Learning Guide
Create a 3D Model Using Polycam

Introduction

Using this Guide, you will create a 3D model of an object in the real world using a mobile application called Polycam. Polycam uses photogrammetry to convert 2D photographs into a 3D model. You can download the Polycam application through the Apple App Store or the Google Play Store, and learn more at poly.cam.

A video Learning Guide for this lesson is available here: https://youtu.be/nUb5bacXnRs.

## Step 1: Understand the concept of photogrammetry

Preview

Before you start using photogrammetry to create 3D models, you should understand how the process works. You will be able to make more realistic 3D models by applying your knowledge of photogrammetry to each stage of the process.

Explore

Look at the graphic to the right, specifically the 3D object that looks like a set of stairs. The green, red, and purple arrows represent different directions from which you can view the object and the two-dimensional view that you would see from each of those vantage points.

Photogrammetry is the process of taking 2D photos (like the side view, front view, and top view images) and using them to create a digital 3D model.
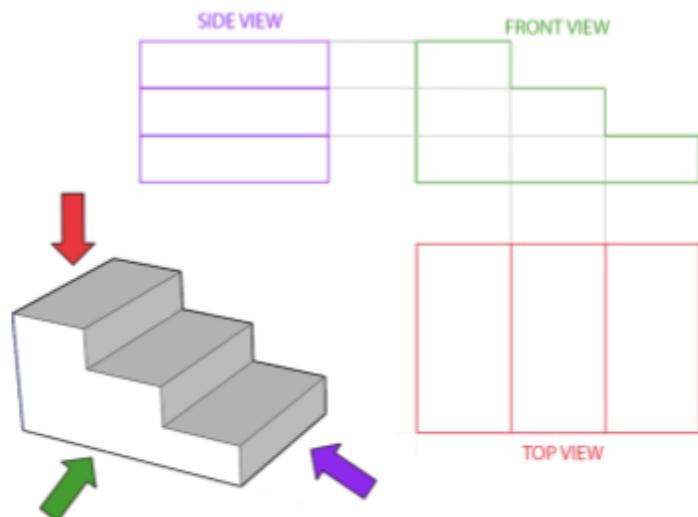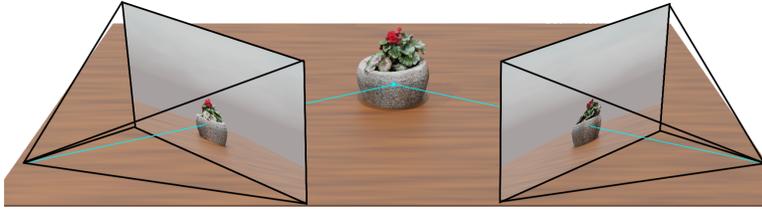
Photos of the real world can be quite complex. Photogrammetry applications use sophisticated algorithms to process images of an object in order to find common points in multiple photos and "stitch" these images together to create a 3D model. Look at the turquoise lines in the image to the left. The lines each target the same point from a different perspective.

In order to create realistic 3D models, photogrammetry applications require lots of overlapping 2D photographs. More photographs usually mean a better quality 3D model, but also require more processing time.
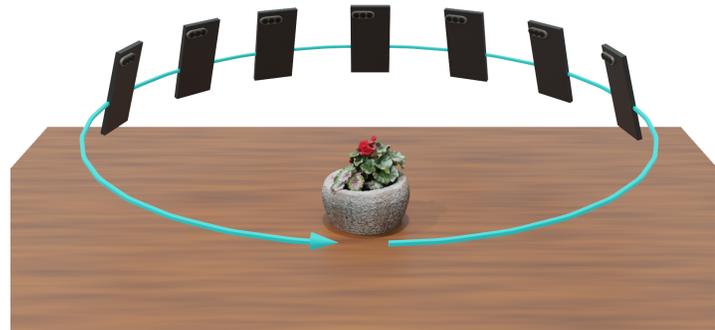
Self Check

Can you explain the basics of photogrammetry to someone else?

Why do photographs need to overlap when creating a photogrammetry model?

Step 2: Select a good object to scan

Preview

Some objects make better candidates for creating high-quality photogrammetry models than others. Understanding the properties of an object that can affect the quality of a photogrammetry model will help you to choose objects that are likely to scan well.

Explore

There are many properties that an object might have that can affect the quality of your photogrammetry model. Here are a few to consider:

SHAPE AND SIZE

Image credit: Giovanni Spoletini on pexels.com

Photogrammetry works at any scale. On the microscopic scale you could scan small organisms and on the macroscopic scale you could use satellite imagery to render entire cities. However, it is important that you are able to take pictures from all angles around the object. Larger objects, like the truck in image to the left, can be hard to capture if you are using a smartphone or tablet for collecting images.

SYMMETRY

Symmetrical objects look the same from multiple angles. This can be a problem for photogrammetry applications that could have a hard time identifying which side of an object is being captured in a photograph. This can result in broken-looking or "flat" models.

The top and the ball may be difficult items to scan because they look the same from all sides.

Image credit: Markus Spiske on pexels.com

Image credit: Aphiwat Chuangchoeam on pexels.com

TEXTURE AND MATERIAL

Image credits: Jubair Bin Iqbal (mug); Cotton Bro Studio (bell); Marianna OLE (vase), all on pexels.com

The texture and material of an object can have an impact on the quality of a photogrammetry model as well.

Reflections on objects like the bell can change the way the same point on the object looks from different vantage points, and can interfere with your scan. Smooth, mono-colored objects like the mug make it difficult to capture depth or surface curvature. Clear objects like the glass vase can be hard to pick up in images and can also create reflections or image distortion, as seen with the flower stems.

QUALITIES TO LOOK FOR

For the best scans, try to select objects that:

- Are a manageable size
- Have a unique shape
- Have non-reflective, textured surfaces
- Have distinct patterns, artwork, and/or variation on their surface

Image credit: Vojtech Okenka on pexels.com

Self Check

Below are a number of items that may or may not result in realistic photogrammetry models. Take a look at each object and think about whether or not you would want to try scanning it and why.
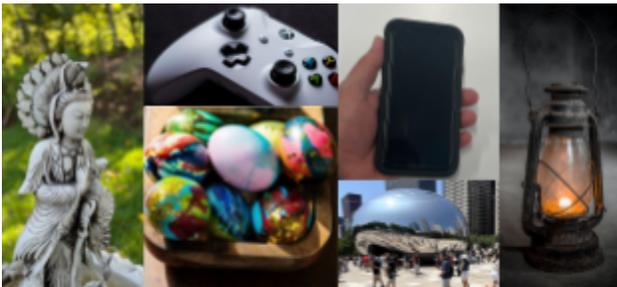

Image credits: Vanessa Quadros Lima (statue); thiago japyassu (controller); Cotton Bro Studio (eggs); Krish Chaitu (lamp), all on pexels.com

Based on what you now know about selecting a good object for photogrammetry, choose an object to scan.

Step 3: Select a good spot to complete your scan

Preview

Selecting a good spot to complete your scan can be just as important as selecting a good object to scan. In particular, when selecting the location where you will complete your scan, consider ease of access, background, and lighting.

Explore

Here are some considerations for selecting a spot where you will complete your scan:

EASE OF ACCESS

When scanning an object, you ideally want to be able to take photos from all angles. If you are using a smartphone or tablet to scan an object, you want to be able to easily walk around it. You may also want to prop it up or rest it on an elevated surface, if possible.

The guitar in the pictures on the right is on a stand that makes it easy to see from all angles, but in the first picture it is too close to the wall to get pictures from behind.

BACKGROUND

Ideally it would be best to scan an object in an area with a simple background. Sometimes that isn't an option, but making sure that other objects are not nearby for your scan will help.

In the first picture on the right, the items on the floor are close to the guitar, and may interfere with the scan. In the second picture, the items in the background are sufficiently far enough so they will be cut out of the scan. If you do capture unintended objects in your scan, it's okay - you can edit them out later.

It is ideal to have balanced lighting to help make sure that the object is easy to view and that it does not have shadows or light glare on the surface. Cloudy days work well for photogrammetry scans.

In the first picture on the right, you can tell by the shadow on the carpet that the back of the guitar will not be well lit. The lighting is more balanced around the guitar in the second photo, and will likely produce a better model.

Self Check

Where can you place your object to have good access to all sides, acceptable backgrounds, and appropriate lighting?

Are there strategies you can use to improve the quality of your model if you are not able to move the object you're scanning?

Step 4: Scan your object

Preview

Scanning your object is a relatively straightforward process, but there are a number of things to consider while scanning that will help ensure that you create a realistic model.

Explore

Try to follow these steps while scanning to help ensure a great scan. Making high quality photogrammetry models can take some practice - experiment with different objects and conditions to help you learn strategies for success!

SELECT AN APPROPRIATE SCANNING MODE
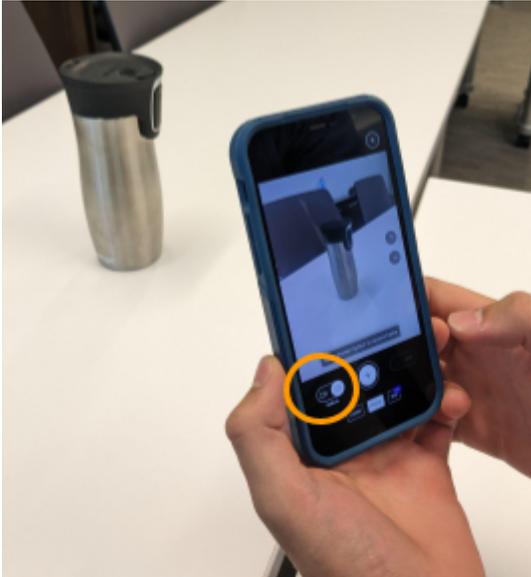
Open the Polycam app on your device. The app opens in **"Capture"** mode, or you can access this mode from other screens by clicking the "+" at the top right of the screen. In Capture mode, you'll notice a toggle on the bottom left of your screen that has "**Auto**" and "**Manual**" options. For your first few scans, try practicing in "**Manual**" mode using the **"Photo"** option, which means you will take photos by touching the button in the bottom-center of your screen whenever you're ready.

In "**Auto**" mode, the app will automatically snap pictures as you move the device around your object. This may be a faster approach to use once you get comfortable with getting positioned well for scans.

TAKE OVERLAPPING PHOTOS OF YOUR OBJECT

You want to have at least 40% overlap between photos and also want to make sure that you take photos from as many angles as possible. It's ideal to take photos systematically in rows of different heights around the object to help you keep track of the areas and angles you have photographed and those you haven't. Try to get as much of your object in each photo as possible, minimizing background.

Once you begin taking photos, a progress bar will appear at the bottom of your screen that will turn green when you have taken the minimum number of photos required for processing. You can take more than this if you wish to help ensure a higher quality model. For smaller objects, you will likely want at least 30-40 pictures. For larger or more complicated objects with lots of parts, you will likely want many more photos.
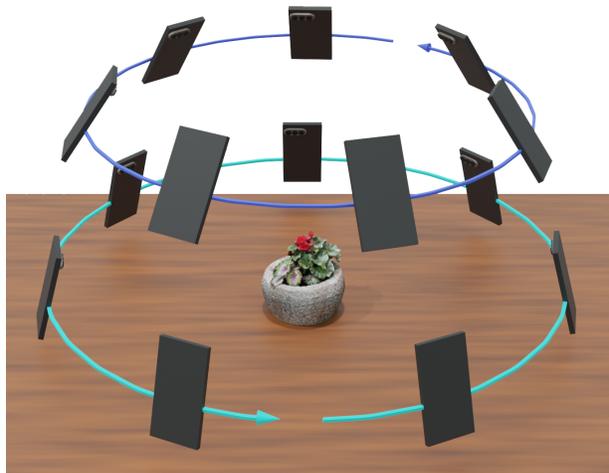
TAKE CLOSER PHOTOS OF MORE DETAILED AREAS OF YOUR OBJECT

It's not necessary to have the whole object in your viewport when taking photos, although you want to be sure that you have enough overlapping photos of every area on your object. You may wish to take more photos of more detailed portions of your object to help create a final model that looks more realistic.

UPLOAD, PROCESS, AND EXPORT YOUR MODEL

Once you are done taking photos and the progress bar has reached at least the "Min" mark, click the "Done" button, and then click "Upload and Process" to process your model. Be sure not to close the app while upload is occurring. It may take several minutes for your model to process.

Once your model is processed, you can view and rotate it in 3D by accessing it under the "My Captures" tab in the Polycam app. You can export your model into a variety of file formats by clicking the small down arrow at the top of the screen and selecting your preferred file format. The "GLTF" format works well for importing models created with Polycam into other 3D creation tools. From there, choose where you would like to save your model. You can easily save it to your computer by logging into your Polycam account from your computer's browser by visiting poly.cam and clicking the "My Captures" tab.

EXPERIMENT WITH OTHER POLYCAM FEATURES

Polycam allows you to "**Extend**" your scan by adding more pictures after the initial scan is complete. It also has features that allow you to move the object mid-scan and to do some basic editing of the model directly in the app. The best way to improve the quality of your models is to experiment with different approaches to see what works best for you!

Self Check

Complete and look over your first scan. Did it come out well? If not, what can you try differently next time?

What would a good scanning space look like? Can you create a space to scan items?

Lesson Closure

Demonstration of Learning

You were able to make a 3D digital model of a real world object because you learned about photogrammetry and how to use Polycam. You also learned about ways to choose objects, environments, and processes that help yield high quality photogrammetry models.

Exploration Opportunities

Try scanning a more challenging object.

Experiment with another photogrammetry platform like RealityCapture, Scaniverse, or Meshroom.

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