Towards a Conceptual Framework for Interaction Design for the Pragmatic Web

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Abstract. In the current World Wide Web, useful information on web sites is often mixed with a lot of information that is not relevant to a user at a particular moment, or is presented in a format that is not optimal for a particular person using a specific artifact. In this paper we argue that to solve problems related to information relevance, presentation and flexibility of use, approaches are required that provide users with uniform ways of accessing and using information and services that are relevant to them at a particular moment in a way that suits their competences and needs. Informed by the Pragmatic Web and hence the questions of how and why people actually access information and services, this work proposes to set a basis for a conceptual framework to better understand, reason about, and design interaction in the Web.

Keywords: Interaction Design, Pragmatic Web.

1 Introduction

In the World Wide Web (Web in the following) useful information on web sites is often mixed with a lot of information that is not relevant to a user at that particular moment. Furthermore, information may be presented in a format that is not optimal for a particular person. Approaches to alleviate these problems include: designing web sites adhering to accessibility and usability guidelines, placing links to frequently accessed content prominently on a page, offering customization options, and offering a search function or a site map. These approaches are all site-specific and may be implemented differently or not at all in different sites, which means that a user has first to try to find her way around when entering a new site. This is a problem that affects all users, but especially those with less experience in Web use and the users of less frequently requested services (e.g. requesting a new passport after a loss).

User-specific strategies to alleviate the problem of retrieving relevant information include using browser bookmarks, memorizing URIs, or using site-external search engines. These strategies impose an additional cognitive load on the users, e.g. the organization of large bookmark collections or the localization of the desired result in the list presented by the search engine. Furthermore, in the case of search engines, users often have to phrase their queries using a vocabulary that is relatively similar to the one used on the desired site and potentially relatively different from their own.

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Regarding the problem of information presentation, solution strategies often involve some form of end-user programming (e.g. user style sheets or web scraping [1]).

We argue that, in order to solve problems related to information relevance, presentation and flexibility of use, approaches are required that are independent of a specific web site or service provider insofar that mechanisms do not depend on a concrete implementation but provide users with uniform ways to access and use information and services that are relevant to them at a particular moment in a way that optimally suits their competences and needs.

A prerequisite for a solution is that a web site needs to provide means to analyze and process its contents computationally. Furthermore, we need to understand how people access and use information and services, as well as how they interact with other people or electronic services. Moreover, this understanding has to inform methods and techniques that can be utilized to effectively design those solutions.

Regarding the analysis and the processing of information in the Web, the HTML-based Web of today, which we will call "Syntactic Web" from now on, offers limited possibilities like analyzing the structure of a document. This makes it difficult to computationally process documents, because code would have to be adapted each time the source document structure changes. In contrast to the document-centric Syntactic Web, the Semantic Web [2] is centered on the meaning of and the relationship between data.

As to the challenge of understanding how people access and use information in the Web and how they interact with each other, the notion of the "Semantic Web" is required, but not sufficient: among the main concerns of the Semantic Web are data integration, interoperability, and automated electronic agents. To date, research that is concerned with user interaction in the Semantic Web often describes only visualization, navigation and search in semantically annotated data sets. The Pragmatic Web [3], on the other hand, permits to analyze the Semantic Web enabled interaction of people with each other or with services. The vision of the Pragmatic Web is "to augment human collaboration effectively by appropriate technologies". Important topics are contextualized meaning, meaning negotiation, and the practices of virtual communities [4].

We hypothesize that, when adopting a Pragmatic Web perspective, the process of interaction design results in information and services that may be more relevant to people, that may use presentations that better fit people's needs, and that may provide a flexibility of use that accommodates a larger variety of competencies. In order to better understand, reason about, and design interactions in the Pragmatic Web, in this work we propose the basis of a conceptual framework. The paper is organized as follows: the next section presents our view of interaction in the Pragmatic Web, illustrated by a usage scenario, and points out how interaction in the Pragmatic Web differs from interaction in today's Web. After that, we present related work that might provide a theoretical and practical underpinning for such a conceptual framework. The subsequent section provides arguments why the definition of a conceptual framework in fact might contribute to the solution of the problems described in the introduction of this paper. The last section concludes.

2 Interaction in the Pragmatic Web

In order to illustrate how the perspective on interaction of people mediated by the Web shifts when introducing the notion of the Pragmatic Web, we describe a short scenario of interaction in the Pragmatic Web and provide a discussion of the differences to interaction in today's Web. While Syntactic Web scenarios are focused on users interacting with other users or with digital artifacts, Semantic Web scenarios often include electronic agents that assist users or execute tasks on behalf of users interacting with other electronic agents or users. As the Semantic Web often is seen as an enhancement and not a replacement of the Syntactic Web, our vision of the Pragmatic Web is that of a Web that builds on the Syntactic and Semantic Web, i.e. uses the respective stacks of protocols, methods and tools. Consequently, Pragmatic Web scenarios include users and electronic agents, but introduce aspects like relevance, intention, or negotiation.

2.1 A Scenario of Interaction in the Pragmatic Web

Alice, an elementary school teacher, still remembers the time when she had to maintain various accounts at different social network, photo sharing or messaging services in order to keep in touch with her friends. Today, when she wants to send a short message to one of her friends, she does not have to worry which social network or messenger he is using. When she takes a photo with her camera or browses her own photo gallery, she can share a photo without having to switch to the client of the photo sharing service or enter their site. She does not have to worry that the principal sees potentially embarrassing pictures of her last birthday party because the fellow teachers that are within her circle of friends are aware that those pictures are not meant to be distributed at work.

Last week, Alice received a reminder from her local government agency, informing that her passport is soon expiring. The reminder contained a list of necessary documents together with the new specifications for the passport photograph. When browsing her photo gallery, Alice is now able to automatically verify if a photo is a valid passport photograph.

Later in the afternoon, she has an online meeting, where she and other teachers discuss the learning process of students, exchange didactic material, review test results, etc. Until some time ago, Alice was forced to use the commonly agreed upon Content Management System to upload files or discuss cases in a forum. Now, she is able to use the same tools that she uses for e.g. sharing photos and videos or chatting with her friends. The files produced during the online meetings or other activities are organized in a manner that suits Alice's needs, while other teachers organize them according to their needs. Although Alice is using some tools she also uses for private purposes, she is always aware of the work context when engaged in activities with other teachers.

2.2 Discussion of the Scenario

The base concepts in the scenario presented above are people acting as users of services and creating or manipulating content. In today's Web, the scenario described

above would not be possible for various reasons. Users are identified by accounts, i.e. they have to maintain and remember information about different user names, passwords, password recovery questions, etc. Services provide operations and can be accessed via different user interfaces. The content created by a user using a service usually stays within the realm of the service provider (of course, the content can be copied and uploaded to the space of a different service provider). The service provider usually defines the user interfaces and the representation of the content (e.g. if you upload a video to YouTube, the video will be converted to different formats with different resolutions that can be displayed by the player at youtube.com). This means, that Bob, a friend of Alice's, would not be able to view her photo using another service than the one Alice used to upload her photo. In order to view her photo, either Bob has to have an account with Alice's service provider, or Alice's service provider has to accept a single-sign-on solution like OpenID (http://openid.net) and Bob has to be a user of this solution. Alice in turn may be able to access her photo via a different service, if all involved services support OAuth (http://oauth.net) or a similar protocol. If Alice would like to share a photo with Bob within the context of a working group at school, i.e. would not like him to share the photo with other friends, she would have to add a comment to the photo or notify Bob in a separate message.

In order to put the scenario in practice, syntactic or semantic approaches (e.g. providing access to services via APIs or enabling data portability or interoperability by providing semantic data descriptions), although necessary, would not suffice. Additionally, methods and techniques are required that allow to put meanings into context and enable meaning negotiation and the analysis and design of practices of virtual communities.

3 Related Work

We see the "Pragmatic Web" in the intersection of the three major areas of Human-Computer Interaction (HCI), Information Systems (IS), and Web Science. From our own perspective of interaction design, different topics from each area will influence and inform the proposed conceptual framework. In this section we will first explore contributions from HCI, IS and Web Science that are candidates for the theoretical foundation of the conceptual framework.

HCI research has acknowledged a long time ago that humans are not simply components of a system that can be studied in isolation in a laboratory environment [5]. This has led to what some researchers call "post-cognitivist theories", theories that go beyond the study of cognitive abilities, and that have a substantial amount of quantitative and significantly less qualitative elements than more traditional HCI theories rooted in cognitive psychology, human factors or ergonomics. Post-cognitive theories and models often start from the notion of language and the notion of action as a form of language use. Examples are activity theory, distributed cognition, actor-network theory, phenomenology (see [6] for a comparison of the four theories from the point of view of activity theory), or the language/action perspective [7]. Some of these theories are also employed in the field of information systems research [8].

"Information Systems are a multi-disciplinary subject, whose objects of study are information and its functions, information technology and its use in organizational

contexts" ([9], page xi). Understanding "organizational contexts" not only as relationships between people in the formal work context, but as relationships between people interacting together towards some end, theories and methods from the field of information systems research that are concerned with the use of IT artifacts are relevant to our proposal. One valuable contribution to our proposal is the fact that in information systems research social aspects that go beyond the direct interaction of people with IT artifacts have always been a concern. One of the theories and frameworks that consider the use of IT artifacts from a technical as well as a social perspective is Organizational Semiotics [10]. It focuses on understanding the different properties of signs on various levels to analyze and design information systems in terms of three human information functions: expressing meanings, communicating intentions and creating knowledge.

Besides Organizational Semiotics, other approaches exist that consider how humans use IT artifacts in organizational contexts, and different efforts to compare, integrate or synthesize those approaches have been made (e.g. [11]). One notable example is socio-instrumental pragmatism [12], a proposal of an action oriented theory for IS research that synthesizes different action theories and thus is better able to cover different demands from IS research than a single theory. [12] further describes different action themes and their theoretic roots, i.e. purposeful, social, interactive, mediated, creative or situational action.

Web Science [13] is an emerging interdisciplinary field that sets out to understand the Web not only as a delivery vehicle for content, but as an object of study in its own right. Besides technical or engineering issues like the Semantic Web or web services, also the social aspects like Web use or governance are considered. Among Web Science research questions that are also relevant to our proposal are those about significance, relevance, reputation and trust.

The Semantic Web has been proposed as an extension to the current Web with the intent to introduce meaning to Web pages, processable by human or machine agents [2]. However, the augmented semantic contents to a great extent remain inaccessible or unintelligible for human agents. Some authors claim that considering meanings is necessary, but not sufficient, and that the purpose and context of information also has to be considered (e.g. [14]). Singh thus states that the vision of the Semantic Web can be implemented via Pragmatics, a branch of Semiotics that deals with context-based meaning [15].

Building on the Semantic Web, the Pragmatic Web sets forth "to augment human collaboration effectively by appropriate technologies" [3]. Although there does not yet exist a commonly accepted definition for the term, research topics comprise contextualized meanings, meaning negotiation, and the practices of virtual communities. Hornung and Baranauskas describe the significance of the Pragmatic Web for interaction design [16].

An important concept of Pragmatic Web research is related to intentions that lead to meaningful actions. Within cognitivist HCI theory, translating intentions into actions in order to realize goals using a tool is part of bridging the "Gulf of Execution" [17]. Among the post-cognitivist HCI theories that conceptualize humans as subjects acting intentionally mediated by tools are activity theory and phenomenology [6]. Regarding the analysis and the design of actual actions, the concepts of usability, affordances, and actability exist, whereas the term "affordance" has different significations in the HCI

and IS communities [18][19]. [16] comment on the different notions and their relevance for interaction design.

After having given a brief overview of general related work in the three areas that influence and delimit a conceptual framework for interaction design in the Pragmatic Web, we will point out more specific topics that provide complementary approaches or pointers to answers for the question of how to implement solutions informed by a conceptual framework for interaction design in the Pragmatic Web.

Semantic Web User Interaction is the name of a community that tries to foster the dialogue between the Semantic Web and the HCI communities. Recurring topics in literature are navigation and search in and visualization of structured datasets, semantic annotation of web pages, creation of semantic data, as well as contextualizing and customizing user interaction [20]. Literature about the Social Semantic Web explores the question of how to apply Semantic Web technologies to the Social Web, combining "the best of the two worlds", i.e. facilitating navigation and searching by semantically annotating content on the one hand and promoting the creation of structured content by using Social Web mechanisms on the other. Main topics in literature are questions of interoperability and integration [21][22]. The subject of both Social Semantic Web and Semantic Web User Interaction literature is the interaction of humans in a semantically enriched Web, whereas Social Semantic Web literature focuses on questions like interoperability and integration, while Semantic Web User Interaction literature focuses on interaction design. Both strands have the potential to bridge the gap between the often technically and computationally oriented Semantic Web community and the, at this stage, rather conceptually oriented Pragmatic Web community.

4 The Pragmatic Web as Proposed

In the scenario of Section 2, people have multifaceted identities and exhibit facets of their identities to other people. Depending on the context, two facets of a single person might even contradict and thus give the impression of different identities. Services enable different operations for different user interfaces. They are independent of content, which implies that users have more freedom to choose the user interface with which they access content and the content presentation that is most adequate. Terms of service and terms of use determine rights and obligations of service and content providers and consumers. A content item has an author and different presentations. The context determines under which conditions people may access content in which way. Customization determines which services are used to access which content presentations in what way. The division into the five dimensions people, services, content, customization and context is depicted in Figure 1, which shows two fictitious services, each with a different set of operations, user interfaces and terms of service. Depending on the facet of the accessing person's identity, the terms of service, the terms of content use, the service user interface and chosen operation, not all presentations of a content item might be available.

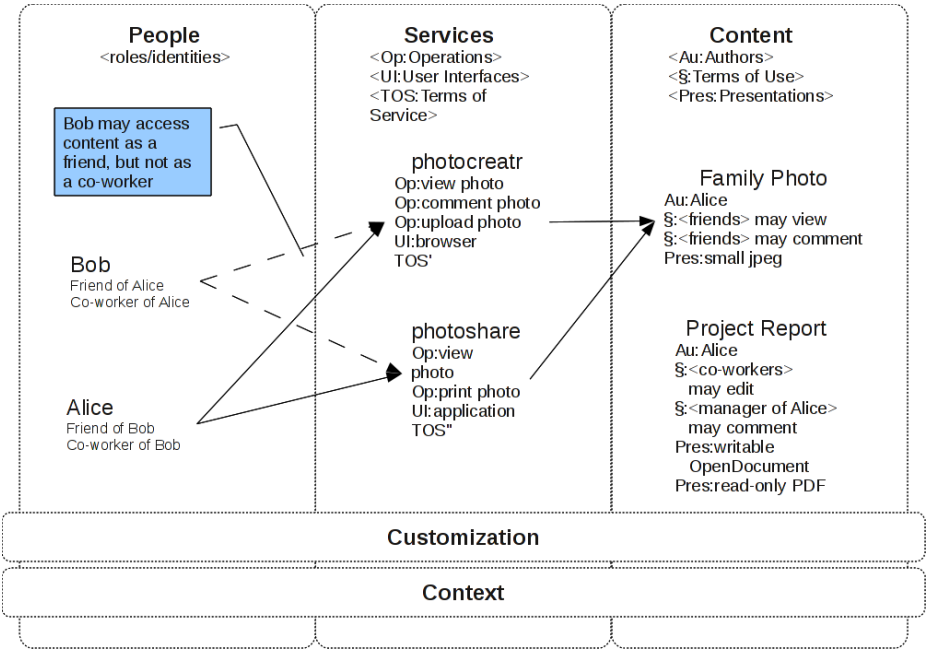

Fig. 1. *People* access *content* independent of *services* but sensitive to *context*

The usage of digital artifacts is not necessarily a primary activity during work and users are not necessarily experts regarding the use of the respective digital artifacts. This point is important regarding our further approach. Breakdowns during artifact interaction of expert users often occur because of usability or accessibility problems of a specific artifact. When considering the interaction of users with a variety of artifacts, e.g. different web sites created by different authors, breakdowns can occur because of what a usability analysis of a single artifact would label "lack of consistency" [23]. Only in this case, each artifact could pass a usability evaluation individually and even if the same or similar design principles had been used during the creation of each artifact, inconsistencies are likely to arise when considering a set of artifacts authored by different entities.

When introducing the Pragmatic Web, the focus hence moves from isolated web pages in the Syntactic Web and semantically structured data in the Semantic Web to the question of how and why people actually access information and services. For example, while teachers create or upload video, audio, text or other documents in the Syntactic Web and semantically annotate those files in the Semantic Web, they now share and access materials such as interviews, test results, educational games, etc.

We believe that this shift of perspective enables us to create artifacts that are more relevant and meaningful to a wider range of people. One might argue that, taking a user-centered or participatory design approach would already result in relevant and meaningful artifacts. This might be true for artifacts that are used by a limited or homogeneous set of people. However, even if many users achieve an acceptable performance, often the created artifact is not optimal for most of them [24]. For example,

web sites of tax authorities have to accommodate for the whole set of requirements of a country's citizens, corporations and other entities, while usually only a small fraction of the whole site is relevant for a single citizen [25].

In the Pragmatic Web, the interaction of people mediated by digital artifacts is substantially different from the interaction in the Syntactic or Semantic Web. In the Syntactic Web, interaction is usually based on web sites (in the case of browser based interaction) or on service provider based interaction (in the case of e.g. instant messaging services). In the Semantic Web, interaction is based on datasets. In our vision of the Pragmatic Web, interaction is based on the intentions of people which are materialized by actions (we do not yet want to enter the discussion whether to call the concept action, activity, act, etc.), i.e. interaction abstracts from a service provider who enables the actual action and gives people the control on how the results of their actions are presented and with whom and under which conditions they are shared.

In order to understand and design interactions in the Pragmatic Web, we aim at defining a conceptual framework, the construction of which will be informed by different theories and models from the following areas: HCI, because we need to analyze and design the interaction of people with digital artifacts or with each other mediated by digital artifacts; IS, because we need to understand how people access and process information in an organizational context, whereas by organization we mean any relationship between two or more people; Web Science, because we need to understand the basic mechanisms and the still many open questions of the Web. The base elements of the conceptual framework will comprise people, services, and content. Context and customization are considered as orthogonal dimensions. Among other important concepts that might have to be considered in the conceptual framework are values like trust, privacy, and authority.

6 Conclusion

In this work we addressed the problems of information relevance and presentation as well as flexibility of access and use of services and information. We hypothesized that a Pragmatic Web perspective can contribute to the solution of these problems by providing means for understanding how people access and use information and services and how they interact with each other in the Web. We presented our vision of interaction in the Pragmatic Web and proposed to develop a conceptual framework for interaction design for the Pragmatic Web informed by HCI, IS, and Web Science. The framework enables the design of interactions, in which people can collaborate while each participant is accessing services and content presentations that best fit his/her needs.

Considering the implementation of solutions that follow the proposed framework, a number of challenges arises regarding the five dimensions: people, services, content, customization, and context. Those challenges range from technical (e.g. protocols or standards) to formal organizational (e.g. forms of meaning negotiation) and informal pragmatic and social challenges (materialize intentions into actions, awareness of effects of an action) and include questions related to interaction design. One of our next steps is to identify and analyze those challenges.

Future work includes a case study where the theoretical conceptualizations can be materialized into a proof-of-concept implementation. In order to be feasible, this proof-of-concept implementation will only implement a small fraction of the framework. The actual part of the framework that will be implemented and the concrete implementation depend on the requirements of a research project in which the authors are currently involved.

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