Text Entry Systems:

*Mobility, Accessibility, Universality*
Text Entry Systems:
Mobility, Accessibility, Universality

Edited by
I. Scott MacKenzie and
Kumiko Tanaka-Ishii
Contents

Preface
by I. Scott MacKenzie, York University, Toronto, ON, Canada
Kumiko Tanaka-Ishii, University of Tokyo, Tokyo, Japan

Part 1 Foundations

1 Historical Overview of Consumer Text Entry Technologies
by Miika Silfverberg, Nokia Research Center, Helsinki, Finland

2 Language Models for Text Entry
by Kumiko Tanaka-Ishii, University of Tokyo, Tokyo, Japan

3 Measures of Text Entry Performance
by Jacob O. Wobbrock, University of Washington, Seattle, WA, USA

4 Evaluation of Text Entry Techniques
by I. Scott MacKenzie, York University, Toronto, ON, Canada
Part 2  Entry Modalities and Devices  103

5  Text Entry Using a Small Number of Buttons  105
   by I. Scott MacKenzie, York University, Toronto, ON, Canada
   Kumiko Tanaka-Ishii, University of Tokyo, Tokyo, Japan

6  English Language Handwriting Recognition Interfaces  123
   by Charles C. Tappert and Sung-Hyuk Cha, Pace University,
   New York, NY, USA

7  Introduction to Shape Writing  139
   by Shumin Zhai, IBM Almaden Research Center, San Jose, CA, USA
   Per Ola Kristensson, Linköpings Universitet, Linköping, Sweden

8  Speech-Based Interfaces  159
   by Sadaoki Furui, Tokyo Institute of Technology, Tokyo, Japan

9  Text Entry by Gaze: Utilizing Eye Tracking  175
   by Päivi Majaranta and Kari-Jouko Räihä, University of Tampere,
   Tampere, Finland

Part 3  Language Variations  189

10  Writing System Variation and Text Entry  191
    by Kumiko Tanaka-Ishii, University of Tokyo, Tokyo, Japan
    Renu Gupta, University of Aizu, Aizu, Japan

11  Text Entry in East Asian Languages  203
    by Kumiko Tanaka-Ishii, University of Tokyo, Tokyo, Japan
    Ming Zhou, Microsoft Research, Redmond, WA, USA
    Jin-Dong Kim, University of Tokyo, Tokyo, Japan

12  Text Entry in South and Southeast Asian Scripts  227
    by Renu Gupta, University of Aizu, Aizu, Japan
    Virach Sornlertlamvanich, NICT Asia Research Center, Pathumthani,
    Thailand

13  Text Entry in Hebrew and Arabic Scripts  251
    by Tsuguya Sasaki, Bar-Ilan University, Ramat Gan, Israel
    Kumiko Tanaka-Ishii, University of Tokyo, Tokyo, Japan
Part 4  Accessibility, Universality  269

14  Text Input for the Elderly and the Young  271
    by Janet C. Read, University of Central Lancashire, Preston, 
    Lancashire, UK

15  Text Entry When Movement is Impaired  289
    by Shari Trewin, IBM T. J. Watson Research Center, Yorktown Heights, 
    NY, USA
    John Arnott, University of Dundee, Dundee, Scotland, UK

16  Text Entry for People with Visual Impairments  305
    by Chieko Asakawa and Hironobu Takagi, Tokyo Research Laboratory, 
    IBM Research, Tokyo, Japan

Index  319

About the Authors  329
Preface

Text entry has never been more important than today. In large measure, this is a follow on to the huge success of mobile computing and, in particular, text messaging on mobile phones and related devices. Yet, today's heightened interest is, arguably, within a second wave of text entry research. The first wave, so to speak, was in the 1970s and early 1980s in response to the new role of electronic computers in automating office tasks such as typing, word processing, document management, and so on. Modeling ten-finger touch typing, categorizing typing errors, task analysis, and comparing document editing strategies are some of the themes in this early research.

There was a lull in text entry research beginning around 1983, as marked by the arrival on the computing scene of the GUI (graphical user interface) and point-and-click interaction. For a time, researchers seemed to shift their attention to the challenges and opportunities in this new genre of direct manipulation interaction. Interest in text entry soon resurfaced. The early 1990s brought pen-based computing. Automatic handwriting recognition was the elixir for this new mode of interaction, or so it seemed. Unfortunately, the promise of pen-based computing did not meet the expectations of demanding users, and the market suffered for this. Yet products and interest continued. The most significant event in pen-based computing was the 1995 introduction of the Palm Pilot PDA with its popular Graffiti handwriting recognition system. However, it is the huge success of text messaging (aka SMS, for short message service) that most dramatically marks the second wave of interest in text entry. Juxtapose the observation that over one billion messages SMS messages are sent each day with the fact that the mobile phone keypad is the dominant input device for creating these messages, and it is no surprise that researchers are grappling with the problem of improving text entry techniques for mobile phones or other anticipated mobile products supporting similar services.

The introductory comments above ignore at least three other aspects of text entry – aspects that fall outside the scope of the two conjectured waves of interest. First, researchers in linguistics have long examined the nature of language and communication with a keen view to understanding and exploiting the inherent statistical properties of text. Word prediction, word completion, phrase completion, and other accelerating techniques have a long history of study that is only by coincidence related to mobile computing. Second, work in improving the quality of life for people with physical impairments involves today, as ever, the development of methods of efficient textual communication. Remember, what is efficient for an able-bodied person with full ten-finger dexterity may be untenable for someone capable of pressing just one button and doing so only once every few seconds. The third aspect is recognition that our world is diverse. While English
may be the universal language for pilots traversing the globe in airplanes, such is not the
case for the millions (billions!) of people using technology to communicate using text. A
text message today is just as likely entered in Arabic or Punjabi as in English. We note, as
well, that text entry is increasingly the domain of young and old alike.

Our goal in this book is to bring together researchers in text entry that span the
mixed collection of interests noted above. Our themes are mobility, accessibility, and uni-
versality. The book is in four parts. We begin with an historical overview of text entry and
follow with guidelines and frameworks for designing better entry systems, focusing on

✦ methodology – to develop and disseminate appropriate methods for validating
research ideas;
✦ measurements – to more accurately and more thoroughly capture user behavior, in
particular with respect to accuracy and error rate issues; and
✦ modeling – to exploit the statistical properties of language for better predictive
interfaces.

The second part discusses devices and modalities. Each chapter summarizes the cur-
rent state of the art for a basic technology. Then, ideas in applying the technology to text
entry systems are summarized. Future possibilities are also elaborated as a basic technol-
ogy becomes more advanced.

The third part examines entry systems in languages around the world, with each
chapter revealing the unique characteristics of a language group. Based on this, the chap-
ter provides the history of entry systems and problems solved so far in combination with
current major entry designs. Each chapter also demonstrates how the study of a specific
language leads to new ideas applicable to other languages.

The last part is concerned with text entry that is accessible to all. Each chapter summa-
rizes the unique characteristics of a group of users and the problems they face for text entry,
and shows how the study of a genre of people leads to new ideas and universal design.

This book is a small contribution on the theme of text entry. One large issue lies in the
background of text entry systems – communication. As put by a seriously disabled person, “It
is communication that keeps me living.” In some measure this is a theme for us all.
Communication today increasingly uses text entry. This book explores the opportunity to
use technology to communicate in any language to anybody.

We wish to extend our deepest gratitude to a number of people who have helped in
bringing this book to its present finished and published state. The book was conceived at a
workshop on Efficient Text Entry in September 2005 in Dagstuhl Germany (http://drops.
dagstuhl.de/portals/05382). We thank Karin Harbusch (University of Koblenz/Landau)
who organized the workshop for her tireless effort in bringing together many of the top
researchers in text entry, some of whom have authored chapters herein. Our initial
proposal and subsequent draft chapters were enthusiastically and meticulously reviewed
by Ravin Balakrishnan (University of Toronto), Poika Isokoski (University of Tampere),
Roel Vertegaal (Queen’s University), Ken Hinckley (Microsoft), and John San Giovanni
(Microsoft). Many thanks, again. Working behind the scenes in editorial and production
roles are many individuals who helped the process in critical yet often unsung ways. Those
we worked directly with are Diane Cerra, Asma Palmeiro, Monica González de Mendoza,
and Mani Prabakaran. Our journey has been both challenging and rewarding and the
result is better because of you. Our sincerest thanks.