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## Reflections on the PC Environment

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The PC world was far simpler when I began writing PC tech columns in 1992. Many of us relied on diskettes for storage; if we had a hard disk, it held only a few hundred megabytes. Software was distributed on diskettes, and its box usually contained a manual. Windows 3.1 appeared that year, and it was the first version that was really practical, but many continued to use DOS. Significantly, Windows required a hard disk; when we used DOS, two diskette drives provided adequate storage. The PC was undergoing a transition from an experimental and educational toy to an essential information appliance. The Internet was available only to governments and large corporations, although some exchanged messages through software bulletin boards, which they accessed (slowly) over telephone lines using dial-up modems—even simple configuration changes required opening the system case to access jumpers and expansion cards. There were frequent PC shows where dozens of vendors sold hardware and software. Bookstores had extensive collections of PC books and magazines. It was an exciting time for us.

The situation is far different today. Most PC users, excluding those reading articles like this, have no interest in what goes on inside the box. They would no more open a PC case than a dishwasher cabinet. As a result, PC books, magazines, and parts vendors have largely disappeared. This is good for most folks who want to communicate with friends and family, surf the Internet, and prepare taxes. But it can be frustrating for those of us who see the larger potential of the PC. However, the barriers are superficial, and the experimental and educational world is still alive, well, and accessible on the PC. We must exercise more care while experimenting with our PCs than we did years ago because it’s become a vital tool in our lives and holds valuable information we have to protect. Let’s look at some of the opportunities.

For years, I took pictures with a 35-mm camera, and film and processing cost about a dollar a click. Editing required a darkroom, expensive equipment, and smelly chemicals, and few did it. Today, we don’t use film; bytes are free, and image processing software costs vary from reasonable to free. Any imaging program can do things that darkroom users couldn’t even imagine. When you’ve finished the processing, you can send the results anywhere in the world for free or, if you have a suitable printer, commit it to paper. Image editing can be complex, and it takes some effort to learn, but there are very few photos that can’t be improved, many substantially. I use the GNU Image Manipulation Program (GIMP), <https://www.gimp.org/>, to retouch JPEG image files. Your camera compresses images to produce JPEG files and discards information in the process. You can often recover this by working with images before they are compressed, using RawTherapee, <http://rawtherapee.com/>, or darktable, <https://www.darktable.org/>. These are complex programs that require some effort to master.

Early PCs limited your programming to BASIC, which, as its name implies, has quite limited potential. However, we have a much wider choice today, including Python, <https://www.python.org/>, which provides an accessible start to programming and includes widespread features among all programming languages. In addition, the required software is free, and although some support tools are not, they aren’t really necessary.

Experimenting with operating systems does require care, as what seems like a simple configuration change can wreak havoc and sometimes require re-installation. (Ask me how I know.) For this, I prefer using a virtual machine, such as one managed by VirtualBox, <https://www.virtualbox.org/>, for this. In the past, I used dual-booting to install an alternative OS, but this requires re-partitioning the hard disk, which is risky, and the UEFI BIOS in modern PCs has features to protect the installed OS. Working around these requires non-trivial expertise. Your OS views each virtual machine as an application, which avoids all this risk and complexity. If you want to experiment with Windows, you’ll have to buy the software, as the virtual machine is legally a different machine. Of course, you can experiment with Linux for free.

Arduino, <https://www.arduino.cc/>, provides an inexpensive way to experiment with both hardware and software. This microprocessor on a small board plugs into a USB port on your PC, which supplies the power for the board and communicates with it. You program in a variant of C++, which you compile on your PC and download to the Arduino. It’s easy to connect the board to external circuits, so this provides a way of learning circuit design and programming. Since all the action takes place off your PC, the risk is minimal.

The Raspberry Pi, <https://www.raspberrypi.com/>, provides a considerably more complex environment than the Arduino. This is a complete PC on a circuit board about the size of a playing card. While the Arduino is a controller that runs only a single program at a time, the Pi is a complete computer running Linux. You’ll need a display, mouse, and keyboard to get started, making this more difficult than an Arduino. However, you can use its peripherals if you have a desktop system. (You might use a USB hub to consolidate the keyboard, mouse, and printer cables. Then you could switch between your PC and the Pi by swapping just two cables, the USB from the hub and the HDMI from the display.) After configuring the Pi, you can connect it to your home network and access it using remote desktop software on a PC; it won’t need dedicated peripherals until you install a new OS on the Pi.

Fabricating objects used to require a shop and tools, but now it can be done with only a 3D printer, about the size of your existing one. You design an object using CAD software, transfer the file to the printer, and (perhaps some hours later) return to find the completed object sitting in the printer. This is an emerging technology and presently is quite limited. Printing is slow, set-up is fussy, and the material is usually plastic, but things are rapidly improving. For example, I recently saw a device, <https://snapmaker.com/>, that could also machine aluminum and cut sheet material and create with plastic. Currently, the projects are limited to small enclosures, key fobs, game tokens, or similar small objects, but this will surely improve.

To learn about electronics, instead of acquiring a collection of tools, parts, and instruments, you can run experiments with a circuit simulator, such as KiCad, <https://www.kicad.org/>. It lets you build circuits with simulated resistors, capacitors, inductors, transistors, and integrated circuits, then test the result. The next step would be to use an Arduino with a prototype board into which you plug physical components to build circuits you’ve simulated. Kits that facilitate this are available from such vendors as Adafruit, <https://www.adafruit.com/>. Because you are using Arduino to generate signals and detect the result, this approach limits you to low frequencies.

If you play a musical instrument, you probably have a collection of scores, some of which are barely legible. However, you could input them into a score composing program such as MuseScore, <https://musescore.org/en>, to make corrections, transpose them to a new key, or just clean up the appearance.

These examples reflect my interests and my preference to use open-source software; your interests and preferences are undoubtedly different, but perhaps these examples will inspire you to search for some that would help you. In the past, we relied on PC magazines to suggest areas to explore. There are many more interesting and useful tools today, but it takes more effort to find them without magazines. Don’t let your PC become just an appliance; it can be a wonderful tool to help you enjoy life.

I’ve been writing these articles for a long time, have about run out of things to say, and it’s time to retire. Thank you for your attention over the years.