A Bucket Architecture for the Open Video Project

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ABSTRACT
The Open Video project is a collection of public domain digital video available for research and other purposes. The Open Video collection currently consists of approximately 350 video segments, ranging in duration from 10 seconds to 1 hour. Rapid growth for the collection is planned through agreements with other video repository projects and provision for user contribution of video. To handle the increased accession, we are experimenting with "buckets," aggregative intelligent publishing constructs for use in digital libraries.

Categories and Subject Descriptors
H.3.7 [**Digital Libraries**]: - *collection, dissemination, systems issues.*

General Terms
Management, Documentation, Design, Experimentation.

Keywords
Digital Video, Digital Objects, Open Source, Buckets.

1. INTRODUCTION
The Open Video project provides a World Wide Web (WWW) accessible standard corpus of public domain video segments suitable for use by the research and education communities [1]. The Interaction Design Laboratory at UNC is the first research group to use this collection of video for research in alternative searching and browsing interfaces for digital video. Other prominent digital video projects, such as Carnegie Mellon University's Informedia Project [2], are not publicly available due to copyright limitations. Another digital video collection, the Internet Moving Images Archive [3], but only some is available at the time of this writing and it is only in MPEG-2 format.

In addition, we are experimenting with storing the video in "buckets": aggregative, intelligent publishing constructs [4]. Buckets are aggregative in that they combine data, metadata and the methods defined on them. This is designed to prevent the information "drift" we have observed in digital libraries (DLs) when there is a multiplicity of data and metadata types and formats which become "unlinked" and "lost" over time. Buckets are intelligent in that they are entirely self-contained and self-sufficient. They do not depend on the existence (or absence) of any particular DL, repository, database or search engine. As a result, they manage their own contents, enforce their own terms and conditions, and internally transport their source code.

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2. ORIGINAL IMPLEMENTATION
The original architecture for the Open Video project was centered around the relational database management system (RDBMS) that maintained the descriptive and structural metadata. The video segments were only in MPEG-1 format, and some of the video segments also had textual output from the "mpeg_stat" program associated with them. The MPEGs and output files were stored as files on a Unix filesystem, and the RDBMS maintained the URLs to these files in its metadata.

However, as the collection grew this approach would have became increasingly unwieldy. Open Video is planning to add multiple video encodings and formats: MPEG-2, AVI, QuickTime, and possibly others. Similarly, we are experimenting with alternate methods for browsing video segments, including overviews, previews, and AgileViews [5]. We are also using software to extract the keyframes from a video and store them as JPEGs, GIFs or PPMs. In short, each logical video segment represents an increasing number of physical data objects, many of them derived from the original segment, and some of them transient and experimental. Rather than expose this level of complexity to the RDBMS, we encapsulate the varying and dynamic nature of video segments into buckets.

3. BUCKET ARCHITECTURE
Buckets provide an aggregative container mechanism to hold all data items that comprise the logical unit of a video segment. Buckets are currently implemented as individual Perl CGI scripts, and their API is accessible through http encoded messages. Although bucket tools make use of the API, buckets appear as normal web sites to the casual user.

There is a subtle shift in responsibility in the bucket architecture. Where the RDBMS used to contain the canonical metadata for the collection, the buckets are now canonical. The metadata is still stored in the RDBMS, but it is harvested from the buckets themselves. We believe this makes it easier for the video segment buckets to be included in other DLs, since all data and metadata content is available directly from the buckets.

An example of a video bucket can be seen in Figure 1. This is the result of direct access to the URL:

http://buckets.dsi.internet2.edu/openvideo/buckets/ov-71/

which is the same as invoking the default "display" method:

http://buckets.dsi.internet2.edu/openvideo/buckets/ov-71/?method=display

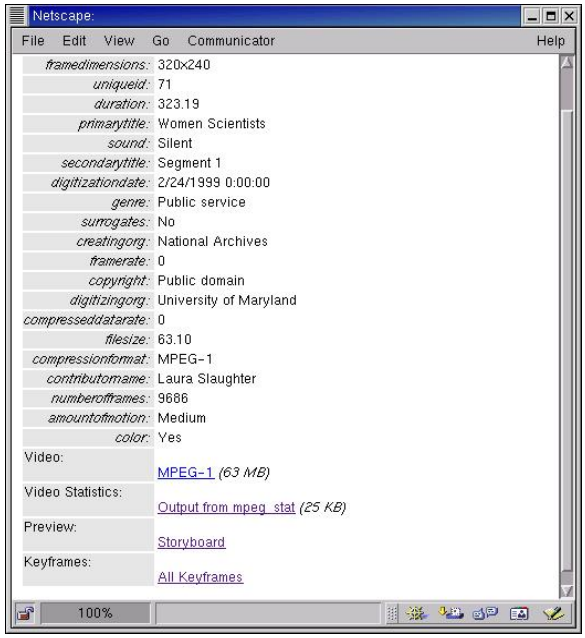

Figure 1. Default Display Method for a Bucket.

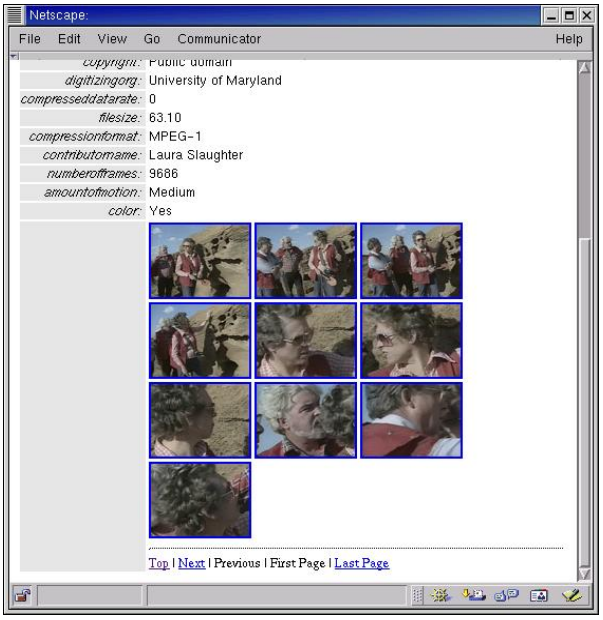

Figure 2. Video Storyboard With Selected Keyframes.

Figure 1 shows all collected information about this one video segment, including the MPEG-1, the textual analysis of the MPEG-1 file, all keyframes, and a video storyboard of 20 keyframes, with pagination control (see Figure 2).

Direct use of buckets exposes the user to the granularity of storage. However, this is not strictly required. It is possible for the interface to present a horizontal slice of the video contents. In Figure 3, the user has requested all video segments that comprise an entire video. Since the MPEGs are individually accessible, each video icon in Figure 3 can link to URLs similar to:

http://buckets.dsi.internet2.edu/openvideo/buckets/ov-71/?method=display&pkg_name=video.pkg&element_name=video.mpg

Thus, the presentation granularity (e.g., all MPEG-1 files that comprise an entire video) does not have to be equivalent to the storage granularity (e.g., all files that comprise or are derived from a single video segment).

4. CONCLUSIONS

We have built a test implementation of the Open Video collection using buckets and are evaluating its performance in anticipation of adopting this architecture as the project evolves. Successful deployment of buckets will not impact the search, browse and preview experience of Open Video users, but should allow for greater flexibility in sharing the Open Video buckets with other projects and long-term management of the project's physical resources. Buckets provide a significant shift from RDBMS as canonical to stored objects as canonical in a DL. This shields the RDBMS (and DL as a whole) from the fluid nature of individual file formats and derived data types.

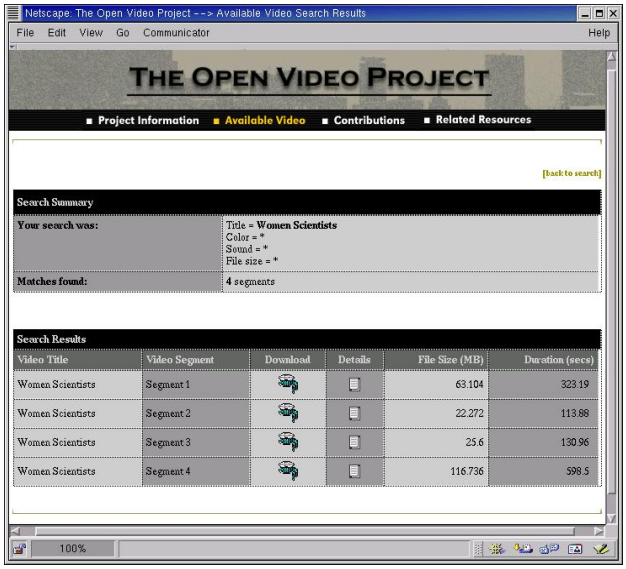

Figure 3. The Open Video Search Results Page.

5. REFERENCES

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