

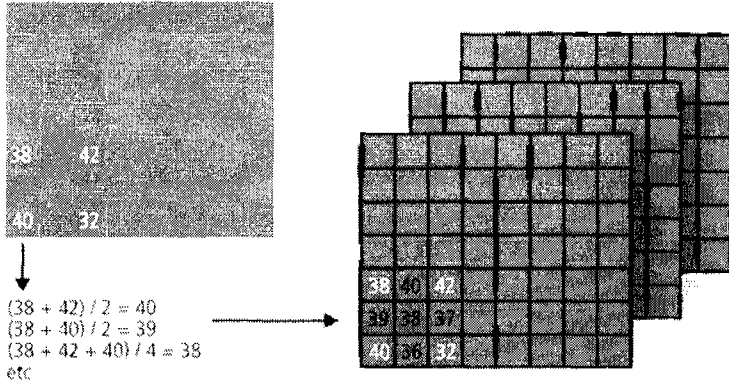


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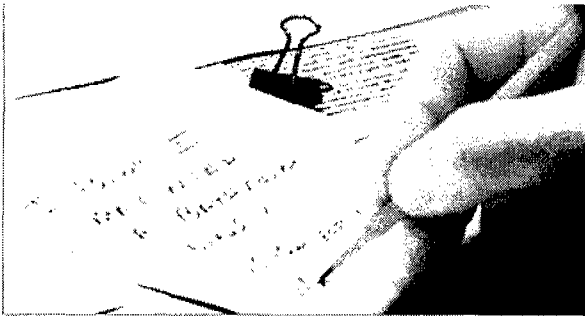
**Camera Fingerprints**

Digital retouching rarely leaves behind a visual trace. Because retouching can take many forms, I wanted to develop an algorithm that would detect any modification of an image. The technique my group came up with depends on a feature of how virtually all digital cameras work.

A camera's digital sensors are laid out in a rectangular grid of pixels, but each pixel detects the intensity of light only in a band of wavelengths near one color, thanks to a color filter array (CFA) that sits on top of the digital sensor grid. The CFA used most often, the Bayer array, has red, green and blue filters arranged as shown below.



Each pixel in the raw data thus has only one color channel of the three required to specify a pixel of a standard digital image. The missing data are filled in—either by a processor in the camera itself or by software that interprets raw data from the camera—by interpolating from the nearby pixels, a procedure called demosaicing. The simplest approach is to take the average of neighboring values, but more sophisticated algorithms are also used to achieve better results. Whatever demosaicing algorithm is applied, the pixels in the final digital image will be correlated with their neighbors. If an image does not have the proper pixel correlations for the camera allegedly used to take the picture, the image has been retouched in some fashion.



My group's algorithm looks for these periodic correlations in a digital image and can detect deviations from them. If the correlations are absent in a small region, most likely some spot changes have been made there. The correlations may be completely absent if image-wide changes were made, such as resizing or heavy JPEG compression. This technique can detect changes such as those made by Reuters to an image it released from a meeting of the United Nations Security Council in 2005 (above): the contrast of the notepad was adjusted to improve its readability.

A drawback of the technique is that it can be applied usefully only to an allegedly original digital image; a scan of a printout, for instance, would have new correlations imposed courtesy of the scanner.

*Datagoid  
or  
Sweetcase*