Enabling Lightweight Video Annotation and Presentation for Cultural Heritage

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ABSTRACT. Collaboration-intensive research is increasingly becoming the norm in the humanities and social science arenas. eResearch tools such as online repositories offer researchers the opportunity to access and interact with data online. For the last 20 years video has formed an important part of humanities research, although dealing with multimedia in an online setting has proven difficult with existing tools. File size limitations, lack of interoperability with existing security systems, and the inability to include rich supportive detail regarding files have hampered the use of video. This paper describes a collaborative data management solution for video and other files using a combination of existing tools (SRB and Plone integrated with Shibboleth) and a custom application for video upload and annotation (Mattotea). Rather than creating new proprietary systems, this development has examined the reuse of existing technologies with the addition of custom extensions to provide full-featured access to research data.

1   INTRODUCTION

As information technology facilitates more avenues of research enquiry, the volume of data created has increased exponentially. Coined the 'data deluge' (Hey and Trefethen, 2003), this vast corpus is growing more difficult to navigate as the volume of data approximately doubles every nine months (Kargupta et al. 2003). In the humanities as well as the sciences, this information is generated from the combined output of multiple computerised systems, simulations, instruments, sensors and the transfer of previously offline resources such as books, publications, and charts into online repositories and digital libraries. As new research is undertaken this data is stored in digital form in online archives for use in collaboration and analysis. eResearch applications in the form of online multimedia tools like blogs, podcasts and videos are increasingly being chosen as the medium of exchange for collaboration during projects and for the dissemination of results. eResearch tools offer the ability for researchers to collaborate online, share data and to facilitate knowledge transfer.

Since the 1980s, the use of video has been a feature of humanities research. Goldman-Segall (1989) suggests that video provides a method of obtaining a "thicker description" than that available by field notes or audio alone. Video can be used as a "quick and dirty" ethnographic technique to deepen the data gathered in the field (Millen 2000) so that if prolonged amounts of time cannot be spent on a site, rich detail can be still be obtained from the video resource. Video is increasingly being used to preserve and transmit cultural heritage that is in danger of being lost. Video histories are an important use of technology in Aboriginal contexts to preserve Traditional Knowledge and write indigenous voices back into Australia's colonial and modern history (Carroll et al. 2002). Cultural knowledge is often transferred orally, but when a group becomes widely dispersed this can become difficult. These recordings not only provide a means to pass on knowledge and culture to the groups' own descendents, but become a rich resource for external researchers (Bidwell et al. 2008). Another valuable service provided by video is in the creation of teaching materials. Education is increasingly being delivered online in an attempt to provide services to students who may not otherwise be able to attend lectures (Harasim 2000). Video recordings of lectures or documentary footage showing the steps necessary in a technical or practical setting are becoming more common (Zupancic and Horz 2002). Annotations of these videos can provide additional information regarding the activity being observed.

Although digital video has become a popular recording medium in both private and public projects, dealing with the complexities associated with working with the files in an online setting has proven difficult with existing tools. To illustrate this point, let us examine some of the restrictions placed on file upload and sharing on online video repositories. Although variations in functionality exist between different online repositories, most hosting applications display files in Flash (FLV) format, therefore, any files submitted are converted from their original format to FLV during the upload process. This adds considerable time to each upload (approximately 1-5 minutes per MB when using a broadband connection). Dealing with fine-grained access is another ongoing issue. Videos often must be either public (everyone) or private (specified contact list), and these details must be set individually for each video. In addition file size restrictions are now being implemented as popularity of these sites have increased, therefore new accounts are often restricted to upload of videos of 10 minutes in length and less than 1GB in size. Many online video repositories are unable to make use of existing authentication schemes such as LDAP or Shibboleth and require ad hoc user validation. This in essence means that users may need to login multiple times; first to their local network and then into the external data repository. An additional issue surrounds the need for researchers to add supplementary material associated with the video. Although some video collections offer the ability to link to external resources, the video is provided as a stand-alone resource. We determined from interviews with our user group (an Indigenous group named the Gugu Badhun) that there was a need for a full-featured video repository, capable of accepting multiple file types and large file sizes, able to integrate with external user authentications systems, providing fine-grained file access management and capable of housing additional documentation and files regarding each video resource.

These requirements could not be met by currently available eResearch tools, which prompted us to develop the application described below. In this paper we will describe a lightweight, online video annotation system that aids researchers in creating and maintaining video repositories with the goal of adding increased value to the data by the inclusion of targeted metadata, context sensitive annotations, collaborative facilities as well other supportive resources. Following a description of this project, in Section 6 we offer further observations regarding the use of web interfaces to digital repositories.

2   A USER STORY: GUGU BADHUN DIGITAL HISTORY ONLINE

The past several years have seen fierce debate in the public arena about the nature of frontier relations and the impact of colonial settlement upon Indigenous people (Reynolds 1989, 1996; Windshuttle 2002; Roberts 2005). Until the publication of detailed studies of frontier relations by Henry Reynolds (1982) and Noel Loos (1982), the Indigenous peoples of North Queensland either did not figure in the region's history or received brief mention in the course of narratives focused on the exploits of explorers and pastoralists. On reviewing the wealth of argument and commentary relating to the stolen generation (Dodson and Wilson 1997, Neil 2002) and the nature of frontier relations, it seems clear the we risk simplifying the historically complex and diverse experiences of Indigenous people and those non-indigenous people with whom they interacted by not exploring history from Indigenous as well as European viewpoints.

The Gugu Badhun people are the Aboriginal traditional owners of the land surrounding the Valley of Lagoons, an inland area to the north-east of the Burdekin River including the town of Greenvale in north Queensland. In the earlier days of colonialism, members of their group were able to live on their traditional country by working on cattle stations. However after World War II with changes in labour laws regarding equal pay, the people began to disperse off of the Valley of Lagoons to find work. Today the Gugu Badhun are spread across sparsely populated rural locations in North Queensland such as Greenvale, Mt. Isa, Charters Towers and Townsville. Elders of the Gugu Badhun community have worked over the past several years to record their language, customs and history in order to pass them on to their descendants and people outside their group. In 2005, the Gugu Badhun requested assistance in creating an online repository for over 50 hours of oral history that they had recorded on digital video (Hardy et al. 2007). As part of the Dataset Acquisition, Accessibility and Annotation eResearch Technologies project (DART; a multi-university programme sponsored by the Australian Commonwealth Government's Department of Education, Science and Training to enable researchers and reviewers to access original and analysed data, collaborate around the creation of research outputs, stored publications, plus add content, annotations and notes), the Gugu Badhun volunteered to work with us to test the use of Mattotea as a mechanism to upload and annotate their oral history and heritage videos.

3 SYSTEM ARCHITECTURE

The development of the video annotation tool was originally targeted toward a cultural history use case, while keeping in mind potential benefits to researchers in other disciplines who would be interested in this application. The Gugu Badhun requested an application that would make it very easy to upload and share digital videos. All subsequent software requirements and development were judged against this criterion. After further discussion with the user group, the development team determined that an online system rather than a desktop-based application would be needed to provide universal access to the data. Administrative features such as file upload and annotation should be restricted based on the users login. Metadata requirements for each video would be determined the site administrators, and there should be no limit to the number of annotations that could be added to each file. In addition, space for a large repository should be made available and this should scale as the videos grew in size and number. Furthermore, the ability to add supplementary files such as web pages about a video or photos and audio files would be needed to make the materials a richer resource.

Based on these initial requirements, design of the application centred on a combination of currently existing open-source software and the creation of a custom-developed video annotation tool. We chose Storage Resource Broker (SRB) as the backend data management tool for the data repository. SRB acts as a 'broker' by mediating access to resources stored in distributed locations (Rajasekar et al. 2003). SRB is widely used in eResearch and allows users to access collections held in federations (i.e. geographically separate locations), via resource queries (Moore et al. 2006). This allows the data to grow as needed and be externally administered by the data holders via a single interface (Hardy et al. 2006). SRB maintains a metadata catalogue (MCAT) containing the storage location of the data as well as metadata describing additional details regarding each file. While SRB provides robust file storage and management facilities, user interfaces to the system have limited functionality (Wyatt et al. 2006). In order to create an easy to use application for video upload and annotation, it was necessary to develop a front-end application capable of interacting with SRB. For the base user interface we chose Plone, an open-source content management system (Zhang et al. 2005). We installed a generic Plone portal and then created a custom video annotation tool dubbed Mattotea, capable of interacting with SRB and embedded it within Plone. This provides two benefits: the ability to create a website for the Gugu Badhun where they can upload photos, stories and video and also give access to the videos through a combination of Plone, Mattotea and SRB. In this implementation, we are utilizing SRB as storage repository, Mattotea as the video annotation and display tool, and Plone as the web container for Mattotea and additional supporting content.
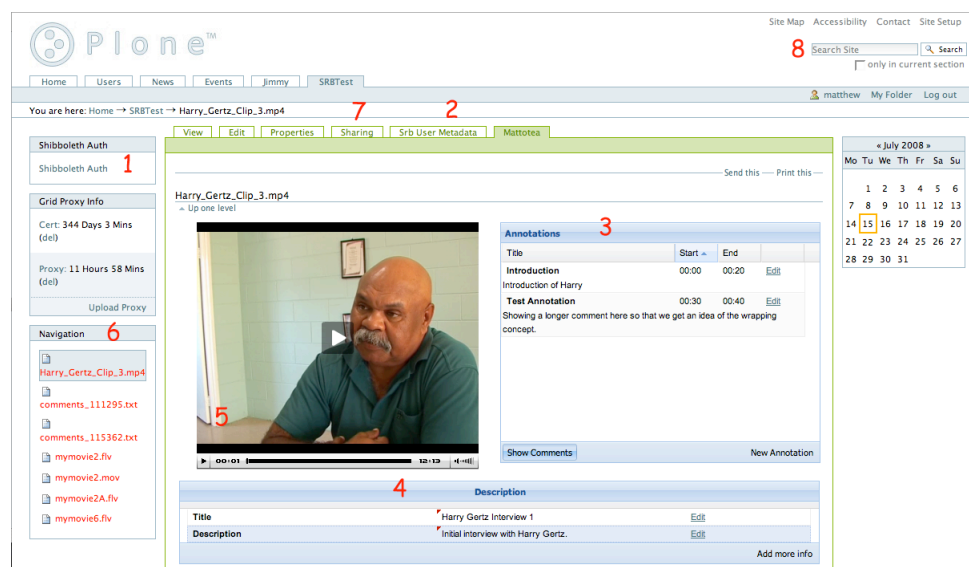

Figure 1 – Mattotea embedded in Plone

1. Shibboleth login	2. SRB Metadata tab	3. Annotations
4. Additional Metadata	5. Video Player	6. File Library
7. File Sharing	8. Live Search	

4   FEATURES AND FUNCTIONALITY

Mattotea is a custom, open-source video annotation tool used to provide both access to, and interaction with persistent data held in digital libraries. Figure 1 above shows a sample set of data loaded in the system. The application is a simple, lightweight, collaborative, web-based video annotation system that provides users with the ability to upload video data and annotate it. The application is connected to a federated data repository in SRB and allows the presentation of videos through an embedded flash player capable of handling multiple file formats. Collaborative comments or annotations can be added via a simple interface. Annotations can be applied at a single frame in the video or cover a specified duration of time and locations in the data. Users can add comments regarding the view in a separate comments box.

In combination with SRB, Plone and Shibboleth, Mattotea provides functionality surrounding four general areas of use: data collection, file management, security and collaboration. Each of these types of functionality is considered further in the following sections.

4.1 Viewing the Data Collection

Upon navigating to a Mattotea-enabled website, the user will see a list of any resources that are publicly available. In order to view secured items, the user will need to login via Shibboleth (described in more detail in section 4.3). After login, the navigation pane is updated to display a list of videos that the user has been granted access to. Users can browse to a video via the navigation tree or by utilising the Search box at the top of the page. The system searches through not only the file names, but also the associated embedded metadata, annotations and comments. Videos in multiple file formats can be viewed within the interface by clicking on the file link that loads the file in the embedded video player. A robust cache accelerator optimises of the display of multimedia files within Plone.

4.2 File Management

When a user uploads a file into Mattotea, the system will allow files to be stored in Plone, but the optimal solution is to store the file is SRB. This allows the user federated access to widely distributed data via the one interface. Mattotea provides a simple method for uploading files to SRB; the user selects "Add new SRBobject" from a menu, and is prompted to choose the file from a local system. The application automatically extracts basic information regarding the file such as filename, size, format and date, and saves this to the metadata catalogue in SRB. Access to this metadata is provided via the SRBMetadata tab. Users can chose to set a custom metadata template for the system, or accept the default setting that allows user-entered metadata to be optional rather than required. Users with sufficient permissions are able to set file access rights to the videos that they upload.

4.3 Security

Mattotea is Shibboleth-enabled, allowing the system to use external authentication credentials associated with the Australian Access Federation (AAF). When the user enters the appropriate login credentials he or she is given access to the application. In Plone, each user is given a specific role that determines their level of access and authentication. The roles currently available are: logged in user and manager. Only managers have approval to upload videos, and add annotations. Plone handles fine-grained file permissions via ad hoc sharing which gives a particular person permission to view or annotate files based on a Plone group. An audit trail is provided via the user logs in the Plone interface.

4.4 Collaboration

Once the file has been uploaded, annotations can be added, specific to a temporal location and duration in the file. An annotation is made up of several pieces of metadata which are stored in the MCAT in SRB: Title, Start, End and Comment. Only site managers are allowed to create annotations, but all logged in users should be able to view this data. The user can either use the scroll bar on the player to navigate to a section where an annotation should be added, or let the movie play and click the "New Annotation" link when the appropriate section comes in view. If a user clicks on the annotation, the video will advance to that section of the recording. Annotations and comments are listed to the right of the video so that viewing of the file is not obstructed by the additional data. Multiple users can view and analyse video data concurrently. While comments on annotations have not been included in this iteration of development, collaboration via threaded messages and comments is available through Plone. Descriptive metadata in addition to that automatically created by Mattotea (at the time of file upload) can be added by clicking the "Add more info" link at the bottom of the screen. Data centric tools such as blogs, forums, news feeds available through Plone allow researchers to collaborate in creating rich datasets associated with the videos, and share this data easily.

5 IMPLEMENTATION ISSUES

Mattotea works in conjunction with SRB, Plone and Shibboleth to provide access to videos and other supplementary content stored in federated repositories. To enable this functionality, Mattotea must be embedded in an instance of Plone that has been SRB-enabled via the SRBContent product. Plone has base functionality that can be extended through the use of third-party modules called "products". In order to display Mattotea within the Plone portal and communicate with SRB, three Plone products must be installed. These products (JCU.Mattotea, SRBContent and GridProxy) were created to enable Mattotea to communicate with Plone, SRB and Shibboleth. The Mattotea module enables Plone to display the Mattotea application within the Plone framework, and the SRBContent and GridProxy products allow Plone to access data stored in SRB federations to make it available in Plone and Mattotea via certificates.
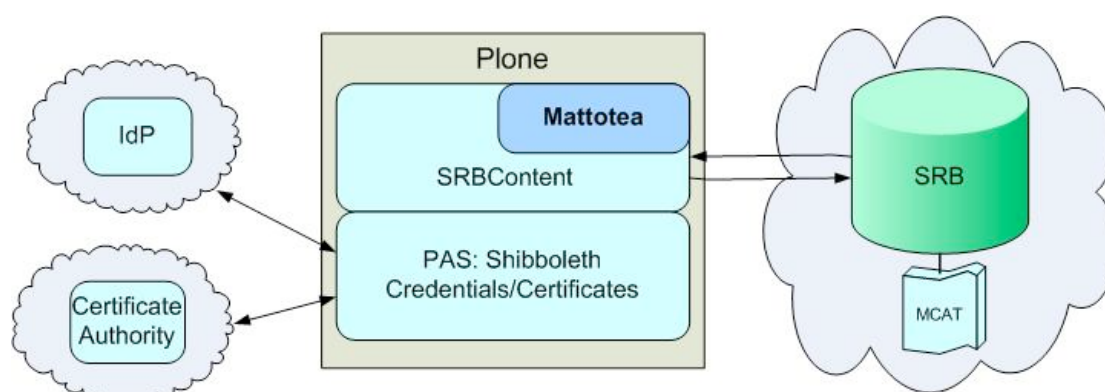

Figure 2 – Architectural view of Mattotea

Additional development was necessary to enable Shibboleth and SRBContent to work together in Plone. This an issue based on "authentication, authorisation and accounting": authentication (determining the digital identity of one person usually through login credentials), authorisation (granting of specific rights to the user based on their authentication), and accounting (tracking of the user's resource use). Users are authenticated to the system via Shibboleth, but what content they have access to is determined by Plone. This issue is complicated by the fact that some content is provided locally by Plone and some externally by SRB. Therefore the system must negotiate in three areas: external user authentication, internal file access in Plone and external federated data from SRB. A custom authentication plugin for Shibboleth was created to handle this three-fold interaction. From this point a user is now able to create SRB objects just as if the user is working from within SRB. Triggers must be set up on the SRB server to ensure that the Plone view of the data is kept in synch with SRB.

Both usability and client acceptance testing were performed on the Mattotea prior to making it available to our user group. Response from the community was positive, and members of the group were able to upload videos, set numerous annotations for each video tied to temporal locations in the video, and create additional information using the Plone CMS. Elder Yvonne Cadet-James of the Gugu Badhun stated, "At a recent meeting of the Gugu Badhun people were very thankful and emotional knowing that our history would be recorded for our future generations".

6 E-HUMANITIES IN FLUX

Key trends are changing the way that research is conducted. In recent years there has been an increase in highly collaborative, trans-national, data-intensive projects in the humanities and social science (Treloar and Groenewegen 2007). However, contrasting with this trend is an equal reticence for some to share data outside of their immediate research group. Burton (2006) found that over 75% of social scientists have never deposited research data in an online repository, and StORE (2006) reports that researchers in the humanities are less likely to share data than those in other disciplines. The rise of institutional and discipline specific repositories have added another layer of complexity to the data sharing issue. Many institutions have developed localised institutional repositories to store and make available published research outputs, often utilising ePrints or similar software (Lyon 2007). In-process data is not sought; indeed the purpose of the repository is often to substantiate research outputs for governmental or other external funding bodies. Much of this data is in danger of being lost as it is often

only saved on a users desktop or laptop and is not backed up to a secure storage area. In contrast, discipline specific repositories span multiple institutions and employ specific knowledge about the datasets belonging to a particular domain (such as DDI for Social Sciences metadata) to allow researchers to both extract the maximum amount of data from the collections and advertise their inclusion in the repository (Green and Gutmann 2006). The contrasting nature of these repositories may be leading to the demise of the monolithic, one-size-fits-all data collection. In a surprising move last year (2007), the Arts and Humanities Research Council in the UK made the decision to cease funding the Arts and Humanities Data Service; a large central archive for varied humanities data. The rationale given was that institutions now have sufficient in-house IT skills and infrastructure necessary to create and maintain repositories without outside assistance (Arts and Humanities Data Service, http://ahds.ac.uk/).
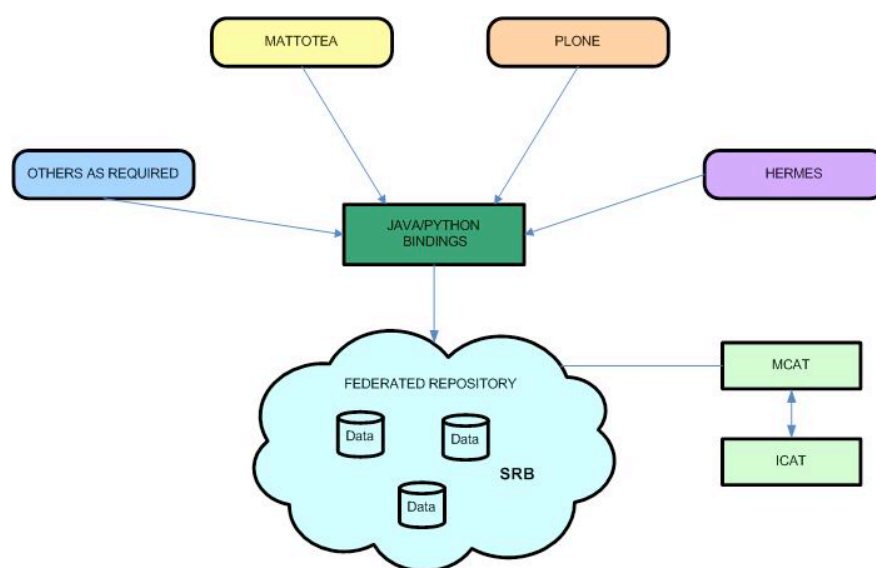

Figure 3 – Federated data repository showing access by separate interfaces

All of these issues: conflicting visions regarding data sharing, reticence to make data available to outsiders, and lack of funding and guidance from decision-makers at a higher level have led to a silo effect where separations are mandated by disciplines, power structures and the research vs publication dichotomy (Jakubowicz 2007). At the institution level, the end result is a tapestry of independent bespoke systems with widely varying requirements, structures and functionality. The burden of supporting these hand-tailored systems is placed upon the often-limited resources of local information technology departments. This problem can be ameliorated by the use of standardised frameworks across projects to create a federation of repositories. The ARROW and the ARCHER data services models (Treloar and Groenewegen 2007) are based on this foundation. Figure 3 above depicts a federation of data sources accessed by independent web-based interfaces. Each interface acts as a separate front-end to the data federation. Multiple interfaces can be built to provide alternate views of the data, thereby eliminating the silo issue where interface and database and tied inextricably together. A federation of data sources can be used to provide a unified repository that is accessible to multiple, authenticated systems and users. New systems can be created without needing to rebuild the underlying data storage infrastructure. Web 2.0 tools such as Mattotea offer the opportunity for researchers to collaborate while engaged in video-based research, as well as providing a secure, accessible storage space for their data for the lifetime of the research life-cycle.

Mattotea is based upon the combination of open-source applications; Plone and SRB; each component providing a stable, robust platform for collaboration. Using open-source instead of proprietary applications provides the opportunity for groups to adapt the functionality of the applications to suit their rapidly evolving collaboration environments. Rather than reinventing the wheel, institutions may be able to save time and energy by modifying existing tools to fit their needs. The use of ePrints across multiple institutions, as in the Australian Digital Theses program, demonstrates the effectiveness of this type of solution.

7 CONCLUSIONS

Collaboration-intensive research is increasingly becoming the norm in the humanities and social science arenas. eResearch tools such as online repositories offer researchers the opportunity to access and interact with data online. For the last 20 years video has formed an important part of humanities research, although dealing with multimedia in an online setting has proven difficult with existing tools. File size limitations, lack of interoperability with existing security systems, and the inability to include rich supportive detail regarding files have hampered the use of video. This paper has described the creation of collaborative and file management solution for video management using a combination of existing tools (SRB and Plone integrated with Shibboleth) and a custom application for video upload and annotation (Mattotea). SRB is used as storage repository, Mattotea as the video annotation and display tool, Plone as the web container for Mattotea and additional supporting content, and Shibboleth as the authentication scheme.

Rather than creating new proprietary systems, this development has examined reuse of existing technology with the addition of custom extensions to provide a method for full-featured access to research data. Plone is currently being used as part of a large repository in the ARCHER project, a collaborative, multi-institutional data-centric solution to provide simplified data access in multi-disciplinary settings (Treloar and Groenewegen 2007). Although the original use of Mattotea, Plone and SRB described in this paper was based on a cultural history use case, large-breadth projects such as DART and ARCHER show that these technologies can be utilized in a number of disciplines.

8 ACKNOWLEDGEMENTS

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