

Art and Technology of Entertainment Computing and Communication

Adrian David Cheok

Art and Technology of Entertainment Computing and Communication

Advances in Interactive New Media
for Entertainment Computing

Foreword by Ryohei Nakatsu

 Springer

Dr. Adrian David Cheok
National University of Singapore
Mixed Reality Lab
7 Engineering Drive 1
117574 Singapore
Singapore
E-mail: adriancheok@mixedrealitylab.org
Twitter: [@adriancheok](https://twitter.com/adriancheok)

ISBN 978-1-84996-136-3 e-ISBN 978-1-84996-137-0
DOI 10.1007/978-1-84996-137-0
Springer London Dordrecht Heidelberg New York

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Control Number: 2010932038

© Springer-Verlag London Limited 2010

Apart from any fair dealing for the purposes of research or private study, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the publishers, or in the case of reprographic reproduction in accordance with the terms of licenses issued by the Copyright Licensing Agency. Enquiries concerning reproduction outside those terms should be sent to the publishers.

The use of registered names, trademarks, etc., in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant laws and regulations and therefore free for general use.

The publisher makes no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility or liability for any errors or omissions that may be made.

Cover design by Wu Chia Hsin Cathie, Mixed Reality Lab, National University of Singapore
Photo courtesy of Beth Hoffman (Adventures in Librarianship)

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

*To my grandfather, and hero, Emmanuel
Pantahos on his 85th birthday. To my mother.
To Midori, and our sweet daughter Kotoko.*



Foreword

New Communications and the Direction Our Society Moves Toward

Various kinds of new media that appeared in the last ten years have been quickly changing the way we communicate each other. These new media include mobile phones, Internet, game machines, etc.

For example, mobile phones changed our communications way as they can connect us anywhere, anytime. Suppose that you are on a plane that has just landed and arrived at a terminal. What do passengers do first? More than half of them take out their mobile phones, turn them on. Some start checking e-mail and some others start calling their family members only to say “I have just arrived”. Suppose that you are a business person attending a business meeting. Probably the first thing most of the attendees of the meeting would do is take their PCs out of their bag, turn them on, and start checking something. Are they checking documents for the meeting? No. What most of them are doing is checking their mail box, answering some of the business/private messages. Also look at the life style of your children. You recognize that they spend a large part of their time at home playing games instead of having a talk with other family members.

The most impressive fact in these phenomena is that this is happening all over the world, both in the Western and in the Asian countries. We have been discussing how we could realize globalization overcoming different nations and different cultures. Already we live in a world of globalization.

Another fact is that these phenomena are happening in various instances of our everyday life. For this we should understand that communication is a most typical human behavior. Reflecting your everyday life, you would understand that most of your behavior could be interpreted as communication. For example, most of the children’s behavior at school is communication; listening to the lectures of teachers, having a discussion in their class, etc. are typical communication behaviors. Also most of the business at an office is communication. You would talk/discuss with your colleagues and the boss. Also you would attend a meeting. Or you would read/write e-mails. Even when you prepare some document, this could be interpreted

as communication with your PC. After coming back to your house, you would enjoy watching movies/drama on TV or reading a book. Watching movies and reading novels are also one form of communication as you are receiving messages sent from the writer of the book or the director of the movie.

These things mean that the new media are changing almost all aspects of our life. Therefore, we should be careful about the direction these new media would change our way of communication and lead our society. At this point, I want to suggest that there are two significant changes in the way we communicate.

The first is that the non-logical aspect of information plays an important role in our recent communications. When we refer to communication, this used to mean conveying logical information and sharing it among a sender and a receiver. What is happening nowadays, especially among communicating youth, is that they are sending non-logical information, in other words, emotional or Kansei information, to each other. Mainly what they are talking is not business, but about the movie they watched or about the food they ate. This means that they are exchanging their experiences, and as a result they want to share the same emotion/feeling. This is something more than sending and sharing information. In this sense, the basic concept of communication has been changing.

At the same time, I want to emphasize that “Asianization” of communication is going on among Westerners. Please pay attention that the above emotional communication, or Kansei communication, is the basic form of human communication. But through thousands of years of human history in the Western cultures, the emphasis has been on the logical thinking as the basis of human intelligence and on trying to extract logical communications from emotional communications, thus trying to keep this emotional aspect only to the private life. On the other hand, in the Asian countries people did not succeed in separating logical and non-logical aspects of communications. Especially Japanese have been executed because they had not been able to separate *Tatemae* (formal opinion) and *Honne* (private opinion). However, we should notice that the emerging of new media again took back Western people to the old style of communications, i.e., emotional communications.

Is this a new trend? The way we communicate is coming back to its original form both in the Western and Asian countries. In this case, as communications are a basic form of human relations, this phenomena would give strong effects on the Western way of thinking, and finally to the Western cultures. Or is this only a transitional phenomenon as these media are totally new to us, and gradually the Western people would invent how to use these new media in the traditional logical communications form?

Still it is too early to judge this. What we should learn now is various aspects of this Kansei communication, and we should try finding a new way of communications that would give us a new way of life. Therefore, it is essential for the researchers in this field of new media to study the various kinds of new communications which our technology could realize and thus give people a chance to understand by themselves the new communication ways they could have in the future, and so that people could choose the direction they would go. We need young talented scientists who would devote themselves in such research.

The author of this book, Adrian Cheok, is one of the most brilliant and talented scientists who are doing such research. He has been working in the area of virtual and mixed realities for many years. His main interest has been in developing new ways of communications using technologies. By connecting the real and virtual worlds, he has been trying to develop various kinds of new demonstrations which would reveal us a new way of being connected to each other, overcoming the time and space gap. His interest did not only stay with human communications. He tried to realize human–animal communications and even human–plant communications. By reading chapters of this book, the readers will understand what I mean by “new communications” and will know the direction our society is about to move towards.

Kyoto

Ryohei Nakatsu

Preface

Just like previous seismic shifts in civilization, the net age has produced a massive change in civilization. The main effect of this shift has been the instant, global, and constant communication, and so in some way this has been a revolutionary change of human communication. What this has meant is that the net generation grow up with new forms of play and communication from previous youth. Their entertainment is immersive, fantastic, and can be played together with thousands or millions of people around the world. Their communication is instant, from many multiple sources simultaneously, constant, and global. In some way there has been an end of solitude (which may also have negative consequences). Now, when the net generation goes to school, they find it totally different, and more and more irrelevant to their daily lives. They are used to constant, immersive, simultaneous multiple source communication. Sitting in a traditional classroom, and being told not to use their mobile phones or send messages must be totally boring and frustrating to them. Having one source of information from the teacher must seem so slow. Students may feel they wish they could press a fast-forward button to the teacher.

Not only the young net generation but also all of society has radically changed. Grandparents are playing games on Nintendo Wii or DS, and parents are using Twitter. What this means is that in general we must understand the new entertainment and the new communication in order to enrich learning and education that is relevant, and also to allow work, family life, and elderly care become more relevant and enriching.

I hope this book will be informative and inspirational to students and the next generation of researchers who will change the world and society for the better through new modes of entertainment and communication. I hope this book will also be useful to academics, researchers, engineers, game designers, interaction designers, venture capitalists, etc. With quantum step innovation and inventions, we can make a better society for children, families, and elderly.

Singapore and Tokyo

Adrian David Cheok

Acknowledgments

This book represents work done together with my students and research staff in the Mixed Reality Lab at the National University of Singapore. Over the years, I have had great pleasure working with several very hard working, talented and creative students and researchers in Singapore. The research described in this book very often required many high pressured late night, weekend, and all night works to meet deadlines such as conference paper submissions, or preparing for international demonstrations, and I really appreciate such great dedication and hard work. Not all students can be so dedicated, and many give up, so I am extremely happy to see those students and researchers who passionately believe we should aim for quantum step innovations and inventions, rather than do incremental research. This way we can help change society for the better, which should be the ultimate aim of researchers. I am deeply grateful for the great work of each student and researcher who helped carry out the research, and also for the help writing the chapters. Each student and researcher, co-author from my lab or otherwise contributor to the project, is listed in Table 0.1.

For this book, I invited some of my closest external collaborators and colleagues to write two of the chapters. Chapter 10 was written by Professor Masa Inakage, and Chap. 11 was written by Professor Michael Haller, with their students and colleagues. Their research represent some of the most interesting and innovative work in entertainment computing, so it is a great honor that they could contribute a chapter to this book.

Without the support of the university and sponsors, the research work described in this book would not have been possible to carry out. Thus, I would like to thank my National University of Singapore (NUS) colleagues, particularly Professor Yeo Swee Ping, former Head of the Department of Electrical and Computer Engineering, who really helped and supported my work in the early days, and Professor Tan Chor Chuan, who is now President, and has supported my work over the years. Thanks go also to the DSTA (Defense Science and Technology Agency) in Singapore for supporting and being major funders of my work throughout the years, from the early years onwards.

Professor Hiroshi Ishii of MIT Media Lab has been a great inspiration and mentor to me for my career, and his harsh but excellent advice and critique made me stay

Table 0.1 List of co-authors

Author name	Contributed chapters
Dilrukshi Abeyrathne	Chap. 9
Yongsoon Choi	Chap. 7
	Chap. 9
Makoto Danjo	Chap. 9
Chamari Priyange Edirisinghe	Chap. 9
Owen Noel Newton Fernando	Chap. 2
	Chap. 3
	Chap. 4
	Chap. 8
	Chap. 9
Kasun Karunanayaka	Chap. 9
Zhu Kening	Chap. 8
	Chap. 9
Eng Tat Khoo	Chap. 6
	Chap. 8
Nancy Lan-Lan Ma	Chap. 9
Yukihiro Morisawa	Chap. 8
	Chap. 9
Roshan Lalintha Peiris	Chap. 4
	Chap. 7
	Chap. 9
Nimesha Ranasinghe	Chap. 8
	Chap. 9
Hooman Aghaebrahimi Samani	Chap. 4
Assoc. Prof. Annett Schirmer	Chap. 7
Roger Thomas Tan	Chap. 2
	Chap. 4
James Keng Soon Teh	Chap. 5
	Chap. 7
	Chap. 9
Ranjith Vijayakumar	Chap. 7
Liu Wei	Chap. 2
	Chap. 3
Janaka Prasad Wijesena	Chap. 4
	Chap. 8

on track to always do something new, to be a true engineer and inventor, and to aim for quantum step research.

I would like to thank Professor Masahiko Inami, Professor Yung C. Liang, and Mr. Ivan Boo for their trust, kindness, advice, and support, especially during the tough times.

Contents

- 1 Introduction 1**
 - 1.1 Introduction to Embodied Media 2
 - 1.2 Introduction to Mixed Reality 4
 - 1.3 Feeling Communication 7
 - 1.3.1 Emotional Communication and Entertainment Using Multi-sensory Media 9
 - 1.4 Social and Physical Entertainment 12
 - 1.5 Conclusion 16
 - References 17
- 2 Human Pacman: A Mobile Augmented Reality Entertainment System Based on Physical, Social, and Ubiquitous Computing 19**
 - 2.1 Introduction 19
 - 2.2 Background 20
 - 2.3 System Design and Game Play 23
 - 2.3.1 Main Concepts: Team Collaboration, Ultimate Game Objectives and the Nature of Pac-world 24
 - 2.3.2 Pacman and Ghost 27
 - 2.3.3 Helper 29
 - 2.3.4 Actual Game Play 31
 - 2.4 User Study 36
 - 2.4.1 Questions and Aims 37
 - 2.4.2 Discussion 37
 - 2.4.3 Analysis of Message Logs 45
 - 2.4.4 Summary Findings 47
 - 2.5 Mobile Service and Ubicomp Issues 48
 - 2.5.1 Mobile Computing 49
 - 2.5.2 Ubicomp 51
 - 2.5.3 Addressing Sensor-Tracking Issues 53
 - 2.6 Conclusion 54
 - References 55

3	Interactive Theater Experience with 3D Live Captured Actors and Spatial Sound	59
3.1	Introduction	59
3.2	Previous Work on Interactive Theater	60
3.3	New Media Art and Interactive Theater	61
3.4	Background	62
3.4.1	Embodied Mixed Reality Space	62
3.4.2	Live 3D Actors	63
3.4.3	Ambient Intelligence	68
3.5	Interactive Theater System	69
3.5.1	3D Live Capture Room	69
3.5.2	Interactive Theater Space	71
3.5.3	System Interaction Design	73
3.5.4	3D Sound in Interactive Theater Space	74
3.6	Conclusion	81
	References	81
4	Metazoa Ludens: Mixed Reality Interaction and Play Between Humans and Animals	83
4.1	Introduction	83
4.2	Objectives	84
4.3	Related Works	85
4.3.1	Human–Animal Interaction System	85
4.3.2	Remote Interaction System	87
4.3.3	Mixed Reality System	87
4.4	Metazoa Ludens: Fundamental Design	88
4.4.1	Remote Interaction	88
4.4.2	Pet’s Choice	88
4.4.3	Pet Interface	88
4.5	System Description	89
4.5.1	System Overview	90
4.5.2	Camera and Tracking Subsystem	90
4.5.3	Hardware Subsystem	93
4.5.4	Moldable Latex Surface	93
4.5.5	Game Subsystem	94
4.5.6	User Game Play Experience	96
4.6	Evaluation, Results and Discussion	98
4.6.1	Study 1: Health Benefits to the Hamsters	98
4.6.2	Study 2: Pets’ Choice	100
4.6.3	Study 3: Users’ Enjoyment Based on Flow	101
4.7	Framework for Human–Animal Interaction System	103
4.8	Veracity of Telepresence	108
4.9	Conclusion	108
	References	109
5	Poultry Internet	111
5.1	Introduction	111

5.2	Motivation for Human–Pet Touch Interaction	114
5.2.1	Why Do We Keep Animals as Companions?	114
5.2.2	The Effect of Touching and Caressing on Poultry and Other Animals	115
5.3	Review of Related Works	115
5.3.1	Previous Tele-haptic Systems	115
5.3.2	Previous Human–Pet Interaction Systems	116
5.3.3	Why Not Just Interact with Virtual or Robotic Pet?	117
5.4	Poultry Internet as a Cybernetics System	119
5.5	Technical Details of the Multi-modal Interaction System	119
5.5.1	Overall System	119
5.5.2	Remote Physical Touch	120
5.5.3	Computer Vision Pet Tracking	125
5.6	Experiences and User Studies	127
5.7	Wider Applications	131
5.7.1	Multiplexing Existing Communication Channels	131
5.7.2	Intimacy Through Ubiquitous Computing	132
5.7.3	Spying/Rescuing Pet	133
5.8	Conclusion and Future Works	133
	References	135
6	Age Invaders: Entertainment for Elderly and Young	137
6.1	Introduction	137
6.2	Related Work	139
6.3	Design Methodology	140
6.3.1	Problem Identification	140
6.3.2	Problem Exploration	141
6.3.3	Design Goals	142
6.4	Design Requirements	143
6.4.1	Resources and Time Constraints	143
6.4.2	User Needs	144
6.4.3	Context of Use	144
6.5	Design Idea Generation	144
6.6	Prototype Iterations	145
6.7	Current System Description	146
6.7.1	System Architecture	146
6.7.2	Game Play	148
6.8	User Studies Results	150
6.8.1	Intergenerational Player Study	150
6.8.2	Focus Group Session with Older Players	151
6.8.3	Physical Interface Design Issues	152
6.8.4	Physicality Issues of the Virtual and Physical Player Roles	154
6.9	Software Libraries and Toolkit	155
6.10	Product Development	158
6.11	Conclusion	159
	References	159

7	Huggy Pajama: A Remote Interactive Touch and Hugging System	161
7.1	Introduction	161
7.2	Background	164
7.2.1	Why Touch Communication?	164
7.2.2	Previous Work	165
7.3	System Description	168
7.3.1	Mediated Touch Module	168
7.3.2	Thermal Controlled Fabric Display	173
7.3.3	Design of Experiments	175
7.4	Results and Discussion	180
7.4.1	Input Touch Sensing Module	180
7.4.2	Output Touch Actuation Module	181
7.4.3	Thermal Control System	185
7.4.4	Evaluation of System	187
7.5	Conclusion	191
	References	192
8	Culture Computing: Interactive Technology to Explore Culture	195
8.1	Introduction	195
8.2	Prior Research	196
8.3	Features of Cultural Computing	197
8.4	Media Me	198
8.4.1	Introduction	198
8.4.2	Motivation	201
8.4.3	System Description	201
8.4.4	Video Indexing	204
8.5	BlogWall	206
8.5.1	Introduction	206
8.5.2	Motivation	206
8.5.3	System Description	207
8.5.4	An Example of Poetry Mixing	212
8.6	Confucius Computer	215
8.6.1	Introduction	215
8.6.2	Motivation	215
8.6.3	System Description	215
8.7	Conclusion	218
	References	220
9	Kawaii/Cute Interactive Media	223
9.1	Introduction	223
9.2	The Cute Aesthetic	223
9.2.1	Kawaii: Cute Culture History and Development in Japan	223
9.2.2	History of Manga	225
9.2.3	Kawaii Culture Development in Modern Japan	227
9.2.4	Kawaii Globalization	228
9.3	Contemporary Perceptions of Kawaii/Cute	230
9.4	Cuteness in Interactive Systems	230

9.4.1	Child-Like Innocence and Play	231
9.4.2	Moments of Surprise	231
9.4.3	Relationship with Object's Personality	232
9.5	Studying Cuteness	232
9.5.1	Defining Cuteness	233
9.5.2	Color Selection	233
9.5.3	Texture	235
9.5.4	Motion	236
9.5.5	Sound	237
9.5.6	Size and Proportion	238
9.5.7	Shapes and Form	240
9.5.8	Smell and Taste	243
9.6	Related Works. Cute Interactive Systems	243
9.7	Cute Engineering	244
9.7.1	Cute Filter	244
9.7.2	Research-Oriented Design	246
9.8	Qoot Systems. Petimo and Virtual World for Social Networking	246
9.9	Sensing, Actuation and Feedback	249
9.9.1	Sensing	250
9.9.2	Actuation and Feedback	251
9.10	Conclusion	253
	References	253
10	Designing for Entertaining Everyday Experiences	255
	Masa Inakage, Takahiro Arakawa, Kenji Iguchi, Yuichiro Katsumoto, Makoto Katsura, Takeshi Osawa, Satoru Tokuhisa, and Atsuro Ueki	
10.1	Introduction	255
10.2	Everyday Media	256
10.2.1	Amagatana	257
10.2.2	Tabby	258
10.3	Embodied Media	259
10.3.1	Morel	260
10.3.2	MYSQ	261
10.3.3	livePic	262
10.4	Sensuous Media	264
10.4.1	Nozoki-Hana	264
10.4.2	Mamagoto	266
10.5	Collective Media	267
10.5.1	Mopie	267
10.6	Conclusion	268
	References	269
11	Tabletop Games: Platforms, Experimental Games and Design Recommendations	271
	Michael Haller, Clifton Forlines, Christina Koeffel, Jakob Leitner, and Chia Shen	
11.1	Introduction	271

11.2	Tabletop Hardware & the Types of Interaction They Support . . .	272
11.2.1	SmartBoard	273
11.2.2	DiamondTouch	273
11.2.3	SmartSkin	274
11.2.4	Microsoft Surface	275
11.2.5	Frustrated Total Internal Reflection (FTIR)	276
11.2.6	Entertaible	276
11.2.7	Stylus	277
11.3	Experimental Tabletop Games	278
11.3.1	Educational	278
11.3.2	Therapeutic	280
11.3.3	Entertainment	283
11.4	Case Studies	284
11.4.1	Jam-O-World: CircleMaze	284
11.4.2	CircleMaze	285
11.4.3	User Testing and Observations	286
11.4.4	Porting to a Direct-Touch Tabletop	286
11.4.5	Comino and NeonRacer	286
11.4.6	User Testing and Observations	287
11.4.7	Interaction Design for a Walk-up-and-Use Tabletop Game	288
11.5	Heuristics for Tabletop Games	289
11.5.1	Evaluation Process	290
11.6	Ten Heuristics for Tabletop Games	293
11.6.1	Cognitive Workload	293
11.6.2	Challenge	293
11.6.3	Reach	293
11.6.4	Examinability	294
11.6.5	Adaptability	294
11.6.6	Interaction	294
11.6.7	Level of Automation	294
11.6.8	Collaboration and Communication	295
11.6.9	Feedback	295
11.6.10	Comfort of the Physical Setup	296
11.7	Conclusions	296
	References	296
Index		299