JDHCS 2010
Volume 1 Number 2

E-Carrel: An Environment for Collaborative Textual Scholarship

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1. Introduction

Digital archives are threatened by obsolescence caused by deterioration of storage media, abandonment of outmoded standards for operating systems and software, and failure to maintain the viability of legacy materials for use on new physical/mechanical systems. Projects can be further hindered by use of eccentric standards and one-off solutions to local problems. Standard responses to these threats include: to use ASCII or Unicode files with standard TEI tagging, to provide adequate documentation, to migrate the material periodically to new storage media, and to hope that someone will continue to be interested enough and knowledgeable enough to maintain the scholarly integrity of content.

New approaches to durability and maintenance, pioneered in scientific fields, follow principles of modular component structure, connectivity, extensibility, and methods for identifying and crediting researchers with their individual contributions to composite research projects. These new trends allow decentralized changes to software and its sources. In free/open source (FOSS) projects, the past was dominated largely by projects where the code was kept under tight wraps, using version control systems such as CVS (Concurrent Versions System) and Subversion. Only a handful of FOSS projects have been successful using this model, notably the Firefox project, but many FOSS projects are already migrating to more distributed approaches (e. g. the Python language and Linux kernel development) Much like archives, software development projects in the FOSS community tend to self-organize and establish their own governance. While they tend to make their code available (as required by the FOSS licensing schemes) they also tend to fall into disuse or an unmaintained state, making it hard for new developers to come along and take the project to the next level. Worse, some successful projects should be branched to allow for new approaches to be demonstrated.

Distributed version control systems (one of the earliest examples being GNU Arch, with a more complete listing at http://en.wikipedia.org/wiki/Distributed_Version_Control_System) are gaining traction and interest within the past two years, wherein a project's entire history and state can be copied freely, allowing derived works to take place. When a copy is made, however, the entire history is kept intact, allowing new contributors to either make their own changes or to push their changes back to the original maintainer. The push/pull model is so sophisticated that anyone who makes changes can get recognition for their work, because their specific changes to the code are encoded in the derived history. In the end, because we are working with plain text (structured or unstructured), the same tools can be used for maintaining texts (and their versions), much like source code (subject to having a proper merge model, which we address in our research). E-Carrel incorporates these principles and adds the functions of stand-off markup and annotation and a dynamic authentication mechanism, neither of which is as yet a standard function in humanities research projects. Experimentation by some projects has, however, shown the considerable promise of such

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functionality. As examples, we will discuss the Just in Time Markup (JITM) system[1] and the work on multi-versioned documents (MVD).[2] These important building blocks and new ideas come together in E-Carrel as a coherent vision for preservation and access, realized in the form of tools and programming frameworks. As indicated below, E-Carrel is designed to be interoperable with other current Humanities texts projects, but we focus on the fundamentals of textual scholarship, where most other projects focus on higher order functions that assume textual stability.

The E-Carrel solution for text preparation and dissemination that enables collaboration and participation by any interested scholar while maintaining file security and avoiding the conflicts and corruptions endemic to Wiki solutions. Another problem of Wiki systems is that text often cannot be exported– all or in part–from the system. Our system allows for easy export and copying, which is essential to meaningfully preservation solutions. The system's textual basis we call the CorTex (not to be confused with the TEX and LATEX software, used to prepare this document), which bears the bibliographical and textual data of all versions of a work. In typical use, The CorTex is copied and distributed on the Internet, guarded by a checksum against corruption to ensure longevity and integrity. Our collaborative construction and enhancement tool, CaTT, enables both the construction of a project's CorTex foundation and its enhancement with stand-off markup and annotation in any standard coding (for example TEI conformant XML). E-Carrel's stand-off markup and annotation leverages existing RDF capabilities modeled in part on the JITM experience and on the MVD (Multi-Variant Documents) work by Schmidt and Fiormonte. While XML-aware, E-Carrel is markup agnostic. Our user interface (The Carrel) not only incorporates CaTT but provides a Carrel Desktop for aggregating, reading, analysing, commenting and enhancing projects. The Carrel Desktop allows the importation of materials from other systems and prepares perspectives of the Carrel materials for export in various forms compatible with other systems (such as PDF and in-line coded XML). The system serves not only to create and use literary projects but ensures long-term maintenance and growth through collective ownership and distributed storage and the principle of LOCKSS (Lots of copies keep stuff safe). E-Carrel projects will have usefulness and purposes beyond the originators' interest span and the functions they imagined for the project. By increasing access to humanities texts as useful, adaptable, reliable source materials, E-Carrel projects will attract continuing contributions by both literary and digital scholars to maintain the viability of the tools and materials.

2. Motivation and Aims

The E-Carrel project addresses the fact that truly collaborative electronic knowledge sites in humanities fields do not yet exist. Two models now dominate: closed proprietary projects and open wikis. The former emphasizes the integrity of texts (and necessarily limits collaboration) and the latter emphasizes sharing (at the expense of guaranteeing the integrity of texts). Both systems now are dominated by in-line coding methods. Electronic knowledge site creation is hindered by standard methodologies which have structures vulnerable to damage during collaborative engagement. Yet, true knowledge sites, too big a task for one person, require collaborative efforts. Furthermore, standard methods fail to ensure endurance beyond the interest or life of project originators.

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[1] http://www.unsw.adfa.edu.au/ASEC/JITM/

[2] Schmidt 2009.

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Although E-Carrel focuses on literary objects and texts for testing purposes, its application to music, philosophy, and historical texts is without question and its further application to archaeology, painting, and architecture is palpable. Electronic knowledge sites should consist of the primary evidence (objects and images and transcriptions of them) in all their significant forms, contextual and ancillary documents linked to primary items, critical and analytical engagements that produce new knowledge, and enhancement open to all, but protected from unwanted changes or intrusive alterations.

To succeed in a collaborative environment of inquiry, E-Carrel offers sound foundation in authenticated representations of primary source texts (images and transcriptions), a secure mechanism for allowing multiple users to add new work without inadvertently corrupting the work of others, and a user friendly system for browsing ever growing, widely distributed, dynamically accessible literary knowledge sites.

Put another way, E-Carrel aims:

- To allow multiple editors and commentators to add scholarly value to basic text files in an Edition/Archive/Knowledge Site.
- To do that without threatening the scholarly integrity of core text files. • To do that without proliferating text files each enhanced differently and accessible only as isolated forms of the project.
- To enable scholarly value to be added to core text files in such a way that all enhancements will be accessible to the user of any single copy of the text files.
- To track and give credit to every student/scholar for the enhancements added or attached to the text files.
- To provide a user-friendly tagging tool so that scholarly enhancements (tagging) can be added with minimal technical expertise.
- To provide a browsing environment enabling students of the text to navigate the textual project and to know precisely what form of the work is being looked at and what alternatives and analyses are available.
- To take advantage of distributed text and enhancement files where the number of copies of the original text files and the number of places where enhancement files are housed is irrelevant to a user who will have access to all of it.
- To ensure preservation of digital texts and their scholarly enhancements by 1) proliferating copies, 2) by keeping projects dynamic and growing beyond the engagement of their creators, and 3) by giving scholars a vested interest in the continuance of the texts and scholarly enhancements.

2.1. Present State of Knowledge

Although digital text archives are the foundation for creative electronic engagements with primary works, digital archives are currently threatened by obsolescence caused by deterioration of storage media, abandonment of outmoded standards for operating systems and software, failure to maintain the viability of legacy materials for use on new physical/mechanical systems, and use of eccentric standards and one-off solutions to local problems.

Standard responses to these threats include use of ASCII or Unicode files with standard TEI tagging, providing adequate documentation, migrating the material periodically to new storage media, aiming to form alliances with university libraries or academic departments to ensure a stable

home for materials, and hoping that someone will continue to be interested enough and knowledgeable enough to maintain the scholarly integrity of content over time.

Electronic projects that restrict construction and enhancement to a select few persons as a way to protect the intellectual integrity of their resources inadvertently introduce a significant threat to the durability of text files, whose hard-won accuracy is the result of expert attention. Anxiety to protect projects dependent on in-line tagging leads to proprietary attitudes and methods detrimental to collaboration because everyone knows that the text files are vulnerable to inadvertent change every time they are reopened for further tagging. Protective restriction also restricts collaborative work. Sharing copies of files for re-purposing or enhancement with non-team members proliferates parallel variant projects with finished in-line coded projects–project that must be accessed separately, with no general access point, no way for markup of one text to apply to other copies of the same work, no preservation scheme, no integrated distribution plan, no collaborative expansion potential, no constituency with a vested interest, no capabilities beyond what it was designed to yield, no invitations to contributing members, no functions beyond those imagined by its creators, no long-term maintenance.

These problems can be mitigated or eliminated by new approaches to collaboration, durability, and maintenance, pioneered in scientific fields following principles of modular component structure, connectivity, extensibility, distribution and aggregation systems, stand-off enhancement mechanisms, and methods for identifying and crediting researchers with their individual contributions to composite research projects.

These new trends allow decentralized changes to software and its sources. But even free/open source (FOSS) projects are not without problems. The past was dominated largely by projects where the code was kept under tight wraps, using version control systems such as CVS (Concurrent Versions System) and Subversion. Only a handful of FOSS projects succeed with this model, notably the Firefox project, but many FOSS projects are already migrating to more distributed approaches (the Python language, the Linux kernel, etc.) Much like archives, software development projects in the FOSS community self-organize and establish their own governance. While they tend to make their code available (as required by the FOSS licensing schemes) they tend to fall into disuse or an unmaintained state, making it hard for new developers to come along and take the project to the next level. Worse, some successful projects should be branched to allow for new approaches to be demonstrated.

Nevertheless, distributed version control systems (DVCS) record a project's entire history and state, which can be copied freely, allowing derived works to take place. When a copy is made, however, the entire history is kept intact, allowing new contributors to either make their own changes or to push their changes back to the original maintainer. The push/pull model is so sophisticated that anyone who makes changes can get recognition for their work, because their specific changes to the code are encoded in the derived history. Some interesting DVCSs that could be incorporated (and evolved) as part of this work include Mercurial, Git, and darcs, among others. In the end, because we are working with plain text (structured or unstructured), the same tools can be used for maintaining texts (and their versions), much like source code.

The E-Carrel environment incorporates these principles and adds the functions of stand-off files for markup and annotation and a dynamic authentication mechanism, neither of which is as yet a standard function in humanities, social science and arts research projects. Experimentation has

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shown the considerable promise of such functionality, found in the Just-in-Time Markup (JITM) system[3] and Multi-Versioned Documents (MVD).[4]

These building blocks and ideas come together in E-Carrel as a coherent vision for archiving creative works for collaboration, preservation, and dynamic interactive access, realized in the form of tools and programming frameworks. E-Carrel focuses on the fundamentals of textual scholarship, where most other projects focus on analytical and commentary functions that assume textual stability, inadvertently reinforcing proprietary tendencies. E-Carrel is designed to be interoperable with other current humanities texts projects.

3. Approach and Architecture

Although in the early stages of development, E-Carrel is built on a solid architectural and component-oriented foundation.. Our approach establishes an image file and a base text for each significant version of a work. Text data for all texts are compressed in an inviolable CorTex file which anchors all stand-off enhancement contributions. Each participant's contribution is credited, and protected from work by other contributors. End-users choose a historical text or critical edition plus desired types of enhancements from a menu dynamically aggregated from distributed sources. The E-Carrel processes and presents perspectives of texts and enhancements for viewing, printing, or export in commonly used formats. E-Carrel system projects do not require an editorial board but individual projects using the system can vet and certify parts of a project. And this system allows the storage, retrieval, and coordination of conflicting and even hostilely different editorial or critical approaches to the same literary work.

E-Carrel develops collaborative functions for creating, enhancing and repurposing foundational textual archives and scholarship in a modular, distributed but coherent form. By giving scholars and students a vested interest in a growing integrated collaborative project, E-Carrel ensures preservation and access to textual research projects and their superstructure of critical analysis at the same time that it promotes collaboration beyond the project initiators' participation and goals. Project viability follows community ownership and becomes a widely distributed responsibility.

The system ensures long-term maintenance and growth through collective ownership, distributed storage, and the principle of LOCKSS (Lots of copies keep stuff safe). Our strong definition of LOCKSS, in which accurate copies, verified by way of the persistent CorText data and checksum system, is significantly different from the "soft" version of LOCKSS that just sends "copies" into the world in whatever state and trusts to the hive mind for endurance and integrity.

E-Carrel leverages RDF capabilities and is XML-aware but markup-agnostic. It allows the importation of materials from other systems and prepares perspectives of the E-Carrel materials for export in various forms compatible with other systems (such as PDF and in-line coded XML).

E-Carrel involves several interrelated foundational concepts:

- *Images and Transcriptions:* Humanistic study of texts builds creative knowledge on foundation textual documents: the answer to the verification and literary research question, "where did

[3] http://www.unsw.adfa.edu.au/ASEC/JITM/

[4] Schmidt 2009.

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that text come from?" is always a document. Except in born-digital projects, it is never the electronic transcription of a document. Hence the cornerstones of E-Carrel are high-definition digital images of documents backed by accurate transcriptions

- *Relationships:* Humanistic understanding of textual foundations involves knowing the relationships among variant documents representing the same work. Text-comparison (collation) tools are needed for use with images and with transcriptions.
- *Collaboration:* Documentary texts are the foundation for analysis and annotations tagged onto the texts. Stand-off tagging allows collaborative work by multiple participants while ensuring the integrity of "shared" files.
- *Tagging Tool:* Humanists (rather than programmers and Digital Humanities persons) require a user-friendly tagging-tool to tag text files–hence, CaTT (Collaborative Tagging Tool).

3.1. Functional Requirements for Bibliographic Records (FRBR)

FRBR was devised by the library community as the emerging common standard for cataloguing library materials. Its application to textual studies and digital humanities rests on its taxonomy: a descending hierarchy, from the abstract to the material, that identifies bibliographic items (material books and documents) and places them in relation to other versions in categories that help us understand their history and significance as items and incorporates additional information about the item (e.g., agency, events, provenance, etc.).

- *Work:* refers to the title or identifying description and refers to all forms belonging to that title or description. Thus Hamlet exists in many documentary forms from the early 17th century to the present and includes stage performances.
- *Expression:* refers to versions of a work and distinguishes between drafts, and revised versions . Thus, the early version of Hamlet represented first in a 1603 quarto, is an 'expression' that persists in all copies and reprints that follow that version. The Folio represents a different expression.
- *Manifestation:* distinguishes between the various forms of a text representing a specific expression of the work. All copies of the first quarto of Hamlet belong to a single manifestation of the work, but facsimiles and all other reprints would belong to separate 'manifestations' of that 'expression' of the 'work'.
- *Item:* refers to the individual material document. Any and every book or manuscript or pamphlet obtained by a library is catalogued as an 'item' and its cataloguing involves determining what Work, Expression, and Manifestation it belongs to, and what distinguishing features identify this copy from all other copies.

A Few Words about Electronic Items

An electronic text file represents a Work only as an Item–an actual book or manuscript—and, thus, represents the work only partially. No item can represent all the different manifestations of all the different expressions of a work. When there are multiple variant texts, all representing one work, but each representing a different expression and manifestation of the work, textual analysis and scholarly editing provide the ways to understand the relations among the texts and the significance of each text.

This fact is not obvious to most users of electronic editions nor to most providers of electronic texts, many of whom believe that any text of Jane Eyre or Hamlet is sufficient to represent the work.

In E-Carrel projects the basic "thing" upon which projects are built is the bibliographic ITEM. In order for an electronic project to represent a 'work' comprehensively, it needs to represent an 'item' from each 'manifestation' of each 'expression' of the 'work' that was deemed authoritative or important. The CorTex for an E-Carrel project compresses into a singe file the data for all of the items deemed relevant to a full representation all authoritative expressions of the work.

3.2. E-Carrel tools

E-Carrel comprises the following tools.

- *CorTex* is a compression process merging variant text files of a single work (manuscripts, proofs, first editions, revisions) into a single text data file to serve as the anchor for stand-off markup and annotation. It consists of both merging and extraction routines, checksums, and naming protocols for distributed storage.
- *CaTT* is a Collaborative Tagging Tool offering users a dynamic menu of tagging options and applying and storing XML or other codes in either in-line or stand-off mode, applying appropriate naming protocols. It tracks tagging sessions and tagging sources so that each collaborator is credited with his/her own work and stores them so that when a project user (as opposed to developer) accesses the project, enhancements are grouped, at the user's discretion, according to type or according to contributor.
- *COOL* is a collation and file management system that displays extracted text data by joining text images to text transcriptions and offering several options for display of variants (standard windowbox variants lists, parallel texts with highlights, links to explanations of complex revisions, etc.) COOL uses new tools (Xray, Transparent, and e-Hinman) to manage images and transcriptions of variant forms of the same text.
- *E-Carrel* is the general tool for developers and users, offering CaTT to developers and serving as aggregate and browser for users. It aggregates the distributed files of a given project, activates COOL display mechanisms, and generates perspectives from dynamically produced menus of enhancement files available on the Internet.

3.3. Development principles

We are guided by the following overarching design and development principles:

- E-Carrel, in all its parts, projects and tools is an on-line, Internet function.
- E-Carrel's modular, component parts are built separately, revised separately, removed and added separately, and can be augmented with additional modular tools and content objects.
- E-Carrel will work with non-Carrel projects opened or dragged onto the desktop, though its design makes it especially apt for projects using stand-off markup and developed with CaTT.
- E-Carrel produces export-perspectives of texts plus enhancements for print or distribution in various forms for use with other text software, for example in PDF and XML forms.
- Transcriptions have a default presentation position hidden behind the image they transcribe.
- Desktop openings for tools and perspectives can be resized, repositioned, and saved.
- Tools for multiple views of a single text file or for simultaneous views of variant files will be linked so that scrolling in one view is kept pace with in other views.
- Display tools (like Transparent) can trigger related tools (like COOL and its sub-tools Xray, e-Hinman, etc.)
- Overall interface design for E-Carrel will inherit that of WoolfOnline and have all of that project's basic capabilities: the ability to move from anywhere in the project to any other place

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with no more than a click or two; the ability to accommodate multiple ways of looking at the same thing; the ability to zoom images; the ability to accommodate many kinds of data and analysis such as pictures, annotations, commentary, articles, audio and video, as well as the genetic documentary materials described above; the ability to provide synchronic and diachronic mapping tools; and enable the personalizing, appropriating aspects already available in WoolfOnline.

E-Carrel improves upon the WoolfOnline design according to the principles above. CorTex construction and the associated stand-off tagging files must be available in fine-grained open-able, size-able, drag-able perspectives in windows inside E-Carrel's desktop and able to interact with Transparent and Cool. That is, although E-Carrel has a modular, component structure in both tools and content objects, it provides project coherence through E-Carrel's ability to "be aware" of each part's relationships with other text documents and tagged enhancements that can be opened in the desktop area. This has serious implications for the development of the collation and variants display capabilities.

3.4. Standards

Preparing Files for Tagging Texts of Works

FRBR concepts about variant forms of a work are important to E-Carrel because some annotations are specific to the item, while some apply to all copies of a manifestation, or to all manifestations of an expression, or to all expressions of a work. Since annotation (tagging) is always done in relation to an item, a system is needed to distinguish analyses and commentaries that apply to all expressions of the work from those which apply only to manifestations of a particular expression and from those which apply only to certain copies (items) of a manifestation. Otherwise, in order to be comprehensive every variant bibliographic item in a project would require a separate electronic file, each with in-line tagging, much of which would be the same for all copies of the work, some to all copies of one expression, some to all copies of a manifestation, and some to a unique copy. Without a system to coordinate and distinguish tagging, a discouraging (infeasible) redundancy of labor ensues.

The E-Carrel solution involves preparing minimally tagged base transcriptions for all relevant (authoritative or significant) items of a work (which are the core texts for a work), proofing them to the highest standards, and then merging them into a single compressed file (the CorTex) that enables

- item-level representation of text-images with associated relevant transcription–extracted from the CorTex by E-Carrel,
- collation and display of textual variation–extracted by COOL,
- stand-off markup that automatically applies any tag to all the items for which it is appropriate but targets tags that apply to unique items or subsets of works.

This process is new and (so far) unique to E-Carrel. The CorTex is locked with a hash key that allows it to be used for multiple purposes but not changed by those uses. Any change in the text would disable the hash key, indicating corruption of the file.

Stand-off markup and annotation: Markup with CaTT can be in-line or stand-off. In-line markup embeds comments, instructions, and qualifications in a code such as XML into a text file, giving the computer instructions on how to display the text and where to put additional commentaries.

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Whenever a new feature is to be tagged in the text, the text file is re-opened and the new feature added, and every time a file is thus enhanced, it is vulnerable to inadvertent alteration (i.e., corruption).

In stand-off markup and annotation, the coded comments, instructions, and qualifications are created in separate files which index but do not change the base text file. Once the base text file is created and proofed and merged into a CorTex, it is locked down and used as an anchor for tagging purposes. Every time that textual analysis reveals a new feature to be tagged, a new stand-off tag-file is associated to the CorTex.

There are at least three advantages of stand-off over in-line tagging:

- the base text is never vulnerable to inadvertent human intervention–its integrity is protected by an authenticating checksum and by the fact that enhancement does not involve changing the text file.
- as a result, any number of people can tag the same base text and offer their added value to a growing body of scholarship related to that document text file. It will not matter which of the distributed copies of the CorTex is used for tagging; the results will be equally associated with all of them.
- it provides one solution to the problem of overlapping hierarchies created by markup systems with OHCO (Ordered Hierarchy of Content Objects) design, in which every part of a file belongs to a single hierarchical arrangement as is the case with HTML and XML. Famously, literary texts do not conform to a single hierarchy of objects: sentences overlap pages, syntactical units overlap stanza breaks, etc.

4. Related Work

Our work builds on Paul Eggert's JustInTimeMarkup (JITM), Desmond Schmidt and Domenico Fiormonte's work on Multi-Variant Documents (MVD), Sindre Sorenson's yet unpublished work on file storage and retrieval for stand-off markup and annotation, Peter Shillingsburg's blueprint for electronic knowledge sites, Nicholas Hayward's yet unpublished work on a collaborative tagging tool (CaTT) designed for "technically-challenged" humanists, and his work on interface design for WoolfOnline project, George K. Thiruvathukal's work on intuitive tagging tools, Federico Meschini's yet unpublished research into best practice in existing and developing electronic scholarly editions and library archiving practice, and Steven Jones's work on Romantic Circles[5] and his research into collaborative game theory and textual studies developed in his book, The Meaning of Video Games.[6]

[5] http://www.rc.umd.edu

[6] Jones 2008.

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Our project has full knowledge of the methods developed for the Blake Archive,[7] the Rossetti Archive,[8] the Whitman Archive,[9] the HYPER-Nietzsche project,[10] the Wittgenstein Archive,[11] and has a watchful eye on developing projects like TextGrid[12] (Germany mainly), InterEdition[13] (Europe), TILE,[14] Talia and Discovery[15] (Italy mainly), and DHO[16] (Ireland), the recently funded Open Annotation Collaboration,[17] and the concerns of the former AHDS[18] (UK), and with umbrella projects like the Oxford Text Archive, NINES , and Romantic Circles[19]. Common to every one of these projects and organizations has been a commitment to in-line tagging of texts, though Talia is developing stand-off markup and stand-off markup is being talked about again at Digital Humanities Conferences. With the exception of TextGrid and InterEdition, these projects are ring-fenced to protect the integrity of project files. TextGrid is experimenting with a Wiki approach which erects a gateway for vetting all contributions. That is a considerable advance over typical individual electronic projects that create finished projects in the "look but don't touch" tradition of printed books but also rejects the openness of the Internet. These are the structural and procedural weaknesses of current standard practice that are addressed in our project and that so powerfully restrict engagement with creative works online.

5. Conclusions

E-Carrel is an ambitious software environment aimed at providing robust support to archives and critical editions, which presently lack robust and genuinely collaborative tools support. Although at an early stage of development, a subset of the E-Carrel has been incorporated and demonstrated via the WoolfOnline project. CorTex (based on Schmidt's work on Multi-versioned Documents) is a available as an open source project via the Center for Textual Studies and Digital Humanities web site.[20] CaTT is available in demonstration form via the WoolfOnline project.

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[7] http://www.blakearchive.org

[8] http://www.rossettiarchive.org

[9] http://www.whitmanarchive.org

[10] http://www.hypernietzsche.org

[11] http://wab.aksis.uib.no

[12] http://www.textgrid.de

[13] http://www.interedition.edu

[14] http://mith.umd.edu/miths-tile-project-funded-by-neh-preservation-and-access

[15] http://net7sviluppo.com/trac/talia/wiki/InstallTaliaForDiscoveryPartners

[16] http://www.dho.ie

[17] http://mith.umd.edu/mith-receives-mellon-funding-for-open-annotation-collaboration

[18] http://ahds.ac.uk

[19] http://www.rc.umd.edu

[20] http://www.ctsdh.luc.edu

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6. Acknowledgments

This project has been supported in part by a start-up grant from the National Endowment for the Humanities (NEH) Office of Digital Humanities (ODH). We are grateful for this support, which has allowed progress to be made on key components of the E-Carrel.

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