



NewTek

Creating Affordable Green Screens for Video and Web Production

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Historical Overview

There has always been a desire by producers and directors with vision to want to improve what is before them. That includes the use of action or scenes that don't exist, or allowing actors to appear to be in any location without leaving the studio. Such was the case with the 1940 movie *The Thief of Bagdad*, which called for Jaffar, a massive genie, to play a prominent role in the film. Special effects coordinator Larry Butler rose to the challenge and is credited with invention of blue screen compositing, for which he won an Academy Award for Special Effects. This was a very tedious and precise process involving several layers of film which had to be precisely aligned when creating the master negative.

Decades later, advancements in computing brought the technology into wider use, including television production. One of the most common examples today is the TV weatherman, who is standing in front of a green wall. A special computer is instructed to replace all regions of a particular color with satellite animations and weather graphics originating on a second computer. Replacing a color with an image is keying or "keying out" the background, which refers to its historical roots as a hole, or "keyhole" in one of the film layers.

Blue or Green?

Why did *The Thief of Bagdad* use a blue background, but you're local TV station opts for a green background? In most circumstances, the compositing is placing a person in another environment, and either blue or green is the furthest color from human skin tone. A decision of blue or green may be decided by wardrobe styling and colors used on set.



Figure 1

Lighting a Chroma Key Set

The technical challenges to creating a realistic-looking chroma key aren't limited to color choice, since the weatherman isn't standing in a dark room. The on-screen talent must be properly lit. This presents a new set of challenges.

- **2 and 3-Point Lighting**

Whatever background image you choose to key over, pay particular attention to how the light and shadows fall in this image – you must now match the direction and angle of lighting on your talent. Is the strongest light coming from the right? Then that needs to be where you place your primary light source, known as the key light. Mount another light above and behind the talent as a separating hair light, and you have a minimal setup: two-point lighting.

2-POINT LIGHTING



Figure 2

This is beneficial in the field when there is limited set-up time or you don't have the space to set up numerous lights.

This backlight can be a problem shining back toward the lens, which introduces flaring, lens artifacts and reduces contrast (all of which will interfere with a successful key).

The solution to our problem is to block the light from shining straight into the lens. This can be accomplished with black foil or a barn door to shield the lens. You can also place a grid in front of the light which reduces its angle to a narrow beam pattern. The illustration below shows a 20-degree grid, which converts a broad, scattered wash of light into a tight spot.



Figure 3

A more common and improved setup is 3-point lighting. Add another light on the other side of the camera but with an output that is 1 to 2 f-stops lower than the key light. This is the fill light, which balances tone and fills in shadows on the other side.

3-POINT LIGHTING

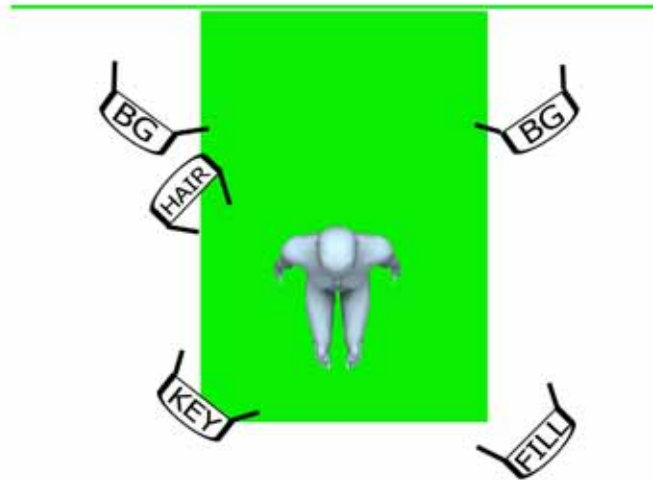


Figure 4

- **It's not how bright the wall is**

Grabbing every available light in the facility and pointing it at the wall will not create an effective key source, but will only make it more difficult to key. It is not how bright the background is, but instead how evenly the light washes over the green or blue background.



Figure 5

- **Soft Lights**

Whether your setup is lit with quartz, halogen or fluorescent fixtures, the background lighting should be separate from the lighting used to illuminate the talent. Many lights are designed to create an adjustable hot spot in the center of the beam, which must be minimized. This is

usually accomplished with a translucent diffuser in front of the light. The diffuser can be made of glass, spun fiber or heat-resistant gels. This causes the light to scatter, eliminating the bright spot on the background.

Fluorescent lighting is preferred to light a blue/green screen, the easiest lighting setup is to use all fluorescent fixtures but this tends to light the talent too soft with little or no shadowing. A combination of fluorescent and tungsten is a good combination to achieve a nice flat blue/green screen light and still be able to control shadows on talent. It is important that the color temperature of all lighting is the same.



Figure 6

- **Cool Lights**

Fluorescent lights offer several advantages: lower energy costs to create the same amount of light as quartz or halogen lighting; a fluorescent tube presents larger source of light than a small, intense halogen bulb, so the light is already somewhat diffused; and most importantly, lower electrical consumption which means a cooler surface that will not burn someone if they accidentally get too close to the light nor require gloves to adjust the light. Fluorescent lighting can be purchased at a hardware store for as little as \$30, and can provide a very soft wash of illumination. There are also special [fluorescent fixtures for video production](#) (pictured above), with an emphasis on long-life, accurate color reproduction and dimmer compatibility. A single fixture unit costs about \$650, and a double fixture about \$900. Satisfactory lighting of both talent and background can be achieved with just three units, so lighting setups can range in price from \$150 for shop lights to \$2,300 for pro fixtures.

- **Separate Lights**

It is important to light the background with one set of lights and the person with another set. This allows flat lighting on the background, with freedom to light the talent as gently or dramatically as you wish. It helps to use lighting above and behind to separate the talent from whatever image will replace the background. Don't overdo this back lighting, however. The limited dynamic range of the camera means there will be little useful color data in over-exposed highlights, which makes it next to impossible to separate fringe zones (such as hair detail) from the background.



Figure 7

Space Requirements for Chroma Keying

The first consideration is whether this is a permanent or temporary setup.

Permanent

A permanent setup will dramatically reduce pre-production before each shoot, as the lights can remain in place and the background color can be painted on the walls and floor. The ideal setup employs a cyclorama, which provides a gentle curve to transition between the wall and the floor, eliminating seams or shadows.

There is special chroma key green paint which can be purchased for about \$50 per gallon. One gallon would cover 300 square feet. If you are on an even tighter budget, search online for “low budget chroma green paint” and find out how your local hardware store can provide a similar gallon of flat green latex for half the cost. Remember to use a durable epoxy-based paint to paint the floor to resist scuff marks on the floor.

If you need to shoot into a corner with multiple camera angles, then a cyclorama can help. A cyclorama, or “cyc”, is a curved piece of material that seamlessly transitions from the wall to the floor, without creating hard lines or unintended shadows.

The distance from your talent to the wall behind them can make a profound difference in key quality. When the subject stands too close to the key wall behind, the key color reflects, spilling back onto the subject, creating an ‘edge’ that is difficult to remove. If you have available space, you should move your subject farther away from the wall. Six to ten feet is a good starting point.

When that much space between background and talent is not possible, you can minimize the issue to some degree by placing lights above and behind the talent, back-lighting them with a complimentary color filter over the light to ‘cancel out’ unwanted reflection (for green use amber filters; for blue, orange).

Temporary

A temporary setup has the advantage of multiple uses for the space in between chroma key productions, and can occupy less space when in use. Instead of paint, seamless paper or fabric hangs behind the talent or an appropriately-sized pop-up panel is used. Green paper comes in 9 by 24-foot seamless rolls, and can be [purchased online](#) for less than \$60. One roll can work for

repeated tapings. As the paper across the floor gets dirty or torn, you can roll out a fresh length to replace it.

If you need to frame the talent from head to toe, paper or fabric will ease keying as it can drape down and cover the floor. A pop-up panel is sufficient when camera angles are limited to medium and close focal lengths. There are also [green fabric backgrounds](#) with stands available for less than \$250.

Through the Lens

It's important to consider the color characteristics of different types of camera signals.

In the analog video realm, you will encounter three main types of camera signals. Here they are, from least to most desirable:

- **Composite** is a two conductor design using the classic RCA connector that sends color and brightness signals in the same data stream. Though sufficient for normal viewing, this signal is the least desirable to use because video brightness and color information are not properly separated.
- **Y/C** typically uses a round, 4-pin mini-DIN connector. Y/C keeps Y (luminance) and C (chrominance) signals separate. Also referred to as S-Video, this is a cleaner video image to use for chroma keying.
- **Component** is a three-wire system typically using BNC (push & twist-on) connectors. This format uses a little math to cleverly juggle the R, G, and B values into something less 'bulky,' in the interest of making best use of precious analog signal bandwidth. Cameras and connections from either Y/C or component are preferred, but it is entirely possible to succeed with just a composite signal if the camera signal is clean enough. Strive to use the best possible signal from your camera. Analog component is a better capture medium than DV, which can be a little too clean, causing stair-stepping artifacts along the edges.

Another camera consideration is how many CCD sensors the camera uses. Consumer-grade MiniDV cameras usually employ a single CCD image sensor and do not capture enough color detail to reliably key finer detail. A 3-chip camera will provide a much cleaner video source to start with, minimizing compositing problems later, whether it is being keyed live or in post-production. The newer HDV cameras have superior resolution, and largely overcomes the problems that digital video can cause. 3-chip cameras can be purchased starting at \$4,000.

Additional best practices during a chroma key session include:

- **Optimize Camera Aperture**
Opening the lens all the way can cause vignetting in the corners, so try to light for a medium-wide aperture between f/ 4 and 5.6
- **Minimize Depth of Field**
The depth of an area that is in focus depends on the aperture and the distance from the camera to the subject. Moving the camera back and zooming in will help to blur the background
- **Manual Operation**
You will ensure consistently better video if you disable all auto controls on the camera, including white balance, auto-focus and aperture.
- **Lock Down Focus**
Even at a moderate aperture, you want to ensure your talent remains properly framed and focused. To make sure there is no movement, place the subject in a straight chair. You should avoid office chairs. Casters and the ability to swivel or recline can easily mis-align the shot.

The Advantages of Live Virtual Production

The benefits of chroma keying can be taken to a higher level of sophistication with virtual sets. A virtual set can be as simple as a photo keyed behind the talent or as complex as a fully-rendered 3D environment in front of and behind the talent.

A constructed studio set for news, television and magazine production can cost tens of thousands of dollars, and once it's constructed and lit, it occupies a large part of your facility, whether it is being used or not. Live virtual sets shatter space and budget limitations. That is why NewTek, the creator of desktop video, developed an advanced line of affordable video switchers with integrated LiveSet™ technology. LiveSet is a standard feature in NewTek VT[5]™ and TriCaster STUDIO™.

LiveSet™ is the live virtual set system in VT[5] and TriCaster STUDIO. LiveSet allows effects to be applied independently to any camera input, as well as the integrated clip playback and remote computer inputs. Each LiveSet effect offers virtual cameras with multiple camera angles and focal lengths, as well as support for secondary video sources, such as on-screen background monitors and video walls. The photo-realistic LiveSet engine allows real-time use of reflections, shadows and more to create an immersive studio environment.

What are Virtual Sets?

Virtual sets are computer-generated studio sets that can be as simple as a photo with the host or anchor super-imposed over the background; or quite elaborate, with the talent interacting with the room's environment, such as reflections across the floor or desk. Virtual sets can be a post-production process, where recorded footage of the talent is rendered into the room. This process can be very time-intensive, as it involves recording, then compositing each shot and camera angle.

How Does LiveSet™ Differ?

While several companies offer software packages providing virtual sets as a post-production tool, the realm of *live* virtual sets has typically been quite expensive, with systems costing \$50,000 or more, depending on the amount of specialized hardware required. NewTek LiveSet provides portable, live production, and allows each camera to have its own angle in the production. Like most virtual set systems, you can cut between angles; but LiveSet lets you use fades or 3D transitions between angles.

NewTek has dramatically improved your access to affordable virtual sets. Unlike simpler live solutions, LiveSet brings realism into your virtual set with textured reflections, video walls, refracted glass and more – in real-time.

What are the Benefits of Live Virtual Sets?

Cue the talent and broadcast your show. Virtual Sets give you the flexibility to use expansive, professional sets, even though your location may have limited space. The real-time scaling capability within LiveSet lets you push the talent into a wide-shot without trucking to the back of the room. This boosts production quality without a sound stage or floor staff.

The explosion of Internet TV means viewers are already expecting higher production quality. LiveSet lets you stream live to a worldwide audience while you save time, save space and save money. Here's how:

Save Space

Sound stages, in use since the days of silent film, are ideal places to set up, construct and shoot expansive newsrooms and show studios; but many producers must shoot within much smaller spaces. This may be the most significant advantage of Live Virtual sets. The talent can be

videotaped in a 6 by 10-foot space, and appear as if he is presenting from a large, 2-story sound stage. NewTek LiveSet's integrated garbage mattes allow you to isolate your talent from the peripheral clutter of light stands, or overhead booms.



Figure 8

Save Time

Get it done *now*. Shoot for broadcast with LiveSet, not for rendering later. This gives your talent the opportunity to interact with virtual monitors and desks. Shooting in different studios no longer requires lengthy set-up and re-lighting.

TriCaster and VT[5] contain everything you'd need for comprehensive virtual set production: switcher, titling, keyer, audio mixer, VCRs and more. This makes studio and field setup a snap. With all cameras time-base corrected and proc-amp adjusted, you can be show-ready in minutes.

Save Money

Say your facility lacks a tape room and router to assign clip playback to your video wall and the plasma monitor behind your desk. If you can not afford those additional set pieces, LiveSet realistically inserts your talent into that environment without the construction costs or additional electronics. Integrated clip playback in dual VCRs means the director can effortlessly roll in produced segments without the need for a videotape operator.

Where Do I Learn More About LiveSet?

See the [gallery of LiveSets](#) that are included with VT[5] and TriCaster STUDIO.

NewTek provides several free tools to design and create custom sets, and you can [discuss and share ideas](#) and sets with other producers.

For more information click [here](#).