

Triangulation Matting Project (7%)

ITCS381 Introduction to Multimedia Systems

Goal : The goal of project is to extract transparent or semi-transparent objects as the foreground matte and composite in a new background picture.

The matting problem is separation of a foreground image from a background image.

$$C = \alpha F + (1 - \alpha)B$$

Solving the above equation is hard since we have more unknown than known values.

Normally, we will know C , but we don't know F, B, α .

Let's assume the color model used in our picture is *red, green, blue* (r, g, b).

Let's also assume that we know 2 different backgrounds (B_1 and B_2) and we can take pictures of the same foreground object against these 2 backgrounds. So we have

$$\begin{aligned} C_{r_1} &= \alpha F_r + (1 - \alpha)B_{r_1} & C_{r_2} &= \alpha F_r + (1 - \alpha)B_{r_2} \\ C_{g_1} &= \alpha F_g + (1 - \alpha)B_{g_1} & C_{g_2} &= \alpha F_g + (1 - \alpha)B_{g_2} \\ C_{b_1} &= \alpha F_b + (1 - \alpha)B_{b_1} & C_{b_2} &= \alpha F_b + (1 - \alpha)B_{b_2} \end{aligned}$$

same fr (no fr1) combine to extracted one pic

Now our problem is that we will have a set of 6 equations to solve for 4 unknowns (F_r, F_g, F_b and α).

A classic paper by Alvy Ray Smith and James F. Blinn [1] called "Blue Screen Matting" introduced a technique to solve this problem by assuming the foreground object to be shot against two arbitrary different backgrounds. They presented a solution to this matting problem. Here is the formula to solve α

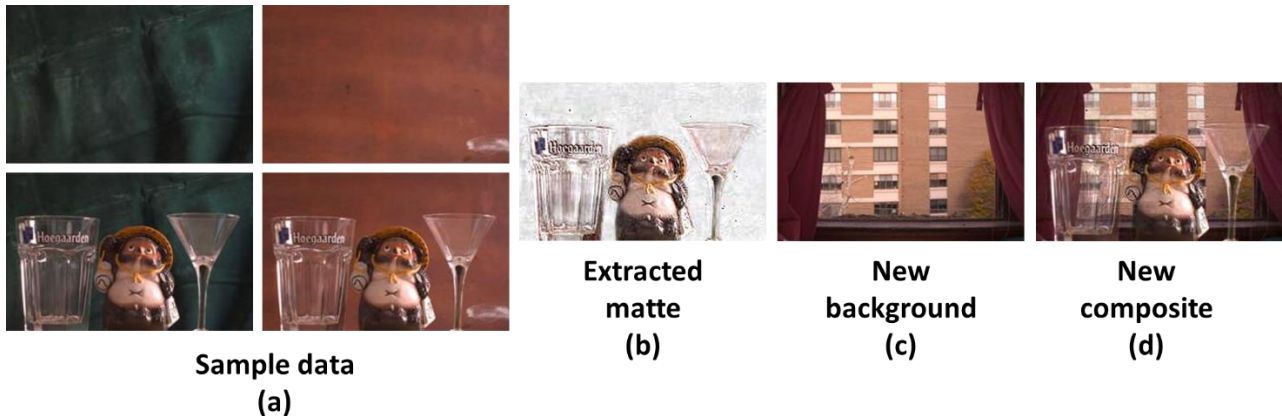
$$\alpha = 1 - \frac{\overset{\text{red}}{\underset{\text{fg1}}{(C_{r_1} - C_{r_2})}} \overset{\text{red}}{(B_{r_1} - B_{r_2})} + \overset{\text{green}}{(C_{g_1} - C_{g_2})} \overset{\text{green}}{(B_{g_1} - B_{g_2})} + \overset{\text{blue}}{(C_{b_1} - C_{b_2})} \overset{\text{blue}}{(B_{b_1} - B_{b_2})}}{\overset{\text{red}}{(B_{r_1} - B_{r_2})^2} + \overset{\text{green}}{(B_{g_1} - B_{g_2})^2} + \overset{\text{blue}}{(B_{b_1} - B_{b_2})^2}}$$

Once we know α , then we can solve for F_r, F_g, F_b .

References

[1] Alvy Ray Smith, James F. Blinn, Blue screen matting, Siggraph 1996, Proceedings of the 23rd annual conference on Computer graphics and interactive techniques, p.259-268, August 1996.

Extraction of transparent or semi-transparent objects :



We can use the explained algorithm to extract transparent or semi-transparent objects from images.

The pictures above show the overall ideas.

We need to take 4 pictures (a)

- 2 pictures with 2 different backgrounds.
- 2 pictures with transparent objects with those backgrounds

Using algorithm to extract matte or transparent objects. (b)

If we want to change the new background, we can composite / overlay the extracted transparent objects over the new background. (c) & (d)

What you need to do :

- 1) Since we are in the middle of COVID-19 situation, this project will be an individual project.
- 2) You will write code in MATLAB software to **extract transparent or semi-transparent objects.**
- 3) MATLAB live scripts are interactive documents that combine MATLAB code with formatted text, equations, and images in a single environment called the Live Editor. In addition, live scripts store and display output alongside the code that creates it.
- 4) You are given a MATLAB live script file (**matting_template.mlx**) to be a starting point of doing this project. Follow the guidelines in **matting_template.mlx** and file your code in it to produce the final results.
- 5) You are also given a pdf file (**matting_template.pdf**) which contains sample results that you need to export from your code as a pdf file when you make your final submission.
- 6) You are given 5 images in order to do this project (you must not change the file names of these images since it might affect the way we grade your project).
 - a. 2 images which contain transparent object (fg1.png, fg2.png)
 - b. 2 images which contain only background colors (bg1.png, bg2.png)
 - c. 1 image which is a new background to use in the composite task (new_bg1.png)

What do you need to submit?

- 1) Your MATLAB live script file with naming as **6388xxx_matting.mlx** that MUST run with the given 5 images.
- 2) The MATLAB live script exported as pdf naming as **6388xxx_matting.pdf** that shows **your code and your results step by step until the final composition with the new background**.