The creativity machine

What will emerge from using the Internet as a research tool? The answer, Vernor Vinge argues, will be limited only by our imaginations.

We humans have built a creativity machine. It's the sum of three things: a few hundred million computers, a communication system connecting those computers, and some millions of human beings using those computers and communications.

This creativity machine is the Internet. It has already changed the way we do science, most importantly by enhancing collaboration between researchers. The present-day Internet provides convenient connections between computerized labs, simulations and research databases. It also represents an enormous financial investment that is driven by the demands of hundreds of millions of consumers. As such, the total Internet software and infrastructure investment dwarfs the budgets of scientific research programmes and even of many government defence programmes. And more than any megaproject of the past, the essence of the Internet is to provide coordinated processing of information. For researchers seeking resources, these are facts worth considering.

For some disciplines, the Internet itself has become a research tool: grid computing has been used to exploit the power of millions of Internet-connected machines. Building on the popularity of SETI@home — an experiment that uses Internet-connected computers to search for extraterrestrial intelligence — and prime-number hunts, there are now physics, medical and proteomics projects enlisting the enthusiasm of people (and their computers) across the world. For linguists[1] and sociologists, new questions can be investigated simply by observing what occurs on the publicly available Internet. Even experimental sociology is possible: in their study of social influence on music preference, Salganik *et al.*[2] recruited more than 14,000 subjects through a popular website, ran online trials on these subjects, and then obtained results directly from their experiment website.

The possibilities do not end there. Even online games are attracting academic interest. Some games have millions of players. MMORPGs (massively multiplayer online role-playing games), such as World of Warcraft and EverQuest, feature vivid three-dimensional action involving both cooperation and combat. Another genre of MMORPGs lack a significant combat or quest element and are more often called 'virtual worlds'. For example, the virtual world Second Life has the visual realism of many MMORPGs, but it exists as a venue for the participants rather than as a predesigned adventure. Second Life provides a range of software tools, including a programming language, that gives participants the power to create artefacts according to their own designs. Thus the game depends on the skill and creativity of its participants to generate content. Such virtual worlds have already been used for educational projects, and are worthy of psychological and social research.

People power

The notion of enlisting users to create content is widespread on the contemporary Internet. Companies such as Google provide users with tools to integrate search and mapping services into their own websites. Interested users are numerous and have their own resources. In the 1990s, we had an early glimpse of the power of this new creativity machine: computers plus networks plus interested people delivered free and open-source software (FOSS) products of the highest quality, including the GNU/Linux operating system. FOSS products provide low-cost and flexible alternatives to proprietary software. For example, there is at least one open-source virtual-world platform, Croquet[3], which allows users to customize and extend its architecture at all levels. FOSS tools can be mixed and matched with proprietary software to deal with an enormous range of projects from quick, *ad hoc* combinations of data harvested from multiple locations[4] to large, long-duration experiments.

Participants in Second Life use software and creativity to build their environment.

All this points to ways that science might exploit the Internet in the near future. Beyond that, we know that hardware will continue to improve. In 15 years, we are likely to have processing power that is 1,000 times greater than today, and an even larger increase in the number of network-connected devices (such as tiny sensors and effectors). Among other things, these improvements will add a layer of networking beneath what we have today, to create a world come alive with trillions of tiny devices that know what they are, where they are and how to communicate with their near neighbours, and thus, with anything in the world. Much of the planetary sensing that is part of the scientific enterprise will be implicit in this new digital Gaia. The Internet will have leaked out, to become coincident with Earth.

How can we prepare for such a future? Perhaps that is the most important research project for our creativity machine. We need to exploit the growing sensor/effector layer to make the world itself a real-time database. In the social, human layers of the Internet, we need to devise and experiment with large-scale architectures for collaboration. We need linguists and artificial-intelligence researchers to extend the capabilities of search engines and social networks to produce services that can bridge barriers created by technical jargon and forge links between unrelated specialties, bringing research groups with complementary problems and solutions together — even when those groups have not noticed the possibility of collaboration. In the end, computers plus networks plus people add up to something significantly greater than the parts. The ensemble eventually grows beyond human creativity. To become what? We can't know until we get there. ■

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