

DEMOCRATIZING KNOWLEDGE

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# PRINT

Visual Communications Journal

Fall 2016, Volume 52, Number 2

*Special Techniques in Digital Photography*

CHRIS J. LANTZ, Ph.D.





GRAPHIC  
COMMUNICATIONS  
EDUCATION  
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# Visual Communications JOURNAL

FALL 2016

Volume 52 Number 2

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The *Visual Communications Journal* can be found on EBSCOHost databases.  
ISSN: Print: 0507-1658 Web: 2155-2428

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# Special Techniques in Digital Photography

by Chris Lantz, Ph.D. • Western Illinois University

## Introduction

This article will address special techniques in photography. First presented will be a step and repeat technique that expands the resolution of digital cameras by using the Gigapan robot. Another step and repeat process using Photoshop photomerge will be explained. Also to be explained is infrared and ultraviolet photography where the response of a digital chip is expanded beyond red or violet to invisible spectra of light to the human eye. Finally, the soft focus photography using optical flaws in primitive lenses to soften unwanted detail will be explained.

## Step and repeat: Gigapan

Cirkut and panoramic film cameras have been around for over 100 years. Cirkut cameras expose long sections of roll film using a clockwork mechanism where film is moved past a lens. Panoramic film cameras use a rotating clockwork lens to expose a static piece of roll film. The Gigapan robot is the modern version of a cirkut and panoramic camera, but it uses a step and repeat motor (instead of a clockwork movement) (figure 1). The Gigapan moves the camera across left to right and top to bottom taking pictures that slightly overlap. These are later stitched together with the Gigapan Stitcher program.

Images are potentially a gigabyte in size and can be enlarged to a great degree on [www.gigapan.com](http://www.gigapan.com), where they can be uploaded with Gigapan Stitcher. Gigapan Stitcher can also output large conventional TIFF files.

Gigapan Epic is for point and shoot form factor cameras. Gigapan Epic 100 is for small digital single lens reflex (DSLR) cameras. The Gigapan Epic Pro is often used with longer telephoto lenses. Many small angle-of-view photo elements can be taken with a long telephoto lens to create a much larger single file or image with the pro model. This is because the Epic Pro is built to be used with heavier high power telephoto lenses. A pro DSLR camera has a remote control plug and the Gigapan Epic Pro model triggers the camera through this remote cable.

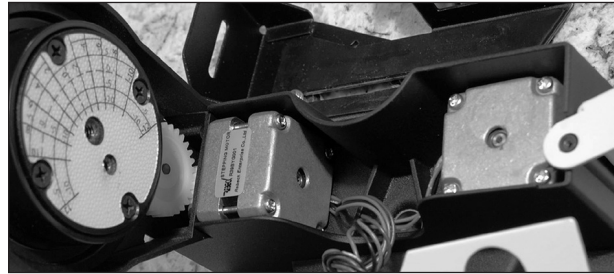
The other models of the Gigapan robot use a solenoid that pushes the shutter release button and does not use a cable. The pro model has stronger stepper motors to accommodate bigger cameras. The author recommends

that the Epic 100 and Beta imager are suitable for most applications because file sizes of 200-800 megabytes are big enough.

The first generation Gigapan Beta imager was about the same as the current models except it had a metal instead of a plastic case and can be found used for a lower price. The biggest drawback of the Gigapan robot is that they use up AA batteries very quickly. Gigapan Robots are not inexpensive to operate because one image is made from 10-70 images and point and shoot cameras are not meant for high actuations. The author suggests a good quality point and shoot camera such as the Canon G-Series because they last longer.

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**Interior shot of the stepper motors in a Gigapan Beta imager. The Beta imager has the same components as the later models but is often found used at a lower price. This Beta imager was ordered before the general release of the product.**



**Figure 1**

Operation of the Gigapan is easy because it lists instructions as the photographer turns on the Gigapan. The photographer needs to mount the camera on the Gigapan near to the lens nodal point or optical center on a point and shoot camera. A bracket is provided so that the camera lens can be centered on the point of movement of the platform. There is a procedure to set-up the nodal point but the author suggests just trial and error. Set the platform at minimum, maximum, and midpoint extension and compare the results. Midpoint works best and an adjustment to midpoint is seldom necessary with point and shoot cameras. This is because the zoom lens does not have an extremely long telephoto zoom setting, and the camera body on a point and shoot camera is compact. Nodal point adjustment is possibly more important with high power telephoto lenses on the

Pro model because of extreme magnification and a larger camera and lens form factor.

A point and shoot camera must be (1) at its maximum zoom setting, (2) on the manual focus setting, (3) the flash must be off, (4) a manual white balance setting must be set to match prevailing lighting conditions such as “sun,” and (5) the Gigapan unit itself must be leveled on a tripod. The photographer must set the upper left shot with the arrow buttons on the Gigapan robot and then the lower left with the arrow buttons (figure 2).

The photographer can review these positions or commence to shoot the photo. There is a pause button on the Gigapan if someone walks or drives into view. One set of six batteries works for one shooting session with possibly three Gigapans. Files are loaded into the Gigapan Stitcher program and then the photographer has to input how many frames in each row and how many rows were used to take the shots (figure 3). A matrix of individual photos is provided to indicate if the photo number per row and number of rows is correct.

The best two tips to better Gigapans is to carefully focus on a midpoint between subject detail and also pick a manual ISO that is the lowest number. Shallow depth of field is usually not a problem with point and shoot cameras because most are at F8 or a higher number for a full telephoto setting with any single image. Anticipating important detail in the entire stitched image made from many single images is more difficult because the entire image can have greater depth. Even an inexperienced photographer can make good gigapans if they follow the instructions carefully in the training videos on [www.gigapan.com](http://www.gigapan.com). An experienced photographer has the edge in finding the hyper-focal distance or ideal focus point and being in command of their ISO, white balance setting, and patience with testing results.

### Step and Repeat: Photomerge

A similar step and repeat concept is used with a large format camera and a DSLR camera. The DSLR is used to shoot several images within one projected image from a lens. Low priced camera mount plates are available from China that allow manual step and repeat within the image from the camera lens (figure 4). Using large format camera movements such as rear-camera-rise-and-fall as well as shift helps position the different overlapping shots.

The advantage of this technique is that Photoshop photomerge does not have to distort and blend images

**Gigapan robot controls with front and back views of the Beta imager with a Canon G9 attached.**



**Figure 2**

together and this eliminates stitching error. This is because the camera to subject angle is the same in all the shots that are stitched together because they come from the same lens (figure 5). For a more complete explanation of the shift back technique see the VCJ article in the reference list (Lantz, 2012). This shift back technique is included here for use in conjunction with the infrared and soft focus sections of this article that follow. This is because small sensor DSLR's are not matched to the large image size of older surplus film

lenses and a standard magnifying glass for soft focus. Infrared photography is often done with older DSLR's that have less than 3MP, and in this case the stitch back technique is useful for increasing resolution.

## Infrared photography

Infrared (IR) is beyond visible red light on the electromagnetic spectrum. It is used to detect heat for industrial applications. DSLR IR photography is not as sensitive as industrial video IR equipment. DSLR IR is

**A 2% (top) and 100% (middle) views of a Gigapan file. The enlarged sections have call-outs in the 2% image. Four rows of thirteen 10MP files (52 images) were used in the Gigapan Stitcher program (bottom) to create this panorama. This is a typical Gigapan with the Beta imager that has a final image size of 3690 x 7914 pixels.**



**Figure 3**



sensitive to the heat from a light source lighting the subject and not heat emanating from the subject itself. It is not sensitive enough to detect a heat signature from people or from lost heat in a house as with some industrial and military IR viewers. For this reason DLSR IR is done as an artistic effect with subjects such as

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**A Shen Hao Nikon mount shift adaptor for a large format camera. A Nikon D40 is mounted on a Crown Graphic 4x5 camera with this adaptor. A lens without a shutter can be used with a shift adaptor because the shutter in the Nikon D40 is used.**



**Figure 4**

people and landscapes and not usually for industrial application (figure 6).

IR light focuses at a different point than visible light so it appears that the light glows on the subject. This is because infrared light is out of focus depending on what f-stop is used. This glow is the artistic effect that is desired for portraits, idyllic landscapes or nostalgic architecture photography. Fresh green plants show the most IR effect (figure 7 and 8). IR photography can be color but not many colors are recorded. Some less expensive IR filters only provide a red picture. IR is more effective in black and white for this reason.

The most simple and inexpensive pathway to infrared photography is to pick a digital camera with a poor infrared blocking filter. Then use a short band IR filter on the lens that is opaque to visible light. Early digital cameras had IR cut filters that were not effective in blocking all infrared light. One example is the Nikon Coolpix 950. This is a 2-megapixel (MP) digital camera with a 28mm lens filter thread on the lens. A 28 mm “Infrared IR Filter 720nm” is available from an on-line very inexpensively. A 2 MP camera is a reasonable

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**A regular panoramic studio shot and an infrared landscape with enlarged detail on the bottom. These panoramas were created from the shift back on a Crown Graphic with an enlarging lens attached as shown in figure 4. Each panoramic shot is made from five images stitched together in Photoshop.**



**Figure 5**

resolution for digital infrared because IR imagery can be of lower image quality with more flare. Lenses designed for visible light focus infrared light at a slightly different point and tend to exhibit flare or stray light reflection to a greater degree.

Another 2MP camera (2.62MP) that works for infrared is a Nikon D1. This is an early professional camera that also had an ineffective IR blocking filter on its CCD sensor. This camera will need a 52mm opaque IR filter for a normal lens such as a 50mm 1.8. One example is the "52 mm 720nm Infrared Filter." For a greater IR effect, the IR blocking filter on the CCD sensor could be professionally removed from a DSLR camera for \$275 (lifepixel.com). Lifepixel can install an opaque IR or UV

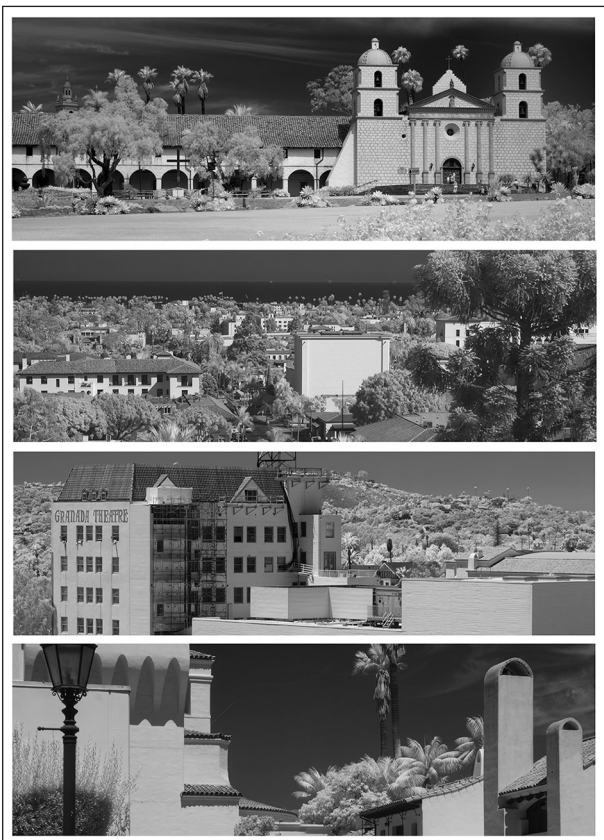
filter in place of the IR blocking filter, but this is a less versatile approach because it results in a dedicated IR-only or UV-only camera. It is best just to leave the sensor without a filter and then add an IR or UV filter to the lens. An infrared converted camera could also be found on the used market with the filter already removed or replaced with an IR or UV filter. Check the camera by opening the shutter on "B." If the chip looks black it is an IR or UV converted camera, and if it is blue it was not converted. If the filter was removed and not replaced with another filter it will appear brown or gray.

Independent repair shops can sometimes offer a lower price because old used digital cameras do not have a high selling price. The camera could be used with an IR cut or blocking filter on the lens for regular visible light photography or an opaque IR filter could be used. This converts the camera back to visible light but some color correction will be needed in Photoshop.

An "87 Wratten" is the Kodak designation for a typical opaque IR filter and it may be worth paying a higher price for a brand name Tiffen, Hoya, or B&W filter if infrared becomes common assignment (Kodak, 1968). Lee filters has an intermediate priced plastic filter option: (LEE filters 3x3" infrared #87 infrared polyester filter). The Cokin A007 infrared resin filter is another option for those who already have a Cokin filter holder.

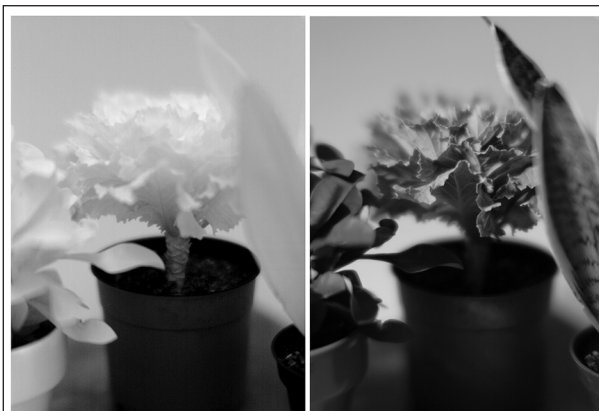
Since IR filters are opaque the photographer needs to focus without the filter. Live view on digital cameras

**Four infrared views of Santa Barbara taken with a shift back on a 4x5 Linhof Technica IV and a 125mm 5.6 Fujinon W CM lens mounted in a recessed lens board. From top to bottom is the Santa Barbara Mission, Lobero Theatre in the distance, Granada Building restoration, and Arlington Theater surroundings. Each view is made from five images stitched together in Photoshop.**



**Figure 6**

**Infrared photo taken with an 87 Kodak Wratten gelatin filter (left) and without the filter (right). A Betterlight 4000 scanback was used to take these photos. A 1000 watt tungsten hot light was used to light the photos. The plant is an ornamental cabbage. A single element dollar store magnifying glass was used to take the photos.**



**Figure 7**

**The palm tree shows greater exposure in the infrared shot on the bottom compared to the visible light shot on the top. The mountains in the distance are also more visible because of infrared reflected off of green foliage.**



**Figure 8**

works with opaque filters but is not convenient. Use a tripod and focus without the filter. Test for exposure with the filter attached because light meters are designed for visible light only. Slow shutter speeds are needed with most IR filters depending on how much IR light is in the scene.

Still life subjects work best for the first assignment with IR. Sunlight, flash and tungsten bulbs are good IR rich light sources. Make sure to use regular hot tungsten filament bulbs for indoor photography. Don't use energy savers that are cool fluorescent lights and don't have much IR. Regular light emitting diode (LED) lamps are not good sources of IR. There are IR LED lamps designed to use with IR security cameras. One example is the night vision IR infrared illuminator light lamp for the CCTV camera. An 87 filter could be used over a flash unit on the manual setting for infrared photography on a DSLR camera in the dark. An old "made in Japan"

Vivitar 283 flash on M-setting is a good flash for this purpose. Don't use the Vivitar 285 HV model for digital. A dull red light would come from the flash, but only in a very dark room and only if the subject was looking directly at it.

Digital medium format backs often have easily removable IR blocking filter's over the imaging chips. Some IR blocking filters are made to be user removable on digital backs such as the Imacon Flexframe 3030 back. It is easy to use a medium format camera without this filter and with an 87 opaque IR filter on the lens. All scan backs with linear sensors do not have an IR blocking filter attached, such as the Phase One Studiokit or Betterlight. It is easy to shoot IR with a large format scan back for this reason.

Purpose-specific IR cameras were available, such as the Fuji S5 IR model. Camera companies had a legal obligation to have a EULA end user license agreement that the photographer had to sign due to potential surveillance uses of IR cameras. One exception to this was the Sigma SD-14 camera that had a user removable IR blocking filter just behind the lens mount. This filter slides up then comes off without fasteners or disassembly (figure 9). This is not a very good camera for standard photography because of color shifts in the shadows, but is a good IR camera and may be found on the used market. An opaque ultraviolet (UV) filter could also be used on the camera lens with the IR cut filter removed from the sensor, as is detailed in the next section of this paper for UV photos.

## Ultraviolet Photography

A corning glass 18A opaque filter is used for ultraviolet (UV) photography. UV is invisible light to the human eye and is beyond violet on the electromagnetic spectrum. A UV filter is a common clear glass filter found on many cameras that is used to block UV light that can cause flare in conventional photography. An 18A is a rare and expensive opaque filter that transmits only UV light. Ultraviolet is not usually used as an artistic technique, but is practical in detecting surface anomalies in materials (figure 10). One example is undetectable water damage in buildings. UV light shows off the slight difference in reflection in paint or cement caused by water damage that is not detectable in visible light. UV light is also useful in detecting melanoma pre-cancer moles and freckles. Cancer cells reflect UV light differently than healthy skin. Regular CCD and CMOS sensors found in digital cameras are sensitive to UV light



without their IR/UV cut filter. The IR/UV cut filter needs to be removed from a camera sensor for effective UV photography. An 18A filter is added to the lens or on top of the sensor for a dedicated UV camera.

## Soft Focus Lenses

A primitive lens is essentially a simple magnifying glass. A magnifying glass is uncorrected and does not focus the edges of the image clearly. Different colors of light do not focus on the same plane, known as color fringing or chromatic aberration. Photographing through a simple magnifying glass can be a fun and challenging class project. The biggest problem is to find a shutter that is big enough to house the magnifying glass if using film,

**Hot mirror or infrared blocking filter being removed from a Sigma SD-14 camera. This filter is user removable on the SD-14 and SD-15. These Sigma cameras use proprietary Sigma mount lenses. This is a similar mount to a Pentax K-mount and K-mount lens could be used but not at far focus distances. A close up of a removed IR cut filter from a sensor in a point and shoot camera is on the bottom.**

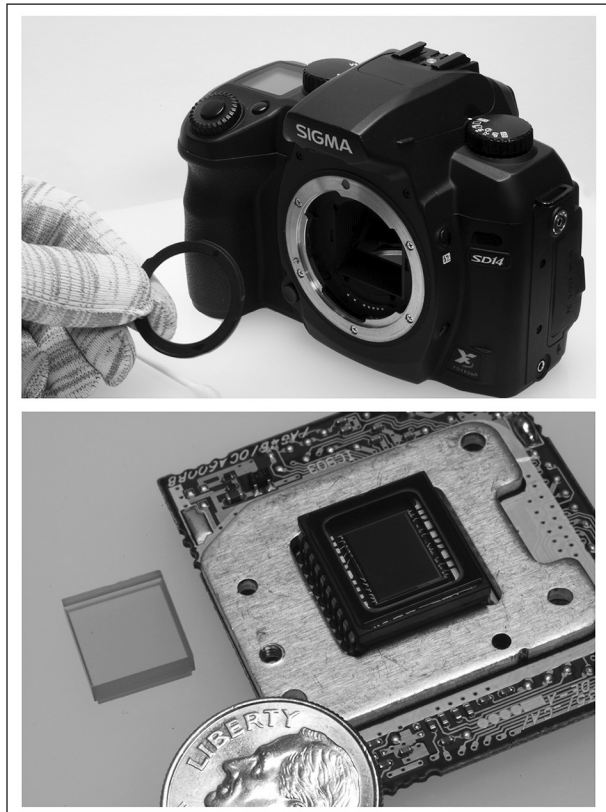


Figure 9

or a big enough digital imaging chip area if shooting digital.

**Santa Barbara mission in visible light, (top) infrared light, (middle) and UV light (bottom). Ultraviolet is often not considered artistic for outdoors photography because skies are rendered white. The bottom UV photo does show mortar water damage detail on the Mission that has been subsequently restored.**

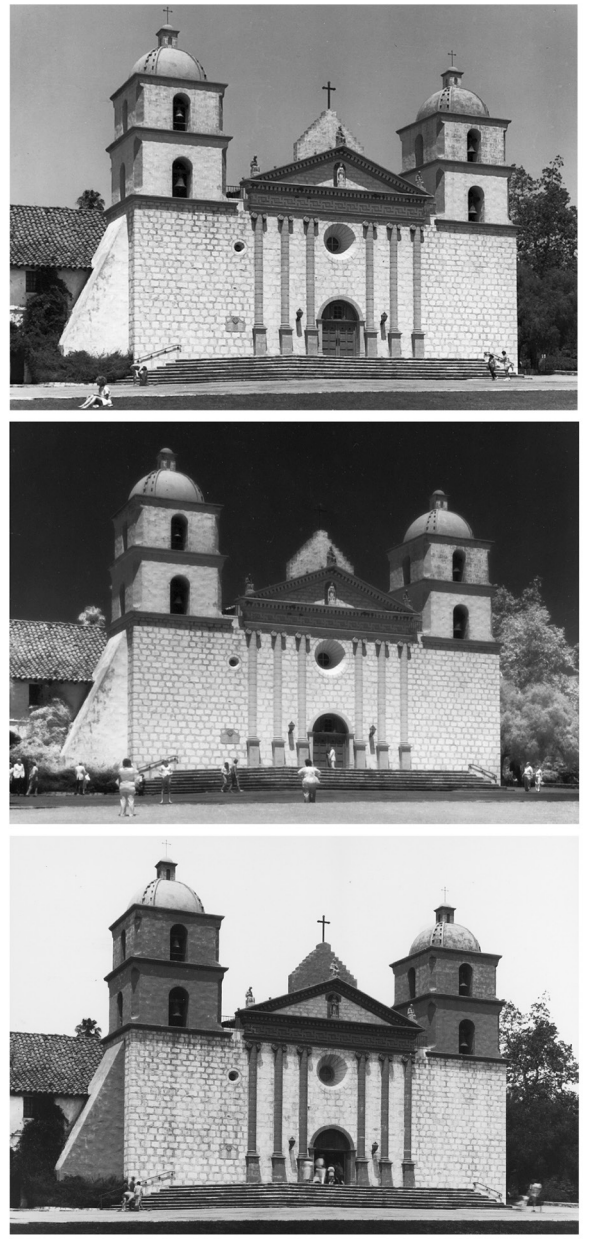


Figure 10

The problem is solved with the step-and-repeat digital technique described in an earlier section. A simple magnifying glass can be mounted in a lens board of a large format camera and then a DSLR lens mount adaptor can be used to shoot five overlapping pictures within the projected image from the magnifying glass. The image from a common magnifying glass is too big for a DSLR APS sized sensor without the stitching technique (figure 11).

Another less popular approach is to use a digital scanning back on a large format camera, as in figure 7. Some project minded photographers have actually mounted a flat bed scanner on the back of their large format camera. The problem with this later technique is that the images have dark scan lines that are hard to remove.

Another easier but more expensive approach to soft focus photography is to use the Lensbaby system. It has a simple magnifying glass optic designed for a small DSLR APS sensor. There are several lens heads that fit the third generation of the Lensbaby, giving students a good selection of different soft focus techniques. One

**A simple magnifying glass from a dollar store was taped into a Toyo large format lens board (bottom) and used to take five photos on a stitch back to create the top panoramic photo. An IR cut filter was used on the magnifying lens in the bottom photo. This was because the IR cut filter was removed on the camera mounted on the stitch back used to create this visible light photo. A Kodak 87 opaque gelatin filter is in the foreground of the image on the bottom photo that was used in figure 7.**



Figure 11

Lensbaby soft focus technique is to tilt the lens up and down and side to side. This adjusts a “sweet spot” of focus onto the subject.

**A two element glass lens, one element plastic lens, one element glass lens, pinhole and zone plate Lensbaby lens heads were used from top to bottom. Different “sweet spots” were used in the top three shots by pivoting the lenses on the Lensbaby. The Lensbaby lends a nostalgic look at a Kodak Instamatic 126 camera and flashcubes the author used in his youth. A Diana camera now gives the same effect with 120 film but no flash cubes.**



Figure 12



The Lensbaby is a popular lens to use for wedding, portrait, and food photography. The lens heads come in a single plastic element, single glass element, double glass element, pinhole and zone-plate pinhole (figure 12 and 13). A pinhole image is slightly indistinct throughout but has great depth of field range, such from the tip of a nose (in a head and shoulders portrait) to a mountain in the background.

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**A homemade Lensbaby can be less expensive. In this case a 80mm 2.8 Mamiya 645 medium format lens was used and rotated at different angles on a rubber downspout for the top photo. Rotating the lens on the downspout changes the "sweet spot" of sharpness on the authors Underwood typewriter. The disadvantage is that the lens can't focus on far distances while mounted in the downspout.**



**Figure 13**

The zone plate is a piece of microfilm with a pattern of concentric circles that has a greater overall fuzziness with a large depth of field when compared to a pinhole. The advantage of a zone-plate is that it has much greater light transmission for in-doors pictures of people.

A pinhole effect that is cheaper is to use a DSLR body cap with a hole punched in it (figure 14). Mount a piece of foil in the hole of the body cap with a pin-prick in it. Use ultra fine sandpaper for a rounder pin-hole. Try a 30 second exposure at ISO 200 for a starting point for indoor DSLR pinhole photography.

A dedicated soft focus lens is easy to find for a film-based camera. These film-based lenses can be used for digital

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**A commercially made pinhole DSLR camera body cap (top). It has a very small laser drilled pin hole like the Lensbaby pinhole lens head to make sharper pinhole images (bottom).**



**Figure 14**

photography on a medium format camera with a digital back (figure 15). A more expensive option is to use a purpose made manual focus soft focus lens on a digital camera. Try a Canon breach mount soft focus lens on a mirror-less camera such as micro 4/3 with a converter for a low price (Lantz, 2015). Large format soft focus lenses are also common, such as the Fuji 180mm SF lens. Large format lenses can be used with a shift adaptor and a DSLR camera, because they have big image areas. This technique is outlined in an earlier section of this article.

## Conclusion

Every photographer should have their own list of special techniques to enhance digital photography. Using step and repeat, Infra-red, UV lenses, and soft focus lenses provide excellent techniques to extend a photographer's toolbox.

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**A Fujinon SF 190mm f8 lens was used on a Fuji GX680 medium format camera for these two photos. The bottom photo has a star highlight reflection effect cause by a drilled disk used in soft focus lenses. These are Polaroid prints taken before the author has a medium format digital back for the Fuji.**



**Figure 15**



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