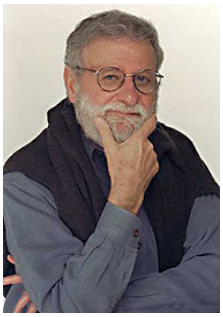

PREFACE

APPLIANCES OF THE FUTURE

Donald A. NORMAN

We have truly reached the era of "The Invisible Computer." In the office and home, automobile and school, embedded computers make our lives more enjoyable.

Even the copying machine has become a computer, or more precisely, a general purpose document device. But it still can be made simple in appearance, easy to use. It doesn't look like a computer - and it shouldn't. On the outside, it looks like it always did: put something down on the glass plate, push a button, and out comes the copy. But the copy might be from an original produced half-way around the world. Or it might have been retrieved from a storage archive. In fact, it may be an original, for what does "copy" mean when the original is a computer image? The copying machine can transform the document: enhance it, modify it, send it around the world or store it. It can find the text and read it, perhaps aloud. It can translate the text, and send the translation around the world, perhaps speaking it aloud. After all, what is the differences between machines that scan, copy, manipulate, combine, compose, fax, or print in a world where everything is networked: answer, there is no difference.

But why stop there? A copying device should copy anything: music, photographs, videos, speeches, text, and even objects. Someday it will be a 3D copier, so you can place a real, physical object on its platen and end up with a physical, three-dimensional copy, and of course, this copy can appear anyplace in the world. Put a coffee cup on the platen in Tokyo and have a copy appear in London. (Copying objects has already been done in research laboratories. Today, stereolithography only makes plastic copies and although we know how to photograph and then reproduce a physical coffee cup the same size and shape as the original, we don't know how to reproduce the coffee.)

Now consider how this same thinking can be applied to almost anything. In the past, technology has done much to aid our lives: we are highly dependent upon the technology of today for our homes, clothes, food, and transportation. We interact with colleagues, friends, and family through the technologies of mail, email, and telephone, complemented by short messaging technologies, some on our computers, and some on portable devices we carry around, such as the cellular telephone. Technology has advanced our lives while also horribly complicating them. But the complications need not accompany the enhancements.

The future for appliances is unlimited. Where do we find ideas? Look around you and see where people are having difficulties. Look at social interaction, business meetings, and everyday life. Anyplace there is irritation, anytime you find yourself doing something you would rather not do (for example, all those meetings), thee is an opportunity. Some of my best inspirations come from the publications of Kenji Kawakami and the Japanese Chindogu Society (Kawakami, 1995; Kawakami & Papia, 1998). Brilliant ideas, all from inspired minds watching everyday activities. I recommend them to everyone for a source of wonderful, fertile ideas. Some of you will think I am joking, but I am not: yes, Chindogu is a joke, but the ideas show brilliant observations, coupled with true invention to satisfy the need that was noticed, coupled with a sense of humor. What more could anyone ask for?

Of course, if you actually manage to make a Chindogu "appliance" into a successful product, you destroy the spirit of "Chindogu": Rule One of the ten rules of Chindogu is that "A Chindogu cannot be for real use." But Rule Four states that "Chindogu are tools for everyday life." And that is what we all need: tools for our everyday lives.

As the computer becomes ever more powerful, small, and inexpensive, as communication becomes part of everything, the potential for enhanced social interaction, work patterns, education, and entertainment are enormous. At the same time, the potential for disruption is also enormous. The new technologies will impact our social interactions, changing the standards for politeness and courtesy now observed. Machines will become smaller and ever more powerful. More and more of our lives - and the necessary technological infrastructure - will be controlled by machines.

Finally, as these devices get smaller, less expensive, and more powerful, they will be important and useful enough for us to want to have them with us at all times. It won't be long before some are implanted within the body, much as organ replacements, limb, and sensory system prosthetic devices are implanted today. Many will do this voluntarily, without medical need, the better to enhance memory, reasoning, vision, or athletic ability.

Just imagine being in a foreign country, able to point the lens of a hand-translator at any text and have it appear on the screen, translated. The concept has already been demonstrated in the laboratory. Or imagine a memory aid that whispers in your ear the name and personal information of the people approaching so you can greet them by name and ask how their child did in the science contest. Will it someday be implanted into the body as a bionic supplement to human memory? If so, what implications does this have for schooling, for education, when a worn - or someday, implanted - device takes over the need to memorize?

Once I imagined a device called "The Teddy," given to each new child in the form of a Teddy bear, but which changed form throughout its owners' lifetimes to fit their maturity and lifestyles (Norman, 1992). The Teddy aided and comforted its owners throughout life, helping them learn, and retaining all of their experiences. Such a device would be far more effective implanted in the body rather than carried about. The science fiction author Neal Stephenson imagined a similar device - a book called "A young lady's illustrated primer" - that acted as an intelligent tutor for children, teaching them far more effectively than normal schooling (Stephenson, 1995).

These examples demonstrate the power of several of the most important changes coming over our technologies: First, the technology is smaller and smaller, so small that they are easy to carry about. Someday they will be so small that they can be implanted into the body. Implant a bionic device into a person and you have a Cyborg: part human, part machine. We already have cyborgs, but for medical reasons: artificial limbs, sense organs, body organs, and pacemakers/defibrillators. These are medical necessities. The new race of cyborgs will be different: now the implants are simply to enhance their normal, natural abilities. Second, the camera will be ubiquitous, built into our devices - as in these the examples of "The Teddy" and "The illustrated primer" - but so pervasive that we can never assume we are alone, never in private. Third, they communicate endlessly, with their owners, other people, other devices, and in the case of the translator, with large databases of information located in remote machines, the better to enhance the quality of the information being provided. And inside all of these devices, of course, is the computer chip, enabler of so many things.

Those are examples of smart, intelligent devices, but still single-function devices intended to serve a purpose. We will also see the emergence of autonomous devices - robots - that can wander about the world, unaided and unguided. Robots will have to be able to set their own goals, develop their own methods of approach, and communicate both with other robots and machines and with their human masters. Intelligence requires emotions: the robots will have to show fear and affection, have pain and fatigue, be surprised (ever see a machine be surprised?), and show caution when necessary, be aggressive and exploratory when necessary. Robots, if we expect them to get better at what they do, will need pride -- pride in the quality of their work.

The internet has clearly changed the way we do business all over the world. Once it becomes wireless, it will change even more. I won't comment on i-Mode or SMS, except to note that this is a technology that is difficult to use, yet leads to billions of messages every month: when something that is difficult is so popular, you know it must be fulfilling some very important function. Once it was for teen-agers, but now it is becoming an essential part of business activities. I watch managers at meetings looking down at their laps instead of paying attention to the meeting, while their thumbs busily type short messages to and from friends, lovers, family, and even the people on the other side of the table.

Postage scales, those small devices found in small businesses and even homes, that weigh the mail and determine how much postage should be applied. Except that they are connected to the internet, so that if postage rates change anyplace in the world, the scale instantly compensates. In other words, it is more than a scale, it is an information appliance. Soon it will advise on the best method of shipping and it will help you fill out any necessary custom forms.

My audio CD player looks up each CD on the internet so

that it can display the name of the music, the composer, and the orchestra. (If you are reading this article several years after I wrote it you may not use a CD is anymore because it will have been replaced by some other medium, but the point is still the same: looking things up on the internet has become a way of life for many of us and soon will become essential for all of us.) This is done without our even noticing. Both the music example and the scale example are done so quickly and invisibly that we forget the internet was used: we simply know that the information we need is available.

THE TECHNOLOGY OF FUTURE THINGS

It is easy to predict some of the directions in which items of the future will move: They will merge several different technologies into one - computer chips, memory, communication, displays, and sophisticated sensors and output mechanisms. This means they will be able to sense their environment through sound and sight, infrared and laser beam. Some will be portable, others will move themselves. Some will be built into our buildings, furniture, and vehicles. Some will talk with us. And they will all be a lot more powerful, smaller, and less expensive than the technology of today. But as we start deploying the technology into the devices of the future, we must always remember that the goal is to help people, to interact gracefully and to serve real human needs. A human-centered design process is ever-more essential, a process I described in "The Invisible Computer." (Norman, 1998). Here are some of the issues to contemplate.

Intelligence

Now, normally intelligent is good, but not always, for intelligence can be misapplied, it can be condescending, imperial, and smug. Intelligence often leads to just the wrong conclusions, made worse by the possessor's arrogance. Our smart things of the future will have all these characteristics: useful, invaluable, and authoritative. Smug, self-centered, arrogant. Irritating, and even dangerous. In other words, like all technologies, they will simultaneously be a boon and a bust.

Communication

The second powerful addition to future things is communication, the ability for one device to communicate with another over both short and long distances. Communication, like intelligence, will be ubiquitous, such a constant feature of our things that we will only be surprised when it is lacking. Short-range communication will be through light, infrared, or very low power radio signals. Medium-range will be by radio and long range through the wired and wireless capabilities of the worldwide telephone and internet networks. Once again, technologies take away as much as they give, and whatever wonders will occur when our machines can do things for us, silently communicating with one another, there can also be horrible harm when these communications are taken over by terrorists, hard-doers, curious students, or just poor programming. Moreover, communication does not mean understanding. Although any device will be able to connect to many other devices, to make this work effectively will require much patient negotiations for international agreements on the rules, protocols, standards, and translators to make effective communication possible.

The computer chip

The major component in all of these changes is, of course, the computer, or more precisely, the semiconductor chip that serves as the computer processor. I find the home personal computer, the PC, dull and boring. The future does not lie with the PC: it lies with the power of computation, coupled with ubiquitous communication and specialization of form and function. The future is most definitely not about the PC, even if beneath the surface of almost all that I cover is a computer and a communicator. Keep it out of the way, below the surface, and I am happy. Inflict its inhuman, impolite temperament upon us and I am dismayed.

Control

Intelligence and communication means little without some way for us to interact with these things. Many of the interactions will be so natural that we will be unaware of them. Thus, drive your automobile just as always, using feet for acceleration and braking, hands for steering and signaling. Meanwhile, sensors will examine whether the auto is traveling in the correct direction, whether the wheels are skidding. Yet another system will analyze the speed and the distance from the autos up ahead, measuring that a safe distance is always maintained. These actions inform the auto's computers to allow them to control the engine to follow our intentions, shifting when necessary, applying the brakes when necessary. A directional system analyzes radio signals from satellites, thereby determining precisely where the car is located not only to give instructions, but to anticipate traffic jams and detour around them. Truly smart systems will even recognize that everyone else's auto will be taking the same detour, and will even attempt to avoid the anticipated traffic jam.

Some day even the driving will be done through smart

systems, reducing accidents and allowing more efficient use of highways, for automated systems will be able to travel at more constant speeds and at closer distances. Once again comes the two-edged sword of technology. Not everyone will welcome the inability to drive and the implied loss of control. And although accidents will be far less frequent and the total death and injury toll smaller, when accidents do occur, they will be larger and more catastrophic. And when the automatic systems become inoperative, as they most certainly will, the entire nation might be brought to a halt.

Displays. Advances in the display of images are increasing rapidly. First there are the physical display devices themselves, becoming less and less expensive while simultaneously more powerful. High-definition color will be ever present, without the high cost and battery drain that they now entail. Almost every surface will have the potential to support a projected display: walls, tables - anything. Some displays will be flexible, so you can roll them up and put them in your pocket. Others will be tiny, worn on the body either as head jewelry or tiny attachments to eyeglasses, projecting their image directly onto the eyes. From these tiny projectors will come the most powerful images of all, for to the eye, they can appear huge and detailed, changing the images in synchrony with head and eye movements to make the display appear all encompassing.

The power of physical displays is being matched by advances in the science of creating images. Couple powerful images with intelligence, and soon we will have virtual images prancing about our screens. The synthetic will be indistinguishable from the real. Imagine an education system where students can see in exquisite detail the things being talked about. Prospective physicians could dissect the virtual body and practice their techniques on artificial beings. Architects and designers could display their products to clients in life-like realism, but without the extreme cost of physical construction. Science itself will be enhanced through these tools of visualization and exploration.

Education, entertainment, and sports - all will be transformed in ways only imagined today. Of course, in a world where the virtual can no longer be distinguished from the real, what can we trust? Certainly not our eyes.

We face a fascinating future, with much exciting new technology, many new information appliances.. We should not have to know how they work. We should not need to know anything about their technology. All we have to know is our job and what we are tying to accomplish. The appliances simply work: they provide the information we need when we need it, effortlessly, without any effort on our part. Smart things, cyborgs, and emotional things: the future will indeed be different.

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PROFILE

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