

# Social Things: Design Research on Social Computing

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**Abstract.** In the era of social networking and computing, things and people are more and more interconnected, giving rise to not only new opportunities but also new challenges in designing new products that are networked, and services that are adaptive to their human users and context aware in their physical and social environments. A research vision on social things is needed, that addresses both the technological and social aspects in design, and that requires a social approach to the Internet of Things.

**Keywords:** Social things · Internet of things · Social computing · Design research

## 1 Introduction

In the concept of Internet of Things, things start to communicate with other things, forming an “Internet of Social Things”, allowing things to have their own social networks, enabled by communication technologies that are both fixed and ad hoc, and both wired and wireless. These “Internet of Social things” are further in connection with their environments and users through sensors and actuators, communicating with the social networks of humans, interacting in social networks with humans and other objects, forming a “Social Internet of Things”. These two levels of social networks of things and humans give rise to not only new opportunities but also new challenges in designing new products (that are networked) and services (that are adaptive to their human users and context aware in their physical and social environments). Therefore, the design research to meet these new opportunities and challenges needs a social approach to the Internet of Things, which brings our attention to a research area, namely “social things”, that address both the technological and social aspects of the Internet of Things.

## 2 Social Things

### 2.1 Social Things for Data Driven and Service Centric Design

The merge of the social networks of people and the Internet of things leads to a shift from product or system oriented design to service centric design. Systems, products and the related services are more connected than ever. Products have become the terminals of the services and systems have become the platforms to deliver the services. Social computing started in late 1990’s and early 2000’s serving as platforms not only for

sharing online content and conversation, but also for processing the content of social interaction and feeding back into systems [1]. The difference is that the social interaction and feedback are tied to things, sensors, and information intertwined in the social channels. These channels create touch points between services and customers, and the feedback from the customers to the services has become quicker, driven by a more flattened and bottom-up social structure. Along with this development, products with embedded connectivity and identification technologies have become part of the Internet of Things, and with embedded sensing technology these products have been integrated into people's lives in a more adaptive and social manner, learning human activities and behavior from the big data in the networks of both humans and things. Figure 1 shows an in-flight entertainment system that collects not only the music preference of the passenger, social recommendations of the music, but also the heart rate to detect the stress level and to reduce it through adaptive music [2].



**Fig. 1.** Heart rate controlled music recommendation for low stress air travel [2]

With the facilitation of social things, service design can be carried out in an interactive and sustainable process. In this process data and input can be collected social interaction among the users; and the stakeholders and from the behavior of the users and the products, analyzed and quickly or directly fed back to the process. The quicker this feedback loop is, the more the design cost can be reduced. This research area needs to investigate how to tightly combine and coordinate these computational, physical and social elements to facilitate the service and the design process of it. Traditional new product design and development methods become insufficient when dealing with the shift towards service centric design, the power from the flattened and bottom-up social structure, and the complexity of the social systems of humans and things. Adaptivity of the intelligent systems and services has to be reinvestigated in the context of social things and social innovation in a larger scale eco-system in which the social networks of people and the Internet of things are intertwined.

## 2.2 Social Things for Social Innovation

The growth and development of distributed and pervasive computing, social networks and mobile technologies have dramatically increased the complexity of the systems, products and the related services, but also the complexity of the design itself. Social things that merge the social networks of humans and the Internet of things, on the other

hand, brings up new solutions against the complexity, towards social innovation, by harvesting the collective intelligence from the social networks of humans, including the designers, the users and the organizations, and the collective intelligence from the Internet of Things, in order to realize greater value from the interaction between people and things, which in turn, inventing innovative and hopefully also sustainable ways of living. In this context, design has become a social activity – design is a result of social innovation; design drives social innovation and leads social transformation.

In this context, the design research on social things aims at developing methods, tools and techniques to support design as social innovation and design for social innovation. In the case of design as social innovation, the research should investigate how social things can be used to support the collaborative design activities by the designers as well as other stakeholders including the end users and to enable collective creativity and intelligence in dealing with the complexity of the systems of today. In this case open source hardware and software are good examples of today (Fig. 2), but more can be expected to happen to other end user products and systems. In the case of design for social innovation, the research shall investigate how to use social things for design to trigger and support social innovation that leads to societal transformations, by introducing design perspectives and design intervention in a social context. The penetrating of social things to the society creates possibilities in creating collective awareness platforms for possible solutions that need collective efforts and shared knowledge, enabling new forms of social innovation.

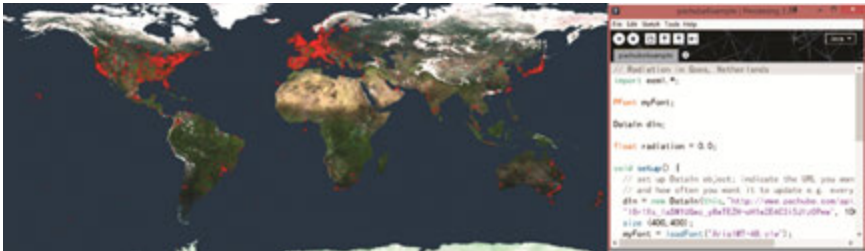


Fig. 2. Open data from internet of things, accessible using open source software tools

### 2.3 Social Things as “Simulation” Platforms for Design

The integration of the networks of humans and things gives the opportunity to bring design much closer to the end users, to other stakeholders and to its social and situational context, and vice versa. It sheds a promising amount of lights on improving the validation process of design, as computational simulation has done to electrical and mechanical engineering when computer was introduced to these disciplines.

Social things have their physical forms, but also can be easily captured and represented in digital means. It enables them to be used for validating design in earlier phases of the process. It is interesting to investigate how social things could be utilized as “simulation” platforms for earlier concepts – in this case physical prototypes might still be necessary but the situational context (people, other things and the environment) can

be brought in or closer in order to quest the concept earlier (Fig. 3 shows a project in which the early concepts of a physical clock was evaluated with potential users in a virtual world [3]).



Fig. 3. Digital model of a physical clock is evaluated in a virtual world [3]

### 2.4 Social Things as a Competency and as a Tool in Design Education

New types of designers have to be equipped with systematic understanding and perspectives, be competent in utilizing the social things to harvest the creativity, the input and the feedback through social interaction. The developments also bring up new opportunities in utilizing social things in facilitating the learning to make learning a more effective and more enjoyable social experience. Figure 4 shows a set of open source software, hardware and learning environment used in the design education at the department of industrial design, Eindhoven University of Technology.

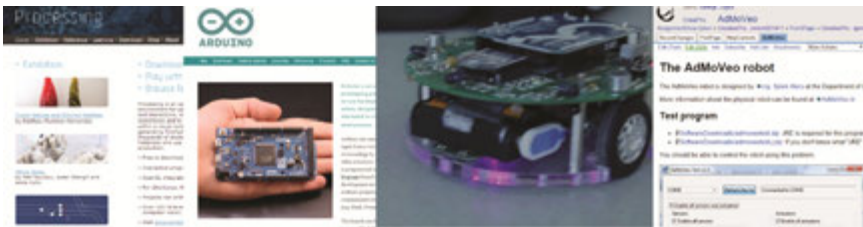


Fig. 4. Open source software, hardware and learning environment in a design education [4]

The perspective and the ability of utilizing social things as an enabler in design should be implemented in the design education. This research area should investigate how this can be carried out in a self-driven learning process, and how to utilize the social things and social computing technologies to facilitate this process.

### 2.5 Research Methods

Social things as a research topic is at the intersection of computational systems and social behavior. This research should employ engineering and empirical research methodologies, or a research-through-design approach, depending on the subject under investigation.

Social things can be used to empower end-users, for example in the medical field, where patients get faster and more accurate information about their personal health

status, exchange experiences, and keep track of the performance of medical institutions. The research question is how to design such social systems, and how to measure their performance, which includes the perceived quality. The measurement instruments themselves can be designed as social tools (on-line questionnaires, data logging with the social things, network-oriented data visualization, distributed data mining, and crowd wisdom).

Not only the end-users will change their way of working, also the design community itself will change when adopting the power of social things and social computing. The effect is already visible in the communities around Arduino, Processing, and DIY 3D printers. Whereas most of the present-day tools are still traditional editors, compilers and CAD tools, the next generation of tools will be designed as social tools. This asks for a research-through-design approach: creating new tools, co-creating and sharing them inside the design community, and evaluate their performance and perceived quality with appropriately designed new tools. State-of-the-art engineering and design methods should be deployed to bootstrap the design of these new tools.

### 3 Research Areas and Activities

With the above mentioned research vision, we have been involved in a number of research projects in related areas. “Social things” as a research area is broad, as seen from the examples to be introduced next. It is not our intention to give a complete overview here, rather it is to demonstrate our effort in its two-fold focus on both technological and social aspects.

#### 3.1 Social Things to Connect the Digital and the Physical

Social things can be utilized to connect the digital and the physical, employing and developing computational technologies such as distributed multimedia and interaction for entertainment in ambient intelligent environments [5–7], semantic web for interoperability of smart objects in intelligent environments [8–10], augmented and mixed reality for installations in social and cultural computing [11–14], virtual reality for serious games as learning or diagnostic tools [12, 15, 16] (Fig. 5 shows an augmented home that integrates a digital game with the physical environment), tangible interfaces



**Fig. 5.** Augmented home: integrating a virtual world game in a physical environment [12]

to digital systems [9, 17, 18]. All these research activates have been engaging sensing and actuating technologies, or embedded technologies that integrate both for an integrated system that merges and blurs the digital and the physical.

### 3.2 Social Things for Health and Care

Sensors, actuators, smart objects and integrated systems have been utilized in several projects in delivery simulators for medical training [19, 20], comfort and bonding in perinatology research [21], reducing stress in long haul flights [2, 22], emotional care for elderly with dementia [23, 24], social connectedness through unconscious and peripheral data [25, 26] (Fig. 6), and relaxation with bio-feedback [27–29]. In recent years, both the ageing society and the general needs of improving the quality of life and well-being have lead policy makers in many countries to turn to individuals at home and the social networks of the individuals, and to deliver the service over the networks, as an important source of long-term health care, where social things and social computing would play important roles.

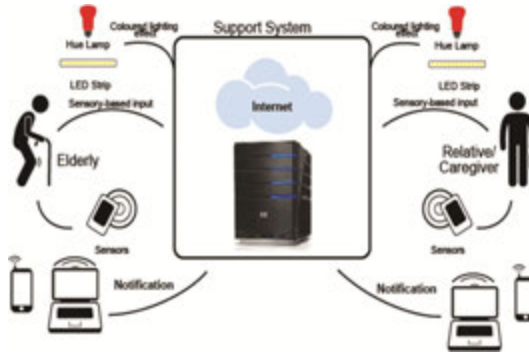


Fig. 6. Social connectedness through unconscious and peripheral data [25, 26]

### 3.3 Social Things in Public Spaces

Social things are often situated in public spaces, enabling social interaction among multiple users and systems, and the analysis of the social behavior based on the collected data [30–33]. Several research carriers in our projects are interactive and participatory public installations, either functional or artistic [11, 34–36]. These interactive installations require gathering input, data and information using computer vision, mobile devices, connected or embedded sensors from either the physical space or social networks. For output, many of these installations using projection mapping to augment the physical objects or spaces with a digital layer, being a good example for designing systems that integrate the physical with the digital. These installations often aim at an environment or connected spaces, being a very good research carrier for the Internet of Things as situated and large scale objects, and for studying the group user behavior and experience [37]. Figure 7 shows the installation designed for the city of Taicang, China.

The installation is roughly 10 by 10 meters on its base and 8 meters high. On top of the base are constructions that give the impressions of a large sail, and the moon rising from the waves. Images, animations and videos can be projected onto the inner surface of sail in the evenings, allowing the public to contribute their photos from social media to induce the feeling of social connectedness [11, 35].



Fig. 7. Moon rising from sea [11, 35]

### 3.4 Social Things for Sustainability

Several projects have been carried out in the TU/e DESIS lab, part of the DESIS (Design for Social Innovation and Sustainability) association, a “network of design labs, basked in design schools and design oriented universities, actively involved in promoting and supporting sustainable change”. Next to the research activities in designing for social interaction in public spaces as already mentioned, activities are mostly educational with student projects. Recently together with two Ph.D. students we started our research activities in a social recipe recommendation system for food sustainability, with the help of the Internet of Things (Fig. 8, mobile devices and intelligent trash bins) [38, 39].



Fig. 8. Intelligent trash bins for a social recipe recommendation system [38, 39]

## 4 Concluding Remarks

The research area “social things” focuses more on social computing as tools and platforms for design. The design context of social interaction, social innovation and service centric design requires close cooperation with other expertise. It is expected to closely collaborate on social interaction with colleagues from the user centered design and research, on tangible and physical interaction as well as social innovation with colleagues in interaction design and social design, and on the service centric design process with the colleagues with a business perspective. The Internet of Things elements of this research will not only generate data for data driven design, but also blend the analyzed results into the physical forms in the created designs.

The research focus is more on designing social computing tools and platforms than it is on developing the enabling technology itself, which requires collaboration with computer science and electrical engineering.

It is also expected to contribute to key societal issues such as energy, health and mobility. Possibilities in contributing to other areas shall be considered, for example the environment and energy domain offers many opportunities for exploring crowdsourcing; techniques and social intelligence in systems design; social networking can provide ad-hoc yet real time information from the drivers and vehicles for a more efficient traffic, or for a better experience on move.

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# Foreword

The 18th International Conference on Human-Computer Interaction, HCI International 2016, was held in Toronto, Canada, during July 17–22, 2016. The event incorporated the 15 conferences/thematic areas listed on the following page.

A total of 4,354 individuals from academia, research institutes, industry, and governmental agencies from 74 countries submitted contributions, and 1,287 papers and 186 posters have been included in the proceedings. These papers address the latest research and development efforts and highlight the human aspects of the design and use of computing systems. The papers thoroughly cover the entire field of human-computer interaction, addressing major advances in knowledge and effective use of computers in a variety of application areas. The volumes constituting the full 27-volume set of the conference proceedings are listed on pages IX and X.

I would like to thank the program board chairs and the members of the program boards of all thematic areas and affiliated conferences for their contribution to the highest scientific quality and the overall success of the HCI International 2016 conference.

This conference would not have been possible without the continuous and unwavering support and advice of the founder, Conference General Chair Emeritus and Conference Scientific Advisor Prof. Gavriel Salvendy. For his outstanding efforts, I would like to express my appreciation to the communications chair and editor of *HCI International News*, Dr. Abbas Moallem.

April 2016

Constantine Stephanidis



# **HCI International 2016 Thematic Areas and Affiliated Conferences**

Thematic areas:

- Human-Computer Interaction (HCI 2016)
- Human Interface and the Management of Information (HIMI 2016)

Affiliated conferences:

- 13th International Conference on Engineering Psychology and Cognitive Ergonomics (EPCE 2016)
- 10th International Conference on Universal Access in Human-Computer Interaction (UAHCI 2016)
- 8th International Conference on Virtual, Augmented and Mixed Reality (VAMR 2016)
- 8th International Conference on Cross-Cultural Design (CCD 2016)
- 8th International Conference on Social Computing and Social Media (SCSM 2016)
- 10th International Conference on Augmented Cognition (AC 2016)
- 7th International Conference on Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management (DHM 2016)
- 5th International Conference on Design, User Experience and Usability (DUXU 2016)
- 4th International Conference on Distributed, Ambient and Pervasive Interactions (DAPI 2016)
- 4th International Conference on Human Aspects of Information Security, Privacy and Trust (HAS 2016)
- Third International Conference on HCI in Business, Government, and Organizations (HCIBGO 2016)
- Third International Conference on Learning and Collaboration Technologies (LCT 2016)
- Second International Conference on Human Aspects of IT for the Aged Population (ITAP 2016)

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# Contents

## Culture and User Experience

Use of Cultural Intelligence to Measure Influence of Online Social Networks on Cultural Adjustment . . . . .	3
<i>Shalinda Adikari</i>	
HCI Within Cross-Cultural Discourses of Globally Situated Rhetorical and Etymological Interactions . . . . .	16
<i>Daniel G. Cabrero, Arminda Guerra Lopes, and Barbara Rita Barricelli</i>	
How to Develop a User-Friendly Chinese Hand Input System for the Touch Device? A Case Study . . . . .	26
<i>Zhe Chen, Pei-Luen Patrick Rau, and Lin Ma</i>	
Group Participation Influence on Members' Gifting Behaviors in a Social Game . . . . .	34
<i>Na Chen and Pei-Luen Patrick Rau</i>	
The Influences of Culture on User Experience . . . . .	43
<i>Tales Rebequi Costa Borges de Souza and João Luiz Bernardes Jr.</i>	
The Brazilian HCI Community Perspectives in Cultural Aspects in HCI . . . .	53
<i>Isabela Gasparini, Luciana C. de C. Salgado, and Roberto Pereira</i>	
Cross-Cultural Study of Tactile Interactions in Technologically Mediated Communication. . . . .	63
<i>Lalita Haritaipan and Céline Mougenot</i>	
The Different Attachment to Virtual Possession Between Young and Elder Adults. . . . .	70
<i>Chia-Sui Hsu and Yuan-Chi Tseng</i>	
Social Things: Design Research on Social Computing . . . . .	79
<i>Jun Hu</i>	
Cross-Cultural Design Learning Tool: Cross-Cultural Design (CCD) Approach: A Study of South Korean Student Projects in Collaboration with Goldsmiths, University of London, UK. . . . .	89
<i>Dong Yeong Lee and Mike Waller</i>	
The Usability of Hand Pose and Gestures for Spaceflight Training System. . .	98
<i>Wanhong Lin, Jiangang Chao, Jin Yang, and Ying Xiong</i>	

Characterizing Intercultural Encounters in Human-Computer Interaction. . . . .	108
<i>Luciana C. de C. Salgado, Clarisse Sieckenius de Souza, Catia M.D. Ferreira, and Carla Faria Leitão</i>	
Do You Trust One’s Gaze? Commonalities and Differences in Gaze-Cueing Effect Between American and Japanese . . . . .	120
<i>Saki Takao, Atsunori Ariga, and Yusuke Yamani</i>	
Usability Comparison of Text CAPTCHAs Based on English and Chinese. . .	130
<i>Junman Yu, Xuna Ma, and Ting Han</i>	
Measuring Disengagement and Chaos in Multitasking Interaction with Smart Devices . . . . .	139
<i>Yubo Zhang, Pei-Luen Patrick Rau, and Runting Zhong</i>	
<b>Cross-Cultural Product and Service Design</b>	
From “Illustration” to “Interpretation”—Using Concrete Elements to Represent Abstract Concepts in Spatial Design . . . . .	153
<i>Li-Yu Chen and Ya-Juan Gao</i>	
The Management Model Development of User Experience Design in Organization: A Case Study for Taiwan Technology Industry . . . . .	163
<i>Henry Been-Lirn Duh, Jim-Jiunde Lee, Pei Luen Patrick Rau, and Mu Qing Chen</i>	
SYSTEMATEKS: Scalable Interactive Modular Simulation (SIMS): Towards Sustainable Design. . . . .	173
<i>Luigi Ferrara and Nastaran Dadashi</i>	
Design in Everyday Cooking: Challenges for Assisting with Menu Planning and Food Preparation. . . . .	182
<i>Atsushi Hashimoto, Jun Harashima, Yoko Yamakata, and Shinsuke Mori</i>	
QUALIA into the Fashion Show Case Analysis . . . . .	193
<i>Shu Hui Huang, Ming Chw Wei, and Tzu Chiang Chang</i>	
The Effect of the Transition Design of Artwork to the Purchasing Demand - A Case Study of Apparel Design . . . . .	205
<i>Chi-Ying Hung and Chung-Liang Chen</i>	
The Behavioral Analysis for Cross-Cultural Understandings Using Place Oriented Internet Radio . . . . .	217
<i>Ayaka Ito and Katsuhiko Ogawa</i>	
The Relationship Between Robot Appearance and Interaction with Child Users: How Distance Matters . . . . .	229
<i>Weijane Lin and Hsiu-Ping Yueh</i>	

Service Design Strategies for Long-Term Effects that Individual Moments Have on the Whole: A Case Study of “Persephone” . . . . . 237  
*Muqing Niu and Linong Dai*

Exploring the Multilingual Efficiency of Urban Online Spaces: Implications for Culture-Centered Design . . . . . 246  
*Antigoni Parmaxi, Anna Nicolaou, Salomi Papadima-Sophocleous, and Dimitrios Boglou*

Bridging Personal Adaptations to Urban Landscape Design . . . . . 257  
*Tatsuya Shibata*

A Study of Relationship Between Personality and Product Identity . . . . . 266  
*Wen-Zhong Su and Po-Hsien Lin*

Digital Display and Transmission of the Culture of Traditional Chinese Furniture . . . . . 275  
*Xinxin Sun and Chao Li*

Survey on Campus Landscape Construction and Study on Suitability Comprehensive Evaluation: Based on the Perspective of the Sustainable Development of Green Campus in China’s Urbanization Process. . . . . 288  
*Wei Wang, Zhongwei Shen, and Huayi Zhou*

Evaluation and Research on Interior Decoration Design of Automobile Cabins Based on Intention Recognition – Taking Control Panel Design for an Example . . . . . 299  
*Chaoxiang Yang, Jianxin Cheng, Zhang Zhang, and Xinhui Kang*

CJM-Based Service Design Process. . . . . 305  
*Fuli Yang and Lili Qu*

A Study on the Comparison and Inspiration for Operation Mode of the Maker Space Brand in China and America . . . . . 316  
*Minggang Yang, Xinhui Kang, Yixiang Wu, and Chaoxiang Yang*

**Cultural Ergonomics**

The Influences of Children’s Temperament and Their Parent-Child Reading Environment on Their Preferences Regarding Parent-Child Reading . . . . . 329  
*Jo-Han Chang and Tien-Ling Yeh*

Influence of Media Forms on Painting Appreciation Experiences . . . . . 338  
*Si-Jing Chen, Chih-Long Lin, Sandy Lee, and Yen-Yu Kang*

From “Idyllic” to “Living Space”—Turning “Art Work” into “Interior Design”. . . . . 345  
*Ya-Juan Gao, Yun Lin, Li-Yu Chen, and David Chang Hsi Dai*



Cultural Ergonomics Beyond Culture - The Collector as Consumer in Cultural Product Design. . . . . 355  
*John Kreifeldt, Yuma Taru, Ming-Xean Sun, and Rungtai Lin*

From Ideality to Reality- a Case Study of Mondrian Style . . . . . 365  
*Rungtai Lin, Hui-Yueh Hsieh, Ming-Xean Sun, and Ya-Juan Gao*

Thoughts on Studying Cultural Ergonomics for the Atayal Loom . . . . . 377  
*Yuma Taru, John Kreifeldt, Ming-Xean Sun, and Rungtai Lin*

Approaching a Chinese Cultural Transferring Design Model Through Analysis of Culturally Oriented Design and Its Context . . . . . 389  
*Wenjin Yao and Gang Lu*

Design and Application of the Illustrations of *Zhuangzi* . . . . . 397  
*Mo-Li Yeh, Yuan-Qian Liu, and Po-Hsien Lin*

**Culture and Mobile Interaction**

Mobile User Interaction Development for Low-Literacy Trends and Recurrent Design Problems: A Perspective from Designers in Developing Country . . . . . 409  
*Elefeliouis G. Belay, D. Scott McCrickard, and Solomon A. Besufekad*

Exploration of Smart Phone Knowledge Management Application Design for Nomadic Maintenance Workers . . . . . 418  
*Ziyang Li, Pei-Luen Patrick Rau, Nan Qie, and Man Wu*

Discovery of Smartphone User Group Profiling Based on User’s Motivations and Usage Behaviors Through Focus Group Interviews . . . . . 426  
*Jimin Rhim, Seul Lee, and Young Yim Doh*

User Requirements of Wearable Technology for Activity Tracking: A Comparison Between German and Chinese Users . . . . . 436  
*Liuxing Tsao, Lukas Haferkamp, and Liang Ma*

Rediscover Herbal Lane- Enhancing the Tourist Experience Through Mobile Applications . . . . . 448  
*Fang-Wu Tung and Min Wu*

Assessing the Effects of Mobile Service Quality on Customer Satisfaction and the Continued Usage Intention of Mobile Service: A Study of Non-gaming Mobile Apps . . . . . 459  
*Wei-Tsong Wang and Wen-Yin Chen*

Research on the Impact of Menu Structure of Smart Phones on Dual Task Performance . . . . . 468  
*Huining Xing, Hua Qin, and Dingding Wang*

Proposal of Chinese Tourist Support System to Enjoy the Holy Land  
Pilgrimage in Japan . . . . . 477  
*Ni Zhang and Katsuhiko Ogawa*

**Culture in Smart Environments**

Crossing Disciplinary Borders Through Studying Walkability . . . . . 491  
*Stefania Bandini, Andrea Gorrini, and Katsuhiko Nishinari*

Optimized Environment Designing of Nanjing South Railway Station  
Based on Pedestrian Simulation . . . . . 504  
*Ying Cao, Qijun Duan, and Ning Zhang*

Observations on Global Urban Millennials’ Social and Civic- Interactions  
Mediated by New Technologies . . . . . 516  
*Suruchi Dumpawar, Vicky Zeamer, Anika Gupta, Blanca Abramek,  
and Federico Casalegno*

Constructing the Research Model of Beijing Neighborhood  
Through the Living Lab Method . . . . . 527  
*Zhiyong Fu and Yaohua Bu*

The Creative City: An Innovative Digital Leadership Program  
for City Decision Makers . . . . . 540  
*Christopher G. Kirwan, Dan Yao, and Wannu Dong*

Co-design, Co-creation, and Co-production of Smart Mobility System . . . . . 551  
*Hiroko Kudo*

Towards the Development of an EIT-based Stretchable Sensor  
for Multi-Touch Industrial Human-Computer Interaction Systems . . . . . 563  
*Stefania Russo, Samia-Nefti Meziani, Tauseef Gulrez,  
Nicola Carbonaro, and Alessandro Tognetti*

Kansei Robotics for Safe and Stress-Free Livesphere: Understanding  
Personal Preferences from Behavior Patterns. . . . . 574  
*Takashi Sakamoto, Toru Nakata, and Toshikazu Kato*

Connected and Open Platform-Based Approaches for Smart Car  
Service Design . . . . . 584  
*Xiaohua Sun, Tong Li, and Zexi Feng*

Environment-Specific Smart Service System Design . . . . . 592  
*Xiaohua Sun and Jintian Shi*

Older Drivers’ Acceptance of Vehicle Warning Functions and the  
Influence of Driving Experience . . . . . 600  
*Lin Wang*

Services, Appearances and Psychological Factors in Intelligent Home Service Robots . . . . .	608
<i>Hsiu-Ping Yueh and Weijane Lin</i>	
Design of User Interface for Elderly Care Supervision System Based on Sensor Network . . . . .	616
<i>Yi-Chong Zeng, Yu-Ling Hsu, Te Yu Liu, Yen-Chieh Cheng, Huan-Chung Li, Grace Lin, and Wen-Tsung Chang</i>	
A Framework for Integrating Industrial Product-Service Systems and Cyber-Physical Systems . . . . .	628
<i>Maokuan Zheng, Wenyan Song, and Xinguo Ming</i>	
Design Research on Urban Public Space Share Interactive Mode Under the Background of Internet Plus . . . . .	638
<i>Ping Zhou and Zhiyong Fu</i>	
<b>Cross-Cultural Design for Health, Well-being and Inclusion</b>	
Can Autonomous Sensor Systems Improve the Well-being of People Living at Home with Neurodegenerative Disorders?. . . . .	649
<i>Tauseef Gulrez, Samia-Nefti Meziani, David Rog, Matthew Jones, and Anthony Hodgson</i>	
<i>Kitchen KungFu: A Match-3 Game to Explore Chinese Medical Beliefs . . . .</i>	659
<i>Shuyu Li and Pei-Luen Patrick Rau</i>	
Young and Elderly, Normal and Pathological Gait Analysis Using Frontal View Gait Video Data Based on the Statistical Registration of Spatiotemporal Relationship . . . . .	668
<i>Kosuke Okusa and Toshinari Kamakura</i>	
Research on the Characteristics of Headforms and Classification of Headforms of Chinese Adults . . . . .	679
<i>Linghua Ran, Hong Luo, Xin Zhang, Huimin Hu, Taijie Liu, and Chaoyi Zhao</i>	
Usability Evaluation of Blood Glucose Meters for Elderly Diabetic Patients . . .	686
<i>Peter Rasche, Pilsung Choe, Sabine Theis, Matthias Wille, Christina Bröhl, Lea Finken, Stefan Becker, Christopher M. Schlick, and Alexander Mertens</i>	
A Cross-Cultural Adaptation in Reporting Perinatal Safety Events. . . . .	695
<i>Weiyang Shan, Chen Liang, Weichao Shan, Na Yang, and Yang Gong</i>	

Research Service Design Based on Online Public Service Platform — APP Design for Mutual Learning Through Sign Language Short Video. . . . . 704  
*Youxin Wu, Yin Liang, Haiyang Sun, Jingxian Chen, Yi Liu, Jian Lin, and Binbin Li*

Design Study of Patient-Oriented Information Service System for Ward Nurses Station by Taking Wuxi Fourth People’s Hospital as a Case . . . . . 717  
*Linghao Zhang, Changfu Lv, Yun Feng, and Jiayu Zeng*

Measuring Chinese Medical Beliefs of Chinese Adults. . . . . 729  
*Runting Zhong, Pei-Luen Patrick Rau, and Shuyu Li*

**Culture for eCommerce and Business**

Every Day for an Active Self-promotion: The Dialogue Between the Shower Gel Packaging on the Shelf of a Point of Sale and the Consumer . . . 739  
*Mu-Chien Chou and Weng-Kit Chong*

Transforming Branding Strategies from Product to Service: A Case Study About Yangshan Tourism Branding. . . . . 752  
*Yin Liang, Han Han, and Davide Fassi*

Mobile Technology Use Among Sales People in Insurance Industry . . . . . 761  
*Ming-Hsin Lu, Hsiu-Ping Yueh, and Weijane Lin*

Cross-Cultural Conflict Management in Taiwan-Funded Enterprises in Mainland China . . . . . 769  
*Lin Ma, Xin Wu, Zhe Chen, and Fuyuan Shi*

The Thinking Model and Design Process of Empathic Design: Cases Studies of Counter Design . . . . . 777  
*Shu-Huei Wang and Ming-Shean Wang*

The Emotional Experience of Inquiry Feedback Delaying in Online e-Commerce Platform Service Design: A Case Study from Chinese Customers . . . . . 788  
*Hao Tan, Wei Li, and Jiahao Sun*

Design for Transition to a Circular Economy . . . . . 800  
*Hao Yang*

To Save or Not to Save? Let Me Help You Out: Persuasive Effects of Smart Agent in Promoting Energy Conservation. . . . . 808  
*Guo Yu, Pei-Luen Patrick Rau, Na Sun, and Xiang Ji*

The Innovation Research of Takeaway O2O Based on the Concept of Service Design . . . . . 816  
*Mei Yu Zhou, Pei Xu, and Pei Long Liang*

**Author Index** . . . . . 825