Paradigm shift from Human Computer *Interaction* to *Integration*

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Abstract
In 1960, JCR Licklider forecast three phases: human-computer interaction, human-computer symbiosis, and ultra-intelligent machines. Human-computer symbiosis or what we call "integration" is already well under way. This SIG will discuss how the CHI community should think about the paradigm shift from interaction to integration as designers, practitioners, researchers, and as a society.

Author Keywords
Artificial intelligence; symbiosis; direct manipulation; intelligent agents.

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

Introduction
"The era of human-computer interaction is giving way to the era of human-computer integration—integration in the broad sense of a partnership or symbiotic relationship in which humans and software act with autonomy, giving rise to patterns of behavior that must be considered holistically. Cyborgs or brain-computer interfaces may come later, but integration is already well under way." [1]

Key takeaways from the motivational paper on Human Computer Integration [1]:

- ✓ Interaction can be described as stimulus-response, whereas integration implies partnership between the human and the computer.
- ✓ There is a continuum from interaction to integration.
- ✓ The CHI community can improve human-computer interaction by focusing on the larger context of integration.

Even when generally aware of this profound change, we continue to observe the world through lenses acquired in the era of human-computer interaction. To most effectively design and evaluate software and hardware, a new perspective is in order. Some engineers and fiction writers have envisioned aspects of such a future. Some had utopian takes, others dystopian; both are evident in the intriguing benefits and cautionary challenges we face. Different research questions and design possibilities emerge when you consciously shift from the familiar perspective of human-computer interaction to a view of human-computer integration that is still coalescing.

Farooq and Grudin claim that HCI with an integration lens offers benefits: novel design opportunities, revised theoretical assumptions, and a more holistic evaluative practice. Assuming this claim to be true, this SIG stages a discussion on how to gain such benefits and how the CHI community can operationalize effective integration between humans and computers.

The evolution of HCI toward integration

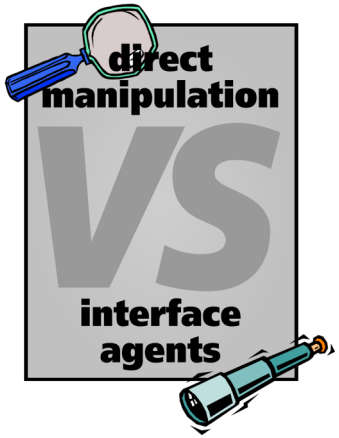
We will not stop interacting with computers and other digital devices. The nature of our interaction has continuously evolved—from switches, cards, and tape to typing, mice, and styluses, adding speech and gesture. Skin sensors might someday become routine, or even brainwave interaction if hats make a fashion comeback. We can see these changes, but a dramatic change affecting human-computer interaction was invisible: what the computer does when we are not interacting with it.

For decades, the relationship could be described as stimulus-response. A computer responded to our last input or command, then waited for the next. Our action could be to load in a program as a deck of cards; the computer then read them, returned a printout, and waited for the next deck of cards. We typed in a command name, the computer processed it, typed back a response, and waited. We clicked on an icon, the computer produced a menu or initiated an action, and then waited. Sometimes the control was reversed: An application issued commands and a human entered information. None of this describes a real partnership.

When the personal-computing era arrived, most computers were usually turned off or displayed a screen saver as they waited for a human to initiate an interaction. A few people installed SETI@home to devote unused cycles to exploring radio telescope data for evidence of extraterrestrial life, and some fell victim to a hacker who took over their computers to redirect large quantities of spam. But in general, little activity occurred until an owner returned.

Over time, slowly, background tasks began utilizing client or server cycles on a user's behalf. Background tasks range from programmed interactions to adaptive processing that proactively does tasks we need to perform or might overlook. Consider browser page predictions, where pages are pre-rendered in expectation that one might navigate there next. Such unseen software activity shapes subsequent interactions.

Although computers aren't like people in most respects, like our friends and colleagues, their sometimes autonomous activity affects how we interact with them. Our timelines are independent but frequently intersect. Devices are busy on our behalf, and we don't even



Key takeaways from a key HCI debate [2]:

- ✓ User interfaces should be predictable, so that users trust them.
- ✓ Direct manipulation supports rapid performance and low error rates while supporting exploratory usage in positive ways.
- ✓ There are real limits to what we can do with visualization and direct manipulation…we will have to, to some extent, delegate certain tasks or certain parts of tasks to agents that an act on our behalf or that can at least make suggestions to us.

know what they get up to when we are asleep. Sound creepy? Not necessarily, and it is happening. But there may be risks. To do it well will certainly require an intense effort to understand what humans expect and need in partnerships. As designers, developers, researchers, product managers, entrepreneurs, and users, we can improve human-computer interaction by focusing on this larger context of integration.

We have emphasized the benefits of adopting the lens of integration; we should also note the potential risks. For example, software that appears thoughtful and considerate in one place could lead users to assume that it is generally thoughtful, as humans often are; but elsewhere the software might not be. Also, an integration lens that recognizes the computer as a partner to the human may have to take sides when computer and human goals are in conflict. For example, a website's goal may be to keep customers engaged, whereas site users may want to leave after a quick transaction. Investigating computer initiative and transparency with respect to human agency is a pressing area for research. This SIG will also identify tradeoffs when adopting an integration lens.

SIG goals & outcomes

This SIG has two explicit goals:

1. The discussion will raise uneasy and disruptive HCI notions. For example, is artificial intelligence about building a mind or about improving tools to solve problems [4]? Can tool-like designs incorporate users' moral values, ethical principles, and socio-cultural conventions [5, 6]. Participants may disagree as to whether or not a machine should in some way try to understand the goals and intentions (or interests) of a user and then act proactively to help. The devil may be in the details of "in some way." This SIG will identify tradeoffs between a machine trying to understand a person in real time versus simply embodying the understanding of its human designers?
2. The discussion will brainstorm a set of considerations for how to better design and build integration between humans and computers. These considerations will be represented in the form of design implications for integration.

Beyond the SIG and based on the above two goals, the intended outcome is an edited book to be published tentatively in 2018. Interested SIG attendees will be asked by the organizers to solidify their contributions from the SIG in the form of book chapters that represent a diverse and constructive viewpoint on Human Computer Integration.

SIG organization

The first and second authors will organize and moderate the SIG. A parallel panel submission [8] debates this topic and includes distinguished members of the CHI community Ben Shneiderman, Pattie Maes, and Xiangshi Ren, with published views on this topic [2, 3]. Our SIG seeks to build on these perspectives, involving some of the same people but engaging the broader CHI community in an effort to take concrete steps toward developing new approaches to researching and designing in this space. Given the importance of the topic, we anticipate a high level of interest and participation.

SIG moderators

The moderators will ensure an equal and constructive discussion while engaging with the SIG participants. Below are succinct profiles of the moderators.

JONATHAN GRUDIN

Jonathan Grudin is a principal researcher in the Natural Interaction research group and affiliate professor at the University of Washington Information School. He has participated in CHI and Computer Supported Cooperative Work since they coalesced in the 1980s, is an ACM Fellow and member of the CHI Academy, and served as Editor-In-Chief of ACM Transactions on Computer-Human Interaction for six years and Associate Editor for Computing Surveys for ten. His book on the history of HCI will be published in early 2017.

UMER FAROOQ

Umer Farooq is a user research manager at Facebook on the Messenger team. Prior to Facebook, he was a principal user research manager at Microsoft. In 2008, he joined Microsoft's Cloud & Enterprise team as a user researcher and advanced API usability methodologies for Visual Studio and Azure. In 2013, he helped to launch Xbox One globally, working on key entertainment scenarios such as media integration. He is now writing a book on the evolution of user research practice based on the CHI 2015 case study "Industry is changing, and so should we".

Conclusion

Licklider envisioned the era of man-computer symbiosis lasting 10 to 500 years [7]. The good news is that he forecast, with some measure of optimism, that the era of human-computer interaction would last five years, and it ended up taking 50. The Singularity has receded ever further into the future. In any case, we can all agree with Licklider: An intellectual adventure lies ahead. This SIG will be the foundation for continuing on such an intellectual adventure.

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