My Digital Shoebox

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One of the most surprising revolutions in the past 15 years has been the transformation of film-based cameras to all-digital cameras. It's one of those events that seemed so unlikely before it happened, but so obviously the path for progress afterward. In fact, this single event has probably done more for the creation of digital user-generated content than any other.

Prior to 1997, most people I knew owned a film camera—either the high-end variety or a point-and-shoot one. Plenty of neighborhood stores would develop your film in a variety of formats, and some would even offer you one-hour turnaround if you paid a little extra. Making photo albums has always been a popular past-time, but in practice, most of us take so many photos, that the majority end up being stored in a pile of boxes—typically, shoeboxes—stacked on top of each other in a closet. If you're the organized type, you might have scribbled a date, event, or year on the side of the box. But in my case, most ended up unlabelled, so that many years later, the only guidance I have is my own memory of the people, places, and events to help me correctly deduce the year.

If you had asked most people in 1996 if they would trade in their film camera for a digital one, the most likely response would have been, "Why?" This was a case of the original technology being very well-honed—the photographic reproduction and color was as good as anyone could hope for, plus the cameras themselves were often a marvel of optomechanical engineering, resulting in a complex device small enough to drop in a shirt pocket. Even before the technology went all-digital, many film cameras had electronic features to make them easy to use, such as

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autofocus, self-timers, and digital date/time stamps superimposed directly on the negative. However, digital cameras were still able to replace these optical marvels within roughly five years—I still remember the excitement at the Comdex tradeshow in 1997 upon their introduction.

The motivation for digital photography is now very clear, and to understand why the revolution happened, it's worth recapping the advantages of this digital medium. First, you can take as many photos as you want without being limited to, say, a 36-exposure film cartridge and agonizing over whether you should use up the last few shots in case a better opportunity came along. In comparison, even the early digital cameras could store a few hundred shots. Each year, we benefit from the exponential growth of flash storage technologies, which lets us store significantly more photographs on a small memory card. Today, a commercial 4-Gbyte SDcard lets you store 2,000 high-quality (typically 2 Mbytes) photos on a stamp-sized device. As one colleague said to me recently, the limiting factor on a typical roadtrip or vacation is no longer the photo capacity but the camera battery's lifetime. Other digital advantages include the ability to see your photos instantly on the camera's LCD screen, and verify the composition or that nobody pulled a face. You can also readily delete your mistakes and only keep the best material.

And after you return from a trip, uploading your photos to the now ubiquitous home PC provides a host of additional benefits; in fact, if PCs didn't exist when cameras turned digital, would the digital photo revolution have been so rapid? After all, the PC lets you take pictures in poor lighting or with artifacts such as red eye and still be reassured that you can correct the problem

later with a photo editor. Your PC or laptop typically has a large-screen LCD monitor for showing photos to friends; you can even connect your PC to a TV through a set-top box, such as a networked TiVo, and bring photos into your living room (some cameras have a direct composite video output that enables them to directly connect to your TV). Emailing photos is a simple drag-and-drop task, and sharing via Internet sites such as on Flickr.com enables the automatic creation of photo Web pages, which opens up a new social dynamic of mutual commentary with groups that you might not even know. Through these sites, you can also order select photos to turn into high-quality prints or print them at home on an inexpensive ink-jet printer. Alternatively, you can transfer them to a digital photo frame and continuously update them. Ultimately, this revolution has greatly simplified my storage solution—I no longer need stacks of shoeboxes. Instead, I can keep many years of photo data on a single computer hard drive or copy them to a small manageable number of DVDs. Storing these disks in an appropriate place is, of course, another consideration, but I calculate a single shoebox is large enough to take care of my photo storage needs for many years to come.

While thinking about all of this, I began to wonder how my own digital photo collection had grown over the years, and with a little research, I captured the history and determined the total disk size my media has occupied for each year from 1998 to 2007, the total number of photos I've taken, and, by sampling representative photos for each year, each photo's average size. Back in 1998, just after the first mass-market digital cameras became available, I took only a few photos, totaling roughly 590 Kbytes, with each photo occupying roughly 50 Kbytes. At this time, I also used a film camera, so I hadn't completed the digital transition, and for good reason—the quality wasn't there yet. By 2002, I had purchased a 3-megapixel device, as
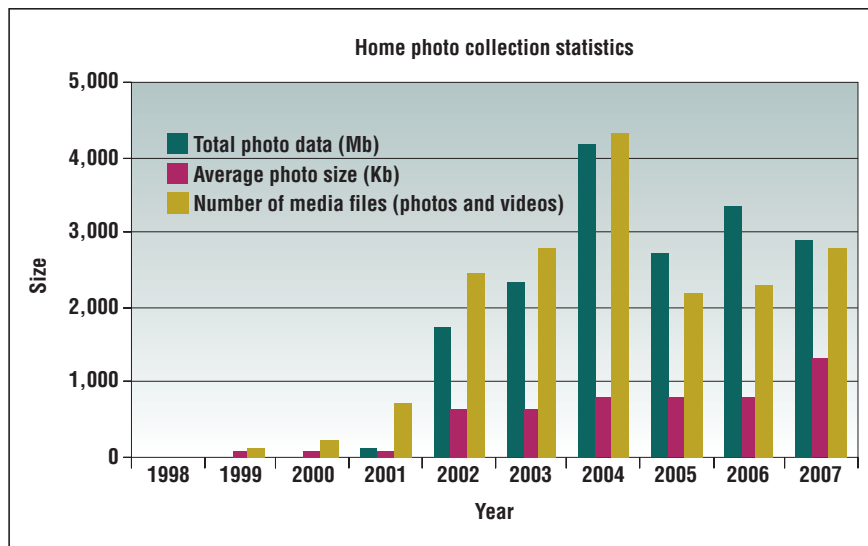
did my wife, and for the first time, my family's user-generated data for one year exceeded 1 Gbyte and continued to ramp up for the next two years. In 2004, we upgraded to a 4-megapixel camera with a three-minute movie mode, and this (along with my eldest daughter's enthusiasm for making movies), resulted in my current family record of generating 4.1 Gbytes of data in one year. The market trend was clear: by 2005/6, digital camera sales exceeded those in the film-camera market. The data my family generated from 2004 to 2008 fluctuates between 2.5 Gbytes and 4 Gbytes per year, which represents the impact of many factors, such as the dulling of the novelty factor, children growing up and now owning their own 6-megapixel cameras, and more critical filtering when uploading content.

Given all this interest in photography, you're probably wondering why I haven't invested in a digital single lens reflex camera. The reason is simple: most of the photos I value are taken serendipitously, which means having a camera with me whenever possible and hence the ability to drop it in my pocket when not in use. Although my current digital camera is pocket-sized, I still need to remember to take it with me. However, I've recently

noticed another trend that affects my camera usage: my new cell phone has a respectable 2.1-megapixel camera built in, and as I'm more motivated to carry my cell phone than an additional camera, I now really do have a camera with me all the time. Searching the Web, I find that data forecasters expect roughly 60 percent of all cell phones sold in 2008 will be camera phones. This amounts to roughly (1.25 billion × 0.6) 3/4 of a billion camera phones on top of a sizeable installed base. Although many support only low-resolution cameras, it's clear that the trend is upward, and soon a large percentage of the world will be able to capture high-quality content anytime, anywhere.

Along with PCs and cell phones, digital cameras have become a key enabler for many pervasive computing applications. In this special issue, you'll find a collection of articles describing the exciting opportunities opened up by user-generated content covering a wide variety of media. In today's pervasive computing world, we all have the opportunity of augmenting documents, the Web, and mobile applications through the ubiquitous creation of digital media. ℙ

Figure 1. Comparison of my digital photo data captured from 1998–2008.