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A Geospatial Narrative Framework

Breathing New Data into Historical Manuscripts

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ABSTRACT

This project has developed a novel framework for online multimedia editions of geospatial narratives with specific support for translated texts. The framework user interface presents textually and geospatially synchronized multilingual manuscripts with audio-narration augmented by maps and images all linked with geo-tagging metadata. The initial test-bed for this framework is built upon the recently completed Italian critical edition and the first English translation of Lorenzo di Filippo Strozzi's *Pistola fatta per la peste*, a 1522 walking tour of Renaissance Florence during a plague outbreak.

Categories and Subject Descriptors

I.7.2 [DOCUMENT AND TEXT PROCESSING]: Document Preparation—*Multi/mixed media, Markup languages*;
H.5.1 [INFORMATION INTERFACES AND PRESENTATION]: Multimedia Information Systems

General Terms

Algorithms, Human Factors

Keywords

Multimedia Retrieval, Digital Libraries, Geospatial Narratives, Cultural Heritage Documents

1. INTRODUCTION

With the recent advent of e-book technology, such as the Amazon Kindle and the Apple iPad, there has been a new focus on digital-born publishing of newly released texts. While this has led to the majority of new publications being simultaneously released in print and electronic forms, we are still left with a tremendous quantity of volumes that remain in print only. However, new developments in digitization technologies [6] have begun to narrow this gap.

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1.1 Document Dissemination

There have been two important developments in electronic access of digitized texts. First, the book scanning initiatives of Google and others are making it possible to perform textual queries on the text itself for millions of manuscripts, revolutionizing search within a book. Second, the British Library's Turning the Pages project [1] has demonstrated a new interactive form of access to the large catalog of classics held in their archives. This type of graphical interaction has been subsequently researched using a wide variety of computational models [7]. Even non-interactive access is being provided for greater sets of rare and deteriorating documents [8].

Even with these breakthroughs in document access, there has been no fundamental shift in the basic way a user interacts with a document. Consequently, these technologies leave the user as a mere consumer of the content and make little use of the vast amount of secondary sources now instantly accessible via the Internet. There have been many tools developed to provide application frameworks for document markup and searching. Calistru et al. [2] have recently developed such a system designed around multimedia content, such as manuscript images, for historical documents. However, these systems are typically designed for expert users which excludes the masses from easy access. Using new multimedia techniques, this limited consumption does not need to be case especially when considering the use of these texts in education.

1.2 Geospatial Playback

A great deal of prior work has been done to incorporate GPS tagged media into web-based applications. For instance, de Silva and Aizawa [4] presented a system to playback a photo album by relying on automatic GPS logging. Moreover, a Flash-based framework, History Browser [9], has been utilized for Thomas Jefferson's travels to present the writings of the US President while showing the geographic locations where he wrote each of his works. However, we have yet to see geospatial information pulled directly from the text to perform queries.

1.3 The Geospatial Narrative

It is our goal to bring together the rapidly growing collection of digitized texts with the even faster growth of digital-born geo-tagged media.

To allow this, we focus on a special subset of texts which

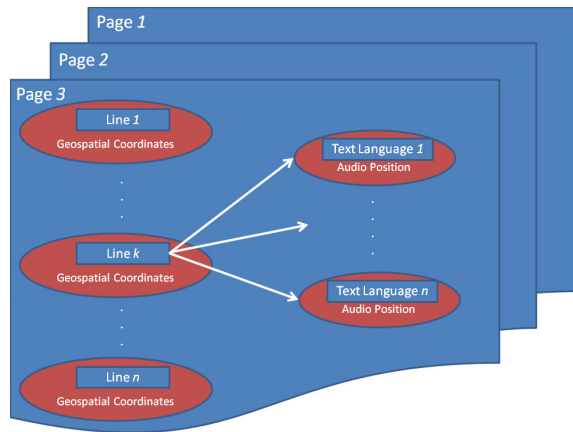


Figure 1: This chart shows the necessary metadata and its planned hierarchy.

we term a *geospatial narrative*. This writing style typically focuses on detailed descriptions of place and possibly events and individuals linked to the location. Typical examples are modern walking tours and historical event accounts – one of which is demonstrated in Sec. 3.

In these texts, the author effectively generates, using natural language, an ordered set of discrete geospatial positions. While work has already started to pragmatically extract these locations using a developed formal vocabulary [3], what our research seeks to do is provide a method for the author, often post-mortem, to perform geospatial queries to augment their original presentation while having the text read in a web-based framework. By developing the application and framework to handle geospatial encoding of a manuscript, we can perform realtime queries on various databases for geocoded media to augment the reading of a manuscript. Many of these original authors could only dream of presenting readers with the information now instantly available via the Internet for application in education and scholarship.

2. FRAMEWORK FOR GEOSPATIAL NARRATIVES

To provide a new form of access to geospatial narratives, we have developed an encoding and playback application framework. This allows for complete synchronization of text and space for all presented primary sources, including translations, using metadata. The web-based multi-modal interface with real-time customization allows users to instantly switch, during playback, between displayed texts, narration, maps, photographic imagery and other secondary sources. Moreover, multi-lingual support was included from the outset to allow not only for international dissemination, but also to provide an additional resource in language education.

2.1 Encoding

To allow synchronized playback of multiple translations, the line number was chosen as the base element for markup. This decision is a logical design choice, since lines are traditionally the common linking element between manuscript translations. The typical arrangement of data for a manuscript, consists of pages with each page consisting of multiple lines.

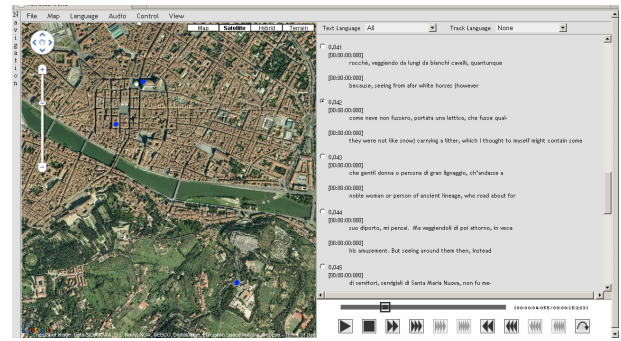


Figure 2: Web interface for manuscript markup.

Each line is assigned a single geospatial position. However, a line may have multiple language translations available, so each line links to each of its translations, each with their own timecode in the respective audio narration file. Fig. 1 shows this arrangement.

To make this system accessible to users of all skill levels and, consequently, encourage a greater number of texts to be encoded, we have developed a web-based graphical interface for performing the geospatial and temporal markup. Fig. 2 shows the web interface used to generate the metadata necessary for playback of a geospatial narrative manuscript.

Listing 1: Example XML Document

```
<pistola>
<language lang="en">English</language>
<page number="419">
.
.
.
<line number="10">
<text lang="it">passando da San Miniato
    infra le torri, dove per lo strepito
</text>
<text lang="en">passing by San Miniato
    between the towers, where I was at one
    time nearly deafened by the
</text>
<audiopos lang="en">[00:02:04:034]
</audiopos>
<audiopos lang="it">[00:03:16:101]
</audiopos>
<position>
<latitude>43.75998857393891</latitude>
<longitude>11.264153366424173</longitude>
</position>
</line>
.
.
.
</page>
</pistola>
```

In practice, a user can upload plain text versions for each translation of the manuscript and apply line numbering manually or an XML version with line numbers pre-encoded. The user can then select a “line” of text with a simple click on the map and assign or delete the respective GPS co-

ordinate. This provides a direct way of adding geospatial markup to a document. Since each language is registered by line, this process need only be completed once for the edited language of choice (typically the editor’s native tongue). For encoding timecodes for audio narration playback, the user must select the line and narration language. This loads the correct audio file into the web-based player. Then, for each line of text, once the appropriate position is found in the audio track, the user may then choose “mark position”, to encode the audio starting time in the respective narration timeline.

Once all of the data is encoded, an XML file may be exported for later use. This XML schema was designed directly from the chart shown in Fig. 1, which led to XML files that appear like the fragment shown in List. 1. This schema was developed to maintain plain text legibility, allowing manual XML generation to be a straightforward process if necessary.

2.2 Playback

Playback delivers a multimedia experience directly from a standard print manuscript by simultaneously querying various data sources. The encoded per-line-timecodes allow for registered playback of the text synchronized with a selected audio track. Thus text of one language from a line is displayed while audio of the same line is played in same or different encoded language.

Using the encoded geospatial information, we have developed a playback environment with audience specific customization features. Any web-based mapping software can be accessed and combined with other mapping providers. Fig. 4 shows a Bing aerial view map with a reference Google map. To further augment playback, we queried additional secondary sources, including Panoramio, for images taken near the author at the current textual line. Fig. 5 shows the typical playback arrangement.

2.3 Implementation

This framework was designed with open-source components where possible. While a complete HTML 5 framework is the ultimate goal of this work, limited implementation required us to use a combination of JavaScript, PHP, MySQL, and XML in the presented application. XML is used as the manuscript transfer container for importing and exporting the geospatial narratives. While a MySQL database is used to store and access the narratives. During playback, the database is queried using both spatial and temporal locators for the encoded manuscripts with the relevant metadata. The full implementation was first deployed using a 16th century Italian manuscript that has only recently been fully translated to English.

3. GEOSPATIAL NARRATIVE EXAMPLE: 16TH CENTURY FIRENZE

Lorenzo di Filippo Strozzi’s *Pistola fatta per la peste* (*An Epistle Written Concerning the Plague*) is a 16th century plague tract. While the *Pistola* is not a well-known piece of literature, it deserves much more scrutiny because it was transcribed for Lorenzo Strozzi by none other than Niccoló Machiavelli. In this writing, the reader finds a literary description that is so intimately tied to a distinct geographic route that to comprehend the text fully the reader must be keenly aware of that provenance and its connection to place.

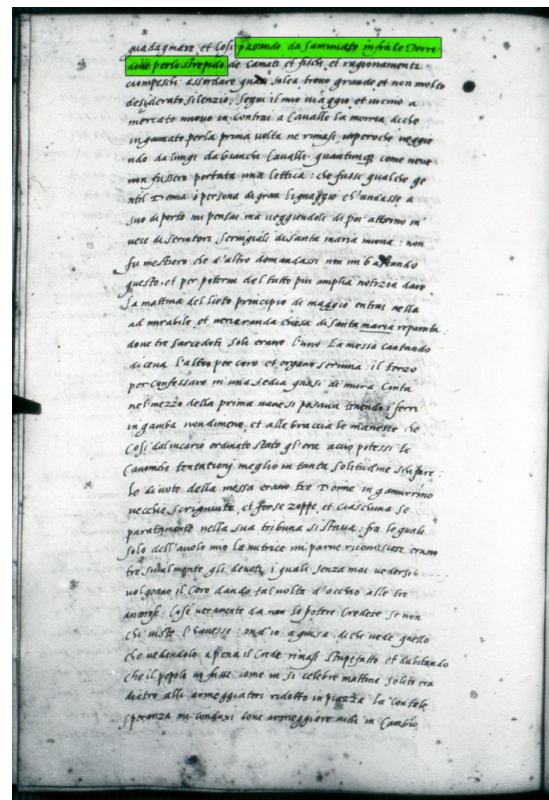


Figure 3: An image of page 85v of the 1522 Pistola[5] shows the classic type of data scholars are typically limited to study. The text from Listing 1 is highlighted. As a side note, one of the two surviving Pistola manuscripts is actually in Machiavelli’s hand with corrections in the margins by Strozzi. The other manuscript is only in Strozzi’s handwriting; and it incorporates the changes and suggestions that he made in the Machiavelli manuscript. ©Biblioteca Medicea Laurenziana di Firenze, Ministero per i Beni e le Attività Culturali della Repubblica Italiana



Figure 4: The web-based geospatial narrative playback showing the same line as Fig. 3. Here Strozzi describes “towers” which can be seen in the aerial image from Bing maps, the photograph from Panoramio, with geographic context shown in the Google maps thumbnail. The audio narration is currently playing the displayed line.

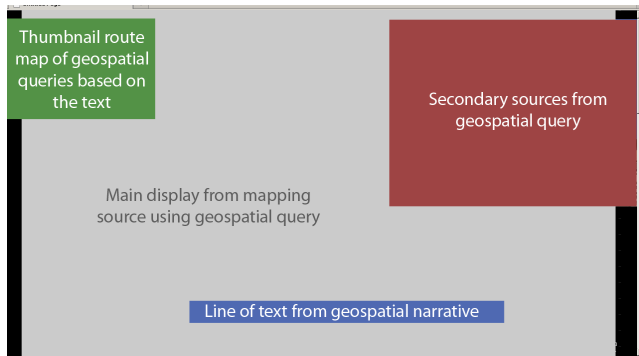


Figure 5: Labeled content from Fig. 4 which specifically highlights the multimodal presentation allowed by the framework.

Thus it is in this Pistola that we find an excellent example of a geospatial narrative.

The Pistola, probably written in 1522, includes a walking-tour of Renaissance Florence. The various places visited by Strozzi are, for all practical purposes, the same places that the modern tourist to Florence considers to be must see stops on their itinerary. A curious tourist with a penchant for the morbid might consider Strozzi’s Pistola as a guide to the modern city. In this geospatial narrative, Strozzi leads the reader along a path visit sixteen different famous sites in Florence. There are presented here in the same order as the text which leads a closed loop as can be seen by the repeated first and last location.

1. The Palazzo Strozzi (The author’s home)
2. San Miniato al Monte
3. Mercato Nuovo
4. Santa Reparata
5. The Piazza (likely della Signoria)
6. Piazza of Santa Croce
7. Santa Croce
8. The Cloister of Santa Croce
9. Santo Spirito
10. Via Maggio the only street name provided by Strozzi
11. Santa Trinita
12. The Spini Bench
13. Santa Maria Novella
14. San Lorenzo
15. The author’s new wife’s home
16. The Palazzo Strozzi

These places are all described, using natural language, in the narration. To demonstrate variety and specificity of these locations, we present four examples from the Pistola’s text which illustrate Strozzi’s geospatial narration. We make note here that not all manuscripts contain this type of sequential localization embedded in the text, however, even texts with a few of the in-line georeferences could be augmented by portions of the framework.

English

“I entered the admirable and venerable Church of Santa Reparata; where there were only three priests: the one was singing Mass; the second serves as the choir and organ; the third hears confessions in a chair surrounded by the wall, in the middle of the first nave.”

“I directed my steps toward the most famous piazza of Santa Croce.”

“I escaped into the church (Santa Croce), where I offered my usual devotions, without a single witness, when I heard from a long way off, a worried and fearful voice.”

“To which drawing myself, I saw laying on the ground, near the fresh graves in the cloister, in black raiment, a pale and afflicted maiden, whose face appeared more that of a corpse than a living woman.”

Italian

“Entrai nella ammirabile et veneranda chiesa di Santa Reparata; dove tre sacerdoti soli erano: l’uno la messa cantando diceva; l’altro per coro et organo serviva; il terzo per confessare in una sedia, et quasi di mura cinta, nel mezzo della prima nave.”

“verso la famosissima piazza di Santa Croce i miei passi rivolsi”

“in chiesa mi fuggii, dove facendo le consuete mie devotioni, nè veggendovi pure un testimone, senti, benchè lontana, una affannata et spaventevole voce;”

“a cui advicinandomi, alle seulture del chiostro vidi in terra distesa in veste negra una pallida et travagliata giovane, la cui effigie più di morta che viva mi pareva...”

These sites, uniquely described in the text, provide a route that the reader must travel to fully “read” the text. Fig. 3 shows the manuscript and, consequently, the access modality that any student or scholar would be currently required to use. While historians and other humanities researchers are accustomed to this type of access, it does little to encourage participation from uninitiated interdisciplinary students and hobbyists. With this motivation, Fig. 4 shows the identical line of highlighted text only now it is fully augmented with the vast amounts of geotagged multimedia web-based content. Fig. 4 displays the default arrangement during playback, and Fig. 6 shows the result of modifying the main map data source to Google StreetView.

4. CONCLUSIONS AND FUTURE WORK

We have developed a new framework that presents geospatial narratives in a completely multimedia-based approach. By making the system accessible to users of all skill levels, we hope to build a large selection of encoded manuscripts. This will produce geospatial cross-referencing between encoded documents, allowing users to navigate between texts that literally cross paths.

Imagine reaching the famous Florentine church, Santa Maria Novella, while reading the Pistola, when an onscreen curve shows the path of another text that passes through the same geospatial point. For example, the narrative of Giovanni Boccaccio’s famous Decameron opens at the high altar of the Santa Maria Novella. In the presented framework, text



Figure 6: A modified playback of *Pistola fatta per la peste* with a different main map component: Google StreetView. In this line Strozzi mentions “I leave my house before that hour in which all the terrestrial vapours are evaporated by the sun”, so the Strozzi Palace can be seen in the left of the Google StreetView image and in the Panoramio image on the right.

and place form an interlocking geo-textual tapestry with the potential to revolutionize the way scholars, students, and laypersons interact with source materials from across the disciplines.

5. ACKNOWLEDGMENTS

Lorenzo di Filippo Strozzi. *Pistola fatta per la peste*. 85v in Codice Ashburnhamiano 606, pages 84r–89v. Su concessione del Ministero per i Beni e le Attività Culturali della Repubblica Italiana.

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