
The State of Tangible Interfaces: Projects, Studies, and Open Issues

Oren Zuckerman

MIT Media Lab
20 Ames Street
Cambridge, MA 02139 USA
orenz@media.mit.edu

Brygg Ullmer

Louisiana State University
302 Johnston Hall
Baton Rouge, LA 70803 USA
ullmer@lsu.edu

Lars Erik Holmquist

Viktoria Institute
Hörselgången 4
SE 417 56 Göteborg SWEDEN
leh@viktorias.se

Hiroshi Ishii

MIT Media Lab
Cambridge, MA 02139 USA
ishii@media.mit.edu

George Fitzmaurice

Alias
210 King St. East
Toronto, Ontario, Canada
gf@alias.com

Yvonne Rogers

Indiana University
901 East Tenth Street
Bloomington Indiana USA
yrogers@indiana.edu

Wendy Mackay

I.N.R.I.A.
Rocquencourt, BP 105
78153 Le Chesnay FRANCE
wendy.mackay@inria.fr

Tom Rodden

University of Nottingham
Nottingham NG8 1BB UK
tar@cs.nott.ac.uk

Abstract

In recent years, the CHI community has seen growth in projects that involve tangible user interfaces and tangible interaction. But, many researchers feel that this emerging field lacks in justifying research, industry adoption, and conceptual frameworks. This panel gathers pioneers and active researchers in the field, in an effort to understand the bigger picture of the TUI field. The panelists will focus on discussion rather than presentations, and will answer questions regarding projects, findings, and the field at large. We hope to review the open issues in the field, and help interested researchers to better direct their future research efforts.

The panel will have three moderators and six panelists. The panelists will start with very short introductions, and then quickly shift to discussion led by the moderators, and to a Q&A session with the audience.

Keywords

Tangible User Interfaces, Graspable User Interfaces, Tangible Interaction, HCI conceptual frameworks.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Copyright is held by the author/owner(s).

CHI 2006, April 22–27, 2006, Montréal, Québec, Canada.

ACM 1-59593-298-4/06/0004.

PANEL OVERVIEW

This panel addresses the research area of tangible user interfaces. The field has existed as a research field within the CHI community since Fitzmaurice, Ishii, and Buxton's 1995 paper. 10 years have passed and many prototypes have been developed, but research findings are not well known. This panel is gathered in an effort to discuss the present and potential future of the field. We hope to give the CHI community an up-to-date picture of relevant research findings and industry adoption, and to moderate an active discussion on the bigger picture rather than individual projects.

The panel will have three moderators and six panelists. The panelists will start with very short introductions, and then quickly shift to discussion led by the moderators. The moderators will present a few questions to the panel, in order to focus on the bigger picture and raise some of the controversial issues with tangible user interfaces. For example, the moderators will ask: "Why is tangibility important?", "when will we see tangible interfaces become more everyday?", "Has the tangibility research area been mined?", "In what areas do tangibles make the most significant contribution?".

After the Q&A session by the moderators, the audience will target questions to the panelists, in an effort to debate the merits and drawbacks of TUIs and to enable the audience to express their opinion and/or raise questions. To conclude, we will have a discussion among the panelists and moderators about the open issues in the field, about missing research they would like to see, in an effort to inform interested researchers on potential research questions.

We hope this panel would inform the CHI community on the current and potential future state of tangible user interfaces research, and would intrigue new and veteran researchers to explore the open issues in the field.

PANELIST SUMMARIES

Oren Zuckerman (*panel organizer*)

Oren is a researcher and PhD candidate at MIT's Media Lab, working with Mitch Resnick. Oren's research focuses on the design, implementation, and study of tangible interfaces for learning and play. Currently, Oren is developing digital learning blocks that make abstract concepts visible and manipulable. Inspired by the wooden objects developed by Maria Montessori, Oren is creating computationally enhanced blocks that simulate advanced concepts such as rate, probability, feedback, and complex causality. Prior to MIT Oren was recognized as one of the World Economic Forum's "100 Technology Pioneers" for the year 2000, as the founder of an Internet startup that developed an asynchronous group collaboration layer over the Web.

Brygg Ullmer (*panel moderator*)

Brygg is an assistant professor at LSU, jointly in computer science and the Center for Computation and Technology (CCT). He completed his Ph.D. in the Tangible Media Group of MIT's Media Laboratory in 2002, where his research focused on "tangible user interfaces." He held a postdoctoral position in the visualization department of the Zuse Institute Berlin, internships at Interval Research (Palo Alto) and Sony CSL (Tokyo), and has been a visiting lecturer at Hong Kong Polytechnic's School of Design. His research interests include tangible interfaces, visualization, programming languages for networked and embedded

systems, RFID, grid computing, and rapid physical and electronic prototyping. He also has a strong interest in computationally-mediated arts and crafts, rooted in the traditions and material expressions of specific regions and cultures. He is applying his work at LSU with collaborators in astrophysics, medicine, molecular biology, network monitoring, and environmental monitoring & simulation.

Lars Erik Holmquist (panel moderator)

Lars is leader of the Future Applications Lab at the Viktoria Institute in Göteborg, Sweden. Before this, he founded and led the PLAY research group from 1997-2001. He received his master's degree in Computer Science in 1996, and his Ph.D. in Informatics in 2000, both at the Göteborg University. His research interests include human-computer interaction, information visualization and ubiquitous computing. He has been member of many international conference committees and published extensively in these research fields. In 2002 he chaired the international conference on ubiquitous computing, UbiComp 2002, which attracted almost 500 visitors from companies, universities and research institutes all over the world. He is an associate editor of the Springer journal Personal and Ubiquitous Computing.

Hiroshi Ishii

Hiroshi founded and directs the Tangible Media Group at the MIT Media Lab pursuing a new vision of Human Computer Interaction (HCI): "Tangible Bits." His team seeks to change the "painted bits" of GUIs to "tangible bits" by giving physical form to digital information. Ishii and his students have presented their vision of "Tangible Bits" at a variety of academic, industrial design, and artistic venues (including ACM SIGCHI,

ACM SIGGRAPH, Industrial Design Society of America, and Ars Electronica), emphasizing that the development of tangible interfaces requires the rigor of both scientific and artistic review. Prior to MIT, between 1988-1994, Ishii led a CSCW research group at the NTT Human Interface Laboratories, where his team invented TeamWorkStation and ClearBoard. In 1993 and 1994, he was a visiting assistant professor at the University of Toronto, Canada. Ishii received B. E. degree in electronic engineering, M. E. and Ph. D. degrees in computer engineering from Hokkaido University, Japan, in 1978, 1980 and 1992, respectively.

George W. Fitzmaurice

George is a senior Research Scientist at Alias and an Adjunct Assistant Professor at the University of Toronto in the Computer Science department. His main research interests focus on novel input devices, 3D and two-handed interaction techniques, graspable/tangible user interfaces, computer-augmented environments, and interactions for mobile devices. Fitzmaurice received a B.Sc. in Mathematics with Computer Science at the Massachusetts Institute of Technology in 1988, an M.Sc. in Computer Science at Brown University in 1991, and a Ph.D. in Computer Science at the University of Toronto in 1996.

Yvonne Rogers

Yvonne is a cognitive scientist focusing on augmenting and extending everyday, learning and work activities with interactive technologies that move "beyond the desktop". This involves designing enhanced user experiences through appropriating and assembling a diversity of technologies including mobile, wireless, handheld and pervasive computing. A main focus is not the technology per se but the design and integration of

the digital representations that are presented via them to support social and cognitive activities in ways that extend our current capabilities. A recent interest has been to explore how the notions of 'physicality', 'embodiment' and 'tangibility' can be taken into account in the design of external representations. This line of research focuses on how physical artifacts and the environment can be augmented in novel ways with computation, digital representations and, even, intelligence.

Wendy Mackay

Wendy is a Research Director, responsible for the in|situ| research group at INRIA Futurs, in France. Initially trained as an Experimental Psychologist, she moved to Digital where she created a multimedia research group which produced the first commercial interactive video system (IVIS), a pre-Hypercard multimedia authoring language and over 30 multimedia projects. She then received her Ph.D. from the Massachusetts Institute of Technology and has subsequently managed research groups at MIT and Xerox PARC's EuroPARC, as well as serving as a visiting professor at the Université Paris-Sud, France and Aarhus University, Denmark.

Wendy has been working with tangible user interfaces since 1991, augmenting paper storyboards, large engineering drawings, air traffic control flight strips and laboratory notebooks enabling users to interact with on-line and off-line information. Recently, she has been exploring 'communication appliances', which enable people to interact with 'ordinary' objects in the home to establish shared awareness with other family members in distant households, using a tangible interface for managing the network. Wendy's research interests are

diverse, and include paper-based tangible interfaces, tangible interaction with information streams, particularly video, and the multi-disciplinary design of interactive systems.

Tom Rodden

Tom is Professor of Interactive Systems in the Mixed Reality Laboratory (MRL) at the University of Nottingham. His research interests focus on the development of computer technologies to support new forms of user interaction. His research work has involved close collaboration with a diverse set of disciplines over a number of years. In addition to the development of novel applications, devices and platforms his research has focused on interdisciplinary research methods and design techniques for interactive computer systems. This has involved work in the areas of HCI, CSCW, Ubiquitous Computing and the usability of e-Science infrastructures. He currently directs Equator, an EPSRC supported interdisciplinary research collaboration (IRC) bringing together researchers from eight UK institutions and different research backgrounds to explore the merging of physical and digital interaction.