

The Digital Paul Klee – A Case Study

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Abstract

In a joint project of the University of Basel and the Zentrum Paul Klee, with SINAR acting as the technology partner, a selection of about 2000 paintings, drawings and other archival material as well as 2000 photographic reproductions (“Ektachromes”) have been digitized with the SINAR digital camera system. The goals to fulfill were

- the capturing of high quality pictures with faithful color reproduction
- the setting up of an efficient workflow
- the definition of metadata and the construction of an image database,
- including the long-term archiving of the digital images.

Introduction

Since the mid-1990s there had been plans to build and operate a separate museum dedicated to the artist Paul Klee in Berne (Switzerland); a museum that will open its doors in 2005 and that would serve the exclusive purpose of communicating Paul Klee’s pictorial work. One of the communication objectives of the medium term program is to make accessible to visitors the vast scientific knowledge base and the findings of future research activities on Paul Klee’s person and work with as few restrictions as possible. For this reason it is planned to digitize Paul Klee’s complete oeuvre.

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Due to the inestimable value of Paul Klee’s oeuvre the photographic part of the project had to be carried out in the Fine Arts Museum in Berne.

The decision to record by direct digitization was taken only after long discussions and several testing sessions. Color reproduction of paintings by means of large format photography has a long tradition and most people in the museum did not or did not want to believe that digital photography could reach the same quality. There were also considerable doubts concerning the stability of digital media. In the end, the main reason for going the digital way was the fact that the color reproduction was clearly superior, i.e. much closer to the original.

Digitization Workflow

The digitization workflow starts with the image capturing and ends with the delivery of color corrected images containing all relevant metadata ready to be inserted into the museum’s database. The whole digitization workflow was done with the goal to produce long-living, archival images, i.e. digital images that are in a quality and format well suited for long-term archiving. The delivered images comprise the high resolution archival copy and the processed (cropped) database copy in different resolutions.

The image capturing took place in the museum’s depot. Illumination was done using electronic flash with the 4-shot mode of the SINAR camera. In 4-shot mode, the whole CCD sensor (which uses a Bayer-pattern color-filter array) is shifted one pixel down and left, taking 4 “micro scanned” images. This technique yields clearly a better quality of the scanned images compared to images taken in one shot mode and subsequent interpolation of the Bayer-pattern image. Image parts with fine texture (linen canvas) or periodical structures show less color-artifacts due to the interpolation algorithm. A complete calibration was carried out for each image, i.e., a shading correction (to eliminate the non-homogenous lighting) and a color calibration based on the Gretag-MacBeth ColorCheckerSG reference chart. The camera-internal color management has not been used. The color management procedure has been carried out in order to exclude all visual editing on the digital images. The raw data images were transferred to the university’s back

office and the following “post-editing tasks” were carried out:

- conversion to uncompressed 16 bit TIFF images (to retain the full photometric information of the sensor),
- assignment of the appropriate color profile calculated from the corresponding reference information and conversion to a standard ICC color profile, i.e. the PhotoRGB resp. ROMM color profile. A large gamut profile has the advantage that no clipping for highly saturated colors (e.g. color-slides) takes place. As we used 16bit images we had no rounding errors with subtle colors.
- The metadata (title, inventory number, etc.) were written in the IPTC header.
- The digital images were finally stored – to keep redundancy - on two different disks (the internal RAID-system and an external FireWire-Disk) and on tape (LTO Ultrium).

In a further step the images were processed for the creation of working copies cutting away the border or eliminating the background by cropping and retouching. This last step had to be carried out manually, a very time consuming task. Finally, the metadata from the museum's database, a subset of the image description, has been inserted into the image file header (as an IPTC record).

Long-Term Archiving Aspects

The digitization and preparation of data for long-term archiving followed the guidelines „Digitization and Long Term Archival of Photographic Collections: Recommendations of the Swiss Federal Office for Civilic Protection” as presented at the IS&T’s 2004 Archiving Conference.¹ That means among other things:

- File format: uncompressed TIFF. This is an open standard, which allows to incorporate color information (ICC-profiles) and metadata in the file header (IPTC, XMP)
- Redundancy 1: Checksums were calculated for all digital data (cksum, md5sum). The checksums were stored together with the digital images. The use of checksums guarantees the integrity of the data
- Redundancy 2: Three copies of the data were produced, two on magnetic tape (LTO-Ultrium) written in the open standard „tar“-Format and one copy on an external large-capacity disk-drive. The magnetic tapes were immediately read back on a different tape-drive to test the integrity of the tape media. The data written on the external disk were compared to the data on the working storage system (internal RAID-system).
- The copies are kept at three distinct geographical locations.
- It is planned to periodically check the media (at least every 2 years), the first data migration is planned to take place in about 6 years.

- The plan to produce analog high resolution images on stable color micro film is currently under discussion.²

Experiences of the Digitizing Project

- The quality of the captured images can be proofed immediately.
- Compared to the classic film material (the “Ekta”) the color reproduction quality of the digital images is superior. The spectral sensitivity of the used SINAR camera however shows metameric effects which results in quite noticeable deviation of color reproduction^{3,4} One of the bright, strong red colorants used by the painter Paul Klee were reproduced as a dull orange!
- Compared to a high-quality analog film the resolution of a modern digital sensor is equivalent or better.
- A state of the art digital camera system allows a smooth workflow and a high productivity as well as a high degree of quality control in situ.
- The possibilities of digital imaging break the limits of the analog photography; e.g. difficult objects (i.e. difficult to lighten) like framed paintings can be scanned without shadows by capturing multiple shots with different illumination directions and digital post-processing.

Things to Take Care Of

Often the available workspace in a museum is not appropriate for the digitization of a large number of images, which finally results in a poorer image quality (suboptimal lighting conditions).

The workflow is over-directed by the museum’s infrastructure and organization. For security reasons a museum staff member is always on location. A digitization task has to be carried out at a specific location, e.g. the museum. The necessary equipment cannot be used simultaneously for a different project. Therefore, the workload must be kept high because of the high costs of a professional digital camera system. The back-office must be able to handle the large amount of data (about five times the actual image data) to keep efficiency high and the risk of a fatal data loss as low as possible.

In most projects a high degree of photographic knowledge as well as IT-knowledge is needed. In order to obtain a good color reproduction, a high degree of knowledge about color management and color science is indispensable. An efficient incorporation of metadata (e.g. as an IPTC Header) is still cumbersome and standards on how to include them into image files are still under development.

Conclusion

Digitizing a large amount of artwork within a museum needs a very good prearrangement. In order to keep the workflow smooth the preparation of the objects must be optimized. Technical or quality aspects of the actual

photographic part are fully equivalent to classic analog photography and specific knowledge is required. A professional digital camera system does not simplify or eliminate the photographic rules to capture a good image. However, the digitization process of a large collection like the one at the Zentrum Paul Klee leads to a high level of usability with all the facilities of digital preservation.

References

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Biographies

Rudolf Gschwind, studied Chemistry at the University of Basel, and got 1979 a Ph.D. in Physical Chemistry in the field of Photochemistry. During his studies he got involved in scientific photography. Since 1980 he is the Head of Department of the “Scientific Photography Lab” at the University of Basel, which changed now its name to “Imaging and Media Lab”. During 1985 he did a 1-year sabbatical industrial research at Ilford AG, Fribourg/Marly, Switzerland (Electronic Imaging) and between 1989 - 1999 he did additional research and teaching at the Swiss Federal Institute (Zürich), Photography Group at the Institute of Physical Chemistry. During this period he also developed new methods for the digital reconstruction of faded color photographs. The main research topics are Image Processing and Analysis, Color Photography, Color Imaging, preservation of audio-visual cultural heritage.

Michael Baumgartner studied history of art at the University of Bern from 1986 to 1992 and completed his studies with a thesis on the imaginary space in the work of the artist André Thomkins. In 1998 he completed his doctoral thesis on the early work of Dieter Roth. He has been working as a research associate for the Paul Klee Foundation since 1996 where he manages the research archive. In the course of his activities he has published numerous articles on Paul Klee's artistic production and as a curator has been responsible for exhibition projects. His research work primarily consists in authenticity checks and in Paul Klee's teaching activities at the Bauhaus. In January 2005 he became conservator of the collection at the Zentrum Paul Klee which will open on 21 June 2005.