In-Context Visualization and Authoring of Metadata for Information Collections

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ABSTRACT

Exploring a large collection of information can be a challenging task. Metadata provides details about an information element that are helpful in understanding what is contained within it, as well as how the information element relates to other elements in a collection. We built a language called *meta-metadata* for defining how metadata is extracted, stored, and displayed. Incorporating meta-metadata, we designed a new form of *In-Context Metadata*, a fluid interface for visualizing and authoring metadata, to support a nested structure of metadata. In-Context Metadata deals with issues of limited human attention, screen real estate, activation, and displaying and interacting with differently typed metadata. In-Context Metadata is used in combinFormation, a creativity support tool for browsing, exploring, collecting, organizing, and searching information. We implemented In-Context Metadata as a reusable component to engage others in collaborative research.

1. INTRODUCTION

We live in the information age. Large amounts of digital media, such as documents, video, and audio recordings are created, stored, and shared. As a result, we construct large information collections. Digital libraries, such as the ACM Portal, provide services to support *information discovery*. Information discovery is the process of exploring, searching, browsing, and organizing information collections to discover new, emerging ideas and form meaningful connections between related information.

Interfaces for exploring collections represent elements as *surrogates*. A surrogate is a representation of an object that provides access to the object. A Google search result entry is an example of a surrogate. A surrogate eclipses the object, becoming the participant's primary view and connection with the source.

Metadata is information about information, providing descriptive details, such as authors of an article or the cost of a book. Metadata is typed, requiring different forms of display and interaction. The price of a book is typed as currency. Depending on locale, the price is converted to reflect the local currency.

We defined a language for describing the life cycle of metadata, called *meta-metadata* [1]. Meta-metadata details how metadata is extracted, defines the strongly typed representations for metadata, and provides properties for how the metadata is visualized. For example, In-Context Metadata uses a meta-metadata property called `alwaysShow` to specify metadata fields that need to be displayed even when the field contents are empty (see Figure 1).

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Visualization of metadata is important when exploring large collections. Metadata can show connections between related objects. Displaying metadata for a surrogate extends the amount of information represented, improving the participant's ability to understand the information accessed through the surrogate.

In information discovery, we explore large collections to form new ideas (e.g. find a research topic) and build understandings of informational relationships (e.g. collect prior work). This process is highly cognitive. It places extensive demand on human attention, which is limited. In-context interfaces alleviate demand on attention by displaying affordances near the participant's point of focus, preventing the participant from navigating a series of menus and making a context switch away from the task at hand.

Screen real estate near the point of focus is limited, necessitating an in-context interface be transitory, only appearing when needed and disappearing when not [5]. Transitory interfaces raise issues of activation. What steps does a participant take to make an in-context interface appear? This question emphasizes the importance of designing clear affordances, which are "perceived or actual properties" of the interface [3], to avoid confusion for the participant in activating and using the transitory interface.

When activated, interfaces such as In-Context Metadata can occupy extensive screen space to visualize considerable data. This can overload human attention defeating the benefits gained from in-context interfaces. Design techniques are needed to minimize information displayed until the participant requests more.

Using fluid movements and layers of activation, a transitory interface can function seamlessly in an interactive space. We call this a *fluid interface* [5]. The layers of activation fluidly transition the appearance of the interface, minimizing demand on attention.

In this paper, we present a new version of *In-Context Metadata*, a fluid interface for contextualized visualization and modification of metadata. We detail the design issues associated with interaction and display of the new In-Context Metadata. We explain the implementation of In-Context Metadata within combinFormation.

2. IN-CONTEXT METADATA

In-Context Metadata (ICM) is an interface component for viewing and authoring metadata near the participant's point of focus. ICM displays metadata fields, each with a label and value. Metadata values are typed, requiring different forms of visualization and interaction. ICM previously supported scalar values, such as a text passage, a URL, or a numerical value. Our new ICM adds support for values that are metadata objects or a set of metadata objects. We call this *nested metadata*. The field values for nested metadata contain fields themselves. These nested fields can have nested

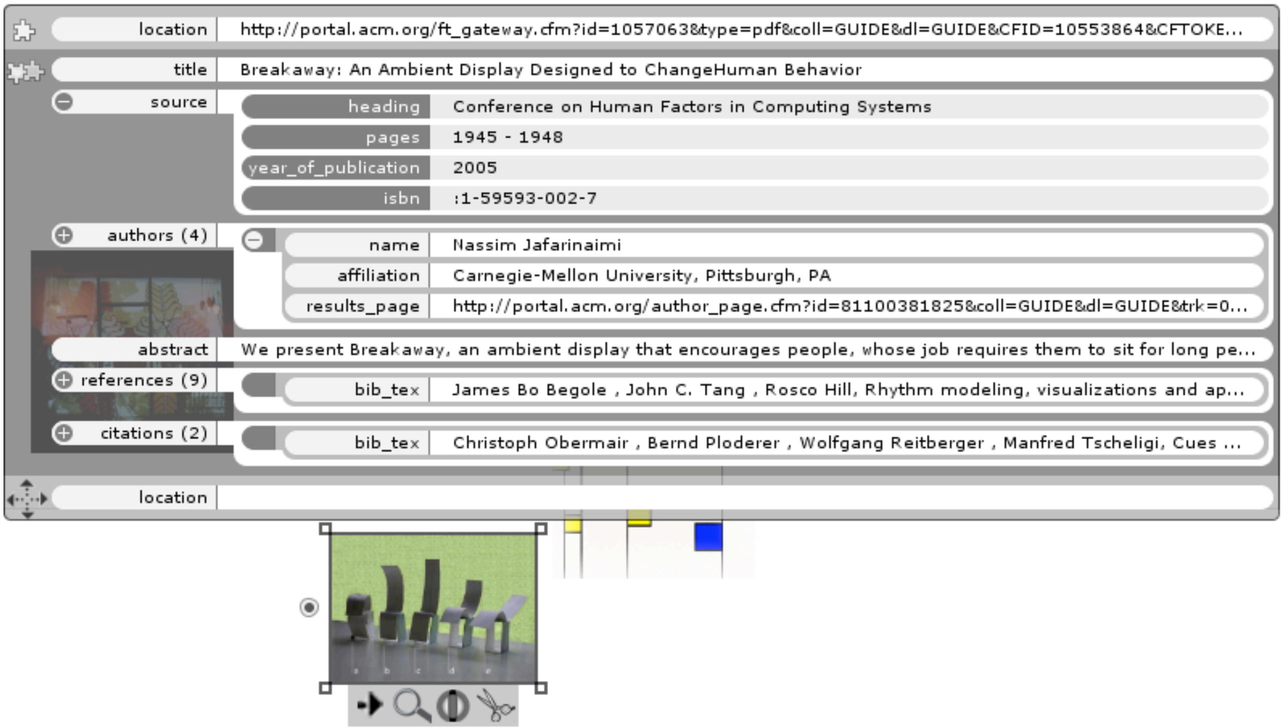

Figure 1: In-Context Metadata example with nested metadata for an article from the ACM Digital Library. Three groups created are from a metadata object for the image itself (top), a metadata object for the document the image came from (middle), and a metadata object for an alternate location that the surrogate can link to (bottom).

metadata, resulting in a hierarchical tree of metadata. The nested structure for metadata is defined within meta-metadata.

ICM constructs the necessary interactive components based on initially provided metadata objects. When given multiple metadata objects, ICM creates groups, designated by alternating color changes in background, (see Figure 1). Values for ICM fields are editable. Participants can correct or author an entirely new value.

For some metadata fields, such as the document a surrogate links to, the type of a navigable location is specified in the meta-metadata. The labels for these location fields serve as hyperlinks. Thus when participants move the mouse cursor over one of these labels, the label is underlined, identifying it as navigable. Participants click the label, which opens the location in a web browser. A non-location metadata field can be navigable to a location specified in another field using a meta-metadata property called `navigatesTo`.

Transitory in-context interfaces appear near the focus element. Many elements may be present around the focus element. The focus element may have other interactive functionality. Activation is an issue. We address this problem using the fluid movement of brushing over a surrogate. When a participant brushes the mouse cursor over a surrogate for a brief moment, ICM is displayed. This timeout prevents activation when the participant is only passing over the surrogate. Without the timeout, activation happens instantly, possibly occluding the participant's targeted surrogate.

ICM supports displaying a large amount of information. Human attention is limited, raising issue with how much information to present. We approach this problem using a gradual transition. A minimum amount of information is first presented. As a participant needs greater detail, affordances exist for displaying additional information. For scalar-typed metadata fields, ICM collapses fields that would occupy multiple lines into a single line with "…" added to the end indicating that additional text can be viewed. After a timeout with the mouse cursor over the field value, the collapsed value is expanded to show the entire text. When the mouse cursor leaves the field value, the value collapses.

ICM displays nested metadata in a hierarchical tree, where higher levels are expanded to show lower levels (see Figure 1). A button with a "+" indicates a nested field can be expanded when the button is clicked. After expansion, the button toggles to a "-", meaning the field can be collapsed. Nested fields start collapsed to minimize used screen space and analogously demand on attention.

We created new designs for fields. We connected label and value into a single rounded rectangle divided by a line and differentiated by changes in background color. Labels are right-aligned to help visualize the divide. Right alignment is maintained across nested levels, simulating columns of labels and increasing legibility.

An alternating color scheme for labels and values is used to maintain consistency across levels of nesting. This helps the participant see layers of separation between the different nested levels, increasing the legibility of the information presented [4].

Translucence is applied to the background of ICM to minimize the obtrusiveness of the in-context affordance with respect to surrounding contextual information. No translucency is applied to the fields themselves to maintain text legibility.

3. COMBINFORMATION

ICM is used in combinFormation (cF), a mixed-initiative creativity support tool for browsing, searching, and exploring large information collections [2]. In cF, computational actions of autonomous agents work concurrently with the design and collection processes of the human participant. The goal of cF is to promote information discovery through composition. cF uses composition, a form of representation that comes from the arts, to

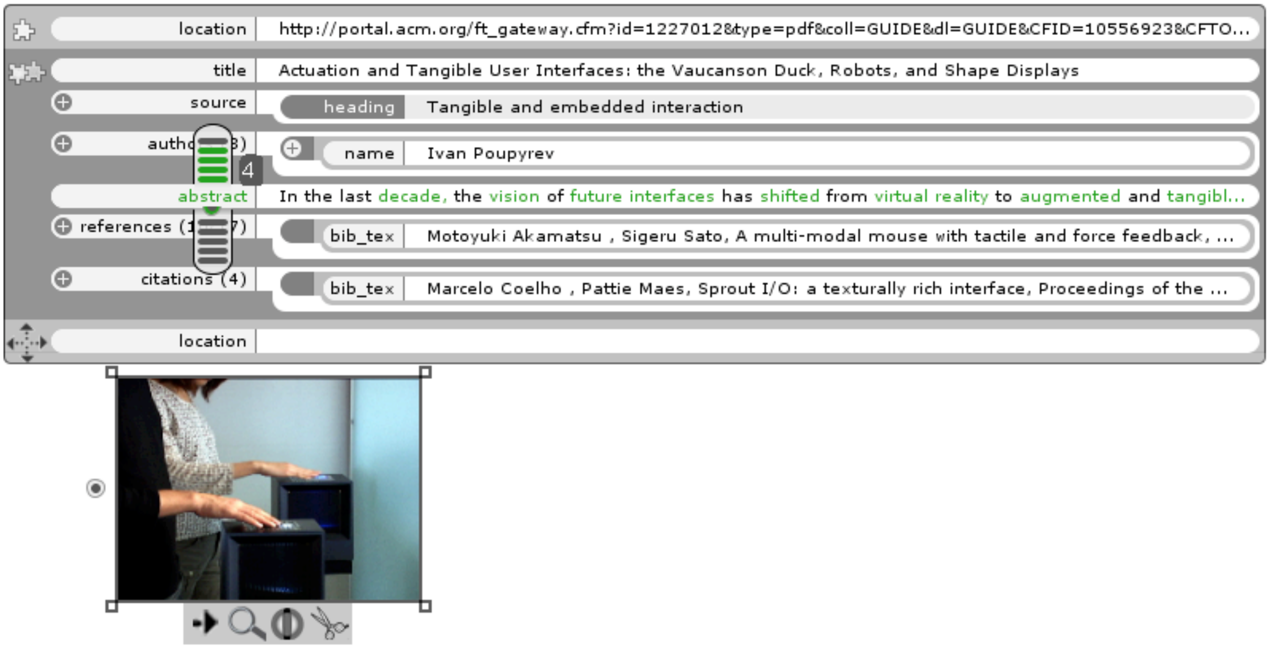

Figure 2: In-Context Metadata example of expressing interest on the "abstract" field using the In-Context Slider. Words in the value part of the field that can have interest expressed in them also change color as the In-Context Slider value is visualized.

allow participants to explore, organize, and convey ideas [2]. In composition, connected parts form a whole. In cF, surrogates, as parts, are arranged by the participant to visualize connected ideas and present a meaningful whole.

The agents collect information resources, and extract relevant image and text surrogates from those resources. These collected surrogates are presented to the participant in the *composition space*. cF's composition space is where the initiatives of the agents meet the initiatives of the user. The agents spatially place image and text surrogates, and the human participant organizes and designs a composition around relevant, expressive surrogates.

Using ICM, participants are able to see additional details about the document represented by a surrogate to help in deciding if a document is useful, preventing the need to always open documents to understand their contents. The metadata allows easier observation of connections between surrogates, such as discovering that two documents were written by the same author.

The agents use metadata to help in deciding which documents to download and extract surrogates from, so it is important the participant can express interest in words and fields within ICM to help direct the agents. Interest expression is done through the *In-Context Slider*. The In-Context Slider is a fluid slider interface component for viewing and adjusting values [5]. The In-Context Slider allows for interest expression on single words, multiple words, ICM fields (see Figure 2), and whole surrogates.

4. CONCLUSION

We presented ICM, a fluid interface for contextualized display and authoring of typed metadata. Metadata is beneficial when exploring large collections of surrogates and documents. Metadata provides details about the document a surrogate represents without needing to access the document. The design goal is to maximize accessibility of the structure and power of metadata without undue cognitive load. We created visual layers of labels, values and nested fields through color and shape to increase legibility. Alternating background colors maintain label and value separation across nested levels. Horizontal lines and rounded ends differentiate metadata fields. Horizontally-aligned orthogonal lines divide label and value. There is a tradeoff between visualizing metadata and the demands on human attention. ICM could fill the entire screen by displaying metadata, overloading attention and occluding the majority of screen space. Background translucence reduces the occlusion, attenuating demand on attention. ICM initially displays minimal information. The participant obtains more information through interaction. Meta-metadata defines the structure of nested metadata, such as that extracted from the ACM Portal. ICM supports visualization of this nested structure. While the expand/collapse interface is not a new technique, its use in the contextual display of metadata is novel. Through the designed visual layers and expand/collapse structure, ICM supports macro and micro readings of metadata [4]. We will conduct a user study to evaluate ICM. We are developing cF, ICM and the In-Context Slider as componentized entities for use in diverse applications. We look to collaborate with other researchers wishing to incorporate these fluid interfaces.

5. REFERENCES

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