

## A DIGITAL LIFE

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Human memory can be maddeningly elusive. We stumble upon its limitations every day, when we forget a friend's telephone number, the name of a business contact or the title of a favorite book. People have developed a variety of strategies for combating forgetfulness, but important information continues to slip through the cracks.

Recently the team at Microsoft Research has begun a quest to digitally chronicle every aspect of a person's life. Digital memories can do more than simply assist the recollection of past events, conversations and projects. Portable sensors can take readings of things that are not even perceived by humans, such as oxygen levels in the blood or the amount of carbon dioxide in the air. Computers can then scan these data to identify patterns: they might determine which environmental conditions worsen a child's asthma. Sensors can also log the three billion or so heartbeats in a person's lifetime, along with other physiological indicators, and warn of a possible heart attack. This information would allow doctors to spot irregularities early, providing warnings before an illness becomes serious. Every word one has ever read, whether in an e-mail, an electronic document or on a Web site, can be found again with just a few keystrokes. Computers can analyze digital memories to help with time management, pointing out when you are not spending enough time on your highest priorities. Digital memories can enable all people to tell their life stories to their descendants in a compelling, detailed fashion.

The vision of machine-extended memory was first expounded at the end of World War II by Vannevar Bush, then director of the U.S. government office that controlled wartime research. Bush proposed a device called the Memex (short for "memory extender") - a microfilm-based machine that would store all of an individual's books, records and communications. The Memex was to be built into a desk and equipped with a keyboard, a microphone and several display surfaces. The person behind the desk could use a camera to make microfilm copies of photographs and papers or create new documents by writing on a touch-sensitive screen. One of the most prescient of Bush's ideas was the suggestion that the Memex should be designed to imitate the associative thinking of the human mind. Over the next half a century intrepid computer science pioneers developed some of Bush's ideas, and the inventors of the World Wide Web borrowed the concept of the "web of trails" to build their system of linking sites. But the Memex itself remained technologically out of reach. In recent years rapid advances in storage, sensor and processor technologies have paved the way for new digital recording and retrieval systems that may ultimately go far beyond Bush's vision.

Manufacturers are producing a new generation of inexpensive sensors that may soon become ubiquitous. Some of these devices can record a wealth of information about the user's health and physical movements. Others can gauge the temperature, humidity, air pressure and light level in the surrounding environment and even detect the presence of warm bodies nearby. And microphones and cameras are now cheap enough to be installed virtually anywhere - particularly in cell phones. The dramatic increase in computing power over the past decade has led to the introduction of processors that can efficiently retrieve, analyze and visualize vast amounts of information.

The existent system requires more development to improve its ease of use and its management of the data. Better software for converting speech to text would greatly enhance the system by allowing users to search for words or phrases in phone conversations or other voice recordings. Automatic face recognition would solve the pesky problem of photograph labeling.

Some of the described scenarios are not all that futuristic. Wearable sensor platforms that collect health data and monitor vital signs such as heart rate, breathing and the number of calories burned are already being commercialized by some companies.

The era of digital memories is inevitable. Even those who recoil at our vision will have vastly more storage on their computers. Some may be frightened at the prospect of ubiquitous recording. Digital memories will yield benefits in a wide spectrum of areas, providing treasure troves of information about how people think and feel. By constantly monitoring the health of their patients, doctors may develop better treatments for heart disease, cancer and other illnesses. Scientists will be able to get a glimpse into the thought processes of their predecessors, and future historians will be able to examine the past in unprecedented detail. The opportunities are restricted only by our ability to imagine them.