
Foreword

For about 25 years research and development projects in the area of human-computer interaction (HCI) have been pursued with the objective to adapt the communication and interaction with the machine to the needs of the human user, and not vice versa. But it was only within the past ten years that significant and substantial progress in the practical realization of the results in this area was achieved with the development of individual forms of interaction like speech processing or visualization. The resulting question, then, was whether it is possible to develop easy-to-use multimodal user interfaces with an attractive market potential.

This was the starting point for the inter-disciplinary research activities in human-computer interaction conducted by six large strategic cooperative projects with 102 partners from science and industry. In 1999, these six so-called lead projects came out ahead of 89 proposals overall in an ideas competition launched by the German federal government. These recently finished research projects were supposed to allow human users in both their private and professional environments to multimodally control and diversely use technical systems via natural modalities of interaction like speech, gestures, facial expressions, tactile and graphical input. Ergonomics and user acceptance of these forms of interaction were the key criteria for the development of prototypes that were supposed to have both a strong scientific attractiveness and a high market potential.

One of these lead projects is SMARTKOM. Coordinated by the German Research Center for Artificial Intelligence in Saarbrücken, a consortium of four well-known industrial companies, two small companies and two middle-sized ones, one research institute and three universities was formed. The objective of SMARTKOM was to conduct fundamental research in the area of robust multimodal interaction under realistic conditions, i.e., interaction has to be possible even if the input is underspecified, ambiguous or partially incorrect. The basic idea was to consider and integrate several modes of interaction — in addition to speech especially gestures and facial expressions — instead of only a single modality, and thereby to achieve a substantially better interpretation of the user's intention. This assessment has been confirmed at international conferences worldwide. Thanks to the dedication of all project part-

ners SMARTKOM's ambitious objectives have been more than accomplished, as for instance:

- the situation-dependent recognition of underspecified, ambiguous or partially incorrect input on both a syntactic and a pragmatic level was demonstrated successfully,
- a multimodal semantic representation language was developed (M3L) that substantially contributes to a worldwide standardization, and last but not least
- speech-based dialogic Web services for car drivers and pedestrians were developed.

Moreover, the know-how gained in the project was protected for the German economy through 52 patent applications, 29 spin-off products and six spin-off companies so far. In the scientific area, the SMARTKOM project resulted in 255 publications, 66 diploma theses, Ph.D. and habilitation theses, State doctorates as well as six appointments to professorships. This makes SMARTKOM the most successful of all 29 lead projects of the Federal Ministry of Education and Research started since 1998. SMARTKOM was funded with 16.8 million € between September 1999 and September 2003. The overall financial means including the matching funds from industry amounted to 25.7 million €.

This book provides a comprehensive overview of the broad spectrum of results of the research conducted in SMARTKOM. I thank and give credit to everyone involved in the project but especially to Professor Wolfgang Wahlster's professional project management and his competent scientific leadership of the distinguished team of researchers.

Bonn, May 2006

Dr. Bernd Reuse
Head of the Software Systems Division
German Federal Ministry of Education and Research

Acknowledgment

A book such as this one could obviously not be put together without the help and cooperation of many people.

I am particularly indebted to the authors who graciously made their contributions available in a timely fashion.

I would like to thank Dr. Anselm Blocher for his excellent editorial assistance and the production of the final camera-ready copy. Special praise goes to Leivy Michelly Kaul and Alexander Kowalski for their assistance in formatting and copy-editing the book. Special thanks go to Ronan Nugent from Springer for his continuous copy-editing and production support.

The SMARTKOM project was made possible by funding from the German Federal Ministry of Education and Research (BMBF) under contract number number 01 IL 905. I would like to thank Dr. Bernd Reuse, Head of the Software Systems Division at BMBF, for his constant and tireless support of the SMARTKOM project.

Saarbrücken, May 2006

Wolfgang Wahlster
Scientific Director of the SMARTKOM Project
CEO of the
German Research Center for Artificial Intelligence
(DFKI)

List of Contributors

J. Adelhardt

Friedrich-Alexander-University
Erlangen-Nuremberg
Martenstraße 3
D-91058 Erlangen
adelhard@
informatik.uni-erlangen.de

J. Alexandersson

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
janal@dfki.de

H. Aras

European Media Lab
Schloß-Wolfsbrunnenweg 33
D-69118 Heidelberg
Hidir.Aras@eml.villa-bosch.de

M. Baudis

Mundwerk AG
Immanuelkirchstraße 3-4
D-10405 Berlin
berlin@excelsisnet.com

A. Batliner

Friedrich-Alexander-University
Erlangen-Nuremberg
Martenstraße 3
D-91058 Erlangen
batliner@
informatik.uni-erlangen.de

T. Becker

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
becker@dfki.de

A. Berton

DaimlerChrysler AG
Wilhelm-Runge-Straße 11
D-89081 Ulm
andre.berton@
daimlerchrysler.com

A. Blocher

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
blocher@dfki.de

N. Braunschweiler

IMS, University of Stuttgart
Azenbergstraße 12
D-70174 Stuttgart
braunnt@ims.uni-stuttgart.de

J. Bryant

International Computer Science Institute
1947 Center Street
Berkeley, CA, USA 94704-1105
jbryant@icsi.berkeley.edu

D. Bühler

University of Ulm
Albert-Einstein-Allee 43
D-89081 Ulm
dirk.buehler@uni-ulm.de

V. Chandrasekhara

quadox AG
Ohmstraße 2
D-69190 Walldorf
vasu.chandrasekhara@quadox.de

G. Dogil

IMS, University of Stuttgart
Azenbergstraße 12
D-70174 Stuttgart
dogil@ims.uni-stuttgart.de

R. Engel

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
ralf.engel@dfki.de

M. Emele

Sony International (Europe) GmbH
Heinrich-Hertz-Straße 1
D-70327 Stuttgart
emele@gmx.net

C. Frank

Friedrich-Alexander-University
Erlangen-Nuremberg
Martenstraße 3
D-91058 Erlangen
frank@
informatik.uni-erlangen.de

D. Gelbart

International Computer Science Institute
1947 Center Street
Berkeley, CA, USA 94704-1105
gelbart@icsi.berkeley.edu

S. Goronzy

3SOFT GmbH
Frauenweiherstraße 14
D-91058 Erlangen
Silke.Goronzy@3SOFT.de

S. Grashey

Siemens AG
Otto-Hahn-Ring 6
D-81730 Munich
stephan.grashey@siemens.com

I. Gurevych

Technical University Darmstadt
Hochschulstraße 10
D-64289 Darmstadt
Gurevych@
tk.informatik.tu-darmstadt.de

U. Haiber

DaimlerChrysler AG
Wilhelm-Runge-Straße 11
D-89081 Ulm
udo.haiber@daimlerchrysler.com

J. Häußler

European Media Lab
Schloß-Wolfsbrunnenweg 33
D-69118 Heidelberg
jochen.haeussler@
eml.villa-bosch.de

G. Herzog

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
Gerd.Herzog@dfki.de

A. Horndasch

Sympalog Speech Technologies AG
Karl-Zucker-Straße 10
D-91052 Erlangen
horndasch@sympalog.de

C. Hying

Sony International (Europe) GmbH
 Heinrich-Hertz-Straße 1
 D-70327 Stuttgart
 christian.hying@
 ims.uni-stuttgart.de

M. Jöst

European Media Lab
 Schloß-Wolfsbrunnenweg 33
 D-69118 Heidelberg
 joest@eml.org

A. Kaltenmeier

DaimlerChrysler AG
 Wilhelm-Runge-Straße 11
 D-89081 Ulm
 alfred.kaltenmeier@
 daimlerchrysler.com

A. Kellner

Philips GmbH
 Weißhausstraße 2
 D-52066 Aachen
 Andreas.Kellner@philips.com

T. Klankert

IMS, University of Stuttgart
 Azenbergstraße 12
 D-70174 Stuttgart
 klankert@ims.uni-stuttgart.de

S. Krüger

SAP AG
 Dietmar-Hopp-Allee 16
 D-69190 Walldorf
 sven.krueger@sap.com

Y.H. Lam

Sony International (Europe) GmbH
 Heinrich-Hertz-Straße 1
 D-70327 Stuttgart
 lam@sony.de

M. Löckelt

DFKI GmbH
 Stuhlsatzenhausweg 3
 D-66123 Saarbrücken
 loeckelt@dfki.de

M. Lützeler

Siemens AG
 Otto-Hahn-Ring 6
 D-81730 Munich
 Michael.Luetzeler@siemens.com

R. Malaka

University of Bremen
 Bibliothekstraße 1, MZH
 D-28359 Bremen
 malaka@informatik.uni-bremen.de

M. Merdes

EML Research gGmbH
 Schloß-Wolfsbrunnenweg 33
 D-69118 Heidelberg
 matthias.merdes@
 eml-r.villa-bosch.de

W. Minker

University of Ulm
 Albert-Einstein-Allee 43
 D-89081 Ulm
 wolfgang.minker@uni-ulm.de

B. Möbius

IMS, University of Stuttgart
 Azenbergstraße 12
 D-70174 Stuttgart
 moebius@ims.uni-stuttgart.de

G. Möhler

IMS, University of Stuttgart
 Azenbergstraße 12
 D-70174 Stuttgart
 moehler@gmx.de

E. Morais

Faculdade de Eng. Elétrica e de
 Computação
 State University of Campinas, Brazil
 emorais@decom.fee.unicamp.br

N. Morgan

International Computer Science Institute
1947 Center Street
Berkeley, CA, USA 94704-1105
morgan@icsi.berkeley.edu

A. Ndiaye

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
ndiaye@dfki.de

H. Niemann

Friedrich-Alexander-University
Erlangen-Nuremberg
Martenstraße 3
D-91058 Erlangen
niemann@
informatik.uni-erlangen.de

E. Nöth

Friedrich-Alexander-University
Erlangen-Nuremberg
Martenstraße 3
D-91058 Erlangen
noeth@
informatik.uni-erlangen.de

D. Pfisterer

University Lübeck
Ratzeburger Allee 160
D-23538 Lübeck
pfisterer@itm.uni-luebeck.de

N. Pfleger

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
Norbert.Pfleger@dfki.de

P. Poller

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
poller@dfki.de

T. Portele

Philips GmbH
Weißhausstraße 2
D-52066 Aachen
Thomas.Portele@philips.com

R. Porzel

European Media Lab
Schloß-Wolfsbrunnenweg 33
D-69118 Heidelberg
porzel@eml.org

S. Rabold

University of Munich
Schellingstraße 3
D-80799 Munich
rabold@phonetik.uni-muenchen.de

J. Racky

Siemens AG
Otto-Hahn-Ring 6
D-81730 Munich
Jens.Racky@siemens.com

H. Rapp

MediaInterface Dresden GmbH
Washingtonstraße 16/16a
D-01139 Dresden
rapp@mediainterface.de

S. Rapp

Sony International (Europe) GmbH
Heinrich-Hertz-Straße 1
D-70327 Stuttgart
rapp@conante.com

N. Reithinger

DFKI GmbH
Stuhlsatzenhausweg 3
D-66123 Saarbrücken
Norbert.Reithinger@dfki.de

B. Reuse

BMBF
Heinemannstraße 2
D-53175 Bonn
Bernd.Reuse@BMBF.bund400.de

H. Röttger

Siemens AG
 Otto-Hahn-Ring 6
 D-81730 Munich
 Hans.Roettger@siemens.com

B. Säuberlich

IMS, University of Stuttgart
 Azenbergstraße 12
 D-70174 Stuttgart
 bettina.saeuberlich@ims.uni-stuttgart.de

F. Schiel

University of Munich
 Schellingstraße 3
 D-80799 Munich
 schiel@phonetik.uni-muenchen.de

O. Schreiner

Technical University Berlin
 Straße des 17. Juni 135
 10623 Berlin

M. Schuster

Siemens AG
 Otto-Hahn-Ring 6
 D-81730 Munich
 Matthias.Schuster@siemens.com

A. Schweitzer

University of Stuttgart
 Azenbergstraße 12
 D-70174 Stuttgart
 Antje.Schweitzer@ims.uni-stuttgart.de

R.P. Shi

Friedrich-Alexander-University
 Erlangen-Nuremberg
 Martenstraße 3
 D-91058 Erlangen
 shi@informatik.uni-erlangen.de

S. Steininger

University of Munich
 Schellingstraße 3
 D-80799 Munich
 steins@phonetik.uni-muenchen.de

A. Stolcke

International Computer Science Institute
 1947 Center Street
 Berkeley, CA, USA 94704-1198
 stolcke@icsi.berkeley.edu

M. Streit

Rue de la Gare 108
 F-57150 Creutzwald

M. Thomae

Technical University of Munich
 Arcisstr. 21
 D-80333 Munich
 thomae@ei.tum.de

S. Torge

Sony International (Europe) GmbH
 Heinrich-Hertz-Straße 1
 D-70327 Stuttgart
 sunna.torge@web.de

V. Tschernomas

TNM Software GmbH
 Grubenstraße 107
 D-66540 Neunkirchen
 tschernomas@tnmsoft.com

U. Türk

University of Munich
 Schellingstraße 3
 D-80799 Munich
 tuerk@phonetik.uni-muenchen.de

Z. Valsan

Sony International (Europe) GmbH
 Heinrich-Hertz-Straße 1
 D-70327 Stuttgart
 valsan@sony.de

J. te Vrugt

Philips GmbH

Weißhausstraße 2

D-52066 Aachen

Juergen.te.Vrugt@philips.com

W. Wahlster

DFKI GmbH

Stuhlsatzenhausweg 3

D-66123 Saarbrücken

wahlster@dfki.de

V. Zeissler

Friedrich-Alexander-University

Erlangen-Nuremberg

Martenstraße 3

D-91058 Erlangen

zeissler@

informatik.uni-erlangen.de

SmartKom: Foundations of Multimodal Dialogue
Systems

Wahlster, W. (Ed.)

2006, XVIII, 645 p., Hardcover

ISBN: 978-3-540-23732-7