INFORMATION

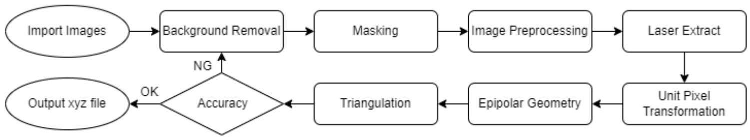
Course Name：Computer Vision and Applications

Student Name：Zheng-Lin, Wu

Student ID：R12522636

Subject：Final project

SOLUTION FLOW



METHODOLOGY

1. **Background Removal:** Using the 'rembg' package to implement background removal, the purpose is to ensure that subsequent laser lines focus solely on the model, the results as shown at the left of Figure1.

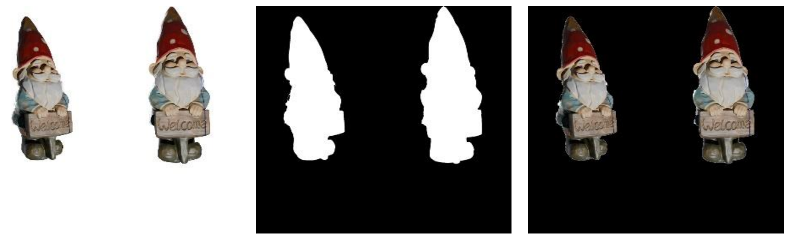


Figure 1: The left image shows the original background removal image. The middle image displays the application of a mask to isolate the model. The right image exhibits the application of a mask to isolate only the model.

2. **Masking:** Through operations such as Gaussian blur, contour detection, and mathematical morphology, the mask is made to fit the model of each image more closely, and the background removal mask is applied to the original image one by one, the results as shown at the middle and right of Figure1.
3. **Image Preprocessing:** Apply more morphological operations for noise removal
4. **Laser Extract:** Extract the differences caused by the laser scanning line by subtracting the RGB channel of the previous image from the subsequent image, the results as shown at the left and middle of Figure2.
5. **Unit Pixel Transformation:** Convert the image from the left perspective into unit pixel (1 row 1 pixel) format to facilitate subsequent calculations of epipolar geometry, the results as shown at the right of Figure2.

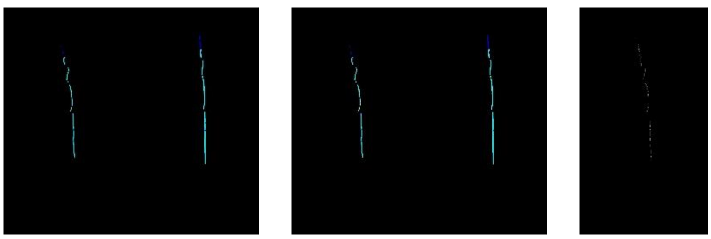


Figure 2: The left image displays the lasers extraction result. The middle image shows noise removal with lasers extraction results. The right image depicts the unit pixel for each left images.

6. **Epipolar Geometry:** Project the unit elements from the left perspective onto the right side using epipolar geometry to find potential points. If there are multiple potential points on a line, return the median of these points. If no points are found when projecting from the left to the right, delete this set of point data to ensure the final number of points on the left and right are consistent, the results as shown at the left of Figure3.

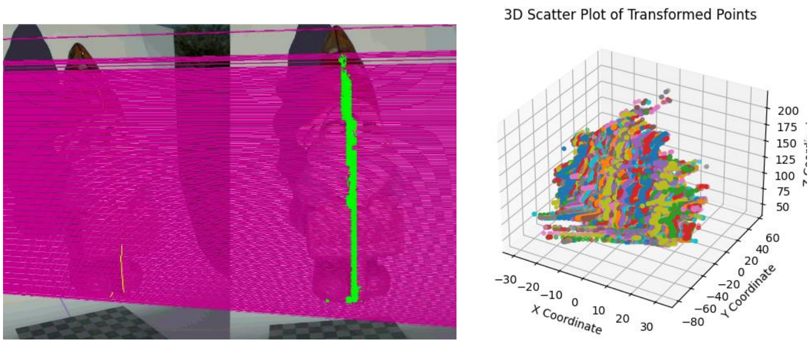


Figure 3: The image on the left shows the epipolar geometry process. The image on the right demonstrates the use of matplotlib to plot a three-dimensional array in the program.

7. **Triangulation:** After obtaining the point data for each image using epipolar geometry, obtain 3D points through triangulation, and retrieve RGB information from the image with index 000 based on coordinates from the left image.

CONCLUSION & COMPARISON

The comparison between my 3D reconstructed point cloud and the ground truth STL file involved sampling 67,043 vertices from the point cloud. The analysis revealed that the minimum and maximum distances from the sampled vertices to the ground truth mesh were both 43.091442 units, which is unusual and suggests a possible issue. On average, the distance between the point cloud and the ground truth was 0.537076 units, with a Root Mean Square (RMS) distance of 3.864763 units, indicating the overall deviation. The entire process of computing these distances and applying the necessary filters took 4325 milliseconds.