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MAKERSPACE

3D SCANNING GUIDE

Einscan SE Scanner

What is a 3D Scanner?

3D scanning captures the shape of a real-world object and turns it into a digital 3D model. It works by using light, lasers, or cameras to scan the object's surface and record its size, shape, and details. Our scanner model is an Einscan SE (rotating scanning platform).

Photo Credit: Shining 3D
https://www.shining3d.com/professional-solutions/desktop-3d-scanner/einscan-se-v2

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Machine Specifications

Our 3D Scanner

The Makerspace has a Einscan SE 3D scanner.

- Scanning Area: 11.2" square x 38" squared (rotating bed); larger for hand held scanning
- Scanning Speed: Single shot <1s, full scan ~30-60min. If you need additional scans to capture other angles of the object it will take more time.
- Accuracy: ≤ 0.1 mm
- Point Distance: 0.17mm ~ 0.2mm

Official Einscan SE Manual

What makes an object difficult to scan?

The following objects are not recommended to scan.

- moving or vibrating objects.
- soft material objects.
- lattice structures with many small deep holes.

Dark or reflective objects are difficult to capture but can be altered using matte spray or cornstarch. See pg.13 for more information on choosing objects for 3D scanning.

What can I do with a 3D scan?

You could 3D print a double, modify it, or personalize it! Some examples of previous uses include capturing a coyote skeleton for educational purposes, capturing objects with emotional value to create replicas, creating an exact missing or broken part or creating a 3D print based on a clay model. See the Smithsonian's 3D Digitization website for some cool examples of 3D scanning!

Bring a USB to save your files, or upload them to a cloud storage service like Google Drive.

Terminology

Term	Definition
Structured Light Scanning	A 3D scanning technique that projects a pattern onto an object and uses camera sensors to measure deformation, creating a 3D model.
Calibration	The process of aligning the scanner's camera and projector system for accurate results.
Turntable Mode	Automatic 360° scanning using a rotating platform.
Alignment	The process of stitching multiple scans together into a single model.
Fusion	Combining multiple aligned scans into a final 3D mesh.
Texture Mapping	Applying color or image detail to the surface of a 3D model.
Mesh	A collection of vertices, edges, and faces that define the shape of a 3D object.
Point Cloud	A set of data points in space representing the external surface of an object.
Watertight Mesh	A fully enclosed 3D model with no holes or gaps. Required for 3D printing.
Mesh Simplification	Reducing the number of polygons in a mesh while preserving its shape. Helps with performance and file size.
Hole Filling	Closing open areas in a mesh to create a watertight model. Essential for 3D printing.
Smoothing	Reducing jagged edges or surface noise to make the mesh look cleaner.
Mesh Cropping / Trimming	Cutting off unwanted parts of the model for a cleaner final result.

Diagrams

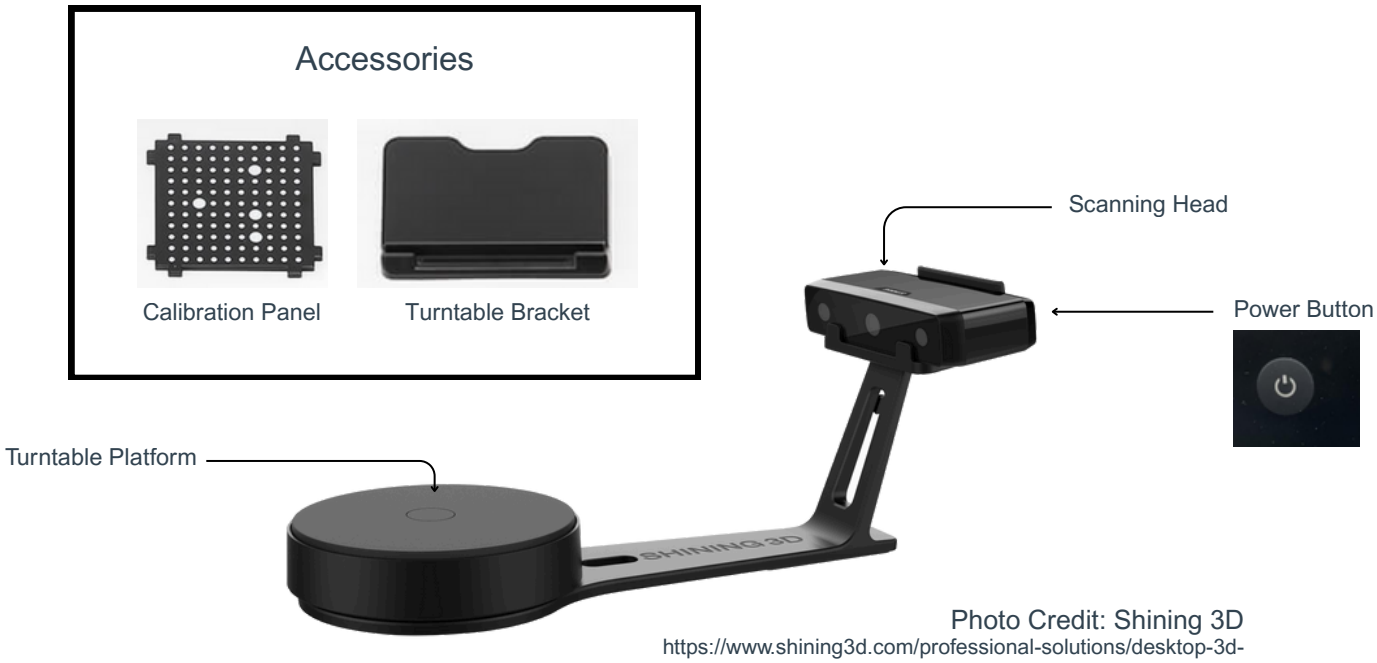


Photo Credit: Shining 3D
https://www.shining3d.com/professional-solutions/desktop-3d-scanner/einscan-se-v2

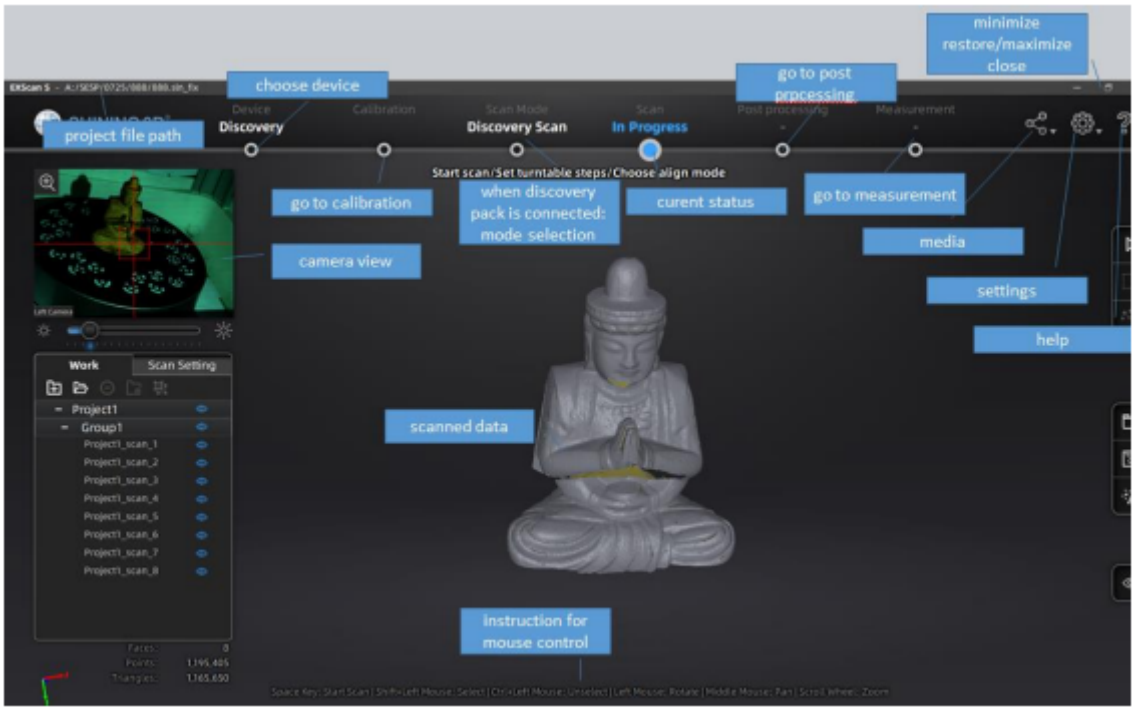
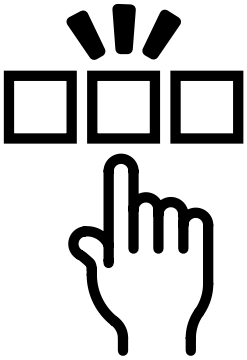


Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

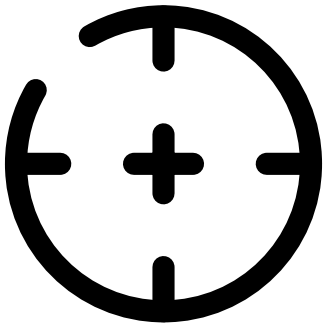
Checklist for Use

Follow this helpful overview of steps

6 Easy Steps for using the 3D scanner

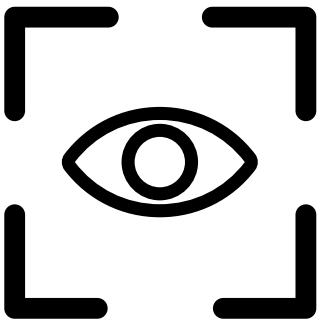


- [ ] **1. Select**
  Choose the object you are scanning

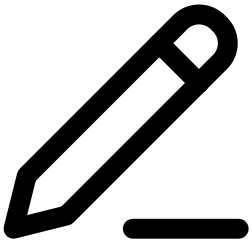


- [ ] **2. Calibrate**
  Follow the software guide

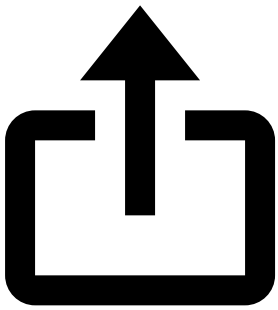
- [ ] **3. White Balance**
  Account for the room lighting



- [ ] **4. Scan**
  Wait ~30-60min until software captures the object



- [ ] **5. Edit**
  Adjust any errors in the model; make it watertight for 3D printing



- [ ] **6. Export**
  Save as a stl. or obj. file

For more detailed instructions continue to pg. -

Beginning to 3D Scan

1. Select

a. Decide on an object you wish to scan. The object needs to be between 1.2" square x 38" squared. Colour is also a consideration see pg.13 for more information around difficult objects to scan.

b. You can also hand sculpt something to scan and then modify in 3D modelling software or 3D print replicas.

2.Calibrate

a. Calibration improves optimal accuracy and scan quality but is not always necessary. You should calibrate the scanner when:

i. The scanner is used after a long time without using.

ii. There is strong vibration or the scanner has been bumped or moved.

iii. There is an alignment mistake or failure frequent appear during the scanning.

iv. The scanning data is incomplete and quality is much worse during the scanning.

b. If calibration is not needed skip to pg.9 and start from step 3 white balance.

c. Click the “Calibration” tab and follow the step by step guide in the software for calibration, moving the calibration panel as indicated. See the following page for more detailed written directions.

YouTube Video Tutorial

3D scanning

Beginning to 3D Scan

2. Calibrate Continued

d. See the below written directions if struggling to follow software guide.

i. Place calibration panel and its bracket at the turntable center. Face calibration panel to scanning head tilted slightly to the left. Move calibration panel to get the cross located at the calibration panel's central area.

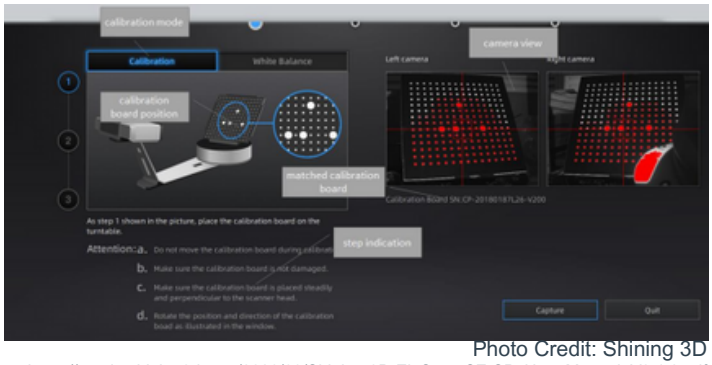


Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

ii. Click "Capture". The calibration panel will turn a circle. Do not touch calibration panel.

iii. Turn calibration panel 90° counterclockwise as guided in software. Slide calibration panel to the turntable right side, until the calibration board's smaller white dots are aligned with the yellow line shown on the image.

Calibration Panel

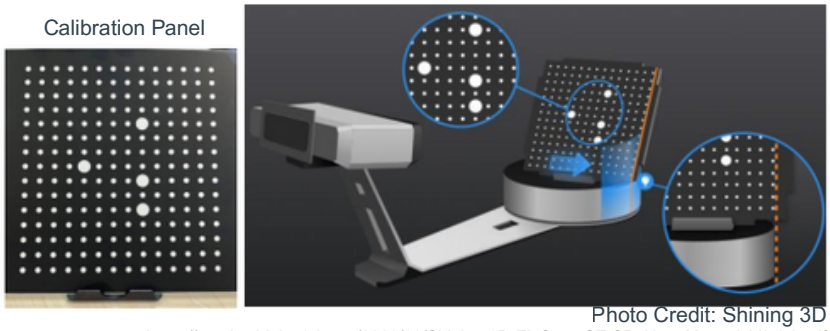


Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

Beginning to 3D Scan

2. Calibrate Continued

iv. Turn calibration panel 90° counterclockwise as guided in software. Slide calibration panel to the turntable right side, until the calibration board's smaller white dots are aligned with the yellow line shown on the image.

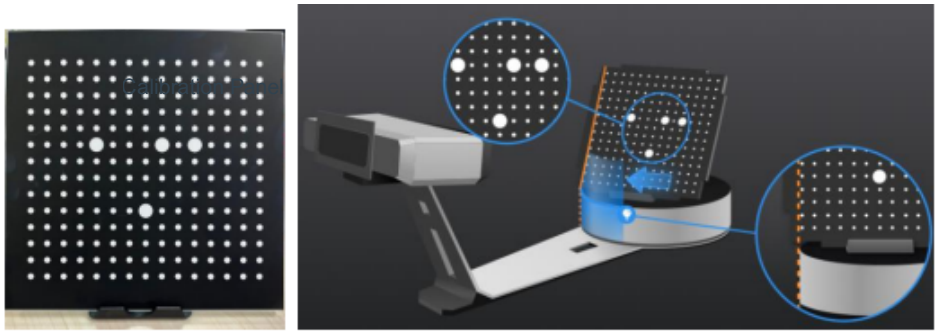


Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

e. If calibration fails click "Redo calibration" to restart the process from the beginning.

f. Click "Next" to preform a white balance calibration.

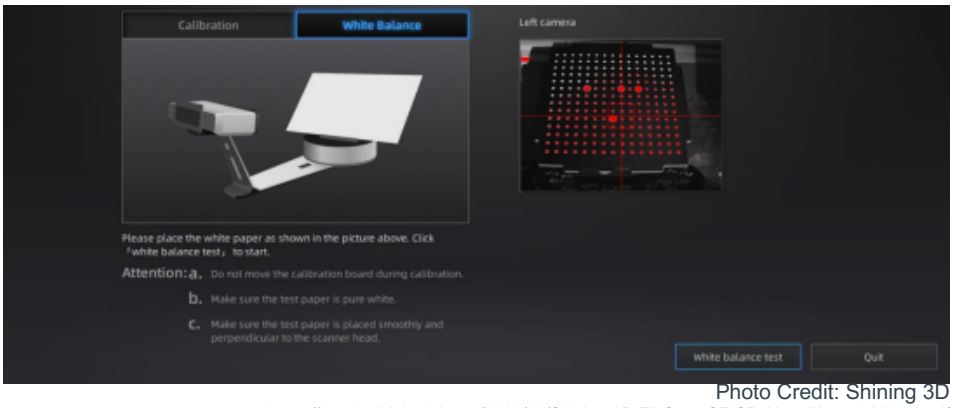


Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

3. White Balance

White balance calibration should be done every time the scanner is used because the lighting environment in the Makerspace can vary.

a. Place a sheet of white paper on the calibration plate and click "White Balance Test".

Beginning to 3D Scan

4. Scan

a. Enter the interface of New Work and Open Work. The initial default work save location is on the desktop unless the user opts to change this. Click “New Work”, enter the work name, then click ‘Save’ to enter the scan parameters window.

b. Adjust the distance between the object and device following the directions in the software.

c. Adjust the brightness by clicking and dragging the button. The correct brightness setting will depend on the lighting in the environment and the texture of the object.

Drag to adjust the brightness setting

Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

d. To scan an object with high contrasting texture, such as something white and black, use HDR. Each single scan will take longer to capture.

e. Before scanning, set the turntable steps from 8 to 36. Turntable steps refers to the number of complete rotations. Using 36 steps will capture more data in some angles and is recommended for the most accurate scan.

f. Click the play button or the space bar to start scanning. When the scan is completed the data is automatically saved in the project file. Make sure the object does not move during the scan.

Beginning to 3D Scan

4. Scan Continued

g. Scanning is time consuming and will take approximately 30-60 min. You can always leave the scan and come back to it.

h. Check the completed file. The model will show yellow sections for areas that did not get captured. Objects with hollow sections or overhangs may need to be rotated and scanned again in the new position. The software will automatically merge multiple scans in one project file.

Scan interface

Scan interface description

No.	Description
1	Zoom in camera window.
2	Adjust brightness.
3	Real-time information.
4	Scanned data.
5	Guide for mouse operation.
6	Function buttons. From top to bottom, they are: Scan, stop or delete, global optimization, create or import a project, align, save data, show or hide texture, and mesh point cloud data.

Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

Beginning to 3D Scan

5. Edit

a. Under mesh you can select “watertight”. This will fill in any holes in the object, and is very important if you are planning to 3D print your scan. Make sure that you have captured enough data so the holes are small. Large holes can cause the software to have difficulty filling the holes in a logical manner.

b. There are multiple editing tools including editing the mesh, manually filling holes, sharpen, smooth, remapping texture and simplifying. See the Einscan Manual for more information. Tip: Simplifying might be necessary for the file to be opened in certain software as the detail may cause too big of a file for the software to read.

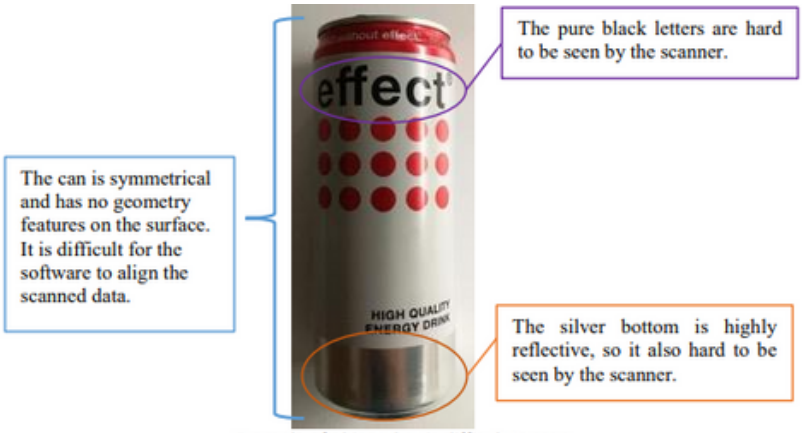
6. Export

a. Save the file as an .stl (for 3D printing) or an obj. (for editing or using as a 3D model).

Choosing Objects to Scan

What objects are not recommended to scan?

- moving or vibrating objects, which cause the shape of object changed during scanning process.
- soft material object.
- lattice structures with many small deep holes.



Example of object that is difficult to scan

Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

How do I scan transparent, reflective or dark objects?

These objects need to be coated using cornstarch or a matte spray. See below images.

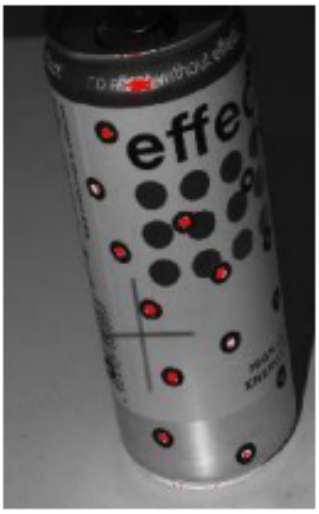
With Spray Without Spray

Photo Credit: AESUB
https://www.youtube.com/watch?v=othWKce1hBU&t=1s

Choosing Objects to Scan

What if I wanted to scan something like the above can that is symmetrical ?

Objects that are symmetrical lack distinguishing features that make it hard for the software to align and stitch multiple scans together. You can improve scan alignment by attaching markers or small pieces of clay to the surface to create additional reference points.



Object with markers

Photo Credit: Shining 3D
https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

When applying markers, follow these guidelines:

- Ensure that at least 4 markers are visible within each scanning frame (i.e., the scanner's field of view). Maintain consistent visibility of markers in the camera preview.
- Place markers in a random, non-linear pattern to avoid alignment errors (see example below).
- Attach markers to flat surface areas, and ensure they are applied smoothly and without wrinkles.
- Only use the markers provided with the scanner. Other types may result in poor accuracy or may not be detected at all. Seek help from a student tutor.

Troubleshooting

Problem	Likely Cause	Fix
Scanner not recognized	Loose USB or power cable	Check all connections, restart scanner and software
Scan is noisy or incomplete	Shiny or dark object; poor lighting	Use matte spray or cornstarch; improve ambient lighting
Software crashes or freezes	Outdated software or incompatible system specs	Update software; check system requirements
Turntable not rotating	Power cable issue or software error	Reconnect power; restart software; check turntable settings
Misaligned scans	Movement during scan; insufficient overlap	Reduce movement; align manually
Calibration fails	Incorrect setup distance or lighting	Follow onscreen instructions closely; adjust scanner distance and lighting
Exported mesh has holes	Incomplete scan coverage	Re-scan missed areas; use hole-filling tools in software
Handheld mode is laggy	System resource overload	Close other programs; lower scan resolution

Tip: If you haven't calibrated and you are having issues with the scan try calibrating and attempting to scan again.

References

Shining 3D. (n.d.). Einscan SE/SP User Manual. https://encdn.shining3d.com/2020/09/Shining-3D-EinScan-SE-SP_User-Manual_V3.1.2.pdf

Vision Miner. (2022). How to 3D Scan an Object - Einscan SP Tutorial. YouTube. https://www.youtube.com/watch?v=A8x4VL8xh-I

I acknowledge the use of ChatGPT (https://chat.openai.com/) to help develop this instructional guide.