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Haute école de gestion
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The International Image Interoperability Framework (IIIF): raising awareness of the user benefits for scholarly editions

Bachelor's thesis submitted for the Bachelor of Science in Information Science

by

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Declaration

This Bachelor's thesis is submitted as part of the final examination requirements of the Haute Ecole de Gestion de Genève (HEG-GE), for obtaining the Bachelor of Science HES-SO in Information Science[1].

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Geneva, Switzerland, 16 July 2017

Julien Antoine Raemy

[1] In French, the title obtained is 'Spécialiste HES en Information documentaire'

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Abstract

The International Image Interoperability Framework (IIIF), an initiative born in 2011, defines a set of common application programming interfaces (APIs) to retrieve, display, manipulate, compare, and annotate digitised and born-digital images. Upon implementation, these technical specifications have offered institutions and end users alike new possibilities.

In Switzerland, only a handful of organizations and projects have collaborated with the IIIF community. For instance, e-codices, the Virtual Manuscript Library, implemented in December 2014 the two core IIIF APIs (Image API and Presentation API). Since then, no other Swiss collection has fully complied with the IIIF specifications to make true interoperability possible.

The NIE-INE project, overseen by the University of Basel and funded by Swissuniversities, has aimed to build a national platform for scientific editions. There is a shared rationale between NIE-INE and IIIF who both advocate flexible and consistent technical architecture as well as providing high-quality user experience (UX) in their content delivery.

Remote and in-person usability tests were conducted on the Universal Viewer (UV) and Mirador, two IIIF-compliant image viewers deployed by many IIIF implementers, in order to assess their satisfaction and efficiency as well as their perceived usability. NIE-INE was the target audience of the usability testing with a view to evaluating how scholarly research and the wider scientific community could benefit from leveraging IIIF-compliant technology.

To conclude this bachelor's thesis, a set of recommendations, based on the usability testing results and throughout this assignment, was drawn for the developing teams of both viewers, the IIIF community and the NIE-INE team members.

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API	Application programming interface
HEG-GE	Haute école de gestion de Genève
HES-SO	Haute école spécialisée de Suisse occidentale
HTTP(S)	The Hypertext Transfer Protocol (Secure)
IIIF[2]	The International Image Interoperability Framework
IIIF-C	The International Image Interoperability Framework Consortium
JSON-LD	JavaScript Object Notation for Linked Data
LIS	Library and Information Science
NIE-INE	Nationale Infrastruktur für Editionen – Infrastructure nationale pour les éditions
SUS	System Usability Scale
UCD	User-centred design
UI	User Interface
URI	Uniform Resource Identifier
UV	The Universal Viewer
UX	User Experience

[2] IIIF is pronounced 'Triple-Eye-Eff'

1. Introduction

High-quality mass digitisation of collection materials in the cultural heritage sector has opened up new possibilities for displaying and using image-based content. Unlike metadata, these images, carriers of primary and secondary sources, have historically not had a protocol or a standard to be shared and harvested across institutions and repositories.

This paradigm was solved with the advent of the International Image Interoperability Framework (IIIF – 'Triple-Eye-Eff'), a community-driven initiative to define a set of common application programming interfaces (APIs) for interoperability in web-based image delivery. The IIIF technical specifications make it possible to develop an ecosystem of compliant servers and viewers capable of breaking image silos.

Notable institutions that have deployed a IIIF-compliant solution for their image repositories include national and research libraries such as the British Library, the National Library of France (BnF), Harvard University, Stanford University, Oxford University, and others. In Switzerland, e-codices, the Virtual Manuscript Library, was first to implement both of the core IIIF APIs (Image API and Presentation API) in December 2014. However, IIIF doesn't only apply to memory institutions such as libraries, museums, or archives but to all kinds of image repositories. The wider scientific community, publishers, and digital humanities centres have also started to join the IIIF community.

Apart from institutional benefits, one of the goals of IIIF is that image viewers should provide a world-class user experience (UX). However, only a handful of user-centred design (UCD) methods, such as user surveys and usability testing, have been carried out by IIIF implementers and developers. Assessing what end users require is a necessity if institutions want to avoid user frustration or apathy.

Since October 2016, a three-year project called NIE-INE, overseen by the University of Basel, has aimed to build a national Web-based platform for scientific editions. As they have many shared interests with IIIF and because they just began to think about their technical architecture, usability tests on IIIF-compliant viewers, namely the Universal Viewer (UV) and Mirador, were conducted.

This thesis explores what the NIE-INE scholarly community wants to achieve in their project and evaluates how they could benefit from leveraging IIIF-compliant technology.

2. Context

This chapter is divided into two sections. The first gives a summary of the assignment and its organization within this thesis. The second section concentrates on terminology around usability.

2.1 Assignment

All of the points of this section were first covered in the Specifications (Raemy 2017a)[3], which were agreed between IIIF, the HEG-GE, and the author. Only extracts of the latter are included in this document.

2.1.1 Essence

The Bachelor's thesis is split into four parts: the first gives an overview of IIIF (§ 3), in terms of technology developed by and around the IIIF community and why IIIF implementation can leverage innovative development within memory institutions.

There is also a focus on Switzerland in the context of the NIE-INE initiative (§ 4), especially on how IIIF can appeal to scientific editions in the humanities[4]. This project aims to encourage the creation of a national infrastructure:

> *'[…] that meets the specific needs of large and complex edition projects and, in particular, to ensure the electronic publication and long-term availability of research data and results in a central area of national humanities research.'*
>
> *(DHLab 2017)*

The third part focuses on usability testing (§ 5). Practical approaches were explored on how end users could benefit from IIIF-compliant image viewers. For the latter, remote and in-person usability tests were conducted on the UV (2017a) and Mirador (2016a), the two UI that are the most deployed by IIIF implementers.

Finally, there is a chapter called Discussion (§ 6) which contains interpretations and recommendations of the results obtained during the usability tests and throughout this assignment as well.

[3] Overall, a couple of minor modifications have been made to the original submission, such as the title. The reorganization of the different parts is the main revision.

[4] In this thesis, the chosen and preferred term is *scholarly editions* (cf. § 4).

2.1.2 Scope

This Bachelor's thesis has been primarily written in support of IIIF and is available to its members and partners, particularly the developing teams of the UV and Mirador. The NIE-INE community in Switzerland (and similar projects elsewhere) is the second target audience.

In a broader perspective, this thesis has been written as well for all kinds of memory institutions and image repositories interested in implementing IIIF.

2.1.3 Expectations

Three expectations were identified:

- **Giving an overview of IIIF**: Members of the IIIF community have put together a number of different resources, such as slide decks, blogs, and demos, that reveal the advantages of IIIF for both organizations and end users, but the resources are scattered. It would be interesting in creating a comprehensive explanation of how IIIF can benefit both institutions and end users. It will also be the first time that IIIF is a Bachelor's thesis' subject.
- **Evaluating two user interfaces (UI)**: the conducted usability tests should focus on specific features that the UV and Mirador offer, such as 'drag-and-drop' or the OpenSeadragon's 'pan and zoom' in order to assess the intuitiveness and perceived usability of the two viewers. There should be an emphasis in terms of efficiency and satisfaction, two usability attributes defined by Nielsen (1993, p. 26). The usability tests should be adapted to NIE-INE's target audience and their technical requirements. Findings and analysis outputs of these usability tests shall lead to a set of recommendations for both the developers and the scientific community.
- **Reaching the scientific community in Switzerland:** The Bachelor's thesis should not only demonstrate that the IIIF ecosystem can play a *'[…] central role in the dissemination of scholarly information'* (Kiley, Crane 2016), but also that scientific communities like NIE-INE have many shared interests in deploying IIIF-compliant technologies. The benefits of IIIF adoption for the NIE-INE initiative should be explored based on the findings of usability tests with Mirador and the UV.

This thesis is therefore designed to answer this research question: *'How can the scientific community in Switzerland, particularly those working on scholarly editions, benefit from using IIIF technology?'*

2.1.4 Objectives

Three objectives have been defined as generic (in **bold**) and are essentially linked to this Bachelor's thesis' expectations. Specific objectives (in *italic*) derived from the three generic and main objectives.

1. **Writing a comprehensive description of the International Image Interoperability Framework (IIIF) for potential new implementers.**
    a. *Giving an overview of IIIF with regard to its history, goals, participants and consortium members, defined APIs, and IIIF-compliant software.*
    b. *Scoping the IIIF universe with a view to making IIIF collections more easily discoverable.*
    c. *Outlining the use and adoption of IIIF based on a survey.*
    d. *Raising awareness of IIIF in Switzerland.*
    e. *Establishing institutional benefits provided by IIIF technology.*
2. **Conducting usability tests to show the benefits of the Universal Viewer and Mirador in terms of efficiency and satisfaction.**
    a. *Reviewing the UX benefits and weaknesses with measurement approaches that will be used to test the features developed by the Universal Viewer and Mirador.*
    b. *Conducting tests with LIS students and a representative sample of users. Both should be assessed by the IIIF community.*
    c. *Giving a set of recommendations to the IIIF community and implementers[5] using or considering IIIF-compliant viewers based on the usability tests and the literature review.*
3. **Assessing the interests of deploying and using IIIF-compliant technologies for complex and large scientific editions.**
    a. *Assessing the similarities and differences between memory institutions and the scientific editions community in respect of interests in deploying IIIF-compliant servers and viewers.*
    b. *Contacting the NIE-INE team and raising awareness of the IIIF initiative.*

2.2 Usability and related terms

This section provides an overview of the terminology and concepts around usability, usefulness, user experience (UX), and user-centred design (UCD). A synthesis concludes these parts.

Throughout this thesis, literature selection has been mainly based on methods and techniques developed by advocates and experts within the field.

Simultaneously, two ISO standards, or rather two parts of the same standard, related to our subject have been reviewed. The first provides definitions and concepts of usability (ISO 9241-11) and the second gives recommendations and common ground for managing UCD principles (ISO 9241-210[6]).

[5] The implementers being NIE-INE or other similar projects.
[6] This standard was previously known as ISO 13407. The numbering has changed with the latest revision in 2010.

2.2.1 Usability

Usability denotes *'[the] degree to which something is able or fit to be used'* (Oxford Dictionary of English 2011). In the field of UCD (cf. § 2.2.4), a usable system is occasionally described as *'easy to use'* (Miami University of Ohio 2004), but according to Whitney Quesenbery (2001), this is an oversimplification as it doesn't provide *'[…] guidance for the user interface designer'*.

The most prevalent and best known multidimensional definition (Jokela et al. 2003) is provided by Jakob Nielsen (1993, p. 26) who ascribes five attributes to usability: *learnability, efficiency, memorability, (few) errors,* and *satisfaction*.

The ISO 9241 standard provides another definition of usability, which has since become the reference (Quesenbery 2001; Jokela et al. 2003; Bararunyeretse 2011). It comprises as well the dimensions of *efficiency* and *satisfaction* given by Nielsen and adds a new angle: *effectiveness*. Importantly, this definition also points outs that a precise context must be given. Here is the full definition:

> *'Extent to which a system, product or service can be used by specified users to achieve specified goals with **effectiveness**, **efficiency** and **satisfaction** in a specified **context of use**.'* *(ISO 2010, § 2.13)*

Aside from these two well-known definitions, an easy-to-remember attempt has been made by Quesenbery (2001) which gives us her own notion of usability by setting up five characteristics: *effective, efficient, engaging, error tolerant,* and *easy to learn*. She coined this as the '5 Es'.

As shown in Table 1 on the next page, these three approaching definitions on what usability means have been condensed and each dimension has been defined. These convergent views for defining usability give us a thorough picture.

Table 1: Usability's dimensions and their concise definition

Nielsen, Usability Engineering (1993)	**ISO 9241-11, Usability: Definitions and concepts (1998[7])**	**Quesenbery, What does Usability mean? (2001)**	***Definitions***
Learnability		Easy to Learn	*A given system should be easy to learn so that users could rapidly work with it.*
Efficiency	Efficiency	Efficient	*A given system should provide a high level of productivity.*
Memorability			*A given system should be easy to remember.*
Few errors		Error Tolerant	*A given system should make few errors and recover from them.*
Satisfaction	Satisfaction	Engaging	*A given system should be pleasant and satisfying to use.*
	Effectiveness	Effective	*A given system should enable users to achieve their goals accurately and with completeness.*
	Context of use		*A given system should take into consideration the characteristics of the users, the tasks, and the environment.*

(Nielsen 1993; ISO 2017; Quesenbery 2001)

Roger Bararunyeretse (2011, pp. 17–19) provides an exhaustive list of how usability is perceived by researchers and experts. He states that the definition of usability given by Nielsen (as well as the ISO 9241-11 standard) provides us a focus on the attributes, but

[7] ISO 9241-11's revision is currently under development, but their definition of usability hasn't changed since 1998.

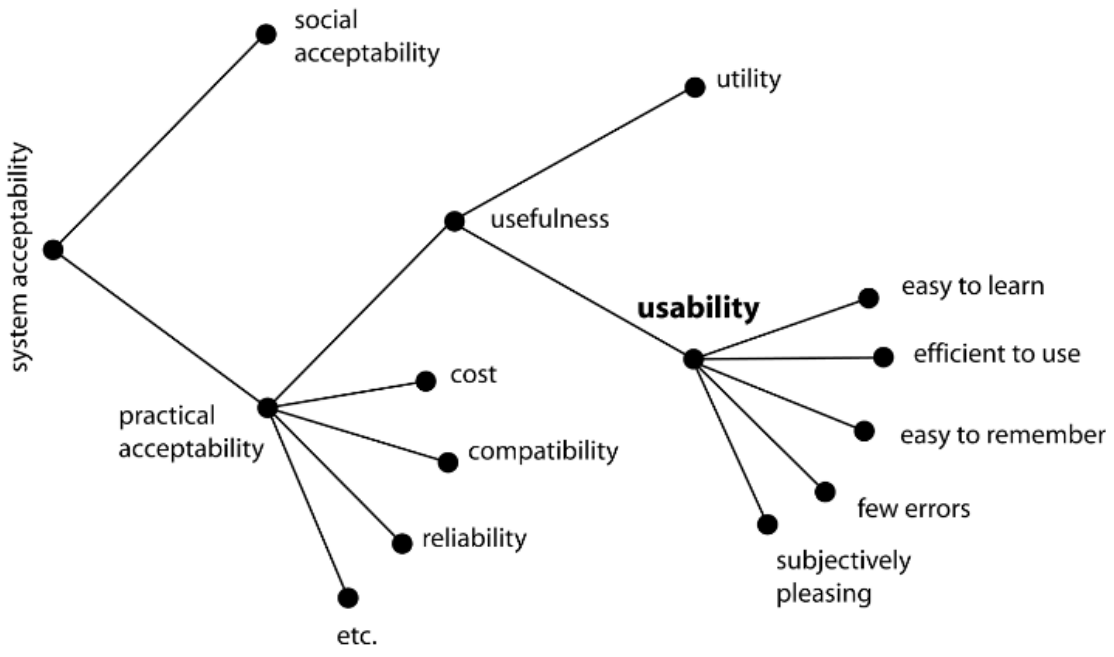
not how it should be measured. Quesenbery (2001), on the other hand, provides some measurement examples for each of the five characteristics:

- **Easy to learn**: recruit users with different levels of domain and knowledge
- **Efficient**: time realistic tasks
- **Error tolerant**: include task scenarios with potential problems
- **Engaging**: carry on user satisfaction survey
- **Effective**: count how often an error is produced

These measurements can be made through several usability methods including focus groups, remote or in-person usability tests, interviews, eye-tracking, questionnaires, or scenarios.

Usability is also considered as being part of a larger compound called 'system acceptability' (Nielsen 1993, p. 25) which is divided into two main categories: social acceptability and practical acceptability. The latter consists of sub-categories such as reliability, compatibility, cost, and usefulness (cf. § 2.2.2), where usability stems from. This model is depicted below in Figure 1.

Figure 1: A model of the attributes of system acceptability



(Nielsen 1993, p. 25)

2.2.2 Usefulness

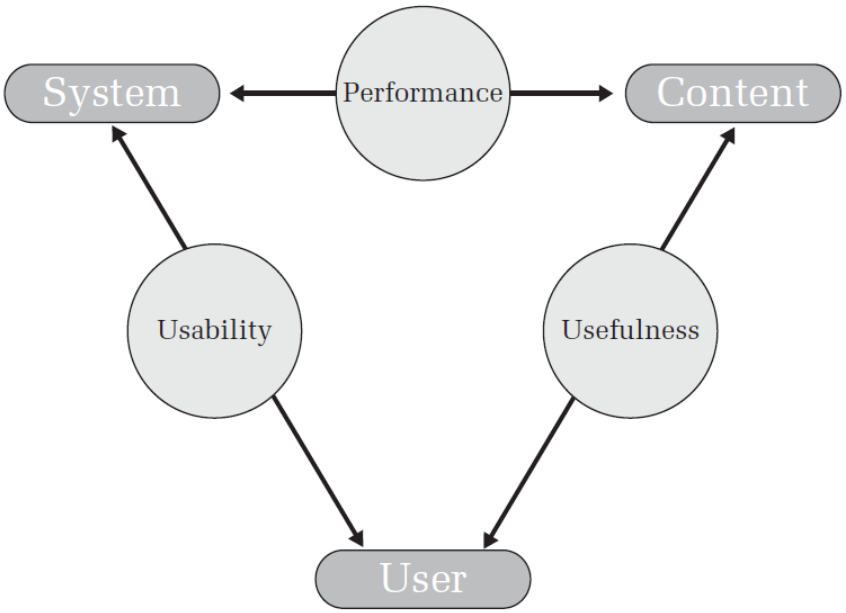
> *'Usefulness is the issue of whether the system can be used to achieve some desired goals. It can again be broken down into two categories of utility and usability [Grudin 1992], where utility is the question of whether the functionality of the system in principle can do what is needed, and usability is the question of how well users can use that functionality.'* *(Nielsen 1993, pp. 24–25)*

For Nielsen, usefulness is therefore the equation of utility + usability. It means that a given system should be functional and usable in order to be useful.

In an effort to evaluate open access digital libraries in terms of usefulness and usability, a theoretical model called the Interaction triptych framework (ITF) (Tsakonas, Papatheodorou 2008, pp. 1237–1239) has been created. As shown in Figure 2, usefulness is the relation between the content and the user. The two other axes of the ITF are system-content (performance) and system-user (usability).

Usefulness contains these five attributes: *relevance*, *format*, *reliability*, *level of the provided information*, and *temporal coverage*. As the matter of usefulness has been rarely evaluated for information services or digital libraries, a research project has created a framework based on the ITF model (Hügi, Schneider 2013a). They have adapted it to contain more attributes by adding *satisfaction* and *competition* to the usefulness evaluation axis and they developed new questions for every attribute in order to have an in-depth framework (Hügi, Schneider 2013b).

Figure 2: Interaction triptych framework (ITF)



(Tsakonas, Papatheodorou 2006)

2.2.3 User Experience (UX)

> *'Person's perceptions and responses that result from the use and/or anticipated use of a system, product or service'* *(ISO 2017, § 3.1.15)*

UX is a broader concept than usability: it covers all facets of the end-user's interaction with a given system (Norman, Nielsen 2007). According to Don Norman (NNgroup 2016), the term is often misused and UX is the way someone experiences everything. Of course, it could be an experience of an application or a website, but when they devised the term in Apple in the 1990s, UX meant '*everything that touches upon [someone's] experience with a product*'.

A balance between perfect usability, where all the users' requirements are covered as in a checklist, and a great UX, which should ensure that users will come back employing the system because it is regarded as valuable, must somehow be found.

Indeed, outcomes from usability testing have to be processed carefully because users don't always know what is best for them, or as Nielsen (1993, pp. 11–12) puts it in one of his slogans: *'The user is not always right'*. Also, it is fine to keep a UI which has some usability issues as long as users have a really positive emotional connection with the UI, because if it takes a lot of effort to reach good usability, it takes even more to achieve good UX.

To visualise what UX means in terms of quality components, Peter Morville (2004) has sketched out a UX Honeycomb in order to 'move beyond usability' where seven hexagons, or facets, are depicted: *useful, usable, desirable, findable, accessible, credible,* and *valuable* (cf. Figure 3).

Figure 3: Morville's User Experience Honeycomb

(Morville 2004)

Morville's UX Honeycomb serves multiple purposes. It can first be used as a tool to decide priorities. It is a modular approach where the design focus of a given system can be made on one facet, rather than trying to cover all qualities simultaneously. Thirdly, the honeycomb enables designers to think outside of the box and *'[…] explore beyond boundaries'* (Morville 2004). All of these points can remind organizations that designing interfaces to meet users' requirements is a lasting prospect (Kurosu 2013, pp. 208-209).

A year after Morville's UX Honeycomb, James Melzer (2005) decided to arrange the hexagons and to refine the diagram by switching accessible and credible with a view to grouping the six outer facets into two categories: *affordance* and *utility*. The two groups are a combination of the central concept: *value*.

> *'Utility answers whether the information satisfy users' demands and expectations; affordance tells us whether users could be able to seek out and use public information service, or the communication between users and system.'*
>
> *(Kurosu 2013, p. 209)*

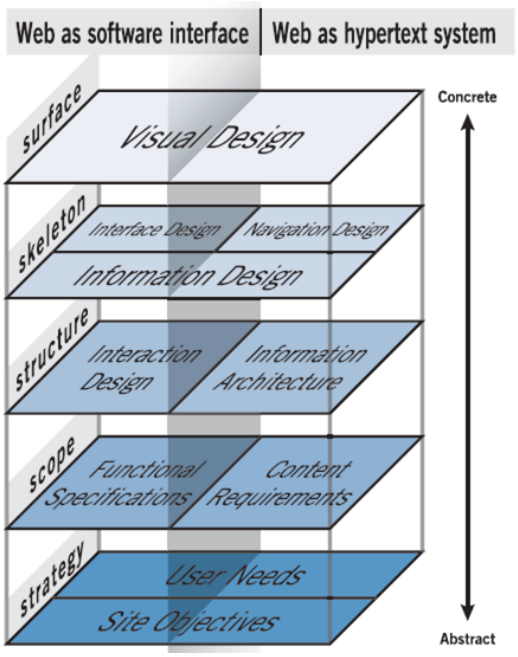
In Melzer's diagram, affordance is the closest to usability. Moreover, Masaaki Kurosu's explanation on the communication between users and system echoes with what you can see on the ITF's usability evaluation axis (cf. Figure 2).

If Morville's honeycomb, and by extension Melzer's, *'[…] deals with the qualities of experience itself'* (Melzer 2005), the creative process is covered by Jesse James Garrett's Five Planes of UX (Figure 4), which is a conceptual framework for designing especially, but not limited to, websites.

Firstly, Garrett identifies five planes, from the most conceptual layer to the most concrete one, as displays on Figure 4: *strategy*, *scope*, *structure*, *skeleton*, and *surface*. Each of them contain elements which contribute to the overall UX (Kumar 2017).

Secondly, for Garrett, the Web can be seen and divided into two main elements: a hypertext system, which was how the Web was originally created, and a software interface. Both of them are known as the '*duality of the web*' (Garrett 2000).

Figure 4: Five Planes of User Experience



(Garrett 2011, p. 33)

2.2.4 User-centred design (UCD)

UCD is a design philosophy, a discipline, an approach, as well as a framework of processes. The needs of end users are not only given special attention, but more importantly the design of a given system is based upon their requirements (ISO 2010, § 2.7; *User-centered design* 2017). UCD processes are iterative and can be applied at each step of a system's implementation (ISO 2010, § 4.5). Four design activities, which are all interdependent of each other, have been drawn by the ISO 9421-210 standard (ISO 2010, § 6.1):

1. Understanding and specifying the context of use
2. Specifying the user requirements
3. Producing design solutions
4. Evaluating the design

The aim of UCD is to make systems more usable, avoid the amount of stress users may encounter, and to reduce errors. Therefore, it is important to involve users throughout the development of a system.

This interdisciplinary field is also known by quite a few different names such as Human-centred design (HCD), Human-computer interaction (HCI), Man-machine interface (MMI), or Computer-human interaction (CHI) (Nielsen 1993, p. 23). All of these terms imply either an interaction between a computer and a human, or that the users should be taken into account first when designing interfaces.

2.2.5 Synthesis

This part provides a condensation of the terms described of this section. Chosen definitions for every term are gathered in Table 2. The ones that are taken word-by-word are highlighted in *italic*. The third column is an attempt to link these concepts to this thesis, particularly to the usability tests, and how they were applied.

Table 2: Chosen definitions and their relevance to this assignment

Terms	Chosen definitions	Relevance to this assignment
Usability	A system which make users able to achieve their goals in a specified context.	The tests on Mirador and the UV assessed the overall usability of these two IIIF-compliant viewers, especially in terms of efficiency and satisfaction.
Usefulness	*Usability + Utility* The relation between the content and the user	Even though this aspect wasn't covered during the usability tests, it is intrinsically related to how participants handled the tasks on the chosen content.
User experience (UX)	*Everything that touches upon someone's experience with a product.*	Providing *'a word-class user experience'* is stated in the third goal the IIIF ecosystem aims to achieve (cf. § 3.2).
User-centred design (UCD)	A design philosophy which focuses on end users at each stage of the product's development.	All the methodological approaches of this thesis aimed to be in concordance with UCD principles. The four activities (ISO 2010, § 6) have also been adapted to the methodology to build the usability tests (cf. § 5.3).

(Quesenbery 2001; Nielsen 1993; Tsakonas, Papatheodorou 2008; NNgroup 2016; ISO 2010)

3. The International Image Interoperability Framework (IIIF)

This chapter is the first of the four main parts of this document. It gives a comprehensive description of IIIF which stems from the first thesis' objective explained in § 2.1.4.

IIIF designates a community, as well as a set of common application programming interfaces (APIs). This chapter is divided into seven sections to reflect the importance of the community and the technical framework that it has created:

- The rationale of IIIF (§ 3.1)
- The three goals defined by IIIF (§ 3.2)
- The IIIF Community in terms of participating institutions, its management, and the different interest groups (§ 3.3)
- The four defined APIs and the validators to conform to the IIIF technical specifications (§ 3.4)
- The main servers and clients that are IIIF-compliant (§ 3.5)
- An insight of the IIIF adoption and projects in Switzerland (§ 3.6)
- The Institutional benefits that provide IIIF to implementers (§ 3.7)

3.1 Rationale

The IIIF initiative started in 2011 at a Cuban restaurant in California after an informal gathering of technologists from Stanford University, Oxford University, and the British Library. They acknowledged that delivery of images on the Web within the cultural heritage field was '*too slow, too disjointed, too complex'* (Snydman, Sanderson, Cramer 2015) and decided to tackle these issues in a joint effort.

3.2 Goals

The purpose of IIIF is to *'make digital image delivery more effective and sustainable for both institutions and end users'* (IIIF 2017a). Three goals have been defined by IIIF:

Table 3: IIIF Goals

1	To give scholars an unprecedented level of uniform and rich access to image-based resources hosted around the world.
2	To define a set of common application programming interfaces that support interoperability between image repositories.
3	To develop, cultivate and document shared technologies, such as image servers and web clients, that provide a world-class user experience in viewing, comparing, manipulating and annotating images.

(IIIF 2017b)

3.3 IIIF Community

First and foremost, IIIF is community-driven. Seven subsections have been laid out to understand which and what kind of institutions have been collaborating in the IIIF community, the purpose of the consortium and the several community and technical specification groups, the different communication channels, the IIIF events, the code of conduct, and lastly the scope of the IIIF universe.

3.3.1 Participating institutions

Participating institutions consist mainly of research, national and state libraries, museums, cultural aggregators, commercial firms, and academic structures such as digital humanities centres. Apart from the three founding institutions, significant IIIF adopters include the Bavarian State Library, Cambridge University, Europeana, the J. Paul Getty Trust, Harvard University, the Internet Archive, the National Library of France (BnF), the Vatican Library, the Wellcome Trust, and the Yale Center for British Art (IIIF 2017c).

Most of the organizations involved in IIIF are from North America, the United Kingdom, and Western Europe. Yet, new adopters from across the globe have deployed IIIF-compliant solutions such as, for instance, the National Library of Cuba, or the University of Tokyo in Japan. In Figure 5, red pinpoints indicate institutions that have already adopted IIIF and the yellow ones those who are considering to implement IIIF or that are currently developing support. As of today, more than one hundred institutions have participated in the IIIF community (Rabun 2017a).

Figure 5: Map of IIIF adoption (June 2017)

(Rabun 2017g)

If adoption and focus have been primarily around memory institutions, IIIF has also been receiving attention from other interest groups such as publishers in Science, technology, engineering and mathematics (STEM) or from the pharmaceutical industry (Kiley, Crane 2016; Moutsatsos 2017). IIIF has also been very interested to expand by foraying into these adjacent communities (Rabun 2017b).

3.3.2 IIIF Consortium (IIIF-C)

Since June 2015, IIIF is also a consortium (IIIF-C), and at the time of writing 41 institutions from around the world have joined it in order to sustain and steer the IIIF initiative (IIIF 2017d).

11 institutions are Core Founding Members as they agreed and signed a Memorandum of Understanding (MOU) to establish the consortium (IIIF 2015). Institutions that have joined the IIIF-C after its inception and up to December 2017 have been considered as Additional Founding Members (IIIF 2017a). A new tier of IIIF-C membership should begin in 2018 (Rabun 2017b). Funds have been managed by the Council on Library and Information Resources (CLIR)[8] and the internal and formal management of IIIF is being done by the following three entities (IIIF 2015, 2017a, 2017c):

- The **Executive Group** which is comprised of representatives of the 11 Core Founding Members plus 2 Additional Founding Members. The Executive Group provides a high-level direction of the IIIF-C.
- The **Coordinating Committee** conducts the weekly activities of IIIF and oversees the IIIF community and technical specification groups.
- The **Editorial Committee** creates and maintains the IIIF technical specifications.

3.3.3 IIIF Community and Technical Specification Groups

Groups have been divided into two types within IIIF (2017c, 2017e, 2017f):

- **Community Groups** where individuals and institutions discuss, collaborate, and work in a specific area of interest. Four IIIF community groups have been formed: manuscripts, museums, newspapers, and software developers.
- **Technical Specification Groups** which are engaged to work on specific goals in relation to the APIs. There are three IIIF technical specification groups: audiovisual (A/V), discovery, and text granularity.

Each group has agreed on a charter and discussions have been led by a chair or several co-chairs. Teleconference calls have been usually scheduled either once a month or once every other week (IIIF 2017f). Creation or dissolution of groups need to conform to the IIIF Groups Framework (IIIF 2017e).

[8] https://www.clir.org/

New IIIF community groups could emerge in the near future as adopters and possible implementers consider possibly creating groups related to three-dimensional (3D) imaging as well as multispectral and scientific imaging (Eichinger 2017; Toth 2017).

3.3.4 Communication

Several communication channels and repositories have been created and used (IIIF 2017c, 2017g):

- The **IIIF Website** where the goals, the list of adopters, the APIs, IIIF-compliant software, showcases, as well as the community newsletter can be found: http://iiif.io/
- The **IIIF-Discuss** Google Group which is the generic electronic mailing list (listserv) for discussion: https://groups.google.com/forum/#!forum/iiif-discuss
- The **IIIF-Announce** Google Group is the second listserv and has been built for people interested in receiving significant announcements and fewer messages than on IIIF-Discuss: https://groups.google.com/forum/#!forum/iiif-announce
- The **IIIF Slack Channel** where members share most of their ideas, thoughts, issues, and demos: http://bit.ly/iiif-slack
- The **Bi-Weekly Community Call** which gives updates on either a community or a technical focus. It is one hour long and is scheduled every other Wednesday at 12pm Eastern Time (either 5 or 6pm in Central European Time): http://iiif.io/community/call/
- The **IIIF GitHub** repository where codes, user stories, fixtures, and links to IIIF resources are gathered[9]: https://github.com/iiif
- The **IIIF Google Drive** directory where notes, presentations, logos, and slide decks are stored: https://goo.gl/vtEJoZ

3.3.5 Events

The wider IIIF community is growing, with the goal of reaching all kinds of institutions and image-driven companies for widespread interoperability in web-based image delivery (IIIF 2017h). With a view to continuing development and expanding to more institutions, IIIF has organised several events such as working groups meetings, outreach events, and conferences[10] in North America, Europe and Asia[11] (IIIF 2017i).

To promote IIIF, representatives have been present at other national and international meetings such as those organized by Code4Lib, the International Federation of Library Associations (IFLA), or the International Medieval Congress (IMC) (Rabun 2017a,

[9] A list with a great number of resources have been created in one repository. It is known as the Awesome IIIF: https://github.com/IIIF/awesome-iiif

[10] The IIIF 2017 Conference held in the Vatican City was the first of its kind.

[11] A IIIF outreach event has been scheduled to take place in Japan in October 2017, which will be the first IIIF session in Asia.

2017c). In addition, institutions have also organized their own IIIF outreach events in Edinburgh, Scotland, or in Basel, Switzerland (Rabun 2017c; Kreyenbühl 2017).

3.3.6 Code of conduct

IIIF elaborated a code of conduct defining the professional ethics one should follow. All interactions within the community is covered by the code:

> *'IIIF is an inclusive, friendly and safe collaboration opportunity. It has always been committed to openness and transparency in all that it does: code, designs, discussions. We are equally committed to helpful and respectful communication both in person and via the internet.'* *(IIIF 2014)*

The code of conduct has been under revision since spring 2017 by a small committee with a view to giving more details on people's behaviours and what to do if anyone should break it (Rabun 2017d). This revision has been done with the help of existing norms and guidelines from several communities in the cultural heritage field such as the Digital Library Foundation (DLF), Islandora, and Hydra.

3.3.7 IIIF Universe

The IIIF Universe means *'the total scope of digital image resources on the Web that are IIIF-compatible'* (Rabun 2016, p. 3). The term has also been used to describe a directory of catalogues containing the top-level collection endpoints of IIIF resources (https://graph.global/universes/iiif). Yet, only a limited number can be found through this central index; not all IIIF-compliant images have been added to this directory by implementers and there is a general lack of top-level collections[12].

In order to scope the IIIF universe, two adopters surveys were launched in February 2017 (Rabun 2017c, 2017e):

- A basic survey launched by the IIIF community to assess how many images were IIIF-compliant, what APIs were in production or considered by adopters, as well as providing the best link to browse IIIF content (website, top-level collection endpoint or an API).
- An extended version done by the University of Toronto for the creation of training materials.

Over 100 institutions have been involved in IIIF and through the basic survey, 70 of them responded. The number of IIIF-compliant images were over 335 million. 51 institutions were currently using the version 1.X or 2.X of Image API[13] and 42 the version 1.X or 2.X of the Presentation API. Only a handful of institutions supported the Content Search API

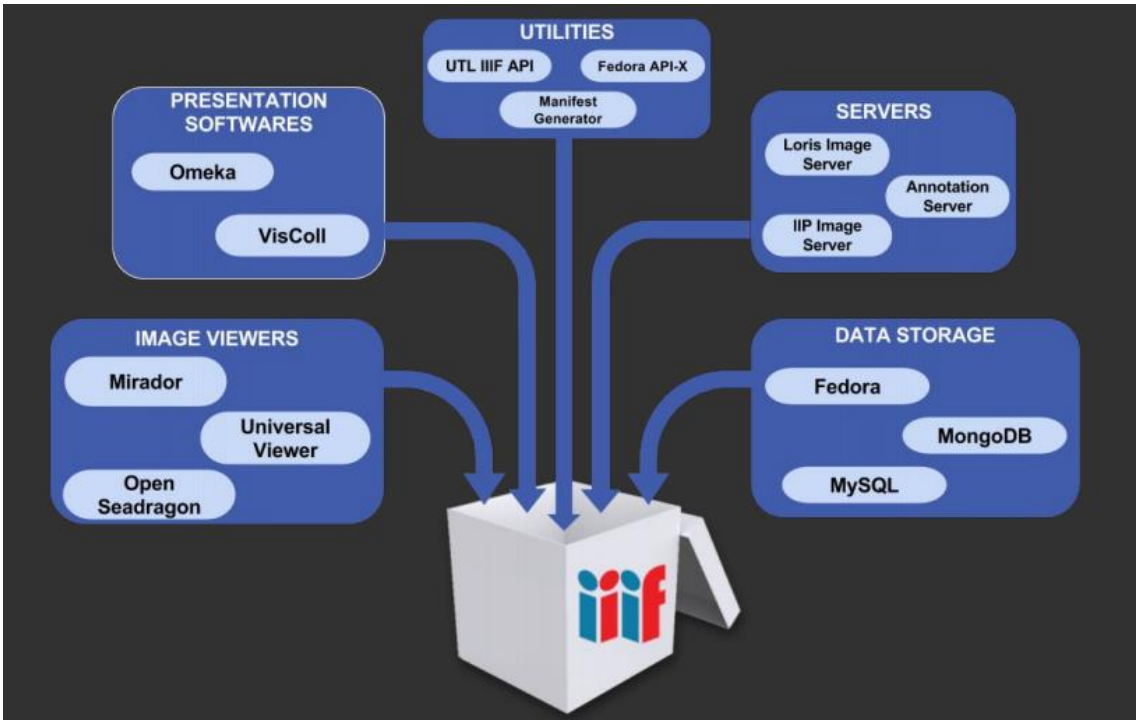
[12] A IIIF top-level collection is a JSON file containing all the IIIF manifests of a given institution.

[13] Cf. § 3.4 for further information on the IIIF APIs.

and 2 institutions the Authentication API. In addition, over 30 institutions were investigating support for any of the IIIF APIs[14] (Rabun 2017a, 2017b).

The extended adopters survey provided clarifications on what the University of Toronto could offer to potential new implementers to overcome technical barriers through their '*IIIF-to-Go*' (cf. Figure 6). This product contained different and flexible components (servers, viewers, utilities, data storage, etc.) to facilitate integration depending on the institutions' requirements (Di Cresce 2017a).

Figure 6: University of Toronto's IIIF-To-Go



(Di Cresce 2017a)

Finally, as '*there is no way to limit searches in commodity search engines to IIIF content only'* (Warner 2017), the IIIF Discovery Technical Specification Group has aimed to find ways to make IIIF resources more easily discoverable. For instance, they have been exploring the best approaches to crawl and harvest content, to index them, to do automatic notification after initial harvesting, as well as to find appropriate and consistent patterns on how to import IIIF content to viewers such as drag-and-drop (IIIF 2017j).

[14] Either as a new implementation or as an upgrade to a latest API version.

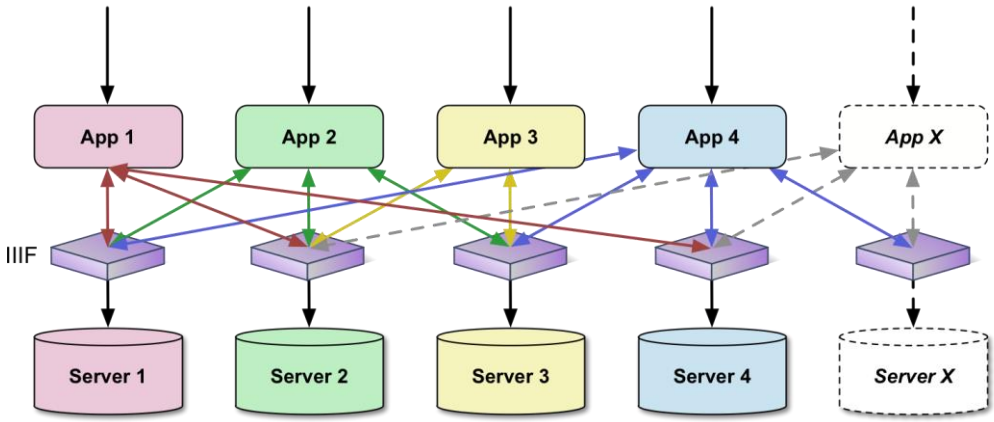
3.4 Technical specifications

The motivation behind developing the IIIF APIs was to remove the virtual silos that cultural institutions have created to deliver images on the Web (Snydman, Sanderson, Cramer 2015) and to leverage consistency, flexibility, and interoperability. Besides, developing shared APIs have also been cost savings (Sanderson 2016).

Four RESTful APIs serialised in JSON-LD have been defined and vetted by the IIIF community: Image API, Presentation API, Content Search API, and Authentication API. The two first are the core APIs of IIIF. All these specifications follow several design patterns like those from '*Web patterns, [which simplify] processes for data migration and sharing'* (IIIF 2017g; Appleby et al. 2017a).

As depicted in Figure 7, a IIIF API works as an intermediate layer interacting between clients and servers that are IIIF-compliant (Cramer 2017a) or that '*play by the rules*' (Sanderson 2016).

Figure 7: IIIF APIs in the client-server model



(Sanderson 2016)

The next subsections provide an overview of the four defined APIs.

3.4.1 Image API

The first stable version was defined in August 2012, the second in September 2014, and the current Image API 2.1 in May 2016. A patch with non-breaking changes (Image API 2.1.1) was specified in June 2017. The Image API gets the technical data (the pixels) of an image content to enable interaction on the Web (Sanderson 2016).

More formally the Image API:

> *'[…] specifies a web service that returns an image in response to a standard HTTP or HTTPS request. The URI can specify the region, size, rotation, quality characteristics and format of the requested image.' (Appleby et al. 2017b)*

In order to request an image or its information (info.json), a canonical URI has been defined. The URI syntax must conform to the following parameters:

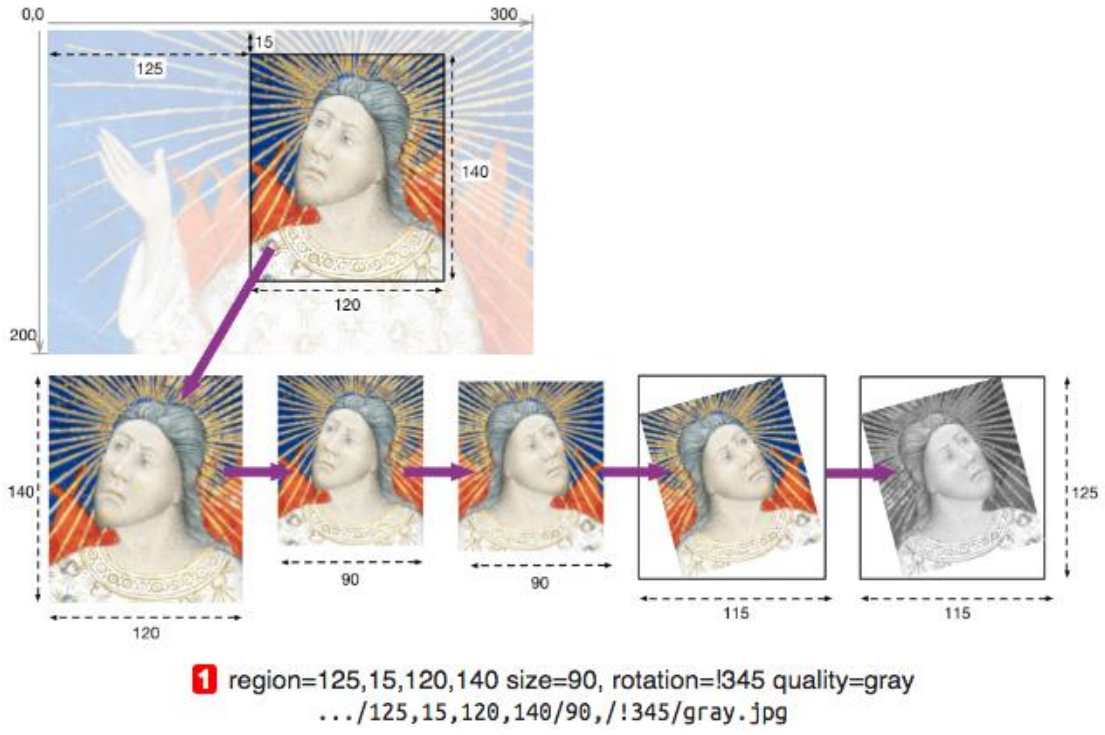
Table 4: URI syntax of the IIIF Image API

Image Request	{scheme}://{server}{/prefix}/{identifier}/{region}/{size}/{rotation}/{quality}.{format} http://www.example.org/image-service/abcd1234/full/full/0/default.jpg
Image Information Request	{scheme}://{server}{/prefix}/{identifier}/info.json http://www.example.org/image-service/abcd1234/info.json

(Appleby et al. 2017b)

From the *region* to the *format* parameters, an example with a cropped image and the URI syntax is shown in Figure 8.

Figure 8: URI syntax – order of implementation



(Appleby et al. 2017b)

Permalink: http://iiif.io/api/image/

3.4.2 Presentation API

Except the release of the Presentation API 1.0 that happened in August 2013 and one year after the Image API 1.0, the Presentation API 2.0, 2.1, and the 2.1.1 patch were defined at the same time of the parallel version of the Image API. The objective of the Presentation API is:

> *'[…] to provide the information necessary to allow a rich, online viewing environment for primarily image-based objects to be presented to a human user, likely in conjunction with the IIIF Image API.'* *(Appleby et al. 2017c)*

The Image API allows users to retrieve and interact with a single image, whereas the Presentation API is the '*glue'* that sticks them together to give users a particular context. The Presentation API provides '*just enough descriptive metadata*' for display purposes, but it is not a new metadata standard[15] as it is not intended for discovery (Sanderson 2016). As for annotations, the Presentation API leverages the Open Annotation Data Model (Sanderson, Ciccarese, Van de Sompel 2013).

The key points of the Presentation API are the structure of the digital object and that each of the following resource types[16] has their own properties[17] (Appleby et al. 2017c):

- **Manifest**: the representation and description of the object. The recommended URI pattern is the following: {scheme}://{host}/{prefix}/{identifier}/manifest
- **Sequence**: the order of the object
- **Canvas**: the layer between the sequence and the content. It is based on the Shared Canvas Data Model (Sanderson et al. 2012) where a canvas is '*an abstract space used for building a view of the object'* (Sanderson 2016).
- **Content**: the image which is associated with a canvas

Lastly, the A/V technical specification group has been working on drafting an extension or update to the IIIF Presentation API that will entail assigning a duration to a canvas for time-based media. In addition, the W3C Web Annotations (Cole 2017) will be leveraged instead of Open Annotation in the next version.

Permalink: http://iiif.io/api/presentation/

[15] It does though provide facilities for linking to external description through the *seeAlso* property. Typically, institutions have either directly included in it the raw data from their catalogue or dereferenced it with standards such as MARC, METS, or EAD.

[16] Manifest, Sequence, canvas, and content are the basic types. A schema of all the types (basic and additional types) has been put in Appendix 1 (cf. Figure 20).

[17] The properties are divided into four groups: descriptive, rights and licensing, technical, and linking.

3.4.3 Content Search API

The Content Search API 1.0 was released in May 2016 (Appleby et al. 2016). It gives access and interoperability mechanisms for searching within the textual annotations of a digital object, such as the full-text transcription or the OCR (Sanderson 2016).

Permalink: http://iiif.io/api/search/

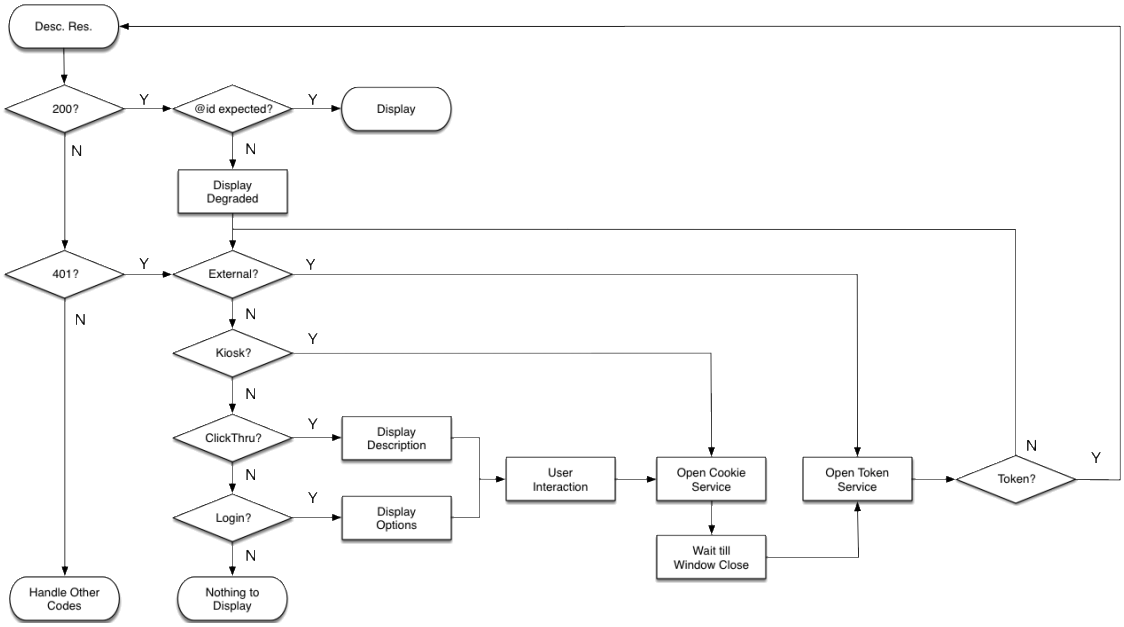
3.4.4 Authentication API

The first version of the Authentication API, designed to allow application of IIIF for access-restricted images, was defined in January 2017. It supports access based on different credentials and acts as a layer on top of existing authentication infrastructures (Sanderson 2016). The different interaction patterns for accessing restricted content are the following (Crane 2016a; Appleby et al. 2017d):

- **Login**: the client prompts the end user to log in
- **Clickthrough**: the end user is required to click[18]
- **Kiosk**: the client is expected to use an access cookie automatically
- **External**: the end user is expected to have already acquired the appropriate cookie

Figure 9 shows the different interactions from the browser client perspective.

Figure 9: IIIF Client Authentication Workflow



(Appleby et al. 2017d)

Permalink: http://iiif.io/api/auth/

[18] If end users aren't able to see some parts of the digital asset (e.g. archival materials), they are prompted with a notification.

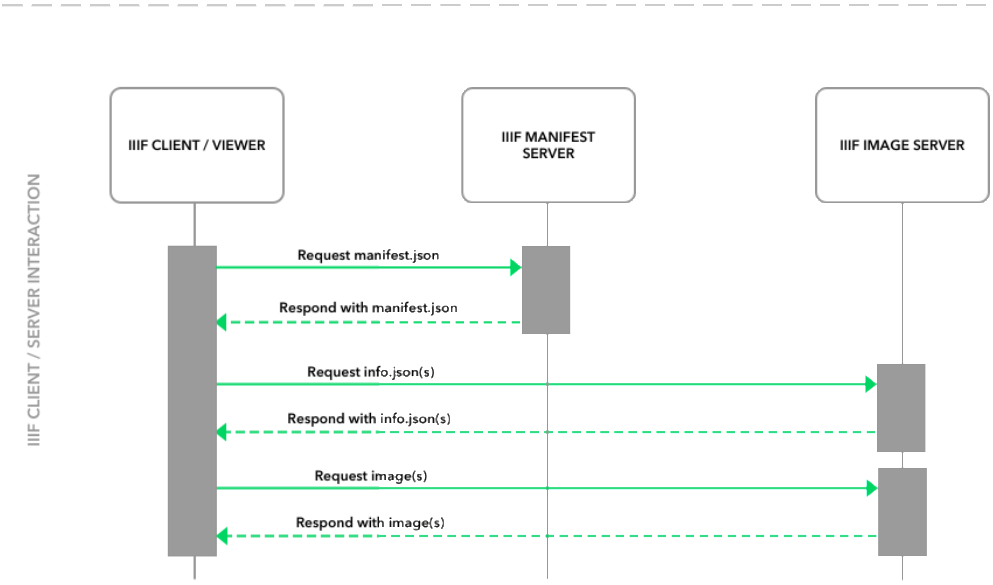
3.5 IIIF-compliant software

Software has been adapted or built anew to implement the IIIF specifications, which have since become *de facto* standards in the cultural heritage field. As a consequence, a developing IIIF ecosystem of compliant servers and clients has made it possible to expose interoperable content, whose metadata only needs to be published once (IIIF 2017k; Ying, Shulman 2015). Below are a list of some (open-source and proprietary) image servers and clients that support IIIF (IIIF 2017l).:

- **Servers**: Loris, IIPImageServer, Cantaloupe, ContentDM, Djakota, SIPI
- **Clients**: OpenSeaDragon, Leaflet-IIIF, Diva.js, IIIFViewer, Universal Viewer (UV), Mirador[19]

Figure 10 shows the interaction where the client requests the *manifest.json* (Presentation API) and the *info.json* (Image Information Request from the Image API) and the server responds with the descriptive information and the requested content.

Figure 10: IIIF Client / Server Interaction



(Reed, Winget 2017)

Institutions interested in implementing IIIF have the flexibility to choose from any IIIF-compliant software and can easily replace one component from their technology stack. As for storage, the Museum Community Group has sent an open letter to Digital Asset Management (DAM) vendors to encourage them to integrate the IIIF APIs into their product (IIIF 2017m).

[19] Further information on the UV and Mirador in § 5.1.

Last but not least, institutions deploying IIIF-compliant technology enable a better UX:

> *'End users can also benefit from the improved functionality that IIIF provides, such as deep zoom and pan, comparing multiple images in a single viewer, creating and saving annotations, and searching across annotations.'*
>
> *(Rabun 2016, p. 2)*

3.6 IIIF in Switzerland

Several private and public organizations in Switzerland have shown their interest in IIIF and some of them have been involved with the community. However, not so many have deployed or built IIIF-compliant solutions and expose IIIF resources on the Web.

The first Swiss project and collection that complied with the two core APIs was e-codices (www.e-codices.ch), the Virtual Manuscript Library of Switzerland, which provides digital access to more than 1800 manuscripts from more than 50 memory institutions[20] (e-codices 2016a). This initiative started back in 2003 and the project took shape in 2008 with the support of the Andrew W. Mellon Foundation, the e-lib Swiss electronic library, and Swissuniversities. E-codices has been managed at the University of Fribourg (e-codices 2016b). E-codices became fully IIIF-compliant in December 2014 when the second version of their website, developed by text&bytes (http://www.textandbytes.com/), was made available to the public (e-codices 2014).

Another upcoming IIIF web application managed at the University of Fribourg in Switzerland is Fragmentarium (http://fragmentarium.ms/), also developed by text&bytes, which will expose and virtually reassemble fragments of manuscripts that have been disseminated over the world. 15 prominent libraries have partnered with Fragmentarium and the platform has projected to go online in 2017 and until the end of the pilot phase in 2018, it will be a closed space (2017a, 2017b).

Three other organizations have come to IIIF Working Groups Meetings or in the 2017 IIIF Conference in the Vatican City to present their IIIF-related work. First, Klokan Technologies (https://www.klokantech.com/) based in the Canton of Zug, has specialised in online map publishing where IIIF manifests can be assigned a geographical location (http://www.georeferencer.com/) and has developed IIIF-compliant solutions such as IIIFServer, IIIFViewer, as well as IIIFHosting. The Digital Humanities Lab of the Swiss Federal Institute of Technology in Lausanne (EPFL) has used Loris, OpenSeaDragon, and the Image API (Rochat et al. 2016) for two of their

[20] The big contributors of e-codices are the Abbey Library of Saint Gall (*Stiftsbibliothek St. Gallen*) and the Bodmer Foundation in Cologny. The digitisation has taken place in both places.

projects: for the archive platform of the Swiss newspaper *Le Temps* (http://www.letempsarchives.ch/) and for the digital library of the Elysée Museum in Lausanne (http://photobookselysee.ch/). They also held a Mirador workshop in 2015 (EPFL 2015) and have been building a suite of tools for the digital humanities field which should comply with the IIIF APIs. Finally, the Digital Humanities Lab of the University of Basel (http://dhlab.unibas.ch/) has become since January 2017 the only Swiss institution to be part of the IIIF-C at the time of writing (Rabun 2017f)[21]. They have built SIPI (https://github.com/dhlab-basel/Sipi), a IIIF-compliant server and they have been interested in leveraging IIIF for long-term preservation purposes (Rosenthaler, Fornaro 2016) as well as using IIIF with audiovisual assets (Raemy, Fornaro, Rosenthaler 2017).

3.7 Institutional benefits

As everything that has been developed is based on real use cases and on existing Web patterns, IIIF helps institutions on a very practical level. IIIF doesn't break only silos between institutions, but internal ones. For instance, the British Library used to have one viewer per project and the overall situation has now become more consistent (Crane 2016b, 01:15).

For Europeana, the European Union (EU) digital platform for cultural heritage, this is also a protocol which can support them in aggregating datasets from partners that comply with IIIF as content has been easier to crawl (Haskiya 2017).

End users can benefit directly from IIIF-compliant technology as it reduces the friction around information access, it makes research and study easier, and lower the barrier behind cross-collections research. Besides, IIIF helps to have a more user-centric approach:

> *'IIIF shifts focus of interoperability from administrative (e.g. OAI-PMH) to end user empowerment'* *(Lewis 2017 citing Howard)*

On the IIIF Frequently Asked Questions (FAQ) webpage, nine different points have been drawn to sum up the benefits of IIIF such as having flexibility around the choice of the system, that IIIF reduces long-term costs, that the global network can unlock new potential for digital content when they are interoperable across institutions, as well as the benefits of joining an international and inclusive community (2017g).

[21] EPFL has also shown interest in joining the IIIF-C and may do so before the end of 2017.

4. NIE-INE

The second part of this thesis surveys the NIE-INE project which formally started in October 2016. This chapter is divided into six sections:

- The purpose of NIE-INE (§ 4.1)
- The coordination and management of NIE-INE (§ 4.2)
- The collaborative projects within NIE-INE (§ 4.3)
- The target audience and types of users of the future platform (§ 4.4)
- A brief insight of the technical architecture (§ 4.5)
- The interest in deploying and using IIIF-compliant technology (§ 4.6)

As NIE-INE began only a couple of months before the start of this bachelor's thesis, information was quite scarce. In addition, personal visits were conducted at the University of Basel to meet team members.

4.1 Objectives

NIE-INE stands for '*Nationale Infrastruktur für Editionen'* in German and '*Infrastructure nationale pour les éditions'* in French. This initiative aims to build a national Web-based platform in Switzerland for scientific edition projects in the humanities, including both primary and secondary sources (DHLab 2017; FEE 2017a).

NIE-INE seeks to ensure the sustainability and access of scientific edition projects in a digital environment and wants to meet the technical requirements of complex use cases such as critical editions of text, commentaries, and any kinds of scholarly enriched editions as well as all the research data that stems from the digital surrogates (Wild 2016; FEE 2016). Four key points have been defined (Wild 2016):

- **An integrated solution** which comprises a Web-based platform, a virtual research environment, a linked open data repository, and a long-term archiving strategy.
- **An agile approach** which can be: efficient in the short-term and developed in accordance with the different edition projects; flexible where tools are based on content; cost-effective to avoid redundancy; in line with requirements of the data management.
- **Compliant with the technologies developed within DaSCH**[22] as the NIE-INE platform will be based on the DaSCH infrastructure and may be extended to their own needs (Rosenthaler 2016).
- **Open technology** where open-source software can be reused.

[22] Cf. § 4.2.

4.2 Coordination and management

Coordination of the project has been conducted by the University of Basel's *Forum für Edition und Erschliessung* (FEE) and the technical background has been moderated by the University of Basel's Digital Humanities Lab (DHLab).

NIE-NIE is funded by Swissuniversities through their SUC-P5 scientific information programme in the area of Publications[23]. The grant will last until September 2019 and until this point, NIE-INE is in its pilot phase where new edition projects can easily be integrated into the platform. From 2019 onwards, the platform will be overseen by the Data and Service Centre for the Humanities (DaSCH) (Wild 2016; DHLab 2017).

Several instances monitor NIE-INE: a steering committee, a project management team, an IT team dedicated to the coordination of tools and its development, a software architecture team, a central repository[24], as well as the link to the different edition projects involved[25] (Wild 2016).

Most of the team coordinators and employees work in Basel, and some in Bern and Zurich. Overall, they are six entities, mostly universities, that cooperate in NIE-INE (FEE 2017a):

- The Swiss Academy of Humanities and Social Sciences – *Schweizerische Akademie der Geistes- und Sozialwissenschaften (SAGW)*
- The University of Basel
- The University of Bern
- The University of Zurich
- The University Library of Basel
- The Cantonal, City and University Library of Zurich – *Zentralbibliothek Zürich*

4.3 Collaborative projects

As shown on the next page in Table 5, there are 14 edition projects, all of them quite eclectic in terms of studied fields, within the NIE-INE initiative.

Most of them already host a website or an internal platform for researchers and the general public. These were often hosted on a Swiss university website or on a separate platform. All the edition projects have been studied in either the University of Basel (8 projects), the University of Zurich (4), or the University of Bern (2).

[23] The SUC-P5 programme is divided into four designated areas: Publications, eScience, Basis, and Services (Swissuniversities 2016).
[24] This part is supervised by DaSCH which has already been promoting the use of IIIF (DaSCH 2017): http://dh-center.ch/.
[25] Cf. § 4.3.

Table 5: NIE-INE projects

Project	Main field	Description
Anton Webern Gesamtausgabe	Musicology	Works from and about Anton Webern (1883-1945), an Austrian composer and conductor.
Basler Edition der Bernoulli-Briefwechsel (BEBB)	Mathematics Physics	Letters from the Bernoulli family members, scientists from Basel that lived in the 17th and 18th centuries.
Bernoulli-Euler-OnLine (BEOL)	Mathematics	*'This project integrates the BEBB and the Leonhardi Euleri Opera Omnia (LEOO) into one digital platform'* (DHLab 2016a).
C. F. Meyer: Verlagsbriefwechsel. Historisch-kritische Ausgabe	Poetry	The correspondence between Conrad Ferdinand Meyer (1825-1898) and his publisher Hermann Haessel (1819-1901).
Commentaries on Peter Lombard's Sentences	Theology	A repertory of all the commentaries on Peter Lombard's *Sentences*, a 12th century theologian. This was one of the most commented work in the Christian literature.
Das Kloster-Tagebuch des Einsiedler Paters Joseph Dietrich	Theology Meteorology	The Monastery diary mostly written by Father Joseph Dietrich which include weather observations during the *Late Manunder Minimum* (1645-1715) (DH UNIBE 2015).
Edition Johann Caspar Lavater	Theology Philosophy	Works of Johann Caspar Lavater, author and pastor from Zurich (1741-1801).
Heinrich Wölfflin: Gesammelte Werke	Art history	Works of Heinrich Wölfflin, art historian that lived in Zurich (1864-1945).
Kritische Robert Walser-Ausgabe	Literature	Critical editions of Robert Walser's works. Walser was a Swiss writer (1878-1956).
Kuno Raebers Lyrik: Historisch-kritische Online-Edition	Poetry Theology Philosophy	Works of Kuno Raeber, a Swiss lyricist and author (1922-1992).
Online Edition of the Paippalāda Recension of the Atharva Veda	Theology	Works related to Paippalāda, one of the nine Hinduism branches of Atharva Veda.
Parzival-Projekt	Mythology Theology	Critical editions of the tales of Percival and its quest for the Holy Grail (13th century).
Reconstruire Delille	Poetry	Critical editions of the works of Jacques Deville, French author (1738-1813).
Rudolf Wackernagel	History	Analysis of the works of Rudolf Wackernagel, Swiss historian and archivist (1855-1925).

(FEE 2017a)

4.4 Target audience and types of users

Mostly, the target audience is academic. Students, professors, researchers, or digital curators have been identified as the NIE-INE types of users. Based on the user stories that NIE-INE has been collating, researchers in the humanities are the prominent end users (Notroff 2017)[26].

4.5 Technical architecture

NIE-INE will map its data into Knora/Salsah[27], an RDF[28] platform providing a RESTful API for access and a graphical user interface developed by the University of Basel's DHLab (Fornaro, Rosenthaler 2016; DHLab 2016c). Kuno Raeber and the Peter Lombard edition projects have been already projected to migrate to Knora/Salsah on a pilot basis (Kaufmann 2017).

The full technology stack has not yet been defined, but pieces have been brought together to convert, for instance, data stored in MySQL into RDF triples (NIE-INE 2017). Besides, a workshop around ontologies took place in March 2017 (FEE 2017b).

4.6 Shared interests with IIIF

As the NIE-INE initiative aims to build a common Web platform for the 14 edition projects, they could use IIIF-compliant components for establishing interoperability within and outside of their scope and to offer new possibilities for researchers across the globe. In addition, NIE-INE and IIIF both advocate open, flexible, and consistent technical architecture as well as providing high-quality UX.

Even if most NIE-INE edition projects are text-based (literature, correspondence, commentaries) and because the focus of IIIF has been heavily on cultural heritage images[29] (and particularly digitised manuscripts), some institutions and individuals have used IIIF beyond this area for large scientific images as well as newspapers and text commentaries (Bertin, Pillay, Marmo 2015; Robson 2017; Witt 2017).

Lastly, as NIE-INE is based at the University of Basel, they could leverage the Digital Humanities Lab's connection with the IIIF-C.

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[26] This work was still in progress at the time of writing. Cf. § 5.3.2 for more details on the user stories.

[27] Knora: Knowledge Organization, Representation, and Annotation. Salsah: System for Annotation and Linkage of Sources in Arts and Humanities (DHLab 2016b).

[28] RDF: Resource Description Framework. '*RDF is a standard model for data interchange on the Web. […] RDF extends the linking structure of the Web to use URIs to name the relationship between things as well as the two ends of the link (this is usually referred to as a triple)'.* (W3C 2014). More information on: https://www.w3.org/RDF/

[29] IIIF has projected to integrate all types of content such as text, A/V, 3D.

5. Usability testing

This chapter focuses on usability tests conducted on two IIIF-compliant image viewers: Mirador and the UV. Usability testing was carried on both remotely and in-person. The chapter is divided in six sections as follows:

- Overview of the two UI (§ 5.1)
- Evaluations done by IIIF implementers (§ 5.2)
- Methods and designs of each usability test (§ 5.3)
- Measurement approach (§ 5.4)
- Results and findings (§ 5.5)
- Limitations and bias of the tests (§ 5.6)

5.1 User Interfaces (UI)

Both UI are IIIF-compatible and share most of the same features like OpenSeadragon IIIF Tile Source[30] as their *'core image viewing technology'* (Mirador 2017a) for deep zoom and pan purposes or the ability to *'navigate structured collections'* (Reed, Winget 2017). They also both support drag-and-drop, which in most implementations entails the ability for the user to click and drag the IIIF logo into a viewing window to display the resource (Crane 2016b; Snydman 2016).

Even if these two viewers can be used interchangeably most of the time, they differ in some aspects[31]. For example, Mirador is a multi-image viewing platform where several IIIF manifests can be loaded, compared, and annotated. Whereas, the UV is more of a configurable, extensible, and embeddable interface with easy-to-share abilities (IIIF 2017a). The two following subsections provide more information about each viewer.

5.1.1 The Universal Viewer (UV)

The UV, formerly known as the 'Wellcome Player' and originally built for the Wellcome Library has been developed by Digirati since 2012. It already supported OpenSeadragon DZI, PDF, and audio-visual assets (mp3, mp4) (UV 2017b) as well as search or authentication. It was conceived as a key component of the Wellcome Library's Digital Delivery System. Moreover, the Wellcome Player was then open-sourced and its code available on GitHub (UV 2017b).

[30] *'OpenSeadragon supports several image serving protocols'* (OpenSeadragon 2017). They added support for IIIF in 2013 based on their Deep Zoom Image (DZI) (Stroop 2013).

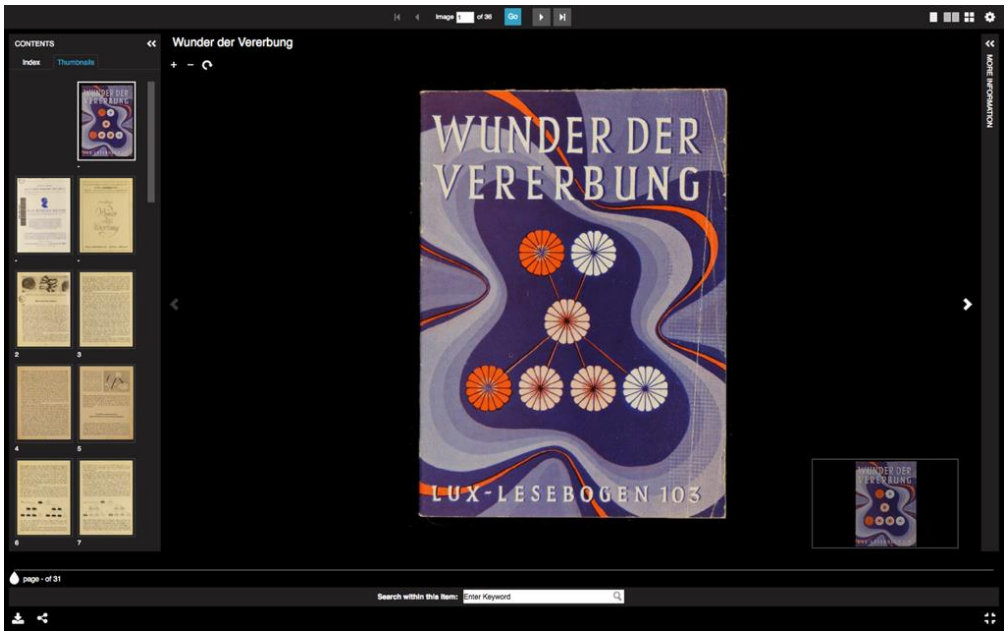
[31] It must be noted that the development teams of both viewers collaborate on a regular basis to develop shared libraries and attend most of the same IIIF community calls. Or as Snydman puts it '*All the viewers are friends'* (2016).

In 2014, when Digirati heard of the IIIF initiative, they started to experiment to see how to comply with their specifications to make their viewer interoperable as it was still a silo, a '*snowflake'* (Crane 2016b). Around the same time, the British Library chose the Wellcome Player in the context of their 'Universal Viewer project' to replace all the different image viewers that they had deployed to provide a uniform stack of technology with a focus on books and manuscripts (UV 2017b). Most of the time each funding programme this large institution received for digitising certain collections would create a new silo with its own server and client. The UV was a way of achieving consolidation and simplicity of the British Library's internal infrastructure (Crane 2016).

Digirati changed the viewer's name and started then to modify it to support IIIF APIs. In the process, they added some new features to cover the British Library use cases such as 'two-up' mode or right-to-left paging support (Digirati 2015, 2017). Other institutions started to join and collaborate on developing the UV. Besides, all digitised content from the Wellcome Library had been made IIIF-compliant by 2016 and the UV had superseded the initial Wellcome Player.

As of today, the UV has many contributors and, amongst the two aforementioned institutions, is being used by the following (UV 2017a): Villanova University, the National Library of Wales, the Princeton University Library, the North Carolina State University Libraries, the Ghent University Library, the Bodleian Libraries (University of Oxford), and the Swedish National Archives. The first version of the UV came out in 2015 and the second in February 2017 (Figure 11). Over the summer 2017, V3.0 should be available.

Figure 11: The Universal Viewer (2.0.1)



(UV 2017c)

Table 6 provides a summary of the UV's main features. They have been selected in terms of visibility. In other words, these features are only those linked to important icons, panels, and controls which are noticeable in the different viewer's areas.

Table 6: UV's main features

Feature	Area	Description
Chevrons and image search	Top	Chevrons and the search of a particular image by its number are two manners of navigating throughout the loaded item.
Zoom and rotation	Top left	Three icons can be used to zoom in or out as well as to rotate the item in a clockwise direction. The buttons appear below the work's title only when interacting on the screen or hovering over them.
Single, two-up page view, or gallery	Top right	The IIIF Manifest can be rendered as a single page, two pages side-by-side, or as gallery of thumbnails (Figure 12).
Settings dialogue	Top right	The settings offer some configuration possibilities such as in which implemented language the information has to be displayed, if a mouse click generates a zoom in or not, or if the zoom should be preserved when going to another page.
Contents panel: Thumbnails and index	Left-hand side	Contents are separated into two different viewing categories: Index and Thumbnails. The latter, which is displayed by default, give an overview of the digital surrogate. As for the index, an end user can select different sections of the work.
More information panel	Right-hand side	It conveys the metadata, the rights, and license that the loaded IIIF manifest contains. It is hidden by default.
Download	Bottom left	An end user can choose between different options: current view to grab an image's region of interest via the Image API, the whole page (as an image), and other renderings if available, such as the raw text or in PDF.
Share and embed	Bottom left	It is possible to share the URI quite easily by clicking on the icon. Besides, embed works like other services such as YouTube where an end user can encapsulate the UV on a third-party webpage. Three different embed sizes are available as well as a custom choice.
Search within	Bottom	It is possible to search within a IIIF manifest that went through optical character recognition (OCR). When a certain request has been found through, matches are highlighted and blue pinpoints (i.e. the number of hits) are indicated on a continuous line representing the structure of the work.
Full screen	Bottom right	The interface can be rendered as a full screen.

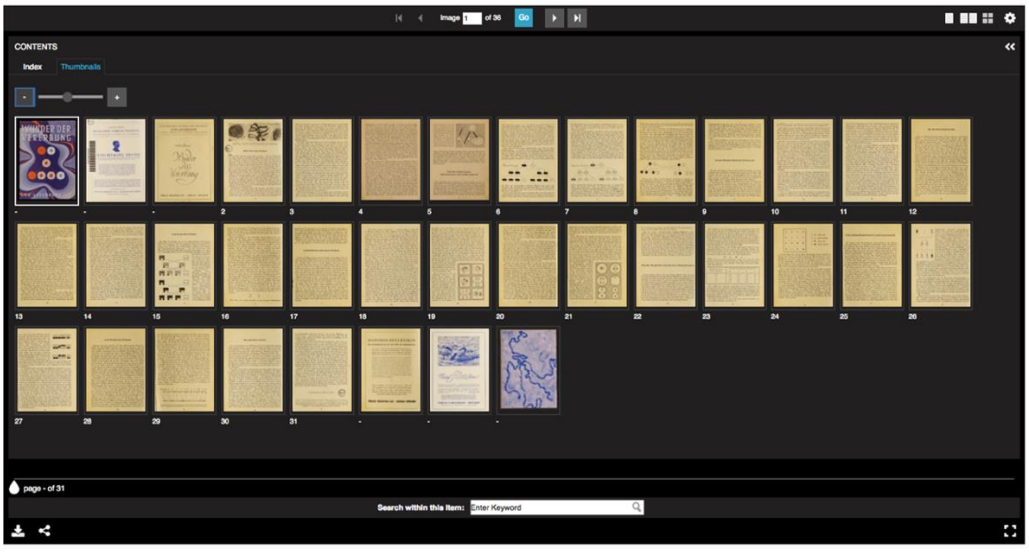
(Crane 2016b; UV 2017b, 2017d)

As for the functions that are not easy to know or observe for new users, the following is a short list of functions that the UV supports (Crane 2016b; Digirati 2017; UV 2017b):

- **Paging**: The IIIF manifest can be rendered like in the original source's natural reading order (left-to-right or right-to-left but also top-to-bottom or bottom-to-top) as the Presentation API tells the viewer how the work was assembled[32].
- **IIIF Collections support**: not only single items can be rendered in the UV, but also collections of those items whether it is a multi-volume work (Crane 2016c) or periodicals that can be navigated through date releases (Crane 2016d). All of these pieces of information can be derived from the Presentation API. The UV is also able to parse collections of collections.
- **Theming**: the UV can be displayed in different colours, layouts, and with other icons as does for example the viewer's flavour configured by the Swedish National Archives[33].
- **Authentication**: the UV supports the Authentication API to protect sensitive content through the four different options the API provides.
- **Extensible**: the UV does not only support images but also PDFs, audiovisual assets, and 3D. For the moment, the UV render these information with an 'IxIF' interim implementation which will be superseded when new IIIF APIs will be defined such as A/V (Crane 2015).
- **Translatable**: the UV has been first translated with transifex[34] to Welsh and other languages can be added in the same manner.

As displayed on Figure 12, this is the overview one can get on the UV by pressing on the gallery view which expands the thumbnails panel.

Figure 12: UV's expanded thumbnails overview



(UV 2017c)

[32] Or indeed, the digital surrogate can be reconstructed in any orders if per se the primary source had been disassembled in several fragments.

[33] This link illustrates quite well how the UV has been modified for the Swedish National Archives' needs: https://sok.riksarkivet.se/bildvisning/R0000004

[34] https://www.transifex.com/

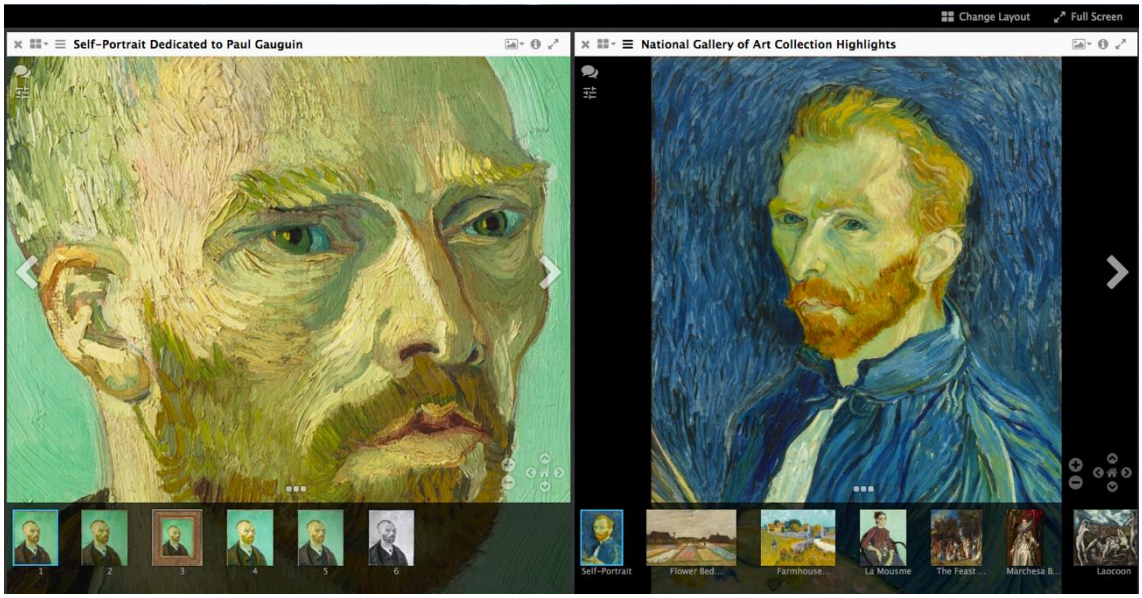
5.1.2 Mirador

Mirador is an image viewer created in 2013 for '*the needs of Art History and Manuscripts scholars at Stanford University'* (Reed, Winget 2017). It was conceived as an open-source interface from the beginning and it *'really took off when Harvard University opted to join the effort in 2014'* (Mirador 2016a).

Development coordination was overseen by Drew Winget from Stanford and Rashmi Singhal from Harvard, and contributors come from around the world. Notable institutions, projects, and aggregators that have adopted Mirador include Biblissima, e-codices, Artstor, the Bodleian Libraries[35], the University College Dublin, the Yale Center for British Art, the Leipzig University Library, or the Bavarian State Library.

Mirador V1.0 was released in December 2013 and V2.0 in March 2015. The workspace construct where each object has its own boundaries and the ability to add multiple resources are two of the main concepts and powerful functions of Mirador as displayed on Figure 13 (Mirador 2015, 2016b, 2017b).

Figure 13: Mirador (2.3.0)



(Mirador 2017a)

Mirador serves several purposes and can be configured or used as (Snydman 2016):

- A simple viewer acting as a book reader or an online exhibition interface
- A complex research workplace
- A comparison and annotation tool

[35] The University of Oxford has deployed Mirador as well as the UV on their online platform since January 2017 (Bodleian Digital Library 2017): http://digital.bodleian.ox.ac.uk/.

Table 7 provides a summary of Mirador's main features. They have been selected in terms of visibility and for similar reasons explained for the preceding table.

Table 7: Mirador's main features

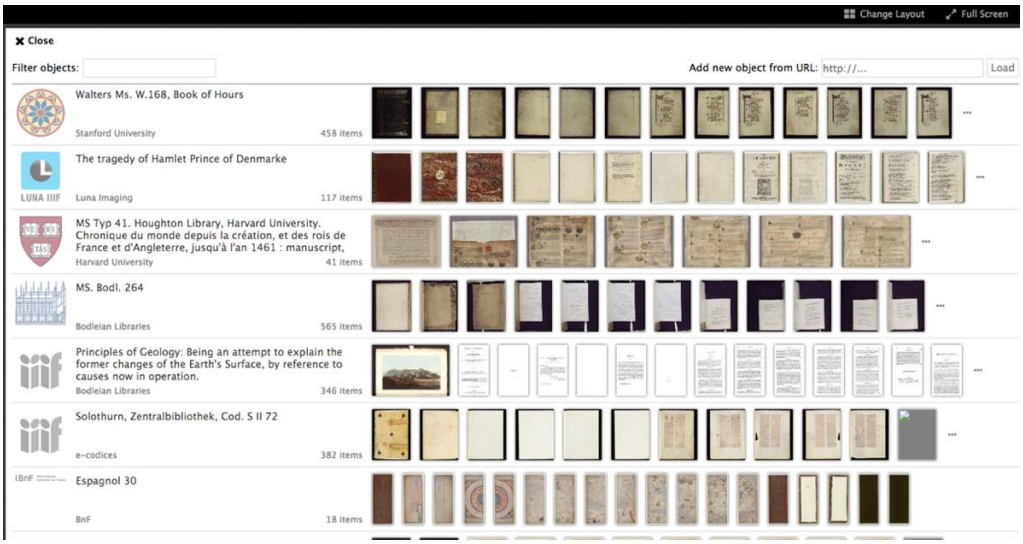
Feature	Area	Description
Window menu	Top left	This enables an end user to replace the loaded object and to change the number of visible windows (slots) by adding new items to be displayed and compared.
Side panel	Top left	This sidebar can be toggled to display the work's table of content (index) and to select available sections pointing for example to a certain chapter.
Change layout	Right of the top menu bar	An alternative to add new items is to choose to change the number of visible windows through a grid. Up to 5x5 objects can be added to the workspace.
Full screen	Top right	The workspace (right of the top menu bar) as well as each window (right of the header) can be rendered as a full screen.
View type	Top right	On Mirador, there are four different ways to consult a IIIF manifest: the image view, the book view, the scroll view, and the gallery view. The two former varieties are more convenient for reading and pan and zoom purposes and the book view display the object in a two-page spread. As for the two latter options, they give end users an overview of the work by either in a side-scrolling format to view the images in sequence or with thumbnails. By default, the image view type is activated.
Metadata view	Top right	It conveys the metadata, the rights, and license that the loaded IIIF manifest contains.
Annotations	top left of the object	It is possible to annotate the IIIF manifest by selecting one of the figures (rectangle, oval, freeform, polygon, pin) and drawing or pointing a zone of interest into the object. Comments and tags can be then added.
Image manipulation	top left of the object	By toggling this icon, an end user can rotate the object (clockwise and anticlockwise) and alter the image by adjusting the brightness, the contrast, the saturation, and the grayscale. It is also possible to invert the colours (turn a positive into a negative image and vice versa).
Thumbnails panel	Bottom	The thumbnails give an overview of the work's structure and can this feature can also be used to scroll through the digital asset. It is possible to hide the panel which is triggered by default.
Pan and zoom controls	Bottom right	Different grouped icons are present to pan and zoom into the image.

(Snydman 2016; Mirador 2016a, 2016b, 2017b)

Lastly, six more aspects of Mirador are addressed below (Snydman 2016; Mirador 2016b, 2017b):

- **Bookmark**: a state of Mirador (a URI) can be bookmarked with a view to keeping track or sharing this information. The icon appears on the left of 'Change Layout' on the header[36].
- **Pre-loaded resources**: a list of different resources can be pre-configured into Mirador and added to the workspace (Figure 14). New objects can also be added from a known URI that contains the info.json or manifest.json of a IIIF image or manifest. The items can be then filtered for better search results.
- **Zen mode**: If an institution is not interested to use Mirador as a comparison tool, there is a zen mode which prevents an end user to close the current window or to add new items to the workspace as the top menu bar, the sidebar, and the bottom thumbnails bar are turned off[37].
- **Annotations saving**: to save the annotations on a back-end service either on a local storage or remotely, an endpoint adaptor must be configured. Mirador provides a JavaScript template in their stable builds with four functions to implement (search, delete, update, create). Saved annotations have to follow the Open Annotation Data Model.
- **Search within**: this feature which allows end users to search the IIIF manifest's annotations have been integrated in Mirador 2.4.0 on April 2017[38].
- **Customisation**: as an open-source interface, extensions can be built to suit institutional and end user's needs. For example, the Bavarian State Library has developed a series of Mirador plug-ins (MDZ 2017) such as a physical ruler (Baiter 2017). In addition, several languages (English, German, Spanish, French, Japanese, Mandarin, etc.) are supported on Mirador.

Figure 14: Mirador's pre-loaded resources



(Mirador 2017a)

[36] This is not configured by default and has to be set up by the implementer.
[37] Ibid.
[38] This feature couldn't be tested in this assignment as the release happened after the beginning of the usability test (cf. § 5.3.4).'

5.2 Literature review

This section concentrates on previous usability tests conducted by the British Library and the University of Toronto. The former did some recorded in-lab interviews on the UV and the latter collected use-cases and carried out a comparison evaluation of Mirador and the UV.

5.2.1 The British Library

These in-lab interviews were conducted in August 2016 at the Wellcome Library with the help of 6 participants on consumer-grade computers and tablets. The evaluations were carried out to test the British Library's flavour of their UV (British Library 2016; Ridge 2017). Scripts were based on Steve Krug's usability test script (2009, pp. 147–152) and the interviews were led and organised by the British Library.

This evaluation sought to assess potential usability problems and was undertaken to prioritise improvements before launching the UV alongside their online catalogue (Ridge 2016a, 2016b). Nine principal outcomes were found (British Library 2016):

1) Participants liked the idea of the keyword search but sometimes found it difficult to find the return result
2) Download options were confusing to some participants (current view versus whole images in two different resolutions)
3) Download selection was the most appealing download option
4) Icons in the bottom left corner of the viewer were not always known (download, feedback, share, embed)[39]
5) Participants found many different ways to navigate
6) Items in the settings menu were confusing for most participants
7) Page and image number results were confusing
8) More information bar was useful but was not always noticed
9) Being able to rotate documents was desired but the rotate button was not always seen and, on iPad, was not always easy to use

5.2.2 The University of Toronto

The University of Toronto carried out interviews in 2016 with 17 medieval manuscript scholars (professors, PhD candidates, and post-docs) with a view toward collecting use cases and a usability test with 15 participants to compare Mirador and the UV based on ten short tasks on both IIIF-compliant viewers (Miekle et al. 2016).

[39] These icons are presented differently than the default UV (Figure 11) and some have also been added (print, feedback). Besides, on the British Library's UV, the title's icon is indicated next to the icon.

Interviews took place at the participant's workplace where they were asked about their current research situation and what kind of work process and software they used. The interview led to several 'pain points' and data referring to existing practices was used by the University of Toronto to create the usability evaluation. The interviewees indicated that tools that they had at their disposal were not sufficient or that they were '*in some way unsatisfied'* with them (Miekle et al. 2016). Data interoperability, findability, comparison, or friendly UI were some of the requirements that needed to be addressed.

The usability testing phase comprised of a monitored test on campus for participants from the University of Toronto and an online and remote survey for those from five other Canadian institutions. The participants were provided with a URI with either Mirador or the UV with a IIIF manifest pre-loaded. The starting viewer was randomised (Miekle et al. 2016). Overall, 12 people preferred Mirador and 3 the UV. The visual aesthetics, the ease of use, and the comparison tool were three arguments put forward by those in favour of Mirador. As for the UV, the most liked features were the ability to download and to search within a manifest. In addition, the thumbnail layout was generally liked better on the UV than on Mirador (Di Cresce 2017b).

The University of Toronto decided to improve Mirador by clarifying some of the icons, displaying pertinent information (title, shelf mark, date) on the top menu bar, and by incorporating some functions into their instance. They also hoped that some functionalities such as the ability to search within would be integrated into the base code as this is a wider user appeal.

5.3 Methodology

This section provides clarification on the process and methods used to carry on usability testing. It is divided in four subsections:

- Context of use
- User requirements
- Selection of software
- Usability test design

5.3.1 Context of use

The usability evaluations for this assignment have accounted for the specificity of the NIE-INE's future platform's users. All the necessary information from the second part (§ 4) to design the tests are synthesized in Table 8 on the next page.

Table 8: Design context

Component	Description
User and other stakeholder groups	Future users of the NIE-INE platform are scholars, essentially researchers working in one of the Swiss universities participating in this project. Swissuniversities, which granted the project, and the Swiss Academy of Humanities and Social Sciences, who will maintain the NIE-INE platform in the long-term, are two significant stakeholders. As for the FEE of the University of Basel and DaSCH, they have to manage their overall operation from collating the scientific requirements to curating the data.
Characteristics of the users or groups of users	Findings are either written in the scholar's native language and in English, or only in English as it is the scientific lingua franca. Extensive computer literacy skills have become a key component for scholars working in the digital humanities field and scholars need powerful virtual research environments. Nonetheless, the latter ought to be intuitive, accessible and interoperable in order to facilitate the work process.
Goals and tasks of the users	End users need a work environment where they can view, compare, and annotate complex scholarly editions, whether textual or image-based content. The analysis has to be carried out on a daily basis and often over a quite long period of time corresponding to academic grants received. Scholars often specialises themselves in one or several linked topics. If they used to work on their own field, the emergence of digital humanities has changed some academic habits and faculties have been seeking cross-disciplinary grants (Liu 2009, pp. 24–26). The NIE-INE project is an example of collaboration between several scholars and different scientific fields working on a uniform platform. They also need tools which facilitates monitoring in order to share and publish the results with their peers.
Environment of the system	All the tests have been designed to take place on a consumer-grade computer as from the author's visits in different Digital Humanities Labs and at the FEE, researchers still massively use large-screen workstations and laptops. Therefore, evaluations targeted at mobile devices and tablets were not taken into consideration. Interfaces in Switzerland are often translated into the three national languages (e.g. Memobase[40]) and in English (e.g. e-codices[41], Réro doc[42], Swissbib[43]) or into one of the two main national languages (German or French) and in English[44].

[40] http://memobase.ch/
[41] http://www.e-codices.ch/
[42] http://doc.rero.ch/
[43] https://www.swissbib.ch/
[44] For the evaluations carried out with the target audience, it was only done in English for the sake of simplicity. However, it was decided to design the pilot test conducted with LIS students in French to make sure every participant understood the tasks and questions.

5.3.2 User requirements

In order to illustrate user requirements, general user stories from IIIF implementers and specific ones from the NIE-INE initiative were taken into consideration.

Four different types of users have been identified: generic end users, students, professors, and researchers. The two latter are the users that need more robust and powerful tools to cover complex use cases. The user stories have been taken and adapted from the IIIF GitHub's stories' page (IIIF 2017n) and from a list received from the NIE-INE project[45]. Below is a list of 14 stories:

- As an end user, I would like to easily scroll though digital assets
- As an end user, I would like to zoom and pan into interesting images and well-written calligraphy.
- As an end user, I would like to find specific words and sentences within digital assets.
- As an end user, I would like to drag and drop the IIIF icon into a compatible viewer.
- As an end user, I would like to be able to jump to the most recently viewed pages*.
- As an end user, I would like to have multilingual navigation options*.
- As a student, I would like to cite digital assets accurately for my projects.
- As a student, I would like to download whole pages or fragments of it.
- As a professor, I would like to easily annotate digital assets and store this information.
- As a professor, I would like to compare multiple digital assets side-by-side.
- As a researcher, I would like to review annotations made on digital assets from my peers.
- As a researcher, I would like to embed an image's precise region of interest into my personal website.
- As a researcher, I would like to view and compare different editions of the same text in their chronological order*.
- As a researcher, I would like to be able to search and discover digital assets by topics*.

[45] The user stories retrieved from the NIE-INE project contain an asterisk*.

5.3.3 Selection of software

This assignment utilises both synchronous and asynchronous tests. After reviewing what software former LIS students at the HEG-GE have used to carry on usability testing (Prongué 2012; Meystre, Rey 2014; Guzzon 2016), two software were selected:

- Loop[11] to conduct remote and asynchronous usability tests[46].
- Morae to conduct in-person and synchronous usability tests.

Both of them come at a price, even if they propose free trial either for a fortnight or a month. For the former software, a two-month subscription was necessary to design, carry on, and analyse the different evaluations. For the latter, the HEG-GE had already one laptop on which every component was installed.

5.3.3.1 **Loop[11]**

Asynchronous tests were carried on Loop[11], a remote online software, accessible on https://www.loop11.com (Loop[11] 2017a). A usability test is known as a project, which can be conducted in different languages and across multiple domains as long as each HTML page contains a couple of lines of JavaScript at the end of the <body>. In addition, usability testing can also be undertaken on mock-ups such as wireframes and prototypes coming from a range of third-party software. The JavaScript snippet, provided by Loop[11], enables the software to track down IP addresses of each participant, their interactions on the tested system in real-time, and to gather results from tasks and questionnaires (Loop[11] 2017b).

A project may contain an unlimited number of tasks and questions. A task is composed of a name, a scenario (i.e., the instructions for participants), a start URI, and eventually one or multiple success URIs[47]. Different kinds of questions can be set up: multiple choice, rating scale, ranking questions, open-ended with one or multiple lines, open-ended comment box, Net Promoter Scale (NPS), and System Usability Scale (SUS)[48].

A project can be restricted to a given number of participants, allow or disallow multiple responses per IP address, and may include or exclude ranges of IP addresses. When a project is launched, either a URI to the usability test is created or a pop-up invitation can be set up on a website. As soon as participants go through the evaluation, a report is built by the software. It provides the average task completion rates, an overview of the results in terms of successes, failures or if the participant has abandoned a task,

[46] The number '11' is part of the software's name.
[47] Success URIs were assigned as each task pertains to a specific webpage.
[48] Cf. § 5.4.1.3.

clickstreams[49] and heat maps[50] of each task, session videos[51], and a summary of the questionnaires. The report may be exported in PDF, CSV, or XLSX.

5.3.3.2 **Morae**

Synchronous and in-person tests were conducted on Morae (TechSmith 2017a) on a HEG-GE's laptop. Morae is a usability testing software that records the user's interactions on a given system, whether it is a website, an application or any kinds of deployable product on a computer. Three components are part of this software: Recorder, Manager, and Observer (TechSmith 2017b).

The **Recorder** component offers the ability to capture audio, video, the screen, as well as the mouse's interactions. Markers identifying what kind of issues occurred during the usability tests can be configured in order to flag a point of time. Similarly to Loop[11], Morae is able to set tasks and surveys. Tasks are separated into three parts: name, description, and instruction. Only the latter shows up to the participant throughout the evaluation. However, URIs can't be assigned to a specific task, and links must be either provided within the instructions or monitored by the person taking notes. Surveys can be customized and one SUS per test is also available. These sets of questions are either attached to a particular task or can manually appear on a given keyboard command.

Manager is used to analyse recordings that can be grouped into projects. This component is able to generate infographic data and to calculate metrics. Markers chosen on the Recorder can be added to the sessions with a view to having a more in-depth output. Videos and extracts of the recorded sessions can be downloaded and shared.

Observer allows another person or multiple team members to watch and evaluate in real time what a participant is doing through a network connection (LAN, WAN, or VPN) to the Recorder.

Only the two first components were used as the third component wasn't installed on another computer and mostly because the moderator was on its own to moderate and analyse the evaluations. Besides, the video recording wasn't activated as it was decided that enough inputs would come from the other elements.

[49] A clickstream shows the navigating path a user has chosen to complete a given task.
[50] A heat map gives *'[…] a graphical representation of where the participants click on [a] website'* (Loop11 2012).
[51] The videos are still at a beta level of development at the time of writing.

5.3.4 Usability test design

This subsection identifies in which web environment the tests were conducted and provides information and context on how, when, and with whom the remote and in-person usability tests were designed.

5.3.4.1 **Testing environment**

The latest versions with the default configuration of the two UI[52] were installed on a 'sandbox'. Only the stable builds were downloaded from their GitHub repositories (UV 2017d; Mirador 2017b), which was easier assembling the viewers through command-line operations. 37 HTML pages were also created with the following aspects:

- 34 webpages which mirrored two times 17 different IIIF manifests full-screen loaded either on the UV or on Mirador[53].
- 1 webpage where users could select different IIIF manifests from a drop-down list and choose to open them with the UV or Mirador.[54]
- 2 webpages where users could select different IIIF manifests and drag and drop the icon either into the UV or into Mirador.
- 1 webpage which contained the embedded versions of the UV and Mirador loaded with the same IIIF manifest.

This sandbox was first installed locally and moved to a GitHub repository (Raemy 2017b) with a view toward monitoring in a structured manner. Finally, It was deployed on a HES-SO server (Raemy 2017c) for web access. It was decided to configure this kind of platform, rather than using a website from a IIIF implementer, in order to more easily insert JavaScript snippet codes for Loop[11] as well as to make sure that the latest UI versions were evaluated.

5.3.4.2 **Remote usability testing**

A two-month licence was bought to use Loop[11]. Between March 14th and May 13th 2017, three usability tests were designed and conducted:

- The **beta test** was conducted between March 23rd and April 2nd with the IIIF community which were informed through their communication channels and on the Bi-Weekly Community Call on March 29th.
- The **pilot test[55]** was conducted on April 5th with LIS students at the HEG-GE during a UCD course[56]. Besides, students were given some contextual

[52] The latest releases at the beginning of this assignment (February 2017) were V2.0.1 for the UV and V2.3.0 for Mirador.
[53] Most of these webpages were not created to provide backup.
[54] Actually, the selected item pointed to one of the two times 17 IIIF Manifests loaded on the UV or on Mirador.
[55] If the pilot test was conducted asynchronously, it was not done remotely as the moderator was there to observe the interactions and to find out if the test could be done seamlessly.
[56] The UCD course has since February 2017 been opened to the Business Computing department, which represented approximately one-fifth of the students.

background and an overview of IIIF. The results from this test were expected to give some kind of benchmark from people that are new to the IIIF ecosystem and who have never used the UV or Mirador before.

- The **target test** was conducted between April 20th and May 8th with the NIE-INE target audience and the broader Digital Humanities community. An email containing the link of the test was sent to one of the NIE-INE coordinators on April 20th. Besides, the IIIF community was informed through their communication channels on the same day and on the Bi-Weekly Community Call on April 26th. Two reminders were also sent on Twitter (Raemy 2017d, 2017e).

Only the results of the two latter tests are analysed in this thesis (cf. § 5.5.1) as the beta test was created as a draft version and was therefore not meant to be disseminated.

A multiple-step approach was followed to design these remote different usability tests. First, the different tasks were set to cover all the features available on both viewers[57]. Secondly, the sets of questions were designed to consider aspects, such as user satisfaction. The perceived usability of each viewer was also evaluated with an SUS questionnaire and an A/B comparison session between the UV and Mirador, consisting of an observational task and a couple of questions, took place near the end of the evaluation. Lastly, because the vast majority of the data is quantitative, a section enabling participants some final comments was created. The scenario can be seen of having three main categories containing questions, tasks or observations: UV, Mirador, and the A/B comparison session.

Before setting up the tasks and questions on Loop[11], a mock-up scenario was modelled with the help of a sequence diagram to have a broad view of what a participant must do to get through a remote usability test with Loop[11] (cf. Figure 21 in the Appendices).

To ensure smooth adoption of both viewers, the most difficult tasks were not put at the start. Searching a word with the UV or adding a new IIIF manifest on Mirador were identified as the ones which could potentially create most of the problems for new users.

A re-evaluation of the scenario occurred between each test. Some minor modifications had to be undertaken, such as correcting typos and giving more contextual information during the instructions. It should be noted that the beta and the target tests were carried out in English and the pilot test in French.

However, three major adjustments happened between the pilot and the target test. They are highlighted below in Table 9, which gives also the purpose of every task and

[57] Some of the tasks have been inspired from the author's observations of the footage coming from the in-lab interviews carried out on the UV (British Library 2016).

question[58]. Green means that this sequence was added to the target test, and a line highlighted in red means that it was removed.

Table 9: Loop[11]'s remote usability test scenario

No.	Type	Name	Purpose
1	Question	Confidence	This first set of questions wanted to assess the confidence of each participant. These six parameters can be seen as an attempt to simulate Nielsen's main dimensions (1993, pp. 43–48) to categorise users: *knowledge about computers, expertise in the specific system, and understanding of the task domain*. In order, each pair of questions is related to one of these three axes.
2	Question	Current status	This question was added only to the target test in order to distinguish different types of users and eventually to filter out an over-represented category.
3	Task	UV (layout)	This first task on the UV, and of the remote usability test, evaluated if a user could find how to navigate through this digital manuscript with different view methods and with the help of the Index, as well as finding how much time on average was needed for a user to find them.
4	Task	UV (search, share, and download)	This second task on the UV assessed if a user could find the search box and find a particular word within the digital asset. In addition, it wanted to find out if a user could easily find how to download and share this manifest or a portion of it. This task is specific to the UV.
4b	Task	UV (drag and drop)	Drag and drop a IIIF icon containing information about an image (info.json) or a structured resource (manifest.json) is supported by the viewer. This task wanted to find out if participants were capable of doing it. Nevertheless, drag and drop was removed from the target test as it took too much time for most participants during the pilot test to figure out how this worked. Also, a considerable number of people failed to complete this task[59].
5	Question	UV Satisfaction	This three-question survey wanted to assess the general satisfaction (expectations, pleasure, fun) around the use of the UV.
6	Task	Mirador (layout)	Similar than task 3

[58] The detailed scenario which participants went through can be found in Appendix 4. IIIF manifests chosen for the tasks are indicated below each screenshot.
[59] Cf. § 5.5.1.6

No.	Type	Name	Purpose
7	Task	Mirador (annotation and comparison)	This specific task of Mirador wanted to assess two of its important features: annotation and comparison.
7b	Task	Mirador (drag and drop)	Similar than task 4b
8	Question	Mirador Satisfaction	Similar than question 5
9	Task	UV (zoom and rotation)	This task was formerly at the beginning of the scenario, but it was decided to move it before the SUS of the UV as a 'reminder'. This task consisted of using the zoom and pan's functionality as well as the rotation's one.
10	Question	SUS of the UV	After having completed the 'reminder task' on the UV, the participant is prompted with an SUS survey.
11	Task	Mirador (zoom and rotation)	Similar than task 9
12	Question	SUS of Mirador	Similar than question 10
13	*Task*	UV/Mirador	This is an A/B observational task where participants are asked to evaluate the difference between the two viewers which are both embedded on the same webpage. It was essential that this task was put before asking the next set of questions in order to have a start URI.
14	Question	A/B[60]	After having observed the different elements between the two viewers, the participants could answer which one they preferred, if they liked both or neither. It was still possible for the participants to interact with the UV or Mirador because the instructions could be hidden.
15	Question	Last questions	Four last open-ended questions were added to obtain some qualitative inputs from participants.[61]

5.3.4.3 **In-person usability testing**

The in-person and moderated usability tests were conducted between April 25th and May 10th 2017. These sessions were conducted in Basel, Lausanne, and Geneva with people

[60] Loop11's task 13 and question 14 can be regarded as one A/B session.

[61] For the pilot test, the two first questions asked the participants which function they preferred in each viewer. Whereas, for the target test, it was about what kind of improvement could be done to each viewer to better support scholarly editions. This was changed as it I thought it'd more interesting to have more in-depth opinions from the target group on this matter.

involved in the NIE-INE project and the broader Digital Humanities community working on scholarly editions. They were carried out at their workplace on the HEG-GE's laptop.

Participants were asked to comply with the thinking aloud protocol (Nielsen, pp. 195-199) where they had to vocalise their thoughts while going through the scenario. This method is very important as verbalisations help to understand why and how users make mistakes on the tested interface.

At the beginning of the session, the participants were given a small introduction to this thesis in order to clarify any doubts. A usability consent form was then handed out (cf. Appendix 5). As soon as the recording started, any outside interruptions were reduced to the bare minimum. Such interruptions consisted of questions such as: '*What are you thinking?'* or *'Any thoughts or comments about what happened?'* whenever a long and silent moment had passed.

The scenario was quite identical to the Loop[11]'s target test in terms of tasks and questions as the essence, and thus the purpose, remained fundamentally the same. However, the sequence was altered and some set of questions were not asked.

Survey about their current status, SUS, and open-ended questions were not included in the in-person tests. For the former, there was enough information about each participant through emails or during the introduction. As for the two latter, enough quantitative data had been drawn from the previous remote evaluations. The other sets of questions were kept essentially to make the participants think and talk, even if some aspects were redundant with the thinking aloud technique.

As for the tasks related to 'zoom and rotation' on the UV and Mirador, they were shifted to become the first task of each viewer. These modifications are highlighted in gold in Table 10. Besides, the 'UV (search, share, and download)' and 'Mirador (annotation and comparison)' were both split into two sequences[62]. These tasks are highlighted in blue in Table 10.

Only one IIIF manifest per main category (i.e. UV, Mirador, and A/B comparison session) was chosen to have a more seamless usability test as Morae doesn't take into account

[62] Substantially, the annotation and comparison part was the task which was the most difficult during the remote usability test and I wanted to assess which portion raised issues. I also wanted to have the same number of tasks for each viewer and decided to cut the longer ones.

the concept of a start URI and it was cumbersome to click on a different link at the beginning of every single task. In total, the scenario had 13 sequences[63].

Table 10: Morae's in-person usability test scenario

No.	Type	Name
1	Question	Confidence
2	Task	UV (zoom and rotation)
3	Task	UV (layout)
4	Task	UV (search)
5	Task	UV (share and download)
6	Question	UV Satisfaction
7	Task	Mirador (zoom and rotation)
8	Task	Mirador (layout)
9	Task	Mirador (annotation)
10	Task	Mirador (comparison)
11	Question	Mirador Satisfaction
12	*Task*	UV/Mirador
13	Question	A/B[64]

5.4 Measurement approach

The usability tests were conducted using both quantitative and qualitative research. Also, one set of data is a mix of quantitative and qualitative inputs.

In addition to these types, there was an emphasis in terms of efficiency and satisfaction, throughout this assignment. The three next subsections provide a focus on how the data were apprehended.

5.4.1 Quantitative inputs

This assignment's quantitative inputs fell into four main categories: efficiency, satisfaction, perceived usability, and A/B testing. Efficiency and perceived usability are continuous data (i.e. data that can be measured). On the other hand, A/B testing consists of discrete data (i.e. data that can be counted). As for satisfaction, it belongs to the two subtypes of data as a gaugeable approach to give a mean satisfaction score was undertaken to convert discrete data into continuous data.

[63] A chosen extract of the scenario which participants went through can be found in Appendix 6. IIIF manifests chosen for the tasks are indicated below each screenshot.
[64] Morae's task 12 and question 13 can be regarded as one A/B session.

In addition to these four categories, two other sets of data come as well from the usability testing: confidence and status. Both of these provide some contextual information and are discrete data. Besides, inputs from the confidence status (6 questions on a Likert-alike scale) were also combined to provide an easier visualisation where responses were given numbered values (very confident: 2, confident: 1, neither confident or unconfident: 0, not very confident: -1, not at all confident: -2[65]). The questions were merged into three dimensions in this manner:

- **Computer experience**: using a computer and finding metadata
- **System expertise**: using image viewers and manipulating digital images or texts
- **Domain understanding**: annotating images or texts and comparing images or texts

5.4.1.1 **Efficiency**

Only realistic tasks in the pilot and target tests were accounted for in the measure of efficiency, which meant that A/B was removed[66]. Two different manners were selected:

- **The success rate**: the percentage of participants who succeeded in regards to the total number of participants.
- **The overall relative efficiency**: the ratio of the time taken by the participants *'who successfully completed [a given task] in relation to the total time taken by all [participants].'* (Mifsud 2015)

The first manner is straightforward to collate as Loop[11] does so automatically. However, this indication is incomplete because it doesn't take into account the efforts participants took to complete a task. The overall relative efficiency was chosen to give a better representation of productivity. In order to do that, the average time taken by participants who succeeded in a given task had to be calculated, and the average time of all participants was already known. $\overline{P}$ (efficiency) is determined as follows:

$$\overline{P} = \frac{\sum_{j=1}^{R} \sum_{i=1}^{N} n_{ij} t_{ij}}{\sum_{j=1}^{R} \sum_{i=1}^{N} t_{ij}}$$

where (Sergeev 2010; Mifsud 2015):

- N = the number total of tasks
- R = the number of users
- n_{ij} = the result of task i by user j
- t_{ij} = The time spent by user j to complete task i. If the task is not successfully completed, then time is measured until the moment the user quits the task.

[65] The maximal score per dimension is 4, the minimal -4.
[66] Only responses from the A/B questionnaire were analysed (cf. § 5.4.1.4).

5.4.1.2 **Satisfaction**

To assess satisfaction on the UV and Mirador, three criteria from a subset of USE (Usefulness, Satisfaction and Ease) were chosen. This survey developed by Lund (2001) proposed seven items related to satisfaction:

- I am satisfied with it
- I would recommend it to a friend
- **It is fun to use**
- **It works the way I want it to work**
- It is wonderful
- I feel I need to have it
- **It is pleasant to use**

Instead of using all of them, only three criteria (in bold) were retained to avoid redundancy. Fun, expectations, and pleasure were measured on a Likert scale.

To convert discrete into continuous data, a score from 1 (strongly disagree) to 5 (strongly agree) was given to each criterion. The mean satisfaction score is the average of all criteria and provides to a certain extent an indication of how engaging the viewer was to participants. A mark below 3 would suggest an overall dissatisfying experience and a mark above 3 a satisfying one.

5.4.1.3 **Perceived usability**

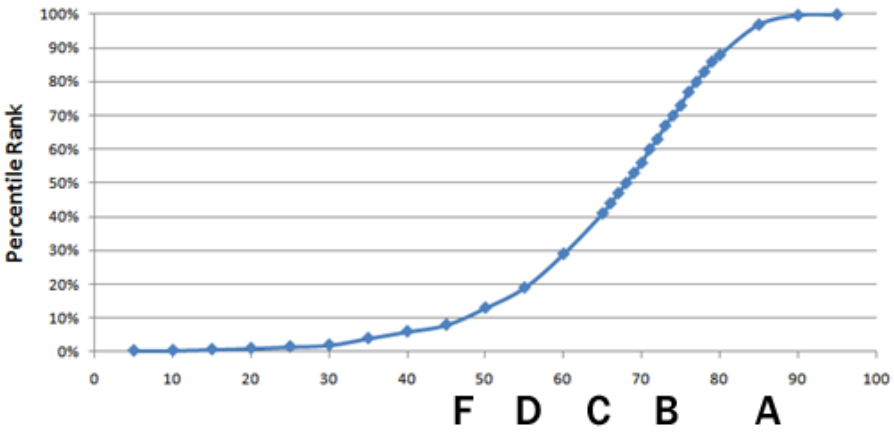
Two SUS, one for the UV and one for Mirador, were prompted to participants who undertook the pilot and the target tests to evaluate the perceived usability per viewer.

An SUS is a measurement survey consisting of ten statements, alternating positive and negatives ones (Brooke 1996). It uses a Likert scale (strongly disagree to strongly agree) and the participant ranks each question from 1 to 5. For the odd-numbered statements (positive), 1 is subtracted from the score and for the even-numbered ones (negative), the value is subtracted by 5. The sum of these new values is then multiplied by 2.5 which gives a usability score between 0 and 100 (Thomas 2015). SUS, though, is not a percentage and according to Sauro (2011):

> *'While it is technically correct that an SUS score of 70 out of 100 represents 70% of the possible maximum score, it suggests the score is at the 70th percentile.'*

A manner to interpret an SUS score is to convert it to a letter-grade from A+ to F. 68 is considered as average and equals to a C. 80.3 and above corresponds to an A and 51 or under is an F (Sauro 2011; Thomas 2015) as displayed on Figure 15.

Figure 15: SUS Curve



(Sauro 2011)

5.4.1.4 **A/B testing**

The A/B testing phase consisted of an observational round and a survey of 7 questions to assess which viewer participants preferred (or if they thought that both viewers were equally good or if neither of them fulfilled their expectations) for the following aspects:

- To scroll through digital assets
- The metadata presentation
- The size and choice of icons
- For manipulating images
- The overall layout
- The overall aesthetic
- The most pleasing

This survey was also an attempt to evaluate the strengths and weaknesses of the UV and Mirador.

5.4.2 Qualitative inputs

The qualitative data from the remote usability tests comes solely from open-ended comments at the end of each test. As for the in-person tests, inputs were gathered based on interactions and remarks which were noticed during the evaluations and then from the recorded sessions. To avoid overcomplicating the results analysis, a moderation of the data was undertaken[67]. The selection focused on representative and recurrent comments as well as a couple of single considerations (cf. § 5.5.1.4 and throughout § 5.5.2).

[67] Comments of the remote usability tests are available in the Appendices without editing or reformatting (cf. Table 21 and Table 31).

5.4.3 Mixed inputs

One kind of assessment that does have a mixed input of quantitative and qualitative data is how participants completed each task during the in-person tests. This may be considered as mixed inputs as it was first based on observations. The task completion was also a manner to reproduce some kind of success rate that was evaluated in the remote tests

After reviewing the recordings, each task was categorised on how well they were being achieved or not by participants with these three markers:

- Completed with ease
- Completed with difficulty
- Failed to complete

If the first and last markers were quite straightforward to give, it was slightly harder to assess if a participant had completed a task with difficulty. Chiefly, this marker was assigned if a task was completed after four minutes, if participant showed signs of struggle throughout the task, or if explicitly they said that it was difficult.

5.5 Results and findings

This section focuses on the usability testing results and findings of the two asynchronous and remote tests done with Loop[11], the moderated and in-person tests conducted with Morae, as well as a subsection providing an aggregation of the important outcomes from the three evaluations.

For subsections § 5.5.1 and § 5.5.2, rather than presenting the results by the exact sequence in which participants went through, they were divided by the following clusters: the UV, Mirador, A/B, as well as some considerations about drag and drop on the pilot test.

Dashboards and extensive results as well as heat maps can all be found in the Appendices[68], between page 94 and the end of this thesis. In addition, two MS Excel files (one for the remote tests and one for the in-person test) are stored on a Google Drive folder and can be accessible on this URI: https://goo.gl/jm33wX.

5.5.1 Loop[11]

NB: Throughout this subsection, the results of the pilot test are first presented, followed by those of the target test. Synthesized results are displayed in § 5.5.3.

[68] Appendix 7: Pilot test dashboards, Appendix 8: Target test dashboards, Appendix 9: Mirador heat maps, Appendix 10: In-person test dashboards.

29 LIS students participated in the **pilot test** using the Loop11 system (Table 12 in Appendix 7) during a UCD course at the HEG-GE.

If pilot test participants were overall confident in questions related to computer experience (Table 13 and Table 14), they were less so in the two other domains (system expertise and domain understanding). In particular, when it comes to annotating digital artefacts, 9 participants (31%) felt neither confident or unconfident and 6 not at all confident (20.7%).

45 people undertook the **target test**. For the latter, 34 had one status, 10 had two statuses, and 1 person responded with three statuses. Notably, 17 participants identified themselves as researchers (37.8%)[69], 11 as students (24.4%), 6 as professors (13.3%), 6 as librarians (13.3%), 5 as developers (11.1%), and 4 as assistants (8.9%)[70]. Other responses included digital curator, digital project manager, conservator, metadata specialist, and software QA engineer (Table 22 in Appendix 8).

Overall, pilot test participants felt very confident in all aspects (Table 23 and Table 24), especially in questions related to computer experience.

All in all, both remote usability tests worked fine. Nonetheless, a few participants during the pilot test experienced some difficulty with the first task on Mirador as the viewer didn't want to load or took way longer than expected. It may be that the server or the tracking feature of Loop[11] couldn't handle too many people being on the same webpage or going through the test.

5.5.1.1 **The UV**

Without the drag and drop task[71], the success rate in the **pilot test** was 95.4% and the overall relative efficiency reached 88.9%. 3 participants abandoned the layout's task and 1 person didn't figure out how to perform the search and download's task (Table 15).

Between 18 and 20 participants agreed or strongly agreed (62 to 69%) that the UV worked as expected, was pleasant, and was fun to use. On the other hand, 4 participants (13.8%) for each criterion thought that the viewer didn't fulfil their requirements. The mean satisfaction of the pilot test gives the UV a score of 3.75 out of 5 (Table 16).

[69] 100% being 45 as the total of participants and not the number of positions held within their institution.
[70] Researchers (9 times), professors (4 times), assistants (3 times), librarians (2 times), and developers (2 times) were the most who had a combined status.
[71] Cf. § 5.5.1.6

The UV received an SUS score of 72.76 by the pilot test participants who perceived the UV as being good in terms of usability (Table 17). They especially thought that the viewer was easy to use and that they shouldn't have to learn a lot of things to understand how to use it. On the other hand, the inclination to use the viewer frequently, its cumbersomeness, and trustiness were the three items that ranked the lowest in the survey. Overall, this score of 72.76 on the SUS curve gives the viewer a B minus.

The success rate, and therefore the overall relative efficiency, tops 100% in the **target test** as all 45 participants achieved what they were asked to do on the UV (Table 25).

Target test participants provided a mean satisfaction score of 4.26 out of 5 for the UV. Between 35 and 42 strongly agreed or agreed that the UV was satisfying in every criterion (77.8 to 93.3%). Especially, participants thought that the UV worked the way they wanted it to work (Table 26).

Through the SUS, the 45 target test participants perceived that the UV was really good in terms of usability. The SUS score attained 86.33 which corresponds to an A. Hardly any participants considered that the UV wasn't usable as at the most 2 people (4.4%) disapproved of the viewer's usability (Table 17).

5.5.1.2 **Mirador**

The success rate of the tasks performed on Mirador in the **pilot test** reached 75.9% by removing the drag and drop session to the equation[72]. 11 participants (37.9%) abandoned the first task[73], 8 the second on annotation and comparison (27.6%), and 2 students didn't finish the task around zoom and rotation (6.9%). The overall relative efficiency obtained was 73% (Table 15).

Even if the 29 pilot test participants had more issues to undertake the tasks on Mirador than on the UV, more than half of them were satisfied or very satisfied to use this viewer. Yet, between 5 and 6 people (17.2 to 20.2%) didn't think Mirador worked as expected, was pleasant, or fun to use. The overall satisfaction score got 3.49 out of 5 (Table 18).

In the pilot test, Mirador obtained an SUS score of 64.05 which is equivalent to a C minus. This grade ranks the interface to be slightly below usability average (Sauro 2011). Criticized aspects of Mirador by the LIS students were that the functionalities were not well integrated, that new users would have to learn a lot before being able to use it, and that it was somewhat a complex interface. Nevertheless, the same participants also

[72] Cf. § 5.5.1.6

[73] An important number of participants didn't perform this first task on Mirador as the viewer took a long time to load and their patience had run out.

thought that they didn't have to learn too much before they could use it and that there wasn't any real inconsistency across Mirador (Table 19).

91.9% of tasks were properly executed on Mirador during the **target test**. Every participant achieved the first task on Mirador. As for the two other tasks, 9 people abandoned annotation and comparison (20%), and 2 didn't finish zoom and rotation (4.4%). The overall relative efficiency rate obtained was 82% as many participants who abandoned the annotation and comparison tried for quite some time to figure out how to complete it before giving up. The average success time for this task was 67.25 seconds against an overall 96.91 seconds (Table 25).

Mirador received a satisfaction score of 3.81 when measuring the answers from the 45 target test participants. Overall, participants were quite satisfied with the viewer as between 32 and 35 of them (71.1% to 77.8%) strongly agreed or agreed in every criterion (Table 28).

As for the SUS, the score obtained in the target test for Mirador was 74.67 which gives the viewer a letter grade of B. Overall, participants thought they could get on going without the help of a technical person or that they felt confident using Mirador. The lowest score per item was in terms of learnability as some participants believed that new users would probably need time to accustom themselves with the interface (Table 29).

5.5.1.3 **A/B**

Pilot test participants preferred the UV over Mirador in almost every aspect, less the metadata presentation that receive an even distribution of 9 responses (31%) through the three fist categories. Besides, between 1 and 3 students (3.4 to 10.3%) thought that neither of the two viewers could fulfil their requirements. This general tendency towards the UV in the pilot test can probably be explained by the buffering issues that encountered participants on Mirador. In addition, this reflects also the difference between the scores given by the 29 participants to both viewers (Table 20).

The A/B testing phase in the **target test** confirmed this inclination for the UV, but in a less nuanced manner than from the first remote usability evaluation. If the UV was first chosen for its overall aesthetic (28 out of 45 participants: 62.2%) and its metadata presentation (20: 44.4%), Mirador was largely preferred for manipulating images (32: 71.1%)[74]. Besides, the option 'both are equally good' was very often selected by participants in most aspects and came first in the ability to navigate through the loaded

[74] This was also the only time where the UV arrived last with 3 responses (equally with 'neither').

digital assets (23: 51.1%), the overall layout (19: 42.2%), the size and choice of icons (17: 37.8%), and most importantly almost one half of the participants (22: 48.9%) thought that both viewers were equally pleasing (Table 30).

5.5.1.4 **Open-ended comments**

In both remote usability tests, participants could add their remarks about the UV and Mirador[75], as well as their thoughts about full-screen and embedded displays. As this section was not mandatory, 24 participants (82.8%) decided to give more feedback in the pilot test and 24 participants (53.3%) opted to do so in the target test[76].

When asked what they liked the most in the UV, three main elements were put forward by the **pilot test** participants (Table 21): the search function, the ability to download or share images, and its overall clarity or simplicity. Also, a few people mentioned the zoom preview on the right-hand side of the UV. On Mirador, LIS students were most pleased with its potential to annotate and compare images, as well as all the features to modify them. A small number of participants indicated that the image manipulation toggle icon was difficult to find.

As for the display preference, 16 pilot test participants preferred to be presented with a viewer in full-screen mode, 7 preferred the embedded display, and 1 person had no preference on the matter. The reasons behind this choice were only explained by those in favour of the embedded mode as this option could give more contextual information while also displaying more easily recognisable functions.

In the **target test** (Table 31), when asked what should be improved for scholarly requirements, most participants felt that annotation and comparison should be added to the UV as the viewer '*doesn't (yet) offer all the necessary tools for researchers*'. As for Mirador, people felt that search within should be integrated into the UI[77] and that some design refinements should be done to make the viewer more intuitive. It was particularly noted that manipulating or comparing resources should be improved as rotation or adding new items into the workspace was seen as difficult. Participants felt that Mirador was a powerful viewer but too '*versatile'*.

[75] As stated in the Methodology, pilot test participants were asked which function they preferred in each viewer, and target test participants could add their thoughts on how to improve each viewer to the needs of scholars working on textual and scientific editions.

[76] The difference of participation between both remote usability tests can probably be explained by the fact that LIS students were in a slightly different position as this test was part of their UCD course as they may have somehow felt compelled to respond to these non-mandatory questions. In addition, some of them knew the bachelor's thesis' author.

[77] This feature now exists in the newest version of Mirador (2.4.0), though not by default.

7 target test participants preferred to be prompted with a full-screen window, 3 as embedded in a webpage, and 8 people thought that both had their uses. The participants who better liked the embedded mode and those who liked to toggle between the two modes argued that this option allows to see '*images with a broader non-IIIF context*', that the viewer can still be expanded, or that it was an easier mode to work on text rather than images.

5.5.1.5 **Heat maps**

Loop[11] was able to build heat maps on Mirador for both remote usability tests, but not on the UV. It didn't work on the latter viewer as by default the URIs changed dynamically and hash parameters were being populated as soon as there was some interaction with the viewer such as, for example, zoom and pan or changing the view mode[78].

The heat maps can be found in Appendix 9 and shows where participants clicked the most in the three different tasks carried on Mirador. The most interesting findings were that pilot test participants apparently thought that the pan and zoom controls would enable them to navigate through the digital surrogate (Figure 36) during task 6. In addition, this feature was rarely used by target test participants even when they were asked to zoom in task 11 (Figure 41) as opposed to LIS students who overly used it (Figure 40).

5.5.1.6 **Drag-and-drop considerations**

The drag-and-drop functionality, in which users can click and drag a IIIF icon conveying the *manifest.json* into a viewer to display the corresponding image, was only included during the pilot test in task 4b on the UV and task 7b on Mirador. These two tasks aimed to investigate if the drag and drop pattern that had been implemented by several IIIF adopters was intuitive enough for new users, especially since the drag-and-drop design hasn't yet been standardised and that it was based on a demo version (Warner, Winget, Matienzo 2015).

55.2% of participants in task 4b and 58.6% in task 7b succeeded in completing the drag-and-drop tasks. On average, it took these students 84.63 seconds on the UV and 56 seconds on Mirador from reading the instructions to dropping the IIIF icon into either of

[78] It would have been possible to stop the viewer to populate hash parameters upon commenting out some content in a UV module called *BaseExtension.ts*. As the UV 2.0.1 distribution was downloaded directly from GitHub, this option was not anymore possible and it was too late to fork the viewer. Yet, in the UV 3.0, this will be possible for implementers to have complete control over this (Crane, Silverton 2017).

these viewers. If people who couldn't complete the tasks are taken into account, the average time climbs to 105.76 and 77.93 seconds (Table 15).

These tasks were removed in the target test for the sake of simplicity. Also, enough data was gathered from the pilot test to demonstrate that it was either too difficult or that it took a long time to carry out. In terms of usability, this showed the quite unintuitive pattern of drag-and-drop, as well as its apparent inefficiency.

It must be noted that the viewer was embedded in the same webpage to avoid further confusion[79]. However, the general pattern and use cases around drag-and-drop are that IIIF icons generated for this purpose and IIIF-compliant viewers can be found in several websites.

5.5.2 Morae

7 participants from the target audience participated in the moderated and in-person usability test. They were either researcher, assistant, or digital project manager in the humanities. Participants felt very confident in the computer experience's area and confident in the questions around system expertise and domain understanding (Table 32 and Table 33).

5.5.2.1 **The UV**

Overall, every task on the UV was either completed with ease (89.29%) or with some difficulty (10.71%). The only task that gave some issues for 3 participants (42.86%) was task 3, where they couldn't find at first all the different view modes available (Table 34).

The satisfaction score of the UV was 4.19. No participants disagreed or strongly disagreed throughout the satisfaction survey. For each criterion, 3 participants (42.86%) strongly agreed that the viewer worked as expected, was pleasant, and was fun to use (Table 37).

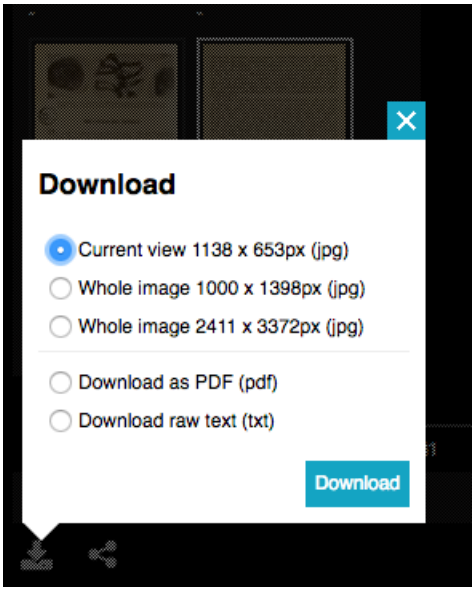
All participants liked how rapidly they could make use of the UV, enjoyed the aesthetic characteristics, and overall thought that all the features were well integrated into the viewer. Though they felt that some functionality, such as having side-by-side the raw text and the digitised corpus, might be added in order to cover their scholarly needs. Below are the different issues that were encountered by participants:

- Participants thought they could use the pinpoint icon to navigate through the digital asset and were quite frustrated that they could not (in-person participant 1, 2, 3, 5, 6, 7).[80]

[79] Besides, Loop[11] doesn't cope very well with several open tabs.
[80] A video clip showing this issue was recorded: https://goo.gl/P8dbUr.

- The difference between the image and page numbering was troubling for 4 participants (2, 4, 5, 7).
- Participants had some trouble to notice if they effectively changed from one view to the other, especially if they were on the first or last image of the IIIF manifest (3, 4, 6).
- Participants liked that they could download different types of formats, but couldn't figure out if there was some difference between the two 'whole image' (1, 2, 5). Cf. Figure 16.
- When searching for a certain word within the digital assets and clicking on the highlighted result, some participants couldn't figure out how to go to the previous or next instance (4, 6)

Figure 16: UV's download options



5.5.2.2 **Mirador**

During 3 out of 4 tasks on Mirador, 1 participant (14.29%) failed to complete (10.71% on average). Otherwise, all tasks were completed with ease (42.86%) and some difficulty (50%) by the 6 other participants (Table 34).

The satisfaction score of Mirador obtained through the survey is 3.67. Overall, most participants thought that the viewer was satisfying to use. Although, 1 participant did not find it pleasant to use and no one strongly agreed that Mirador worked the way they expected it to (Table 38).

Even with a lesser satisfaction score than the UV's, participants really appreciated most aspects of the viewer. They especially liked the comparison and annotation features. The general outcome is that participants had trouble to find the different functions and had a hard time to distinguish the different icons. Lastly, they thought that the layout should be refined with a view to making it seamless. On the next page is a list of the usability issues and bugs from the in-person and moderated test.

- Participants found it difficult to find how to rotate an image. They thought that the toggle image manipulation logo was not appropriate (in-person participant 1, 2, 3, 4).
- Participants often mistook these two icons: 'change view type' and 'change layout' (1, 2, 3).
- Participants had trouble annotating an image because they had switched to the 'book view type' (1, 7).
- Two participants tried to drag-and-drop a canvas into an empty slot when asked to add a new item (1, 5).[81]
- Most participants would have liked the index to not be displayed by default and most didn't find how to hid the thumbnails (2, 3, 4, 7).
- The pan options were seen as confusing and unnecessary (2, 4, 5, 7).

5.5.2.3 **A/B**

In-person test participants tended to prefer the UV or thought that both viewers were equally good in all aspects. The UV was mainly selected for its overall layout (4 participants: 57.14%) and as being the most pleasing viewer to use (4: 57.14%). In addition, when Mirador was better liked, it was by 1 participant (Table 39). Below are some additional comments that were made during the A/B testing phase:

- Three participants liked to have a darker background and preferred the UV over Mirador for this aesthetic aspect (in-person participant 2, 3, 7).
- Most participants feel the UV is more intuitive than Mirador, but that the latter offers more options for the research field (2, 3, 5, 7).
- Clockwise and anticlockwise rotation options were highly appreciated in Mirador (1, 4, 6, 7).[82]

5.5.3 Aggregated results

This subsection gives a broader overview of all usability tests conducted on the UV and Mirador during this assignment.

Overall, the results outlined by the evaluations demonstrated that both viewers ranged from average to excellent in terms of perceived usability, from fair to high in terms of efficiency, and from satisfying to very satisfying.

For both viewers, lesser scores were obtained in the pilot test. This may be explained that it is harder for new users to accommodate themselves with image viewers and also that buffering issues appeared during the first usability evaluation. On the other hand, better scores came from the target test.

[81] Firstly, it doesn't work, but the main usability issue is that the empty slot can't be closed with the regular 'close window' icon and this situation can only be resolved by changing again the layout. A video clip showing this issue was recorded: https://goo.gl/WDyLZE.

[82] By default, it is only possible to rotate in a clockwise manner in the UV.

Throughout the tests, the UV received better marks than Mirador and is also chiefly preferred in the A/B session. The synthesis is displayed in Table 11 where one can notice that there is a correlation between scores obtained from the satisfaction survey, the efficiency or the task completion measurement approaches, as well as the SUS score.

Table 11: Usability testing synthesis

	Pilot test		**Target test**		**In-person test**	
	UV	Mirador	UV	Mirador	UV	Mirador
Satisfaction	3.75	3.49	4.26	3.81	4.19	3.67
Efficiency	88.9%	73%	100%	82%	-	-
Task completion	-	-	-	-	89.29% completed with ease 10.71% completed with difficulty 0% failed to complete	42.86% completed with ease 50% completed with difficulty 10.71% failed to complete
Perceived usability (SUS)	72.76 (B-)	64.05 (C-)	86.33 (A)	74.67 (B)	-	-
A/B[83]	UV: 6/7 UV, Mirador, and Both: 1/7		UV: 2/7 Mirador: 1/7 Both: 4/7		UV: 2/7 UV and Both: 3/7 Both: 2/7	

NB: The results can be found in more details in the Appendices and on https://goo.gl/jm33wX.

5.6 Limitations and bias

This section discusses the limitations and bias of the usability testing. It is divided in three categories: overall observations, remote usability testing, and in-person usability testing.

All the different issues or remarks that are listed in this section are an attempt to have a better judgement of the obtained results and findings as well as to make future usability tests on IIIF-compliant viewers easier and more consistent. It is not an exhaustive list of all the elements that could be refined but rather an enumeration of the main areas of improvement.

[83] Number of aspects that arrived first in the A/B surveys.

5.6.1 Overall observations

Four different elements had not been observed or fully done throughout the usability testing:

- There was no comparison, even on a theoretical level, with viewers that are not compatible with IIIF standards or other IIIF-compliant viewers (such as Leaflet-IIIF or the Internet Archive Book Reader), due to time constraints.
- Even if the items displayed to the participants of the target audience were related to their studied collections, it might still have been difficult for them to see how IIIF-compliant image viewers could appeal to their needs.
- Consideration of provenance, sex, and age were not taken into consideration. This is especially true for the target test as participation was anonymous. For the pilot and in-person tests where participants were known, the data could be more easily reconstructed.
- Some tasks like annotating an image or a portion of a text may have been artificial to some participants.

5.6.2 Remote usability testing

Four factors have probably limited or biased the remote usability test with Loop[11]:

- The randomization of tasks was non-existent as it was not possible to do so on Loop[11]. An alternative would have been to create parallel tests, but it wasn't done mostly due to the time constraints. The major bias is that all remote participants first had to carry on tasks on the UV and then on Mirador.
- A majority of LIS students couldn't perform the first task on Mirador due to performance issues.
- In the comments section, some LIS students also analysed the features of the sandbox even if it was prompted that only the viewers were evaluated.
- It was impossible to know if participants committed themselves to carry on the target test without doing anything else.

5.6.3 In-person usability testing

Two major elements were noticed during the usability tests with Morae:

- All the instructions were in English and people either had French or German as their first language.
- As the HEG-GE's laptop is quite old, a computer mouse was used instead of its trackpad. Therefore, some of the interactions couldn't be fully experienced because modern trackpads allow you to navigate quite effortlessly into both viewers.

6. Discussion

The final chapter of this thesis is a broad discussion of results. This chapter is divided into three sections:

- The retrospective of this assignment and the collaboration with the IIIF community (§ 6.1)
- The recommendations based on the usability testing and the use cases (§ 6.2)
- The future steps that should be done (but that have not necessarily been tested during this assignment) for IIIF, the developing teams of the UV and Mirador, as well as NIE-INE (§ 6.3)

6.1 Retrospective

Overall, all main objectives were attained during this assignment. Yet, in terms of methods and means identified in the specifications (Raemy 2017a), two elements were **not** explored:

- **Carrying out a survey to assess the use of IIIF in Switzerland**: due to time constraints, it has been decided not to undertake this point.
- **Creating personae**: the scarcity of information led the author to give up on designing personae as creating them based solely on user stories didn't seem enough.

As for the usability evaluations and besides the aforementioned points on limitations and bias, there are many potential areas for improvement. For instance, it would have been possible to save time during the deployment phase when communicating to the HEG-GE's IT team the purpose of the sandbox. Also, it wasn't noticed that Loop[11] couldn't built heat maps with the UV.

Also for time constraints purposes, it was not possible to assign tasks on other real environments that have integrated the UV or Mirador such as the Digital Bodleian or the Scholastic Commentaries and Texts Archives (SCTA)[84].

Last but not least, collaboration within the IIIF community would give anyone a great insight of their knowledge. This initiative and the ecosystem have been significant for helping out memory institutions to better disseminate their content and to better streamline their internal issues. In this assignment, two major milestones were reached:

- Meeting IIIF enthusiasts and some members of the Mirador developing team at Stanford University in February 2017.
- Presenting and demoing the early results of the usability testing at the 2017 IIIF Conference in the Vatican City (Raemy 2017f; Cramer 2017b; Bonicel 2017).

[84] Cf. § 6.2.3

6.2 Recommendations

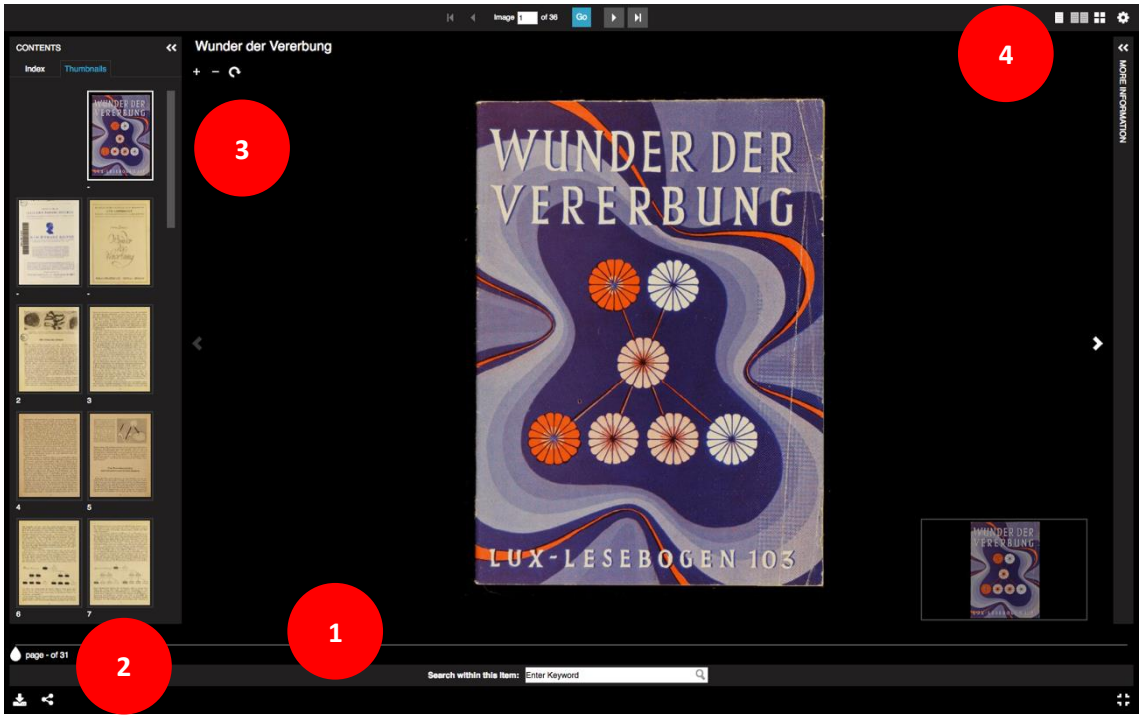
This section is divided into four subsections where recommendations are given to the developing teams of the UV and Mirador, the IIIF community, and the NIE-INE project. It must be noted that the recommendations are not intended to be prescriptive.

6.2.1 The UV

Overall, the UV developing team should find a compromise between its ease of use and the requirements of savvy users from the research community. In other words, the UV 2.01 has received a great perceived usability score but it may become less intuitive and less satisfying to the greater audience if new features (such as annotation or comparison) are added. It may be possible to integrate different modes that can be toggled by the implementer of the user (reader mode vs expert mode).

Figure 17 shows the four main usability issues of the UV based on the evaluations. Below it, there is a description of the different zones and ways to resolve these issues.

Figure 17: UV's main usability issues



1) **The pinpoint**: this feature was quite frustrating for most in-person participants who tried to slide the pinpoint to scroll through the images. It might be a good idea to add this sliding functionality as it seemed natural for most end users.

2) **The download options**: there are too many confusing options, and especially the two 'whole image' options. My recommendation is either to keep one 'whole image' or to prompt a clarifying message to end users who would like to download.

3) **The zoom and rotation icons**: Participants felt that the icons disappeared too quickly when not in use. Increasing their duration from the current time – which was observed to be under two seconds – may be useful. In addition, adding an anticlockwise rotation icon may increase value.

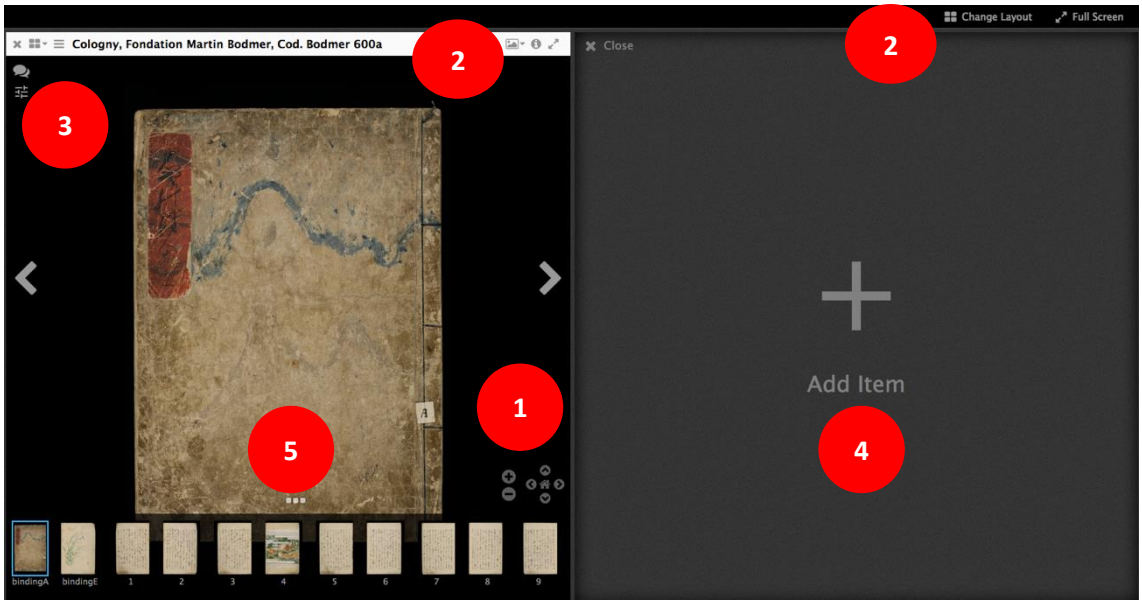
4) **The view types**: the icons are too small and the grey highlighting that indicates which view is used is not readily noticeable. Some refinements around that would be a good thing to do to give the UV more accessibility.

6.2.2 Mirador

Mirador needs a couple of refinements to achieve better usability. Mostly, its powerful features make it a quite cumbersome viewer for non-experts. As with the UV, it may be worth considering the addition of different modes based on user requirements and skills either directly by the user or through the client, such as improving the zen mode by fixing some issues and bugs.

In Figure 18, five main usability issues in six different zones have been identified. Explanations and ideas to enhance the interface can be found below the image.

Figure 18: Mirador's main usability issues



1) **The pan and zoom controls**: this zone was confusing for new users and rarely used by expert users. It should either be refined by keeping only the zoom controls or completely be removed.

2) **The view type/change layout**: often these two icons were mistaken for each other by new users and the view type icon was not easily noticed by in-person participants. It

should be refined by either writing ‘view type’ next to it or by modifying the image view icon (mountain).

3) **The image manipulation options**: participants had a hard time to find how to rotate an image. It would be a good idea to either put the clockwise and anticlockwise rotation options somewhere else or that it shouldn’t be necessary anymore to toggle the image manipulation to see all the different icons. Perhaps they could appear when an end user hovers the mouse cursor over it.

4) **Adding a new item/drop to load manifest**: when an end user utilises the drag-and-drop functionality to open a canvas in a new slot, it is impossible to close the window the usual way (the end user has to change the layout). This bug should be fixed by either Mirador accepting to load the dropped canvas (or the manifest) or by prompting an error message to the end user.

5) **The thumbnails panel**: quite a few participants couldn’t hide the thumbnails panel. There should be some refinements around the colour of the three dots to make it more obvious to the end users.

6.2.3 The IIIF community

UX is cited in the third IIIF goal, and usability has been a topic discussed within IIIF, especially in the IIIF Software Developers Community Group and the IIIF Discovery Technical Specification Group. Conversations on these topics have revealed that in general, responsibility for ensuring usability and high quality user experience often lies with the implementer who deploys a IIIF-compliant image viewer.

In order to enhance UX, some UCD best practices could also be integrated into the IIIF Design Patterns (Appleby et al. 2017a). In addition, a cross-disciplinary task force willing to give advice to existing and new implementers may be a good start. For instance, it would be a great idea to think about a generic set of usability tasks and questions based on existing scenarios.

Lastly, all usability content conducted by implementers and individuals (the British Library, the University of Toronto, this thesis) should automatically be shared and discussed with the IIIF community.

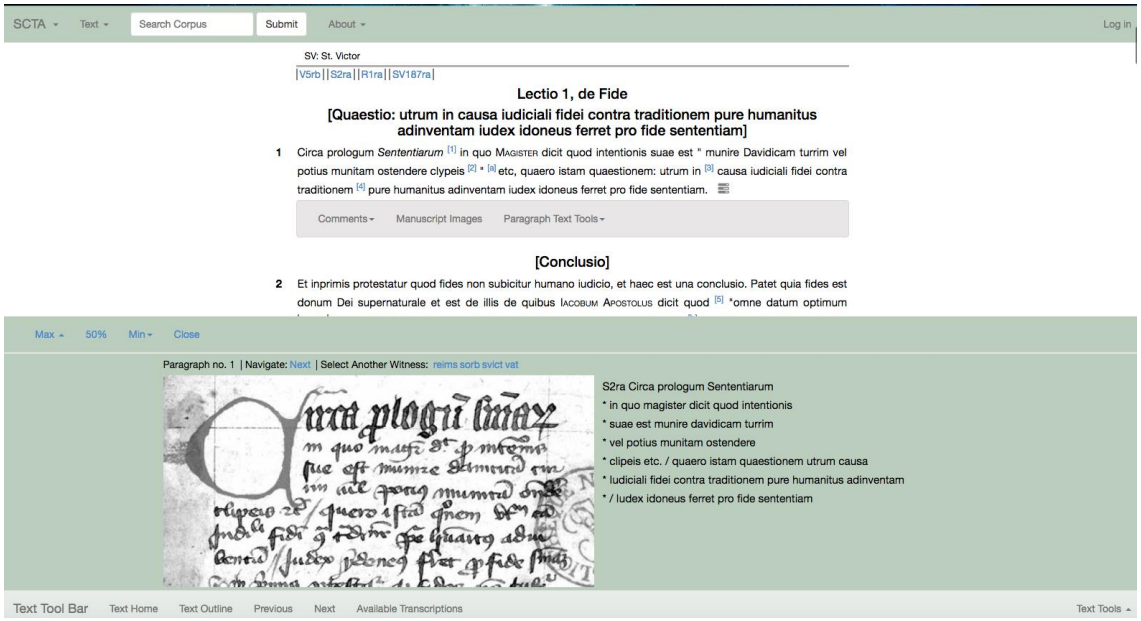
6.2.4 NIE-INE

A narrow interoperability just between the different edition projects in Switzerland doesn’t seem enough. One suggestion for NIE-INE would be to deploy SIPI, developed by the University of Basel’s Digital Humanities Lab, as their IIIF-compliant image server.

Then they would be able to make their collection IIIF-compatible and choose to integrate an image viewer into their technical framework. They can do it as a standalone application, which can either be Mirador for annotation and comparison purposes or the UV for searching and reading purposes.

Or indeed, as a customisable component of their website, like the SCTA (http://scta.lombardpress.org/) platform (Figure 19) where the same text (*Lectio 1*, de Fide) can be compared to four different editions (Reims, Vatican, Sorbonne and St. Victor). At the end of each paragraph, it is possible to see the image relation to the text of each version as well as comparing the text variation. The SCTA has deployed a Mirador instance (http://mirador.scta.info/) containing all available text collections and codices. This instance allows to search[85] the transcription of each object thanks to the mapping of TEI/XML[86] and the URI syntax of the IIIF Image API.

Figure 19: The Scholastic Commentaries and Texts Archive (SCTA)



(Witt 2011)

To accommodate scholarly needs for editorial standards and optimal outputs, NIE-INE should follow and join the IIIF Text Granularity Technical Specification Group which has aimed to work on specifying levels of granularity for textual annotations (i.e. word, sentence, paragraph, etc.).

[85] The search within feature added to Mirador 2.4.0 was created by Jeffrey C. Witt, developer of the SCTA.

[86] TEI: Text Encoding Initiative. XML: eXtensible Markup Language

Last but not least, their use cases and user stories should be compared with existing IIIF user stories and new ones should be given to the IIIF community on the IIIF-stories GitHub repository. Any issues specific to NIE-INE would be better solved by sharing and collaborating with the IIIF community because when new cases emerge, discussion to integrate them or not into the technical specifications can formally happen.

6.3 Future Work

Quite a few items related to usability practices could be undertaken. Following is a small selection of suggestions that were not adequately covered in this project, but which should be addressed in the future.

The main usability issues listed in the Recommendations (cf. § 6.2.1 and § 6.2.2) should be monitored by the developers of the UV and Mirador[87]. Any institutions that have implemented either of these viewers should follow as well what they would like to be updated or integrated into the base code. For instance, implementers and individuals from the IIIF Community could collaborate on the respective GitHub repository by creating or responding to UX issues.

The IIIF Discovery Technical Specification Group will be given some new recommendations around the drag-and-drop pattern. The refinements should be tested with real users before being implemented in IIIF-compliant viewers and by institutions.

Usability testing on the UV and Mirador was only conducted on consumer-grade computers in this thesis. The same process should also occur on smartphones in the near future.

Raising awareness of IIIF in Switzerland has still a long road to go. A survey and a IIIF event in the Western part of Switzerland, held for example at the HEG-GE, would be excellent opportunities to spread the word and improve interoperability on image-based content.

[87] Some of the usability results shown to both developing teams at the 2017 IIIF Conference in the Vatican City have already been taken into consideration. For instance, the UV's location indicator (pinpoint) might be modified into a navigation control (Crane 2017).

7. Conclusion

Much the same as the cultural heritage field, the NIE-INE project and the wider scientific community have the opportunity to take advantage of IIIF-compliant technology. All potential adopters would benefit from the IIIF ecosystem in terms of joining a thriving community, by streamlining their internal operations, and giving their end users the possibility to have access to interoperable collections as well as being able to manipulate, compare, and annotate these resources.

Discussing and collaborating with the IIIF community is a very simple matter to achieve because of the inclusiveness and the sound understanding of the global network of institutions and individuals that participate and contribute on a daily basis on the same content dissemination matters. Many, if not all, of the NIE-INE user stories are already covered either by the IIIF specifications or by implementers who have leveraged IIIF to reduce the friction around information access.

The results obtained during the usability testing have shown that both the UV and Mirador had their strengths and weaknesses and that none of these IIIF-compliant viewers displayed considerable issues that would impede end users to work. Both developing teams were first informed of the discovered usability issues during the 2017 IIIF Conference in the Vatican City and all the results and raw data have been available. Because both viewers have open-source licenses, it is also possible to collaborate by raising and fixing issues through their GitHub repositories or to fork the viewers and create plugins, for instance.

On all counts, institutions modifying or building Web-based platforms should consider to implement robust and friendly interfaces. As innovation in scholarly research can really occur with true interoperability, any new IIIF implementers should consider deploying viewers such as the UV or Mirador. The former for its simplicity and its seamless integration of features and the latter would be a better choice for expert and savvy end users. Based on the studied topic and the types of users, it may as well be possible to deploy both viewers as they can complete each other.

It is absolutely necessary to have a user-centric mindset at all stages in the cultural heritage field and the wider scientific community. In other words, defining user-centric strategies for any institutions delivering information is imperative.

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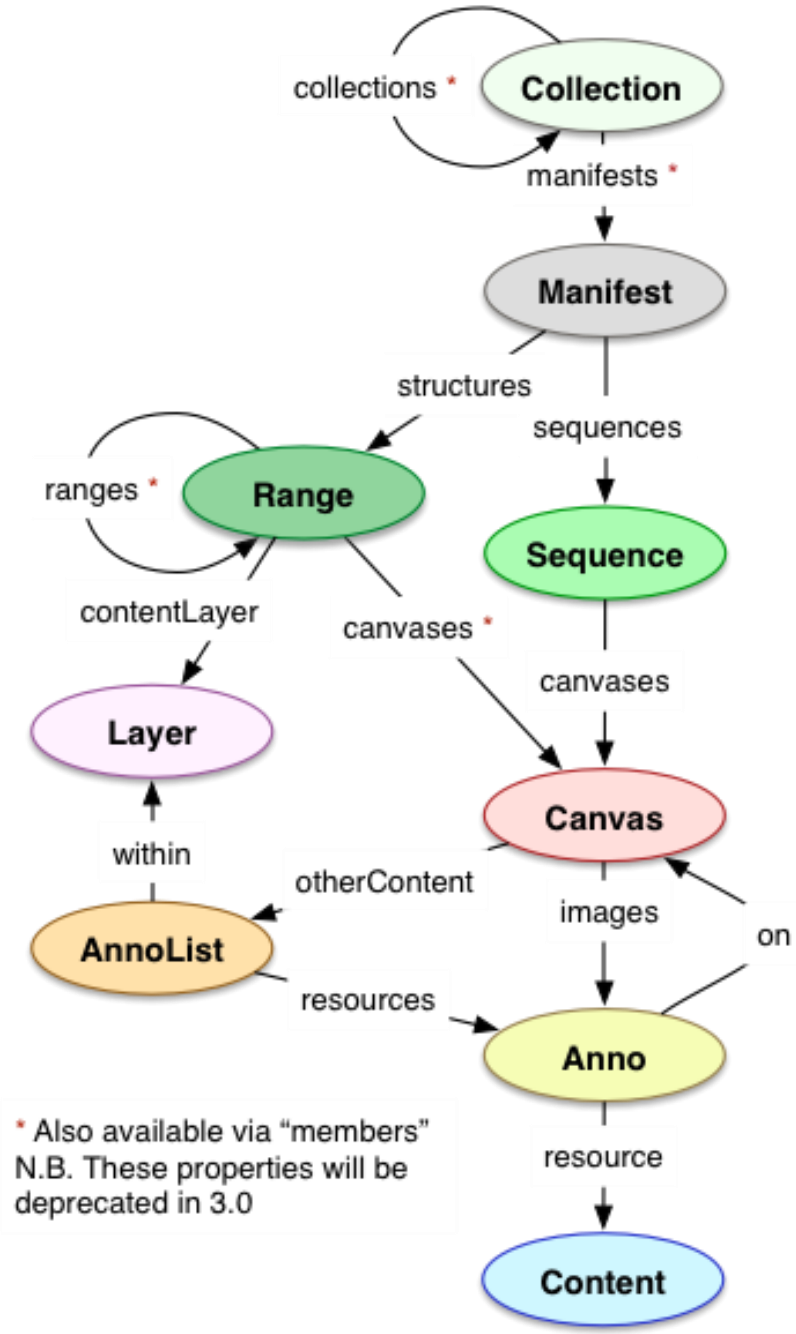
Appendix 1: IIIF Resource type overview

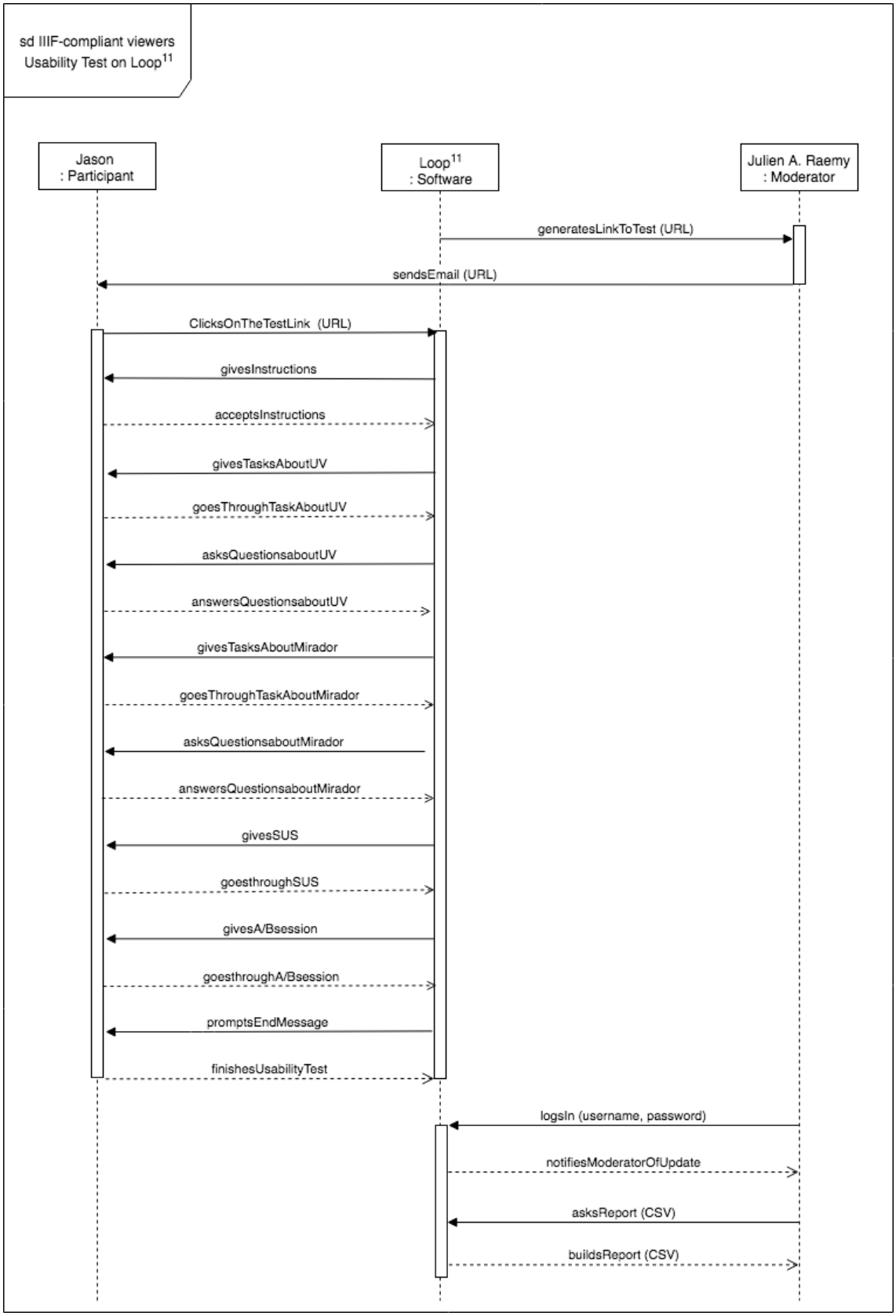
Figure 20: Presentation API 2.1.1 – Additional types



(Appleby et al. 2017c)

Appendix 2: Remote usability test's sequencing prototype

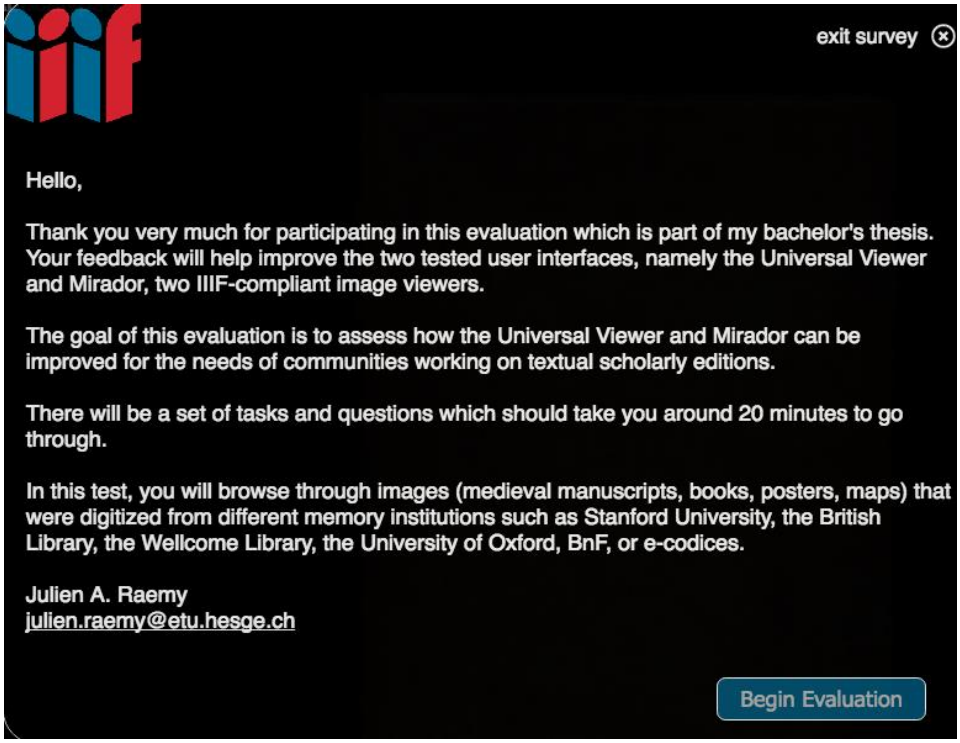
Figure 21: UML Sequence diagram sketch with Loop[11]



Appendix 3: Loop[11]'s welcome messages

Figure 22: Pilot test's welcome message

Figure 23: Target test's welcome message



Appendix 4: Loop[11]'s remote usability test scenario

1) Confidence. First of all, how confident are you with the following statements. [option range: *very confident, confident, neither confident or unconfident, not very confident, not at all confident*]

- Using a computer
- Finding metadata
- Using image viewers
- Manipulating digital images or texts
- Annotating images or texts
- Comparing images or texts

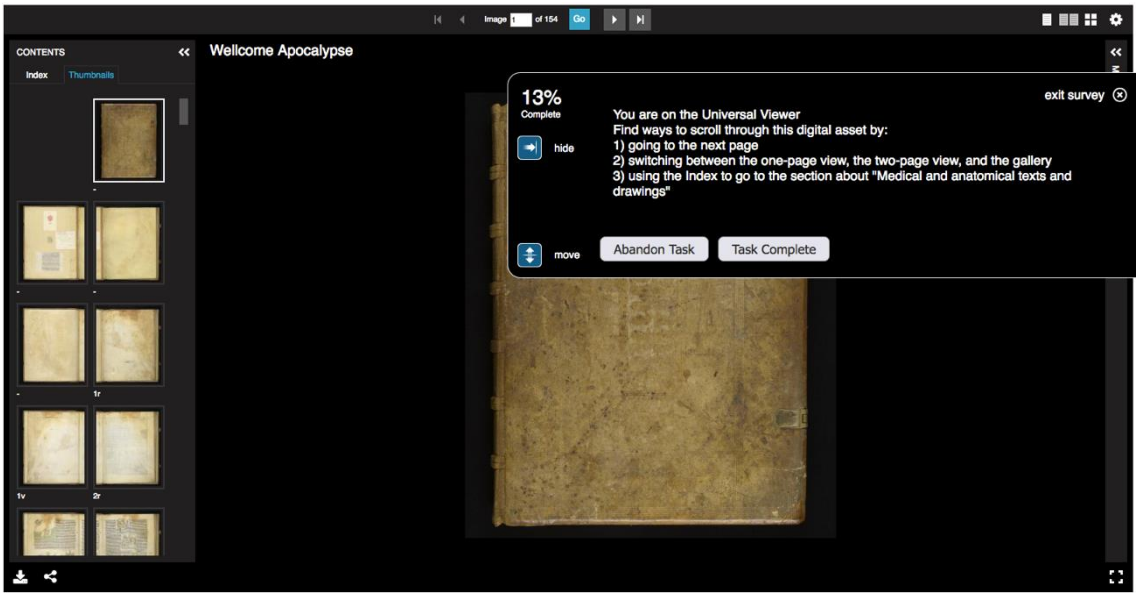
2) Status. What is your current status? [multiple-choice]

- Student, Assistant, Professor, Researcher, Librarian, Digital Curator, Developer, Other, please specify

3) UV (layout). You are on the Universal Viewer. Find ways to scroll through this digital asset by:

- going to the next page
- switching between the one-page view, the two-page view, and the gallery
- using the Index to go to the section about 'Medical and anatomical texts and drawings'

Figure 24: Loop[11]'s task 3 – UV (layout)

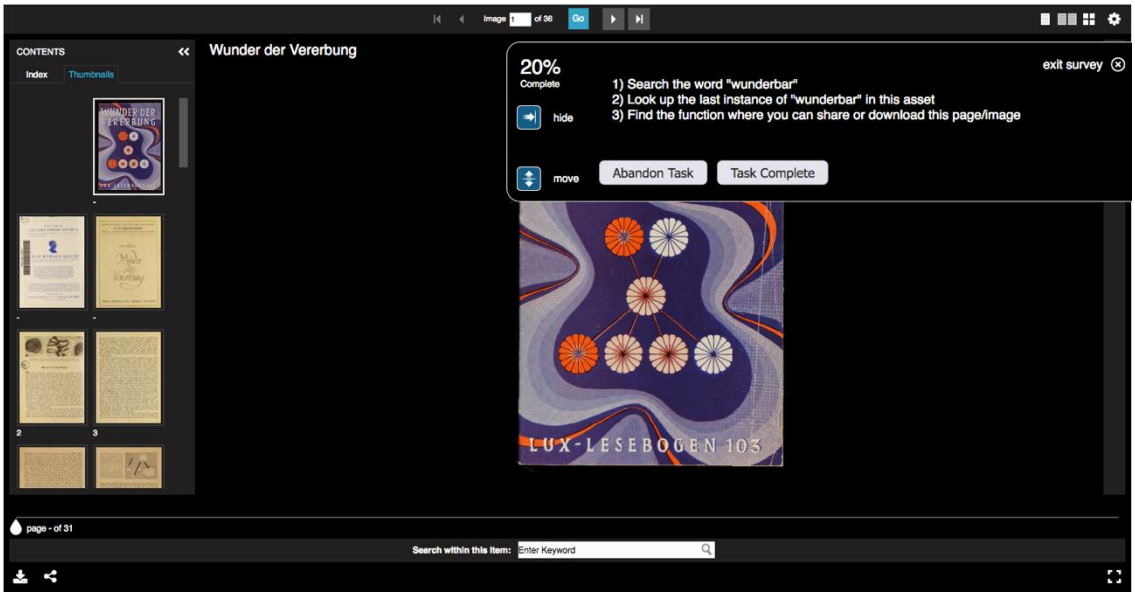


Wellcome Apocalypse, 1420. London, Wellcome Library: MS. 49.

4) UV (search, share, and download)

- search the word ‘wunderbar’
- look up the last instance of ‘wunderbar’ in this asset
- find the function where you can share or download this page/image

Figure 25: Loop[11]'s task 4 – UV (search, share, and download)

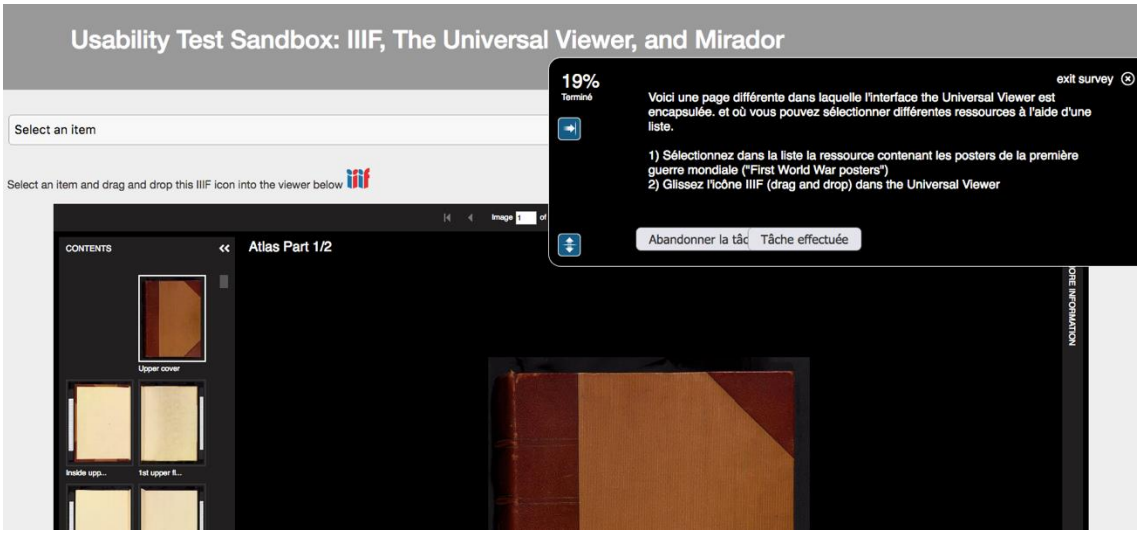


FRITZ, Bolle, 1951. *Wunder der Vererbung*. London, Wellcome Library

4b) UV (drag-and-drop). Here is a different webpage on which the Universal Viewer is embedded and where you can select different items from a list.

- Select the item that is called ‘First World War posters’
- Drag-and-drop the IIIF icon into the Universal Viewer

Figure 26: Loop[11]'s task 4b – UV (drag-and-drop)



ORTELIUS, Abraham, 1573. *Theatrum oder Schawplatz des erdbodems [Theatrum orbis terrarum]*. Oxford, Hertford College: Atlas Part 1/2

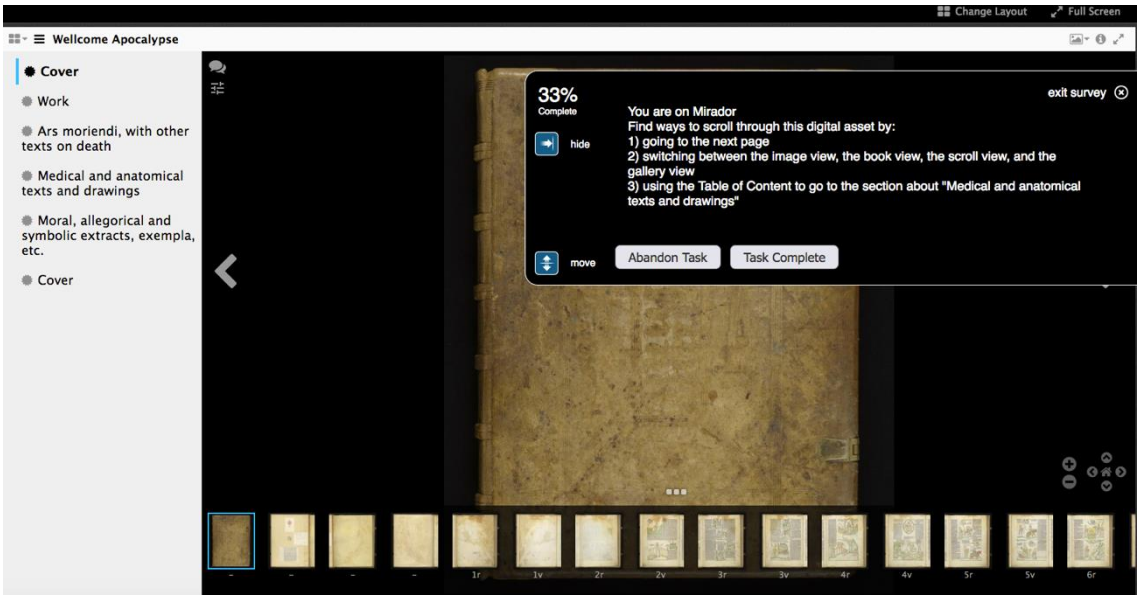
5) UV Satisfaction. Please describe how you agree or disagree with the following aspects after completing the tasks with the Universal Viewer. [Likert scale]

- The Universal Viewer works the way I want it to work
- The Universal Viewer is pleasant to use
- The Universal Viewer is fun to use

6) Mirador (layout). You are on Mirador. Find ways to scroll through this digital asset by:

- going to the next page
- switching between the image view, the book view, the scroll view, and the gallery view
- using the Index to go to the section about 'Medical and anatomical texts and drawings'

Figure 27: Loop[11]'s task 6 – Mirador (layout)

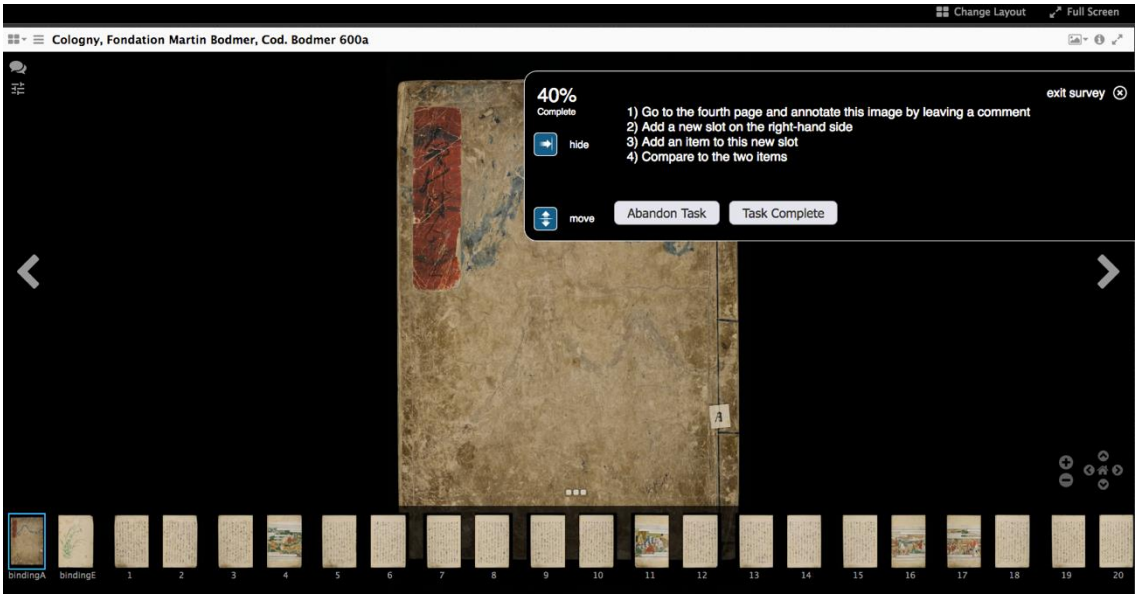


Wellcome Apocalypse, 1420. London, Wellcome Library: MS. 49

7) Mirador (annotation and comparison)

- Go to the fourth page and annotate this image by leaving a comment
- Add a new slot on the right-hand side
- Add an item to this new slot
- Compare to the two items

Figure 28: Loop[11]'s task 7 – Mirador (annotation and comparison)

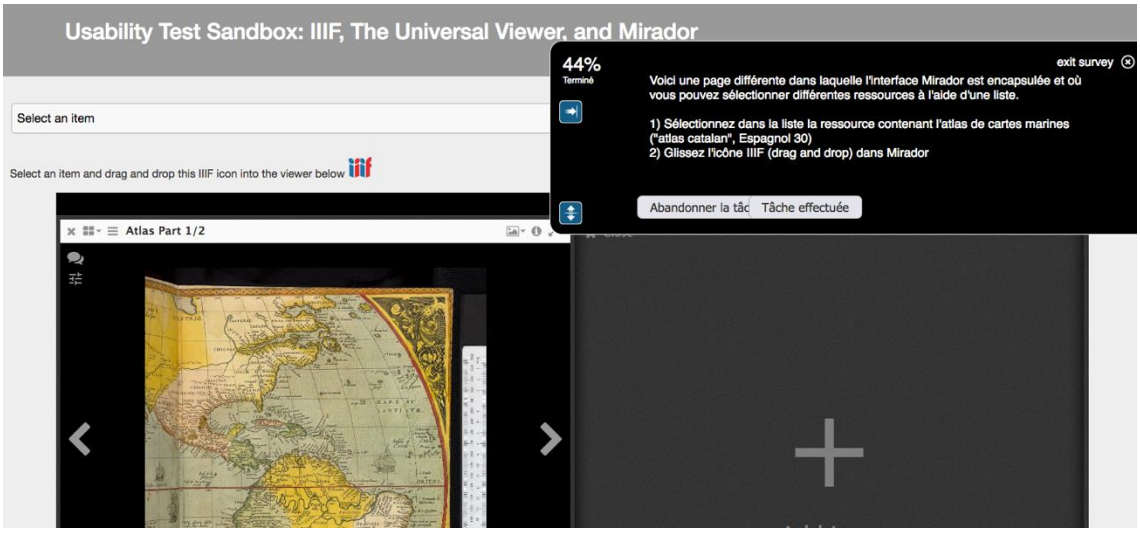


The Life of Buddha, first book (Shaka no Honji, jō), 1596-1615. Cologny, Fondation Bodmer: Cod. Bodmer 600a

7b) Mirador (drag-and-drop). Here is a different webpage on which Mirador is embedded and where you can select different items from a list.

- Select the item that is called ‘Atlas catalan’
- Drag-and-drop the IIIF icon into Mirador

Figure 29: Loop[11]'s task 7b – Mirador (drag-and-drop)



ORTELIUS, Abraham, 1573. *Theatrum oder Schawplatz des erdbodems [Theatrum orbis terrarum]*. Oxford, Hertford College: Atlas Part 1/2

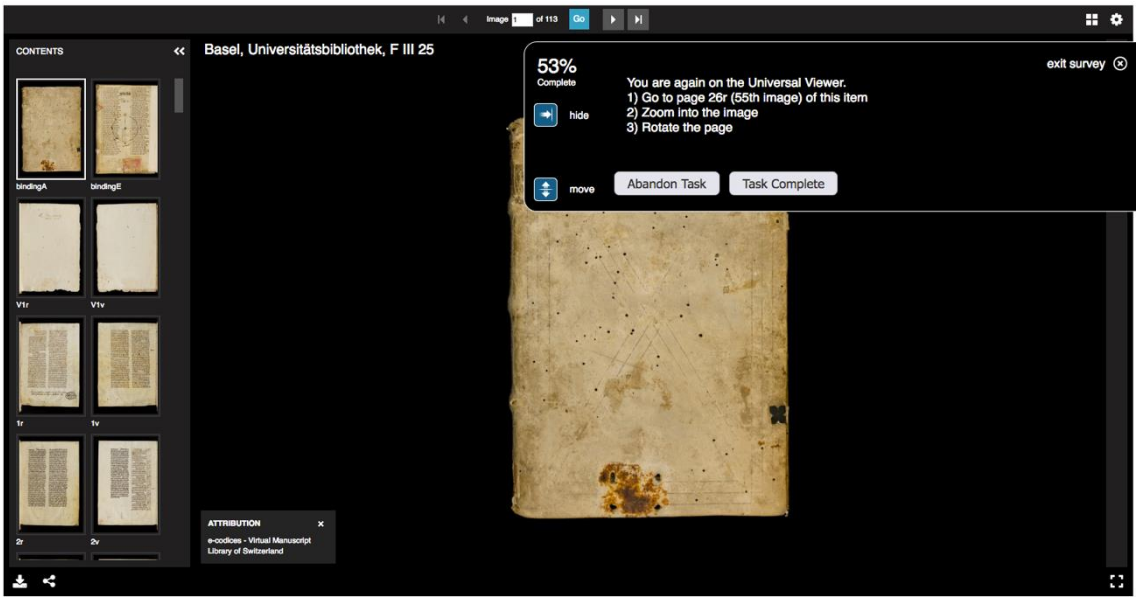
8) Mirador Satisfaction. Please describe how you agree with the following aspects after completing the tasks with Mirador. [Likert scale]

- Mirador works the way I want it to work
- Mirador is pleasant to use
- Mirador is fun to use

9) UV (‘close’ – zoom and rotation). You are again on the Universal Viewer.

- Go to page 26r (55th image) of this item
- Zoom into the image
- Rotate the page

Figure 30: Loop[11]'s task 9 – UV (zoom and rotation)



Composite manuscript (Astronomy), 13th-14th century. Basel, Universitätsbibliothek: F III 2

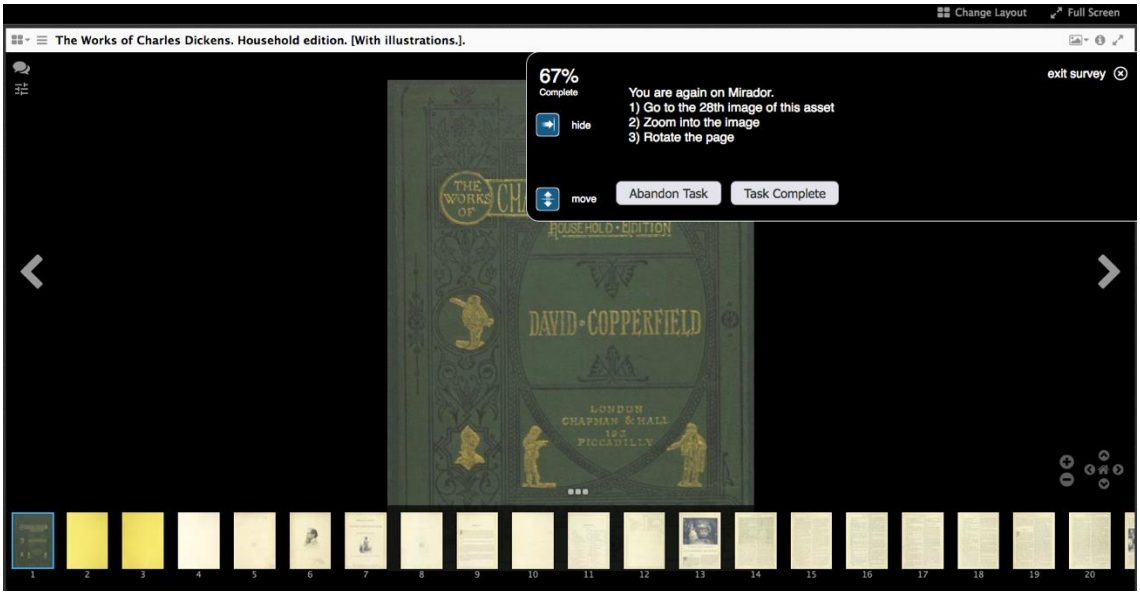
10) SUS of the UV. Please indicate how you feel with the following statements about the Universal Viewer. [Likert scale]

- I think that I would like to use the Universal Viewer frequently
- I found the Universal Viewer unnecessarily complex
- I thought the Universal Viewer was easy to use
- I think that I would need the support of a technical person to be able to use the Universal Viewer
- I found the various functions were well integrated into the Universal Viewer
- I thought there was too much inconsistency
- I would imagine that most people would learn to use the Universal Viewer very quickly
- I found the Universal Viewer very cumbersome to use
- I felt very confident using the Universal Viewer
- I needed to learn a lot of things before I could get going with the Universal Viewer

11) Mirador ('close' – zoom and rotation). You are again on Mirador.

- Go to the 28th image of this asset
- Zoom into the image
- Rotate the page

Figure 31: Loop[11]'s task 11 – Mirador (zoom and rotation)



DICKENS, Charles, 1872, The Works of Charles Dickens, Household edition. [With illustrations]. London, British Library.

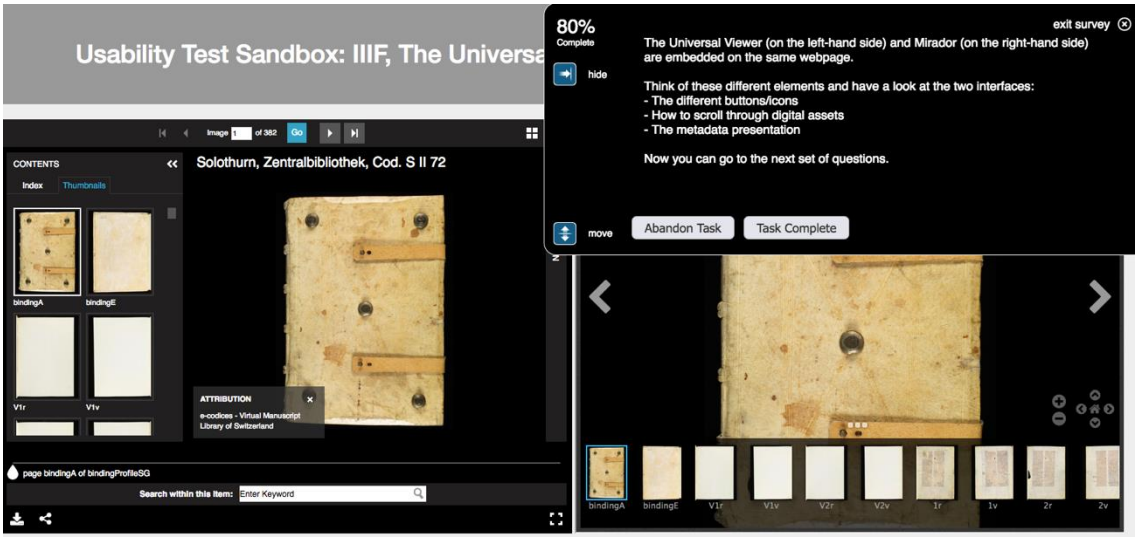
12) SUS of Mirador. Please indicate how you feel with the following statements about Mirador. [Likert scale]

- I think that I would like to use Mirador frequently
- I found Mirador unnecessarily complex
- I thought Mirador was easy to use
- I think that I would need the support of a technical person to be able to use Mirador
- I found the various functions were well integrated into Mirador
- I thought there was too much inconsistency
- I would imagine that most people would learn to use Mirador very quickly
- I found Mirador very cumbersome to use
- I felt very confident using Mirador
- I needed to learn a lot of things before I could get going with Mirador

13) UV/Mirador. The Universal Viewer (on the left-hand side) and Mirador (on the right-hand side) are embedded on the same webpage. Have a look at the two interfaces and think of these different elements:

- The different buttons/icons
- How to scroll through digital assets
- The metadata presentation

Figure 32: Loop[11]'s task 13 – UV/Mirador



LOMBARDUS, Petrus, 12th century. *Liber sententiarum I-IV*. Solothurn, Zentralbibliothek: Cod. S II 72

14) A/B. Which viewer did you prefer to use for the following aspects? (The Universal Viewer is on the left-hand side, Mirador on the right-hand side). [option range: *The Universal Viewer, Mirador, both are equally good, neither*]

- To scroll through digital assets
- The metadata presentation
- The size and choice of icons
- For manipulating images
- The overall layout
- The overall aesthetic
- The most pleasing

15) Last questions. [Non-mandatory and open-ended questions]

- *What function was the most pleasant in the Universal Viewer (pilot test)?* What should be done to the Universal Viewer to enable better comparison of texts from scholarly sources (target test)?
- *What function was the most pleasant in Mirador (pilot test)?* What should be done to Mirador to enable better comparison of texts from scholarly sources (target test)?
- Do you prefer to see the interface as a full-screen page or embedded in a webpage?
- Do you have any further comments?

Appendix 5: Morae's usability test consent form[88]

This usability test conducted by Julien A. Raemy, Library and Information Science Student at the Haute école de gestion (HEG) in Geneva. It is done in the context of a Bachelor's thesis in support of the International Image Interoperability Framework (IIIF) to see how IIIF-compliant technology can be improved for the scholarly community.

In this usability test:

- You will evaluate two IIIF-compliant image viewers: The Universal Viewer and Mirador
- You will be asked to perform certain tasks on a laptop.
- You will be asked to 'think aloud' during your interactions with the system.
- You will be asked to answer surveys regarding the tasks you performed.
- Your screen interactions as well as your voice will be recorded with Morae.

Please remember that this usability test will not evaluate your skills, but only the interfaces as the findings may be used to improve them. However, at no time will your name or any other identification be used.

The participation in this usability test is voluntary. Please do immediately raise any concerns or areas of discomfort during the session.

Please sign below to indicate that you have read and understood the information on this form and all the questions you might have about the session have been answered.

Date: _____

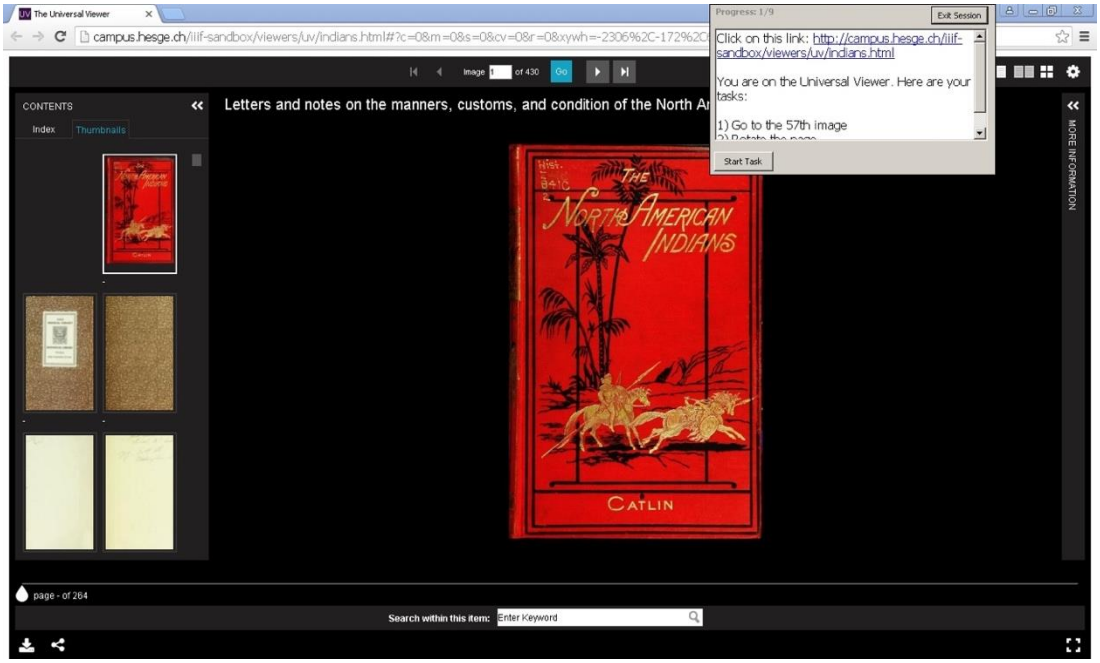
Signature: _____

Thank you very much for participating!

[88] The layout of this consent form has been slightly modified from the original. Source of inspiration: Eric Mao's consent form (http://vis.berkeley.edu/courses/cs160-sp12/wiki/images/e/e5/Group-omg-consent.pdf)

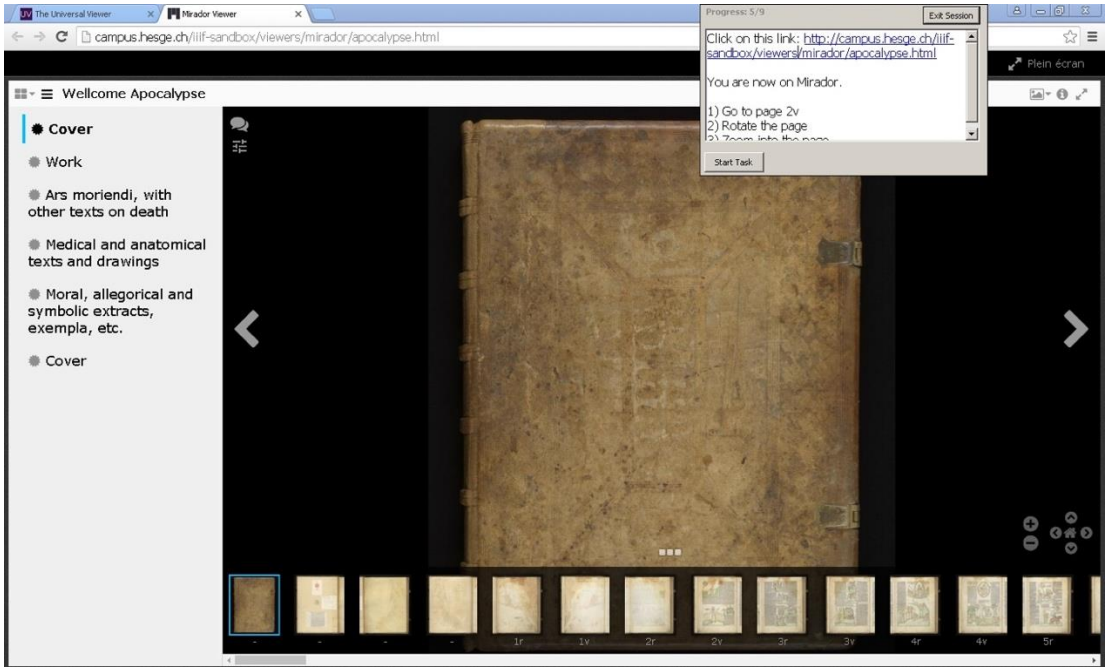
Appendix 6: Morae's in-person usability test scenario[89]

Figure 33: Morae's task 2 – UV (zoom and rotation)



CATLIN, George, 1841, Letters and notes on the manners, customs, and condition of the North American Indians. London, Wellcome Library.

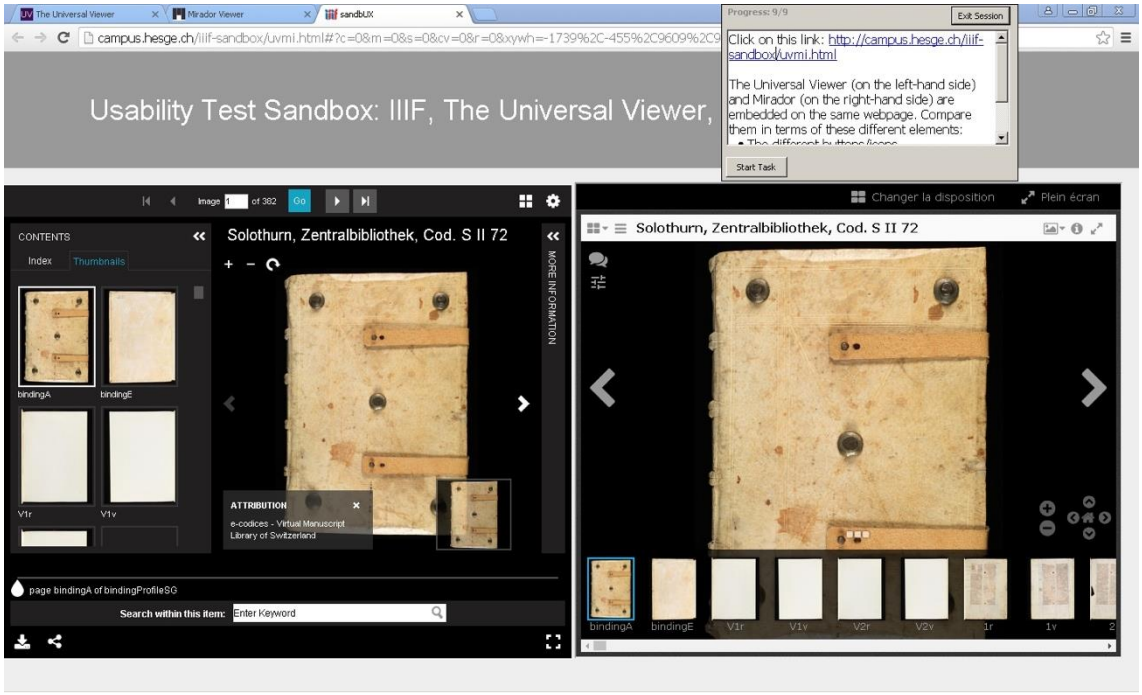
Figure 34: Morae's task 7 – Mirador (zoom and rotation)



Wellcome Apocalypse, 1420. London, Wellcome Library: MS. 49

[89] Only the tasks 2, 7, and 12 are being displayed to demonstrate what participants saw as questions are substantially the same that in the remote usability test.

Figure 35: Morae's task 12 – UV/Mirador



LOMBARDUS, Petrus, 12th century. *Liber sententiarum I-IV*. Solothurn, Zentralbibliothek: Cod. S II 72

Appendix 7: Loop[11]'s pilot test dashboards

Table 12: Pilot test's time spent per task[90]

PILOT TEST Time spent per task (seconds)	STATUS	UV - Layout	UV - Search + Share/Download	UV - Drag and drop	UV - Zoom and rotation	Mirador - Layout	Mirador - Annotation and Comparison	Mirador - Drag and drop	Mirador - Zoom and rotation	TOTAL	*TOTAL without drag and drop*
Participant PT1	LIS Student	71	84	70	41	64	172	37	42	581	*474*
Participant PT2	LIS Student	108	148	132	41	66	204	106	72	877	*639*
Participant PT3	LIS Student	63	97	87	60	82	124	35	87	635	*513*
Participant PT4	LIS Student	98	92	49	86	92	98	50	89	654	*555*
Participant PT5	LIS Student	210	102	131	34	80	207	87	41	892	*674*
Participant PT6	LIS Student	312	144	123	27	59	141	79	24	909	*707*
Participant PT7	LIS Student	88	107	54	35	48	280	188	33	833	*591*
Participant PT8	LIS Student	87	82	186	20	44	115	50	41	625	*389*
Participant PT9	LIS Student	24	93	182	44	62	172	132	85	794	*480*
Participant PT10	LIS Student	43	79	104	47	45	231	104	21	674	*466*
Participant PT11	LIS Student	37	127	144	48	72	146	184	39	797	*469*
Participant PT12	LIS Student	80	148	51	43	35	172	76	90	695	*568*
Participant PT13	LIS Student	120	51	104	31	57	89	46	62	560	*410*
Participant PT14	LIS Student	93	78	74	30	29	77	33	74	488	*381*
Participant PT15	LIS Student	142	147	118	31	19	354	70	46	927	*739*
Participant PT16	LIS Student	133	109	161	38	90	130	136	18	815	*518*
Participant PT17	LIS Student	75	241	63	44	107	135	64	29	758	*631*
Participant PT18	LIS Student	121	47	202	22	88	117	159	28	784	*423*
Participant PT19	LIS Student	83	77	121	52	92	136	60	66	687	*506*
Participant PT20	LIS Student	150	119	97	49	66	87	64	63	695	*534*
Participant PT21	LIS Student	95	257	156	30	91	186	73	25	913	*684*
Participant PT22	LIS Student	176	68	129	17	49	146	58	24	667	*480*
Participant PT23	LIS Student	41	31	58	15	77	127	67	24	440	*315*
Participant PT24	LIS Student	189	86	102	37	127	232	78	31	882	*702*
Participant PT25	LIS Student	57	46	71	25	73	158	61	74	565	*433*
Participant PT26	LIS Student	245	75	174	23	32	118	78	33	778	*526*
Participant PT27	LIS Student	29	37	40	40	19	77	34	42	318	*244*
Participant PT28	LIS Student	36	28	35	25	22	54	23	20	243	*185*
Participant PT29	LIS Student	17	28	49	30	47	80	28	32	311	*234*
OVERALL AVERAGE		**104.24**	**97.52**	**105.76**	**36.72**	**63.24**	**150.52**	**77.93**	**46.72**	**682.66**	**498.97**
OVERALL MEDIAN		**88.00**	**86.00**	**104.00**	**35.00**	**64.00**	**136.00**	**67.00**	**41.00**	**695.00**	**506.00**
SUCCESS AVERAGE		*87.58*	*92.39*	*84.63*	*36.72*	*61.11*	*147.67*	*56.00*	*44.11*		
SUCCESS MEDIAN		*85.00*	*85.00*	*72.00*	*35.00*	*60.50*	*141.00*	*60.00*	*39.00*		

Table 13: Pilot test's participants' confidence

Premièrement, à quel point êtes-vous à l'aise dans les compétences suivantes						
	Très confiant	Confiant	Ni confiant ni inconfiant	Pas très confiant	Pas du tout confiant	Response Count
Utiliser un ordinateur	15	13	1	0	0	29
Chercher les métadonnées	5	16	6	2	0	29
Utiliser des visionneuses d'images	8	10	11	0	0	29
Manipuler des images numériques	4	13	8	4	0	29
Annoter des images ou des textes	5	9	9	6	0	29
Comparer des images ou des textes	7	13	5	4	0	29

[90] If a participant abandoned a task, it is highlighted in red.

Table 14: Pilot test's participant skills

Max: 4 / Min: -4	Computer experience	System expertise	Domain understanding
Participant PT1	2	1	-4
Participant PT2	2	-1	2
Participant PT3	2	3	2
Participant PT4	2	1	3
Participant PT5	1	-1	1
Participant PT6	2	2	2
Participant PT7	1	2	1
Participant PT8	3	4	3
Participant PT9	3	3	2
Participant PT10	3	2	0
Participant PT11	2	0	0
Participant PT12	2	1	-2
Participant PT13	1	2	1
Participant PT14	3	2	1
Participant PT15	1	0	-2
Participant PT16	3	1	4
Participant PT17	3	0	-1
Participant PT18	2	3	3
Participant PT19	4	0	3
Participant PT20	3	1	1
Participant PT21	2	0	-2
Participant PT22	2	3	4
Participant PT23	1	4	1
Participant PT24	3	1	1
Participant PT25	1	2	1
Participant PT26	2	-1	-1
Participant PT27	3	1	2
Participant PT28	4	4	4
Participant PT29	4	3	4
Average	**2.31**	**1.48**	**1.17**
Median	**2**	**1**	**1**

Table 15: Pilot test's overall results

PILOT TEST									
29 Participants	**5th April 2017**			**Success 80.3%**			**Abandon 19.7%**		
Task	**Success**	**Abandon**	**Average time (seconds)**	**Average success time (seconds)**	**Median time (seconds)**	**Minimum (seconds)**	**Maximum (seconds)**	**Overall Relative Efficiency**	**Satisfaction (out of 5)**
3. UV (Layout)	89.7%	10.3%	104.24	87.58	88.00	17	312	75.3%	-
4. UV (Search + Share/Download)	96.6%	3.4%	97.52	92.39	86.00	28	257	91.5%	-
4b. UV - Drag and drop	*55.2%*	*44.8%*	*105.76*	*84.63*	*104.00*	*35*	*202*	*44.1%*	-
9. UV (zoom and rotation)	100.0%	0.0%	36.72	36.72	35.00	15	86	100.0%	-
The Universal Viewer (without dnd)	**95.4%**	**4.6%**	**-**		**-**	**-**	**-**	**88.9%**	**3.75**
6. Mirador (Layout)	62.1%	37.9%	63.24	61.11	64.00	19	127	60.0%	-
7. Mirador (Annotation + Comparison)	72.4%	27.6%	150.52	147.67	136.00	54	354	71.0%	-
7b. Mirador - Drag and drop	*58.6%*	*41.4%*	*77.93*	*56.00*	*67.00*	*23*	*188*	42.1%	-
11. Mirador (zoom and rotation)	93.1%	6.9%	46.72	44.11	41.00	18	90	87.9%	-
Mirador (without dnd)	**75.9%**	**24.1%**	**-**		**-**	**-**	**-**	**73.0%**	**3.49**

Table 16: Pilot test's UV Satisfaction

Merci d'indiquer à quel point vous êtes en accord avec les les aspects suivants après avoir effectué ces tâches sur l'interface the Universal Viewer.							
	Pas du tout d'accord	Pas d'accord	Ni en désaccord ni d'accord	D'accord	Tout à fait d'accord	Response Count	Score (out of 5)
Cette interface fonctionne comme je l'attendais	2	3	4	9	11	29	**3.83**
Cette interface est plaisante à utiliser	1	3	7	10	8	29	**3.72**
Cette interface est amusante à utiliser	1	3	6	13	6	29	**3.69**
							3.75

Table 17: Pilot test's UV SUS

Indiquez dans quelle mesure vous êtes d'accord ou en désaccord avec les énoncés suivants par rapport à l'interface the Universal Viewer.								
	Pas du tout d'accord	Pas d'accord	Ni en désaccord ni d'accord	D'accord	Tout à fait d'accord	Response Count	Mean SUS per item	SUS Score
J'aimerais utiliser cette interface fréquemment	0	3	7	14	5	29	2.72	6.81
Je trouve que cette interface est inutilement complexe	10	10	4	4	1	29	2.83	7.07
Je pense que cette interface est facile à utiliser	1	5	3	5	15	29	2.97	7.41
J'aurais besoin d'un support technique pour pouvoir utiliser cette interface	12	8	4	3	2	29	2.86	7.16
Les différentes fonctionnalités de cette interface sont bien intégrées	1	4	4	10	10	29	2.83	7.07
Cette interface est truffée d'incohérences	10	8	9	2	0	29	2.90	7.24
Le grand public peut apprendre à utiliser cette interface très rapidement	1	4	4	11	9	29	2.79	6.98
Cette interface est lourd à utiliser	6	13	6	4	0	29	2.72	6.81
J'ai confiance en cette interface	0	3	10	8	8	29	2.72	6.81
J'ai du apprendre beaucoup choses avant de pouvoir utiliser cette interface	24	4	0	1	0	29	3.76	9.40
								72.76

Table 18: Pilot test's Mirador Satisfaction

Merci d'indiquer à quel point vous êtes en accord avec les les aspects suivants après avoir effectué ces tâches sur l'interface Mirador.							
	Pas du tout d'accord	Pas d'accord	Ni en désaccord ni d'accord	D'accord	Tout à fait d'accord	Response Count	Score
Cette interface fonctionne comme je l'attendais	0	5	3	15	6	29	**3.76**
Cette interface est plaisante à utiliser	1	5	8	11	4	29	**3.41**
Cette interface est amusante à utiliser	2	4	8	13	2	29	**3.31**
							3.49

Table 19: Pilot test's Mirador SUS

Indiquez dans quelle mesure vous êtes d'accord ou en désaccord avec les énoncés suivants par rapport à l'interface Mirador.								
Answer	Pas du tout d'accord	Pas d'accord	Ni en désaccord ni d'accord	D'accord	Tout à fait d'accord	Response Count	Mean SUS per item	SUS Score
J'aimerais utiliser cette interface fréquemment	1	5	10	11	2	29	2.28	5.69
Je trouve que cette interface est inutilement complexe	3	11	6	8	1	29	2.24	5.60
Je pense que cette interface est facile à utiliser	1	5	8	10	5	29	2.45	6.12
J'aurais besoin d'un support technique pour pouvoir utiliser cette interface	4	11	6	7	1	29	2.34	5.86
Les différentes fonctionnalités de cette interface sont bien intégrées	0	7	10	10	2	29	2.24	5.60
Cette interface est truffée d'incohérences	14	12	2	1	0	29	3.34	8.36
Le grand public peut apprendre à utiliser cette interface très rapidement	1	5	9	11	3	29	2.34	5.86
Cette interface est lourd à utiliser	1	18	7	1	2	29	2.52	6.29
J'ai confiance en cette interface	0	2	8	14	5	29	2.76	6.90
J'ai du apprendre beaucoup choses avant de pouvoir utiliser cette interface	9	15	4	1	0	29	3.10	7.76
								64.05

Table 20: Pilot test's A/B

Quelle interface avez-vous préférez utiliser dans ces cas-là?					
	The Universal Viewer	Mirador	Les deux interfaces se valent	Ni l'une ni l'autre	Response Count
La navigation à l'intérieur de la ressource	14	7	7	1	29
La présentation des métadonnées	9	9	9	2	29
La taille et le choix des boutons/icônes	15	8	4	2	29
La manipulation des images/pages	14	8	6	1	29
La disposition globale des éléments	12	10	5	2	29
Les aspects esthétiques/le design (dans sa globalité)	12	7	7	3	29
La plus plaisante	14	8	5	2	29

Table 21: Pilot test's comments

	Quelle est la fonction la plus plaisante de l'interface The Universal Viewer ?	**Quelle est la fonction la plus plaisante de l'interface Mirador ?**	**Avez-vous préféré quand l'interface était en plein écran ou encapsulée ?**	**Avez-vous d'autres commentaires ?**
Participant PT1	La recherche	La comparaison et le choix des dispositions (grille)	Plein écran	Universal Viewer me semble plus compliqué. Par conte je n'ai pas trouvé la fonction recherche sur Mirador.
Participant PT2	Le téléchargement et le partage	Les commentaires	En plein écran	Universal Viewer est plus intuitive
Participant PT3	Manipulation totale des images & Recherche avancée en bas de la page.	Commenter les images.	Sur une page web et en plein écran.	Mettre en avant les réglages sur Mirador, déplier les possibilités quand on passe la souris par dessus par exemple.
Participant PT4	La recherche	Le défilement des pages	Plein écran, même si la version encapsulée est pratique	Je suis sûr qui si Borges avait utilisé ces interfaces, il aurait écrit une suite à la Bibliothèque de Babel
Participant PT5	changement de dispositions des images	commentaires	plein écran	Je préfère de loin The Universal Viewer
Participant PT6	visualisation des pages sur la gauche	Titre des pages sur la gauche	plein écran	

	(possibilité de scroller)			
Participant PT8	Fenêtre de recherche	Les images en bas	plein écran	
Participant PT9	La fonction More Information	La liste dans laquelle on peut sélectionner des ouvrages	Encapsulée	
Participant PT10	cherche un mot	les boutons	plein écran	
Participant PT14	La gestion des pages, en haut avec de gros boutons	Les commentaires	Plein écran	Le coup du drag and drop du logo iiif... c'est pas très intuitif.
Participant PT15	Boutons des fonctionnalités plus visibles	Image sélectionnée plus grande	Encapsulée	
Participant PT17	la possibilité de chercher facilement	les pages au fond qu'on peut faire défiler facilement	pas de préférence	
Participant PT18	La clarté des boutons	la possibilité de mettre des commentaires	Encapsulée	Absolument pas intuitif dès qu'on veut aller plus loin qu'un zoom
Participant PT20	la recherche	le résumé des infos	plein écran	les deux interfaces sont équivalentes
Participant PT22	La barre de recherche en bas au milieu		Encapsulée, car c'est plus petit, donc plus facile de savoir ou sont les éléments	
Participant PT23	Scroller pour voir les pages.	Index	Plein écran	Mirador est moins instinctif que The universal viewer
Participant PT24	La fonction zoom avec la visualisation de la zone zoomée à droite	Plus de réglage possible de l'image (contraste, etc)	Plein écran	Les boutons sont trop petits
Participant PT25	La barre de menu à gauche	Le fait de pouvoir mettre en plusieurs pages	En plein écran	L'interface est mieux en plein écran mais devrait être plus accessible en mode encapsulée

Participant PT26	Les fonctions pour tourner les images qui sont directement visibles	Vue en horizontal en bas des images	en plein écran	
Participant PT27	vision des pages	modification des images	Plein ecran	
Participant PT28	La recherche plein texte, le téléchargement, le partage	La comparaison des images	Encapsulée car ça donne un contexte de recherche	L'icône IIIF pour le drag and drop devrait être différent, ce n'est pas intuitif
Participant PT29	Pas une fonction, mais sa simplicité	Les annotations	Encapsulée	

Appendix 8: Loop[11]'s target test dashboards

Table 22: Target test's time spent per task[91]

TARGET TEST Time spent per task (seconds)	STATUS	UV - Layout	UV - Search + Share/Download	UV - Zoom and rotation	Mirador - Layout	Mirador - Annotation and Comparison	Mirador - Zoom and rotation	TOTAL
Participant TT1	Student	26	22	13	32	26	15	134
Participant TT2	Professor	25	33	13	24	29	24	148
Participant TT3	Developer	109	71	37	152	11	41	421
Participant TT4	Digital Project Manager	122	99	22	99	123	47	512
Participant TT5	Librarian	76	87	25	59	181	34	462
Participant TT6	Conservator	142	42	42	75	742	44	1087
Participant TT7	Digital Curator	48	51	46	62	51	30	288
Participant TT8	Librarian	55	46	39	202	101	24	467
Participant TT9	Developer	56	74	43	80	193	35	481
Participant TT10	Researcher	23	33	27	24	43	36	186
Participant TT11	Assistant, Student	36	22	14	16	28	14	130
Participant TT12	Student	16	51	27	54	105	29	282
Participant TT13	Researcher	24	14	21	29	34	18	140
Participant TT14	Professor	45	61	28	76	109	22	341
Participant TT15	Digital Project Manager	30	44	27	24	67	30	222
Participant TT16	Digital Curator	44	47	17	34	62	33	237
Participant TT17	Researcher	25	18	19	11	21	32	126
Participant TT18	Software QA Engineer	129	80	25	64	83	69	450
Participant TT19	Student	31	25	13	35	31	19	154
Participant TT20	Researcher	79	73	11	55	28	25	271
Participant TT21	Researcher, Assistant	25	19	12	49	37	47	189
Participant TT22	Researcher	36	55	17	31	110	93	342
Participant TT23	Librarian, Researcher	72	65	45	117	193	66	558
Participant TT24	Student	22	19	18	22	40	33	154
Participant TT25	Developer, Researcher	58	69	50	60	192	33	462
Participant TT26	Researcher, Metadata Specialist	51	54	18	63	50	46	282
Participant TT27	Digital Curator	211	211	93	187	382	79	1163
Participant TT28	Librarian	44	1538	40	68	91	45	1826
Participant TT29	Librarian	59	43	22	38	107	38	307
Participant TT30	Researcher, Professor	65	37	53	76	141	30	402
Participant TT31	Researcher	55	75	10	86	40	9	275
Participant TT32	Assistant	67	24	18	52	28	22	211
Participant TT33	Developer, Professor	1401	100	35	102	214	41	1893
Participant TT34	Researcher, Assistant, Student	22	15	16	23	46	19	141
Participant TT35	Researcher, Professor	23	25	19	25	46	34	172
Participant TT36	Developer	130	128	61	73	107	37	536
Participant TT37	Researcher, Professor	42	26	17	27	38	196	346
Participant TT38	Student	21	51	15	22	39	16	164
Participant TT39	Student	85	31	30	36	56	48	286
Participant TT40	Librarian, Researcher	43	24	12	20	40	19	158
Participant TT41	Researcher	27	33	28	32	42	20	182
Participant TT42	Student	43	58	22	24	88	21	256
Participant TT43	Student	27	19	10	99	58	16	229
Participant TT44	Researcher	57	46	19	59	48	21	250
Participant TT45	Student	46	66	21	55	60	45	293
OVERALL AVERAGE		**86.07**	**84.98**	**26.89**	**58.96**	**96.91**	**37.67**	**391.47**
OVERALL MEDIAN		**45.00**	**46.00**	**22.00**	**54.00**	**56.00**	**33.00**	**282.00**
SUCCESS AVERAGE		*86.07*	*84.98*	*26.89*	*58.96*	*67.25*	*35.72*	
SUCCESS MEDIAN		*45.00*	*46.00*	*22.00*	*54.00*	*46.00*	*32.00*	

Table 23: Target test's participants' confidence

First of all, how confident are you with the following statements						
	Very confident	Confident	Neither confident or unconfident	Not very confident	Not at all confident	Response Count
Using a computer	35	10	0	0	0	45
Finding metadata	27	17	1	0	0	45
Using image viewers	24	18	3	0	0	45
Manipulating digital images o texts	25	16	4	0	0	45
Annotating images or texts	23	18	4	0	0	45
Comparing images or texts	26	16	3	0	0	45

[91] If a participant abandoned a task, it is highlighted in red.

Table 24: Target test's participant skills

Max: 4 / Min: -4	Computer experience	System expertise	Domain understanding
Participant TT1	3	3	4
Participant TT2	4	1	3
Participant TT3	3	3	0
Participant TT4	4	4	4
Participant TT5	2	1	1
Participant TT6	3	4	4
Participant TT7	4	3	2
Participant TT8	4	2	2
Participant TT9	3	3	2
Participant TT10	4	3	4
Participant TT11	4	4	4
Participant TT12	4	4	4
Participant TT13	4	4	4
Participant TT14	3	2	2
Participant TT15	3	2	2
Participant TT16	4	4	4
Participant TT17	3	2	2
Participant TT18	3	3	2
Participant TT19	4	4	4
Participant TT20	4	4	4
Participant TT21	3	3	4
Participant TT22	4	4	4
Participant TT23	4	3	4
Participant TT24	4	4	4
Participant TT25	4	4	3
Participant TT26	4	3	2
Participant TT27	2	0	0
Participant TT28	4	4	3
Participant TT29	4	4	4
Participant TT30	4	4	4
Participant TT31	3	2	0
Participant TT32	4	4	4
Participant TT33	4	2	2
Participant TT34	2	2	4
Participant TT35	2	3	4
Participant TT36	1	0	2
Participant TT37	3	4	4
Participant TT38	2	2	2
Participant TT39	2	2	2
Participant TT40	2	2	2
Participant TT41	4	4	4
Participant TT42	4	4	4
Participant TT43	4	3	3
Participant TT44	3	2	2
Participant TT45	2	1	3
Average	3.31	2.89	2.93
Median	4	3	3

Table 25: Target test's overall results

TARGET TEST									
45 Participants	**20th April - 8th May 2017**			**Success 96.5%**			**Abandon 3.5%**		
Task	**Success**	**Abandon**	**Average time (seconds)**	**Average success time (seconds)**	**Median time (seconds)**	**Minimum (seconds)**	**Maximum (seconds)**	**Overall Relative Efficiency**	**Satisfaction (out of 5)**
3. UV (Layout)	100.0%	0.0%	86.07	86.07	45.00	16	1401	100.0%	-
4. UV (Search + Share/Download)	100.0%	0.0%	84.98	84.98	46.00	14	1538	100.0%	-
9. UV (zoom and rotation)	100.0%	0.0%	26.89	26.89	22.00	10	93	100.0%	-
The Universal Viewer	**100.0%**	**0.0%**	**-**	**-**	**-**	**-**	**-**	**100.0%**	**4.26**
6. Mirador (Layout)	100.0%	0.0%	58.96	58.96	54.00	11	202	100.0%	-
7. Mirador (Annotation + Comparison)	80.0%	20.0%	96.91	67.25	56.00	11	742	55.5%	-
11. Mirador (zoom and rotation)	95.6%	4.4%	37.67	35.72	33.00	9	196	90.6%	-
Mirador	**91.9%**	**8.1%**	**-**	**-**	**-**	**-**	**-**	**82.0%**	**3.81**

Table 26: Target test's UV Satisfaction

Please describe how you agree with the following aspects after completing the tasks in the Universal Viewer.							
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Response Count	Score (out of 5)
The Universal Viewer works the way I want it to work.	2	1	1	16	25	45	**4.36**
The Universal Viewer is pleasant to use.	2	0	1	28	14	45	**4.16**
The Universal Viewer is fun to use.	2	0	8	22	13	45	**3.98**
							4.26

Table 27: Target test's UV SUS

Please indicate how you feel with the following statements about the Universal Viewer.								
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Response Count	Mean SUS per item	SUS Score
I think that I would like to use the Universal Viewer frequently	0	0	1	26	18	45	3.38	8.44
I found the Universal Viewer unnecessarily complex	24	18	1	2	0	45	3.42	8.56
I thought the Universal Viewer was easy to use	0	0	3	20	22	45	3.42	8.56
I think that I would need the support of a technical person to be able to use the Universal Viewer	34	9	2	0	0	45	3.71	9.28
I found the various functions were well integrated into the Universal Viewer	0	0	2	25	18	45	3.36	8.39
I thought there was too much inconsistency	24	17	4	0	0	45	3.44	8.61
I would imagine that most people would learn to use the Universal Viewer very quickly	0	0	2	25	18	45	3.36	8.39
I found the Universal Viewer very cumbersome to use	24	18	1	2	0	45	3.42	8.56
I felt very confident using the Universal Viewer	0	1	1	20	23	45	3.44	8.61
I needed to learn a lot of things before I could get going with the Universal Viewer	30	12	2	1	0	45	3.58	8.94
								86.33

Table 28: Target test's Mirador Satisfaction

Please describe how you agree with the following aspects after completing the tasks with Mirador.							
	Strongly disagree	Disagree	Neither agree or	Agree	Strongly agree	Response Count	Score
Mirador works the way I want it to work.	2	0	8	25	10	45	**3.91**
Mirador is pleasant to use.	2	2	9	25	7	45	**3.73**
Mirador is fun to use.	2	3	8	21	11	45	**3.80**
							3.81

Table 29: Target test's Mirador SUS

Please indicate how you feel with the following statements about Mirador.								
	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Response Count	Mean SUS per item	SUS Score
I think that I would like to use Mirador frequently	0	2	8	19	16	45	3.09	7.72
I found Mirador unnecessarily complex	20	12	7	6	0	45	3.02	7.56
I thought Mirador was easy to use	0	3	11	17	14	45	2.93	7.33
I think that I would need the support of a technical person to be able to use Mirador	19	21	4	1	0	45	3.29	8.22
I found the various functions were well integrated into Mirador	0	6	9	18	12	45	2.80	7.00
I thought there was too much inconsistency	10	21	13	1	0	45	2.89	7.22
I would imagine that most people would learn to use Mirador very	0	5	8	27	5	45	2.71	6.78
I found Mirador very cumbersome to use	16	16	8	5	0	45	2.96	7.39
I felt very confident using Mirador	0	2	8	18	17	45	3.11	7.78
I needed to learn a lot of things before I could get going with Mirador	16	20	5	4	0	45	3.07	7.67
								74.67

Table 30: Target test's A/B

	The Universal Viewer	Mirador	Both are equally good	Neither	Response Count
To scroll through digital assets	11	11	23	0	45
The metadata presentation	20	5	19	1	45
The size and choice of icons	12	15	17	1	45
For manipulating images	3	32	7	3	45
The overall layout	18	8	19	0	45
The overall aesthetic	28	7	10	0	45
The most pleasing	15	7	22	1	45

Table 31: Target test's comments

	What should be done to the Universal Viewer to enable better comparison of texts from scholarly sources?	**What should be done to Mirador to enable better comparison of texts from scholarly sources?**	**Do you prefer to see the interface as a full-screen page or embedded in a webpage?**	**Do you have any further comments?**
Participant TT1	Being able to find similar digital artefacts	search within the digital document	both are good depending on the task	
Participant TT2	Icons are too small and the metadata presentation is difficult to see	ability to download and share pages	embedded because we can still make it a full-screen if needed	Both interfaces are very easy to use
Participant TT3	support slots like Mirador	add native support for persisting a configured view - make it downloadable for example and support reconstituting the view from a saved configuration	it really depends on the context - both viewers have full screen mode, but sometimes it's necessary to be seeing images within a broader non-IIIF context	Mirador in particular needs some more attention to metadata presentation, particularly at the canvas level - it would also benefit from UX refinements. Universal viewer is very good at what it does. Mirador tries to do a lot, e.g. annotation, slots, etc. and those are great tools, but they need some UX refinement so they're as polished and intuitive as those of the UV. Mirador has a lot of white space in the user interface as well - UV seems to make the best use of the space allocated to it,

Participant TT4	Group tools in the same area if possible.	Nothing, it works fine.	Full-screen	Improve Mirador text annotations to display the areas drawn on when the annotation text is highlighted
Participant TT5	I like the side-by-side ability of Mirador	Too many of Mirador's features are hidden, but once you find them (e.g., annotation), it's cool to use. However, the comparison function itself (adding a second image for viewing) didn't work - the second image never showed.	Full-screen page - I feel like I lost Universal Viewer functionality when embedded	Mirador seems more powerful, but Universal Viewer was much more intuitive to use.
Participant TT6	More viewing options and ability to annotate/manipulate images--choices similar to those offered by Mirador. Metadata could be presented in a cleaner fashion.	Better integration of tools. User interface is not intuitive or seamless, especially for annotations. There are a lot more options but the appearance and functions are clunky.	I prefer to have the option to expand to a full screen. The ability to zoom in makes either acceptable.	These look old and are not organized well. I think both systems should be able to do better, considering the technology we have now. I feel as if the actual audience/users of these tools are an afterthought.
Participant TT9		the icons in the top left corner need a more intuitive representation	full-screen page	
Participant TT11	comparison of different images like in Mirador	to be able to search words		
Participant TT13	More information panel is hard to see, but the Universal Viewer is overall very intuitive	Mirador should enable have a download or share option	full-screen even if I understand the needs to have them sometimes embedded.	
Participant TT14		The comments and annotations function should be completely revised. I couldn't figure it out. The icon I wanted to press to comment	Embedded	Great test!

		was the toggle icon. It made no sense.		
Participant TT22	Nothing, I felt it did everything it should.	I could not find how to rotate the image, so the buttons should be more prominent	Either, I think both have their uses	I preferred Universal, the contents page is more aesthetically pleasing and I find it easier to navigate the left column than images beneath the source
Participant TT25			Both possibilities would be nice, it depends on the circumstances; full-screen in general	
Participant TT26	Side by side comparison	Change the layout button, it's not entirely clear this is to add extra items. Not optimized for just adding one extra item.	Both would be fine.	-
Participant TT28	"portfolio" or "cart" of items for a search session		toggle between	
Participant TT30	comparison of different items	the icons are not very intuitive but Mirador is a great viewer when you start to discover them, also the ability to search OCR assets would be great		
Participant TT33	improve annotation tools	improve annotation tools	as a full-screen page	
Participant TT34		to search OCR texts	Full-screen to see and compare the images. embedded for context.	
Participant TT35	I would like the Universal Viewer	the "toggle image manipulations" icon is not very intuitive, I would	it depends	I had difficulty to select an image when I clicked on a thumbnail with

	to have some annotation tools.	choose a different one		Mirador, and when I could Mirador didn't give me the image I was looking for.
Participant TT36	It's hard to compare when annotation capability is not shown in UV. Is it not available there?	More intuitive layout/description of tools - again, more tools are shown for Mirador, so I get the impression that Mirador is more versatile yet more confusing to use	Full-screen. Or rather, fully occupying the window.	
Participant TT37	I thought I could use the pinpoint to scroll through the book and I couldn't understand the difference between download 'whole image' and 'current view'	it's difficult to find how to rotate an image. Also, I think the background should be darker.		
Participant TT39	Annotation options	I don't like the fact that the index is automatically open. Also, I think there should be some work around icons, they are difficult to see.		
Participant TT42	Every function is well integrated but I guess the Universal Viewer doesn't (yet) offer all the necessary tools for researchers.	the layout is not very pleasant to the eye		The two viewers can complete each other.
Participant TT45		I couldn't annotate two different sources at the same time, why is that?	When working on images: full-screen. When working on text: embedded.	The Universal Viewer is the most intuitive of the two viewers. Mirador seems on the other hand to be very powerful.

Appendix 9: Loop[11]'s Mirador heat maps

Figure 36: Loop[11]'s task 6 (pilot test's heat map)

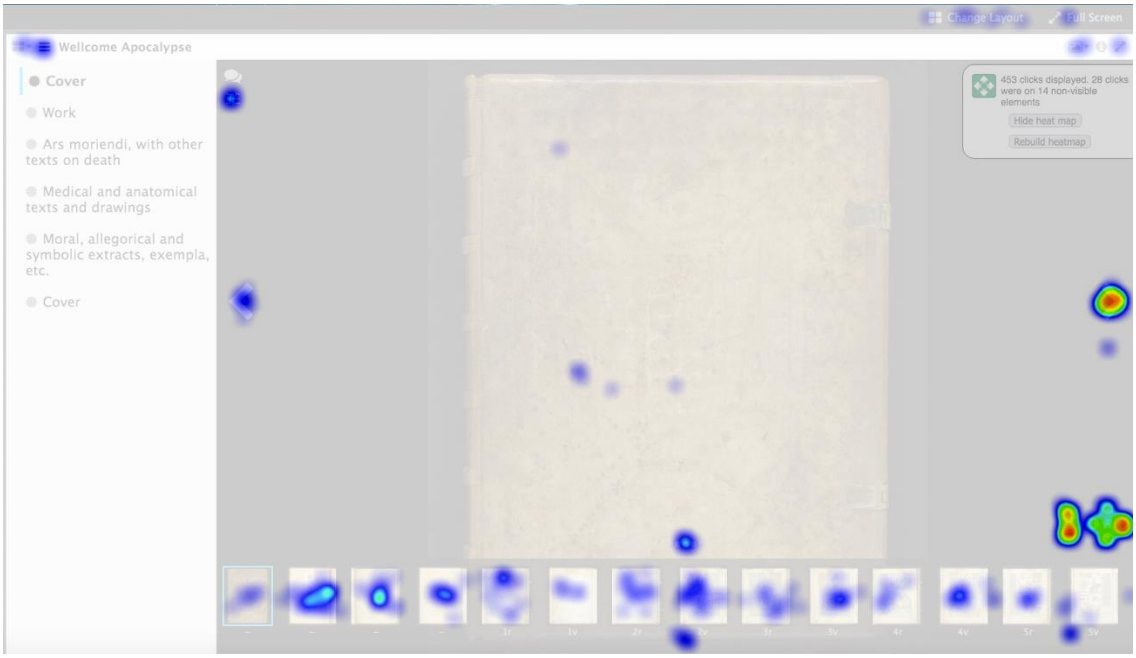


Figure 37: Loop[11]'s task 6 (target test's heat map)

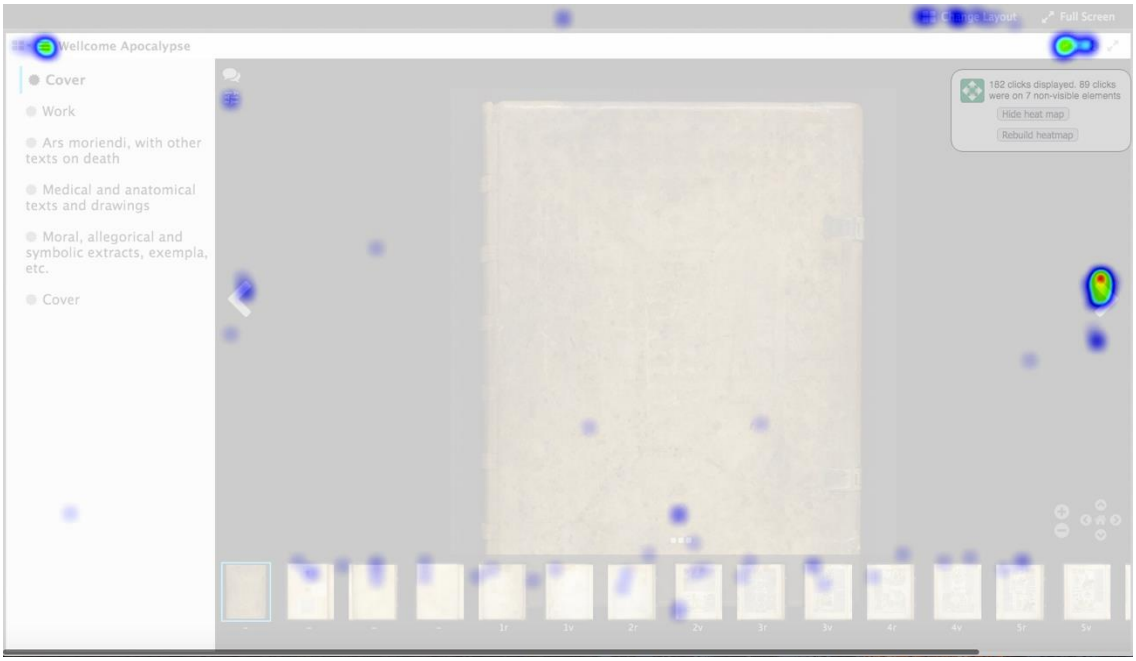


Figure 38: Loop[11]'s task 7 (pilot test's heat map)

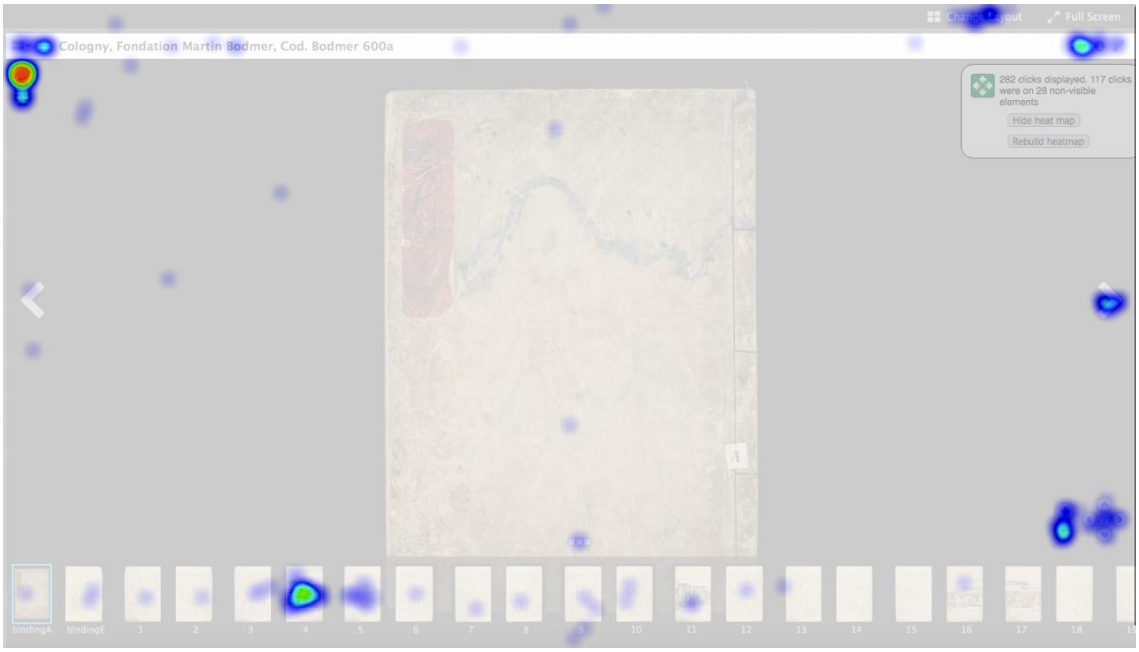


Figure 39: Loop[11]'s task 7 (target test's heat map)

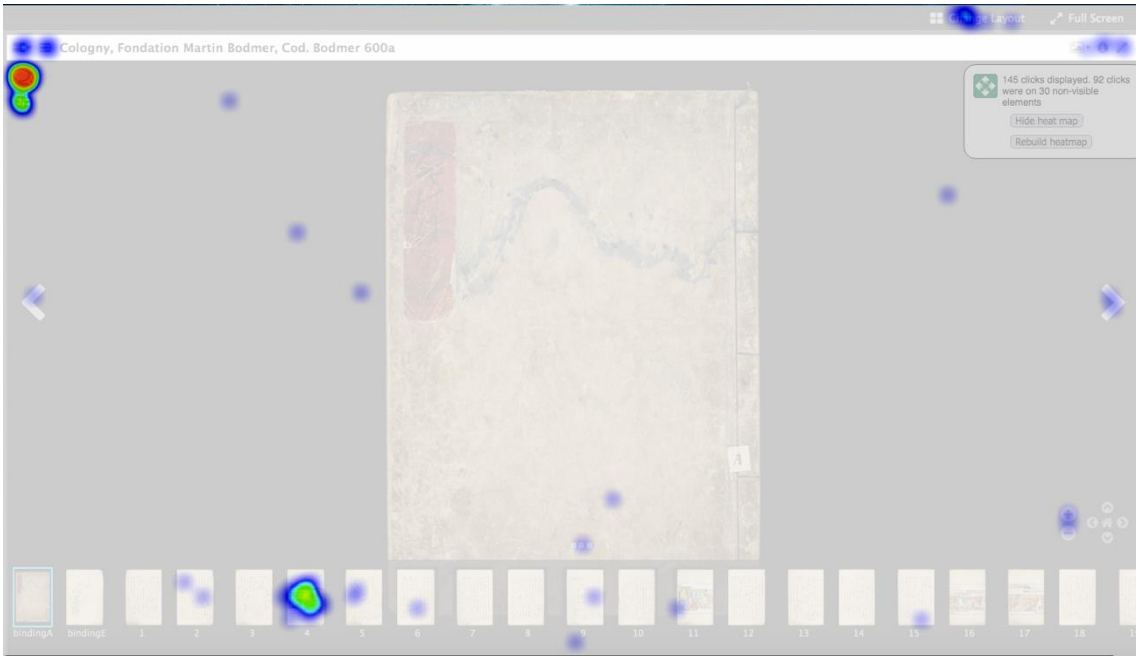


Figure 40: Loop[11]'s task 11 (pilot test's heat map)

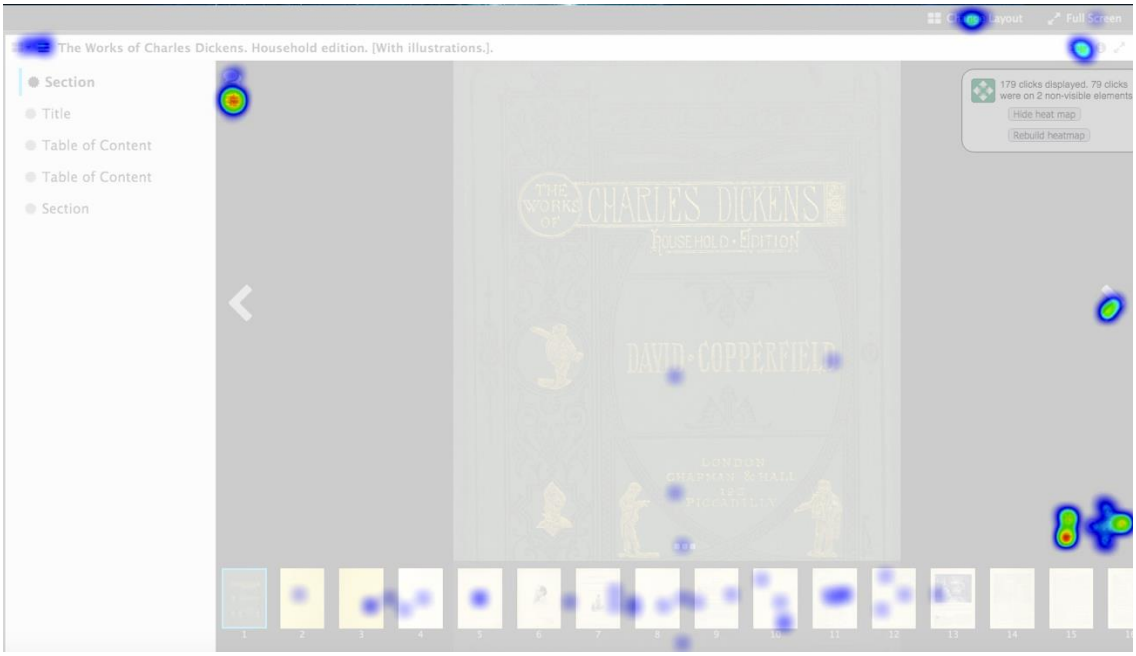
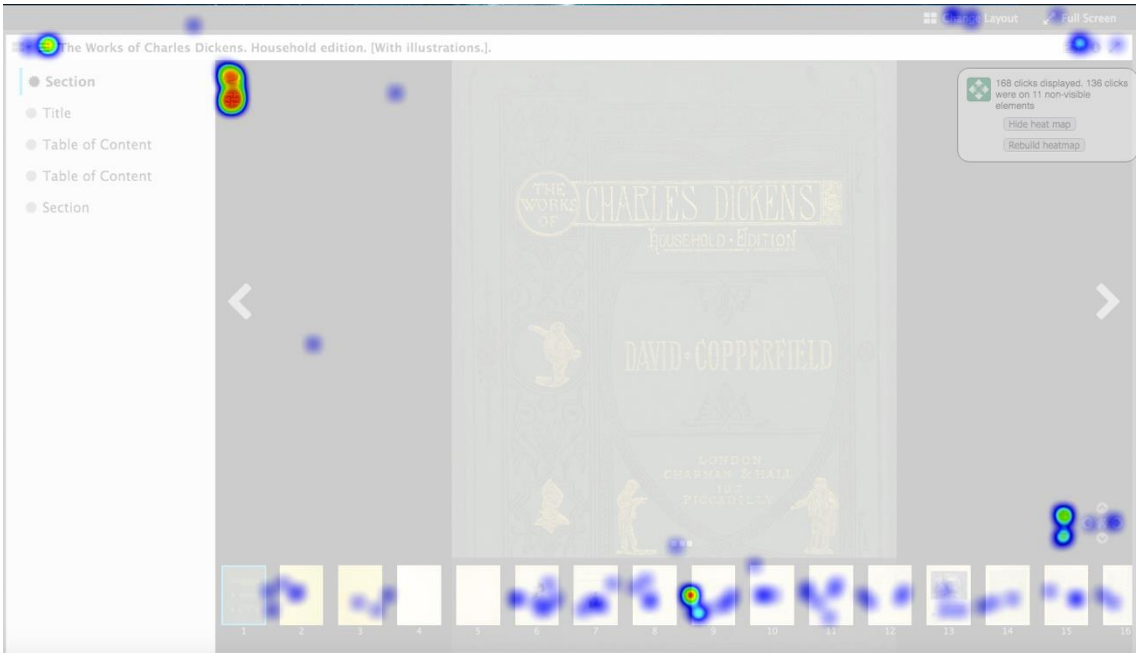


Figure 41: Loop[11]'s task 11 (target test's heat map)



Appendix 10: Morae's in-person test dashboards

Table 32: In-person test's participants' confidence

	Very confident	Confident	Neither confident or unconfident	Not very confident	Not at all confident	Response count
Using a computer	5	2	0	0	0	7
Finding metadata	4	1	2	0	0	7
Using image viewers	3	3	1	0	0	7
Manipulating digital images or texts	0	5	2	0	0	7
Annotating images or texts	2	3	2	0	0	7
Comparing images or texts	1	5	1	0	0	7

Table 33: In-person test's participant skills

Max: 4 / Min: -4	Computer experience	System expertise	Domain understanding
Participant M1	1	0	1
Participant M2	4	3	2
Participant M3	4	3	1
Participant M4	3	2	3
Participant M5	4	3	2
Participant M6	4	2	3
Participant M7	1	1	2
Average	3	2	2
Median	4	2	2

Table 34: In-person test's task completion

	Completed with ease	Completed with difficulty	Failed to complete
UV (zoom and rotation)	100.00%	0.00%	0.00%
UV (layout)	57.14%	42.86%	0.00%
UV (search)	100.00%	0.00%	0.00%
UV (share and download)	100.00%	0.00%	0.00%
UV (overall)	*89.29%*	*10.71%*	*0.00%*
Mirador (zoom and rotation)	28.57%	71.43%	14.29%
Mirador (layout)	42.86%	57.14%	0.00%
Mirador (annotation)	85.71%	0.00%	14.29%
Mirador (comparison)	14.29%	71.43%	14.29%
Mirador (overall)	*42.86%*	*50.00%*	*10.71%*

Table 35: In-person test's time on task

Time on task (Seconds)								
	UV (zoom and rotation)	UV (layout)	UV (search)	UV (share and download)	Mirador (zoom and rotation)	Mirador (layout)	Mirador (annotation)	Mirador (comparison)
Participant M1	75.4	109.32	43.04	15.57	48.92	53.22	50.83	143.28
Participant M2	114.27	104.55	129.16	89.39	91.43	272.6	225.05	269.36
Participant M3	100.32	101.34	38.98	12.91	106.25	111.41	111.86	75.95
Participant M4	27.62	71.49	54.77	37.93	77.52	129.14	46.66	103.33
Participant M5	103.05	183.63	31.22	79.91	77.37	165.19	69.08	164.06
Participant M6	87.68	296.9	30.12	32.84	79.6	119.05	266.23	95.54
Participant M7	40.71	196.12	77.44	44.05	147.54	198.71	189.41	133.6
Minimum	27.62	71.49	30.12	12.91	48.92	53.22	46.66	75.95
Maximum	114.27	296.9	129.16	89.39	147.54	272.6	266.23	269.36
Average	78.43	151.91	57.82	44.66	89.81	149.9	137.02	140.73
Standard Deviation	*32.83*	*78.6*	*35.43*	*29.67*	*30.79*	*70.57*	*89.47*	*64.27*

Table 36: In-person test's mouse clicks

Mouse Clicks (Count)								
	UV (zoom and rotation)	UV (layout)	UV (search)	UV (share and download)	Mirador (zoom and rotation)	Mirador (layout)	Mirador (annotation)	Mirador (comparison)
Participant M1	18	16	3	4	11	10	9	24
Participant M2	8	17	9	8	10	28	39	105
Participant M3	15	22	3	0	22	13	13	3
Participant M4	5	20	8	6	11	23	13	23
Participant M5	13	32	4	19	13	29	13	12
Participant M6	12	28	2	2	12	9	35	12
Participant M7	7	23	7	5	10	25	21	7
Minimum	5	16	2	0	10	9	9	3
Maximum	18	32	9	19	22	29	39	105
Average	11.14	22.57	5.14	6.29	12.71	19.57	20.43	26.57
Standard Deviation	*4.67*	*5.77*	*2.79*	*6.18*	*4.23*	*8.64*	*11.93*	*35.43*

Table 37: In-person test's UV Satisfaction

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree	Response count	Score (out of 5)
The Universal Viewer works the way I want it to work	3	2	2	0	0	7	4.14
The Universal Viewer is pleasant to use	3	4	0	0	0	7	4.43
The Universal Viewer is fun to use	3	1	3	0	0	7	4.00
							4.19

Table 38: In-person test's Mirador Satisfaction

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree	Response count	Score (out of 5)
Mirador works the way I want it to work	0	4	3	0	0	7	3.57
Mirador is pleasant to use	2	2	2	1	0	7	3.71
Mirador is fun to use	1	3	3	0	0	7	3.71
							3.67

Table 39: In-person test's A/B

	The Universal Viewer	Mirador	Both are equally good	Neither	Response count
To scroll through digital assets	2	1	4	0	7
The metadata presentation	3	1	3	0	7
The size and choice of icons	2	0	5	0	7
For manipulating images	3	1	3	0	7
The overall layout	4	1	2	0	7
The overall aesthetic	3	1	3	0	7
The most pleasing	4	1	2	0	7