statistical information can be integrated, and—by the example of the histogram of the temporal range-slider—can be visualised also. The faceted browsing approach can work as a solid basis for database exploration. It could be further enhanced by combinations with graph-based network layouts or other integrations of visualisation techniques.

5.4 How can a reference work profit from being online?

The initial research question was aiming to examine the possibilities that arise from an online medium in the particular domain of reference works. A reference work, like for example an encyclopedia, tries to fulfill certain needs, such as providing an ideally complete and correct information in an easily accessible way. It was investigated how these needs can be realised with an online medium. The implemented features were tested in a user study in order to get reliable results.

View counting For each item in the database the number of times it was viewed by someone is counted. The hypothesis is that the amount of views correlates to the importance of items. Therefore, by externalising this number, readers that are not familiar with the topic can find valuable entry points for their research.

Starring items This feature enables people to create a short-list of items that they are interested in and as a side-effect the community can also profit,

as items which are starred frequently are highlighted.

Social Tagging By letting the people leave arbitrary annotations for each item, social tagging can help people structure the items for themselves, also providing another way of externalising knowledge.

Commenting The commenting feature invites people to leave questions, observations and other annotations.

Backed by the results of the user study such features can induce new value to reference works on the web. Additionally, two more enhancements are assumed to potentially improve the daDA interface and reference works in general.

5.5 Open features

Wikipedia-like collaboration Supporting the strive for completeness, reference works can open themselves for the general public. The creation of collaborative spaces is not trivial, however, the Wikipedia project can work as a role-model.

Recommendations To enhance the short-list feature, where people can "star" items to save them on a personal short-list, a recommendation algorithm could suggest new items for each person, based on collaborative filtering techniques.

Apart from what was covered in this thesis, it can be taken for granted that there are more ways to leverage the possibilities that the WWW provides and it remains to be a target of further research and investigation. The current hype around *Facebook* which causes not only the supporters of these new developments to exaggerate, but also its critics, should not hinder researches to thoroughly and critically analyse the possibilities of the WWW. Cooperative information retrieval is an interesting area, which takes exploratory IR as a basis and also tries to take the social dimension of sense-making into account. Research in the area of e-Learning also can contribute to and benefit from this effort. Just like a library, the WWW should be seen as source of knowledge. The goal is to provide access to information and more importantly to education via the WWW for people all over the globe.

Appendix A

Survey results

A.1 Detailed results of the survey

In the following all results from the survey are shown. For all questions that base on a Likert scale, the average of all answers is provided. The questions are listed in the same order and formulation as in the questionnaire.

Ease of use	
<i>Questions</i>	<i>Average</i>
Using the "faceted browsing" interface is easy	4.27
Selecting multiple categories (e.g. multiple artwork types) is easy	4
Selecting a timespan to filter the results temporally is easy	4.7
Controlling how the result-list is sorted is easy	4.3
Browsing through multiple pages of the result set is easy	4.4
Creating an user account is easy	4.8
Leaving a comment on an item is easy	4.25
Annotate an item with a keyword ("tag") is easy	2.71
"Star" an item is easy	4.4

Table A.1: Results regarding the ease of use (On a 5 point Likert scale. 1 = Strongly Disagree, 5 = Strongly Agree).

Usefulness	
<i>Questions</i>	<i>Average</i>
The "faceted browsing" interface in general is useful	4.4
The keyword search to filter the result-list is useful	4.55
The category-filter (e.g. filter by artwork-type) is useful	4.3
The temporal filter of the result-list is useful	4.7
The tag-filter of the result-list is useful	4.1
To sort according the name of the item is useful	4
To sort according the number of views is useful	3.55
To sort according the number of comments is useful	3.55
To sort according the number of "stars" is useful	4.18
The possibility to leave comments is useful	4.4
The possibility to "star" an item is useful	4.7
The possibility to tag items is useful	4.67
The list of user that are currently online is useful	2.64
The list of the most recent comments is useful	3.64
The list of popular content is useful	4.18
The list of new users is useful	2.22

Table A.2: Results regarding the usefulness (On a 5 point Likert scale. 1 = Strongly Disagree, 5 = Strongly Agree).

Popularity of giving personal information	
<i>Questions</i>	<i>Average</i>
Do you like to upload a profile-picture?	3.18
Do you like to enter your real name?	3
Do you like to show your country of origin?	3
Do you like to link to your personal website?	3.36

Table A.3: Results regarding the popularity of leaving personal information on the user profile. (On a 5 point Likert scale. 1 = Strongly Disagree, 5 = Strongly Agree).

Which feature did you like in particular?
Year of Creation filter
the Timeline
Search by: Role for "People", Type and Year of Creation for "Artworks"
I especially like browsing by tag and timeline because it is very clear and easy to use
direct update of the results while typing keywords
Search by Year of Creation
search by keyword, temporal constraint selection
search by year of creation. I like the way you use it and visual also

Table A.4: Answers to the question of the favourite feature.

Do you have any suggestions or further comments?
Keep the previous filter settings when going back from the detailed view to the faceted browsing view.
Going back to the artwork overview is exhausting... detail- and overview should be better integrated
The "sorted by" feature is a bit confusing, it's not easy to see how it affects the order of the results (For example, sort by title, then by number of stars, then by number of views)
It is not clear how I can tag artwork, tagging should be possible right where the artwork details are displayed.
the "star" button is a little bit hard to notice at first
How useful the different search methods are depends of what you are looking for. A good idea for the servey whould have been a certain job to search a piece of art and rate the methods would have been more meaningful.
I found a little inconsistency. The work Hypercube is an animation, and the work Catalog also. Buuuut, in the first one the video is under the media link, and on the latter it is in summary. A little confusing, and I think this is not the only case.

Table A.5: General comments.

Is there any feature missing that you would like to have?
Next/prev button in the detailed view for iteration over the selection.
I'd like the artworks to pop up in a new small window rather than jump to another page. In a situation like that, it would be also useful to be able to, from this new window, go to next or previous artworks.
And it would be great if the pictures of the artwork (detail and grid view) are bigger - so the focus is on the art and not on the text around the art.
if possible: accountless access
somewhere on the page saying "Logged in as" and also "Logout". I think the only way to log out is going to your profile, right? I don't think many people would go there to log out...

Table A.6: Further suggestions regarding new features.

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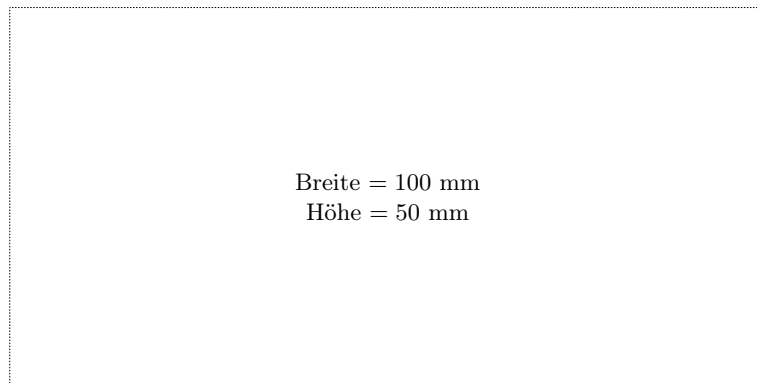
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