Improving Motive-Based Search

Utilization of Vague Feelings and Ideas in the Process of Information Seeking

Mandy Keck[1], Martin Herrmann[1], Andreas Both[2], Ricardo Gaertner[3], and Rainer Groh[1]

[1] Chair of Media Design, Technische Universität Dresden, 01062 Dresden, Germany
[2] Unister GmbH, Barfußgäßchen 11, 04109 Leipzig, Germany
[3] queo GmbH, Tharandter Str. 13, 01159 Dresden, Germany
{mandy.keck,martin.herrmann,rainer.groh}@tu-dresden.de,
andreas.both@unister-gmbh.de, r.gaertner@queo-group.com

Abstract. In complex search scenarios like planning a vacation or finding a suitable gift for a friend, the user usually does not know exactly what he is looking for at the beginning. However, this is the question that most search interfaces present as first step. In this paper, we discuss approaches for supporting the user in expressing a search query based on vague feelings and ideas. We therefore consider search interfaces on the syntactic, semantic and pragmatic level and discuss different mechanisms of these levels to support the first stages of the information seeking process.

Keywords: search interfaces, motive-based search, implicit interaction, context-aware systems, emotional interfaces.

1 Introduction

Complex search tasks such as looking for a suitable car, planning a vacation, or finding the perfect investment opportunity can last days or weeks and usually the user does not know exactly what he is looking for at the beginning. Unfortunately, most conventional web search interfaces require the user to transform a possibly vague information need into a specific search query [1]. These search systems are based on a bottom-up, system-driven approach that originated from a bibliographic paradigm. It is centred on collecting and classifying texts and devising search strategies for their retrieval, which describes the use of information from the system's perspective [2, 6]. But information seeking is an inherently complex human experience that includes a wide range of emotions and motivations beyond a particular problem or need. Consequently, search criteria are often based on emotional and desire-oriented decisions [3, 4]. There is an obvious gap between the system's traditional patterns of information provision and the user's natural process of information use: the system assumes certainty and order, whereas the problems of the user are characterized by uncertainty and confusion [5]. To get a better understanding of how people seek information and to describe the process of information search from the user's perspective, Carol Kuhlthau performed a series of studies and identified distinct phases and emotions

N. Streitz and C. Stephanidis (Eds.): DAPI/HCII 2013, LNCS 8028, pp. 439–448, 2013.

unique to each phase [6] (see Fig. 1). Particularly in the beginning stages, uncertainty and anxiety are an integral part of the process, followed by feelings of confusion, doubt and frustration in the exploration phase. The stage of exploration is often the most complex phase and involves actions such as locating information about the general topic, reading to become informed, and relating new information to what is already known to extend personal understanding. The formulation stage is the crucial turning point at which all the information explored thus far is expressed in a concrete, tangible requirement and the feelings change towards a sense of clarity. Although the first phases include the most complex tasks for the user, most search applications invest most of their effort in the collection and action phases [7] and the user is forced to express his vague ideas and feelings as a specific query which the system can understand.

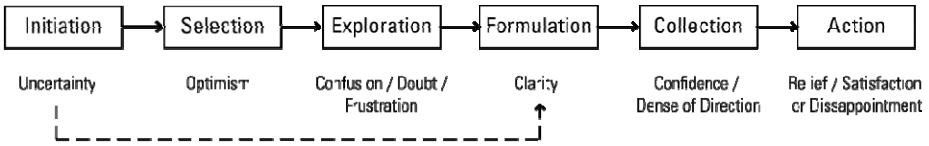

Fig. 1. The stages of the information seeking process and its distinct emotions [6]

Our goal is to investigate strategies and methods to support the first stages of the process of information search. In this paper, we focus on the stage of selection and exploration to lead the user from a feeling of uncertainty to clarity (see Fig. 1). Therefore, we concentrate on complex search tasks - we use the example of planning a vacation - in which the user is unsure of what he is looking for at the beginning. There is just a motive that specifies some general conditions and is influenced by emotions and interests of the user. Because this motive is the starting point of the search task, we call this type of task "motive-based" search.

2 Levels of an Information Retrieval System

Information retrieval systems operate on different levels depending on their ability to understand the user's needs. The three core levels described in Becker's IR Layer-Model [2] are defined as syntactic, semantic and pragmatic Level. These layers originate from linguistic and communication theory and can be subsumed under the large research area of semiotics [8].

2.1 Support on the Syntactic Level

Syntax operations represent the lowest form of semiotic user support. They are widely supported by popular search engines. Based on the contents of web pages, XML-descriptions and databases, the syntactic level enables the system to offer spelling corrections, query completion and many other search strategies described in [9] to improve the number of relevant hits and avoid empty results or deadlocks in the search process. The majority of these operations and moves still need explicit intervention by the user like choosing the most promising proposal or supplements for his query.

2.2 Support on the Semantic Level

The semantic model describes the meaning of signs and objects in form of hierarchies, whole-part relations and other meaningful linkages between concepts. Using these semantic models to provide the computer with a knowledge domain is a central idea of the Semantic Web [8]. With the help of web languages like RDF, DAML+OIL and OWL it is possible to create "machine understandable" knowledge by defining entities and their relations in subject-predicate-object triples [10]. The resulting Ontology Networks are a means of an intelligent and implicit user support and of the autonomous understanding of the domain and the goal of the user's actions. Lopez [11] identifies three different approaches to create a semantic engine: *The closed domain approach* supports only one previously selected domain (embodied by one or few linked ontologies). *Approaches restricted to the own semantic resources* like Wolfram Alpha[1]allow open domain requests relying on their own permanently updated dataset representing the knowledge of the world. *Open Linked Data search approaches* try to use the broadest information base by consulting different large knowledge sources like Freebase [2] or DBpedia[3].

2.3 Support on the Pragmatic Level

While the semantic level centres on the content [8] and its meaning for the computer, the pragmatic level is concerned with the context of the user's interaction with the machine. From the user's point of view, most of his information retrieval actions are basically on the pragmatic level [2]. He is trying to solve a specific task by combining his knowledge with the information presented by the search system. Therefore, the main challenge on this level is to present the most relevant information by considering the user's intentions. Since Computer and user don't share the same knowledge base it is important to observe and understand the context of the user [12].

The Pragmatic Web initiative addresses these issues by focussing on the user and his intention [8]. The goals of the initiative range from describing tools, practises and theories of why and how people use information [13] to improving the quality of collaborative, goal-oriented discourses in communities [14].

The Pragmatic Web cannot be seen as a separate web technology. Instead, it should be used as an additional input to enrich semantic technologies [15] to support and automate human to human knowledge exchange.

3 The Role of Context in Search Interfaces Design

When humans converse with other humans, they are able to incorporate implicit situational information like facial expressions and emotional dispositions of their conversational partner. In human-computer dialogue, the computer cannot take full advantage of the immediate situation of the user. By improving the computer's access

[1] http://www.wolframalpha.com/ (last access: 28.02.13)
[2] http://www.freebase.com/ (last access: 26.02.13)
[3] http://dbpedia.org/ (last access: 28.02.13)

to the context, the richness of communication in human-computer interaction can be increased [16, 17].

The context plays an important role in the research areas of embodied interaction and the design of search interfaces. This leads to a wide variety of definitions. Dourish claims that context can be manifold such as the tasks that the system is being used to perform, the reasons for which the tasks are being carried out, the settings within which the work is conducted, or other factors that surround the user and the system [17]. Schilit et al. define the main aspects of context as the computing environment such as devices and network capacity, the user environment such as location, collection of nearby people, social situation and the physical environment like lighting and noise level [19]. Abowd et al. define the context as "any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."[16] Abowd et al. also distinguish between primary context types and secondary context. The primary context types such as location, identity, time and activity are used to characterize the situation of a particular entity. They can act as indices of other sources of contextual information and can help to find secondary context for the same entity, e.g. phone number or address to a given identity, as well as primary context for other related entities, e.g. other people in the same location [16].

Gathering contextual information to get a picture of the user's current task, problem or emotional disposition is a key for creating pragmatic and semantic support functions in information retrieval systems. Especially for a user who is entering a new and unfamiliar knowledge domain, context information could be used to adapt the interface, provide help or correct, specify and extend his inputs. An approach to the modeling of the user's context is to analyze interactions of the user. This includes explicit interactions such as direct and intentional clicks or touches, but also implicit interactions such as accidental movements, gestures and facial expressions. Since the visual analysis of the emotional disposition and spatial situation of the user is still a research issue, other clues could provide pieces of the context puzzle. Schmidt [18] and Davies [12] propose different sources of information like the location, time, duration, and technical aspects of the interaction, previous queries and parallel activities while searching, or the user's level of sophistication in language and tendency to spelling errors.

3.1 A Pragmatic Scenario

Tamani et al. propose a simple model to describe a pragmatic scenario with four types of collaborators [20] (see Fig. 2). The *Requestors* goal is to find web services providing solutions to his needs and problems. These services are made available by a large number of different *Providers*. The entity that matches the requirements of the requester with the services on the provider side is called *Broker Service*. To fulfill this task the broker needs to combine pragmatic and semantic functionality. It therefore needs access to contextual information on the requestor side as well as comprehensive meta information on the provider side. To make sense of the given information and resolve conflicts and ambiguities the broker should use machine readable ontologies and knowledge graphs of *Trusted Knowledge Bases (KB).*

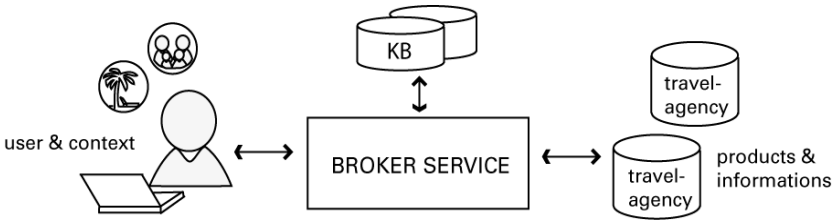

Fig. 2. A pragmatic scenario based on [20]

3.2 The Architecture of a Broker Service

Yuanchun et al. [21] refine the idea of the context sensitive Broker Service by adding a context layer to store personal, implicit, and explicit information about the user in a dedicated *Context Base*. The associated *Context Components* provide functions to acquire, manage, and distribute information about the user context. This covers detecting implicit and explicit context information by observing the input and sensors of the physical *Input Layer*, transferring them to the *Context Base* and offering an interface for the web service layer. The web service layer uses the preprocessed user information for Discovery and Collection of services that are likely to match the user's intentions. The *Service Composition Component* collects the service data and presents it to the user in a coherent and uniform way via the *Output Layer*.

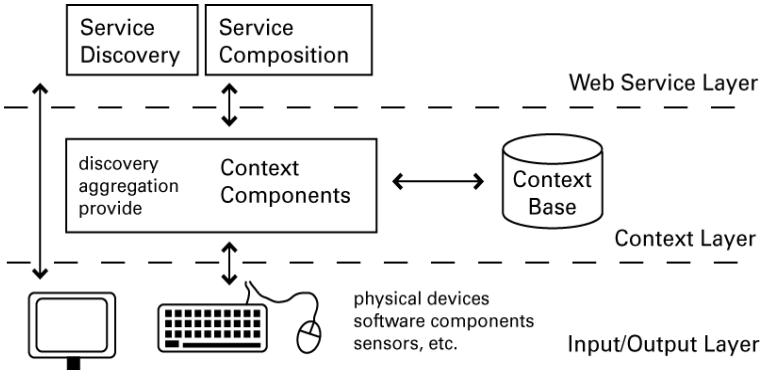

Fig. 3. Layered architecture of context services based on [21]

4 Supporting the Exploration Process

As shown in section 1, the initial stages of the search process need more support by the system and the user interface. Our goal is to develop a model with proposals on different layers for the interface designer to support the user in the exploration stage. Therefore, we distinguish different phases during the stage of exploration and, use the

scenario of planning a vacation as illustration. In the beginning of the search, the user decides to book a vacation without concrete idea where he wants to go. Based on his motive for the vacation, some basic conditions and constraints have to be met. In our example, he is looking for a cheap short trip in the near future and all travels by air can be quickly discarded because of his fear of flying.

To support the user on creating new ideas, the interface has to provide functions that broaden his scope of information (see Inspiration, section 4.1). When finding some interesting topic, e.g. a trip to Paris, Rome or Madrid, the user's task is to read thematically relevant information, and to relate this information with previous knowledge in order to extend the personal understanding of the topic. The interface can support the user by offering functions to construct and organize his knowledge space (see Investigation, section 4.2). Subsequently, the user has to grasp the many possibilities of combining bits of information and different alternatives. The task of the interface is to help the user to narrow the scope and to create a focus (see Evaluation, section 4.3). These phases, illustrated in Fig. 4, cannot be seen as a sequential process; rather they describe different situations the user can be confronted with during the process of expressing his vague feelings and ideas as a concrete and tangible query.

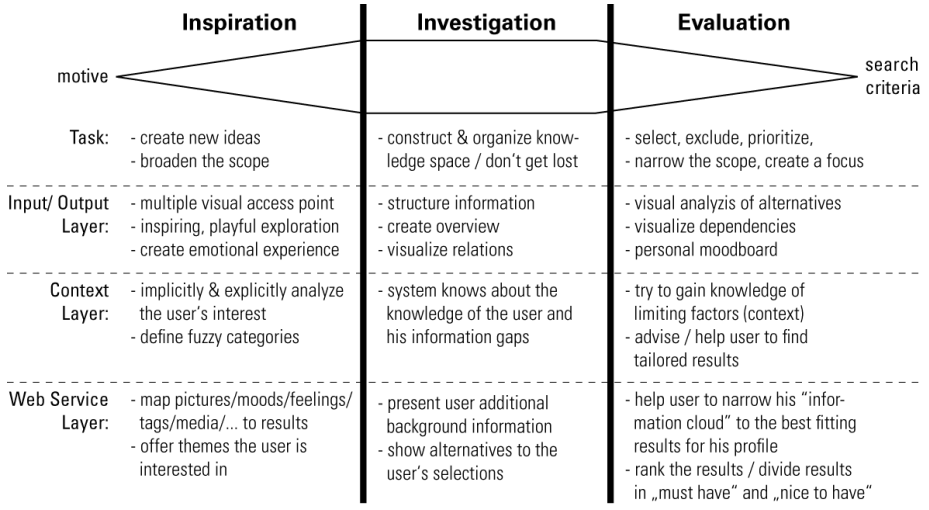

Fig. 4. Functions to support the exploration process

4.1 Inspiration

The motive of the user can depend on several factors such as a special reason for planning a vacation, e.g. relaxation, an activity like surfing or hiking, or a special place he wants to visit. For this reason, it is important to offer multiple access points to select the basic conditions and provide inspiration according to the user's needs.

Besides the collection of context information, the input/output layer displays the information to the user. To create an emotional experience, generate needs and stimulate desires, media like pictures, sounds, and movies can be used, e.g. mood boards in stylepark [22] or gettyImages Moodstream[4]. A playful interface is helpful as well, to increase curiosity, e.g. etsy.com, where the user can choose between different colour moods to explore the products (see Fig. 5, left).

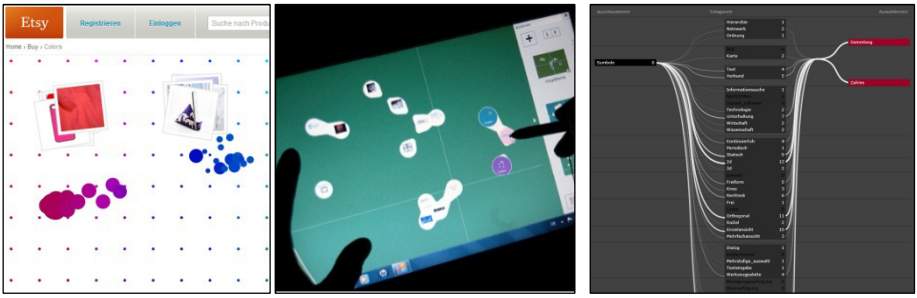

Fig. 5. Left: playful interaction on etsy.com, center: organizing collected items in BrainDump [23], right: visualized relations between included and excluded tags in DelViz [24]

The Context Layer is responsible for gathering information about the user and for analyzing where his interests lie. Therefore, context information can work with implicit information about the user, that is already known, or the device type, location, time etc. or the user can explicitly enter his interests, e.g. in form of selection of a theme or a questionnaire. For instance, the Moodstream of gettyImages offers different sliders describing tagged asset attributes, such as happy vs. sad, warm vs. cool, or nostalgic vs. contemporary, to gather explicit context information and match the pictures and sounds to this situation. Fuzzy Categories [26] can be helpful as well to describe vague ideas. The Context Layer has to deal with the challenge of generating fuzzy categories out of cultural, regional and individual preferences, e.g. "what does the colour red mean to the user?", "what is warm for the user?".

Finding suitable information according to the constructed context is the task of the Web Service Layer. It presents interesting articles concerning the user's interests or other people with similar interests and maps the selection, e.g. in form of a picture, sound or colour, of the user to relevant results.

4.2 Investigation

If the user is uncertain about the results gathered in the inspiration phase, e.g. a city he saw on a picture, he has to become informed about the topic, find relationships and create categories. In this phase, the user often has to handle a large amount of data and getting lost in this information space is highly probable.

[4] `http://moodstream.gettyimages.com` (last access: 26.02.13)

The interface can support the user in structuring his gathered information and visualize relations between his findings. The BrainDump system for example provides the functionality to create and manipulate visual images of his result set (see Fig. 5, center). The user can group collected items and annotate content during the search process, to visually memorize his findings [23]. In this case, the relations are made explicit. By using the capabilities of the Context Layer, the system keeps track of the current knowledge and the information gaps of the user. This can be used to visualize implicitly the state of knowledge in this topic and show relations between the read articles. The task of the Web Service Layer is to provide missing information e.g. climate and main season in the chosen country, and similar results to the ones found in the inspiration phase. This can be another place where the user can visit the concert of his favorite band.

4.3 Evaluation

To narrow down the scope of possibilities and create a focus, the user has to select, exclude, and prioritize his findings. For example, the user reads information about Paris and finds out that a concert of his favorite band is taking place there as well as in Rome, Madrid, and Berlin. Paris is easy to reach via train, but simultaneously with the concert the fashion-week takes place there, which leads to increased prices for accommodations in this time.

The task of the interface is to visualize the properties of his findings such as location, time, price, and activities and the dependencies between his constraints to support the user to compare the alternatives. For example, the search interface DelViz offers the selection and exclusion of different entities and the analysis of the relationships between these constraints using Bezier curves [24] (see Fig. 5, right). Another example is the Bohemian Bookshelf that uses interlinked visualizations to offer an efficient and analytical view on the properties of the result set [25]. The results that match the ideas of the user can be collected in a personal mood board as used in the Moodstream of gettyImages.

The Context Layer tries to gain knowledge of limiting factors, e.g. holiday times, religion, health issues, dislike, fears, and income of the user. With this kind of information, the system can advise against choosing Madrid by taking into account the user's fear of flying and the duration of travelling by car or train that would exceed a short trip. The Web Service Layer helps the user to narrow his "information cloud" down to the most fitting results for his profile and to rank his results, e.g. in likes/dislikes, must-have/nice-to-have.

5 Conclusions and Future Work

Search interface design in the area of embodied interaction has to address context as an important tool to adapt the interface to the user's needs. Recently many approaches have been developed that collect and provide contextual information through automated means, which removes the need for users to make all information explicit [16].

We introduced a scenario in the context of travel search that is supported on the syntactic, semantic, and pragmatic level and discussed requirements in different phases of exploration as well as the implicit use of context. We also emphasized the important role of visualization to support the user in finding (e.g. creating an emotional experience to inspire the user), structuring (e.g. visualize the state of knowledge) and analyzing (e.g. in visualize dependencies between the constraints of the user) huge amounts of data that the user has to deal with. Developing interfaces considering these levels and supporting the user in different stages of the search process to express his needs and to find suitable information is part of our future work.

Acknowledgments. This work has been supported by the European Union and the Free State Saxony through the European Regional Development Fund (ERDF). The research presented in this article has been conducted in cooperation of the Chair of Media Design -Technische Universität in Dresden, Unister GmbH from Leipzig and queo GmbH from Dresden, Germany. Thanks are due to Fred Funke, Annett Cibulka and Dana Henkens for their invaluable comments and support in this research.

References

1. Dörk, M., Williamson, C., Carpendale, S.: Navigating tomorrow's web: From searching and browsing to visual exploration. ACM Trans. Web 6(3), Article 13, 28 pages (2012)
2. Beckers, T., Fuhr, N.: Towards the Systematic Design of IR Systems Supporting Complex Search Tasks. In: Talk at the ECIR Workshop "Task Based and Aggregated Search" (TBAS), Barcelona, Spain (2012)
3. Dörk, M., Carpendale, S., Williamson, C.: The Information Flaneur: A Fresh Look at Information Seeking. In: CHI 2011: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1215–1224. ACM (2011)
4. Baethies, S., Gaertner, C., Spanihel, S., Tsatsas, D.: Design of an Emotional Search in an Existing Product Platform. In: Proceedings of the IEEE/WIC/ACM International Conference on Web Intelligence, WI 2004, pp. 514–518, 20–24 (2004), http://www.stylepark.com
5. Kuhlthau, C.C.: The role of experience in the information search process of an early career information worker: Perceptions of uncertainty, complexity, construction, and sources. J. Am. Soc. Inf. Sci. 50, 399–412 (1999)
6. Kuhlthau, C.C.: Inside the Search Process: Information Seeking from the User's Perspective. Journal of the American Society for Information Science and Technology 42(5), 361–371 (1991)
7. Russell-Rose, T., Tate, T.: Designing the Search Experience: The Information Architecture of Discovery. Morgan Kaufmann (2012)
8. Di Maio, P.: The Missing Pragmatic Link in the Semantic Web, Business Intelligence Advisory Service Executive Update. Clutter Consortium 8(7) (2008)
9. Bates, M.J.: Information Search tactics. Journal of the American Society for Information Science 30(4) S. 205–S. 214
10. Mutton, P., Golbeck, J.: Visualization of semantic metadata and ontologies. In: Proceedings of the Seventh International Conference on Information Visualization, IV 2003, pp. S. 300–S. 305 (2003)

11. Lopez, V., Fernández, M., Motta, E., Stieler, N.: PowerAqua: Supporting users in querying and exploring the Semantic Web. Semantic Web 3(3), S. 249–S. 265 (2012)
12. Davies, C.: Finding and Knowing. Taylor & Francis (2007)
13. Paschke, A., Weigand, H.: The Pragmatic Web (and its many relations). In: 7th AIS SIGPRAG International Conference Session on Pragmatic Web, Monpellier (2012)
14. Schoop, et al.: The pragmatic Web: a manifesto. Communications of the ACM 49, S.75–S. 76 (2006)
15. de Moor, A.: What's up with the Pragmatic Web? Conversations in Context: A Twitter Case for Social Media Systems Design (2010), http://communitysense.wordpress.com/2010/09/14/whats-up-with-the-pragmatic-web/
16. Abowd, G.D., Dey, A.K.: Towards a Better Understanding of Context and Context-Awareness. In: Gellersen, H.-W. (ed.) HUC 1999. LNCS, vol. 1707, pp. 304–307. Springer, Heidelberg (1999)
17. Dourish, P.: Where The Action Is: The Foundations of Embodied Interaction. The MIT Press (2001)
18. Schmidt, A.: Implicit human computer interaction through context. Personal and Ubiquitous Computing 4(2), 191–199 (2000)
19. Schilit, B., Adams, N., Want, R.: Context-Aware Computing Applications. In: Proceedings of the 1994 First Workshop on Mobile Computing Systems and Applications (WMCSA 1994), pp. 85–90. IEEE Computer Society, Washington, DC (1994)
20. Tamani, E., Evripidou, P.: A Pragmatic and Pervasive Methodology to Web Service Discovery OTM Workshops (2006)
21. Yuanchun, L., Xianghong, Z.: A Personalized Service Oriented Pragmatic-Context Architecture and Supporting System. In: Seventh International Symposium on Instrumentation and Control Technology (2008)
22. Baethies, S., Gaertner, C., Spanihel, S., Tsatsas, D.: Design of an Emotional Search in an Existing Product Platform. In: Proceedings of the IEEE/WIC/ACM International Conference on Web Intelligence, WI 2004, pp. 514–518, 20–24 (2004), http://www.stylepark.com
23. Brade, M., Heseler, J., Groh, R.: An Interface for Visual Information-Gathering During Web Browsing Sessions: BrainDump. In: Proceedings of the Fourth International Conference on Advances in Computer-Human Interactions, Le Gosier - France, February 23-28, pp. S. 112–S. 119 (2011)
24. Keck, M., Kammer, D., Iwan, R., Taranko, S., Groh, R.: DelViz: Exploration of Tagged Information Visualizations. In: Informatik 2011 - Interaktion und Visualisierung im Daten-Web, Berlin (2011)
25. Thudt, A., Hinrichs, U., Carpendale, S.: The bohemian bookshelf: supporting serendipitous book discoveries through information visualization. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2012), pp. 1461–1470. ACM Press, New York (2012)
26. Kianmehr, K., Koochakzadeh, N., Alhajj, R.: AskFuzzy: Attractive Visual Fuzzy Query Builder. In: IEEE 28th International Conference on Data Engineering (2012)