Digital Imaging as a Tool in Preservation

Franziska Frey

Abstract

Digital imaging is having a great impact on collections of photographic materials and documents in libraries and archives. The technical aspects of digital imaging present collection managers with very difficult and complex choices. Institutions must be able to relate the digital image projects to the fundamental collection activities, such as access and preservation. In addition, there is still a lack of standards concerning the technical as well as the quality issues. While the great benefits of digital imaging can be confidently foreseen, both a learning process and experience are needed to get from here to there.

Zusammenfassung

Die digitale Bildverarbeitung hat momentan einen großen Einfluß auf Bibliotheks- und Archivsammlungen, die photographische Materialien und Dokumente beinhalten. Die technischen Aspekte der digitalen Bildverarbeitung präsentieren Sammlungsmanager mit sehr schwierigen und komplexen Wahlmöglichkeiten. Institutionen müssen daher imstande sein, Digitalisierungsprojekte auf fundamentale Sammlungsaspekte wie Verfügbarmachnung und Bestandserhaltung zu beziehen. Außerdem gibt es zusätzlich noch das Problem, daß immer noch eine Mangel an Standards herrscht, was technische wie qualitative Aspekte betrifft. Obwohl die Vorteile von digitaler Bildverarbeitung mit Zutrauen vorhergesehen werden können, baucht es doch eines Lernprozesses und der Erfahrung, um von hier nach da zu gelangen.

Introduction

The question of the role of digital-image conversion in the preservation of photo collections and other artifacts goes considerably beyond the obvious issue of reducing the handling of originals. It involves a number of complex questions and assumptions about the collections materials, their values and purpose in the institution and in broader culture, and whether or not digital information can be considered to be "permanent" at all. Most digital image database projects are justified mainly on the basis of improved access, and so it is easy to avoid confronting preservation-related issues. After all, it is reasoned, replacement-quality images are too expensive, technology will change, and digital images are not permanent, so we might just as well go forward and obtain the benefits of better access and not be too concerned about preservation at this stage.

In fact, there are several reasons why preservation is very much an issue for all digital-image database projects. The first being that institutions have finite resources. Any expense on the scale of a large digital image database project will claim a sizeable share of limited budgets, money that could be spent on other things, including "conventional" preservation in the form of improved enclosures, storage conditions, photographic duplication, preventive conservation, etc. The choice should not be presented in these either/or terms. Some institutions already have the policy that every digital project has to include money to improve housing and storage of the original photographs.

The second reason why digital image database projects have an impact on preservation is that some collection managers already want to use digital files as "preservation masters," i.e., as replacement images, dispensing with the original photographs altogether. As technology improves and costs for high-quality imaging decrease, more and more collection managers will raise the question of what is the best form in which to retain images. However, even the best digital copy is no substitute for the original.

Use of digital imaging

One of the big issues that institutions have to consider prior to implementing a project is the anticipated users and use of their digital image collections. Will the images be made accessible on a stand-alone workstation or via the World Wide Web? Will they be used for printing reproductions? What size will the prints be? Are there restrictions on access that must be honored? These are only a few questions that have to be answered before a digitization project starts.

The use of the new imaging technologies requires experience and interdisciplinary knowledge, which probably only a few museum professionals and collection managers are likely to have. Without this know-how, it is diffucult for curators and archivists to estimate the possibilities and risks which the new technologies impose on their work. It is therefore imperative, that these new technologies be part of curricula for professionals dealing with photographic collections.

Digital master

As the digitization of large image collections is not likely to be attempted more than once a generation, due to cost, educated decisions about the scanning and archiving processes

are imperative. The term "archival" implies that all digitized images are not only optimized for current work flows and imaging devices, but will continue to be usable on future, as yet unknown, delivery and output systems.[1]

There is a consensus within the preservation community that a number of image files must be created from every photograph to meet a range of uses. First, an "archival" or master image should be created. From this archive file, various access archival files can be produced as needed to meet specific uses.

Decisions have to be made about spatial resolution, tone, and colour reproduction before the images are digitized. All original artwork cannot be treated equally. Different digitizing approaches have to be established according to the type, condition, and perceived value of the original.[2] [3] [4]

Once a photograph is digitized, the original can be kept at optimal storage conditions, because optimally all further access to the image can be handled by accessing the digital file. How could preventive preservation be applied better? There are, however, additional reasons for digitizing photographic collections.

Digital reconstruction of photographs

It is possible to reconstruct the visual contents of partially destroyed photographs using digital data processing. In cases where chemical treatment is impossible or very problematic, these techniques give new opportunities to photographic archives. Moreover, it offers the obvious advantage that a digital reconstruction can never modify or destroy the original photograph.[5]

Restoration of faded materials by chemical processes, is possible for black-and-white photography, but it is not possible for colour photography because dye fading is an irreversible process. Methods to restore images through photographic copying have been developed, but these methods are slow, need skilled operators, and work only if fading has not proceeded too far. Digital techniques now make it possible to reconstruct the colours of faded photographs in a fast and easy way.[6]

Until now, only a few projects have dealt with the digital restoration of photographs. Note that digital restoration is not a restoration in the classical sense, where the image is usually restored and conserved on its original support. Therefore, the term "reconstruction" should be used instead of "restoration." To carry out a reconstruction, the photographic processes have to be well known. Digital reconstruction is a very new topic, and there are still a lot of problems to be solved, both technical and philosophical.

Simulation of the fading of colour photgraphic materials

Digital imaging also offers the possibility of visualizing deterioration processes that we usually cannot see because they proceed so slowly. The simulation of the fading of coloured photographic materials will be described as an example.

Of all photographic materials, coloured photographic materials show most rapid degradation. It is absolutely essential that the caretakers of these images are well educated about the ageing of their colour photograph collections. Correct storage is expensive.

Until recently, there was no data available from manufacturers about the permanence of their material. Today, it is possible to obtain data sheets containing information on the durability of certain products. However, unless the reader has specific knowledge on photographic processes, these data are meaningless. To interpret the provided graphs, one must be familiar with photographic definitions such as density, sensitometry, and tone reproduction. Furthermore, the general method of predicting dark-keeping changes with the Arrhenius model should be known. In addition, the question of durability (for example, how long it takes until 20% of the cyan dye of a colour material is faded) is of secondary importance for the curator. What really counts to curators is to be able to visualize how images will look in several years if not stored under appropriate conditions.

Using electronic imaging technologies, it is now possible to simulate the fading of colour material. To carry out a simulation, the photographic fading processes have to be well known and have to be described by a mathematical model.

An important issue when dealing with colour is the visual judgment of color. The original and the faded image normally are not looked at side by side. If the curator ever had the opportunity to see the unfaded image, years may have passed before the image is viewed again. Therefore, colour judgment is usually vague and imprecise, unless the faded image can be compared to an unfaded original. Furthermore, the viewing conditions have to be considered. The eye is most sensitive to changes in a reflection print that is viewed in a well-lit room, because there are many reference points against which the image can be compared. Fading of transparencies or motion pictures is less noticeable because the eye accommodates to small colour contrast changes in a darkened room.

The lack of an unfaded original also means that observers get accustomed to the appearance of the faded image. After a certain time, the appearance of the faded image might be considered to be the original appearance. This point is very important, because fading is a slow process.

Digital imaging technology makes it possible not only to simulate the fading of the photographs but also to compare the original and the faded image side by side.

Digital long-term archiving

The long-term preservation of photographic images is always a very demanding task.[7] The principles of secure preservation for digital data is fundamentally different from those for traditional analogue data. Firstly, while in traditional preservation there is a more or less slow decay of image quality, the digital image data can either be read accurately or cannot be read at all. Secondly, every analogue duplication process results in a slight deterioration of the quality of the copy. The duplication of the digital image is possible without any loss at all.

In a traditional image archive the images should be stored under optimal climatic conditions and never be touched again.

As a consequence, access to the images is severly hindered while the decay is only slowed down. A digital archive has to follow a fundamentally different strategy. The safe keeping of digital data requires an active and regular maintenance of the data. The data have to be copied to new media before they become unreadable. Since information technology is evolving rapidly, the lifetime of both software and hardware formats is generally less than the lifetime of the recording media. However, since the digital data can be copied without loss, even if the media type and hardware are changing, the image is in a "frozen" state, and the decay has completely stopped.

The quality of the image is determined only by the quality of the original image at the time of digitization and the quality of the digitization process itself. Given the appropriate active care of the digital archive, there is no time limit to the preservation of digital images.

The fundamental difference between a traditional archive and a digital archive is that the traditional archiving approach is a passive one with images being touched as little as possible. However, this often only works in theory. If a document is known to be available, it is likely to be used. Therefore, in practice, we see an increased handling of the original documents as soon as they are available in digital form. The future will show whether a good enough digitization can reduce this behavior.

The digital archive needs an active approach in which the digital data (and the media it is recorded on) is monitored continually. This constant monitoring and copying can be achieved with a very high degree of automation through the use of databases, media robots, etc., and is quite cost-effective.

At first sight, the concept of storing visual information in a form that is not directly readable to the naked human eye seems unusual. However, judgment of the archival methods should depend on the risk and the quality of preservation. Given active care as described above, the risk in for a digital archive might not be higher than for a traditional archive, and the quality of preservation is better.

Information and storage medium

For the professionals in the field of photographic preservation, it is rather unusual to differentiate between visual information and the information carrier itself. In traditional photography, such a distinction is superfluous, because visual information cannot be separated from its support. Therefore, the conservation of an image always implies the conservation of the carrier material. The situation is quite different with digital images as the medium can be replaced. After a digital image is copied from a floppy disk to a magnetic tape the floppy disk can be destroyed without losing any information, since an identical reproduction of the image data is available on the new support.

The distinction between information and support leads to new reflections with regard to the conservation of digital information. The interpretation of numeric data requires that the medium the data is recorded on is intact, that the reading machine is working, and that the format the data are recorded in is well known. If any of these prerequisites is not met, the data are lost.[8]

Quality and cost

In the long term, the cost of a digital archive is not dominated by the cost of digitization but by the cost of careful storage. The quality of a digital archive is not only based on the quality of the digitized images but also on the long-term security of the digital data.

One of the major obstacles to the long-term preservation of electronic media is the lack of standards. Existing "industry standards" tend to be distillations of vendor responses to the imperatives of a competitive marketplace. As such, preservation is seldom a priority. Preservation of electronic media is dependent upon the permanence of the media, the hardware, and the software. All three are essential for retrievability of information that is only machine-readable. Permanence of the magnetic tape or optical disk media is very dependent upon the material as manufactured. The promise of broadly accepted standards is that institutions charged with the preservation of cultural material can embrace new technology whilst managing the inevitability of equipment and file format obsolescence.

References

1. F. Frey, 'Digital Imaging for Photographic Collections: Foundations for Technical Standards', *RLG DigiNews*, 1 (3), December 1997, <www.rlg.org/preserv/diginews/diginews3.htm#com>.
2. F. Frey and S. Süsstrunk, 'Image Quality Requirements for the Digitization of Photographic Collections', *Very High Resolution and Quality Imaging*, SPIE Vol. 2663, pp. 2-7, 1996.
3. F. Frey and S. Süsstrunk, 'Color Issues to Consider in Pictorial Image Data Bases', *Proceedings IS&T's Fifth Color Imaging Conference*, Scottsdale, AZ, November 17-20, pp. 112-115, 1997.
4. M. Ester, *Digital Image Collections: Issues and Practice*, Commission on Preservation and Access, 1996.
5. J. Palm and M.S. Koch, 'Restoration without Treatment - Analogue Information Lost and Found - Digitally Retrieved', *Proceedings Conference on Research Techniques in Photographic Conservation*, Copenhagen, May 14-19, pp. 111-113, 1995.
6. R. Gschwind and F. Frey, 'Electronic Imaging, a Tool for the Reconstruction of Faded Color Photographs', *Journal of Imaging Science and Technology*, 38, no. 6, pp. 513-519, 1994.
7. R. Gschwind, L. Rosenthaler, F. Frey, and A. Günzl, 'Digital Long Term Archiving of Photographs and Movie Films', Internal Report, Scientific Photography Laboratory, Basel, Switzerland, 1998.
8. J. Rothenberg, 'Ensuring the Longevity of Digital Documents', *Scientific American*, 272, no. 1, pp. 42-47, 1995.

Biography

Franziska Frey is a research scientist at the Image Permanence Institute at the Rochester Institute of Technology. She holds a Ph.D. degree in Natural Sciences (Concentration: Imaging Science) from the Swiss Federal Institute of Technology in Zürich, Switzerland. She worked for several years on a research project dealing with the digital reconstruction of faded colour photographs. Most recently she has been working on an NEH-funded project called "Digital Imaging for Photographic Collections: Foundations for Technical Standards." She is also developing solutions for image production and quality control for digital image databases and is consultant for various museums and government agencies. She has taught, lectured, and published widely on various aspects of electronic imaging and its applications for photographic collections.

Contact address

Dr. Franziska Frey
Image Permanence Institute
Rochester Institute of Technology
70 Lomb Memorial Drive
Rochester, NY 14623
USA
Tel.: +1 716 475 2302
Fax.: +1 716 475 7230
E-mail: fsfpph@rit.edu