The Future of Graphic User Interfaces: Personal Role Managers

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May 14, 1994

Personal computer users typically manage hundreds of directories and thousands of files with hierarchically structured file managers, plus archaic cluttered-desktop window managers, and iconic representations of applications. These users must deal with the annoying overhead of window housekeeping and the greater burden of mapping their organizational roles onto the unnecessarily rigid hierarchy. An alternate approach is presented, Personal Role Manager (PRM), to structure the screen layout and the interface tools to better match the multiple roles that individuals have in an organization. Each role has a vision statement, schedule, hierarchy of tasks, set of people, and collection of documents.

Keywords: Personal Role Manager, desktop metaphor, graphic user interface, coordination, computer supported cooperative

work

1. Introduction

The transition from the first generation command line interfaces (such as DOS 3 or UNIX) to second generation point-and-click graphical user interfaces (GUIs) was accompanied by an important metaphorical shift. The older systems required users to understand computer-domain concepts such as executable binary software (the .EXE or .COM files), file naming rules, and hierarchical directories. The designers of second generation GUIs presented users with more meaningful metaphors and supported direct manipulation interactions (Shneiderman, 1982). The graphical user interface offered a desktop with applications represented as icons, documents organized into folders, and even a trashcan as an affordance for the delete action. This visual representation of the world of action made objects and actions visible, permitted rapid, incremental and reversible actions, and emphasized pointing and clicking instead of keyboarding.

The current third generation approach emphasizes a "docu-centric" design (Microsoft's Object Linking and Embedding or Apple's OpenDoc Architecture), unified suites of software, and "information at your fingertips" through hypertext linking. Documents become more important and applications fade into the background. The enriched documents contain multiple object types such as text, drawings, photos, spreadsheets, sound, animation, and even video with links across documents to share common objects. Actions that earlier had required opening an application, such as spell checking, thesaurus reference, or faxing a document, are now integrated into the unified docu-centric interface.

While these are useful steps away from the underlying technology and more in harmony with the users's perceptions of their work, larger steps are needed to reach the fourth generation in the evolution of user interfaces.

We believe that the natural progression is towards a "role-centered" design which emphasizes the users tasks rather than the documents. This is in harmony with the current movement toward computer-supported cooperative work and groupware. These tools are aimed at coordination of several people performing a common task with a common schedule. Our goal is to substantially improve support for individuals in managing their multiple roles in an organization. Each role brings them in contact with different sets of people for separate hierarchies of tasks following independent schedules. Our goal is to improve performance and reduce distraction while working in a role, and facilitate shifting of attention from one role to another.

This proposal for a Personal Role Manager is at an early stage of development. It emerged from a research project with the World Bank to explore future desktop environments. Our screen mockups and MacroMind director scenarios are merely the first step in a long path towards commercial software development. We hope that by describing this work at an early stage we can elicit feedback from colleagues and encourage others to refine, expand, and apply our concept.

2. Previous efforts

Earlier efforts on roles have come more from the perspective of the organization (Sarbin & Allen, 1968; Biddle & Thomas, 1979; Roos & Starke, 1981). Singh and Rein (1992) write that "Briefly stated, role theory views individuals as occupying positions in organizations...Roles are the building blocks of organizational structures and are descriptive of such organizational phenomena as division of labor and specialization." As a result the focus is on coordination among roles within the organization. Although there is some recognition that an individual might have multiple roles, the emphasis is on the assignment of individuals to a single organizational role.

The ensuing coordination theory and technology applies petri net methods and other formal specifications to develop useful methods for human-human coordination (Singh, 1992; Singh and Rein, 1992). This managerial emphasis places greater concern on ensuring that organization goals are met, rather than facilitating the individuals's tasks of managing their time, organizing their information, and communicating with peers or subordinates. The user interface designs that are suggested by this established research direction serve the needs of managers more than subordinates.

Recent attempts to help users structure their work within multiple roles focus on personal schedulers to manage time and on tools to manage documents. Most users will group related documents in directories or folders, and can create screen displays with multiple related windows. The "rooms" notion (Henderson & Card, 1986) does support the storage and retrieval of groups of windows (for example, Rooms for Windows (Xerox), Dashboard (Hewlett-Packard), and the Unix-based HP-VUE (Hewlett-Packard)). The rooms notions could be expanded to support coordination across windows such as triggered deletions, synchronized scrolling, hierarchical browsing, and hypertext linking (Shneiderman, 1992). Other useful concepts have emerged from studies of how knowledge workers organize and use information (Malone, 1983; Kidd, 1994).

3. Personal Role Manager: An Overview

In our proposed Personal Role Manager, each role has a vision statement (a document that describes responsibilities, quotas, goals, etc.) that is established by the user or manager. The explicitness of the vision can simplify the training and integration of new personnel into the organization and also facilitate the temporary covering of responsibilities among employees (for vacations or parental leave).

For example, a professor may have roles such as a teacher of courses, advisor to graduate students, member of the recruiting committee, principal investigator of grants, author of technical reports, and liaison to industry. In the teacher role the professor's vision statement might include the intention to apply electronic mail to facilitate a large undergraduate course. Files might include homework assignments, bibliography, course outline, etc. The task hierarchy might begin with tasks such as choosing a text book and end with administering the final exam. The subtasks for administering the final exam might include preparing the exam, copying the exam, reserving a room, proctoring the exam and grading it. The set of people include the students, teaching assistants, bookstore manager, registrar, and colleagues teaching other sections of the course. The schedule would begin with deadlines for submitting the book order to the bookstore manager and end with turning in the final grades to the registrar.

Similarly, a World Bank employee may have the role of a task manager (e.g. handling two projects: drinking water in Mali and a dam in Kenya), a role as a domain expert on steel construction, a member of the task force on information management, be the Lotus 1-2-3 peer training leader, and also organize the holiday party.

Our approach was stimulated by our experiences in managing complex projects with many participants. We also observed and interviewed experienced users to understand what their needs are and how current systems fail to support their tasks. While there are various scheduling, time management, address book, document management packages available, the coordination of these efforts is often under-emphasized. The Personal Role Manager (PRM) that we propose would simplify and speed the performance of common coordination tasks, in the same way that GUI interfaces simplify and speed file management tasks. We believe that the PRM provides a novel foundation and will generate refinements and extensions.

The key to PRM is organizing information according to the roles that an individual has in an organization. In our mockup, when users are working in a role, they have most relevant information visually available. These visual cues remind them of their goals, related individuals, required tasks, and scheduled events. The initial layout of roles may be established by a manager for a new employee, but then the employee can adjust, combine, or split roles as the demands change.

Screen management is one of the key functions of the PRM. All roles should always be visible but the current focus of attention could occupy most of the screen. As the user shifts attention to a second role, the current one would shrink and the second one would grow to fill the screen. Users could simultaneously enlarge two roles if there were interactions between them.

3.1 Vision statement

Each role has a vision statement that reminds the users of their goals. As a professor, my teaching role might have a vision statement about my desire to "increase class participation by collaborative methods, improve teamwork on term projects by requiring regular management meetings, prepare careful notes to facilitate future teaching of the same course, and coordinate with my teaching assistants by weekly meetings and email discussions." Such vision statements would likely be personal, but they could become a useful basis for discussions with peers or superiors.

3.2 Set of people

When acting in a given role users interact with a set of people that is a subset of the large number of people who might be in a personal or organizational phone book. Making the role-relevant group of people continuously visible (for example with names or small photos on the border of the large screen) has at least two benefits. First, the images will act as cues to remind the user of the need to inform, request or communicate with that individual (similar to seeing someone in the hallway which triggers some communication to coordinate work). Second the images act as active menus to initiate phone, fax, or email communication. For example, a document can be dragged and dropped onto an image triggering email plus a log of the action. Providing direct access to those people without the need of a directory search speeds performance and reduces cognitive load.

3.3 Task hierarchy

Tasks are hierarchically organized into subtasks using an outlining tool, or other display of tree structured information. The professor role may have a task for each of several courses or the principal investigator role may have tasks for multiple grants. Each course has multiple subtasks such as writing the syllabus, ordering textbooks, giving exams, and preparing final grades. A World Bank employee can have two or three projects to manage, each with multiple subtasks. The task hierarchy acts as a to-do list, and is linked to the schedule calendar to remind the user of upcoming deadlines.

3.4 Schedule

Each role has an associated schedule that is a component of a user's master schedule. When viewing a role, the user initially sees only the role-related schedule. For example, when in the professor role, the semester schedule is visible and when in the principal investigator role, the 2-year grant schedule is visible. Schedules can be combined to reveal a master schedule to allocate time and ensure that travel, vacations, and required meetings are blocked off on every schedule.

4. Related Developments

The Personal Role Manager is potentially an important development, although it must be refined and its viability tested. However, there are a number of other important developments that will influence the PRM and other initiatives.

The central development appears to be the increased emphasis on visual information seeking (Ahlberg & Shneiderman, 1994) and the dynamic queries approach (Shneiderman, 1994). These both are extensions of the direct manipulation principles of visual display of the world of action, rapid, incremental and reversible actions, and immediate (within 100 ms) and continuous display of the results of actions. These approaches start with a complete overview of a database, followed by zooming and filtering to narrow attention, and then pointing to get details-on-demand. By effective organization of visual displays, large amounts of information (3000 or more objects on the screen at once) can be absorbed, patterns recognized, and anomalies spotted. The remarkable human capacity for visual perception is underutilized in most contemporary applications.

To gain the benefits of visual information seeking larger displays will be necessary for many applications. The current 640 x 480 pixel standard display is inadequate for many tasks and larger display such as 1280 x 1024 pixels will be helpful. Of course high performance computation to support animation, smooth zooming, and rapid panning will also be necessary.

Even with larger display spaces, careful screen management could dramatically improve performance. Dialog boxes should appear close to but not on top of related information. Dialog boxes should automatically disappear as tasks are completed. Improved image browsers (Plaisant, Carr & Shneiderman, 1994), hierarchical browsers, and other coordinated displays are possible (Shneiderman, 1992).

Improved input devices, gestural methods, and two-handed input (Bier, Stone, Fishkin, Buxton & Baudel, 1994) will also speed performance on the larger and denser displays. The proportion of computer input by keyboard will decline as pointing techniques mature, as designers create improved interfaces, and as increased fractions of relevant information are available online. High-speed network connections will continue to spread more rapidly than we can anticipate and participation will increase. Video email, video-conferencing, video-information services, and video-entertainment will spread as the network connections increase, hardware/software improves, and prices decline.

5. Vision statement, again

Computer scientists have an appreciation for recursion and therefore it seems fitting to consider a vision statement for the role of futurist. We in the computer sciences and related disciplines will earn greater respect if we increase our attention to serving human needs, as opposed to focusing on technology. Future developments could be more regularly guided by our fundamental values and societal goals. Allowing individuals to function more effectively inside larger organizations seems vital to improving health care, education, social services, etc.

User interface developments are more likely to contribute to shaping a better world if there is an open discussion of goals, participatory design involving multiple viewpoints, and thoughtful consideration of the social impact (Shneiderman, 1990). We cannot guarantee a better world through advances in science or new technologies, but if we explicitly attend to the social impact in our work we can more often bend the technology to serve genuine human needs.

Acknowledgements

We gratefully appreciate the support of the World Bank for this opportunity to brainstorm about the future. We recognize the important assistance provided during the interviews with 18 World Bank personnel and the encouragement of Michael Sharpston.

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