Gaussian Splatting: Automated 3D Content Creation Report

Test Scenario

For this task, the chosen object for 3D reconstruction via Gaussian Splatting was an orange ceramic vase with an engraving of a stork in a lake on it. The object had a classic clay structured surface and most importantly as specified in the task, it is neither transparent or opaque or reflective.

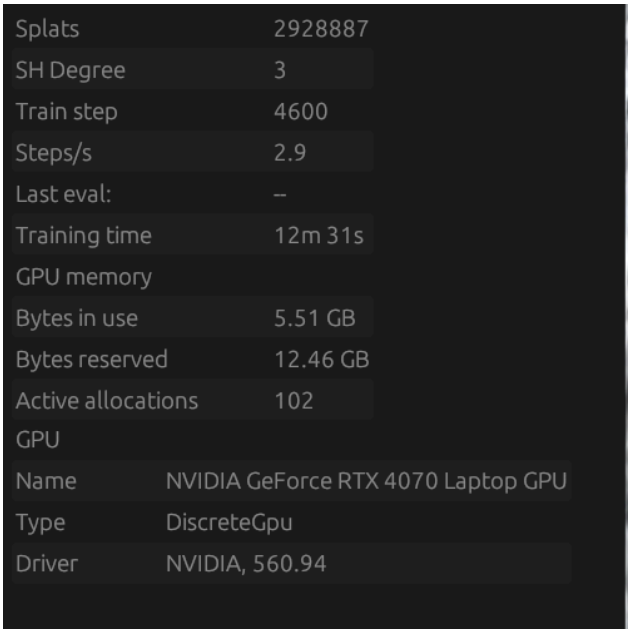
To capture the object, a total of 25 photos were taken. The capturing process involved walking in a full circle around the vase and for each position photographing it from close to horizontally and a 45 degree angle upwards. The background was moderately complex: not perfectly clean, but also not overly cluttered. It is yet to be discovered which background is optimal for this experiment.

The processing was done on a rather powerful laptop equipped with:

- GPU: NVIDIA GeForce RTX 4070 Laptop GPU
  CPU: AMD Ryzen 9 7945HX with Radeon Graphics
  Base speed: 2.5 GHz
    - Cores: 16 (32 logical processors)
- RAM: 64 MB L3 cache

The alignment of the images, done using the Colmap-based Google Colab alignment script, took approximately **6 minutes**. Following this, training the Gaussian splat model with the `brush` tool took **11 minutes** and reached a total of **4350 steps**.

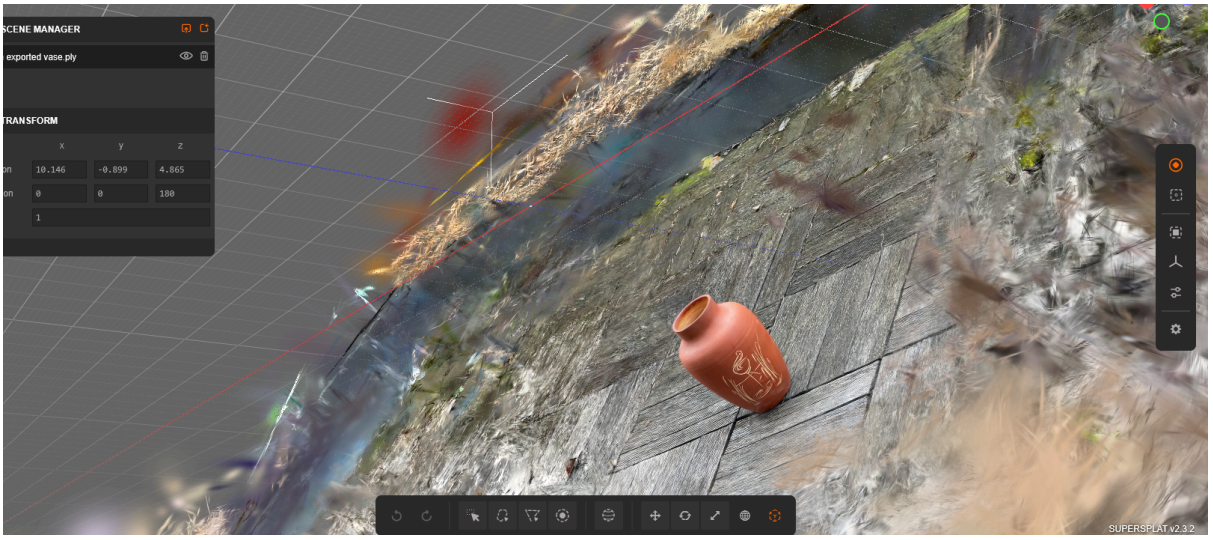
The following screenshot was taken after I exported the splats and is not an accurate depiction of my model training time and steps, it is just there to show that the Bytes in use never reached the Bytes reserved, which I found interesting enough to add to this report.



Model Quality Analysis

The final Gaussian splat model consisted of 2,928,887 splats and used Spherical Harmonics degree 3 for view-dependent rendering. Overall, the model is visually impressive and photo-realistic, especially at a mid-range distance. Textures from the vase were accurately reproduced, and the blending appeared smooth, mimicking natural lighting and shading effects.

Below we can see two fotos of the result. The first is farther away and clearly depicts the engraving or decorations of a stork in a lake. The floor also looks very sharp from this distance.



The second one is a little bit closer zoomed in. Now we can see that the vase is not as sharp anymore and the floor shows some misaligned Gaussian Splats, which should be parallel but are not. Also visible are slight ghosting and soft streaks around the borders of the vase, general background blur and misaligned splats in areas with fewer observations. Interestingly enough, the border from vase to floor is also not very realistic, but only from the angle we can see in the picture below. I suspect that there was more shadow from this side.

Further reasoning where artifacts can be attributed to:

- Limited number of photos: 25 images may not be enough to fully resolve all spatial angles and occlusions, especially under the vase rim or areas facing downward.

- Probably not ideal background: It seems to me that the background was not what the lecturers had in mind, because it has too much detail. Less detail would likely be more ideal.

Suggestions for improvement:

- Capturemore photos and include more varied vertical and oblique angles.

- Use a more uniform background to avoid blending scene elements into the model.

- Ensure even lighting to prevent overexposure or shadows which might have caused the crisp edges from specific angles.

- Generally, longer training time should enhance the details of the model, but watching the training process closely, I noticed little improvement in the last 1000 steps. I also let the program continue to train until close to 6000 steps and I could only see slight improvement.

Prospects of Gaussian Splatting in Applications

Games:

- Allows for realistic and soft appearance of scanned objects, useful for stylized or photogrammetry-based environments.

- Supports dynamic level of detail (LOD) and can be optimized for real-time rendering performance.

- Ideal for background props, environmental scanning, and fast prototyping.

- Could be used alongside meshes to enhance realism in specific situations (e.g., character faces, small props, or natural surfaces like rocks or terrain).

- Reduces artist workload by enabling asset reuse from scans with little manual cleanup.

- In VR games, Gaussian Splatting offers increased realism at close range, which is critical in immersive environments. Also, Gaussian Splatting's efficient rendering pipeline can help achieve detailed visuals without compromising performance.

- In AR games, integrating virtual objects seamlessly into the real world is crucial. Gaussian Splatting can render objects with realistic lighting and shadows, enhancing the believability of AR experiences.
    - Efficient Rendering on Mobile Devices: Given the computational constraints of mobile devices used for AR, Gaussian Splatting's efficiency is beneficial for delivering high-quality visuals without excessive power consumption.

- Enables fast previewing of scanned real-world spaces inside VR — useful for virtual tourism, training simulations, or interactive storytelling.

- Could power procedurally scanned worlds or user-generated content — where players scan and share real objects.

- Helps in real-time asset streaming in large open-world games — splats can be streamed and rendered progressively.

- Useful for modding communities, allowing them to quickly incorporate scanned items.

- Can act as a tool for rapid iteration — developers can visualize environments before committing to high-poly asset production.

- Potential use in AI-generated or personalized worlds, where scanned objects are introduced as environmental elements.

- Could reduce need for complex texturing and UV-mapping, lowering the barrier to entry for indie developers.

- Hybrid use with deformation rigs might allow integration into character models or facial expressions in the future.

Movies and VFX:

- Ideal for creating realistic digital doubles, props, and set extensions with natural lighting and soft appearance.

- Faster than traditional mesh-texture-lighting pipelines for specific environments or non-deforming assets.

- Great for previsualization (previz), where directors want fast, high-quality previews with minimal modeling.

- Can be used for background assets, reducing time spent on manual modeling and texturing.

- Useful in virtual production pipelines (e.g., LED stages), where assets need to be rendered in real time with natural softness and photorealism.

- Helps bridge the gap between on-set scanned elements and CGI, offering hybrid asset use.

Other Applications:

- Cultural heritage preservation: Accurate and visually rich 3D scans of artifacts, sculptures, and historical sites.
- AR/VR applications: Enables consumer-level scanning and sharing of physical objects with high fidelity.
- E-commerce: Real-world product visualization — allowing customers to view items in 3D interactively.
- Virtual production: Replaces or complements mesh-based digital assets in LED volumes.
- Interactive education: Students can explore realistic 3D models of organs, fossils, or machinery.
- Digital twins: Scanned assets for architecture, urban planning, or engineering visualizations.
- Rapid scene prototyping: Environment artists can populate scenes quickly with scanned splat assets.
- Forensics and documentation: Police and insurance may use 3D scans of crime scenes or accidents.
- Remote collaboration: Share and annotate scanned environments for team reviews in design or architecture.

Conclusion

The test of Gaussian Splatting with a vase model showed that even a relatively modest setup and short training time can yield highly realistic results. While artifacts remain due to data limitations, the method offers strong potential across a wide range of digital visual applications.