

2008 | English
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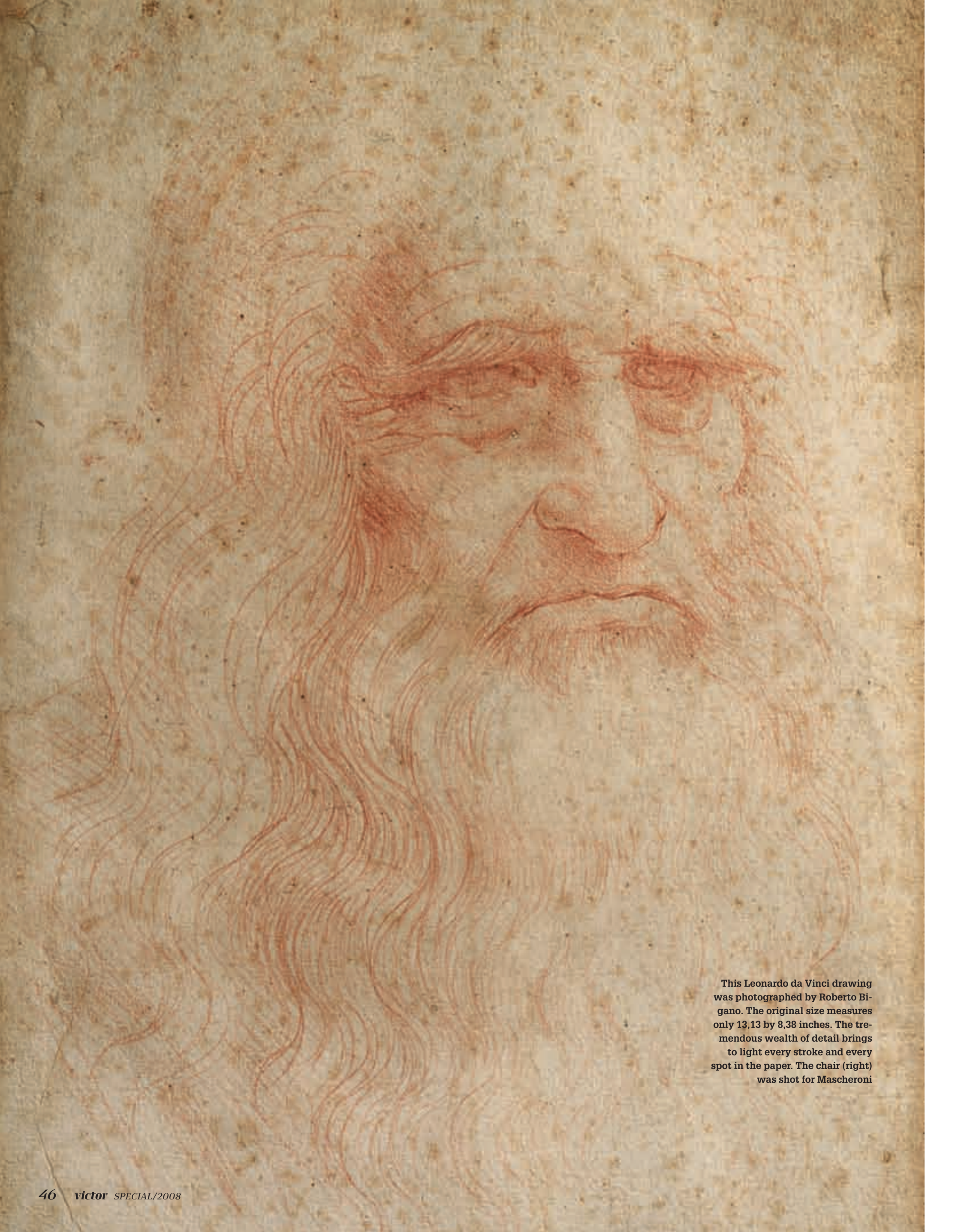
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TAKING
PHOTOGRAPHY
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This Leonardo da Vinci drawing was photographed by Roberto Bigano. The original size measures only 13,13 by 8,38 inches. The tremendous wealth of detail brings to light every stroke and every spot in the paper. The chair (right) was shot for Mascheroni

Pictures like the one made for Misuraemme have to be free of distortion and vignetting. Fortunately, DAC makes this possible – even in multi-shot images. That's why Ezio Prandini didn't hesitate to purchase a H3DII-39MS as soon as it became available

Sometimes it's the small steps that make the big difference. The multi-shot edition of Hasselblad digital cameras and backs shifts the sensor between exposures by a nominal 6.8 micrometers and, in doing so, opens up new dimensions of resolution and accuracy. Every pixel is registered for every color, greatly increasing the richness of detail and improving the color accuracy of every shot.

In 2005, Italian photographer Ezio Prandini, whose work is featured on these pages (together with work of his fellow countryman Robert Bigano), switched to a Hasselblad Ixpress 528 digital back with multi-shot after testing a number of solutions and discovering that only the multi-shot was capable of clearly exceeding the 4 by 5 inch slides he was using: "Photos taken using multi-shot possess more depth in the detail and color. Moiré disappears entirely and the sharpness can even be too much at times." When the H3DII-39MS finally hit the market, he was quick to secure one for himself: "My clients expect 100 percent distortion-free pictures, and I immediately recognized that the multi-shot, co-powered by DAC, would deliver the necessary results. And it is compatible with the amazing HCD 4/28. Now, I couldn't be happier with my equipment!"

The image quality is spectacular. Even laymen will recognize it imme-

diately: the tiniest detail in the image appears as if it had been taken at substantially higher resolution and intricately post processed. Moiré is an unknown concept to multi-shot cameras that thrive particularly well in details of an image, producing the finest tonal differentiation without a trace of noise. Multi-shot photography is limited to working with static subjects: the camera remains tethered to the computer with Phocus software installed, and the processing time is about 10 seconds. This is more than tolerable however considering the benefits: more quality and less post-production.

MULTI-SHOT FOR PINNACLE IMAGE QUALITY

"I use the multi-shot for almost everything apart from portraits – sometimes even in landscape photography," explains Italian photographer Roberto Bigano. "The multi-shot makes the best of every situation, even when you need long exposures or the air is full of dust". Roberto Bigano is a longstanding master of multi-shot technology and is frequently summoned when pinnacle image quality is of the essence. For example, when priceless drawings from Leonardo da Vinci's Codex Atlanticus were removed from their

safekeeping in Milano's famous Biblioteca Ambrosiana for a very short period, it only made sense to use the best possible equipment available on the planet for their photographic documentation. Bigano also photographed Leonardo's famous drawing on page 46 (Turin, Biblioteca Reale) which is often referred to as a self-portrait. There were certain, unforeseen side effects: "Because the exposures were so sharp, we discovered that several drawings showed serious conservation issues," Bigano says.

For still-life photographers, multi-shot yields a welcome increase in quality. In other areas, however, the camera is like a long-awaited key to hidden possibilities. Today, a sizable number of museums and galleries around the world are using multi-shot cameras from Hasselblad to document and catalog famous paintings and sculptures for which only the best camera technology can be considered. Conservators, who refer to these high-resolution photographs as a means to check their work, are adamant when it comes to the authentic, undistorted reproduction of tiniest details. For those, multi-shot is the only real option.

MULTI-SHOT VERSIONS OF ALL H3DII CAMERAS IN THE FUTURE

Multi-shot technology is not new and throughout its existence, Hasselblad has received both praise and prejudice. What photographers aren't always aware of is that every multi-shot camera can also be run in single-shot mode. Multi-shot is an option that can be activated on occasion – it is by no means compulsory. And a camera equipped with multi-shot technology even remains portable thanks to CompactFlash cards and Hasselblad's ImageBank II hard disk. It can take a beating and doesn't restrict the photographer's ambitions. The only difference between a standard Hasselblad and the 'MS edition' is two centimeters added camera depth – which doesn't interfere enough to reduce the pleasure working with the camera.

Today the equipment line consists of the H3DII-39MS, a multi-shot camera complete unto itself and the CF-39-MS, a universal multi-shot back that complies to an array of cameras. Hasselblad is extremely happy with the outstanding quality that the current multi-shot cameras and backs deliver, but this doesn't stop the company from constantly developing the technology further. Right now the Hasselblad engineers

are investigating the compatibility of the all new 50 megapixel sensor used in the H3DII-50 as well as the sensor of the H3DII-31 with the multi-shot technology. The goal is to have multi-shot versions of the complete H3DII line in the future. And there are still many more interesting ideas to explore once the sensor can be moved in very small steps – so stay tuned for the further development of this powerful technology.

MULTI-SHOT AND COLOR THEORY

Apart from some examples that are completely irrelevant in professional digital photography, sensor pixels are always coupled with color filters in so-called Bayer Patterns (VICTOR 2/2008, page 36). In the case of the sensor installed in the H3DII-39, about 20 million pixels are endowed with green filters, 10 million with red and 10 million with blue.

An image sensor carrying a Bayer Pattern therefore only sees one third of the color; either red, green or blue. The missing two colors are interpolated by the camera's firmware – or, in the case of Hasselblad cameras, in Phocus or Flexcolor software on the computer. This is simple enough if the surfaces are large and monochrome, since the information needed to complete the color information of one pixel is stored in the neighboring pixel. Interpolation becomes more complicated however in the intricate details, where the camera begins to meet the limits of its resolving power. At this level, adjacent pixels no longer contain reliable information.

The question is: how do we deal with the detail in the reproduction? We can take the 'aggressive' approach by attempting to guess the missing color or pattern but in this case, the demosaicing algorithm produces disturbances and potentially even moiré. The 'defensive' method arbitrarily allocates a neutral grey to the colors in the details as opposed to representing them as radiant and flawed. In this case, the image becomes softer, poorer in detail and seemingly less sharp. It all depends on the programmer's skill level. Hasselblad's demosaicing algorithms have been developed and refined over many years and are consistently being improved, even today.

The demosaicing process has a tendency to work far better than critical users suspect. Even mediocre algorithms easily extract two thirds of the theoretical maximum, even though the sensor only actu-

Ezio Prandini can't afford to compromise on quality. Whenever models are required or windows come into view, he shoots them in single-shot mode and superimposes them later on in the multi-shot scene – and all it takes is the multi-shot camera and a solid tripod



TECHNOLOGY MULTI-SHOT

ally registered one third. Hasselblad sensors combined with FlexColor or Phocus in turn are far more powerful, partly also because Hasselblad votes against the usage of antialiasing filters – which cripple the resolution. Image files generated through Bayer sensors are always loaded with a certain amount of unnecessary ballast, since as a tribute to the demosaicing process not all pixels contain useful information. Only the multi-shot technology can increase the resolution substantially.

SMALL STEPS WITH BIG EFFECTS ON IMAGING

Multi-shot technology shifts this at the core, using a high-precision Piezo motor to move the sensor, pixel by pixel, between exposures and registering every color for every pixel. From these four exposures the software can calculate the contents of each pixel by drawing upon real values for red, green and blue. With this technology, no form of interpolation or probability analysis is needed and misreadings are practically excluded. The quadruple amount of raw data increases the accuracy as a whole

by a third-generation multi-shot mechanism which has been further developed and patented over the years. The symmetrical design compensates for thermal fluctuations and transports the sensor with nanoscopic precision. The Piezo drive containing the sensor mounts in front of the (otherwise unchanged) digital back unit.

Every multi-shot back is calibrated at the factory under the most scrupulous conditions and can be fired reliably for continuous, high-stress operation. Multi-shot backs can also be mounted on view cameras and third-party bodies, the only prerequisite being electronic exposure compliance – using the computer-regulated multi-shot mode to generate four exposures in quick interval.

PRACTISING WITH MULTI-SHOT

In terms of handling, there is little difference between an exposure shot with a multi-shot camera and a customary single-shot. The photographer connects the camera to the computer, boots up the Phocus or FlexColor software, selects multi-shot as the exposure mode and

a little work and care. However, the multi-shot camera will achieve this result from the ground up – and with a higher quality, as every photographic pixel and byte will contain valuable information. The sharpness isn't achieved through digital post production but, rather, in a more 'natural' and appealing way.

It's difficult to quantify the extra something that multi-shot provides. In conventional tests the multi-shot perceptibly renders more line pairs than the respective single-shots. However, here's something that isn't always appreciated in standardized tests: even the smallest nuances such as color droplets in fabrics, which single-shot cameras will simply just desaturate to be on the safe side, are color-accurate down to the last pixel. Paradoxically, it's thanks to modern technology that the picture is endowed with a certain naturalness – where the sharpness isn't generated through digital manipulation but, rather, through optical means. This saves a great deal of time in post production, especially if a super sharp and clean image is what you want.

Ezio Prandini claims that digital images taken with multi-shot have a unique aesthetic, much differ-

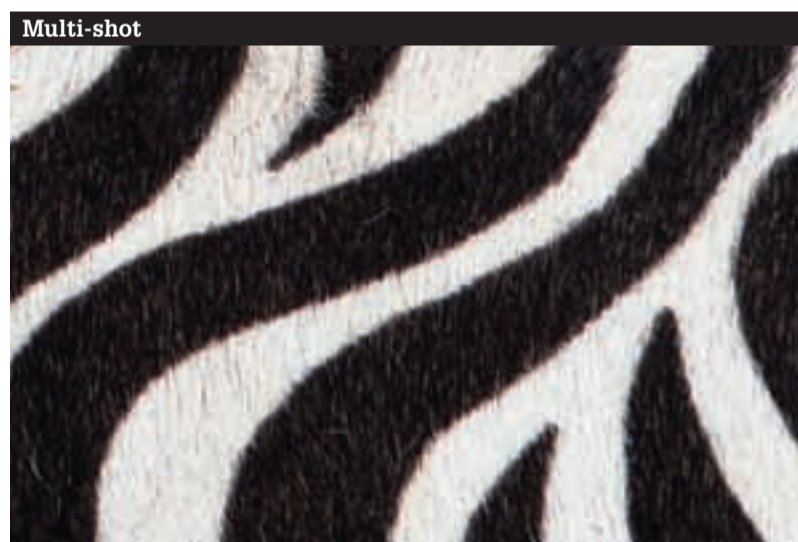
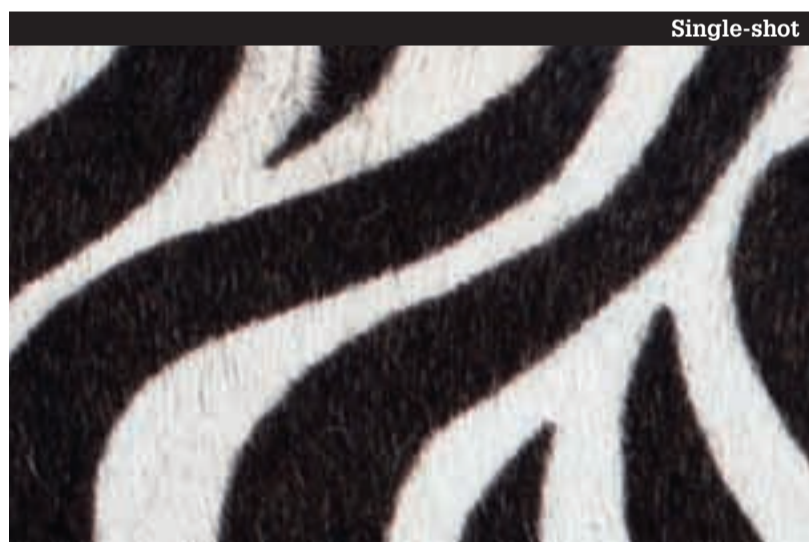
ently impossible. When the subject involves people entering the scene or a window on the outside world, he likes to combine single exposures with multi-shot images, taking the 'moving parts' from the single-shot images and preserving the multi-shot quality for the rest. "First I'll photograph the people who move in accordance with the instructions of the art directors. In single-shot mode I can shoot as many people as I want and, in the end, create a good multi-shot of just the scene alone. On location it can be difficult to control the scene outside the windows, so I'll simply mount part of the window, taken in single-shot, in a perfect multi-shot image of the interior."

CALLING ON THE LAST RESERVES

If you're an avid still-life photographer who works with multi-shot technology, you'll have already experienced the benefits of spending less time in post production while getting the best quality possible with the only sacrifice being a longer exposure time.

Today this is all too tempting. If you're seeking optically perfect,

Small details, smooth sofa textures and fine zebra hair – a total nightmare for just about any digital camera but the ideal moment for the H3DII-39MS, which solves this problem in a matter of ten seconds. The image was shot for Bonacina



The difference of single-shot and multi-shot mode is plain. Both images are crude, printed with default sharpening and no other correction in 100 percent view to show the pixel level. Without post production the multi-shot image is razor sharp right off the bat

and minimizes noise. Because of the Bayer color pattern, green is registered twice to increase its precision yet again and thereby also to enable the software to give off a warning signal if something has moved between the exposures.

The technical condition for multi-shot photography is a motor powered by Piezo actuators, which moves a frame with the CCD sensor inside it. The Piezo actuators operate within a 10 micrometer field, shifting the sensor between exposures by exactly one pixel – i.e., 6.8 µm in the case of the 39 megapixel sensor – about one-tenth of the thickness of a human hair.

The H3DII-39MS and the CF-39-MS back are already powered

finally – this is the difference – leans back for about 10 seconds while the software fires a control exposure followed by four individual frames in the (adjustable) interval of about one second. It then takes another couple of seconds for the software to generate the final image combining the four exposures. The result is nothing short of phenomenal.

The key difference between a single-shot and a multi-shot exposure is probably the fact that a multi-shot exposure tends to be outstanding from the word go. It's as sharp as it gets, whereas a single-shot exposure can often look a little soft at pixel level and require careful tweaking. A single-shot photo will, without a doubt, deliver a sublime result with

ent to that of film: "The sharpness is increased beyond belief. It can be great for one kind of picture, bad for another, and new for some other area which we are yet to discover, understand and appreciate." Using a digital multi-shot camera instead of a film view camera has completely changed the way he works: "I normally work on large sets or on location, and I remember the nightmares we used to have testing the lighting and styling with Polaroids, a medium I still love today. Now however, I connect the camera, shoot as much as I want and reach a level of precision and quality never before experienced."

As demonstrated on pages 50/51, Prandini likes using multi-shot even when you'd think it was techni-

unadulterated images of the world at large, there is practically no other way except Hasselblad's exclusive multi-shot technology. Multi-shot exploits every available capacity of the digital sensors made by Hasselblad. "Compared with old technology, today's digital files, cameras and accessories provide us with an amazing spectrum of possibility," says Ezio Prandini. "It's clearly the dawn of a new era. We need the humility to learn new technologies, new approaches and new ways to solve our daily problems. And it's a challenge that gives me a great enthusiasm for my work and passion".

For further information please visit www.hasselblad.com