The Evolving User Interface From Graphical UI to Environmental UI

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An examination of the future of the user interface shows that, near term, the evolution and application of new UI models to niche markets will be incremental. Longer term, more-significant change will be driven by real-world Web applications.

Analysis

For decades, researchers have tried to create user interfaces (UIs) that more-closely reflect human communications. However, few advances have gone beyond the lab to drive a shift in the UI model. The graphical user interface (GUI) — conceived in the 1970s and commercialized in the 1980s — is an exception. The GUI allowed a more-flexible and pleasing display with iconic representations of real-world concepts and flexible graphical output. Adopted first in high-value niches (electronic publishing, for example) and then broadly embraced by consumers, the GUI has been the dominant UI paradigm since the early 1990s.

The GUI will remain the main UI model through 2010. However, several factors are increasing the pressure to extend the interaction model — especially for targeted niche markets:

- Computing has moved off the desktop and into the world via handheld devices and embedded systems in both mobile and fixed locations.

- Computing has continued to expand to broader and more-diverse (in terms of geography, culture, age and so on) populations with different real-world experiences and physical capabilities.

- Computing is being applied to more business activities in increasingly specialized environments with unique requirements.

- Consumers are becoming more comfortable with and more sophisticated in how they use technology, increasing the frequency with which they expect computer interaction.

In "Hype Cycle for Human-Computer Interaction, 2005," a range of emerging user interface technologies is analyzed. These technologies range widely in their levels of development and adoption from the earliest stage of research through mainstream acceptance. New UI technologies face many hurdles on the way to adoption.

In "Presenting the User Interface Adoption Model," we present a model to determine when, where and how emerging user interface options are likely to be adopted. As a baseline, planners must evaluate the contextual value of the UI, the capability and quality of the technology, its cost in relation to the need addressed, and the simplicity as measured by ease of implementation/use and the ability to remove complexity from the overall interface. The degree to which the UI is appealing and interesting to the user and the degree to which society and culture encourage or hinder use of the new UI are also important.

Greater use of the UI element by multiple users (the network effect) and/or applications and its adoption by major vendors will also accelerate adoption. The level of maturity required in each factor for a particular UI method to establish itself in a niche market or to break into more-widespread mainstream use will vary. It is the complex interplay among the factors that determines the breadth and depth of adoption.

New UI technologies can have a significant impact on cost and revenue. In "Organizations Can Make a Business Case for New User Interface Technologies," we expand on elements of the UI adoption model and examine the business impact in more detail. When determining the cost of a new UI technology, users should examine the cost in terms of task efficiency (for example, error reduction) and task offloading. When examining the "leverage factor," planners should consider the effect of new technologies on regulatory, legal or compliance requirements and the degree to which the technology enables new business opportunities. When examining simplicity, look especially at how the UI can improve accessibility to key demographics.

Organizations must also look beyond functional issues to psychological ones to identify all potential economic consequences. Many of these influences are hard to quantify, but organizations with strong metrics programs are more likely to assess them.

When examining particular UI technologies, one can see the adoption factors and business case at work. In "Speech Recognition: Still Niche After All These Years," the obstacles to speech recognition and its potential are explored.

Despite delivery of continuous speech recognition in 1997 and subsequent advances that now deliver accuracy superior to the average person's typing, speech recognition has not been widely adopted. Broad adoption is hindered by personal or emotional factors, social barriers and low value combined with high complexity for most users. Most people are accustomed to a writing style in which one watches what is written and corrects errors on the fly. In addition, talking to the computer is often seen as a social faux pas or raises concerns about personal privacy.

For most users, there is no pressing need or compelling advantage over existing interfaces. Only when users learn to speak as part of the creative process, unlearn the correct-as-you-go habit and become familiar with the conventions of a speech-centric interaction model (navigating, formatting and so on) will speech recognition become widely adopted. Speech recognition will not become the dominant mode of text entry for at least a decade.

Mobile and workflow applications are more-promising candidates for gaining value from speech recognition, however. These applications use speech recognition for application control and will

feed speech recognition to the desktop over time as users become comfortable with the voice interface paradigm.

Another emerging UI technology is video. In "The Future of Videoconferencing in Desktop User Interfaces," we examine how to incorporate video into desktops and application designs. Holding video back are bandwidth requirements, and expensive and fussy hardware. Largely incompatible platforms/protocols and operational difficulties add to the cost and complexity. Consumer experience with inexpensive Webcams and free videoconferencing services have increased user interest, but many remain uncomfortable with these technologies, making the personal and social drivers ambiguous at best.

Through 2007, fewer than 20 percent of organizations will adopt desktop videoconferencing (0.8 probability). Through 2010, the use of video in corporate environments will split into low-end and high-end markets. Meanwhile, improved display technologies and sound will make multipoint videoconferencing more palatable for most environments. In addition, increased consumer use in real-time environments combining instant messaging (IM)/voice/video will infiltrate business much as text-based IM has in the past few years. IT departments should resist the impulse to ban video, and should rather provide guidance to interested users. Eventually (2010 to 2015), high-end video systems will allow the remote experience to approach that of being in the same room with a remote speaker (0.8 probability).

Another area of interface evolution is centered on the Web. In "Eliminating the Click-and-Wait Interface," we explore the emergence of fast, rich Web microapplications and how this will influence the evolution of the UI for Web-based applications. The asynchronous JavaScript and XML (Ajax) application design style has crystallized, and this market approach is gathering speed.

The emergence of rich Internet applications (see "Rich Internet Applications Are the Next Evolution of the Web") combined with user demands to reduce interface latency illustrates how the emergence of a UI technology can drive new business opportunities. The application service provider (ASP) market failed because users were unwilling to step back from the user experience with the client/server and locally hosted applications or to experience poor latency and extended data entry times. The new style of rich-client applications could help overcome the problems faced by ASP developers. As users access these applications from external Web providers, they will increasingly expect similar attributes from corporate applications. Enterprises should transfer the best public microapplication design learning to corporate application development to provide advice on application selection and appropriate use, to track use, and to create policy and controls on corporate information security issues.

The anchor point for the mainstream UI remains the desktop. As described in "Desktop User Interface Changing Gradually During Next Three Years," this environment is about to undergo changes, many related to the interaction models. These will be cumulative, incremental changes rather than major breakthroughs, but they will alter the user experience. Driven by increased expectations from users conditioned to glitzy high-definition graphics, increasing levels of customization and application complexity, and new price points for display and interconnect technologies, new styles of UI and interactions will become increasingly common. Microsoft will drive evolution of the base Windows GUI with Office 12 and Vista.

Here we have an example of vendor promotion driving the introduction of new user interface elements, and it is too early to determine whether these changes will deliver the level of capability, contextual value and simplicity to be effective. On the display front, the desktop interface is evolving to larger, higher-resolution and multiple screens in response to more-complex GUI requirements (see "Bigger and Better Displays Will Boost Productivity at Last"). Today, multiple symmetric displays are used primarily in specialized applications to stretch the desktop but will become mainstream by 2009. Asymmetric displays will become prevalent, especially task-focused, at-a-glance displays for calendar or status information.

By 2010, e-paper capabilities will be addressed, providing wall-size, low-resolution monochromatic displays, which will dip into the price range of a cubicle wall or high-end wallpaper by 2015. Interaction with wall-size displays will finally bring gesture recognition into the mainstream, illustrating how the emergence of one UI element can influence the value and adoption of another technology. Falling prices for screen digitizers and OS support (Windows Vista) for pen interfaces will make the pen input and touch screens more prevalent because this form of direct interaction is highly intuitive and simplifies many tasks.

Beyond the desktop, personal devices, such as mobile phones and music players, are gaining widespread adoption and have shrunk in size while gaining in functionality. In "Sociable Interfaces Evolve for Mobile Devices," we examine how the UI for mobile devices will evolve during the next decade. Through 2008, new interfaces for established functions will dominate, with sociable devices growing through 2012. Enablers include advancing technical capabilities (processor power and memory), falling prices and the network effect. Combined with the drive to smaller devices, which demand different interfaces, the need to address the anti-social aspects of mobile devices (for example, phones ringing in cinemas), and vendors' need to differentiate, these drivers will result in the evolution of the mobile UI. In the long term (2010 and beyond), devices will integrate information from many sources to deliver an integrated and sociable user experience.

Looking to 2015, there is potential for more dramatic shift in the UI. The so-called desktop will flow off of the desk and into office appliances and the walls around the user. Meanwhile, the expansion of personal/mobile devices and evolving embedded systems (for example, radio frequency identification [RFID], telematics and consumer electronics) will further fragment the desktop model of computing (see "The Real-World Web Will Connect Objects and Places").

In this world of ambient intelligence, any nontrivial device will contain some degree of embedded processing and communications capability.

The traditional model of a user interface is insufficient for a more-robust environment in which most computer interaction is not through a traditional desk-bound keyboard and screen. In this new environment, the focus shifts from interfaces on individual devices (desktop devices, for example) to the overall experience users have as they interact with the interconnected devices that surround them.

The UI shifts from GUIs attached to individual devices to an "environmental user interface," acting as a contextual user access and information delivery engine across multiple devices. Today, this model is only a concept, driven primarily by the projected intersection of technology, business and consumer trends during the next 10 years. However, focused implementations of location-based

services linking a bounded set of devices in a targeted environment, as well as the explosion of Web 2.0 "mashups" combining Web applications into a new UI, are indicators of this trend.

By 2015, the focus will shift from designing individual interfaces for particular devices to creating a proactive UI framework for the environment (0.6 probability).

Additional Reading

"The Real World Web Will Connect Objects and Places"

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