NEEDED: DIGITAL ASSISTANTS THAT SEE AND HEAR

by Lance A. Glasser

Please do not hand me a saw when I am holding a nail. Do not tell me about restaurants in Pittsburgh when I am gathering my luggage in San Francisco Airport. I want the services of a competent assistant who understands the context of what I am doing, whether that assistant is a digital machine or a human being.

We work in the information age. Over the last thirty years, the microelectronics revolution has improved the price-performance ratio of digital equipment by over a millionfold. The resulting information revolution has networked my office and brought computers into my home; it has also created a niche for digital assistants in my home as well as my office.

Over the next thirty years there will be a second information revolution where information appliances support active people doing jobs not normally classified as information work. Today's cellular phones, pagers, laptop and palmtop computers, calculators, navigation aids, portable radios, handheld video games, and video cameras are precursors of this second revolution. And the price-performance ratio of the products of this second information revolution will plausibly improve by another factor of a million. The capability will then exist for information assistants to help me when I am on the move because they can see and hear and know at all times the context in which I am operating.

In addition to the ability to access libraries and databases, communicate with people and computers, and help with planning, computing, and entertainment, I want to augment my senses. Functions that are needed to support information services for the active individual include lightweight portable sensors that can image visible light and other parts of the electromagnetic spectrum, such as millimeter waves or infrared radiation; sensors that can hear everything I can hear, and more; sensors that can figure out where I am by, for instance, using the Global Positioning System (GPS) or dead-reckoning using microaccelerometers; and other sensors for interrogating or viewing my environment, such as radars, ultrasound systems, and chemical or biological sensors. In the information world of the future, sensors will enable my digital assistant to anticipate my requirements and respond to them immediately, whether I want access to the national information infrastructure or a teleconference call with my colleagues. In addition to outward-looking sensors, I will want inward-looking sensors that observe my actions to better anticipate my needs, attend to my medical and health requirements and, for security, validate that I am indeed who I say I am to the information infrastructure. And if these sensors can all be networked together and plugged in and out as needed in a person local-area network, then I will have an information assistant that is truly useful.

The technologies that underlie these functions represent some of the most exciting new research and development areas in electronics. For imagers with low-profile optics, this includes plastic optics that combine the physical mechanisms of refraction and diffraction. For communication, radar, and GPS, it includes advanced microwave and millimeter-wave integrated circuits, modules, and antennas. We will need new architectures, circuits, and devices that minimize power dissipation. We will need safe secondary batteries that are as effective as primary ones. We will need very low power display technologies, possibly using reflective or emissive technology. For sensing and controlling many parts of our environment, we will need microelectromechanical systems. And we will need advanced packaging and precision assembly technologies for putting it all together in a stylish enclosure.

Not everyone does the same job or plays the same sport. We will want digital assistants that are flexible, easy to use, and task specific. Indeed, in many products digital assistants will be hidden away in cameras, drills, breadmakers, and other appliances where information processing takes on an ancillary role. For services based primarily on computation and memory, customization can be accomplished by software programming. Customization at the physical world interface will often have to be done in hardware (e.g., no single sensor can image at all the wavelengths of the electromagnetic spectrum). Thus, while the world might be satisfied with a few microprocessor families that can be programmed with many applications, the sensor area will keep many engineers employed delivering the application-specific sensors, sources, actuators, and displays required. Component cost is a reflection of market structure and value to the customer. As digital computers have gotten smaller, the fraction of the cost of the system that is the display (as one example of an interface component) has increased to the point that it is now over 50 percent of the cost of many palmtop computers and digital assistants. Quality physical interfaces command value in the market.

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