DIGITALIZATION IN THE SERVICE OF PRESERVING THE CULTURAL HERITAGE OF THE METROPOLITAN LIBRARY OF ZAGREB'S ARCHBISHOPRIC, CROATIA

Emilia Domazet[1], Goran Vržina[2]

[1]Metropolitan Library of the Zagreb's Archbishopric – Croatian State Archive (CROATIA)
[2]Acos d.o.o. (CROATIA)

Abstract

Metropolitan Library of Zagreb's Archbishopric is a jewel among Croatian libraries with its valuables. The Library presents a treasure of the written word and is highly cherished in our cultural and national history. Development and prevalence of ICT in all segments of everyday life resulted in progress of social sciences and production of new knowledge platforms. The digitalization enables access, preservation and possibility of multiple uses of materials by libraries, archives and museums. In the Library there are many manuscripts (codices), incunabula, books printed from 16th to 20th century and occasional publications. Valvasor's graphic collection is a part of a corpus that provides insight into graphic production from late 15th until 17th century. Digitalization of the collection improves permanent protection and online availability of digital content. The aim of this paper is to introduce this valuable Metropolitan Library collection to the entire professional community by applying new technologies. This paper will highlight the cooperation between institutions and experts of different profiles, depending on the type of material that is situated in the Library itself. Its unique goal is the preservation of cultural heritage which represents national identity. Certain number of units has been digitized with the non-invasive Low Light digitization, which will also be presented in this paper. Using the non-invasive Low Light digitalization, the criterion how to carry out any digitalization has been elevated to higher standards, and it simplified the creation of quality documentation consistent with library, archival and especially museum informational standards. This system was created with an idea that it should uncompromisingly preserve historical original from any physical and chemical degradation. That makes the system extremely suitable for any type of digitalization, especially digitalization of originals before restoration. Using this system, it is possible to preserve important yet interesting "part" of the original before restoration.

Keywords: digitalization, *Low Light* digitalization, Valvasor's graphic collection, cultural heritage, manuscripts (codices), institutional collaboration

INTRODUCTION

The protection of written heritage is related to the cultural and social value of history and identity for future generations, so we must first protect it from the decline and loss of its primary function, namely the transfer of information and readability (Krtalić, Hasenay, & Aparac-Jelušić, 2011). Libraries are places of storage of a culture that cares for the preservation of written words (Gorman, 2007). Libraries are primarily implementing a digitization project to protect the originals. No, digitization in archives, libraries and museums is also conducted to replenish the fund, to create new services for users, for better availability of materials or digitization at the request of users (Faletar Tanacković, 2005/2006). Longevity, choice, quality, integrity and access are fundamental principles of protection in the digital world as well as in the analogue world, and the term "protection" means "responsible custody" which includes all policies and options, including conservation and restoration procedures (Conway, 1999). However, before starting the digitization of old material, it is necessary to determine the criteria for selection of material, techniques for digitization, method of use, financial resources,

method of processing digitized material for the purpose and goal of digitization (Katić, 2003). The key factors in the selection of material for digitization are the users and the uniqueness of the material.

COLLABORATION TOWARDS DIGITIZATION: VALVASOR'S GRAPHIC COLLECTION

For many years, the Metropolitan Library has been involved in international projects, and cooperation is an important key to digitalization. The Library has established an international cooperation between the Slovenian Academy of Sciences and Arts (SAZU), especially with its Janez Wajkard Valvasor Foundation from Ljubljana (Budin, 2006). The result of the collaboration were exhibitions, a catalog of Valvasor's library, editions of Valvasor's manuscripts and works, and the most valuable among them is a facsimile edition of Valvasor's graphic collection (Budin, 2006).

Valvasor's graphic collection and the related library has been in the holdings of the Metropolitan Library since 1690, when Janez Wajkard Valvasor (1641-1693), due to personal bankruptcy, sold it to Bishop Aleksandar Ignacij Mikulić through the mediation of his associate and friend Pavle Ritter Vitezović. Already in the 17th century, Valvasor had all his collected graphics and drawings bound, but unfortunately we come across data in the 18th century during the time of Bishop Maksimilijan Vrhovec, the fourth volume is missing (Magić, Pelc, & Abaffy, 2016).

Today, seventeen volumes are kept in the Metropolitan Library in a partially original form, and the collection itself has preserved its cultural-historical and artistic value of 17th-century material (Magić, Pelc, & Abaffy, 2016). This commendable project made it possible to acquaint the general public with Valvasor's cultural, historical, and scientific contribution. The cooperation enabled us not only catalog processing, identification of authors, unification of professional names and titles, but also protective recording, i.e. digitization, was performed on the entire collection. Digitization has allowed us to protect the original, thus reducing physical access to the collection itself, while leaving the original undamaged (Stančić, 2000). Cultural heritage is too important to exist only in its original form, so digitalization allows us the concept of a "library without walls" in which there are no space-time constraints.

DIGITIZATION OF AN OLD BOOK USING A UNIQUE SYSTEM FOR NON-INVASIVE *LOW LIGHT* DIGITIZATION

The approach and method of digitization of the 13th century book original (Figure 1) using the system for non-invasive Low Light digitization raised the level of criteria for the implementation of the digitization process and facilitated the creation of quality documentation in accordance with library, archival and especially museum information standards[5].

[5] In 2012, the digitization service ACOS from Zagreb, owned by Goran Vržina, who is also the creator of the unique *Low Light* system, began a quality cooperation with the Metropolitan Library, situated within the Croatian State Archives at Marulićev trg 21 in Zagreb, and that cooperation in various ways continues to this day. The owner of the library is Prvostolni Kaptol from Zagreb, Kaptol 27 in Zagreb. In 2013, the cooperation continued, and on that occasion, non-invasive digitization of MR72 I and II with extremely low light levels significantly below 50 lux was performed in accordance with the practice of heritage institutions and the rules of the profession.

Figure 1. *MR 72 consists of Parts I and II.*

TECHNICAL FEATURES AND ADVANTAGES OF THE LOW LIGHT SYSTEM

Low light system is designed and realized in Croatia, it is designed as a multifunctional device for non-invasive contactless digitization with a very low level of homogeneous indirect light. The system is technically designed as an open platform for future ideas and possibilities, it is able to accept new and advanced, but thoroughly tested technologies in optotronics and electronics without interfering with its basic structure, and thus able to significantly improve or change its technical properties. Thanks to this approach in system construction, upgrades, innovations, and new features, it is possible to implement and logically connect within just a few days. The time required to upgrade the system is among the shortest in the world when considering related techniques. The system is light and portable and is fully adapted to various requirements and types of digitization in the premises of the holders of historical material, *in situ*. The system was created with the idea that in its field of work it uncompromisingly "protects" the historical original from physical and chemical degradation, which makes it extremely suitable for any type of flat and relief digitization, and especially for the digitization of the original before restoration, which preserves an important and interesting part of the "story" of the original before restoration.

The pages of the original are not aligned and held using a glass plate, but the alignment of the pages is achieved by using special optics that in a completely natural way, like the eye, aligns the pages that are digitized. This creates a digital copy of the page with excellent readability and rich detail and texture of the material with authentic colors and appearance. In addition to reading, studying and reproducing, digital copying of this quality is also suitable for computer text recognition - OCR. With this method of digitization, subsequent computer processing of the pages is unnecessary, and the book is not damaged.

It should be emphasized here that the use of a glass plate during the digitization of historical book originals, in addition to known weaknesses, irreversibly loses details at the binding of pages but also the texture of page material, regardless of whether the book is digitized across both pages or only one page per shot. In the first case, larger parts of the pages that are in direct contact with the glass are sharply visible, and the details of the binding that are not in contact are increasingly disappearing in depth due to low light and loss of sharpness (Figure 2).

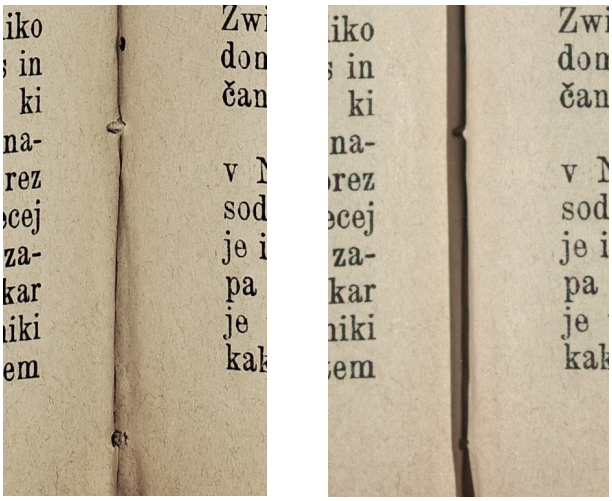

***Figure 2**. The same part of the book digitized left without glass and right with glass. There is an obvious difference in the amount of useful detail on the page link. On the left we see that, for its protection, the book is not opened 180 degrees, which is not the case on the right.*

In the second case, the entire page is sharply visible, but the edge of the glass closest to the binding, with its edge line, thickness, and refraction of light, prevents the visibility of details at the junction of the pages. This loses valuable information that can be useful to conservators and restorers. With a *Low light* system, it is possible to digitize a very wide range of original sizes (Vržina, 2017). The system can digitize codices, incunabula and many other old and valuable originals, as well as graphics, coins, charters, reliefs, paintings, etc. without geometric distortions with authentic three-dimensionality and texture of the material (Horić, & Vržina, 2018).

High-quality digital copies of the original can also be used as a source of information for restoration, virtual exhibitions, as a basis for making facsimiles, etc. (Horić, & Vržina, 2018). This way of digitization gives the restorers the opportunity to notice even the smallest details without the presence of the original. In this way, many very valuable copies of various historical materials and printed and written books have been digitized so far, as well as thousands of pages of very rare medieval originals from the 8th century onwards[6].

MR72: A DESCRIPTION OF THE COURSE OF DIGITIZATION OF ORIGINALS FROM THE 13TH CENTURY

On the MR72 codex (*Breviarium notatum St. Lustinae*), non-invasive digitization was performed by the described system with a homogeneous indirect diffused light of only 18 lux. The museum standard is 50 lux. The extremely low level of said light was used because the MR72 is in rather poor condition, which can be determined by a more detailed analysis of the first and second parts of the codex, which will be described in more detail later (Figure 3).

[6] A significant number of old and rare books and various originals from other institutions were digitized: for the State Archives of the City of Zagreb, among others, microfilms and Minutes of the City of Zagreb from 1912 to 1930 were digitized, for the Zagreb City Museum the Zagreb calendars from 1170 to 1809 were digitized, Croatian Museum of Medicine and Pharmacy - diplomas and charters with stamps, Institute of Ethnology and Folklore - the entire opus of drawings by Dr. Živko Kljaković and the digitization of slides, and others. 6900 pages of various and very valuable originals were digitized for the Metropolitan Library and the Kaptol Archives in Zagreb. In addition to the MR72 digitization process described here and the following: MR 89, MR 126, MR13, MR153, MR165, MR166, MR10, MR156, MR159, MR170, MR160, Inventory ZG Cathedral 13949, *Nos Stephanus Selischevich*, *Mappa Dioecesis Zagrabiensis*, *Baptismal register* 1714 - 1780, and finally, the digitization of 368 historically important pages from many originals of the Metropolitan Library, which were the basis for the creation of the monograph of the Metropolitan Library.

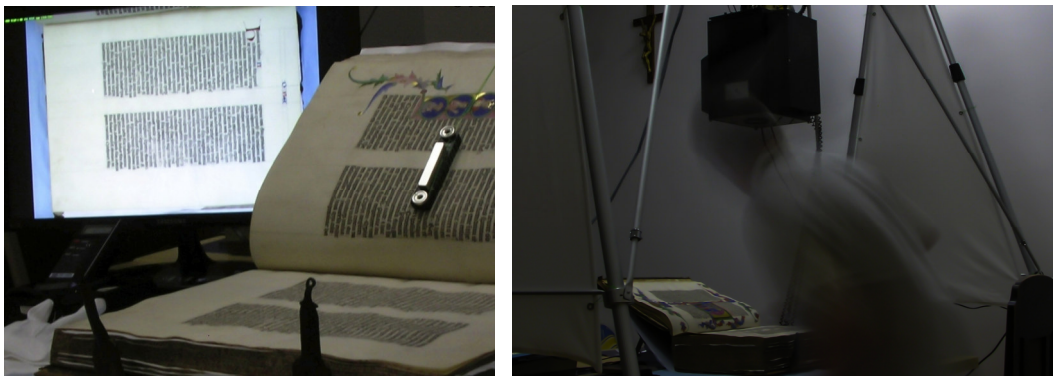

Figure 3. *Digitization of MR156 (Biblia Veteris Testamenti) under similar conditions as MR72.*

In order to better illustrate the course of digitization of the mentioned original and the problems occurring during that process, it is necessary to describe its physical characteristics from the perspective of the executor of the digitization process.

MR72 consists of two books, MR72 I and II. The cover is 22.6 cm wide and 33.5 cm high, the page width is 22 cm and the height is 33.3 cm. The total number of cover pages is: MR72 I -314, and MR72 II -386. The thickness of the book is about 4,5 cm. The cover and the back are covered with leather, which is more severely damaged in several places, and the upper final layer is mostly damaged. On the back of the books, the elements of the binding under the leather cover stand out. The books have two leather clasps each with iron attachments for closing, and in the MR72 II, the lower clasp lacks a metal extension.

Bookbinding sheets are made of paper and also the inner surface of the cover. Watermarks can be seen on the bookbinding sheets and the inner surface of the cover. The parchment sheets were subsequently marked with Arabic numerals in pencil. The covers and leaves at the beginning and end of the books are damaged by wormholes, and a significant number of leaves in both books have various damages, most of which are poorly repaired. The binding of the books was also damaged in several places. In Parts I and II of MR72, we find numerous miniatures (illuminations) with gold details, which adorn the initial letters of the sentences (Figure 4).

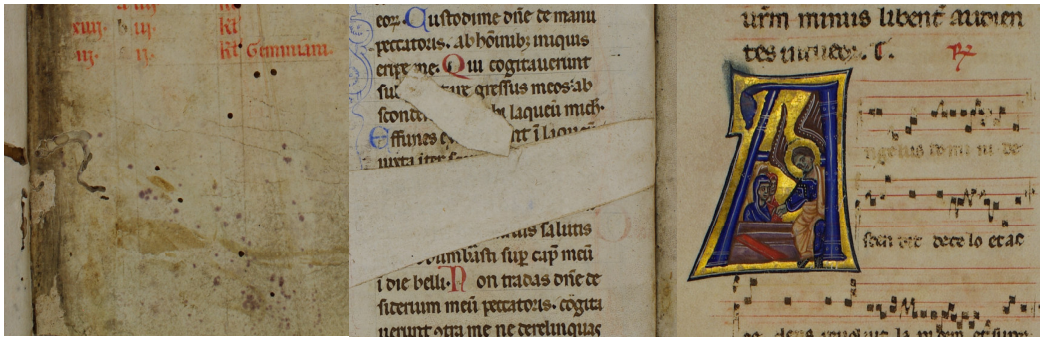

Figure 4. *Various damage MR72 and miniatures with gold details as initials.*

Only the pigment of black letters falls off the parchment. It should be noted that the majority of the text and notes are written in black pigment. A very light sliding touch on the surface of the page is enough to delete the text on most pages. In the places where the black pigment has fallen off, a pale shadow of these letters remains. Damage is also visible in a number of the previously mentioned illuminations. In some parts of the MR72, we can notice the transferal of the red pigment letters to the next page, such as MR72 I-0011V to MR72 I-0012R (Figure 5).

Figure 5. *Noticeable text damage, thumbnails and well-visible migration of red pigment to the adjacent page.*

Due to the fact that the original is extremely valuable, both scientifically and historically, it is completely unacceptable to carry out the digitization process with the slightest possibility of its damage. After considering the specifics of the book presented above, it was decided that its digitization must be done extremely non-invasively and without the complete opening of the books. Before the start of digitization, several more requirements were set that would enable not only good and authentic visibility of the pages, but also the recognition of the shadows of letters and musical notes without black pigment as much as possible.

All of the above required a very special and careful approach to the digitization of this original. It would be simple if the original in question did not contain color thumbnails with gold details, and even simpler if the authentic appearance of the pages did not have to be taken into account. It was decided that due to the fragility of the MR72, it would be digitized with an extremely low light level that was close to the lower limit of the system's capabilities at the time. To illustrate, at such a low light level, it is very difficult to read text that is not on a white surface. Regardless of the brightness level of only 18 lux, the digitized pages must be completely legible, the appearance of the page must be authentic, and the brightness seems to be all digitized with a high level of light. At such a low level of illumination, there is a high risk of electron migration between individual sensors on the camera sensor, resulting in digital noise appearing in the form of ugly artifacts across virtual pages (Figure 6).

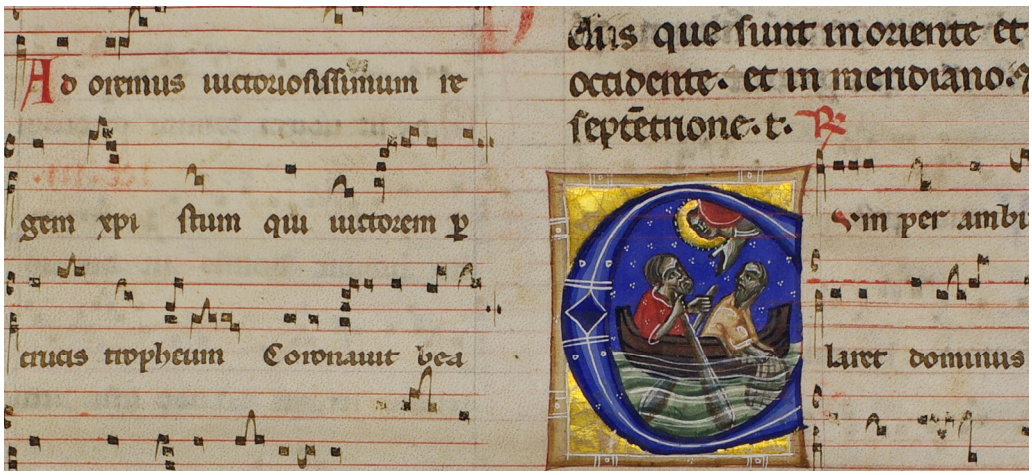

Figure 6. *Readability and illuminance is optimal without artifacts, and some of the mentioned damages are visible.*

For such an extreme approach to digitization, it was necessary to adjust the settings of optics,

electronics and lighting systems in a completely different, new way.

Digitization was performed *in situ* in a technically optimal room with completely darkened windows, large enough for the air moisture content and temperature to be stable. After mounting the system, the previously mentioned adjustments and calibrations were performed. TIFFEN and Lastolite Professional standards were used for color control. The original is placed on a special stand with which it is possible to precisely adjust the opening angle of the book, and which also has a special mechanism for supporting the back of the book. The original did not open more than 130 degrees during digitization.

The speed of digitization was dictated by the original. Regardless of the fact that the system could produce a recording every two seconds in these conditions and with the then state of the art, it took at least 10-15 seconds per page, and often more. The primary concern was the preservation of the original and the quality of the recordings.

The pages are indexed in such a way that the virtual book exactly matches the original from cover to cover. TIFF page files are derived in high quality AdobeRGB color space (gamut) and resolution, suitable for faithful reprint and viewing on professionally calibrated AdobeRGB monitors. Also derived are high-resolution JPEG files and minimum-resolution watermarked JPEG files for quick viewing and the Internet in the sRGB color space, suitable for viewing on regular monitors and mobile phones. Watermarks on the inside of the cover and bookbinders were also recorded due to this cooperation, with the important note that they were recorded without a backlight. When digitizing MR72, it was not known that they existed at all (Figure 7).

Figure 7. *MR72 II inside of back cover. To the left and right we can see two watermarks. Watermarks can be seen on the upper fragment, and on the lower fragment software manipulation improved its visibility.*

CONCLUSION

Digitization, as already mentioned, is used to protect or preserve old and rare materials. Instead of the originals themselves, the material can be used on a daily basis, leaving the original undamaged due to the reduced need for physical access. In addition, digital copies can be used as backups in case of loss or damage to the original. As an example, we will cite the robbery of the National and University Library in Zagreb, which took place in 1987, and the Metropolitan

Library was deposited at that site. More than 130 volumes of books, mostly from Valvasor's library, went missing in the robbery, and only a small number (9 of them) were found in an antique shop in Munich. After that, preventive security measures for old and rare bools material have been updated, in line with contemporary standards of valuable cultural heritage protection (Magić, Pelc, & Abaffy, 2016, p. 43).

Finally, the holder of historical material, who is also the client of digitization, must articulate his requirements correctly and with complete knowledge of the issue and the end result of digitization, which the executor of digitization must accurately and understandingly translate into adaptation of digitization techniques and implementation of digitization. In other words, a good knowledge of historical material and rules of the profession on the one hand, and precise knowledge of the possibilities and limitations of the technique used as well as compliance with standards present in the field on the other hand, can result in maximum quality results in digitizing cultural heritage.

We can conclude that the technique itself, no matter how innovative, high quality and advanced it is, is not enough to achieve the best digitization results without good and positive communication and mutual knowledge of work procedures and protocols of partners in the digitization process.

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