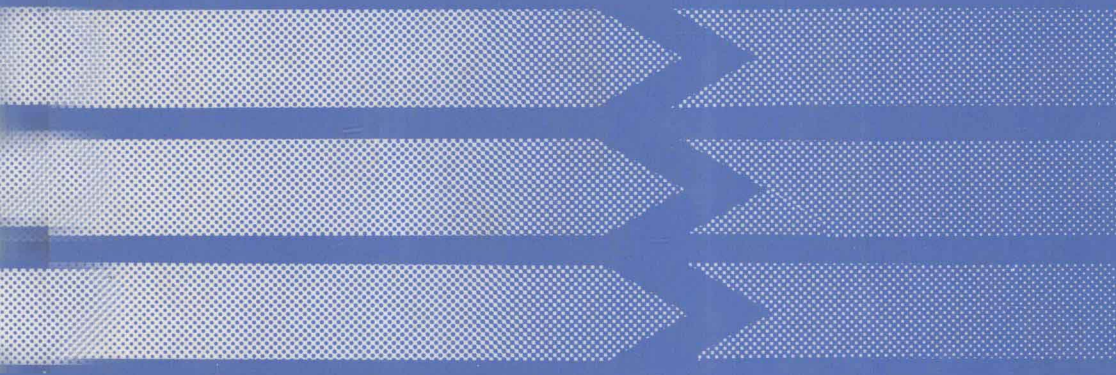
LANGUAGES AND INFORMATION SYSTEMS

HUMAN-MACHINE INTERACTIVE SYSTEMS



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PREFACE

Many hardware devices present either results or alternatives selected by computers to users. A few are video display terminals (VDTs), touch-tone telephones, and computer-generated speech systems. In part this book concerns the impact and implications of such tools. Alternatively this is an attempt to provide material for researchers, students, and managers concerned with computer interfaces. The subject of computer interfaces is at one level a technical subarea sharing common interests with the broad disciplines of computer science, psychology, and bioengineering. However, it is also a topic thrust to the forefront of interest of a wide variety of individuals who confront one of the most striking technological changes that has occurred in human history—the introduction of contact with computing devices as an essential component of many kinds of ordinary transactions. Point of entry sales, travel and entertainment reservations, and library information, are commonly conducted today by interaction with digital calculating devices that did not exist in the recent past.

The papers in this book present several concerns arising from the widespread use of computing. One involves the future implications of further advances of this technology. This is a twofold issue: (a) the potential consequences of changing the basic way that information is managed in areas ranging from design, engineering, and management/planning to information access, education, and clerical function; and (b) improvements that could be instituted from further development of the special characteristics of display techniques, technologies, and algorithms. The latter provides another way to describe the chapters that appear here.

The prevalence of information-presenting hardware in society today is a consequence of computer programs that turn digital computers into useful symbol-handling tools. The utility comes from two features not immediately apparent when computers are viewed as calculating machines: high speed, and large volume of accessible data. The authors of the chapters presented here address several ways that both features have been put to use; they also reflect on the consequences of existing or likely new technology involving massive increase in the amount of storage, hence the size of data sets that are computer-accessible.

The contributions fall into two main groups. One concerns such broad themes as *knowledge*, *information*, and *communication*, as well as recent special

emphasis in computing on techniques involving *menus*, *icons*, and *objects*. The other involves extending the capability of the computer to images, and senses, items normally the province of people such as *visualization*, *depth*, and *touch*. The first group represents data and applications currently well underway in terms of adaption to the computer, but also includes recent development of techniques to support interactive and personal computing. The second group extends computing power to design, planning, and complex data. Hence there are two parts to the organization of chapters: part one is called "Accessing Knowledge," part two, "Display and Design."

In both areas new computer-based products require *learning*. Knowledge of proper keystroke sequences or technical areas of applied mathematics, computer software, or hardware systems: prefix and postfix expressions; stack, tree, and array concepts; and active and secondary memory are relatively technical for the current workplace. The rapid pace of technological change and lack of standardization leads to needs that are being met by individuals such as those who contribute to this volume. Many of the chapters in this book address learning issues, and concern steps toward more useful methods to handle tasks using computer technology.

The book began as an attempt to communicate with a few graduate students in the UCLA Computer Science Department. Many thanks are due them, and my colleagues, for their helpful assistance to me that enabled me to gain some competence in dealing with computer interfaces. Thanks are also due to the organizers of the Third International Conference on Human –Computer Interaction, that took place in Boston, September 1989, particulary to Michael J. Smith, University of Wisconsin, the Program Chairman, whose electronic mail helped me to the process of organizing two sessions at that meeting. Six of the chapters were presented in those sessions in earlier form and one other was included in the session proposal. Valued assistance by Susanna Reyn aided in preparing manuscript copies of several of the papers. Numerous individuals contributed technical expertise to further the process of evolving the contributions as they are now in this book; a partial list of technical reviewers appears following the Table of Contents. Apologies are offered to those who have been inadvertently omitted, and grateful thanks to all.

The fourteen chapters in this book, like the broad society as a whole, are only beginning the process of coming to terms with the implications of the new reality, that powerful information-handling tools are widely available, and that many kinds of individuals deal with computer interfaces. Some are scientists and engineers. Others are unfamiliar with science and mathematics, and often resent computer requirements. We all, the authors, reviewers, and other contributors to this work, have begun to address the wide use of computers in design or commerce, but there is much more to be

concerned with as we put greater and greater information-handling power in the hands of society. The hope here is that this work will contribute to our understanding of the power and potential of the new computer technology.

ALLEN KLINGER

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CONTENTS

I

ACCESSING KNOWLEDGE

THE FREESTYLE SYSTEM
A DESIGN PERSPECTIVE

STEPHEN R. LEVINE AND SUSAN F. EHRLICH

1. Introduction

The increase in speed, memory, and display characteristics of personal computers creates a new opportunity to support a larger set of fundamental types of human communication. In order to communicate with groups of people in the past, we have used standard alphabets that are efficiently reproduced using typing, printing, word processing, and copiers. People have shared these typed messages across distance using sophisticated means of transporting both paper and electronic mail. While we have grown to accept our dependence on the written word to reach large numbers of people quickly, we have also sought ways to use technology to capture more fundamental types of human communication.

The telephone has allowed us to speak across distance, while the television has allowed us to capture most dimensions of communication—including speech, pointing, and gesture—in one-to-many communication. We have continued to look for two-way and multiway communication media that can capture these multidimensional fundamentals. Video conferencing and videophones have been tried with some limited success.[1, 2]

People can now *point* to things on computer screens with free-roaming cursors, capture *voice* in compressed computer files, as well as capture *hand-drawn input* into drawing packages, typically with a mouse. In face-to-face meetings, people rarely use these types of communication separately. There is a need, then, to simultaneously capture them as they are *used in concert* and share them via electronic mail.

The Freestyle system was designed to capture synchronized pointing, speaking, drawing, and writing with electronic versions of familiar tools: paper, pencil, and voice handset/speaker-phone (Fig. 1). People simultaneously use combinations of real world versions of these tools to

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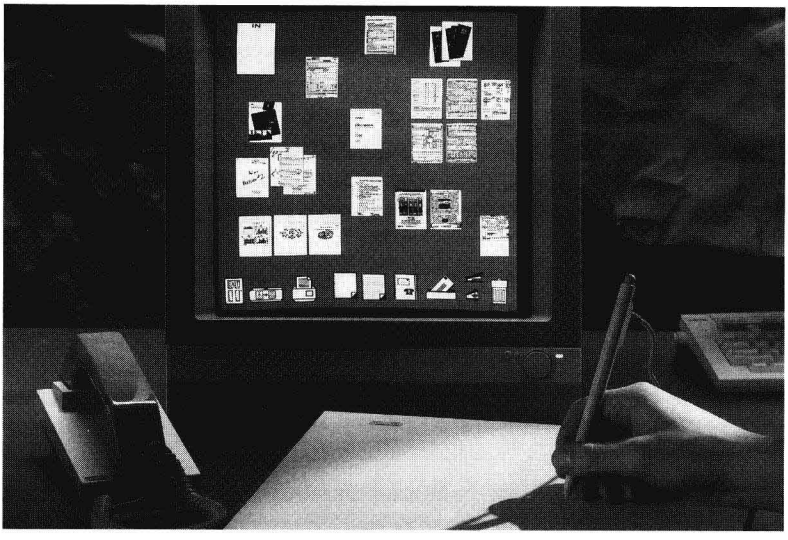

FIGURE 1. Components of the Freestyle system including pencil, tablet, and voice handset. © Wang Laboratories Inc., 1989.

communicate with each other in the initial stages of almost all work. As a project solidifies, a formal record is often kept in a typed form that can easily be reproduced and distributed. But up to this point, the computer has not supported the capture and distribution of synchronized verbal and handwritten communication. Nor has it supported such synchronized discussions *about* formal documents.

This new type of electronic mail is made possible partially because of the increasing ability of high-speed graphic interfaces to provide rich, immediate, multidimensional *feedback* that is similar to that in the real world. (See discussion of the data glove[3] and the alternate reality kit[4] below.) Even as display capabilities of personal computers have been improving, so has the ability to interconnect them. With the general introduction of networking into the work force, there has been an upsurge in the use of computer-based mail systems. The Freestyle project was in the position to take advantage of existing networks.

The design of this system was based on a combination of original ideas and discovery of needs through laboratory and field research. It was partially driven by a theory of users' communication needs and by a particular approach to graphics design based on real-world mimicry. This chapter will outline how various contributions to the design were interwoven as it evolved over time from an initial prototype through multiple versions that were tested in business environments. (See also Francik and Akagi,[5] Perkins *et al*,[6] and Hsiao and Levine[7] for details of the design process.)

2. *User Interface Design*

Freestyle was designed to be a voice and handwriting based communication system that sits on top of the current world of personal computing. It leaves intact the DOS operating system and PC software used for calculation, typing, or record keeping (e.g., spreadsheets, word processing, database, etc.)

2.1. *Image Annotation*

The starting point was to enable the user to capture any visible screen shown on a standard PC (including a completely blank screen, or an image that was previously scanned into the PC) and convert it into an "electronic piece of paper." Once the screen was frozen, it could then be pointed at and written on using a tablet with a pencil-shaped stylus (Francik and Akagi[5]).

The system also provided the ability to record speech via a handset/speaker-phone even as the user is writing or pointing with the stylus (Hsiao and Levine[7]), thus supporting four fundamental means for synchronized

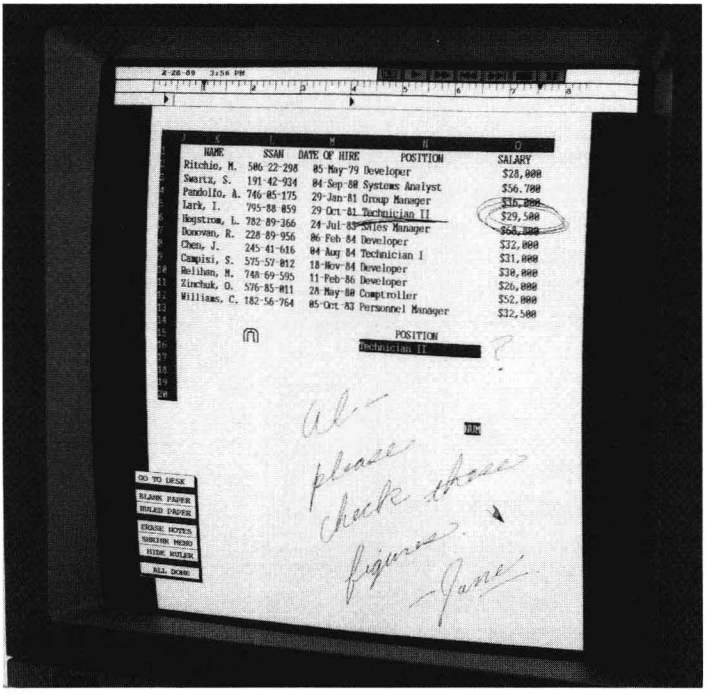

FIGURE 2. The Freestyle annotation environment. © Wang Laboratories Inc., 1989.