

Signature Flip and Clip: Virtually Flipping and Dog Earing Pages in a Digital Lab Book

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ABSTRACT

Paper-based lab books have been used successfully by scientists for hundreds of years. The historic success of the lab book has much to do with the affordances of paper: ease of data entry, robustness of the media, rapid access to previous content, ease of marking pages of interest. We describe Signature Flip and Clip, an interaction technique that provides the affordances of two of the attributes of a paper lab book: flipping through pages of experiments and dog earing information of current interest. We describe our approach, and its deployment within the Smarttea Lab Book system [5], and present the results of a design test of the system with chemists, and plans for generalizing the technique.

KEYWORDS: Alphslider, Dateslider, Signature, SmartTea, Comb-e-Chem

INTRODUCTION

Modern analytic chemists working in a lab environment still largely rely on paper log books to record their data during experiments. While this approach has clearly proven effective, the trend toward digitising data for security, communication and efficiency has meant that digital replacements for the paper lab book need to be considered. Digital lab books would have the advantages of rapidly making results available to the community. The challenge for digital lab books is that the paper-based affordances of flipping through pages or dog-earing corners for later reference have proven challenging for digital lab book systems to emulate.

Recently, as part of the Smart Tea project, we have been working with chemists to develop an in-lab digital recording system for experiments. The first phase of our prototype has been to develop an in-situ experiment capture tool that lets chemists interact with the digital system as they would their lab book. That part of the project has been



a success [5].

Chemists frequently not only flip back and forth between ongoing experiments (they will usually have several operating at a time), they also regularly flip back to previous experiments for comparison purposes. The current prototype requires chemists to scroll through an index of past experiment labels, much as one would scroll through the table of contents of a document. This text-only approach has at least two disadvantages: it forces chemists to leave their current context of recording one experiment to look up the name of another; that list of names does not afford the richness of information that one gets flipping through pages of a real log book, where one gets multiple cues for reminding one of where a particular piece of information is. Cues like location (middle end start), data, and for chemists, drawings of chemical compounds, are frequently used to locate previous information. Flipping through information means that chemists can also rapidly compare and contrast previous and current work.

Approach

From our interviews with chemists we learned that their main way of identifying a previous experiment is by what is referred to as an experiment's signature: interaction scheme that represents the experiment. Our design approach has been to provide an interface that lets chemists first, rapidly scroll through signatures of past experiments without interrupting their current work, and second, lets them compare other salient features of those experiments, once identified, with their current work.

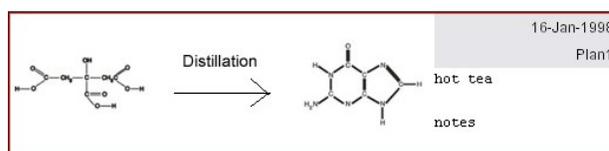
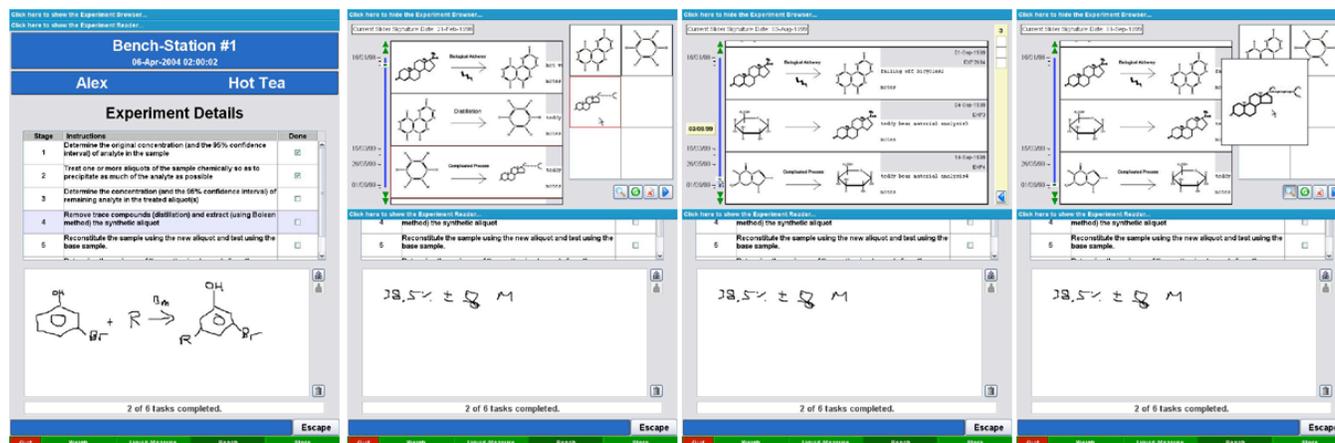


Figure 0 Chemical signature for an experiment

In the following sections we describe Signature Flip and Clip and related work. We discuss the results of a design review with chemists, and conclude with next steps for generalizing signature scroll for the larger science



(a) The digital lab book (b) The signature flip and clip overlay (c) Expansion of signature area (d) Signature clip
Figure 0. Walkthrough of Signature Flip and Clip

application space.

SIGNATURE FLIP AND CLIP

In the Smart Tea lab book, the process of an experiment is presented as a list of prepared steps referred to as “the bench” and shown in the upper pane of Figure 2a. An annotation area is available (lower pane, figure 2a) to make notes on any step as the experiment is in progress.

Signature Flipping

In order to flip back through previous experiments, we developed a drop down palette for the Smart Tea lab book. The palette, shown in Figure 2b, displays a listing of all the experiment signatures in the lab book. The chemist can rapidly scroll through this list. The scroll bar for the signatures is also marked with date ranges. Both the date demarcations themselves, and where they are on the slider indicate by density the periods where most experiments have been recorded.

As soon as the chemist begins to scroll through the signatures, by default, the signature palette expands (Figure 2c) to reveal more information about the experiments: their plain language name, the specific date of the experiment, and any marked-as-critical annotation about it.

With these signature elements visible, chemists can rapidly move through the data in their lab book, as if flipping through pages, scanning for key features.

Signature Clipping

Once chemists locate experiments of interest, they can either “open the book” to reveal that experiment in detail (Figure 3), or they can virtually dog ear, or “signature clip” a number of experiments for later reference. We describe signature clipping first.

In signature clipping, chemists can drag the signatures of experiments to a signature clip board (Figure 2 d). The signature clip board acts as a visual reminder of the related work the chemist has identified for consideration to the current experiment. The signature board also acts as a fast

tool to open up more detail about the experiments in the clip board.

The process of signature flip and clip, therefore, is quite simple: scrolling through the chemical signatures allows for rapid assessment of the lab book data; signature clipping allows chemists to build dynamically a context-appropriate list of related experiments.

Open Book

At any point when the chemists wish to investigate an identified experiment they’ve either flipped to, or clipped, they can open up a detailed view of that experiment, similar to the way they may open up their lab book to look at a page from a previous experiment.

In watching chemists open up an experiment of previous work, we noticed it was quite common for them to keep their hand at the current experiment. Alternately they would roll the pages of the book between the current and past experiment in towards the current experiment. This rolling was done either to keep their current place in the lab book or to help compare the current and past activity.

We wanted to emulate this paper-like ability to roll in pages for comparison. First, there are three ways to open up the book to the detail view of a past experiment. A chemist can either select a signature by clicking on it in the scroll area and then clicking on the experiment reader bar at the top of the bench will open a detail view of the selected experiment. Alternately, chemists can either double click on the signature in either the scroll view or the clip board. Each of these actions triggers the Experiment Reader palette to pop down over the current experiment. (Figure 3, left figure). The Experiment Reader presents a condensed version of the Bench page: a listing of the steps, the experiment signature, the list of chemicals used, and any annotations on the process (Figure 3, center). In Figure 3, left image, the whole page of the lab book has been largely occluded by the Experiment Browser and Experiment Reader panes. This result is similar to keeping one’s hand

at the page where the current experiment is, while focusing on the previous work. Clicking on the Experiment Browser bar causes that palette to roll back up, window shade fashion, to reveal either the annotations of the current experiment (Figure 3, right) or its bench steps. This state is equivalent to rolling the lab book pages between experiments into the current experiment page. Alternately, for better direct comparison between the current and previous experiment than a paper lab book affords, two concurrent Experiment Reader palettes can be opened for direct comparison.

RELATED WORK

There are a number of components in previous work that improve rapid access to functions or navigation for better document control.

Marking menus

Marking menus [2] are a radial pointer, movement-based menu browsing system that allows for effective and rapid browsing of large menu hierarchies. Marking menus are effective for hierarchical navigation of a relatively small set of functions. The signature database for a lab book is currently a very flat data structure with a large number of entries, so we could not achieve marking menus' efficiencies with marking menus' approach.

Alphaslider

This is a compact UI component designed for rapid visual skimming through large lists of textual strings such as film titles or names of people. The basis for the component design is that humans are good at scanning rapidly through serial visual representations of text. Experiments have shown that novice users of the Alphaslider can locate one item in a list of 10,000 film titles in 24 seconds on average, while expert users can do the same in about 13 seconds [3]. We extended the Alphaslider in our case to skim through the dates of experiments as a complement to their visual signatures. We describe this further in the next section.

The Table Lens

The signature database is a flat data structure; a table-like structure or list we have found is an effective for visualising it for browsing. However, due to the large number of experiments to browse, a normal table or list is impractical to visualize in one page. The table lens [4] provides a means by which interesting data can be magnified within a table structure while maintaining an overall context on the table as a whole or at least a major surrounding region. In a sense, the scrolling signature area of the Experiment Browser, combined with the Date Slider, acts as a kind of fixed table lens: the scrolling signature list focuses on the signature elements of the lab book, while the date slider provides persistent context about the both the scope and current region in focus.

Current Digital Lab Books

Although these currently exist, such as CambridgeSoft's lab book [2], they are desktop-based systems that aim at embedding office applications and chemical data and drawing applications into a single package (see [5] for a

review of other lab book systems). Indeed, the Smart Tea lab book [5] was designed in response to problems in take up with extant systems. While it supports chemists in the lab for current experiment entry, as noted at the outset, it has not had a facility for rapid experiment browsing.

IMPLEMENTATION

The Signature Scroll system has been implemented using Java/Swing to facilitate integration into the Java/Swing-based Smart Tea Lab Book. Data access is achieved using Web-Services via a SOAP interface, locally cached on the lab-book, linked to an external triple-store of digital experiments.

The system had to solve two basic problems. The first problem has been how to reduce an experiment into the small space of a tablet page while both retaining access to the current experiment, and still providing enough information for unique and quick identification by a chemist. This problem was solved by the chemists describing the key attributes they use for identifying previous experiments: the result was our visualization of an experiment "Signature".

The second problem is navigating through a large number of these Signatures within a small screen space. As noted, the Alphaslider is a component that was designed to meet the requirements of searching through large lists of up to 10,000 alphabetical strings, such as film titles and names of people. It relies on the principal that the human mind is very good at scanning and matching serial strings of text at speed. Current estimates put the number of experiments in a chemist's log book history at up to 500 experiments. So for the application of browsing the chemist's own experiments, our adapted alpha slide as a date slider, combined with the chemistry signature, gives us a rapid way to flip through virtual lab book "pages" of experiments.

The Dateslider is also configurable to allow for four effectively different modes of operation. Deciding upon the most suitable mode for this application is part of a future evaluation. The four modes are achieved by combining a choice of two scales and two scrolling modes.

The first scrolling mode, seen in Figures 4(a) and 4(b), LINEAR_TIME, lets the user scroll along the bar such that any given equal increment along the bar is equal to an equal increment in time. In other words the slider represents an uncompressed timeline. This provides the user with an overall time-based context within which to navigate.

The second scrolling mode, which can be seen in Figures 4 (c) and (d), EVENT_DRIVEN_TIME, sets the slider up so that an equal increment along the bar moves the list to the next experiment associated with the slider. This is more like a user would expect a conventional scroll bar to behave.

Of course the Dateslider needs to be tied in to the system to be useful. This is shown in Figure 3, in which one can see the Dateslider, the associated date label that chemists would be expected to look at while scrolling through by date, and

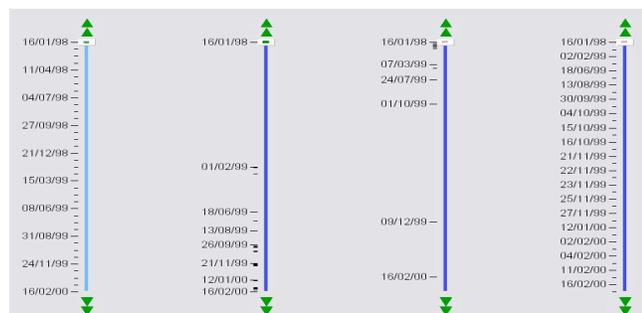
the associated experiment signature list. The date label increments linearly when the slider is in linear time mode and snaps to the nearest event when the thumb is released, as does the list. The only other noteworthy component is the signature clipboard onto which signatures that the chemist is interested in while scrolling through the list can be dragged for later analysis.

The above constitutes the browser side of the interface. The other half of the interface is the reader side that allows viewing of the experimental data. The browser and reader can be separately minimised to allow for the maximum space to be visible on the digital lab book as possible (see Figure 4). This allows for much easier comparison between the current working experiment and the old experiment.

The reader presents the past experiment in full detail based on the tasks associated with the experiment, the ingredients for the experiment and the associated annotations made by the chemist.

EVALUATION

Chemists have been involved in each stage of the signature flip and clip widget's development, through interviews and a series of design reviews. In the first design review of the working prototype chemists suggested two core revisions: the first was to revise the signature from simply reflecting the product of the experiment to including the entire reaction scheme, which is what we use now. The second main revision was to refine the signature display to make it more navigable. This resulted in the signature extension on scrolling, shown in Figure 2c.



(a) (b) (c) (d)
Figure 4. Scales for the Date Slider. The first scale (a and b) is a linear time. The second (c and d) are event driven.

With successful iterative design reviews and tests of the Signature Flip and Clip approach for rapid thumbing, bookmarking and opening of lab book experiments for review and comparison, we are planning a longitudinal study of signature flip and clip in use. This means, however, transferring the contents of several, currently, paper-based lab books into the lab book system so that chemists can work with their own data. This is a time-intensive process. By using chemists' own data, however, we leverage the chemists' associations about their own work context to see how well signature flip and clip reflects their current review practices of their own data.

CONCLUSIONS AND FUTURE WORK

The Signature Flip and Clip interface widgets provide a novel technique for rapidly vetting experiments in a virtual lab book. The widgets break with the metaphor of the lab book – no attribute looks like a literal page or dog eared page corner – but they inscribe the experience and affordances of flipping through and clipping pages in a paper-based lab book.

Immediate updates are likely to involve the move from JPEG images of signatures to the open source ISS draw's royalty free open XML based file format for almost any chemical information. This would enable the signatures to be both machine and human-searchable.

Signature Flip and Clip has been designed to support chemists flipping through their own, local lab book content. To support the broader access goals of the eScience community, we are interested, however, to see how the approach may scale and be adapted to support flipping through any past lab book of a chemist, or *any* lab book in a lab, which may have related work, and which that chemist is authorized to see. In these cases, the signature may act as the context for interpreting the associated processes. How to switch from local to such global contexts is also an interesting challenge for our design.

While our approach has focused on supporting lab book interaction, signature flip and clip can be seen as a general interaction technique to translate the rapid information triage afforded by paper to a GUI-based mobile computing document space where persistent document features can be leveraged for review.

ACKNOWLEDGEMENTS

Thank you to the U of Southampton chemists who have taken part in the design process. This work is supported by the Smart Tea project (www.smarttea.org), CombeChem, EPSRC grant no: GR/R67729/01.

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