Digital Immortality[1]

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Digital immortality, like ordinary immortality, is a continuum from *enduring fame* at one end to *endless experience and learning* at the other, stopping just short of *endless life.* Preserving and transmitting your ideas is *one-way immortality:* allowing communication with the future. Endless experience and leaning is *two-way immortality:* allowing "you," or at least part of you, to communicate with the future in the sense that artifact continues to learn and evolve. Current technology can extend corporal life for a few decades. Both one-way and two-way immortality require part of a person to be converted to information (*Cyberized*), and stored in a more durable media. We believe that two-way immortality where one's experiences are digitally preserved, and which then take on a life of their own will be possible within the this century. We are exploring points along the one-way two-way spectrum in our Cyber All Project [1,2].

Hamarabi, Aristotle, Shakespeare, Mozart, Rembrandt, and Euler are immortal – or at least their ideas are. They each recorded their ideas in enduring form that could be passed on to the future. These great ideas, images, music, writing, architecture, and even algorithms will survive as long as people do. Of course these people are dead, but their ideas are effectively immortal.

Paper and then the printing press made it easier and less expensive to record, preserve, and disseminate ideas. Voice recorders, cameras, and camcorders now make it easy to record events – and sometimes, even experiences. Moore's Law is bringing recording costs down to the point where you can record everything you see and hear.

Digital technologies offer new kinds of information we can convey to the future. They allow almost anyone to create his or her own immortality for any sized community: either a family's future generations or an intellectual community. Web sites e.g. `www.123456789.net`, `www.legacy.com`, www.forevernetwork.com and www.memorymountain.com offer (for a fee) to store letters, essays, photos, videos and stories "forever" in order to pass them on to future generations. These are the digital equivalents of tombs, crypts, and libraries.

Future technologies will surely enhance our ability to convey ideas and experiences– creating a one-way relationship with future generations (should they care to listen or look.) Even today it is becoming reasonable to record everything we read and hear. For example, retaining every conversation a person has ever heard requires less than a terabyte (for adequate quality).

Gordon Bell is engaged in building a personal archive along the lines envisioned by Bush [4]and Gates [5] as a memory aid and research tool. The Cyber All Project is a store for documents, photos, music, audio, and video recordings. Bell's archive is currently about 12 gigabytes, including the store for 4 books, 20 encoded video lectures, 150 music CDs, several thousand documents, and an archive of email messages. It has and has an accumulation rate of two gigabytes per year. This rate will increase as speech and video are added – but it is still a fairly modest expense. Indeed, the real cost of an archive is in the data capture, data organization, and data presentation. That is where our research efforts are directed.

Table 1 gives the requirements for storing various media for a lifetime at modest fidelity. Within 5-10 years, personal stores of a terabyte will cost of a few hundred dollars – hence a person will can be immortal in terms of the media they've encountered. For "famous" people, one will be able to access their entire life.

Table 1. Estimated lifetime storage requirements

Data-types	Rate (Bytes/hour)	Per day / per 3 year	Lifetime amount
read text, few pictures	200 KB	2 – 10 MB / GB	60-300 GB
Email, papers, written text		0.5 MB / GB	15 GB
photos w/voice @100KB	200 K	2 MB / GB	60 GB
photos @200 KB	Ten images/day	2 MB / GB	150 GB
spoken text @120wpm	43 K	0.5 MB / GB	15 GB
spoken text @8Kbps	3.6M	40 MB / GB	1.2 TB
music or high quality sound	60 M	60 MB / GB	5.0 TB
video-lite 50Kb/s POTS	22 M	0.25 GB/TB	25 TB
video 200Kb/s *VHS-lite*	90 M	1 GB/TB	100 TB
DVD video 4.3Mb/s	1.8 G	20 GB/TB	1 PB

There are many unresolved technical and social issues associated with the Cyber All Project. How should the information be preserved, given changes in media, platforms, and programs[3]? How should it be organized and presented (will it take a lifetime to see another's lifetime)? Who should be able to see what, and when? What are the legal and ethical rights and responsibilities concerning information that involves other people? Again, we are exploring some of these issues – but mostly we are focusing on the basic tasks of acquisition, preservation, and recall.

Beyond this one-way immortality, we begin to see hints that at least some aspects of a person could be expressed as a program that interacts with future generations. It is interesting that, given and archive of a person's spoken output; it is possible to make a compelling avatar of that person. This avatar can "live forever" in a virtual world and respond to queries about that person's past life. For example, like many great people, Albert Einstein has several posthumous web sites. But in addition, computer science researchers at CMU [8] authored an avatar of Einstein that responds to questions from viewers. In fact the avatar is an actor hired to read quotes from Einstein's writings. Many who have seen this demonstration understand that in the future it will be easier and easier to author such avatars (without needing actors). The real question is whether such a program could ever "learn" enough to stay current is a speculation and a clear challenge. Having an immortal, interactive program begins to look a bit like two-way immortality -- being able to "live and communicate" forever.

We believe with Ray Kurzweil [6], Hans Morovec [7], and others, that it is likely there will be more and more faithful avatars over the next century. By 2040, Morovec predicts that robots will be as smart as humans. Successive generations of question-answering avatars will gradually become indistinguishable from the actual persons we know and love in 2001, enabling that person to appear to "live forever".

References

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