

Information on the Web: How End Users Make Use of Data

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1. Introduction

In recent years, the proliferation of online authoring tools and services has encouraged end users to share their own creations on the web. As of January 2009, the video web site YouTube is averaging 15 hours of video uploaded every minute [6]. For many users, the best and sometimes only way to sift through the enormous amount of information that results are search engines. But while search engines provide users with a general method for locating information, a single query is not always sufficient. Moreover, search engines present users with pages related to their search terms, but further analysis and integration of the information becomes its own task. As for any open-ended task, Web developers cannot anticipate solutions to every possible use in their designs. Instead users must create their own solutions by adapting their activities, or by programming solutions of their own.

One possibility for making web information tasks more flexible and efficient for end users may be web mashups – hybrid web applications that integrate multiple information sources into a single interface. Mashups can provide users with a new view of information that is readily available online. For example, mapping images of local landmarks and nearby restaurants would be a mashup. Mashups can also allow users to ask questions and find solutions to problems. For example one can create a mashup to making pricing comparisons for restaurants in different regions of a city, or invite users to submit comments about the mapped information.

While the mashup integration technique allows programmers to generate novel or unanticipated ways to collect and work with online information, average web users do not have the skills necessary to find and incorporate the many available online data sources. Most web development tools assume at least some programming background, although tools aimed at end users are beginning to emerge [3]. However to best meet the needs of novice users, we must first understand their online activities and goals – what sorts of web mashups might end users want to make? And how would they think about such goals?

In this paper I briefly review my preliminary studies of end users' understanding and expectations of online information activities. I consider some features of current tools that might be useful to such users and describe how this preliminary work has led to a set of research questions that will be used to guide the next phase of my work.

2. What information do end users deal with on the web?

Our past work has identified a population of end users who have little or no programming skills, but do have the technical initiative to take on new challenges to improve their experiences online [7]. Arguing that such an end user might be an ideal candidate for a novice mashup creator, we invited 12 undergraduates who fit this general profile to participate in an interview study [8]. To orient them to the opportunities in online information, we prompted them to think about situations where they needed to gather information from different online sources for a single activity. Following that we asked them to propose any combinations of online information that might be useful to them.

From these interviews, I found a broad range of ideas, varying in personal interests, complexity and the specific information used. For example, one participant suggested combining job listings with company information to assist in interview preparation. Another idea combined an online shopping site with weather and local events, and included recommendations for clothing to buy for a given event (e.g., an outdoor game).

Two themes that were prevalent in the participants' responses were locale and social networking. I observed many mentions of local sources of information such as town newspapers, as well as physical locations like stores or events. In most cases, the participants seemed to use real world events to drive their information seeking goals. Social networking was a central source of information for every participant. Some mentioned Facebook as a source for many of the types of information that they work with online.

While many of the users were able to come up with novel ideas for information integration, and could de-

Describe
real world
setting

Identify
problem

Describe
approach
to solve
the stated
problem

Describe
progress
to date

Explain why more work is needed

scribe how they now go about solving problems with online information, and they were not able to express how to do this in computational terms [8]. It is clear that Web end-user programming (Web EUP) tools will need to include considerable scaffolding to transition novices from search engines to information collection and combination. At the same time, the study also demonstrates that these users are able to generate goals that could be served by Web EUP technologies.

3. Tools for Web EUP

Explain how this work is related to other existing work

A small but growing set of tools are emerging to support Web EUP, each with its own array of features [3]. Looking back at the user-generated ideas from my earlier work, several features seen in current tools seem to have particular promise.

Popular tools, like Yahoo! Pipes [5] and Microsoft Popfly [4] provide a visual interface for users to manipulate data. Both use modules to represent a data flow within the mashup. Essentially, these tools are visual programming environments. While this technique allows users to directly manipulate the building blocks for the program, the hidden data processes obfuscate the functions the system performs and can lead to confusion. Moreover, for either of these tools to be useful to an end user, the user must be able to specify his or her actions in a programmatic way. For a non-programmer, this may not be possible.

Tools like Transcendence [1] and CoScripter [2] provide a more natural method of conveying intentions. Transcendence can identify key form fields in a website and perform analogous queries on other sites. This function is similar to what many users enact when searching for information; indeed it is part of what creates a need for a mashup. CoScripter allows users to record, edit, and execute macros that perform actions on web pages. An important feature is that users can make their scripts available for others to edit and reuse. This provides a social and collective knowledge sharing aspect to the users of the tool, something likely to appeal to users who already spend considerable time sharing and reusing each others' content.

4. Discussion and Future Work

I have summarized some of my initial steps towards understanding and supporting Web EUP, specifically support for end-user mashups. As I continue this work, one of my major considerations will be issues related to motivation and learning for end users on the web. What motivates end users to adopt a new technology or tool as a part of their daily activities? How can I operationalize end-user motivation and support or engage it

with tool features? My earlier work has touched on this issue, but in a very exploratory fashion [7]. For many users, it may not be completely evident how a tool can help enhance their own experiences. The repository model that is used by CoScripter and Pipes can enable users to explore examples of others' mashups.

Another issue is that users do not remain in a static state as they explore new tools. They are always learning. Thus while presenting novices with a minimalist, feature-limited interface may help them get started as they become more experienced their needs may become more complex. How should a tool support these evolving skills? Is there a balance between simple functionality and generality that provides sufficient benefit?

Using the themes from the interviews and lessons learned from prior work as a framework, I pose the following research questions to guide my future work:

- *What factors motivate web-active end users to explore and adopt Web EUP technologies?*
- *How can a Web EUP tool leverage these factors to engage end users in simple programming tasks?*
- *To what extent will simple Web EUP tasks promote a more computational view of web activities?*

We have recently begun to design a modular tool platform to better study the role that specific features play in end user motivation and learning. Using existing web scraping and data visualization methods, we plan to allow users to import personal data and retrieve online resources to integrate as they wish. As a part of this work, we will perform a series of user studies and targeted interviews to build a better model for understanding user motivation.

6. References

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Describe plans for future research