



GUIDELINES FOR THE CREATION OF DIGITAL COLLECTIONS

Digitization Best Practices for Three-Dimensional Objects

This document sets forth guidelines for digitizing three-dimensional objects for CARLI Digital Collections. Topics covered in this document include image capture, image management, adding compound objects to CONTENTdm, and metadata. An appendix with links to examples of photographed artifact collections is also provided.

This guide was originally created by the CARLI Digital Collections Users' Group (DCUG) and is maintained and updated by the CARLI Created Content Committee (CCC).

For questions about this document, please contact CARLI at support@carli.illinois.edu

Introduction

For the purposes of this document, a three-dimensional (3-D) object is a human-made artifact, replica of an artifact, or naturally occurring entity that can be measured in terms of height, width, and depth. Examples include models, sculptures, toys, or any other object where the content is the physical form itself.

The digitization process for such content essentially “flattens” three-dimensional physical objects into two-dimensional digital representations; therefore, additional issues arise when considering how best to create, display, and describe the digital surrogate.

The sections below provide guidance on the processes of creating digital images from three-dimensional objects and making them accessible online via a digital object management system such as CONTENTdm.

Creating Images

For obvious reasons, images of objects and artifacts cannot be created using a scanner, and must be created via digital photography. Depending on the significance of the collection and resources on hand (staff time, expertise, etc.), some libraries may wish to hire a professional photographer to document a collection. However, with the right tools (as well as some practice and experimentation), high-quality images can be created in-house by libraries and archives.

Equipment needed

A camera is only one component of successful 3-D digitization project; also needed is an environment suitable for photographing objects, including lighting, background, and materials to properly position the objects for capture:

- Professional-quality digital SLR camera with 50mm lens and shutter release cable
- Tripod or copy stand
- Lighting
 - 2-3 mountable photo lights with stands and/or
 - Photo tent/cube for tabletop photography
- Black, neutral grey, or white background (paper or cloth can be used)
- Color and/or grayscale separation guide (preferably with scale in inches or cm)
- Cradles, paperweights, tape, tweezers, and other items as needed to position objects
- Image editing software (such as Adobe Photoshop)

Camera settings

Camera settings will vary depending on the setup being used and the object being photographed, but these settings can be used as a general starting point. Consult the camera manual to find out how to adjust these settings.

Setting	Recommendation	Comments
ISO	between 100-200	A lower ISO produces a smoother image with less digital “noise.”
Shutter Speed	1/25	This may require some experimentation depending on the setup being used. If the photos are too dark, a longer shutter speed may be needed. However, a longer shutter speed can cause blurring in the image, especially if a tripod is not being used.
Aperture	between f8-f11	A smaller aperture gives a better depth of field in the image (objects both near and far are in focus).
White Balance	Auto	If saving images in RAW format, the white balance can be adjusted later.
File settings	10 to 16 megapixels; 48-bit RGB	The initial images should be captured at the highest size/quality possible for the camera.
File Type	RAW (Alternate: TIFF)	RAW files save the image exactly the way the camera’s sensor “sees” it, and allows color and white balance to easily be adjusted later.



Photographing Objects

Photographic techniques will vary depending on the setup and the item being photographed, but some general guidelines are listed below. Consult the Appendix A at the end of this document for examples of photographed artifact collections.

Basic technique:

- Mount the camera on a tripod and use a shutter release cable when taking photographs to avoid blurring.
- Avoid shadows in the images by using multiple lighting sources in various positions around the object.
- Position the object on or in front of a neutral background.
- Position the object as straight and/or level as possible.
- Include the color or grayscale separation guide and scale in the image.
- Make sure the complete object is in the frame (except in the case of capturing specific details).
- Photograph the object from multiple angles (front, back, left, right, above, below, etc.) if there are details that cannot be viewed from a single angle.
- When shooting multiple angles, keep the object and the camera at the same distance/position.
- In general, avoid using the camera's digital "zoom" functionality as this will lead to lower quality images. Physical zoom functions that physically move the lens are also acceptable.
- Capture any specific areas of interest, such as trademarks, signatures, seals, hallmarks, etc.

Other Recommendations:

- For smaller objects, a macro lens may be required.
- For clothing, place the objects on a mannequin if possible. If a mannequin is not available, lay the objects flat and photograph from above.
- If the item has multiple components or moving parts, photograph the object(s) multiple times in various states.
- For reflective objects, take care to ensure that the photographer and/or camera are not visible on the reflective surface of the object.

Managing Digital Images

Because digitization of three-dimensional physical objects relies on two-dimensional digital representations, capture and management of the component images is conducted in much the same manner as for two-dimensional object digitization. Although no universal standards for quality image capture exist and technical standards are constantly evolving, member institutions participating in the CARLI Digital Collections should adhere to the best practices adopted by recognized leading institutions when the collections' purpose would benefit from those actions.

Information in this section is derived from the CARLI's *Guidelines for the Creation of Digital Collections: Best Practices for Images* document (http://www.carli.illinois.edu/sites/files/digital_collections/documentation/guidelines_for_images.pdf). Additional information on image digitization may be found there.

Digital Images

A digital image is a two-dimensional array of small square regions known as pixels. Images typically fall into one of three categories: monochrome (bitonal), grayscale, and color.

At least one copy of a digital master or archival image file should be created for each view of a object photographed or scanned. From that master file, derivative files should be created, including an access image, which is used for detailed on-screen viewing.

Master (archival) Image	Derivative (access) Image
<ul style="list-style-type: none"> • Represents as closely as possible the information contained in the original • Uncompressed, or lossless compression • Unedited • Serves as long term source for derivative files and print reproductions • Stored in the TIFF file format, though JPEG2000 is gaining acceptance as a master file format 	<ul style="list-style-type: none"> • Used in place of master image for general web access • Generally fits within viewing area of average monitor • Usually stored in JPEG or JPEG2000 file format

Taken from Western States Digital Standards Group, Digital Imaging Working Group, *Digital Imaging Best Practices*, available from <http://www.lyrasis.org/>, January 2003 and Technical



Guidelines for Digitizing Cultural Heritage Materials: Creation of Raster Image Master Files
http://www.digitizationguidelines.gov/guidelines/FADGI%20Federal%20%20Agencies%20Digital%20Guidelines%20Initiative-2016%20Final_rev1.pdf, September 2016

Processing Digital Photographs

Once the photographs have been taken, they will need to be imported into a computer and edited to create the master image. Some cameras come with their own software to import and process images, or image editing software such as Adobe Photoshop can be used.

When opening RAW files in an editor such as Adobe Photoshop, a dialog will appear allowing white balance, color, and black-and-white levels to be adjusted. If the camera settings during the initial photography were well-calibrated, then very little adjustment should be needed at this stage.

The color or grayscale separation guide can be used to help ensure proper color balance. By selecting a point on the separation guide and analyzing the RGB settings for that point, overall adjustments to the color or grayscale settings can be made so that that RGB values indicated match those in the separation guide. Lastly, convert the image color profile to Adobe RGB 1998 profile, 8 bits per channel (total 24 bits).

Crop the image so that the artifact is in the center and extraneous content is removed. Straighten or rotate the image as necessary.

Master Images

The master image file should be at least 300 dpi, and the long dimension of the image should measure between 4000-6000 pixels.

A digital master should be generated for each view of the 3-D object. The digital master image represents as accurately as possible the visual information in the original object. This image's primary function is to serve as a long-term archival record, as well as a source for derivative files and printed materials. Master files are most often saved to a designated server or other long-term storage device.

Master images should be saved at an appropriate level of quality to avoid re-handling of any original materials. Scanned master images should not be edited for any specific output or use, and should be saved as TIFF (.tif) files with lossless or no compression.

Creating digital master files:

- Guidelines for file size and resolution of digital master files will vary by collection



- Each library should develop specific scanning guidelines based on individual collection needs and requirements.
- Where possible, the creation of digital master files should follow the specifications outlined in the Guidelines for Digitizing Cultural Heritage Materials: Creation of Raster Image Master Files:
http://www.digitizationguidelines.gov/guidelines/FADGI%20Federal%20%20Agencies%20Digital%20Guidelines%20Initiative-2016%20Final_rev1.pdf, September 2016
- CARLI member libraries using CONTENTdm **should not** upload full resolution TIFF files to the CARLI server. Archival image file storage is the responsibility of each contributing institution and must be managed locally. Please note that the CONTENTdm Full Resolution Manager does not upload TIFFs to the server, so use of this CONTENTdm feature is acceptable.

Derivative Images

Derivative files are used for editing and enhancement, conversion to different formats, and presentation or transmission over networks. For each master image, two derivative files are created: an access image (for more detailed onscreen viewing) and a thumbnail image (for searching and browsing). In the case of collections using CONTENTdm, the software can be configured to automatically generate access and thumbnail images from the master file. Specifications for creating derivative files can be found in the Guidelines for Digitizing Cultural Heritage Materials: Creation of Raster Image Master Files
http://www.digitizationguidelines.gov/guidelines/FADGI%20Federal%20%20Agencies%20Digital%20Guidelines%20Initiative-2016%20Final_rev1.pdf, September 2016.

File Naming Conventions

Each image in a 3-D compound object should be assigned a unique identifier. Unique identifiers should follow a consistent naming format to ensure ongoing identification and retrieval of digital files. Guidelines for file names will vary by collection based on local needs and specifications. Each library should develop specific file naming conventions based on individual collection needs and local requirements.

Examples from the CARLI CONTENTdm collections include the following:

- ACWC0002
- bru004_03_nF
- Images/W-04.jpg
- Lor137_01.jpg

Creating 3-D Views in CONTENTdm

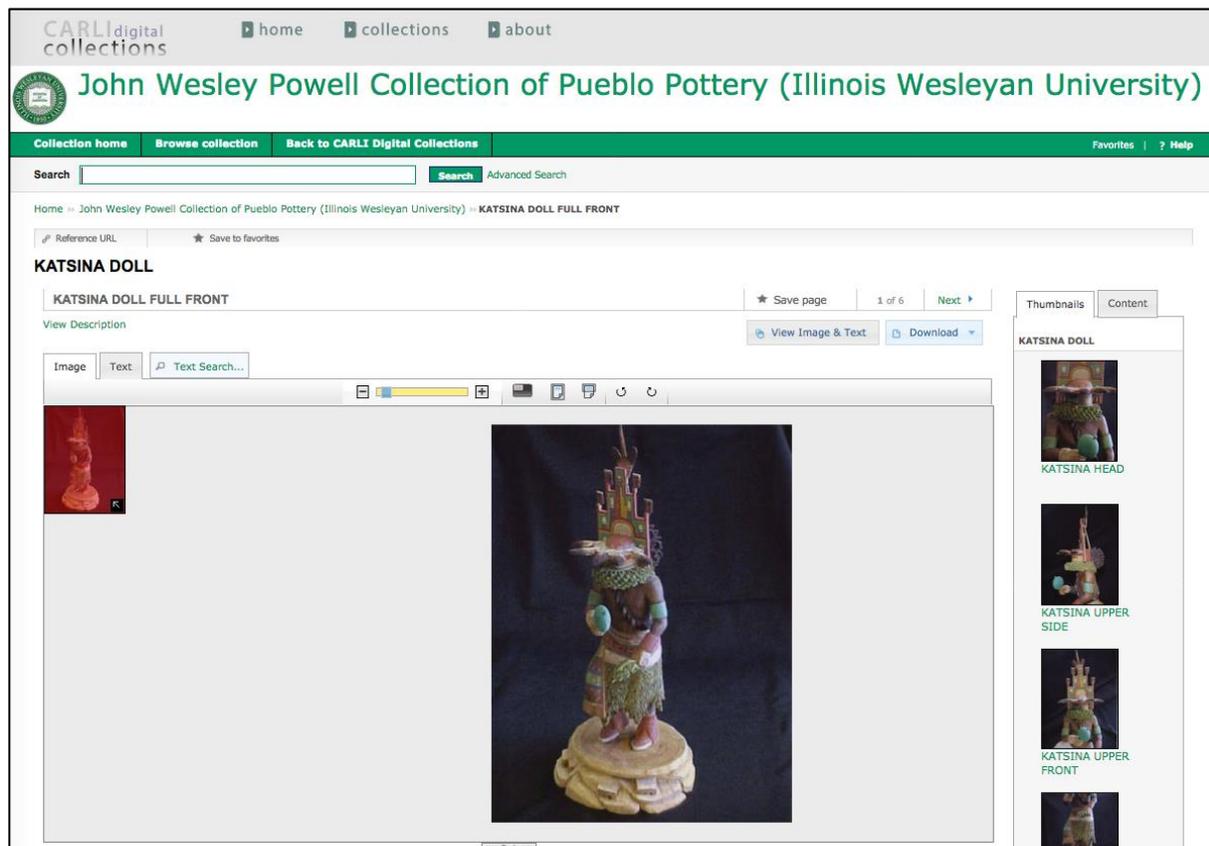
Compound Object

Libraries can create a unified way for users to view different parts of a three-dimensional object within CONTENTdm by using one of the software's "Compound Object" structures:

- documents (used in order to display an unlimited number of images),
- monographs (documents with hierarchy; unlimited number of hierarchical levels and images within them is possible),
- picture cubes (associates up to six images), and
- postcards (when only two images of the same object are needed).

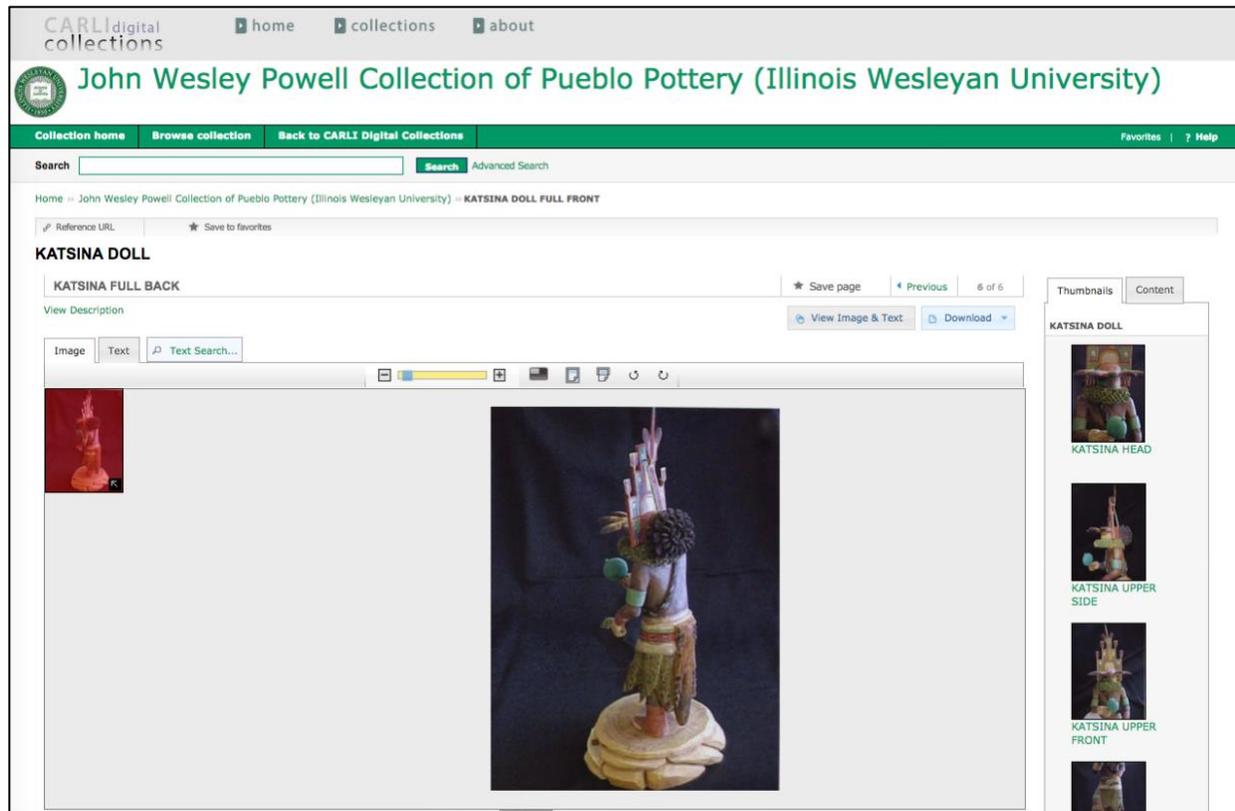
For complete directions on creating all kinds of Compound Objects, see:

http://www.oclc.org/support/services/contentdm/help/project-client-help/adding-items-objects/adding-compound-objects.en.html#par_text_e393.



An example of a picture cube in CONTENTdm v.6 showing a frontal view of an object

Note: navigation to different views is available in the right sidebar. Additionally, metadata for the object as a whole appears below each view as “Object Description.” Metadata for each individual image appears below the Object Description and is called only “Description.” That information will change depending on which image the user is viewing.



An example of a picture cube in CONTENTdm v.6 showing a back view of an object (Examples from: http://collections.carli.illinois.edu/cdm/ref/collection/iwu_enthno/id/512).

Other Options

To display three-dimensional objects, libraries may also create videos or other web presentations and then upload a link along with metadata as described in the “Add URL” instructions at http://www.oclc.org/support/services/contentdm/help/project-client-help/adding-items-objects/adding-a-url.en.html#par_text_5eb1.

Metadata for 3-D Objects

Many types of metadata (frequently defined as “data about data,” but basically referring to information about the digital object) exist: descriptive, administrative, technical, structural, preservation, etc. Metadata standards such as Dublin Core are intended to describe the digital surrogate, but institutions creating metadata often wish to include information about the original object as well.

With regard to 3-D objects, an additional consideration is whether the object is digitized as a single still image, a series of still images providing multiple views, or a moving image (e.g., QuickTime video).

If only a single view is provided, follow the guidelines for images

<http://www.carli.illinois.edu/sites/files/digital_collections/documentation/guidelines_for_image_s.pdf>

If creating a CONTENTdm compound object using multiple still images, two levels of metadata need to be addressed: “compound object-level metadata,” which describes the object as a whole, and “page-level metadata,” which describes a particular view of the object.

If presenting the object in a moving image format, consult the guidelines for moving images

<http://www.carli.illinois.edu/sites/files/digital_collections/documentation/guidelines_for_video.pdf>

Descriptive Metadata

CONTENTdm offers a “picture cube” option, permitting the inclusion of as many as six images of a single object. If the object is thought of in terms of a cube, then the six sides of the cube (top, bottom, front, back, left, right) might be represented in the six images. Not all objects are cubical in form with clearly defined sides, however, nor does the cube concept allow for additional detail images of the object.

In any case, information about the view of the object depicted in the image should be included in the metadata. The terms used to describe the view depend on the nature of the object but should be applied consistently throughout the collection. The most appropriate fields in which to indicate view are Title (example: [Name of object], [view]) or Description (examples: “Angle view looking northwest,” “View of east façade,” “Aerial view,” “Corner view,” “Interior view,” “Side view,” “Three-quarter view,” “Lower front view,” “Partial rear view,” “Upright view,” “View of box with lid open,” “Unfolded view,” “Full view,” “Detail view of ___”).

Technical Metadata

In the interest of preservation and reproduction, it is helpful to capture technical metadata in the creation of the digital image file. Digital cameras and scanners can automatically capture this information and embed it in the object file. NISO Standard Z39.87 (Data Dictionary – Technical Metadata for Digital Still Images) is widely accepted for use in the management of technical metadata. Among the attributes that can be described by the technical metadata are the following¹:

- file format
- file resolution (pixels per inch)
- dimensions (image dimension or size in inches or centimeters)
- bit-depth (e.g., 8-bit, 16-bit, 24-bit, etc.)
- color mode (e.g., RGB, CMYK, or grayscale)
- scanner or digital camera brand, name, and model number
- software used to manipulate or compress the image, including the software name and version.

Collection of technical metadata will vary according to equipment used and local policy.

Inclusion of technical metadata is not required for items in CARLI Digital Collections, but it can be included.

CARLI Metadata Documentation

- “Guidelines for the Creation of Digital Collections: Best Practices for Descriptive Metadata”:
https://www.carli.illinois.edu/sites/files/digital_collections/documentation/guidelines_for_metadata.pdf
- “Required Metadata Fields for Collections in CARLI Digital Collections”:
<https://www.carli.illinois.edu/products-services/contentdm/mdatafields>
- “Adding and Populating a Metadata Field in a Preexisting CONTENTdm Collection”:
<https://www.carli.illinois.edu/products-services/contentdm/secure/add-populate-field>

¹ From Best Practices for Technical Metadata, University of Illinois at Urbana-Champaign Library:
<http://guides.library.illinois.edu/c.php?g=365756&p=2471328>



CONTENTdm Metadata Documentation (Online Help – Version 6)

- “Entering Metadata”:
https://help.oclc.org/Metadata_Services/CONTENTdm/Project_Client/Enter_metadata
- “Metadata Field Types”:
https://help.oclc.org/Metadata_Services/CONTENTdm/CONTENTdm_Administration/Collection_administration/060Field_properties
- “About Mapping Fields”:
https://help.oclc.org/Metadata_Services/CONTENTdm/Project_Client/Add_items_and_objects/About_mapping_fields
- “Use Metadata Templates”:
https://help.oclc.org/Metadata_Services/CONTENTdm/Project_Client/Enter_metadata/Use_Metadata_Templates



Appendix A. Examples of 3-D Content in CONTENTdm Collections

Asian Art

Gettysburg College Special Collections

<http://www.gettysburg.edu/library/gettdigital/asianart/index.html>

Biological Specimens

Ball State University

<http://libx.bsu.edu/cdm4/collection.php?CISOROOT=/BioSpec>

Conner Prairie Historic Clothing Collection

Indiana University-Purdue University Indianapolis

<http://ulib.iupui.edu/digitalscholarship/collections/CPClothing>

Digital Dress Collection

Wayne State University Libraries

<https://digital.library.wayne.edu/item/wayne:collectionDigDressColl>

The Plastics Collection

Syracuse University Library Special Collections Research Center

<http://plastics.syr.edu/>

Roderic C. Knight Musical Instrument Collection

Oberlin College

<http://www.oberlin.edu/library/digital/knight/default.html>

Sculpture at the Villanova University Flavey Memorial Library

Villanova University

<https://digital.library.villanova.edu/Item/vudl:172391>

Wisconsin Decorative Arts Database

Wisconsin Historical Society

http://content.wisconsinhistory.org/cdm4/index_wda.php?CISOROOT=/wda

Appendix B: Further Reading

Avila, Regina L., Susan Sanders, and Keith Martin. "Tips and Tools for Digitizing a Museum Collection" ONLINE Magazine. Vol. 35 No. 6. Nov./Dec. 2011

<http://www.infoday.com/online/nov11/Avila-Sanders-Martin-Tips-and-Tools-for-Digitizing-a-Museum-Collection.shtml>

Canadian Heritage Information Network: Digitization Standards for the CMCC: Scan and Artifact Photography

<https://www.canada.ca/en/heritage-information-network/services/digitization/standards-canadian-museum-civilization.html>

U.S. National Archives and Records Administration (NARA): Technical Guidelines for Digitizing Archival Materials for Electronic Access: Creation of Production Master Files – Raster Images

<http://www.archives.gov/preservation/technical/guidelines.pdf>