Broadening Human Horizons through Green IT

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Abstract

Environmental concerns such as global climatic disruption occur over long time periods, large distances, and vast scales of complexity. Unassisted, humans are not well equipped to deal with problems on such broad scales. Throughout history, technological innovations have enabled human cultures to engage with broader suites of problems than we would otherwise be able to address. In particular, information technology (IT) involves tools and techniques for dealing with vast bodies of information across wide ranges of time, space, and complexity, and is thus well suited for addressing environmental concerns. While IT carries with it a number of significant environmental challenges (e.g., power consumption, ewaste), the opportunities for improving the sustainability of human civilizations that are enabled by IT are significantly greater than these drawbacks. This paper presents the idea of "extended human-centered computing" – that computing should focus on humans not only to satisfy their immediate needs and desires, but also to extend their horizons with regard to environmental sustainability and other broad scale concerns.

1 Introduction

Humans are currently facing significant environmental concerns such as global climatic disruption, species extinction, and overpopulation. The key problem in the way humans understand and act on the environmental issues is one of scale: environmental problems tend to occur on very broad scales of time, space, and complexity compared to the typical scope of human concerns. Human anatomy, physiology, and behavior evolved to deal with a certain set of problems that recurred frequently in our ancestors' lives. As humans developed more and more complex societies, moving to unprecedented forms of communication, memory, and collective action, cultural factors began to broaden our horizons. Nevertheless, in many cases, humans still tend to focus on our own local concerns, rather than attending to the very large problems in the distance.

Technology developed alongside human communities and has a long history of extending our reach. Technology has provided a "force multiplier" in many domains of human experience, letting us act with greater impact for less effort. Information technology (IT) in particular has proved to be effective at broadening our horizons by compressing time, space, and complexity. IT compresses time in many ways, for example storing abundant information for later retrieval, by letting us model the past and predict the future, and by enabling synchronization of many different human activities. IT compresses space by allowing us to communicate over great distances, to browse maps of the entire world, and to transport goods and people around the globe. IT compresses complexity by augmenting our memories, allowing devices to perform redundant calculations, and establishing agreed-upon standards for co-operation of devices and people. Across human history, technology in general, and IT in particular, has been a critical factor in broadening the scales on which humans operate. To address the world's current environmental concerns, we need systems that broaden our understanding and ability to take action across broad ranges of time, space, and complexity; framed another way, we need compression algorithms that shrink global environmental problems to human-comprehensible scales.

Technology and IT have not always worked to the benefit of environmental sustainability. In fact, quite the contrary: technological innovations have allowed us to farm, burn, mine, fish, drive, reproduce, and buy to the significant detriment of many environmental concerns. From these problems, though, arise numerous opportunities for people to make the way we live more sustainable. A recent report has offered

that the environmental benefits that could be made possible by IT are five times as great as the environmental costs of the IT sector (The Climate Group, 2008).

By helping spread information about environmental issues and enabling humans and our organizations to share best practices for addressing them, Green IT can hopefully help mitigate the significant global problems that appear to be looming in our future.

2 An Extended Human Centered Approach

This paper is grounded in the field of human-centered computing, and takes a human-centered approach to the field of Green IT. Human-centered computing focuses on humans as the most important element in the development of computing systems. Moving beyond narrowly-scoped human centered computing, however, this paper presents an extended view of human-centeredness, looking at how computing can situate human civilizations at the locus of responsibility for environmental issues, and enable individuals and groups to act to resolve these issues. This human-centered approach is distinct from anthropocentrism, and is not meant to downplay the importance of the survival of other species; rather, it sees humans as the species with the greatest potential to orchestrate a coherent response to the world's current environmental problems, and therefore the most expedient path to addressing those issues.

Extending the focus of human-centered computing to consider factors on a broader set of horizons than the usual scope of individual humans is critical to the development of the field of HCI. This "extended human-centered omputing" (EHCC) discards the notion that the immediate gratification of human desires is an unconquerable problem for the world's ecosystems. A broader set of horizons for human-centered computing is necessary if the world's environmental concerns are to be addressed effectively.

There is already awareness in the CHI community of the need for broadening the impacts of research. NSF includes "broader impacts" as one of its key evaluation criteria for grant-making. Blevis's focus on sustainable interaction design seeks to give computing systems greater longevity in a variety of ways (Blevis, 2007). The value sensitive design approach puts forward a need to "broaden the goals and criteria for judging the quality of information systems to include those that advance human values" (Friedman & Freier, 2005). Value scenarios (Nathan, Klasnja, & Friedman, 2007) can help support long-term thinking about important design problems. Research on the design of mobile phones has examined ways to lengthen the perceived life cycle of devices (Huang & Truong, 2008). Efforts to support large-scale social action, e.g., (Mankoff, Matthews, Fussell, & Johnson, 2007), are indicative of the broadening of social scales. Focusing on the impact of IT systems a century or a millennium from now, or on a whole-Earth scale, may seem impractical, given people's predilections for thinking of their own immediate, local issues first. However, certain ways of thinking about computing may help shift the focus in order to serve the same goals as a human-centered perspective with a very broad horizon in time, space, or complexity.

The EHCC approach, focused on broadening people's horizons in time, space, and complexity, has several key values. First, EHCC can provide a structure for analyzing potential responses to particular environmental problems. Designers can engage in thought experiments regarding the ways people have contributed to certain issues, and how we might be enabled through technology to mitigate or reverse our effects. Second, with particular existing technological innovations, the EHCC approach can provide guidance in evaluating and refining the system to enable it to have greater Green impact. By analyzing the ways in which systems alter people's horizons, this approach may help discover direct or indirect environmental impacts of IT systems that were not originally designed to be Green. With systems that are intentionally designed to be Green, an analysis of how it affects people's scales of time, space, and complexity may help to assess each system's success and overall impact. Finally, EHCC can be used to compare different technologies, and help provide an organizing structure. By arranging systems in a taxonomy according to whether they extend people's horizons of time, space, and/or complexity, and the

degree to which they do so, it may be possible to find gaps in the taxonomy that point to fertile space for Green innovation. These benefits primarily relate to the development of technologies and the sociotechnical systems in which they are embedded, but ultimately must lead to an improvement in the world's environmental condition in order to have true value.

3 Conclusion

Green IT is a growing field that seeks to understand the ways in which IT and environmental issues interact. It takes an interdisciplinary approach, drawing on disciplines from computer science to ecology to economics. There are many projects already in existence in this area, and many more are likely to be developed in the coming years. By enabling innovations in infrastructure, education, personal change, community involvement, and many other domains, Green IT can help people live more sustainable lives. This shift need not be instantaneous; rather we can seek ways to transition from current ways of living to more sustainable ways. Green IT systems can help with all stages of this transition. For the past several millennia, technology has multiplied the rate at which humans brought about the current environmental concerns; by broadening humans' horizons of time, space, and complexity, Green IT can provide a multiplier effect on our ability to resolve those same environmental issues in the future. Taking an extended human-centered computing approach to these systems can help improve their efficacy in enacting change toward a sustainable future.

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5 References

Blevis, E. (2007). Sustainable interaction design: invention & disposal, renewal & reuse. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 503-512). San Jose, California, USA: ACM. doi: 10.1145/1240624.1240705.

Friedman, B., & Freier, N. G. (2005). Value Sensitive Design. In K. E. Fisher, S. Erdelez, & E. F. McKechnie (Eds.), *Theories of information behavior: A researcher's guide*. Medford, NJ: Information Today.

Huang, E. M., & Truong, K. N. (2008). Breaking the disposable technology paradigm: opportunities for sustainable interaction design for mobile phones. In *Proceeding of the twenty-sixth annual SIGCHI conference on Human factors in computing systems* (pp. 323-332). Florence, Italy: ACM. doi: 10.1145/1357054.1357110.

Mankoff, J., Matthews, D., Fussell, S. R., & Johnson, M. (2007). Leveraging Social Networks To Motivate Individuals to Reduce their Ecological Footprints. In *Proceedings of the 40th Annual Hawaii International Conference on System Sciences* (p. 87). IEEE Computer Society. Retrieved May 8, 2008, from http://portal.acm.org/citation.cfm?id=1255497.

Nathan, L. P., Klasnja, P. V., & Friedman, B. (2007). Value scenarios: a technique for envisioning systemic effects of new technologies. In *CHI '07 extended abstracts on Human factors in computing systems* (pp. 2585-2590). San Jose, CA, USA: ACM. doi: 10.1145/1240866.1241046.

The Climate Group. (2008). *SMART 2020: Enabling the low carbon economy in the information age*. Retrieved March 3, 2009, from http://www.theclimategroup.org/assets/resources/publications/Smart2020Report.pdf.