Computer as Partner: A Critique Perspective of Interaction Design for Social Sustainability

Jeffrey C. F. Ho
School of Design, Hong Kong
Polytechnic University
Hong Kong SAR, P.R.C.
jeffrey.cf.ho@polyu.edu.hk

ABSTRACT
Sustainable human-computer interaction (HCI) is emerging as a major theme in the HCI community. Sustainability refers to fulfilling the long-term spiritual, environmental, and social requirements of humans. The previous discussions on sustainable HCI, specifically on the spiritual and social needs, were limited. Digital artifacts are essential parts of human life. A design critique perspective that considers computers as partners of users are proposed based on the human-computer integration concept. Three cases are reviewed in this paper to illustrate the critique perspective. Opportunities and implications are also discussed.

Author Keywords
Sustainability; Social Sustainability; Sustainable HCI; Human–Computer Integration; Design Critique; Computer as Partner

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION
Modern lives are heavily shaped by digital technologies. For example, the Internet enables people to communicate efficiently and allows businesses to grow exponentially. Although digital technologies contribute in modern lives, their fulfillment of the needs of people at present while securing the future generations remain questionable. Given the massive impact of digital technologies, human–computer interaction (HCI) is relevant to the environmental, social, and economic sustainability.

Sustainability is an emerging topic of interest in HCI. However, studies have focused mainly on the environmental impact of digital artifacts and human behavior. The influence of HCI on social and economic sustainability has yet to be emphasized.

Recently, digital technologies have become more integrated into the daily lives of people. The concept of human-computer integration is discussed in HCI community. Computers have become more intelligent and do not always require user instructions. Thus, potential partnership between computers and the users can be formed.

Viewing computers as partners offer a new perspective in critiquing interaction designs and digital artifacts. In this paper, the concept of "computers as partners" is proposed as a new critique perspective for social sustainability.

SUSTAINABILITY
The United Nations have been urging the world to pay attention to sustainable development since 1980s [24]. Sustainability has many definitions [3]. Knowles, Walker, and Blair defined sustainability as "the ability to meet our current environmental, social, and economic needs without compromising the ability of future generations to meet theirs" [15, p.493]. Walker [22] suggested that the necessary conditions for people to be meaningfully human should be considered. These discussions on sustainability cover the environmental, social, and economic aspects of human needs.

Recently, researchers have focused on digital artifacts. Knowles, Walker, and Blair [15] introduced the concept of cyber-sustainability to start a discussion on the impact of the development of the Internet on real-world environments. Cyber-sustainability is "concerned not simply with our continued ability to maintain our technologies for cyberspace but instead with how and the degree to which cyberspace may factor into living full and fully human lives." [p. 495, 15]. They suggested that cyberspace or the web should not only be revealed with modern values, such as efficiency, technological progress, and growth but should also be analyzed to examine the extent to which it allows people to be fully human.

The authors argued that the discussion on sustainability in cyberspace should not only focus on the environmental impact of digital technologies but also on how the web can fulfill human needs in social engagements. They argued that the current web technologies do not address these concerns effectively. Thus, users will eventually reject the technology.

SUSTAINBLE HCI
A research work that focuses on the role of HCI community in addressing sustainability issues is available. DiSalvo et al. [6, 7] presented an overview of the landscape of sustainable HCI. They identified several genres.

The first dominant genre is convincing the users to perform sustainable behavior with persuasive technology. The two approaches include strong persuasion by judging user behavior and passive persuasion by showing the users the consequences of consumption and waste.

The second genre focuses on ambient technologies. The two common approaches include allowing the consumption behavior and the desired consumption behavior to be visible.

The third genre is a formative user studies that "aims to understand user attitude toward the environment and/or the sustainable/unsustainable design." The designers are thought to contribute to unsustainability by introducing new electronics and ignoring electronic waste. The work that follows this approach considers and understands how the users are embedded in social and cultural systems.

The last genre is the sustainable interaction design that uses sustainability as "a lens to rethink the role and outcomes of design." (p. 22) [7]. Instead of applying known methods in HCI for sustainability, this line of work urges the need to rethink the methods of HCI to address sustainability issues.

In his proposal of sustainability as a focus of interaction design, Blevis [2] suggested the following two principles: "linking invention and disposal" and "promoting renewal and reuse." He also mentioned two categories of research questions for sustainable HCI. The first category includes questions that are concerned with public policy, simulation, and prediction (e.g., How is unsustainable impact measured? Who is responsible for designing products with sustainable materials?). The second category is about motivating sustainable behavior. For example, the design of digital artifacts is considered in allowing users to prefer sustainable over unsustainable behavior.

According to [7], discussions on and definitions of sustainability are limited. A disconnection between sustainable HCI and sustainable work in other design communities exists. The discussion on sustainability in sustainable HCI mainly focuses on environmental impact. However, the social and economic aspects of human needs are not emphasized.

DESIGN FOR SUSTAINABILITY: UNIQUE NATURE OF INTERACTION DESIGN

The design for sustainability is a common theme in different design disciplines. The nature of relationships between design artifacts and human varies across design disciplines. The sustainable design discussions focus on slightly different aspects. For example, architecture is concerned on physical structures that provide physical space for humans. Sustainability discussions on architecture are often about the ongoing uses of energy and materials [13]. Product design creates products that are typically produced in massive scale. Therefore, sustainable design in product design often focuses on the materials used [21].

The outcome of interaction design is in a form of digital artifacts. Digital technologies have become highly integrated in a healthy or unhealthy manner. People have become dependent on their mobile phones [11]. Mobile phones have become extremely popular and thus have become an extension of people [4]. For example, chatbots are becoming more integrated into people's lives which opens new ethical and societal challenges [11]. Interaction designers should consider the impact of their designs on sustainability.

This view of integration has already been discussed in HCI, which potentially offers a new design critique perspective on sustainability.

HUMAN-COMPUTER INTEGRATION

Farooq and Grudin [8] also discussed the concept of human-computer integration. Instead of a stimulus–response model, they proposed a view of integration of human and computers. Computers can become partners. They perform tasks in parallel without user intervention. Partners are codependent with each other and create meaning from their activities. As partners, computers should understand the users and behave according to user contexts. For partners, understanding each other is crucial. This form of partnership between human and computers was envisioned in films decades ago.

The first notion of Farooq and Grudin is that the integration perspective poses new opportunities for design and development. The second notion is that the shift from interaction to integration is actually a continuum.

COMPUTER-AS-PARTNER PERSPECTIVE

Licklider [16] envisioned a future where human users form partnerships with computing machines in the 1960s. In the envisioned partnerships, human users solve problems and make decisions together with computers. The focus of the vision was technical and scientific tasks. Farooq and Grudin [8] used partnership as a metaphor to explain the relationship between human and computers. The metaphor of a computer as a partner can be a design critique perspective on sustainability. The question is how shifting the view of digital artifacts as stimuli to partners influences the critique of these digital artifacts on sustainability.

Studies have shown that people may apply social rules to technologies as if they are humans [18]. Integrating computers and humans has a trend that implies that their relationships are becoming "intimate." With the traditional view of the stimuli and response model, computers are often considered as tools; thus, a tool cannot be too intimate to a person, similar with other personal items, such as keys and clothes. The computer-as-partner perspective reminds the designers that computers may be consciously or unconsciously considered by the users as human partners. Once computers are reviewed by designers as partners, social sustainability (or unsustainability) in any intimate relationships between the designs and potential users can be prominent.

SOCIAL SUSTAINABILITY

It is considered that sustainability covers environmental, social, and economic aspects. In this paper, the focus is social sustainability. Social sustainability has received attention in the research communities of different disciplines [23]. Dujon et al. point out that [8] social aspect of sustainability should be viewed as both "the processes that generate social health and well-being now and in the future, and those social

institutions that facilitate environmental and economic sustainability now and for the future" (p. 4). The "social health and well-being" can cover many aspects such as diversity, interconnectedness, social cohesions, and maturity [4].

TWO REAL-WORLD CASES

This section presents two examples of modern digital artifacts and services reviewed with a computer-as-partner perspective to illustrate how sustainability issues can be revealed.

Personalization on Social Media and Web Services

Personalization of content in news feed is a common feature on social media. Personalization feature learns about user preferences via clicking or reading behavior; it also provides contents that users prefer. By using the computer-as-partner metaphor, the personalized feature of the computing service or device is similar to a friend or colleague who observes and learns about one's preferences and only tells the stories that one prefers. This seems to be a very understanding partner. However, a partner, who only tells stories that one prefers and keeps some things (which is often the case for personalization features), can be an unethical partner. This problem can be particularly serious if the partnership is extremely intimate that the partners communicate every few hours. This form of partnership in a massive scale creates social problems because most people believe in their one-sided stories from intimate partners. People experience difficulty in tolerating those who believe in the stories that were hidden from them. This prevents diversity and social cohesions in communities and around the world. Thus, a socially unsustainable situation is created.

This digital artifact is a social media platform with personalized content. Therefore, the partner in the metaphor is the social media. The socially unsustainable situation is similar to the current societal problems of divided views caused by "filtering bubble" effect of web services, including social media [16, 19].

This socially unsustainable effect was not foreseen when it was first launched on different web services because digital service was reviewed with a stimulus–response perspective [1, 20].

If social media was viewed as a partner in the first place, then the designers could have warned that the personalization of content may prevent exchanging different views.

Location-aware Applications on Smartphones

Many smartphone applications solve problems in the current context, such as nearby dining recommendations, transportation instructions, and weather alert. In the computer-as-partner perspective, a smartphone equipped with these applications is similar to a partner that instantly solves all the problems in the current context. The users can ask this partner for help on all problems in the current moment. The partner can solve the problems instantly, regardless of its importance. Without such intimate and helpful partner, the users would not know where to dine, how to go to a certain place, or when they should bring an umbrella. They would probably feel uncomfortable or even anxious. Many of them would be extremely attached and dependent on their partners.

If the partner is an actual person, then an intimate partnership may be created. However, in reality, this scenario indicates that the users are extremely dependent on a digital device. Separation from their smartphones may affect their cognition, emotion, and physiology [4]. They may even experience anxiety [11]. This form of relationships between users and smartphones hinders the users from connecting with one and other. It reduces the interconnectedness in communities. Thus, this condition is socially unsustainable.

FUTURISTIC CASE OF INTELLIGENT ASSISTANT

This section presents the analysis of a futuristic case of intelligent assistant. The future version of an intelligent assistant is envisioned and then analyzed with computer-as-partner perspective based on current technologies and design direction.

Most smartphones at present from the major brands include intelligent assistants that can understand verbal instructions by users and can provide verbal feedback. Given the limitation of current technologies, these assistants are not yet capable of a fluid conversation with the users. They often do not understand references to content in the same conversation. This state is also called third-order dependency [14]. It prevents complicated step-by-step instructions. Furthermore, although smartphones are connected to the Internet, the functions of intelligent assistants are still limited (e.g., starting an application, playing a song, checking the weather). These functions are similar to the simple activation of functions on the smartphone.

When technologies advanced, the intelligent assistants would understand long and complicated instructions. They might be able to understand simple logical statements in human conversations (e.g., "Buy me an ice cream; but do not buy if the only available flavor is chocolate."). The intelligent assistants may also be able to operate the applications on a smartphone. Therefore, users would be able to verbally provide step-by-step (sometimes conditional) instructions to their intelligent assistants to operate the applications on their smartphones.

This future scenario in computer-as-partner perspective would consider the intelligent assistants as partners of the users. The users could easily ask their partners to perform complicated tasks, such as stock trading (e.g., "Monitor the Twitter for me. If there is any rigorous discussion on increase of interest rate, then sell 5% of my stocks."). Unlike human colleagues or friends, the partners do not perform any moral judgment. They would perform whatever the users ask them to do. For example, the users could ask them to perform cyberstalking (e.g., "Follow my wife's activities on social media while I am at work. If there is any sign that she is with

another man, then keep a record and alert me."). This instruction is unethical. If a similar phenomenon occurred to the mass group of users, then it would create social problems such as distrust. Therefore, the social cohesion and interconnectedness in a society may be reduced. The situation would be socially unsustainable.

The current design approach of intelligent assistant focuses on the approach of the users in providing instructions and tasks that intelligent assistants can perform. It still adopts a stimulus–response perspective, in which the intelligent assistant is provided with verbal instructions. With this perspective, the advances of technology will enable complicated forms of calling functions. Thus, the users can enjoy more convenience and thus better lives.

However, the analysis of intelligent assistants with computer-as-partner perspective reveals that the advanced technologies might allow every smartphone user to have a partner with no ethical considerations. A socially unsustainable situation can easily be imagined. Although perspective may not conveniently offer a solution, it highlights the potential issues with the current design direction.

INCLUDING SOCIAL SUSTAINABILITY IN DESIGN

Throughout the process of a design, designers and stakeholders can evaluate a design in different perspectives. Examples are organizational perspective (e.g., to check whether a design fits in any constraints) and technical perspective (e.g., to check if a design is technically feasible). Computer-as-partner can be one of the perspectives that they can adopt when they evaluate designs. The aim is to remind them to think about computers as partners of human users.

With computer-as-partner perspective, designers and stakeholders can examine whether the "computer partners" in a design can facilitate social sustainability. Considerations can include whether the "computer partners" is responsible to offer views from different sides of issues, whether they encourages the human users to be too dependent on them, and whether they should provide moral guidance to the human users.

CONCLUSION

This paper is an attempt to connect sustainable HCI with the body of knowledge in sustainability via the concept of partnership in human-computer integration. The author proposes that the lack of discussion on social sustainability in sustainable HCI can be enriched by using partnerships as a metaphor to critique the interaction design on social sustainability.

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