KNOWLEDGE MODEL VIEWERS FOR THE IPAD AND THE WEB

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Abstract. Knowledge Models are used extensively by the concept mapping community for a variety of purposes, including education, organizing content, and depicting expert knowledge. The CmapTools software suite automatically generates Web-based (HTML) versions of Knowledge Models when they are stored in a CmapServer. As a result, Web browsers are often the tools used to browse Knowledge Models. However, the HTML generated by CmapTools does not take advantage of new technologies, such as large high-resolution screens and tablets like the iPad. In this paper we present new Knowledge Model Viewer programs for the iPad and the Web that provide an improved navigation experience.

1   Introduction

Within the concept mapping community, and in particular among the CmapTools software (Cañas, Hill, et al., 2004) users, a *Knowledge Model* is considered to be an organized collection of concept maps and associated linked resources about a particular domain of knowledge. Knowledge Models are often built as part of a knowledge elicitation and documentation project (Coffey et al., 2003; Ford et al., 1992; Hoffman et al., 2001), but are also used as a tool to organize and navigate through collections of resources. Research has shown that a Knowledge Model is an effective tool to navigate and search through large collections of resources (Carnot et al., 2001). Large Knowledge Models often consist of hundreds of concept maps and thousands of linked resources, as is the case of the *Return to Mars* project (Briggs et al., 2004). Knowledge Models have been proposed and used for course content creation and delivery (Cañas & Novak, 2010; Coffey, 2008; Coffey & Cañas, 2003) and for curriculum development (Heinze-Fry & Ludwig, 2006). In addition, the construction of Knowledge Models by students is part of the concept map-centered learning environment proposed by Novak & Cañas (2004) in their New Model of Education.

2   Knowledge Models in CmapTools

Support for the construction and maintenance of large and small Knowledge Models was one of the main objectives in the design of CmapTools (Cañas, Hill, & Lott, 2003). Figure 1, part of the CmapTools website, summarizes the tools and features that CmapTools provides for the construction of Knowledge Models. In particular, CmapTools encourages the collaborative building of Knowledge Models, whether they are a knowledge engineer and an expert, students learning in teams, or other collaborative efforts. As a result, CmapTools has been used to develop Knowledge Models by users of all ages.

3   HTML Version of Cmaps

A popular feature of the CmapTools suite is the automatic generation of an HTML (Web) version of Cmaps[1] that are stored in a CmapServer, which can then be viewer and navigated using a Web-browser (Cañas, Carvajal, et al., 2004). Links from concept maps to other maps or to other linked resources (e.g. Web pages, videos, images, PDFs, etc.) can be opened when browsing the Web version of Knowledge Models. The CmapTools architecture allows the Knowledge Model to span beyond a single CmapServer, with Cmaps and resources located anywhere on Internet (Cañas, Hill, Granados, et al., 2003). The CmapTools (http://cmap.ihmc.us) and the International Conference on Concept Mapping (http://cmc.ihmc.us) Websites are examples of Web-based Knowledge Models that are familiar to the Cmappers community.

The Web versions of the Cmaps generated by CmapTools have limitations that can be classified into two types. First, there are features of the Cmaps themselves that are available in CmapTools that don't work on the Web version, including Annotations, Discussion Threads, Knowledge Soups, Nested Nodes, and the Info box that is displayed when the mouse is left over a concept. The purpose of generating a Web version was to provide a 'browsable' version of the Cmap, not an editable or collaborative version, and so the Annotations, Discussion Threads and Knowledge Soups don't fit within the stated purpose. The Nested Nodes and Info box do belong within intended objectives, but are not implemented.

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[1] We use the term Cmap to refer to a digital concept map created with CmapTools.
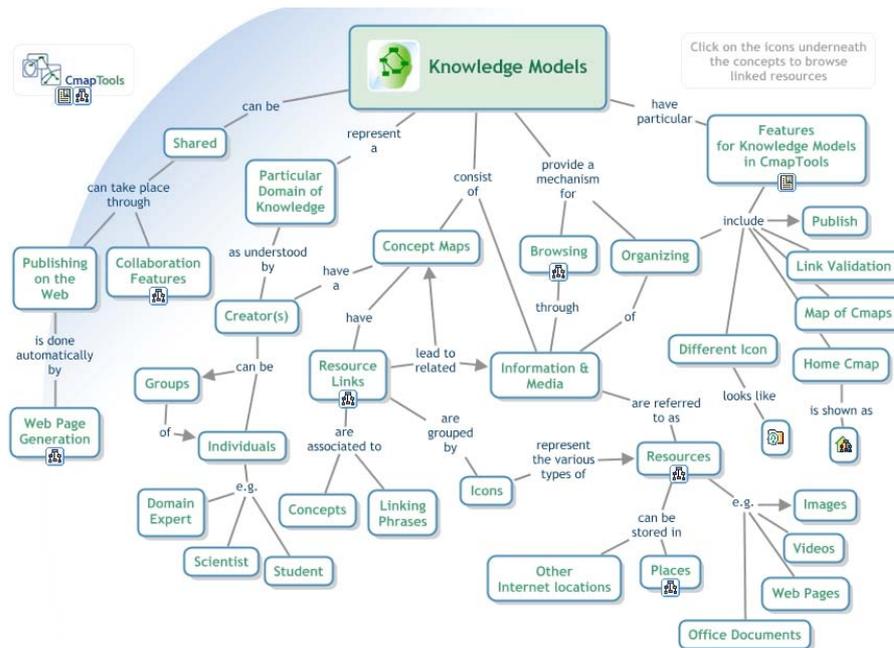
Figure 1. Support for Knowledge Models in CmapTools (from http://cmapskm.ihmc.us/rid=1064009710027_1421983319_27104/).

The second limitation is due to the way the Web version of the Cmap is implemented, which consists of a static image of the Cmap together with javascript code to implement the links on the icons under the concepts. The static image implies that the size and resolution of the Web version of the Cmap is determined at the time the Web-version of the Cmap is generated and does not take into account the size or resolution of the screen where the Cmap is viewed. For example, a Cmap may display very small on a large 27" screen, not taking advantage of the size and high resolution of new screens, or will display larger than the size of the screen on a small netbook. The limitations in the implementation are more obvious, and critical, when browsing a Knowledge Model using a tablet such as an iPad or a smartphone: the icons underneath the concepts that are 'clicked' to display the list of linked resources are most of the time displayed too small to be 'tapped' on a tablet. In this paper we report on an effort to overcome this second limitation.

4 Objectives of the New Viewers

To provide a better experience while navigating through Knowledge Models on an iPad and on the Web we developed a Viewer program for each platform. The development of these two Viewers followed the following objectives:

4.1 Scalable Viewer

The Viewer should scale the Cmap to the size of the window or screen instead of displaying a static image. To achieve this, the Viewer renders the CXL (Cañas et al., 2006) version of the Cmap as an SVG image. Since the Viewer renders the image at the time its displayed, it is presented at the highest resolution and taking advantage of the size of the screen or window. In addition, if the Cmap is resized the image is re-rendered without any loss in quality.

4.2 Presentation Mode

To better present the Cmaps, the Viewer should provide the possibility of displaying the image scaled to the size of the display. On the iPad the Cmap takes over the whole screen. On the Web, the Viewer scales the image to fill the browser's windows. If the browser provides the feature of displaying full-screen, it will then allow the display of the Cmap full screen. The Viewer will scale and re-render the Cmap to fill the screen as the user resizes the window or enter/exits the Presentation Mode.

4.3 Lists of Resources

Briggs (2004) -- who has built some of the largest Knowledge Models we are aware of -- reports on the need to provide alternative ways to reach Cmaps and resources in addition to navigating from an single Root Cmap. His Return to Mars project (http://cmex.ihmc.us) provides a categorized list of Cmaps that provides users a means to open a Cmap directly. The Viewers should provide categorized lists of resources in addition to Cmaps, such as videos, images, documents, Web pages, etc. Through these lists the user should be able to select these resources directly.

4.4 Configurable

The Knowledge Model support on the CmapServer does not provide all the information needed by the Viewers, as will be explained when each Viewer is discussed in detail below. Therefore, the Viewers should read the lists of resources to display and other configuration information from a configuration file. The knowledge modeler sets up the configuration file providing the Viewer all the information it needs to display the browse-able Model.

5 The Viewer Architecture

For each Knowledge Model separate Apps are generated: an iPad Viewer App and a Web Viewer App. A suite of programs, as shown in Figure 1, generates these Apps. As described above, the knowledge modeler specifies a configuration file. This file consists of two sections. The first section contains basic configuration information such as the name of the App, icons for the App, Help videos, and other basic configuration information. The second section consists of a list of Cmaps and other resources to be included in or referenced by each App, and the categories for the classification of the resources. For each of the resources the configuration file will indicate information indicating whether the resource will be included in the iPad App as a local resource or a remote source, the URL to the resource in a CmapServer, the type of resource, etc.
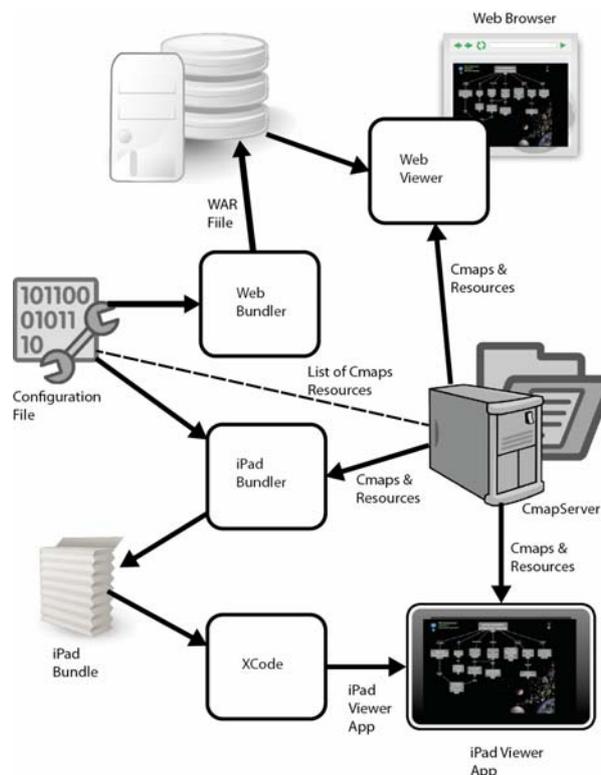
Figure 2. Architecture of the environment used to generate the iPad and Web Viewer Apps.

For the iPad Viewer, a separate iPad App is generated for each Knowledge Model. An iPad Bundler program obtains configuration information from the configuration file, retrieves from the CmapServer(s) the resources that are to be stored locally in the iPad in CXL format, and generates an iPad Bundle (set of files). Using Apple's Xcode Development Environment, the information in the iPad Bundle is used to generate an App

that contains the iPad Viewer and all the local resources. This App is then transferred to the iPad, where it can be used to browse through the Knowledge Model.

In the case of the Web Viewer, a Web Bundler program obtains configuration information from the same configuration file and generates a WAR file that is then transferred to a server machine to run under the Tomcat Web server. In the case of the Web Viewer, there are no "local" resources to be retrieved at this stage. That is, all resources accessed by the Web Viewer are from the CmapServer or other Internet locations. The Web Viewer app is then launched from a Web Browser program to navigate through the Knowledge Model.

6   Sample Apps: Rationale for Human Space Exploration & Cmappers.Learn

We present two examples of Knowledge Models for which Viewer Apps have been generated.

6.1   SpaceExp: Rationale for Human Space Exploration

As part of a research project at IHMC sponsored by NASA, we developed a large-scale Knowledge Model on the *Rationale for Human Space Exploration*. The purpose of the effort was to construct collection of concept maps and associated resources that explained why humans should continue to explore space. The target user was any 'intelligent, interested' user. The project covers the human exploration of the Moon, Mars, Mars' Moons, and Near Earth Asteroids. It also incorporates a large number of maps and resources from the Return to Mars project developed by Briggs (2004) mentioned above.

The Knowledge Model consists of 130 Cmaps. After confirming that short video clips from expert scientists and astronauts from NASA were a fitting complement to the Cmaps, 227 interview video clips were prepared and linked to the Cmaps. Several hundred other video clips, and over a thousand images and Web pages were included in the Knowledge Model. The Web Viewer for the SpaceExp Knowledge Model can be reached at http://spaceexp.ihmc.us.

6.2   Cmappers.Learn

The second Knowledge Model for which Viewers were generated corresponds to the Cmappers.Learn site for learning how to do concept mapping through the navigation of Itineraries (Cañas & Novak, 2010). This is a much smaller Knowledge Model, which is under development and currently consists of less that 10 concept maps. It provided a good contrast to the large scale SpaceExp Knowledge Model.

7   iPad Viewer

Figure 3 shows a screenshot of the full screen display of a Cmap/Itinerary from the Cmappers.Learn iPad App. Tapping on a concept that has resource icon(s)s displays a list of all resources that are linked to that concept, as shown in the figure. In Figure 4, a Cmap from the SpaceExp Knowledge Model is not displayed full screen, allowing the list of categories to display at the left (in this case "Human Space Exploration", "Moon", "Mars", "Asteroids", "Videos"). If a category is tapped, the list of local resources for that category is displayed, from which a resource can be tapped to display it. Above the list a search box allows the user to search for Cmaps and resources that match a term.

The configuration file determines which resources are copied onto the iPad and which ones remain in the CmapServer(s), allowing the knowledge modeler to decide the desired size of the App (storing videos on the iPad consume a lot of memory). Figure 4 shows a user tapping on a concept to display the list of linked resources.
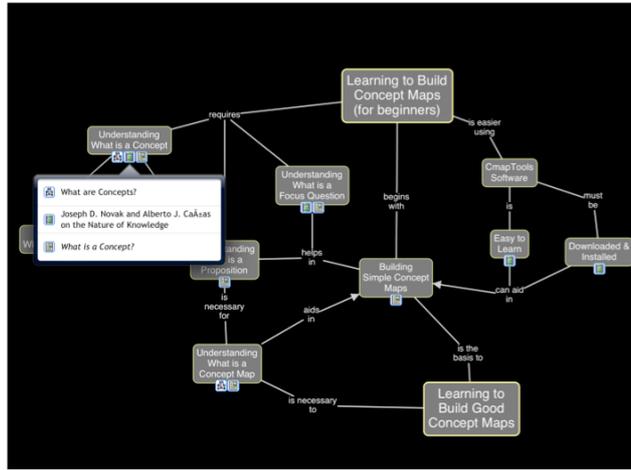
Figure 3. A full screen screenshot of the Cmappers.Learn iPad App showing a list of resources linked to a concept.
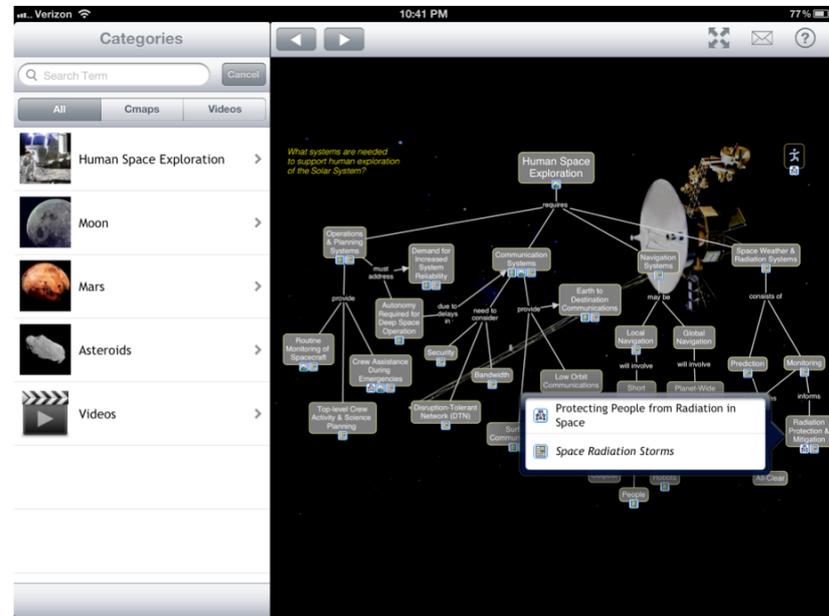

Figure 4. The SpaceExp iPad App with the list of categories on the left which provide access to the lists of resources stored locally on the iPad. The App also allows users to search for Cmaps and resources that match a term.

Figure 5. User tapping on a concept to navigate through the SpaceExp iPad App.

8   Web Viewer

The Web Viewer provides a much better navigation experience than the Web version of the Cmaps. Figure 6 shows the Root Cmap for the SpaceExp Knowledge Model. Menu entries above the Cmap provide options to "Enter Presentation Mode" and to display the list of "Cmaps and Videos" (see Figure 7). The Cmap displayed is scaled to fill the available space in the browser's window. The Web Viewer retrieves the Cmaps in CXL format from the CmapServer and renders the Cmap in SVG. Figure 7 shows a partial view of the list of Cmaps available under the selected Asteroids category, displayed after selecting the "Cmaps and Videos" category in Figure 6. To display the rest of the list of Cmaps the user must scroll window in the Web Browser. Figure 8 shows the result of clicking on the "Presentation Mode" option. The Web Viewer rescaled the Cmap to the size of the window. Some Web Browsers have the option to remove the top tab or menu and display the Cmap full screen.
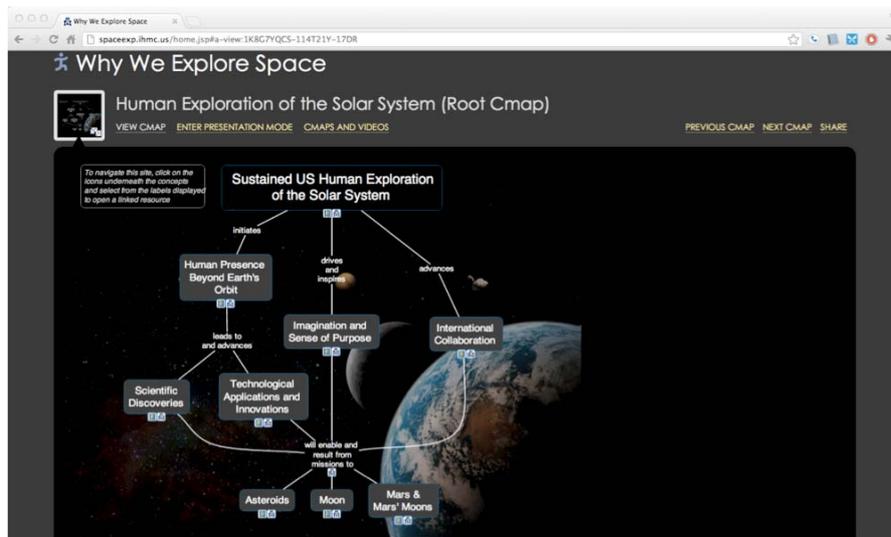

Figure 6. The Root Cmap for the Web Viewer version of the SpaceExp Knowledge Model.
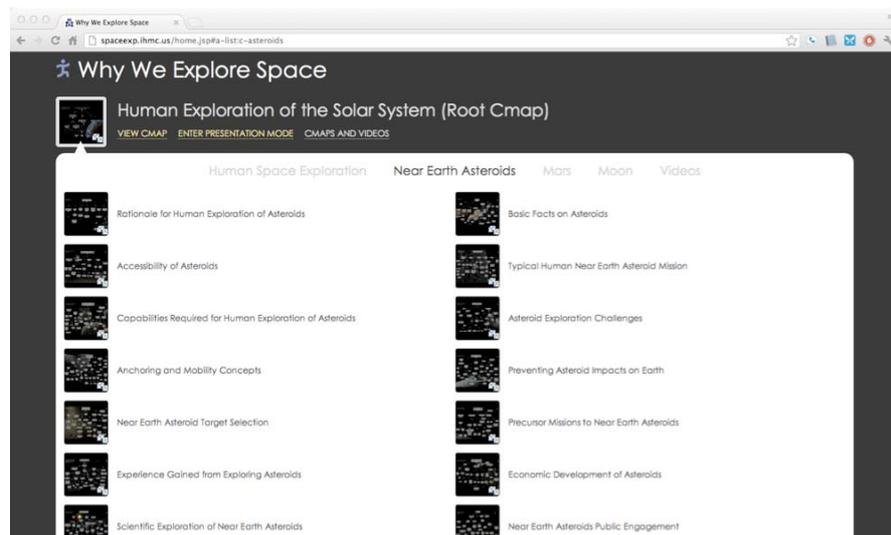

Figure 7. The List of Categories and a partial view of the list of Cmaps on Asteroids as displayed by the Web Viewer of the SpaceExp Knowledge Model.
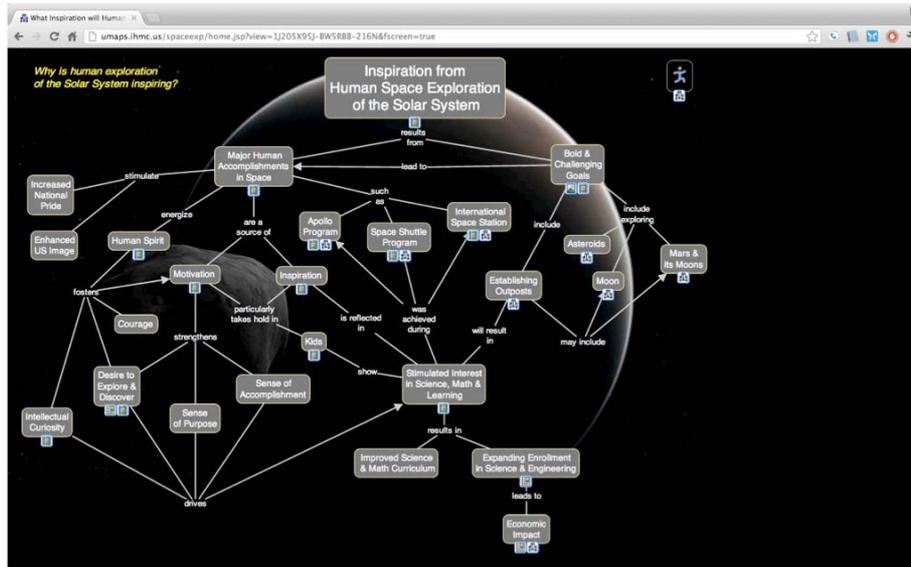
Figure 8. The Web Browser window after the Presentation Mode option is selected in the Web Viewer for the SpaceExp Knowledge Model.

9 Conclusions

New Knowledge Model Viewers for the iPad and the Web have been developed that improve on the navigation experience of the HTML-based Cmaps generated by CmapTools. A software environment utilizes user-prepared configuration file to refer to or retrieve Cmaps and other resources stored in a CmapServer to generate Viewer Apps (a WAR file and an iPad App) for each particular Knowledge Model that are then stored on a Web server and moved to iPads.

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