Final Project_Team 18
Virtual Museum: Infuse Life into Art

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Introduction

- Virtual Museum
  - Exhibit famous painting in digital
  - Convert famous 2D painting to 3D painting

3D painting of horse

Model Architecture

1. Convert 2d image to 3d model
2. Project 3d model and image on input video

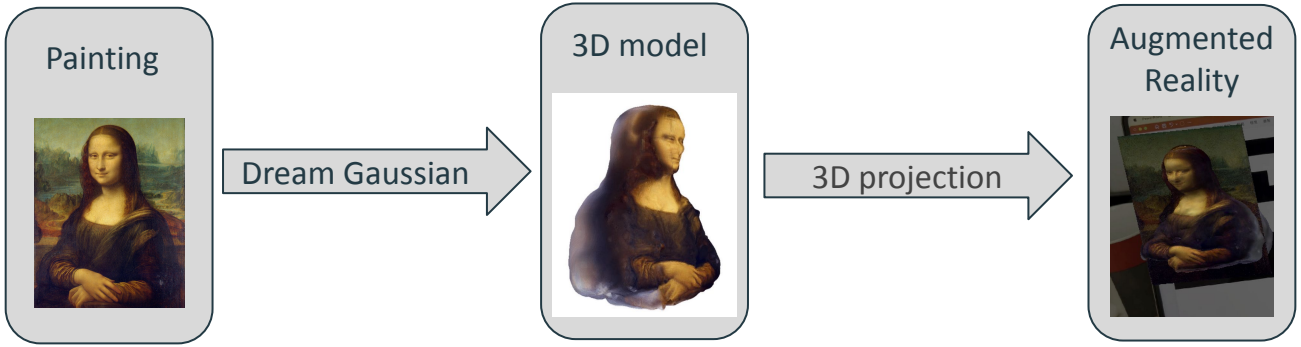

Image to 3D - DreamGaussian

DreamGaussian: Generative Gaussian Splatting for Efficient 3D Content Creation

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- Submitted on 2023 CVPR
- Produces high-quality textured meshes in just 2 minutes from a single-view image

First step: Background Removal

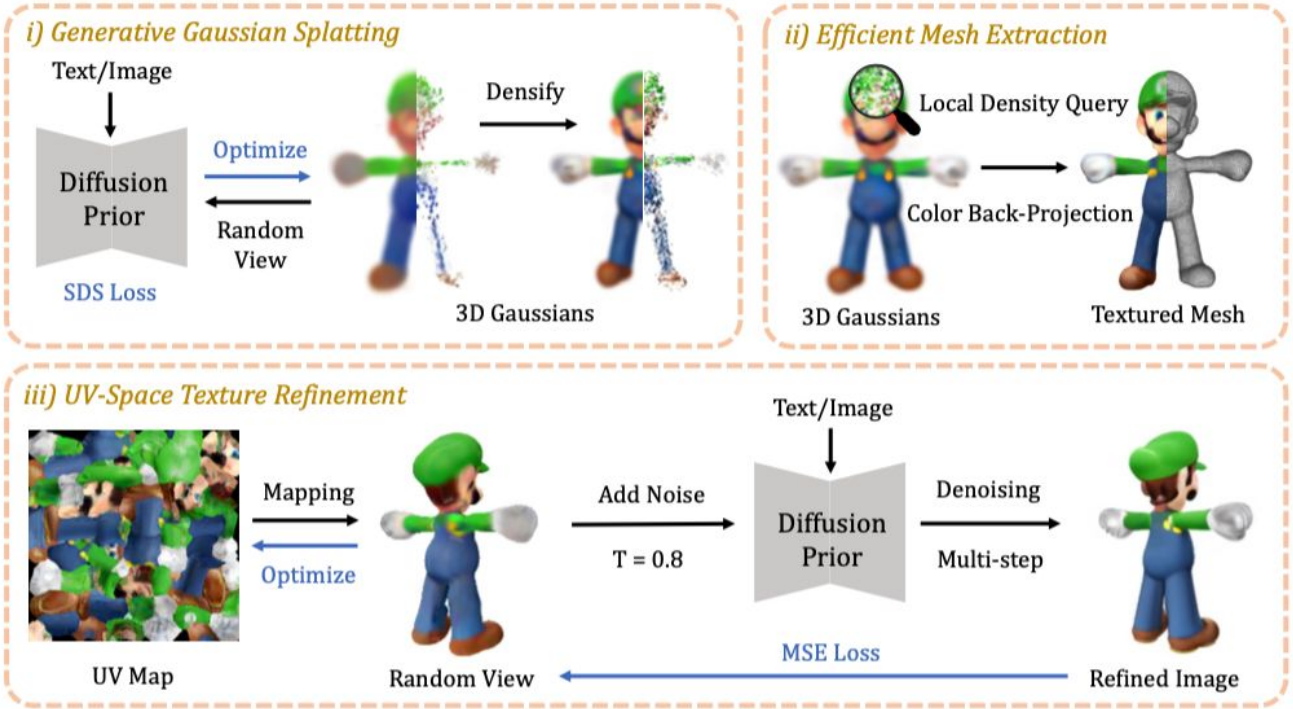
Rembg

downloads 176k/month | License MIT | Hugging Face Spaces | Streamlit Community Cloud

Rembg is a tool to remove images background.

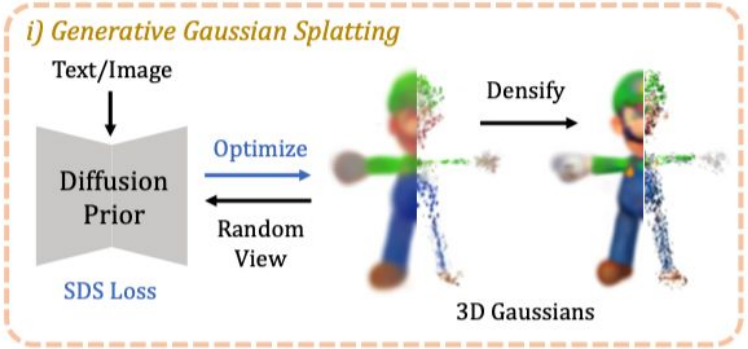
CarveKit

DreamGaussian



Step 1: Gaussian Splatting

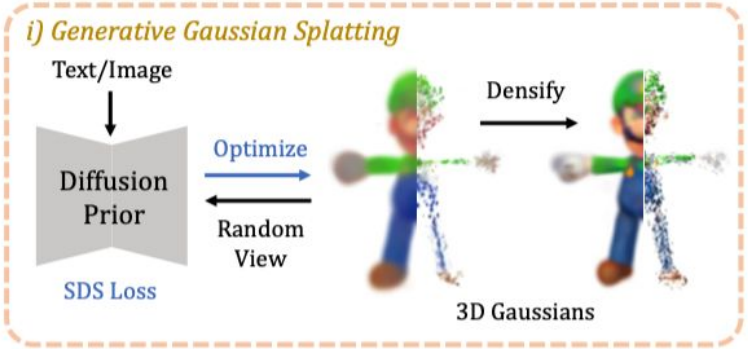
- Represents 3D information with a set of 3D Gaussians
- Effective in reconstruction settings
- Its usage in a generative manner has not been explored
- DreamGaussian is the first to employ Gaussian Splatting in a Generative approach.



Step 1: Gaussian Splatting

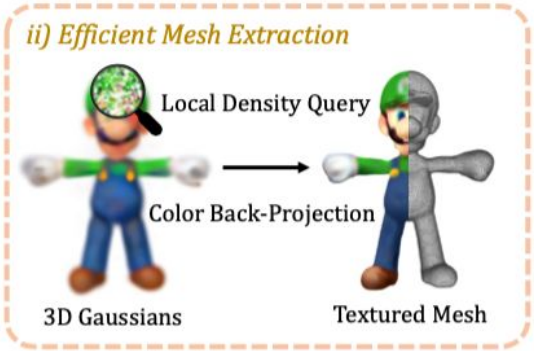
Optimization technique:

- Use SDS (Stochastic Descent Solver) Loss to optimize 3D Gaussians.
- Randomly sample camera pose p at each step, render RGB image and transparency
- Similar to Dreamtime (Huang et al., 2023), linearly decrease timestep and use 2D diffusion priors for denoising



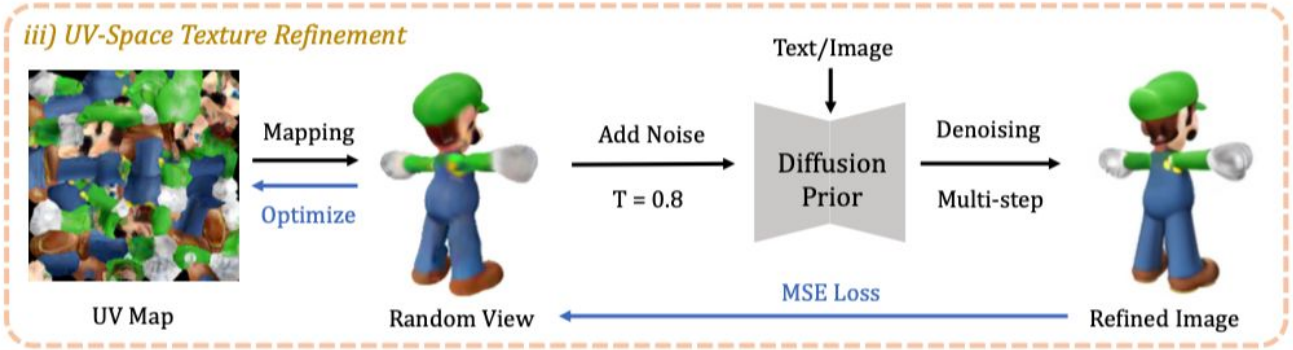
Step 2: Efficient Mesh Extraction

- The spatial density is described by a large number of 3D Gaussians
- Brute-force querying of a dense 3D density grid is slow and inefficient
- Local Density Query
  - divide 3D space into blocks: (-1, 1)^3 → 16^3 → 128^3
  - split or prune oversized Gaussians
- Color Back-Projection
  - bake texture



Step 3: UV-Space Texture Refinement

- SDEdit: render a blurry image from the initialization texture
- Use a 2D diffusion
  - multi-step denoising process to obtain a refined image
- optimize the texture through a pixel-wise MSE loss



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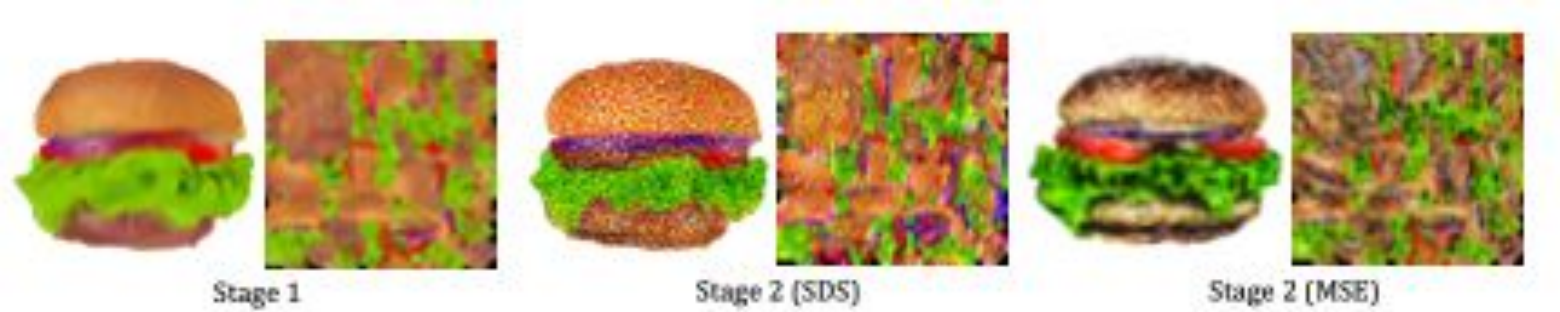
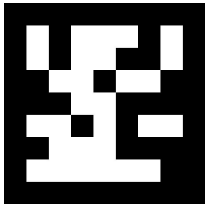
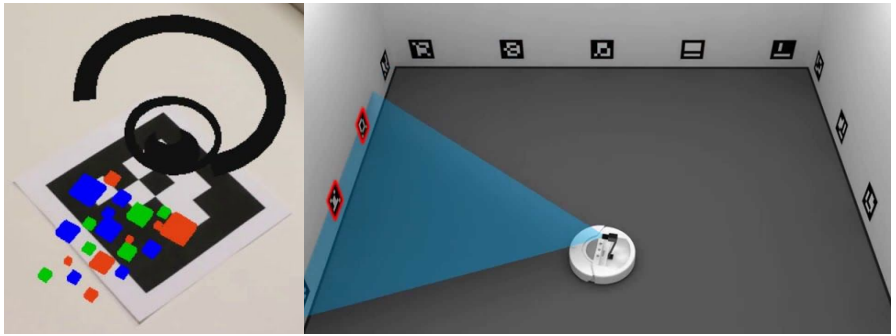


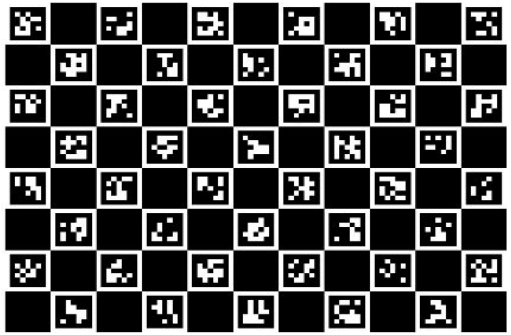
Aruco Marker: Help Plane Detection



- Binary square, consisting of black border and internal binary matrix
- Application Scenarios involving AR, Robotics, and Camera Calibration
- Simple Implementation: Directly utilize `OpenCV` package



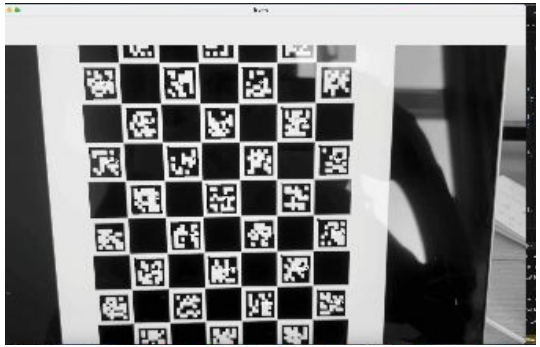
Application in AR, Robotics



3D Calibration Board

Aruco Marker (Cont.)

- Preprocessing Step of 3D object Projection: Utilization Aruco Marker for
  a. Camera Calibration
  b. Given a video, detect the plane and its number



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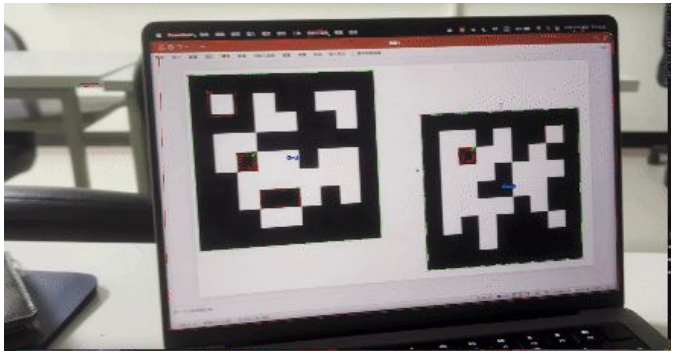
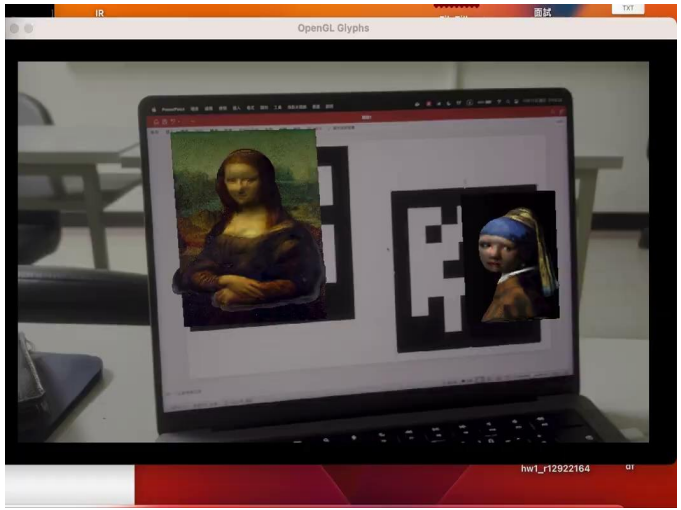


Plane Detection

Augmented Reality

- 3D object Projection:
  a. Given rotation and translation vectors, project 3D model and paintings on Aruco Marker location



Conclusion

- We utilize Image-to-3D, Aruco Marker, OpenGL to transform 2D artworks into 3D objects, and project them onto the plane
- If there is a chance, we would find other ways to make the effect of stereoscopic more significant