Web Sites Need Much More User-Driven Interactivity

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Abstract: ***Websites present information or services but often do not allow users to provide feedback or ask questions. The topic of this paper is to first discuss various types of interactivities that are currently available, and then explain what one would expect from advanced systems. The article makes it clear that much has still to be developed. We start by mentioning a number of currently used approaches and show that they almost exclusively belong to a category we call "provider-driven". They miss the very desirable possibility of what we call "user-driven" feedback that is, at the most, available in a very rudimentary form. We then present some user-driven feedback attempts that culminate with a description of some of the features of a new system NID (for Net-Interactive Documents). We analyze and describe the first results obtained and, finally, summarize to show what future systems should provide.***

Index Terms: ***annotations, dialogues, discussions, feedback, interactivity, remarks, questions***

1. INTRODUCTION

Many websites, including some of the very large companies, provide lots of textual and multimedia information yet do not allow users to report errors or omissions discovered, or to ask questions. Often no E-Mail address is provided (usually because an avalanche of emails is feared), and if a phone number is provided, users are usually "entertained" for many minutes with music while they are waiting for an attendant, or are presented with a long list of FAQs that very often do not contain the question the user is interested in. Automated answer robots usually react only to standard phrases, i.e. are often not much better than help systems with a search function. Some systems allow discussions with specialists but are usually not free of charge.

However, some systems do allow, even insist on, inputs from users. Typical cases are E-Learning systems that require users to answer questions or multiple-choice quizzes, (multi-person) computer games that require inputs from users and possibly communication between users, and systems that expect users to grade activities that were offered (like booking systems for hotels or restaurants, online shops, etc.). This kind of input that is required from the user, we call "provider-driven" interaction.

User interactions can be categorized at multiple levels, the most basic form can be simple one-click interactions such as likes or dislikes. On a secondary level of interaction, the user interactions may require an effort of typing something such as comments and feedback. Another more progressive type of interaction involves the possibilities of content co-creation that allows next-level user interactions. While some conventional web information portals allow generic forms of basic and secondary interactions by users, they are not linked with the context of the content. It is very important that users are allowed to give inputs on specific information entities available on the website.

User interactions or user data is considered to be a fuel for running artificial intelligence (AI) based analytics on next-generation websites. Business intelligence engines running at the back of most modern consumer services websites gather user data implicitly. It is equally important to provide site users with easy opportunities to control the data inputs given to the system.

In our work, we explore the importance of user interactivity and data inputs in conventional information system websites e.g. libraries and content publishing platforms. These platforms are now increasingly making use of cutting-edge AI algorithms thus requiring the needed fuel (user data) for optimal performance.

The second author was involved in advanced E-Learning environments and multi-person gaming efforts using distributed computer networks even before the arrival of the Internet see e.g. [1], [2], [3] or [4], using what was then called *Telesoftware* (similar to today's apps) and later [10] allowing arbitrary types of interaction. It is amazing how many years many of those ideas were lost due to the success of the originally only one-way-information-presenting system - WWW.

The rest of this paper is structured as follows. We present attempts at "user-driven" interaction (in contrast to the mentioned "provider-driven" interactions) in the next two sections. Then, we discuss the basics and problems of a new NID system (Net- Interactive Documents) which allows many types of user-driven interactions. Finally, we have a brief look at some special features of NID

in a separate section, followed by a conclusion and an outlook.

2. *Early Attempts at User-Driven Feedback*

The turn of the decade 1980 to 1990 was decisive for developing interactive systems on networks of computers. Until the end of the '80s a number of superb networked multimedia systems were created in the US e.g. the famous HyperTIES, *"an early hypertext system at the Human-Computer Interaction Laboratory (HCIL), University of Maryland (starting1984)"* by Ben Shneiderman, or the famous Hypermedia System from the Brown University based on ideas of Andries van Dam. Those systems were tied to some existing networks.

Starting around 1990, the progress of the internet made it possible to develop systems accessible via the net. Gopher, developed at the University of Minnesota by Mark McCahill was certainly the leader for a while, with thousands of installations worldwide. WWW started to emerge as an information system for physicists worldwide headed by Robert Cailliau with Tim Berners-Lee as a collaborator (whose role was later overemphasized), see [5]. Also, the second author of this article was, with a large team in Graz, involved in developing Hyperwave, see [6] or [9], certainly the most advanced system of the three. However, the first graphic browser was developed for WWW, driving Gopher from the market and Hyperwave into a niche of big companies who desperately needed more structure than offered only with links by WWW.

Those developments are important in the context of this paper since both Gopher and Hyperwave had already advanced features for adding "annotations" to existing material. Maybe it is worth mentioning that Hyperwave permitted users to even associate information with a moving object in a video clip. That was a highlight moving with the object and remaining clickable all the time. The simpler HTML protocol used for WWW did not allow this, so this feature was later eliminated from Hyperwave.

The second author and some of his best friends were convinced early on, that users of an information system should have the possibility to add questions or information to the material presented on websites.

Their first major attempt was to establish a truly open-source journal J.UCS https://jucs.org, (nothing to pay for the submission or publication, nothing to pay for reading). The comparatively low costs for running this on a Hyperwave server were picked up by a consortium of universities, see [7] and [8].

Every paper in this journal (now in year 26 with over 350 issues!) has a field "Comments" that allows adding links to the presented material or to insert further information. Such comments will be called "annotations" in the rest of this paper, following more modern terminology. All such annotations are reviewed by an editor of the journal and, after approval, they are visible to the public. Note how important such annotations are for (scientific) papers: A paper may thus suddenly get a link to a more recent result, improving the earlier one; or someone may point to an error that the author then can correct; or may prefer not to present certain special issues of a definition but refer to details discussed in an earlier paper, etc. The three instigators of J.UCS (Calude, Maurer and Salomaa) are proud to have established this first truly open source journal and even with, at that time, still unusual features like being able to add annotations. For the explanation of annotations, the journal says: *"annotations go through a refereeing process much like other contributions and are made available to the public if deemed appropriate."*

The number of annotations obtained was small, yet led to several improvements. It was argued for a long time that the reason for the small number of annotations was that it often took a long time until annotations were available to the public. Be it as it may be, between 1994 and about 2010 J.UCS [7], [8] was one of the few (if not the only one) big information servers allowing user-driven annotations.

A radical change came with Austria-Forum which was first implemented in 2007 [16]. Austria-Forum is by now a network with some 1.4 Million multimedia entries and almost 4.000 digitized books.

Registered users are allowed to add comments (annotations) at the bottom of every page on this server, showing their user names and thus allowing the administrator to change or erase comments or contact authors where it is necessary. This approach produced two problems: (a) If users registered with an E-Mail address that stopped working at some stage, such contacts became impossible; (b) Over the years the feature was misused seriously at least four times. A typical misuse was that someone wrote a program that added overnight annotations to thousands of pages with advertisements or such. Hence the facility has now been restricted to

members of the Editorial Board of Austria-Forum. However, to permit all users to send messages, each page of the server contains a "Feedback button" that allows anonymous feedback to the administration of Austria-Forum. Anonymous means that writers of annotations are unknown, i.e., if they ask a question, they cannot get an answer unless they include in their message a way to contact them. This anonymity was supposed to reduce the effort to send messages, but was still only used by less than 1% of all readers: Since messages only went to a small group, misuse was impossible. However, it also meant that sometimes the same kind of message (correction, complaint, ...) was sent by several persons. Overall, even a comparatively small number of messages obtained created quite a load on the Austria-Forum team, since some annotations could not be answered by the team but required contacting some specialists. It is this additional burden which has prevented annotations in cases where they would be very desirable.

Typical examples are the thousands of conference proceedings and other books made available electronically by some publishing companies. Discussing this issue, why they do not allow readers to send annotations (typically questions) concerning a particular contribution, the answer of the publisher was not unexpected, along the following lines: *"This is too much effort. When we receive an answer, we have to find the contact parameters of the author(s). In many cases, this is nontrivial, since authors were in contact with book editors, not with us. Even if we find contact parameters, they may not be valid anymore; and even if they are, it may take a long time to receive a reply which we then have to forward. All counted, we cannot afford such an effort."*

Facts like this influenced how we started to look at user-driven feedback, resulting in some major decisions when developing NID, as will be seen in section 4. However, we will first discuss other approaches to user-driven feedback.

3. Other Approaches to User-Driven Feedback

To avoid the mentioned problems some publishers of scientific journals, such as one of the most widely read scientific IT journals - the Communications of the ACM, do allow annotations to contributions that are only made public after the reviewers of the paper have approved it. This distributes the effort of answering the questions to the small expert group that acted as reviewers and accepted the paper for publication. A problem with this kind of user feedback is that it is at the end of a paper, so it is not easy to pinpoint the exact place the annotation is referring to. The former editor in chief of CACM, Moshe Vardi, explained that the feature is used, but less than expected, yet he and many colleagues think that "passive reading" will be more and more replaced by "active reading", i.e., reading with the possibility of user-driven interactions as time goes by. This was another encouragement for us to proceed with the development of NID.

The most common forms of user-driven feedback, are discussion forums and blogs, stand-alone or attached to newspapers, journals, etc. Authors of contributions are known to the public only by a pen-name they have chosen. Only the information provider (hopefully) has valid contact parameters. In most cases the information provider just acts as a mild censor, rarely interfering with the material. Thus, such attempts are more for communication between users rather than users and information providers.

We believe that annotations in papers and books placed right at the spot they are addressing would be very valuable, but clearly, some mechanism has to be developed to reduce the burden to deal with them. This has led us to the development of a software-package NID (Net-Interactive Documents) that seems to effectively address some of the problems mentioned and additionally provides for further possibilities, as we present in the following section.

4. Net-Interactive Documents (NID)

NID documents range from a few pages to arbitrarily thick books. They reside on a NID server and consist of a number of pages, each presented as a picture according to the IIIF standard [17]. Thus, it may be a scan of the document. Such a scan is then usually also converted into a PDF file using advanced OCR techniques. Consequently, this allows full-text searching in NID documents, where even the text in pictures of the original book is searched. The reason for choosing IIIF will be explained in a separate paper in this issue by the first author of this paper who is responsible for many ideas and the implementation of NID. NID books can also be produced from PDF or Word files, or PPTs.

Concerning user-driven interaction, the main points are: (a) each page allows anonymous feedback using a form as shown in Fig.1 or (b) allows an annotation at **any spot** of the NID document by taking from the menu-line a pencil

and using it to outline an arbitrary area on the page, This action opens a form that allows inserting text, links, images, or other multimedia objects, using the form shown in Fig.2.

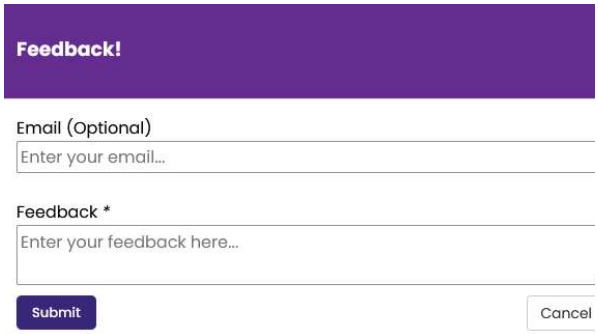

Fig.1.: The feedback form is available on every page of a NID document.

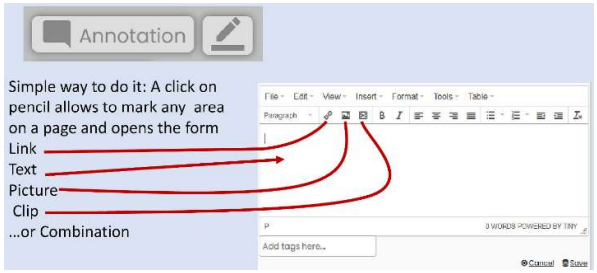

Fig.2: This form allows the insertion of various types of information at any place on any page.

Fig.3: This shows parts of a NID page with various areas highlighted.

Using mouse-over the last marked item “Josef W. Wohinz”, opens a picture of professor Wohinz as seen in Fig.4

Fig. 4: Picture of Professor Wohinz and a link to his biography

Whenever an annotation is made by anyone, a message is sent to someone who is supposed to check the annotation.

The crucial point in NID is that the message concerning a new annotation is sent to one or more persons responsible for the relevant part of the document. I.e. evaluating and modifying an annotation is completely distributed to those persons responsible for the items at issue, without bothering editors or publishers!

This was successfully done with the EUROSPI 2021 proceedings [13]. The 55 individual papers of the conference are associated with the respective authors, see https://nid.iicm.tugraz.at/Home/Collections/31, parts of it as shown in Fig.5.

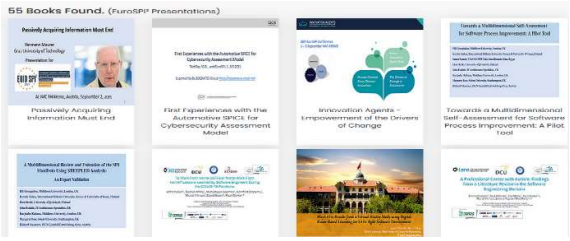

Fig.5: Eight of the 55 papers of Eurospie 2021.

Let us look at the first one, written and presented by the second author, see https://nid.iicm.tugraz.at/Home/ViewBook/411. The first page is shown in Fig.6. All annotations that were added by someone trying to correct or add information or asking a question went directly to the author of this paper, who would react promptly. Thus, later readers would find additional material not incorporated in the original paper.

The book mentioned has been picked on purpose since it also gives an independent overview of other features of NID.

Fig. 6: First page of the NID document of Maurer's talk at Eurospi 2021

The annotation feature of NID is not just important for technical reports but has also been successfully used for engaging students of all age levels to read a contribution, do some research on a topic of interest and add the information found as an annotation. Even high-school students got quite enthusiastic, as pages like https://nid.kinderphilosophie.at/Home/ViewBook/253 show. But applications of NID are also useful for communities and all kinds of organisations acting as a simple knowledge-management system and much more, as explained in [16].

NID offers, for every document, handling annotations in different ways. One can define for a NID document that annotations, even done by anonymous users, are possible and immediately available to the public; or that annotations can only be done by registered users; or can be made by anyone, but are made visible only after potential changes by the information provider, or to all, or to a certain group of users, or only to the one having made the annotation, etc. NID offers a very flexible group structure e.g. that allows different groups to see pages with annotations, or doesn't allow even to look at some pages.

Our experiments to embed explicit user interaction opportunities at all levels in a content publishing platform opens a gateway to many new features. We believe that such systems in the future will use all sorts of machine learning algorithms and automated inference tools. It is essential that best practices are used for needed sustainable data pipelines for the system from its users. One unique feature of NID is the possibility of multimodal content co-creation in the right context, in the form of annotations.

NID offers many more novel and interesting features, some mentioned in the papers [13], [15] and [16]. A fuller presentation is left to other sources: Some of it is explained in the paper by the first author, who was the main driving force for many ideas and all of the implementation. His contribution is included in this special issue as a separate paper.

Let us just conclude this section with a few remarks concerning interfaces. First, when a NID document is opened the interface language (typically English or German, but others are also available) can be chosen. Furthermore, the complexity of the menu shown to users can be adjusted to the intended user group, providing either a full menu, a reduced version ("half menu"), or a very simple one only for anonymous users who can just turn pages, do a full-text search, look at the table of contents (if at all available, it is available with a click on every page), and a small set of other possibilities. If they decide to log in, the system will present a more sophisticated menu.

5. Conclusion

NID offers a completely new way of providing digital books or documents allowing users to interact with the material in unprecedented ways. Thus, the "passive studying" of some material is replaced with NID by "studying information with active participation", and as a by-product is increasing the knowledge provided in the document. This is seen by many IT researchers as the future of consuming digital material.

Clearly, other systems are starting to appear. A major one is Hypothes.is [14]. It is a powerful tool for annotations, also for groups, yet lacks many of the advanced features of NID.

It is expected that the development of NID will deeply influence what future digital libraries will look like, yet the inertia to change existing systems to new ones will require several years of patience.

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