How to Build a 3D Imaging Program

An Overview of Technology, Skills, and Labor

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Possible Influencers

- Collaborators
- Limitations of the Technology
- Application of the Technology / End Product
- Data Preservation Practices
- Resources (Funding)
Fluxus

fluxusdigitalcollection.org
Fluxus Collaborators

Grantor

Donor

Studio Classic

Designer

Developer

Project Manager

Special Collections

Digital Research & Publishing

3D Scanner

Digital Preservation

Repository

Scholar

Created by Mello from Noun Project

Created by Yo! Baba from Noun Project
Collaborators

- Principal Investigator (PI)
- Subject Specialist
- Specialist in 3D imaging
- Funders
- Repositories
- Administrators
- Audience**
Technology, Workflows, and Costs

There are four main types of 3D scanning

- Structured Light Scanners
- Photogrammetry
- Laser Scanners (Lidar)
- CT Scanning
Structured Light Scanners - Technology

- Most popular of all 3D Imaging Technologies
- Lowest quality of technologies for the moment
- Easiest entry point and very fast in production
- Uses structured light to build density
- Photogrammetry to build texture
- Portable and doesn’t require expensive lighting
- Supports all major file formats for output
Structured Light Scanners - Workflows

- Begin with calibration and registration of scanner
- Perform series of scans of the object in 360°
- Capture different angles and distances with a combination of auto and manual alignment
- Finalize model in proprietary software
- Export model into 3D output and save data
- Occasionally perform measurement checks
Structured Light Scanners - Costs

- Higher End
  - Artec Space Spider $25k
  - HDI Advance R3X $20k
  - Creaform Go!SCAN $17k

- Lower End
  - Scan in a Box $3k
  - EinScan-SP (Platinum) $2k
Photogrammetry - Technology

- DSLR Camera
- 24mm, 35mm, and 50mm lens
- LED lighting recommended
- Tripod and Monopod
- Computer with robust processing capabilities
- Adobe Photoshop and Agisoft Photoscan Pro
- Supports all major file formats for output
Photogrammetry - Workflows

- Photograph 360° in 12° increments for objects and spaces overlap images in a flat plane
- Process Raw files in Adobe Camera Raw
- Preserve Raws and Uncompressed Tiffs
- Process Tiffs in Agisoft Photoscan Pro
Photogrammetry - Workflows
Photogrammetry - Workflows
Photogrammetry - Costs

- 50mp DSLR----------------------------- $3500
- 35mm Lens----------------------------- $500
- Tripod and Monopod ------------------ $300
- LED Lights----------------------------- $2000
- 3D Targets and Color Charts --------- $500
- Agisoft Photoscan--------------------- $550
- Total---------------------------------- $7350
Photogrammetry - Advantages

- Highest possible quality for single image capture
- Highest possible quality for texture
- Highest possible accuracy for color management
- Scientific Accuracy with targets and color charts
- Can be used to capture in studio and environment
- As technology changes processing will advance
- DSLR is easily used for other types of capture
Photogrammetry - Training

Cultural Heritage Imaging

www.culturalheritageimaging.org

https://www.flickr.com/photos/culturalheritageimaging/25116583785
Laser Scanners or (Lidar) - Technology

- Light Detection and Ranging. (Laser/Radar)
- By far the most accurate technology
- Uses lasers and sensors for measurement
- Mostly used for geographic spaces and mapping
- Builds dense point cloud with lidar technology
- Builds image overlay with an internal camera
- Supports all major 3D file formats for output
Laser Scanners or (Lidar) - Workflows

- Set up scanner and configure settings first
- Define scan parameters and image options
- Begin scanning and wait for capture to complete
- Transfer data to computer and open scanned information in proprietary software for processing.
- Process data and output desired for 3D file format
- May also implement other software at this point
Laser Scanners or (Lidar) - Costs

- Higher End
  - Leica ScanStation P40 3D $125k

- Lower End
  - Leica BLK360 $16k
  - Leica 3D Disto $8k
CT Scanners - Technology

- Radiographic or X-Ray technology
- Obtains Interior and Exterior 3D information
- Mostly used for health care field and or paleontological specimen
- Best technology for micro or small specimen
- Non-destructive methods
- Supports all major file formats for output
CT Scanners - Workflows

- Mostly proprietary hardware and software
- Hard to find information about specific workflows since the technology is proprietary
- Only a small number of manufacturers
- Requires trained specialists and technicians
- You can also send specimen to companies for imaging rather than purchasing equipment
CT Scanners - Costs

- Prices only provided by request from companies
- All scanners require contracts for setup, maintenance, and upgrades
- Prices range from $100k to $1 million
- A few common models I was able to find:
  - The Nikon XT H 225 at [www.nikonmetrology.com](http://www.nikonmetrology.com)
  - The Skyscan 221 available at [www.bruker.com](http://www.bruker.com)
## Technology, Workflows, and Costs - Overview

<table>
<thead>
<tr>
<th>Method</th>
<th>Structured Light</th>
<th>Photogrammetry</th>
<th>Laser (Lidar)</th>
<th>CT Scanning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Handheld or mounted scanner and a robust computer with various 3D software.</td>
<td>DSLR camera, tripod, lighting, and a robust computer with Agisoft Photoscan, Photoshop, and various 3D software.</td>
<td>Lidar system, tripod, dedicated hardware, and a robust computer with various 3D software.</td>
<td>CT Scanning system in special designed space (not portable), dedicated hardware and software and various 3D software.</td>
</tr>
<tr>
<td>Labor</td>
<td>Basic Photo Skills recommended per scanner model.</td>
<td>Advanced photo skills recommended. Basic skills required.</td>
<td>Trained specialists and technicians required.</td>
<td>Trained specialists and technicians required.</td>
</tr>
<tr>
<td>Outputs</td>
<td>STL-OBJ-PLY-etc.</td>
<td>STL-OBJ-PLY-etc.</td>
<td>STL-OBJ-PLY-etc.</td>
<td>STL-OBJ-PLY-etc.</td>
</tr>
<tr>
<td>Cost</td>
<td>$10k - $25k</td>
<td>$5k - $10k</td>
<td>$17k - $125k</td>
<td>$100k - 1million</td>
</tr>
</tbody>
</table>
Dissemination of 3D Objects

Content Management System with 3D Viewer

- Morphosource
- SketchFab
- Institutional Repository with 3D PDF Viewer Only
- 3D HOP / Potree
- UMorph
SketchFab in ContentDM
IUPUI Model
**Title**: Benjamin Harrison small model statue

**Sketchfab ID**: [https://sketchfab.com/models/6921816042154ed9b8783ec00308d9c3](https://sketchfab.com/models/6921816042154ed9b8783ec00308d9c3)
Considerations

● Resolution/Reduction of polygon counts
● Copyright/Creative Commons
● Ethical Implications
● File Formats-Currently no established standards
  ○ What are the best formats for viewing, printing, AR/VR?
Preservation concerns

- Preserving scholarly record = main function of libraries
- Creation of digital 3D models ≈ preserve physical things
- Digitization ≠ preservation

Standards & best practices for digital 3D preservation are underdeveloped or non-existent
Goals of Digital Preservation

- Reproduce
- Reuse
- Protect from loss/obsolescence
Preservation - Issue 1 - methods vary

- Many ways to create a 3D model -
  - Free-form
  - Measurement
  - Algorithm
  - Observation
  - Approaches vary widely even within these methods
  - Combined methods
Preservation - Issue 2 - means of production

In most cases model creation is iterative & project oriented… take scanning:

○ Scan, stitch, scan, stitch, scan, combine, finalize
○ Process & post-process - fill holes, smooth
○ Software works like a black box
○ Models may appear accurate, but may not be
○ Was it all documented?
Preservation - Issue 3 - lack of guidance

● There are some best practices, but not enough
● There are no standards

Which means…

● We can do it, but don’t have consistent methods or means to document what we did so…

We can’t reuse, reproduce or protect what we did
Preservation - What guidance exists?

- The Guides to Good Practice - ADS/Digital Antiquity
- The London Charter
- 3D Icons report from the European Commission

And there are efforts forthcoming…

★ Community Standards for 3D Data Preservation (CS3DP)
Summary of Challenges

Lack of standards and best practices in production, representation, preservation

Reproducibility and replicability

Absence of non-proprietary systems for visualization, distribution, and use
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Thank you!