Evaluating Large Image Support for DSpace

Marius Nel, Kyle Williams, and Hussein Suleman

Department of Computer Science
University of Cape Town
Private Bag X3, Rondebosch, 7701
realrocknroller@gmail.com, {kwilliams,hussein}@cs.uct.ac.za

Abstract. Access to large images in digital libraries is desirable from a preservation perspective and may even be a requirement in some domains, such as cartography. However, providing access to large images often poses a problem as a result of the size of the images as well as the limited screen real-estate for displaying the images. Even when these issues are addressed, there is a lack of evidence about how well large image related tasks can be performed in a digital library. In investigating this, a survey was conducted in order to identify well-performing large image support tools and the best of these tools was integrated into DSpace. A user study was conducted in order to evaluate how well large images could be supported in a digital library and it was found that users were able to successfully and easily perform tasks related to large images.

Key words: DSpace, large image support, preservation

1 Introduction

Digital archives and collections often include high resolution images that have been captured in a lossless format in order to preserve as much detail as possible. This is desirable from a preservation perspective in order to ensure high quality data and may also be necessary from a domain perspective, for example, in cartography, where minute levels of detail are desirable. The problem arises, however, in providing access to large digital images in a digital library. These images may run into 10s or even 100s of megabytes in size, making real-time access via the Web infeasible. Furthermore, typical computer screens are only able to display a fraction of the resolutions of large images, thus forcing solutions such as scaling of images, which results in significant loss of detail.

While many of these issues have been addressed on the Web, to the knowledge of the authors, no formal study has ever been conducted in order to evaluate interaction with large images in a digital library. In investigating this issue, this paper describes the integration of a well-performing standard large image support tool into DSpace and then evaluates the use of large images in a digital library by means of a user study. The hope is that, in doing so, insight can be gained into the usability of large images in a digital library.

2   Related Work

There are a number of approaches to supporting large images on the Web. The most common approach involves the use of Zooming User Interfaces (ZUIs) [1], that provide an infinite canvas that can be accessed through panning and zooming controls [2] and that allow users to zoom into layers of an image. Images being accessed through a ZUI often are constructed from multiple derivative images or an image pyramid where the original large image is processed to produce "tiles" of the image at different scales. The user can then zoom into the tiles that they are interested in, in order to access the desired level of detail. This method successfully limits the amount of data transferred to only match the region of interest at the user's zoom level. An example of a popular ZUI interface is Google Maps[1]. One of the few tools that provides large image support in a digital library is @mire's Image Zoom Module[2], which integrates with the DSpace platform to provide image processing to facilitate ZUI-based large image support. Another example of a large image support tool is Zoomify Image [3], which is based on the Zoomify tool to create tiled images and display them via a content management system. An alternative approach to tile-based zooming is used in the Djatoka project [4], which supports large images by taking advantage of JPEG 2000's multi-resolution file format.

While the above all clearly address the two main issues related to large images - large image size and limited screen real estate - none of them have explicitly evaluated the use of large images in digital libraries.

3   A Survey of Large Image Support Tools

There are a number of large image support tools. In order to gain an idea of the usability of current large image support solutions, a user survey was conducted where users were asked to complete a set of large image related tasks with four different tools and then asked to comment on their usability. The tools investigated were: Zoomify[3]; Microsoft Seadragon[4]; the West Texas Digital Archives (WTDA) implementation of @mire's Image Zoom; and Northwestern University Library's experimental large image viewing solution. 24 users with technical and creative backgrounds completed the survey and answered 7 questions (on a scale of 1-5) related to: the ability to perform image zooming tasks (Q3); rating of control (Q4), feedback (Q5) and response (Q6) mechanisms; and rating of the effectiveness of the different tools (Q7). Figure 1 summarises the results of this survey for questions 3-7 (questions 1 and 2 required yes/no answers and had similar results for all tools). As can be seen from the figure, Zoomify and Seadragon were consistently given better ratings for issues related to control, feedback, response and usability in general. Based on these findings, the decision was made to integrate Seadragon into DSpace as a large image support tool.
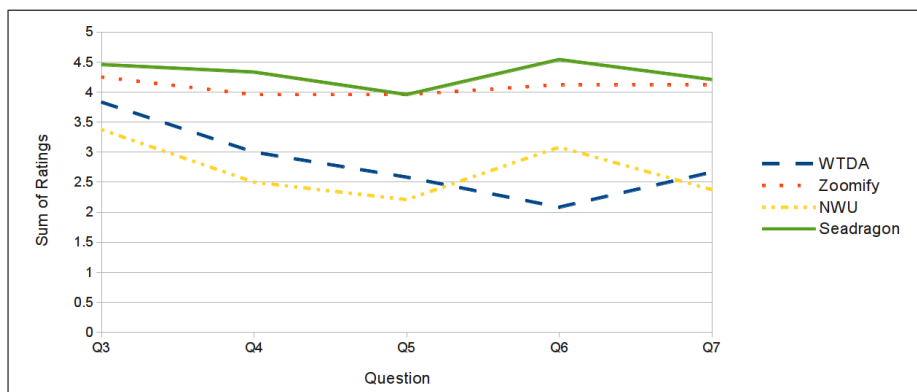
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[1] http://maps.google.com/
[2] http://atmire.com/website/?q=modules/iz/
[3] http://www.zoomify.com/
[4] http://seadragon.com/developer/ajax/

Fig. 1. Average responses for questions on usability of tools

4   Incorporating Large Image Support into DSpace

In order to comply with DSpace's data organisation, DSpace *items* are used to represent large images and *bundles* to represent tiles and supporting files. To create the image tiles, Microsoft Deep Zoom Composer[5] was used. The output of Deep Zoom Composer is a directory that contains the image data XML file and sub-directories that store tiles for each tier of the image pyramid. However, DSpace bundles expect all bitstreams to be in a single directory, thus the output of the Deep Zoom Composer was modified to output all tiles to a single folder.

DSpace's batch import function was used to import images and their tiles. The batch import function requires that there exists: a qualified Dublin Core metadata record for each item; a mapfiles folder to accompany all imported items; and a contents file that lists each bitstream in an item's bundle. In addition, for each image-item, a HTML file is generated that serves as the primary bitstream for the item and that contains a reference to the image data XML file, which is used to locate the image tiles. A desktop tool was developed that facilitates the batch import by allowing the user to select the large image to import and specify the collection details. The tool automatically handles the processing of the images to create tiles and the ingesting of the data into DSpace.

Viewing of large images was provided by Seadragon, which was modified to read image tiles from a single flat directory structure. While this tool provides similar functionality to @mire's Image Zoom Module and other large image support tools, to the knowledge of the authors, this study presents the first formal evaluation of large image support in digital libraries.

5   Evaluation

A user study was conducted to evaluate the large image support tool, when integrated into DSpace. 24 participants took part in the evaluation, which re-

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[5] http://msdn.microsoft.com/en-us/library/dd409068/

quired users to use the desktop import tool to import large images into DSpace and also use the Seadragon interface to interact with the large images in the repository. Some of the participants in the study were recruited via the DSpace General Mailing List, while others were computer science students and professionals working in the field of online marketing and Web development. All users were able to easily use the tools to import large images into DSpace, suggesting that the tool greatly simplified the task and abstracted away the complexities of creating and importing image tiles. In terms of interacting with the large images, all users were able to view large images, pan across them and zoom in and out of them. Comments from the user feedback included *"that was easy"* and *"smooth zooming effect"*. Given that users were able to perform the large image related tasks and that Seadragon was rated by the users as being highly usable, it can be concluded that the interface could successfully provide a usable means of interacting with large images in a digital library.

While the user study showed that users were able to interact with large images in a digital library, the amount of bandwidth consumed is also important since it directly affects usability. To investigate bandwidth usage, an experiment was conducted to measure the extent to which the bandwidth consumption could be reduced. Measuring the bandwidth consumption while interacting with 6 large images, ranging in sizes of 10-150 megabytes, over a period of 5 minutes on a 34KBps connection, showed that the interface led to data transfers of between 9 and 45% of the size of the original images, with the largest percentage being for the smallest images. The average data transfer for the 6 images was 22% of the size of the original images. These findings clearly show how the reduced bandwidth usage improves usability by reducing image loading times.

6   Conclusions

While supporting large images on the Web is not new, there is little evidence of how well they can be supported in a digital library and if users are able to perform large image related tasks. To investigate this, a well-performing large image support tool was integrated into DSpace. A user study found that users were able to successfully import large images and perform large image related tasks effectively. Furthermore, the system led to a significant reduction in bandwidth utilization, thereby further improving usability by reducing image loading times.

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