Intelligent Environments 2016
P. Novais and S. Konomi (Eds.)
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doi:10.3233/978-1-61499-690-3-524

i-Ribbon: Social Expression Through Wearables to Support Weight-Loss Efforts

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Abstract. Many research prototypes and commercial wearable devices have features for detecting health-related data and providing feedback or reflection to their users. However, due to the development of social network and Internet of Things, the social aspects of wearable devices could be far more enriching. In this paper, we describe the concept, design and implementation of i-Ribbon, a wearable ribbon to show a user's weight-loss efforts. i-Ribbon has two types of function: to symbolize the support of weight-loss efforts, and to present the user's amount of physical activity. These features provide a subtle social channel for people who are struggling with overweight to show their efforts and determination, especially before they obviously become less overweight. Prototypes have been made to evaluate the concept. Feedback from participants has been collected and analysed. We summarize the findings and discuss the options for future work.

Keywords. social interaction; self-expression; wearable; ribbon; weight loss; health; symbol; behaviour change

1. Introduction

In recent years, there has been a proliferation of wearable technologies for fitness and weight loss. Devices such as Fitbit Flex, Jawbone UP and Garmin Vivofit provide similar services for users to track and manage their physical activities. Most of these services consist of a wearable device for activity tracking and a mobile or web application for logging, visualization and reflection. With these wearable devices and applications, users could have a better understanding of their physical condition. However, in addition to self-management, social interaction can also be an important factor to be taken into account.

The starting point of the work described in this paper is the Obesity Awareness Ribbon designed by Dr. Gerbrand van Hout and described in his book [21] (Figure 1) and an article [22] which were published in 2015.

Wearable devices that people wear in their daily lives, similar to clothing and jewellery, can play an important role in social expression. Unlike the expressive

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features of conventional apparel, social expression through a wearable device is not limited to the variation of style, material and colour. With the help of social network platform and Internet of Things (IoT) technology, wearable devices may present dynamic, multi-dimensional and meaningful information.

In this paper, we present i-Ribbon, a wrist-worn wearable device that shows the wearer's weight-loss efforts through an awareness ribbon and a dynamic pattern. With early prototypes, we conducted interviews to evaluate the preliminary design concept. Reflection upon the design and evaluation process improved our understanding on how social expression through wearable devices can support weight-loss efforts.

2. Related Work

Ribbon wearing is a conventional social expressive behaviour, people wearing different ribbons to show awareness, solidarity or mourning. Moore [16] explored the sociological implications of awareness ribbons and interprets ribbon wearing as "a particularly salient example of how we attempt to traverse the perceived gap of the private, essential self and the social, knowable self." Van Hout [22] proposed an Obesity Awareness Ribbon to support people who are losing weight or struggling with obesity.

Figure 1. The book of Gerbrand van Hout, entitled "U Verdient een Lintje!" (in Dutch) which means "You deserve a ribbon!" The cover of the book shows the physical version of the ribbon which is given by Gerbrand van Hout to his patients, colleagues (in the Obesity Centre of Catharina hospital in Eindhoven) and other people supporting weight-loss efforts.

In addition to ribbon wearing, some prior research employs wearable technologies as a platform for social expression [4], [6], [7], information is represented through wearable devices not only to the wearer but also to people in his or her proximity [18]. Moere et al. [15] mapped the wearer's historical behaviour data into a wearable folding display

to provide a novel form of self-expression. Other information such as distance between people [8], common interests [10] and activity log [11] have also been represented through a variety of wearable devices. Fajardo et al. [3] compared the abstract and overt visualization of skin conductivity on a wearable display device and proposed a contextual wearable display model to describe the relationships between wearable device, its wearer and onlookers.

As wearable devices have become increasingly ubiquitous, health-related information such as heart rate, steps and calories can be easily detected and shared. Several previous efforts integrated health-related information into social interaction to motivate physical exercise and support the weight loss process. Strategies which have been used include socially sharing heart rate data [2], [14], [20], [23], heart beat rhythm [13], [17] and activity level [1], [12].

3. Design of i-Ribbon

3.1. Initial explorations

In the very first iteration we explored the idea of preserving the essence of van Hout's Obesity Awareness Ribbon but somehow enhance its expressive feature through digital means. We did not define precisely what "digital" is, but worked in a hands-on manner to identify the range of possibilities. Starting with the concept of digital yellow ribbon, literature research on awareness ribbon, ribbon culture, ribbon wearing and pink ribbon was carried out [7], [16], [19]. Several prototypes were made to explore the possibilities of a digital yellow ribbon. Figure 2 shows the explorations on ribbon wearing behaviours and potential interaction related to a digital yellow ribbon.

Figure 2. The upper four pictures showing the explorations on ribbon wearing behaviour and the lower pictures showing the potential interaction related to a digital yellow ribbon

Through the simple models shows in Figure 3, we explored visual and tactile outputs on the yellow ribbon through LED and vibration actuators. These outputs could enrich the ribbon's social expression attributes through carrying meaningful information like body temperature, feedback on movement, or personal statement transmitted from social media platforms. Although we did not connect the digital ribbon with other applications via Bluetooth etc., it is clear that this could be done technically. We identified possibilities of richer visual output and other modalities such as audio feedback and digital storage (through non-functional demos), see Figure 4.

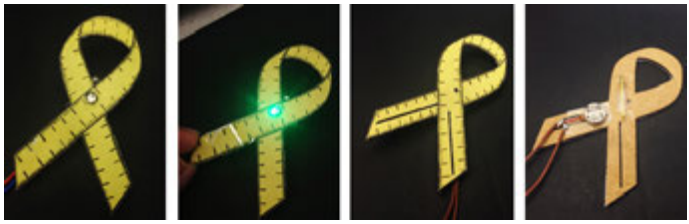

Figure 3. Two versions of the digital yellow ribbon, the first two pictures showing a concept based on visual output, the last two pictures showing the tactile output (vibration).

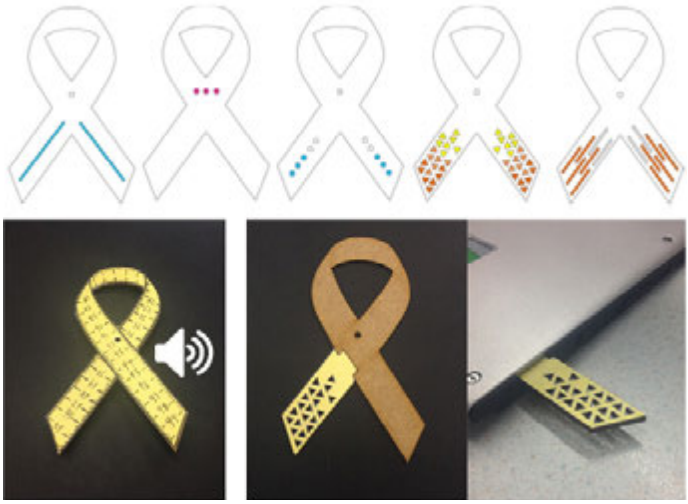

Figure 4. Additional possibilities for the digital yellow ribbon.

Evaluation through interviews was carried out and provided some inspiring feedback. We asked two persons with weight loss experience for their opinion showing the models of Figure 2, 3 and 4. The most important finding from this exploration was that users would like to show not just the symbol, but also their efforts made in the weight loss process through more expressive ways.

3.2. Concept

According to the findings of these initial explorations, we designed i-Ribbon, a wrist-worn wearable device that expresses the wearer's weight-loss efforts. Based on the Obesity Awareness Ribbon, a dynamic pattern which represents the wearer's physical activity was integrated with the conventional ribbon to enhance its social expressiveness. The pattern on i-Ribbon change according to the wearer's amount of physical activity (reflected by steps, distance and floors), see Figure 6. The wearer can also personalize the expression of i-Ribbon through a mobile application. Therefore, the concept of i-Ribbon consists of two parts:

- A wrist-worn device, which is visible to onlookers and carries symbolic meanings. At the same time, it has a built-in accelerometer to detect movements, similar to other commercial activity trackers.
- A mobile application, providing an additional interface, which would not fit on the limited size of the wrist-worn device.

Traditional ribbons are worn on different body locations in multiple ways. The decision to make i-Ribbon a wrist-worn device was motivated by the following factors: first of all, the wrist is a body location that can be seen by both the wearer and onlooker. Therefore, a wrist-worn device offers the opportunity for the wearer to express more actively [3]. Additionally, the wearers can conceal the device worn on their wrist, so they will have more freedom to decide where and when to show i-Ribbon to others. Moreover, as a product designed to support weight loss, a wrist-worn device will not cause inconvenience in most physical activities.

Figure 5. Model of the wrist-worn device and the mobile application of i-Ribbon (non-functional mock-up).

3.3. Prototype

Instead of creating the fully implemented wrist-worn ribbon (which would be too expensive and time-consuming at this stage) we created two complementary parts, the first part being a mock-up of the physical part of i-Ribbon and its mobile application (Figure 5), the other part being a screen-based simulation of the dynamic pattern (Figure 6).

4. Evaluation of i-Ribbon

4.1. Participants

We recruited three participants with the experience of weight loss (two males and one female), one of them is currently being overweight (P3) and the other two have

previous experience of overweight (P1 and P2). All the participants have strong interests in the topic related to weight loss and physical activity.

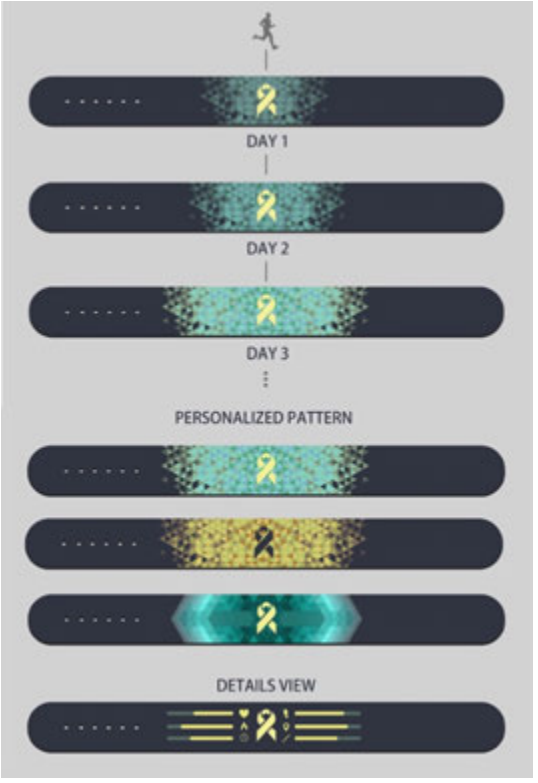

Figure 6. Model of the wrist-worn device of i-Ribbon (screen-based simulation of the surface).

4.2. Material

The mock-ups (Figure 5 and 6) were provided to each participant to help them understand the concept and the working mechanism of i-Ribbon.

4.3. Procedure

One-on-one semi-structured interviews were conducted. As a start, we asked several basic questions on personal experience and opinions about weight loss. The participants were then asked to experience the i-Ribbon with mock-ups (Figure 5 and 6). After that, we asked a series of questions following the Think Aloud Protocol [9] according to their feeling and experience of i-Ribbon. Finally, the participants were asked to imagine the potential functions and social attributes of i-Ribbon in addition to the presented concepts.

4.4. Results

4.4.1. Showing weight-loss efforts

The participants' overall impression of the idea of showing weight-loss efforts through i-Ribbon were positive. All of them found it helpful to have such a social expression channel. P3 emphasized that the appreciation from friends will be motivating for him: "…I think it is interesting and also important, to let people know that I am exercising and making efforts. And if I get any sort of appreciation from my friends, it motivates me and makes me go further." P2 is a user of Fitbit, she compared her experience of i-Ribbon to Fitbit Flex: "… this way (the idea of i-Ribbon) is better, I like the idea that it (the dynamic pattern on i-Ribbon) can spread after you did some exercise…people may see that you do workout a lot today and show a little bit respect." From the perspective of onlookers, P1 believed that wearing of i-Ribbon is a sign of hardworking on weight loss, and confirmed that he valued the efforts rather than result in weight-loss progress: "If I meet somebody, and I see this device. It shows that they are really working hard…the efforts matters, not the outcome. He did something, and that is more important for me."

4.4.2. The role in social interaction

Two participants mapped the use of i-Ribbon into their previous experience of social interaction related to weight loss. P2 described the device as a gentle and subtle show of what she did. She recalled a scene during the dinner: "…in a round table everyone is eating, somebody may ask me 'do you want to try that?' I actually need to tell them I am losing weight, so I can't eat dessert. This (i-Ribbon) could be a kind of subtle hint or something, that I am losing weight recently, not because your food is not good." P3 thought it will be beneficial to show the device when talking to people who are not losing weight, stating: "Gently, when you just talk, you can show some evidence to prove yourself even better…it's a better way to show (i-Ribbon) than just talk, it's a kind of natural conversation." It is also worth noting that both P2 and P3 used similar terms like "gentle", "subtle" and "natural" to describe the role of i-Ribbon in social interaction with others.

4.4.3. Symbolic meaning of the ribbon

When being asked about the ribbon showed in the centre of the device (originally designed by van Hout) [21], [22]. P1 and P3 emphasized the ribbon is an important symbol for losing weight. P1 said: "If I see a band, it could be everything. But if I see the symbol, Oh, it's the band for losing weight, the symbol is very important." P3 considered the ribbon as symbol that makes i-Ribbon a serious product rather than a toy: "I think if you have this ribbon, they know it's not just a toy, the ribbon holds the meaning." While P2 worried that not everybody knows the ribbon stands for weight loss, so he might have to explain this to others.

All the participants insisted that they preferred to wear the ribbon which was designed for everyone who was making efforts on losing weight and enjoyed physical activity. They did not want to be labelled as overweight or obese when wearing this ribbon, as P1 said: "If anybody who enjoy workout can wear this, it's not like you are becoming depressed, it's becoming a good thing you are doing, and everybody will encourage."

4.4.4. The way to show weight-loss efforts.

All the participants expressed their wish of showing their weight-loss efforts in a more visible way. P1 and P2 both mentioned using colour as a distinction between different levels of efforts. When being asked about the idea of details displayed on the surface of i-Ribbon, participants did not show a strong interest to let other people know this information. P1 worried about the privacy problem of personal data period, P2 and P3 preferred to know the details themselves without sharing.

For the personalized patterns, P1 and P3 (both are male) like the feature but did not have specific reasons, while P2 (female) have stronger interests in various forms of pattern, stating: "I do want it to be diverse, I don't want to wear the same pattern as other people do…I might think it's an abstract version of my beautiful dress."

5. Reflection and Options for Future Work

5.1. Expression of weight-loss efforts

Through the evaluation of i-Ribbon, we confirmed the user's needs to socially express their weight-loss efforts. In the research described in this paper, we used common information like steps, distance and floors as indicators of weight-loss efforts and visually represented them on a wrist-worn wearable device. However, other information such as calorie intake and consumption could also indicate weight-loss efforts. Participants in initial explorations proposed some information that they were concerned about in their process of weight loss, including body weight, changes in body weight and body fat ratio.

In addition to the diversity of indicators, there are also many ways to represent this weight-loss related information. The result of the evaluation revealed that participants had a strong will to show their weight-loss efforts in more visible ways. A large number of existing applications represent the user's personal information through a variety of charts and progress bars. However, for the social expression purpose in our research, these strategies used for self-management may not be appropriate anymore.

Therefore, an option of future work is to identify appropriate ways to show user's weight-loss efforts by investigating different indicators and strategies of representation.

5.2. Impact of social context

Although users are willing to show their weight-loss effort, their specific behaviour is affected by social context. The evaluation reveals that users have different ways of talking about their weight-loss experience depending on their social contacts. When communicating with people who are also interested in weight loss, users are willing to share their positive progress and encourage each other. On the other hand, if their social contacts do not have any relevant experience of weight loss, users prefer to gently start a natural conversation rather than show their weight loss result directly. Similar to the impact of social contacts, different environment may also lead to different social behaviour. Some participants showed stronger willingness to share their weight-loss efforts in places (like gym, sports centre, canteen, etc.) that related to exercise and food intake.

In future research, a deeper study on the impact of the social context could be conducted. The wearer's possibilities to show, conceal and switch the i-Ribbon in different situations should be seriously considered.

5.3. Symbol and the meaning behind

A symbol can carry lots of meanings which are given by the people who design and promote it. For the Obesity Awareness Ribbon described in this paper, some meaning has already been given to it when it was designed [21], [22]. The meaning behind this ribbon could be refined through further studies and be strengthened by specific applications. In this paper, through the design and evaluation of i-Ribbon, we recognized that "supporting weight-loss efforts" could be an important branch of the ribbon's symbolic meanings.

In future iterations, a fully functional prototype will be made to evaluate the concept in real social contexts. With such a prototype, we may have the opportunity to further develop and reinforce the symbolic meaning behind this ribbon.

5.4. Getting inspiration from the pink ribbon

The pink ribbon designed for breast cancer is one of the most well-known awareness ribbons. During the evaluation, pink ribbon has been mentioned several times by different participants. They tried to use the pink ribbon as an example to help them explain their experience of i-Ribbon. Therefore, a deeper understanding of the pink ribbon could be very helpful for further research. Although breast cancer and weight loss are essentially different, there are still lessons to learn from the perspective of awareness ribbon, product semantics [5] and social expression.

6. Conclusion

We presented the concept of a wearable device designed to express wearer's weight-loss efforts. Initial explorations were conducted based on the Obesity Awareness Ribbon [21], [22]. Through prototyping, evaluation and reflection of i-Ribbon, we explored how a wearer's slimming behaviour might be affected by socially sharing their weight-loss efforts. Several options for improvement on the representation of weight-loss efforts were found. We identified several insights for further research to support weight-loss efforts through wearable expression.

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ISSN 1875-4163 (print)
ISSN 1875-4171 (online)

Intelligent Environments 2016

Workshop Proceedings of the 12th International Conference on Intelligent Environments

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IOS Press

Amsterdam • Berlin • Washington, DC

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ISBN 978-1-61499-689-7 (print)
ISBN 978-1-61499-690-3 (online)
Library of Congress Control Number: 2016952174

Publisher
IOS Press BV
Nieuwe Hemweg 6B
1013 BG Amsterdam
Netherlands
fax: +31 20 687 0019
e-mail: order@iospress.nl

Distributor in the USA and Canada
IOS Press, Inc.
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PRINTED IN THE NETHERLANDS

Introduction to the Proceedings of the Workshops of IE'16

London, United Kingdom 12–13 September 2016

Intelligent Environments (IEs) refer to physical spaces in which IT and other pervasive computing technologies are woven and used to achieve specific goals for the user, the environment, or both. IEs have the ultimate objectives of enriching user experience, improving the management of that environment and increasing user awareness.

Research in IEs is driven by inventive, innovative and fast-paced ideas, and, as such, there is a sense of urgency in materializing them, assessing their practical implications, and verifying whether they deliver their promised results. The mantra for research in this area is well conveyed by a thought brought to us by Steve Jobs: "Let's go invent tomorrow instead of worrying about what happened yesterday". Workshops, as brief gatherings towards the establishment of collaborations and incitement of creativity, are the ideal venue for creating and sharing this "tomorrow".

The 12th International Conference on Intelligent Environments focuses on the development of advanced intelligent environments, as well as newly emerging and rapidly evolving topics. In the present edition, we are pleased to include in this volume the proceedings of the following workshops and symposia that emphasize multidisciplinary and transversal aspects of IEs, as well as cutting-edge topics:

- 5th International Workshop on Smart Offices and Other Workplaces (SOOW'16);
- 5th International Workshop on the Reliability of Intelligent Environments (WoRIE'16);
- 1st International Workshop on Legal Issues in Intelligent Environments (LIIE'2016);
- 2nd International Symposium on Future Intelligent Educational Environments and Learning (SOFIEE'16);
- 2nd International Workshop on Future Internet and Smart Networks (FI&SN'2016);
- International Workshop on Intelligent Environments Supporting Healthcare and Well-Being (WISHWell'2016);
- International Workshop on Computation Sustainability, Technologies and Applications (CoSTA'2016);
- Creative Science 2016 (CS'16) and Cloud-of-Things 2016 (CoT'16);
- Workshop on Wireless Body Area Networks for Personal Monitoring in Intelligent Environments (WBAN-PMIE);
- Physical Computing Workshop.

As is visible from the list, the workshops and symposia organized in conjunction with the main conference provide a forum for researchers, scientists and engineers to engage in many interesting and active discussions that will encourage further research in these key areas of Intelligent Environments.

The proceedings contain a series of contributions reflecting the latest research developed in IEs and related areas, focused on stretching the borders of the current state of the art and contributing to an ever increasing establishment of IEs in the real world.

It is our aim to inspire readers in their own work, in the hope that reading these proceedings plants the seeds for new, interesting, and original ideas.

We would like to thank all the contributing authors, as well as the members of the Organizing Committees and Program Committees of the workshops and symposia for their highly valuable work, which contributed to the success of the Intelligent Environments 2016 event. We are also grateful to the conference organizers and local staff who worked for the success of this event.

Thank you for your help, this event would not exist without your contribution.

As a final note, the Workshops Chairs would like to take the opportunity to thank Professor Juan Carlos Augusto and the other members of the IE'2016 organization for the trust they placed on us.

We are looking forward to seeing you all in London and actively participating in these exciting workshops.

September 2016
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Contents

Introduction to the Proceedings of the Workshops of IE'16 v
Paulo Novais and Shin'ichi Konomi

Committees vii

5th International Workshop on Smart Offices and Other Workplaces (SOOW'16)

Workshop on Smart Offices and Other Workplaces 3
Peter Mikulecký, Pavel Cech and Goreti Marreiros

Intelligent Reports for Group Decision Support Systems 4
João Carneiro, Luís Conceição, Diogo Martinho, Goreti Marreiros and Paulo Novais

Smart Classroom Study Design for Analysing the Effect of Environmental Conditions on Students' Comfort 14
Pavel Cech

Simulating Decision Processes in Intelligent Environments 24
Peter Mikulecky and Richard Cimler

Smart Office Automation Based on Semantic Event-Driven Rules 33
Sergio Muñoz, Antonio F. Llamas, Miguel Coronado and Carlos A. Iglesias

A System Architecture for Assistance in Manual Tasks 43
Fabian Quint, Frieder Loch, Marius Orfgen and Detlef Zuehlke

5th International Workshop on the Reliability of Intelligent Environments (WoRIE'16)

Introduction to the Proceedings of WoRIE'16 55
Miguel J. Hornos and Juan C. Augusto

A Formal Model for Event-Condition-Action Rules in Intelligent Environments 56
Claudia Vannucchi, Diletta Romana Cacciagrano, Flavio Corradini, Rosario Culmone, Leonardo Mostarda, Franco Raimondi and Luca Tesei

From Raw Data to Agent Perceptions for Simulation, Verification, and Monitoring 66
Michele Bottone, Giuseppe Primiero, Franco Raimondi and Neha Rungta

A Framework for the Development of Smart Ubiquitous Real-Time Systems Based on the Internet of Agents and Internet of Services Approaches 76
Pablo Pico-Valencia and Juan A. Holgado-Terriza

A Risk-Driven Methodology in Developing Ambient Intelligence Healthcare Systems 86
Giuseppe Cicotti and Antonio Coronato

Trending Technologies and Standards Supporting the Development of Quality Collaborative Web Applications: The Case Study of VIRTRAEL 94
Carlos Rodríguez-Domínguez, Francisco Carranza-García, Gabriel Guerrero-Contreras and José Luis Garrido

1st International Workshop on Legal Issues in Intelligent Environments (LIIE'2016)

Introduction to the Proceedings of Workshop on Legal Issues in Intelligent Environments 107
Pedro Miguel Freitas and Massmo Durante

Intelligent Environments: Challenges for Privacy and Data Protection 108
Carlisle George

Control and Supervision in a Post-Modern Technological Society 109
Pedro Miguel Freitas, Paulo Novais and Vicente Julián

Personal Data and Surveillance: The Danger of the "Homo Conectus" 115
Teresa Coelho Moreira and Francisco Pacheco Andrade

Legal Aspects on Smart House Welfare Technology for Older People in Norway 125
Veralia Gabriela Sánchez and Carlos F. Pfeiffer

2nd Int'l Symposium on Future Intelligent Educational Environments and Learning (SOFIEE'16)

2nd Int'l Symposium on Future Intelligent Educational Environments and Learning 137
Minjuan Wang, Vic Callaghan and Juan Augusto

Identifying Cultural Learning Preferences: Develop Effective Training for Chinese Learners 139
Minjuan Wang, Yun Zhang, Wendy Sanyk and Marcus Velasco

Integration of Learning Activity and Process-Oriented Assessment to Promote the Self-Directed e-Learning 149
Xiaofeng Wang and Shengquan Yu

The Case for Small Data in Higher Education 159
Berlin Fang and Jennifer Shewmaker

Design Principles for Massive Open Online Courses (MOOCs) 169
Minjuan Wang and Nancy Owsiany

Improving English as a Foreign Language Education in China with Creative Science 177
Shumei Zhang, Victor Callaghan and Hongmei Wang

Q3D-Game: A Tool for Training Users' 3D Spatial Skills 187
Zoe Falomir and Eric Oliver

ICUPRES: To a Standardized Recommendation and Profiling Services for Learning Management Systems 197
Alberto Oliva, Alberto Caballero and Andrés Muñoz

Keeping Them Interested and Keeping Them Honest: Using an On-Line Learning and Development Environment Called NoobLab to Improve Outcomes and Prevent Plagiarism in Undergraduate Programming Pedagogy 207
Paul Neve, Gordon Hunter and David Livingstone

Improving Automatic Speech Recognition for Mobile Learning of Mathematics Through Incremental Parsing 217
Marina Isaac, Eckhard Pfluegel, Gordon Hunter, James Denholm-Price, Dilaksha Attanayake and Guillaume Coter

A Comparison of Mobile Learning Platforms in Teaching: Marriott's China Hospitality Education Initiative 227
Sean Hauze, Mary De Lepe and William Olmstead

Creating Smarter Teaching and Training Environments: Innovative Set-Up for Collaborative Hybrid Learning 238
Georgios A. Dafoulas, Cristiano Maia, Martin Loomes, Fatma C. Serce, Kathleen Swigger, Robert Brazile, Victor Lopez, Ferda N. Alpaslan and Allen Milewski

Harnessing the Potential of Augmented and Virtual Reality for Military Education 249
Andrew T. Greenwood and Michael P. O'Neil

Supervising and Improving Attentiveness in Human Computer Interaction 255
Dalila Durães, Davide Carneiro, Javier Bajo and Paulo Novais

Flipping the Automotive Class in a Vocational College 265
Hüseyin Can Şenel and Abdullah Topçu

2nd International Workshop on Future Internet and Smart Networks (FI&SN'2016)

Introduction to the Proceedings of FI&SN'2016 277
Alexandre Santos, António Costa and Pascal Lorenz

Policy-Based Management for Smart Mobility 278
Teresa Vazão, João Duarte Gomes and Ricardo Chaves

Named Data for Mobile AdHoc Networks 288
Ana Filipa Pereira, Maria João Nicolau, António Costa, Joaquim Macedo and Alexandre Santos

Optimizing Load Balancing Routing Mechanisms with Evolutionary Computation 298
Vítor Pereira, Miguel Rocha and Pedro Sousa

A Survey on Vehicular Communication Technologies 308
Bruno Ribeiro, Alexandre Santos and Maria João Nicolau

Data Similarity Based Dynamic Node Clustering Using Bio-Inspired Algorithm for Self-Organized Wireless Sensor Networks 318
Misbahuddin and Riri Fitri Sari

7th International Workshop on Intelligent Environments Supporting Healthcare and Well-Being (WISHWell'2016)

7th International Workshop on Intelligent Environments Supporting Healthcare and Well-Being (WISHWell'16) – Sept. 12, 2016, London, UK 331
Wei Chen and Juan C. Augusto

3D Tune-In: 3D-Games for TUNing and lEarnINg About Hearing Aids 332
Lorenzo Picinali, Mirabelle D'Cruz and Luca Simeone on behalf of the 3D Tune-In Project Consortium

Sensing the Music: An Audiovisual Environment for ASD Therapy 338
Katarina Biljman

Towards Integrating People with Intellectual Disabilities in the Digital World 348
Jaime Medina, Horacio Saggion, Ineke Schuurman, Leen Sevens, John J. O'Flaherty, Annelies De Vliegher and Jo Daems

Including Affect as a Part of the Context in Assistive Technologies for Cognition 358
Juan C. Torrado, Javier Gomez and Germán Montoro

RFID-Based Object Localisation with a Mobile Robot to Assist the Elderly with Mild Cognitive Impairments 366
George Broughton, Tomáš Krajník, Manuel Fernandez-Carmona, Grzegorz Cielniak and Nicola Bellotto

ViewBricks: A Participatory System to Increase Social Connectedness for the Elderly in Care Homes 376
Xu Lin, Kai Kang, Cun Li, Jun Hu, Bart Hengeveld, Matthias Rauterberg and Caroline Hummels

Fuzzy Modeling of Duality Security/Independence in Patients with Alzheimer 386
J. Meza, V. Zamudio, A. Rojas, R. Baltazar, C. Lino, F. Doctor and M. Lopez

Statistical and Computational Study of the Photomotor Reflex in Diabetic Patients for Recognition of Specific Characteristics 396
David Asael Gutiérrez Hernández, Víctor Manuel Zamudio Rodríguez, María Trinidad Galván González, José Gerardo Cárdenas Solís, Sergio Uribe López and Carlos Lino Ramírez

POSEIDON – Personalized Smart Environments to Increase Inclusion of People with Down's Syndrome – Results of the First and the Extended Pilot Study 405
E. Schulze and A. Engler

International Workshop on Computation Sustainability, Technologies and Applications (CoSTA'2016)

Introduction to CoSTA'2016 415
Fábio Silva, Shin'ichi Konomi, Rui Costa, Cesar Analide and Paulo Novais

Monitoring Electrodermal Activity for Stress Recognition Using a Wearable 416
Arturo Martínez-Rodrigo, Antonio Fernández-Caballero, Fábio Silva and Paulo Novais

RFID Based People-Object Direction of Pass Detection 426
Raúl Parada, Joan Melià-Seguí and Rafael Pous

A Conceptual Framework for Occupant-Centered Building Management Decision Support System 436
Sanja Lazarova-Molnar and Hamid Reza Shaker

Gamification and the Improvement of Urban Sustainability 446
Fábio Silva and Cesar Analide

Internet of Things for Energy Efficiency and Personalization 456
Joao C. Ferreira

Creative Science 2016 (CS'16) and Cloud-of-Things 2016

Creative Science 2016 (CS'16). Cloud-of-Things 2016 – London, UK. 12–26th of September 2016 469

Creative Prototyping as an Inter-Dimensional Portal Between Disciplines 470
Tiina Kymäläinen

We Think – Therefore We Are 480
Jim Hensman

The Pain Gods 490
Jennifer O'Connor

Diegetic Innovation Templating 498
Ping Zheng and Vic Callaghan

Dark Future Precedents: Science Fiction, Futurism and Law 506
Michael Bennett and Brian David Johnson

From Imagination to Innovation: A Creative Development Process 514
Hsuan-Yi Wu and Vic Callaghan

i-Ribbon: Social Expression Through Wearables to Support Weight-Loss Efforts 524
Nan Yang, Gerbrand van Hout, Loe Feijs, Wei Chen and Jun Hu

Workshop on Wireless Body Area Networks for Personal Monitoring in Intelligent Environments (WBAN-PMIE)

Workshop on Wireless Body Area Networks for Personal Monitoring in Intelligent Environments 537
Daniel Lai and Rezaul Begg

Characterization of Ultrasonic Wave Propagation for Intra-Body Communication 538
Francois Rivet, Samuel Redois and Yann Deval

Intrabody Communication for Implants in Body Area Network Scenarios 544
Assefa K. Teshome, Behailu Kibret and Daniel T.H. Lai

Effect of Changing Body Fluid Levels on Intrabody Signal Propagation 552
Clement Ogugua Asogwa and Daniel T.H. Lai

Neonatal Seizure Detection with Wearable Sensor System 560
Hongyu Chen, Mengru Xue, Sidarto Bambang Oetomo and Wei Chen

A Low Cost, Wireless Spinal Motion Measurement Device 570
Sammuel A. Sobey, Paul N. Grimshaw, Steven Grainger, William S.P. Robertson, Isaac Taylor and Melissa Weston

Tutorials

Introduction to the Summaries of the Tutorial Sessions Held at IE'16 579
Gordon Hunter

Designing Data Visualizations for Intelligent Environments: A Human Factors Primer 580
B.L. William Wong

Deciphering the Growing Docker Ecosystem 590
Pethuru Raj

Prototyping IoT-Based Applications for Ubiquitous Smart Environments and Healthcare 604
Jeanette Chin and Alin Tisin

The Emergence of Affective and Physiological Computing in Ambient User Centred Systems 605
Faiyaz Doctor

End-to-End Security for the IoT 606
James Dooley

Intelligent Automation – Smart Manufacturing 607
Raphael Grech

Design and Research for Advanced Human Augmentation in the Industrial Work Context 608
Tiina Kymäläinen, Hanna Koskinen, Eija Kaasinen and Susanna Aromaa

Subject Index 615

Author Index 619