

LNCS 3941

Stephen W. Gilroy
Michael D. Harrison (Eds.)

Interactive Systems

Design, Specification, and Verification

12th International Workshop, DSVIS 2005

Newcastle upon Tyne, UK, July 2005

Revised Papers



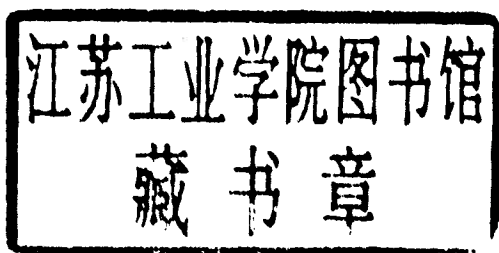
Springer

Stephen W. Gilroy Michael D. Harrison (Eds.)

Interactive Systems

Design, Specification, and Verification

12th International Workshop, DSVIS 2005
Newcastle upon Tyne, UK, July 13-15, 2005
Revised Papers



Volume Editors

Stephen W. Gilroy
Michael D. Harrison
University of Newcastle upon Tyne
School of Computing Science
Newcastle upon Tyne, NE1 7RU, UK
E-mail: { steve.gilroy,michael.harrison }@ncl.ac.uk

Library of Congress Control Number: 2006925462

CR Subject Classification (1998): H.5.2, H.5, I.3, D.2, F.3

LNCS Sublibrary: SL 2 – Programming and Software Engineering

ISSN 0302-9743
ISBN-10 3-540-34145-5 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-34145-1 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springer.com

© Springer-Verlag Berlin Heidelberg 2006
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11752707 06/3142 5 4 3 2 1 0

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Moshe Y. Vardi

Rice University, Houston, TX, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Lecture Notes in Computer Science

For information about Vols. 1–3894

please contact your bookseller or Springer

- Vol. 3994: V.N. Alexandrov, G.D. van Albada, P.M.A. Sloot, J. Dongarra (Eds.), *Computational Science – ICCS 2006, Part IV. XXIX*, 1094 pages. 2006.
- Vol. 3993: V.N. Alexandrov, G.D. van Albada, P.M.A. Sloot, J. Dongarra (Eds.), *Computational Science – ICCS 2006, Part III. XXX*, 1138 pages. 2006.
- Vol. 3992: V.N. Alexandrov, G.D. van Albada, P.M.A. Sloot, J. Dongarra (Eds.), *Computational Science – ICCS 2006, Part II. XXIX*, 1121 pages. 2006.
- Vol. 3991: V.N. Alexandrov, G.D. van Albada, P.M.A. Sloot, J. Dongarra (Eds.), *Computational Science – ICCS 2006, Part I. CCXX*, 1090 pages. 2006.
- Vol. 3987: M. Hazas, J. Krumm, T. Strang (Eds.), *Location- and Context-Awareness. X*, 289 pages. 2006.
- Vol. 3986: K. Stølen, W.H. Winsborough, F. Martinelli, F. Massacci (Eds.), *Trust Management. XIV*, 474 pages. 2006.
- Vol. 3984: M. Gavrilova, O. Gervasi, V. Kumar, C.J. K. Tan, D. Taniar, A. Laganà, Y. Mun, H. Choo (Eds.), *Computational Science and Its Applications – ICCSA 2006, Part V. XXV*, 1045 pages. 2006.
- Vol. 3983: M. Gavrilova, O. Gervasi, V. Kumar, C.J. K. Tan, D. Taniar, A. Laganà, Y. Mun, H. Choo (Eds.), *Computational Science and Its Applications – ICCSA 2006, Part IV. XXVI*, 1191 pages. 2006.
- Vol. 3982: M. Gavrilova, O. Gervasi, V. Kumar, C.J. K. Tan, D. Taniar, A. Laganà, Y. Mun, H. Choo (Eds.), *Computational Science and Its Applications – ICCSA 2006, Part III. XXV*, 1243 pages. 2006.
- Vol. 3981: M. Gavrilova, O. Gervasi, V. Kumar, C.J. K. Tan, D. Taniar, A. Laganà, Y. Mun, H. Choo (Eds.), *Computational Science and Its Applications – ICCSA 2006, Part II. XXVI*, 1255 pages. 2006.
- Vol. 3980: M. Gavrilova, O. Gervasi, V. Kumar, C.J. K. Tan, D. Taniar, A. Laganà, Y. Mun, H. Choo (Eds.), *Computational Science and Its Applications – ICCSA 2006, Part I. LXXV*, 1199 pages. 2006.
- Vol. 3979: T.S. Huang, N. Sebe, M.S. Lew, V. Pavlović, T. Kölsch, A. Galata, B. Kisačanin (Eds.), *Computer Vision in Human-Computer Interaction. XII*, 121 pages. 2006.
- Vol. 3978: B. Hnich, M. Carlsson, F. Fages, F. Rossi (Eds.), *Recent Advances in Constraints. VIII*, 179 pages. 2006. (Sublibrary LNAI).
- Vol. 3976: F. Boavida, T. Plagemann, B. Stiller, C. Westphal, E. Monteiro (Eds.), *Networking 2006. Networking Technologies, Services, and Protocols; Performance of Computer and Communication Networks; Mobile and Wireless Communications Systems. XXVI*, 1276 pages. 2006.
- Vol. 3970: T. Braun, G. Carle, S. Fahmy, Y. Koucheryavy (Eds.), *Wired/Wireless Internet Communications. XIV*, 350 pages. 2006.
- Vol. 3968: K.P. Fishkin, B. Schiele, P. Nixon, A. Quigley (Eds.), *Pervasive Computing. XV*, 402 pages. 2006.
- Vol. 3967: D. Grigoriev, J. Harrison, E.A. Hirsch (Eds.), *Computer Science – Theory and Applications. XVI*, 684 pages. 2006.
- Vol. 3966: Q. Wang, D. Pfahl, D.M. Raffo, P. Wernick (Eds.), *Software Process Change. XIV*, 356 pages. 2006.
- Vol. 3964: M. Ü. Uyar, A.Y. Duale, M.A. Fecko (Eds.), *Testing of Communicating Systems. XI*, 373 pages. 2006.
- Vol. 3962: W. IJsselstein, Y. de Kort, C. Midden, B. Eggen, E. van den Hoven (Eds.), *Persuasive Technology. XII*, 216 pages. 2006.
- Vol. 3960: R. Vieira, P. Quaresma, M.d.G.V. Nunes, N.J. Mamede, C. Oliveira, M.C. Dias (Eds.), *Computational Processing of the Portuguese Language. XII*, 274 pages. 2006. (Sublibrary LNAI).
- Vol. 3959: J.-Y. Cai, S. B. Cooper, A. Li (Eds.), *Theory and Applications of Models of Computation. XV*, 794 pages. 2006.
- Vol. 3958: M. Yung, Y. Dodis, A. Kiayias, T. Malkin (Eds.), *Public Key Cryptography – PKC 2006. XIV*, 543 pages. 2006.
- Vol. 3956: G. Barthe, B. Gregoire, M. Huisman, J.-L. Lanet (Eds.), *Construction and Analysis of Safe, Secure, and Interoperable Smart Devices. IX*, 175 pages. 2006.
- Vol. 3955: G. Antoniou, G. Potamias, C. Spyropoulos, D. Plexousakis (Eds.), *Advances in Artificial Intelligence. XVII*, 611 pages. 2006. (Sublibrary LNAI).
- Vol. 3954: A. Leonardis, H. Bischof, A. Pinz (Eds.), *Computer Vision – ECCV 2006, Part IV. XVII*, 613 pages. 2006.
- Vol. 3953: A. Leonardis, H. Bischof, A. Pinz (Eds.), *Computer Vision – ECCV 2006, Part III. XVII*, 649 pages. 2006.
- Vol. 3952: A. Leonardis, H. Bischof, A. Pinz (Eds.), *Computer Vision – ECCV 2006, Part II. XVII*, 661 pages. 2006.
- Vol. 3951: A. Leonardis, H. Bischof, A. Pinz (Eds.), *Computer Vision – ECCV 2006, Part I. XXXV*, 639 pages. 2006.
- Vol. 3950: J.P. Müller, F. Zambonelli (Eds.), *Agent-Oriented Software Engineering VI. XVI*, 249 pages. 2006.
- Vol. 3947: Y.-C. Chung, J.E. Moreira (Eds.), *Advances in Grid and Pervasive Computing. XXI*, 667 pages. 2006.
- Vol. 3946: T.R. Roth-Berghofer, S. Schulz, D.B. Leake (Eds.), *Modeling and Retrieval of Context. XI*, 149 pages. 2006. (Sublibrary LNAI).
- Vol. 3945: M. Hagiya, P. Wadler (Eds.), *Functional and Logic Programming. X*, 295 pages. 2006.

- Vol. 3944: J. Quiñonero-Candela, I. Dagan, B. Magnini, F. d'Alché-Buc (Eds.), *Machine Learning Challenges*. XIII, 462 pages. 2006. (Sublibrary LNAI).
- Vol. 3943: N. Guelfi, A. Savidis (Eds.), *Rapid Integration of Software Engineering Techniques*. X, 289 pages. 2006.
- Vol. 3942: Z. Pan, R. Aylett, H. Diener, X. Jin, S. Göbel, L. Li (Eds.), *Technologies for E-Learning and Digital Entertainment*. XXV, 1396 pages. 2006.
- Vol. 3941: S.W. Gilroy, M.D. Harrison (Eds.), *Interactive Systems*. XI, 267 pages. 2006.
- Vol. 3940: C. Saunders, M. Grobelnik, S. Gunn, J. Shawe-Taylor (Eds.), *Subspace, Latent Structure and Feature Selection*. X, 209 pages. 2006.
- Vol. 3939: C. Priami, L. Cardelli, S. Emmott (Eds.), *Transactions on Computational Systems Biology IV*. VII, 141 pages. 2006. (Sublibrary LNBI).
- Vol. 3936: M. Lalmas, A. MacFarlane, S. Rüger, A. Tombros, T. Tsirikia, A. Yavlinsky (Eds.), *Advances in Information Retrieval*. XIX, 584 pages. 2006.
- Vol. 3935: D. Won, S. Kim (Eds.), *Information Security and Cryptology - ICISC 2005*. XIV, 458 pages. 2006.
- Vol. 3934: J.A. Clark, R.F. Paige, F.A. C. Polack, P.J. Brooke (Eds.), *Security in Pervasive Computing*. X, 243 pages. 2006.
- Vol. 3933: F. Bonchi, J.-F. Boulicaut (Eds.), *Knowledge Discovery in Inductive Databases*. VIII, 251 pages. 2006.
- Vol. 3931: B. Apolloni, M. Marinaro, G. Nicosia, R. Tagliaferri (Eds.), *Neural Nets*. XIII, 370 pages. 2006.
- Vol. 3930: D.S. Yeung, Z.-Q. Liu, X.-Z. Wang, H. Yan (Eds.), *Advances in Machine Learning and Cybernetics*. XXI, 1110 pages. 2006. (Sublibrary LNAI).
- Vol. 3929: W. MacCaull, M. Winter, I. Düntsch (Eds.), *Relational Methods in Computer Science*. VIII, 263 pages. 2006.
- Vol. 3928: J. Domingo-Ferrer, J. Posegga, D. Schreckling (Eds.), *Smart Card Research and Advanced Applications*. XI, 359 pages. 2006.
- Vol. 3927: J. Hespanha, A. Tiwari (Eds.), *Hybrid Systems: Computation and Control*. XII, 584 pages. 2006.
- Vol. 3925: A. Valmari (Ed.), *Model Checking Software*. X, 307 pages. 2006.
- Vol. 3924: P. Sestoft (Ed.), *Programming Languages and Systems*. XII, 343 pages. 2006.
- Vol. 3923: A. Mycroft, A. Zeller (Eds.), *Compiler Construction*. XIII, 277 pages. 2006.
- Vol. 3922: L. Baresi, R. Heckel (Eds.), *Fundamental Approaches to Software Engineering*. XIII, 427 pages. 2006.
- Vol. 3921: L. Aceto, A. Ingólfssdóttir (Eds.), *Foundations of Software Science and Computation Structures*. XV, 447 pages. 2006.
- Vol. 3920: H. Hermanns, J. Palsberg (Eds.), *Tools and Algorithms for the Construction and Analysis of Systems*. XIV, 506 pages. 2006.
- Vol. 3918: W.K. Ng, M. Kitsuregawa, J. Li, K. Chang (Eds.), *Advances in Knowledge Discovery and Data Mining*. XXIV, 879 pages. 2006. (Sublibrary LNAI).
- Vol. 3917: H. Chen, F.Y. Wang, C.C. Yang, D. Zeng, M. Chau, K. Chang (Eds.), *Intelligence and Security Informatics*. XII, 186 pages. 2006.
- Vol. 3916: J. Li, Q. Yang, A.-H. Tan (Eds.), *Data Mining for Biomedical Applications*. VIII, 155 pages. 2006. (Sublibrary LNBI).
- Vol. 3915: R. Nayak, M.J. Zaki (Eds.), *Knowledge Discovery from XML Documents*. VIII, 105 pages. 2006.
- Vol. 3914: A. Garcia, R. Choren, C. Lucena, P. Giorgini, T. Holvoet, A. Romanovsky (Eds.), *Software Engineering for Multi-Agent Systems IV*. XIV, 255 pages. 2006.
- Vol. 3911: R. Wyrzykowski, J. Dongarra, N. Meyer, J. Waśniewski (Eds.), *Parallel Processing and Applied Mathematics*. XXIII, 1126 pages. 2006.
- Vol. 3910: S.A. Brueckner, G.D.M. Serugendo, D. Hales, F. Zambonelli (Eds.), *Engineering Self-Organising Systems*. XII, 245 pages. 2006. (Sublibrary LNAI).
- Vol. 3909: A. Apostolico, C. Guerra, S. Istrail, P. Pevzner, M. Waterman (Eds.), *Research in Computational Molecular Biology*. XVII, 612 pages. 2006. (Sublibrary LNBI).
- Vol. 3908: A. Bui, M. Bui, T. Böhme, H. Unger (Eds.), *Innovative Internet Community Systems*. VIII, 207 pages. 2006.
- Vol. 3907: F. Rothlauf, J. Branke, S. Cagnoni, E. Costa, C. Cotta, R. Drechsler, E. Lutton, P. Machado, J.H. Moore, J. Romero, G.D. Smith, G. Squillero, H. Takagi (Eds.), *Applications of Evolutionary Computing*. XXIV, 813 pages. 2006.
- Vol. 3906: J. Gottlieb, G.R. Raidl (Eds.), *Evolutionary Computation in Combinatorial Optimization*. XI, 293 pages. 2006.
- Vol. 3905: P. Collet, M. Tomassini, M. Ebner, S. Gustafson, A. Ekárt (Eds.), *Genetic Programming*. XI, 361 pages. 2006.
- Vol. 3904: M. Baldoni, U. Endriss, A. Omicini, P. Torroni (Eds.), *Declarative Agent Languages and Technologies III*. XII, 245 pages. 2006. (Sublibrary LNAI).
- Vol. 3903: K. Chen, R. Deng, X. Lai, J. Zhou (Eds.), *Information Security Practice and Experience*. XIV, 392 pages. 2006.
- Vol. 3902: R. Kronland-Martinet, T. Voinier, S. Ystad (Eds.), *Computer Music Modeling and Retrieval*. XI, 275 pages. 2006.
- Vol. 3901: P.M. Hill (Ed.), *Logic Based Program Synthesis and Transformation*. X, 179 pages. 2006.
- Vol. 3900: F. Toni, P. Torroni (Eds.), *Computational Logic in Multi-Agent Systems*. XVII, 427 pages. 2006. (Sublibrary LNAI).
- Vol. 3899: S. Frintrop, VOCUS: A Visual Attention System for Object Detection and Goal-Directed Search. XIV, 216 pages. 2006. (Sublibrary LNAI).
- Vol. 3898: K. Tuyls, P.J. 't Hoen, K. Verbeeck, S. Sen (Eds.), *Learning and Adaption in Multi-Agent Systems*. X, 217 pages. 2006. (Sublibrary LNAI).
- Vol. 3897: B. Preneel, S. Tavares (Eds.), *Selected Areas in Cryptography*. XI, 371 pages. 2006.
- Vol. 3896: Y. Ioannidis, M.H. Scholl, J.W. Schmidt, F. Matthes, M. Hatzopoulos, K. Boehm, A. Kemper, T. Grust, C. Boehm (Eds.), *Advances in Database Technology - EDBT 2006*. XIV, 1208 pages. 2006.
- Vol. 3895: O. Goldreich, A.L. Rosenberg, A.L. Selman (Eds.), *Theoretical Computer Science*. XII, 399 pages. 2006.

Preface

The 12th year of this workshop brought further development to familiar themes but also welcomed inclusion of less familiar topics such as “experience” and “quality-based design.” The two keynote speakers, Cliff Jones and Peter Wright, described contrasting research and in so doing added zest to the meeting, emphasising the interdisciplinary breadth of the problems of interactive system design and verification. Cliff Jones, taking an approach that is familiar to the workshop faithful, discussed the role that a careful formal framing plays in specifying how an interactive system relies on its environment, including users. Peter Wright, in contrast, discussed the nature of human experience and how new conceptions of user experience can critically inform interaction design theory, principles and practice.

As usual, the submitted papers placed a strong emphasis on task representation as a means of modelling the requirements for the interactive system. CTT appears to be emerging as a defacto standard for describing tasks within this community and several papers describe model-orientated approaches based on task representation. Montero et al. address a broad framework rendered in terms of a tool, while Ponsard et al. give a specific example of model-based design and Nobrega et al. deal with the more specific issue of mapping CTT to UML. Other papers consider different aspects of conceptualising the design. Paterno and Volpe consider how to move from sketches or informal descriptions to task representations, while Paquette and Schneider deal with templates that ease the process of producing task descriptions. Naghsh et al. on the other hand consider annotations and paper prototypes. A further set of papers deals with the peculiar and novel requirements of mobile and migratory applications. Hence there are papers about platform fusion (Dupuy-Chessa et al.), a taxonomy of migratory user interfaces (Berti et al.). As usual there are papers that concern the modelling and analysis of properties such as moding (Gow et al.), menus (Zhang et al.), the verification of haptic algorithms (de Boeck et al.) and group interactions (ter Beek et al.).

Other papers hint at the more radical agenda suggested by Peter Wright’s keynote address. The paper by Dix et al. addresses a framework for thinking about the design of computer interfaces that support performance. Two papers discuss how distributed cognition issues might be addressed in design. Blandford and Furniss’s paper draws on claims analysis and distributed cognition, while Campos and Doherty fold an analysis of information resources into a formal approach. Finally, Lee et al. address an approach to measuring user preferences using utility trade-offs.

The workshop stimulated new ideas, working groups reflected on present and future issues in the community. We fully expect that the meeting triggered significant collaborations. The location of the workshop, the North East of England, is an area full of character and history. Overall the workshop was a rewarding and illuminating experience.

From the 60 or so papers that were submitted to the conference, the reviewers worked hard to get down to the 20 papers included in these proceedings. Submissions

came from a range of countries, including the UK, Italy, France, Belgium, Spain, Korea, Canada, USA, Portugal, Ireland, Brazil and Switzerland.

The papers are organised into six themes reflecting common issues and approaches explored by the accepted papers. In addition, four papers summarise break-out discussions. These centre on issues that the workshop participants chose as being important in future research that might be presented in later DSVIS meetings. In summary, we hope that the proceedings will give the reader a feeling for the values and goals of the community and provide a context that links all of the papers presented here.

Stephen Gilroy
Michael Harrison

Organisation

Conference

Programme Chair

Michael Harrison

University of Newcastle upon Tyne, UK

Reviews and Proceedings

Stephen Gilroy

University of Newcastle upon Tyne, UK

Conference Support

Annabel Bixby

University of Newcastle upon Tyne, UK

Christine Wisher

University of Newcastle upon Tyne, UK

Programme Committee

Remi Bastide

LIHHS-IRIT, France

Ann Blandford

UCL, UK

José C. Campos

University of Minho, Portugal

Anke Dittmaar

University of Rostock, Germany

Alan Dix

Lancaster University, UK

Gavin Doherty

University of Dublin, Trinity College,
Ireland

Peter Forbrig

University of Rostock, Germany

T.C. Nicholas Graham

Queen's University, Kingston, Canada

Philip Gray

University of Glasgow, UK

Chris Johnson

University of Glasgow, UK

Joaquim A Jorge

IST-UTL, Portugal

Rick Kazman

Carnegie Mellon University, USA

Karsten Loer

Germanischer Lloyd AG, Germany

Panos Markopoulos

Technische Universiteit Eindhoven,
Netherlands

Mieke Massink

CNR-ISTI, Italy

Laurence Nigay

Université Joseph Fourier, France

Phillippe Palanque

LIHHS-IRIT, France

Fabio Paternò

CNR-ISTI, Italy

Chris Roast

Sheffield Hallam University, UK

Kevin Schneider

University of Saskatchewan, Canada

Harold Thimbleby

University of Wales, Swansea, UK

Jean Vanderdonckt

Université Louvain-La-Neuve, Belgium

Additional Reviewers

Patrick Olivier

University of Newcastle upon Tyne, UK

Shamus Smith

Durham University, UK

Supporting Societies

British Computing Society

British HCI Group

IFIP Working Group

Informatics Research Institute, University of Newcastle upon Tyne

Table of Contents

Keynote

User Experience and the Idea of Design in HCI <i>Peter Wright, Mark Blythe, John McCarthy</i>	1
--	---

Teams and Groups

Formalising Performative Interaction <i>Alan Dix, Jennifer G. Sheridan, Stuart Reeves, Steve Benford, Claire O'Malley</i>	15
DiCoT: A Methodology for Applying Distributed Cognition to the Design of Teamworking Systems <i>Ann Blandford, Dominic Furniss</i>	26
Towards Model Checking Stochastic Aspects of the thinkteam User Interface <i>Maurice H. ter Beek, Mieke Massink, Diego Latella</i>	39
Incident and Accident Investigation Techniques to Inform Model-Based Design of Safety-Critical Interactive Systems <i>Sandra Basnyat, Nick Chozos, Chris Johnson, Philippe Palanque</i>	51

Sketches and Templates

Natural Modelling of Interactive Applications <i>Fabio Paternò, Marco Volpe</i>	67
Task Model Simulation Using Interaction Templates <i>David Paquette, Kevin A. Schneider</i>	78
Investigating Annotation in Electronic Paper-Prototypes <i>Amir M. Naghsh, Andy Dearden, Mehmet B. Özcan</i>	90

Away from the Desktop

Test of the ICARE Platform Fusion Mechanism <i>Sophie Dupuy-Chessa, Lydie du Bousquet, Jullien Bouchet, Yves Ledru</i>	102
---	-----

A Method for the Verification of Haptic Algorithms
Joan De Boeck, Chris Raymaekers, Karin Coninx 114

A Specification Language and System for the Three-Dimensional
Visualisation of Knowledge Bases
El Mustapha El Atifi, Gilles Falquet 126

Migration and Mobility

A Calculus for the Refinement and Evolution of Multi-user Mobile
Applications
W. Greg Phillips, T.C. Nicholas Graham, Christopher Wolfe 137

A Taxonomy for Migratory User Interfaces
Silvia Berti, Fabio Paternò, Carmen Santoro 149

Solving the Mapping Problem in User Interface Design by Seamless
Integration in IDEALXML
*Francisco Montero, Víctor López-Jaquero, Jean Vanderdonckt,
Pascual González, María Lozano, Quentin Limbourg* 161

Analysis Tools

Concept Analysis as a Formal Method for Menu Design
Guo-Qiang Zhang, Gongqin Shen, Ye Tian, Jiayang Sun 173

Supporting Resource-Based Analysis of Task Information Needs
José Creissac Campos, Gavin J. Doherty 188

Automatic Critiques of Interface Modes
Jeremy Gow, Harold Thimbleby, Paul Cairns 201

Quantitative Measurement of Quality Attribute Preferences Using
Conjoint Analysis
Kwang Chun Lee, Ho-Jin Choi, Dan Hyung Lee, Sungwon Kang 213

Model-Based Design Processes and Tools

A Model-Based Design Process for Interactive Virtual Environments
Erwin Cuppens, Chris Raymaekers, Karin Coninx 225

Mapping ConcurTaskTrees into UML 2.0
Leonel Nóbrega, Nuno Jardim Nunes, Helder Coelho 237

Goal-Oriented Design of Domain Control Panels

<i>Christophe Ponsard, Nadiya Balych, Philippe Massonet, Jean Vanderdonckt, Axel van Lamsweerde</i>	249
---	-----

Group Discussions**Future Challenges of Model-Based Design**

<i>Sandra Basnyat, Joan De Boeck, Erwin Cuppens, Leonel Nóbrega, Francisco Montero, Fabio Paternò, Kevin Schneider</i>	261
--	-----

Supporting Values Other Than Usability and Performance Within the Design Process

<i>Nick Chozos, Jennifer G. Sheridan, Özcan Mehmet, Amir Naghsh, Kwang Chun Lee, Ann Blandford</i>	262
--	-----

Ambience and Mobility

<i>Gavin J. Doherty, Lydie du Bousquet, José Creissac Campos, El Mustapha El Atifi, Gilles Falquet, Mieke Massink, Carmen Santoro</i>	264
---	-----

Outdated Ideas of the Design Process and the Future of Formal Models, Methods and Notations

<i>Dominic Furniss, Alan Dix, Christophe Ponsard, Guo-Qiang Zhang</i>	265
---	-----

Author Index	267
---------------------------	-----

User Experience and the Idea of Design in HCI

Peter Wright¹, Mark Blythe¹, and John McCarthy²

¹ Department of Computer Science,
University of York, Heslington, York YO10 5DD, UK
{peter.wright, mark.blythe}@cs.york.ac.uk

² Department of Applied Psychology,
University College Cork, Cork, Ireland
john.mccarthy@ucc.ie

Abstract. In this paper we argue that the idea of design in HCI is changing. For many years the design-as-engineering approach has dominated HCI research and practice, but now technological developments and new conceptions of 'the user' require more interdisciplinary conceptions of design. In particular, the turn to experience in HCI has lead us to consider a design-as-craft perspective which we exemplify in this paper by the work of digital jeweller, Jayne Wallace. But our aim is not to supplant one design perspective with another. On the contrary, we argue that experience design requires a new form of radically interdisciplinary dialogue between different design perspectives that span the arts, sciences and humanities. However, such radically interdisciplinary dialogue is not without its problems and points of contention. We conclude by arguing that not only new conceptual tools but also new HCI curricula may be helpful in achieving this interdisciplinary dialogue.

1 Introduction

Fifteen years ago the idea of design in HCI was taken for granted and not a point of concern or discussion. Design meant the process of modelling users and systems and specifying system behaviour such that it fitted the users' tasks, was efficient, easy to use and easy to learn. In short, design in HCI was about engineering usability. Research agendas around this idea involved how best to model the user and to overcome the technical problems with specifying interactive programs in a way that promoted usability. The translation from the specification of user tasks to the specification of system dialogues presented significant technical interest and research opportunities but was not seen as fundamentally problematical. It was simple to see that designing the behaviour and visual appearance of a system to match the user's tasks, goals and action possibilities was a fundamentally sound proposition, which could be progressed not only as a human factors enterprise (task modeling, cognitive functional analysis, etc.) but also as a formal software engineering enterprise [17].

But more recently various technological developments have led to a questioning of this idea of design in HCI. The confluence of information and communications technologies, and the reconceptualisation of interactive systems as new media [5] brings a much broader set of ideas about what it means to design an interactive system and

indeed what it is that is being designed. Just consider for example, some common terms that permeate text books and research papers in HCI:

- User-centred design
- Dialogue design
- Information design
- Interaction design
- Emotional design
- Experience design

What is clear is that design has always been a central concern, but when Norman and others [23] introduced the idea of user-centred design there was little argument about what it was that was being designed—PCs and other desk-based computer interfaces. But the remainder of the list speaks to changing concerns. It appears we no longer design dialogue but interactions, information spaces, affect and now, user experience. Moving down the list also reveals differences in our understanding of ‘the user’—the user as someone who engages in dialogue through to someone who has an experience with- or through- the technology. This raises the broader question of whether design means the same thing with these different conceptions of the user. Can we design experiences in the same way as we design dialogues? So the question is whether these changes to the focus of study in HCI have any implications for what our idea of design is or should be? Our recent research programme exploring theory and method for experience-centred design has led us to conclude that we need to change our ideas about design in HCI. Within HCI research there is a tendency to simplify accounts of the idea of design, the most common of which is a simplification to a single, linear developmental trajectory wherein one technique, tool or viewpoint, overwrites its earlier predecessor. For example,

- First came batch processing, then command line, then GUI. . .
- First came task analysis, then scenario-based design, then personae-based design. . .
- First came the user as human factor then as human actor then. . .
- First the user was a cog in a virtual machine now the user is a consumer. . . .
- First came psychology, then ethnomethodology, then phenomenology. . .

These simplifications are often pedagogically useful but potentially misleading. It seems more appropriate (certainly as we view HCI practice as it is on the ground today) to understand these as coexisting perspectives, but where at certain times or in certain situations, one view, one metaphor, or one practice, is more central than another, one argument or one discourse is the dominant discourse for a while. Such a multi-perspectival view leads us to consider the boundaries between these accounts and encourages a dialogue between them. The quality of that dialogue will determine the effectiveness of our multi-disciplinary approach. A dialogue that tries to reduce ideas on the margins to more central ideologies will tend to stifle creativity, dialogues which at least for a time try to reverse centre and margin, or dialogues which strive to avoid replicating centre-margin distinctions, tend to foster creativity [1]. A number of different perspectives on HCI design already exist, ranging from engineering through to design as arts and crafts. If practitioners and researchers with these different perspectives can be helped to work together in some way then the new challenges of HCI

design will be more easily met. We want to argue that this can be best done by a kind of radical interdisciplinary research programme. By radical interdisciplinarity, we mean not just psychologists, electronic engineers and computer scientists talking together and collaborating, for these groups fundamentally share a common idea of design. We mean psychologists, computer scientists, and electronics engineers talking to visual and performance artists, industrial designers, product designers and so on. A kind of cross-faculty collaboration that Buchanan refers to as a liberal arts of design [7]. But in order for such radical interdisciplinarity to work and in order to be able to engage meaningfully and productively across these radically interdisciplinary boundaries we need a much deeper critical understanding of what design thinking or design practice is both within the discipline of HCI (which is broad enough as it is) and within these other disciplines. We also need to explore ways in which the difficult job of dialogue across boundaries can be achieved.

2 Design-as-Engineering

One perspective on design that has held a central position in HCI at times is what we have termed the design-as-engineering perspective but which some authors have referred to as the conservative view of design [12]. In this account design is seen as going from a fixed problem statement (or requirements specification), to an abstract specification of the solution that is then refined down into an actual implemented solution through a sequence of well-prescribed steps. The design problem, which is seen as given when design begins, may be broken down into smaller parts in order to divide and conquer. This breakdown is followed by a synthesis stage in which solutions to problem parts are aggregated into an overall design solution. This approach is at the heart of most software engineering and formal approaches to system design. Within this approach the emphasis is on proceduralising as much of the design process as possible to ensure knowledge is independent of individual designers and hence the process is replicable. Fallman [12] describes it as the conservative account to emphasise the idea that system properties and behaviours specified first at the abstract level are conserved throughout the subsequent refinement steps. Fallman describes the approach thus:

"According to this account of design, the design process is supposed to progress gradually from the abstract (requirements specifications) to the concrete (resulting artifacts). Progress is achieved through following a sequence of well-described, discrete and rational and structured methodological steps. A good designer in this tradition is someone who is able to follow prescribed action. This tends to de-emphasise the role of the designer, striving towards a disembodied design process built on structured methods and externalised guidelines rather than on the skills and judgment of individual designers." p. 226.

Within HCI, the kinds of approaches to design that seem to fit this account very well are exemplified by methodologies such as MUSE [19] and approaches to usability engineering proposed by both Nielsen [22] and Whiteside et al [28]. Within the more formal software engineering world of HCI, the engineering account is exemplified by approaches to specification based on abstract modelling of the user and the system

followed by refinement through to implementation, in which users goals are refined into task sequences which are then mapped to dialogues. Even some scenario-based design view of design [24]. The key features which unite these under the engineering approach are

- Representation of the user or use context as a fixed set of well defined goals, tasks, or needs
- Relatively abstract representations of typical users
- Adherence or orientation to a task or scenario procedural methodology
- An attempt to encapsulate usable design in terms of principles, guidelines or methods that can be re-produced by engineers who are not HCI specialists
- A tendency to see usability as a property of the interface
- An attempt to control the interaction with the user through design

The design-as-engineering approach to HCI can be highly successful. Particularly where the domain of application is well regulated, relatively closed and the user's role and goals in the system can be well defined and adequately captured in for example, a task analysis of tractable size. In these situations there are relatively uncontentious criteria as to what counts as an improved design [16]. But there are limits to this approach and there are other disciplines which offer equally valuable perspectives on HCI. One new area of HCI research that offers challenges to the design-as-engineering approach, and illustrates the value of different perspectives is experience design.

3 The Challenge of Experience-Centred Design

Experience is becoming an increasingly important problem for HCI research and over the last two or three years much has been written about not only what 'user experience' is but also how to design for it. For some, the shift towards placing experience, 'felt-life', and technology at the centre of our theorizing and design practice has led to an exploration of quite radically interdisciplinary literature (E.g. [9, 13, 20]). As an example, our own approach takes its inspiration from the pragmatist philosophy of John Dewey [11] and also the philosophy and literary theory of Mikhail Bakhtin [21]. Briefly our account can be characterised by three themes:

1. A holistic approach to experience wherein the intellectual, sensual and emotional stand as equal partners in experience
2. Continuous engagement and sense making wherein the self is the centre of experience, is already engaged in experience and brings to a situation a history of meanings and anticipated futures in order to complete the experience through acts of sense making
3. A relational or dialogical approach wherein self, object and setting are actively constructed as multiple centres of value with multiple perspectives and where an action, utterance or thing is designed and produced but can never be finalised since the experience of it is always completed in dialogue with those other centres of value.