

# **FUTURE DIRECTIONS FOR HUMAN-COMPUTER INTERACTION**

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## **ABSTRACT**

This paper offers a set of goals for user interface development and then scenarios of future developments. The applications include home control, hypermedia, office automation, digital photography, collaborative meeting/classrooms, public access, professional workstations, and medical record-keeping. Also, predictions are made for some of the underlying technologies such as User Interface Management Systems, remote control, flexible search, display devices, and touchscreens.

## **INTRODUCTION**

It is dangerous, but necessary, to dream about the future. Dangerous because misguided dreams mislead designers, necessary because without vision navigation is difficult. Without dreams we risk stagnation, and lose the chance to make a better world. This biased and partial portrait of the future is offered to guide designers of future interactive systems. It is organized top-down, from goals to applications to software/hardware. Planning for the future is never easy, but when innovation is the propelling force, prediction is especially difficult. This portrait is mainly an extrapolation of current trends, shaped by the high-level goals, and colored with a bit of wishful thinking.

## **GOALS**

The goals of interactive system designers are varied: productivity increases, reduced error rates, easier learning, and more consistency in performance are often cited and are relatively easily measured. But larger goals are often implicit in the broader work environment:

- increased production of high quality goods and services at low cost,
- improved user or customer satisfaction,
- increased safety or health,
- improved communication or cooperation among people,
- better educational tools,
- reduction in disease or famine, and
- even global goals such as world peace.

These work-related and societal goals might be expanded to include personal goals for users:

- increased sense of self-worth,
- empowerment to deal with large institutions,
- means to communicate facts, ideas, or feelings,
- capacity to innovate,
- reduced stress,
- opportunity to explore, and
- relaxation through entertainment.

Designers may debate the relative importance of these goals, and explicit discussion in public forums is strongly encouraged. As a professional community, I believe that we will be more productive and more appreciated if we engage in such discussion. However, the longer debate about underlying values is not the focus of this paper; specific applications and directions are.

## **APPLICATIONS**

In the past decade improved user interfaces have opened up the door to the widespread use of word processors for writing, spreadsheet software in accounting, computer assisted design for engineering, and desktop publishing plus graphics in organizational communications (Shneiderman, 1987). Here are some predictions about which applications will be similarly expanded in the next decade. The first group of applications have personal impact such as home control, public access information resources, and medical record keeping. The second group contains home and work related applications such as hypertext and digital photography. The last group of applications focus on work related aspects of electronic mail, collaborative meetings, and professional workstations.

### **Home controls & household automation**

Internationally, many companies have logically concluded that the next big market will be the inclusion of richer controls in homes (Time Magazine, January, 1989). Simple ideas such as turning off all the lights with a single

button or remote control of devices (either from one part of the home to another, from outside, or by programmed delays) are being extended in elaborate systems that channel sound and audio throughout the house, schedule lawn watering as a function of ground moisture, offer video surveillance and burglar alarms, and provide multiple-zone environmental controls plus detailed maintenance records. Demonstrations such as the Smart House project and installations such as those by Custom Command Systems are a testing ground for the next generation.

Some futurists and marketing types promote voice controls and home robots, but the practical reality is more tied to traditional pushbuttons, remote controllers, telephone keypads, and especially touchscreens, with the latter proving to be the most popular. Providing users with rich feedback and a clear sense of control is vital in these and most other applications.

In our own studies (Plaisant & Shneiderman, 1989) we explored four touchscreen designs for scheduling operations such as VCR recording or light switching:

- 1) digital clock that is set by pressing step keys (similar to "onscreen programming" in current video cassette players),
- 2) a 24-hour circular clock whose hands could be dragged with the fingers,
- 3) a 12-hour circular clock (plus AM/PM toggle) whose hands could be dragged with the fingers, and
- 4) a 24-hour time line where ON/OFF flags could be placed to indicate start/stop times.

\*\*\*\*figure 1\*\*\*

Figure 1: This scheduler was most successful in our usability studies. The users select a date by pointing on the calendar and then drag ON and OFF flags to the 24-hour time lines. The feedback is a red line on the calendar and the time lines. (Copyright 1988 University of Maryland)

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Our results indicate that (4) a 24-hour time line was easiest to understand and use (Figure 1). We continue to make further trials with more complex tasks such as editing schedules, repeated events (lights on every Friday night at 7PM), and long duration events. Many interesting product suggestions have emerged during our trials, for example an alarm clock that would ring only on weekdays, thus avoiding the oversight that leads to a ruined Saturday morning when the alarm rings at 6 AM.

Controlling complex home equipment from a touchscreen reshapes how we think of homes and their residents. New questions arise, such as whether

residents will feel safer, be happier, save money, or experience more relaxation. Are there new notations such as petri net variants or role/task diagrams for describing home automation and the social relations among residents? The benefits to handicapped users and the aged were often on our minds as we designed these systems, since they may be substantial beneficiaries of this technology even though initial implementations are for the healthy and wealthy.

### **Public access information resources**

From the early days of computing, there have been innovators who have put computers in public access situations such as airports, hotels, libraries, banks, museum exhibits, or stores. Many of the early design were difficult to use, slow, poorly organized (too many or confusing menus), hard to read (small displays, poor fonts, garrish colors), error prone (imprecise touchscreens), and unreliable. Much has changed and there is the possibility of a new generation of public access applications, if users can be convinced to forget the bad impressions that have already been left.

Automatic teller machines are remarkably more successful than they were a decade ago because of thorough attention to the user interface by some leading banks. Improved designs have been proven to lead to increased usage and greater customer satisfaction. A similar movement is in progress with respect to online public access card catalogs at libraries where the awkward first generation of designs are being challenged by designers who believe they can do better. Museum and exhibit designers are developing attractive computer and interactive videodisc projects that have the potential to revolutionize museum going by making the vast knowledge and resources of curators more accessible to patrons (Shneiderman, Brethauer, Plaisant and Potter, 1989).

Commercial projects such as interactive sales information on sports equipment, tourist destinations, vacation resorts, real estate, shoes, home redecorating, and clothing are now succeeding more regularly because the user interface designers have been able to build on a growing body of knowledge and experience. We will undoubtedly see many more such projects.

### **Medical records**

It is disturbing that technology has progressed rapidly in many areas, but that medical record keeping is quite similar to what it was a hundred or more years ago. While I am a great devotee of paper and pencil approaches, there are substantial benefits to having records in machine readable form. First let me make the case for machine readable medical records and then suggest some of the mechanisms for creating and manipulating the information.

If all my medical history were kept in a standardized electronic database form, I would be able to more easily transfer my records to a new physician or to a specialist during a consultation. My wife recently needed surgery and had difficulty getting her current records delivered on time for each consultation, and never could succeed in getting vital records about two previous surgeries. While computers are no guarantee that 20 year old records would be available,

there does seem to be a better chance of success. Certainly, if physicians could see records of recent lab tests, examinations, or consultations, there is a chance that better medical advice could be given.

But now, let's assume a standard electronic medical history, and explore the benefits and dangers. Having good records of weight or blood pressure would enable monitoring of abnormalities or sudden changes. Within a community, a doctor might be able to spot a pattern of influenza or food poisoning that might be otherwise undetected. Early warning approaches might alert neighboring communities of potential problems so that vaccination or health emergencies might be called for. On a societal level, researchers could analyze data from large numbers of people to study the effects of smoking, obesity, exercise, or diet on a scale that was not imaginable till now. The pioneering Framingham, MA study would be dwarfed by longitudinal studies of millions of individuals rather than thousands. Of course, there are dangers of loss of privacy and violation of the doctor/patient relationship, but these have been dealt with effectively in the banking, credit, and telephone industries and there is every reason to believe that adequate protection is possible. In fact, considering the lax security in many doctors offices that I have visited, I might prefer electronic records to increase privacy protection.

Once the idea of electronic medical histories becomes acceptable, then other possibilities emerge. Each citizen might carry a magnetic card with a brief version of their medical history and links to their full record. In an emergency, physicians would immediately have the relevant medical information (pharmacological information, recent electrocardiogram, reports on recent illnesses, etc.) and be able to contact the patient's physician.

Data collection could become much more thorough. For example, records of workouts (pulse rates, duration), medication (frequency and time of day), minor illnesses (headaches, colds), even bathroom scales might be recorded regularly. While not everyone might want such a complete record of body weight, blood pressure, or temperature there are many situations (hypertension monitoring, fertility programs) that currently require more detailed histories over long periods. Research on the linkage between diet, exercise, or sleep habits on mental or physical health would be greatly facilitated by larger clinical databases. This seems like a grand opportunity.

## **Hypertext and hypermedia**

Hypertext is rapidly emerging, but the idea of reading fragments of text on computer screens and following links still has a long way to go to gain acceptance (Conklin, 1987; Marchionini and Shneiderman, 1988; Shneiderman, 1989; Shneiderman and Kearsley, 1989). Hypertext is most appropriate when there are a large number of short information fragments that cross reference each other, and when the users need to view only a small slice at a given time. Catalogs, diagnostic problem-solving guides, business procedures manuals, organizational guides, museum exhibits, encyclopedic sources, reference books, and cookbooks seem likely candidates for practical commercial

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