Scope and Issues in Alpha Compositing Technology

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Abstract— ***Alpha compositing is the process of combining an image with a background to create the appearance of partial transparency. The combining operation takes advantage of an*** **alpha channel***, **which basically determines how much of a source pixel's color information covers a destination pixel's color information. In this documentation, the authors discuss different types of alpha blending modes which are used to achieve this partial transparency. Alpha compositing is a process which is used to combine two images and there are the ranges of alpha value which is multiplied with the source pixel to generate target pixel.). Alpha values also range from 0 to 255, with 0 being completely transparent (i.e., 0% opaque) and 255 completely opaque (i.e., 100% opaque. Alpha blending is a way of mixing the colors of two images together to form a final image. In the preset paper the authors tried to give a comprehensive review on different issues and scope in Alpha Compositing technology. A good example of naturally occurring alpha blending is a rainbow over a waterfall. The rainbow as one image, and the background waterfall is another, then the final image can be formed by alpha blending the two together.***

Keywords— Alpha Compositing; pixel; RGB; Android; Blending Equation

I. INTRODUCTION

Pixels are the smallest element of the picture. In graphics, a portion of each pixel's data that is reserved for transparency information.32-bit graphics systems contain four channels -- three 8-bit channels for red, green, and blue (RGB) and one 8-bit alpha channel. The alpha channel is really a *mask*-- it specifies how the pixel's colors should be merged with another pixel when the two are overlaid, one on top of the other.

Typically, you wouldn't define the alpha channel on a pixel-by-pixel basis, but rather per object. Different parts of the object would have different levels of transparency depending on how much you wanted the background to show through. This allows you to create rectangular objects that appear as if they are irregular in shape -- you define the rectangular edges as transparent so that the background shows through. This is especially important for animation, where the background changes from one frame to the next.

Alpha compositing is the process of combining an image with a background to create the appearance of partial transparency. It is mostly used in 2D graphics. Compositing also used to combine images and live footage. It is a vital but simple process. To combines these images in an effective manner, it is essential to keep the matte of each element. This contains information corresponding to each element. This matte also contains the coverage information - the shape of the geometry being drawn. This allows us to distinguish between parts of the image where the geometry was actually drawn and other parts of the image which are empty. Alpha channel is the concept designed to store information. Additional information is stored corresponding to each pixel in the alpha channel with a value between zero and one. A value of 0 means that the pixel does not have any coverage information and is transparent; i.e. there was no color contribution from any geometry because the geometry did not overlap this pixel. A value of 1 means that the pixel is opaque because the geometry completely overlapped the pixel. The technique is used in many applications like Android, Mac OS, Plan 9 and many more. Rendering overlapping objects that include an alpha value is called *alpha blending.*

Key for gaining popularity:

Alpha compositing is the most used due to its easy way of usage and amazing features. The result is worth taking notice and better than that found in any other method.

II. WHAT IS ALPHA

The alpha idea been used to composite billions of pixels (if not more) to create images for print, video, film, and probably every other application of computer graphics. Alpha is obviously incredibly useful for compositing images. In addition to the red, green, and blue components of each color, there is an additional optional fourth component, referred to as the color's "alpha." Alpha means transparency and is particularly useful when you want to draw elements that appear partially see-through on top of one another. The alpha values for an image are sometimes referred to collectively as the "alpha channel" of an image.
Smith states,
"There are two ways to think of the alpha of a pixel. As is usual in computer graphics, one interpretation comes from the geometry half of the world and the other from the imaging half. Geometers think of "pixels" as geometrical areas intersected by geometrical objects. For them, alpha is the percentage coverage of a pixel by a geometrical object.

Imagers think of pixels as point samples of a continuum. For them, alpha is the opacity at each sample. In the end, it is the imaging model that dominates, because a geometric picture must be reduced to point samples to display - it must be rendered. Thus, during rendering coverage is always converted to opacity, and all geometry is lost. The Porter-Duff matting algebra that underlies what we present here is based on a model that is easiest to understand by alternating between the two conceptions."

So once again, alpha seems to be either coverage *or* opacity, depending on one's needs.

III. ALPHA COMPOSITING

Compositing is the process by which graphical objects are combined. Alpha compositing uses the alpha values, or channel (bit mask) to represent the coverage of each pixel. The alpha channel is often said to represent the 'opacity'. This coverage information is used to control the compositing of colors. In other words, alpha compositing (also known as alpha blending) is the process of layering multiple images, with the alpha value for a pixel in a given layer indicating what fraction of the colors from lower layers are seen through the color at the given level. Simple alpha compositing, composites each object onto the background image using a simplistic formula that has the effect of overlaying the object over the background. Where the objects overlap and coverage is not complete the color of the background may show through the object that has just been rendered. This is known as the over operator in Porter Duff compositing. Most of the alpha compositing functions blend two input images—a top image and a bottom image—to create a composite image.

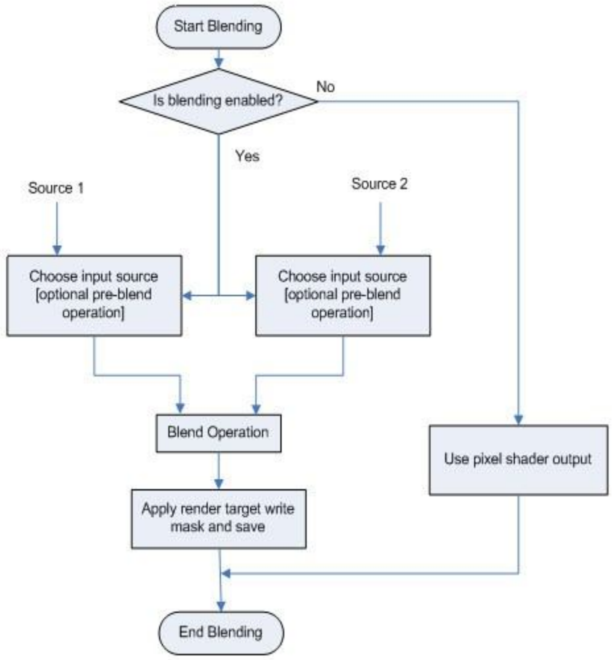


Fig.2 : Before applying the blending and after applying the blending.

Fig.1 : Flowchart of Blending

IV. ALPHA CHANNEL

The alpha channel is a color component that represents the degree of transparency or opacity of a color i.e., the red, green and blue channels. It is used to determine how a pixel is rendered when blended with another. It controls the transparency or opacity of a color. Its value can be represented as a real value, a percentage, or an integer: For example-

	Real value	Percentage	Integer
Full transparency	0.0	0%	0
Full opacity	1.0	100%	255

Fig.3 : Values of Alpha

When a color (source) is blended with another color (background), e.g., when an image is overlaid onto another image, the alpha value of the source color is used to determine the resulting color. If the alpha value is opaque, the source color overwrites the destination color; if transparent, the source color is invisible, allowing the background color to show through. If the value is in between, the resulting color has a varying degree of transparency/opacity, which creates a translucent effect. Typically, the higher the value of an alpha channel sample, the more opaque that pixel is (some file formats work the other way around, though, so calling it the transparency channel is fine). The alpha channel is typically represented by the letter A (ex.,"RGBA").
The alpha channel is used primarily in alpha blending and alpha compositing.

V. TECHNICAL ASPECT

However, discussion of compositing is based on the idea of *pre-multiplication*.
If an alpha channel is used in an image, it is common to also multiply the color by the alpha value, to save on additional multiplications during compositing. This is usually referred to as premultiplied alpha. Premultiplied alpha leads directly to the notion of image object, or sprite—a shaped image with partial transparencies. In pre-multiplication process, we store a color's components (typically red, green, and blue) already multiplied by alpha. We could save that in pre-multiplied form Note that the alpha value is unchanged, while the R, G, and B values get multiplied by alpha. Here we'll look at two issues in particular: efficiency, and transparent pixels. Both of these issues are most easily discussed in terms of over, the most common compositing operation.

- Porter and Duff proposed a number of basic operations, which are performed on a per pixel, per RGB channel basis
- Most of these operations presuppose that the RGB channels have already been pre-multiplied by the alpha value

Simply blending combines the pixel color in the render target with the new pixel color to be drawn at that position. The blending equation- Final color = (Src pixel color * src pixel blend factor) Some blending operator (+/-/*) (Dest pixel color * dest pixel blend factor). In graphics terminology the new pixel to be drawn is termed the source (SRC) pixel and the back buffer pixel is the destination (DEST) pixel.

VI. TRANSPARENCY:

Colors have 4 components: red, green, blue and an alpha component, the first three are obvious and alpha value which defines how opaque (solid) or transparent a color is. A value of 1 is completely solid and a value of 0 is completely transparent. The reason that the range is from 0 to 1 should be quite obvious, to get the final color for every pixel in the image we multiply its color values by the alpha channel, so if the alpha is 1 then the color value remains unchanged and the lower the alpha the duller the color will be. So if I had a rather dirty window and I represented it using a colored quad, a good alpha value is 0.3, its mostly see through but not completely.

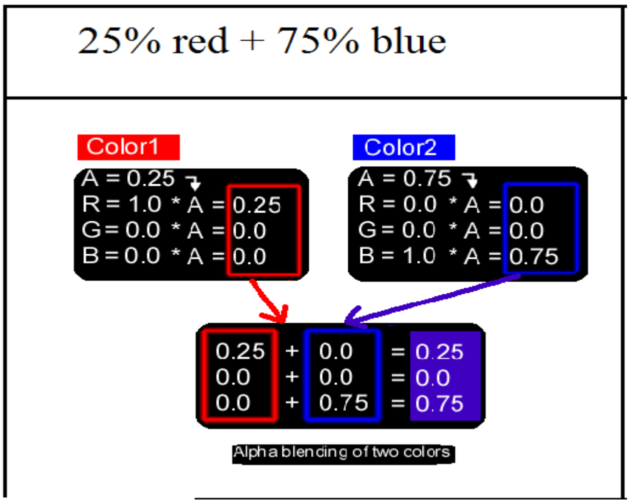


Fig.4

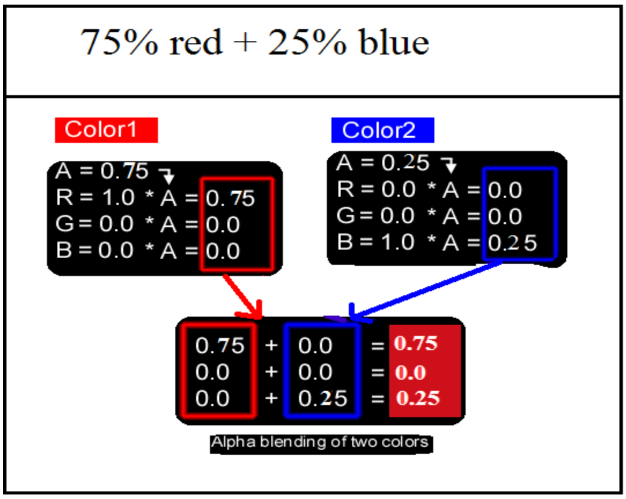


Fig.5

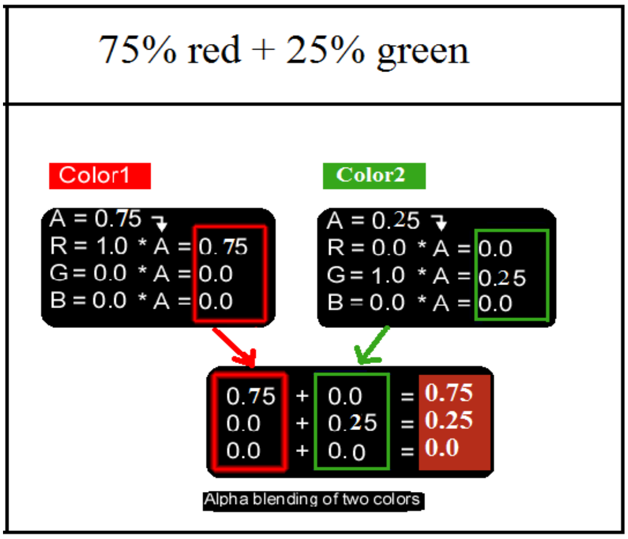


Fig.6

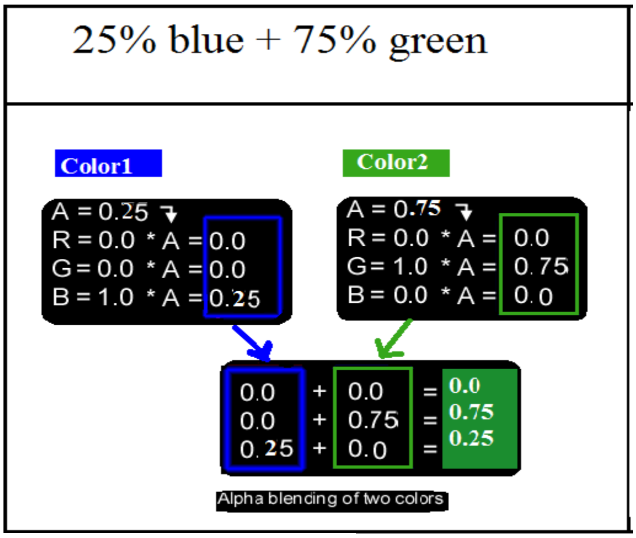
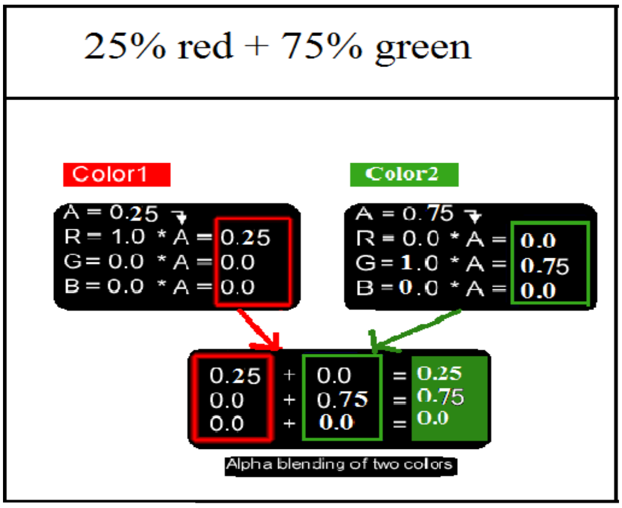


Fig.8



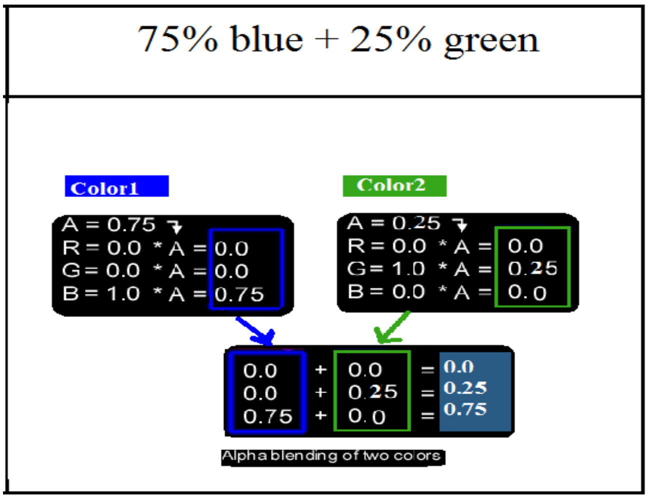


Fig.9

Fig.7

The blending operation is a basic mathematical operation like addition or subtraction, and the two blend factors are user set. Alpha blending is a blending technique that allows for the combination of two colors allowing for transparency effects. The alpha blending equation is as follows:
Final color = src color * src alpha + dest color * (1-src alpha)

What this does is linearly interpolate between the two colors according to the alpha value. If a src pixel has an alpha of 0.8 it contributes 80% of the final color while the destination pixel only contributes 20% of the final color of the new pixel color. This obviously means the lower the source pixel alpha the larger the contribution of the destination pixel.

VII. COMPOSITING COMPOSITE ALPHA

Suppose we want to use traditional alpha blending to stack up four images: A, B, C, and D.And suppose the most convenient way for us to compute these is to first form F=A over B, and then form G=C over D, and then put the two intermediates together to make H=F over G. Then while computing F we need to find not just the new color for each pixel, but a new alpha, so we can use it in the next stage when finding H.

[PorterDuff84] doesn't offer a formula for computing this new alpha. Both [Smith85] and [Blinn94] provide this expression for the composite of A over B:

$$F\alpha = A\alpha + (1 - A\alpha)B\alpha \qquad (1)$$

Where, αA and αB represent the opaqueness of semi-transparent object which fully cover the pixel As usual, we write all the alpha values involved with capital letters, since they are not pre-multiplied by anything.

The formula is derived in [Blinn94] by working through the algebra of the over operator. In order to make that operation associative (which is very desirable), then this is the necessary expression. But that doesn't provide us with an intuitive interpretation of alpha. In other words, we know how to compute it, but we don't know how to interpret it. Suppose you have two scalar values, p and q, and you want to mix some of each to produce a result r. One way to go is to multiply each of the inputs by a weighting factor. Whichever gets more weight will dominate in the output.

For example we could weight p with wp and q with wq to make

$$r=wpp+wqq \quad (2)$$

There's a problem with this r, though: it incorporates the weights into the result, rather than just the values we're blending. This is important to remember any time we're blending together values by weighting and summing them. To remove the effect of the weights, we must divide by their sum. We will use this fact below to keep our book-keeping straight as we track opacity through the composition operation. We're
combining the colors Ac and Bc by using $A\alpha$ and $(1-A\alpha)B\alpha$ as the weights. The results are pre-multiplied, and should have been written with a lower-case letter. Therefore the equation is-
$Cc= A\alpha Ac+(1-A\alpha)\ B\alpha\ Bc\ A\alpha+(1-A\alpha)B\alpha$ (3)

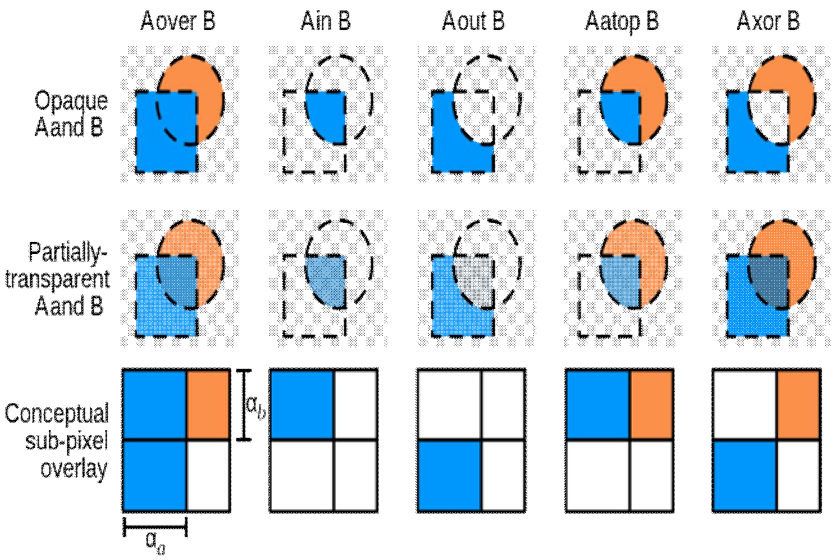


Fig-10

VIII. CONCLUSION

There are several ways for selection such as-pull a matte, use an existing alpha channel, create a mask. It's even possible to composite without selections at all, instead using blending modes (Add, Multiply, Screen) to combine color channels mathematically, pixel by pixel, in ways that mimic how light and shadow play out in the world. From any other methods, alpha compositing technique blends the images very quickly. The combining operation takes advantage of an alpha channel, which basically determines how much of a source pixel's color information covers a destination pixel's color information. From this study we can blend two images appropriately using alpha channel and using alpha compositing or alpha blending.

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